PLANNING AND DEVELOPMENT ACT 2005

LOCAL PLANNING SCHEME AMENDMENT AVAILABLE FOR INSPECTION

SHIRE OF VICTORIA PLAINS LOCAL PLANNING SCHEME NO.5
AMENDMENT NO.3

Notice is hereby given that the Victoria Plains Shire Council has resolved, pursuant to Section 75 of the *Planning and Development Act 2005*, to amend the above Local Planning Scheme to rezone portion of Lot M1991 (No.10353) Great Northern Highway, Yarawindah from 'Rural' to 'Special Use: Satellite Communication Facility (European Space Agency)' and amend the Scheme Text and Scheme Map accordingly.

A document setting out and explaining the scheme amendment proposal is attached.

Comments on the proposal are now invited and can be emailed to reception@victoriaplains.wa.gov.au or posted to the Shire's Chief Executive Officer at PO Box 21 CALINGIRI WA 6569. All submissions must include the following information:

- Your name, address and contact telephone number;
- How your interests are affected whether as a private citizen, on behalf of a company or other organisation, or as an owner or occupier of property;
- Address of property affected (if applicable); and
- Whether your submission is in support of or objecting to the proposal, either in part or in whole, and any reasons supporting your comments.

Comments on the scheme amendment proposal may be submitted to the local government on or before **Friday 27 August 2021.**

All submissions received may be made public at a Council meeting and included in a Council Agenda, which will be available on the Shire's website in due course, unless a submission specifically requests otherwise.

GLENDA TEEDE
CHIEF EXECUTIVE OFFICER
SHIRE OF VICTORIA PLAINS

SHIRE OF VICTORIA PLAINS

LOCAL PLANNING SCHEME N^0 5

AMENDMENT N^0 3

An Amendment to rezone portion of Lot M1991 (No.10353) Great Northern Highway, Yarawindah from 'Rural' to 'Special Use: Satellite Communication Facility (European Space Agency)' and amend the Scheme Text and Scheme Map accordingly.

PLANNING AND DEVELOPMENT ACT 2005

RESOLUTION TO ADOPT AMENDMENT LOCAL PLANNING SCHEME

SHIRE OF VICTORIA PLAINS

LOCAL PLANNING SCHEME N^0 5

AMENDMENT N^0 3

Resolved that the Local Government pursuant to section 75 of the *Planning and Development Act 2005,* amend the above Local Planning Scheme by:

i) Rezoning portion of Lot M1991 on Diagram 14747 being No.10353 Great Northern Highway, Yarawindah from 'Rural' to 'Special Use: Satellite Communication Facility'; and

ii) Amending the Special Use Zone No.1 in Schedule 4 of the Scheme Text as follows:

No.	Description of Land	Special Use	Conditions
1.	Lot 11 on Plan 24201 and portion of Lot M1991 on Diagram 14747 being No.10353 Great Northern Highway, Yarawindah.	Satellite Communications Facility (European Space Agency)	As determined by the local government when determining all required development applications.

iii) Amending the Scheme Map accordingly.

The Amendment is standard under the provisions of the Planning and Development (Local Planning Scheme) Regulations 2015 for the following reasons:

i) The amendment would have minimal impact on land in the scheme area that is not the subject of the amendment; and

ii) The amendment does not result in any significant environmental, social, economic or governance impacts on land in the scheme area.

Dated this _____ day of _____ 20___

_____

(Chief Executive Officer)

SCHEME AMENDMENT REPORT

1.	**LOCAL AUTHORITY**	:	SHIRE OF VICTORIA PLAINS
2.	**DESCRIPTION OF LOCAL PLANNING SCHEME**	:	LOCAL PLANNING SCHEME N^{O} 5
3.	**TYPE OF SCHEME**	:	DISTRICT ZONING SCHEME
4.	**SERIAL N^{O} OF AMENDMENT**	:	3
5.	**PROPOSAL**	:	i) REZONING PORTION OF LOT M1991 ON DIAGRAM 14747 BEING NO.10353 GREAT NORTHERN HIGHWAY, YARAWINDA FROM 'RURAL' TO 'SPECIAL USE: SATELLITE COMMUNICATION FACILITY'; AND ii) AMENDING THE SCHEME TEXT AND SCHEME MAP ACCORDINGLY.

REPORT

1.0 INTRODUCTION

Lot M1991 comprises 2ha of vacant farming land currently zoned 'Rural'. Lot 11 'Special Use: Satellite Communication Facility' (SCF) is directly to the north and the other surrounding land is rural.

The European Space Agency (ESA) currently operates a Satellite Communication Facility at Lot 11 Great Northern Highway, Yarawindah, which is too small to accommodate the requirements of the BIOMASS antenna. The site has been selected for the installation of an antenna to facilitate calibration of the BIOMASS Satellite. The Satellite is scheduled to be launched in 2023 and the infrastructure is required to be installed prior to the launch.

The amendment is to provide additional land to accommodate a new 'BIOMASS Mission' calibration antenna for the European Space Agency (ESA).

The additional land is required for the following reasons:

a. The site is to be used for a calibration transponder in support of the ESA BIOMASS Satellite which will provide global maps of the amount of carbon stored in the world's forests and how this has changed over time;
b. The site was selected from seven (7) suitable short-listed locations in the world due to its location in a "clutter free area", existing facilities, appropriate horizon profile, environmental conditions, proximity to international airport/port and the provisions of suitable power, communication and security resources;
c. The antenna will expand upon and utilize the current facilities at the site;
d. The current antennas at the site cannot be repurposed due to the location of other infrastructure and a requirement for use of a different radio band frequency; and
e. The location of the antenna in a clear location is a key requirement for accurate calibration to ensure the BIOMASS Satellite accurately measures the Earth's forest biomass.

The key element for the antenna is the surrounding area. The following details regarding the suitability of the site have been provided by ESA. In order to minimize the multipath effects during the calibration process, the BIOMASS site needs to contain and meet the following requirements.

- The site is to have an area of 325m X 300m and be clear of any objects greater than 10cm above the surface including any rock/boulders.
- No metallic structures, except for the BIOMASS calibration transponder (BCT) building, lightning pole and the antenna itself.
- Suitable ground grades and adequate drainage to prevent water pooling.

The land proposed to be rezoned comprises a two hectare portion of Lot M1991 which is considered sufficient to allow the installation of the required infrastructure.

To this end ESA has entered into a contract to purchase the relevant portion of Lot M1991 for the infrastructure. This land will be amalgamated into ESA's existing Lot 11. ESA has also reached agreement to lease a further portion of Lot M1991 to maintain a suitable cleared area around the proposed BIOMASS antenna to minimise any potential interference. The BIOMASS Satellite is anticipated to have a project life of 10-13 years once launched with that portion of Lot M1991 to be rezoned made available for future projects as required. The sales and lease contracts are therefore conditional upon rezoning the relevant portion of Lot M1991 to 'Special Use: Satellite Communication Facility'.

2.0 BACKGROUND

Location

Lot M1991 is located on the Great Northern Highway, approximately 130 km north-east of Perth. The "New Norcia Ground Station" on Lot 11 is one of three (3) deep space ground stations in the ESA's tracking station network, the others being located in Spain and Argentina.

Site Area

Lot M1991 comprises a total area of approximately 634.6 hectares. That portion to be rezoned comprises an area of two hectares.

Ownership

Lot M1991 is owned by Graham Thomas Nixon, Natalie Michelle Nixon and Timothy William Nixon. Lot 11 is owned by the European Space Agency. The CSIRO are responsible for the day-to-day operational support and maintenance of the 'ground station' on Lot 11.

Current & Surrounding Land Uses

That portion of Lot M1991 proposed to be rezoned contains no buildings and has been identified in the Flora and Fauna survey as degraded woodlands. The overall property has been used for cropping and grazing.

To the north of the proposed rezoning area is Lot 11 zoned Special Use SCF which is occupied by the European Space Agency. To the west, east & south is land zoned 'Rural' which is predominantly used for cropping and grazing of livestock.

Physical Characteristics

As discussed above, the subject site is a degraded parcel of woodland land used for broadacre agriculture (i.e. cropping & grazing). The topography of the site to be rezoned has a gentle to moderate incline.

Infrastructure

The site will be amalgamated into Lot 11 and all required service provisions will be made from the existing services on this lot.

Lot 11 is serviced by Great Northern Highway on the eastern side, which is a sealed and drained State road under the care, control and management of Main Roads WA.

3.0 LOCAL PLANNING CONTEXT

State & Regional Planning Context

The *State Planning Strategy* seeks to balance competing demands on land use. It lists 6 interrelated and interdependent principles:

- Community
- Economy
- Environment
- Infrastructure
- Regional Development
- Governance

In recognizing these it "….places a priority on economic and population growth as the key drivers of land use and land development." ("Delivery Culture") The current proposal is critical for the management of global emissions and will provide essential support to United Nations treaties on the reduction of carbon emissions from deforestation and forest degradation.

The *State Planning Framework* utilizes the same principles, sans Governance. The proposed Amendment will clearly satisfy the Community and Economic aspects by providing support to the International actions to manage emissions and guide sustainability. It will consolidate an existing SCF area and not create any negative impacts on the environment.

4.0 PROPOSAL

European Space Agency established a satellite communication facility on Lot 11 in early 2000. It now requires additional land for the installation of facilities associated with the BIOMASS satellite project. The additional facilities will expand the current land uses occurring on Lot 11 and expand the international tracking work done at the site. This additional land is required as the "New Norcia" site is one of the most suitable locations in the world for the proposed new antenna. Unfortunately, due to separation and radio frequencies requirements the current antenna at the site can't be used and additional land is required.

The ESA have outlined that the "objectives of the BIOMASS are to reduce the uncertainty in the in the worldwide spatial distribution and dynamics of forest biomass in order to improve current assessments and future projections of the global carbon cycle."

Current satellites can detect forest types and forest cover worldwide, but the BIOMASS will enhance this information through use of a P-band synthetic aperture radar which can accurately map tropical, temperate and boreal forest biomass. This information cannot be obtained using ground measuring techniques. The intention is that the initial five-year mission will record at least eight growth cycles in the world's forests.

The antenna is required to undertake the calibration of the satellite and ensure the accuracy of the data collected. The collected data will provide a "better insight into rates of habitat loss and, therefore, the effect this may be having on biodiversity in the forest environment."

The "New Norcia Ground Station" is an important international centre required as part of the ESA tracking network. Securing and supporting the growth of such sites is critical for the works undertaken by the ESA in conjunction with the CSIRO.

The location of that portion of Lot M1991 proposed to be rezoned achieves the key requirements for the antenna and will be amalgamated with the current SCF land adjoining it (i.e. Lot 11) as stated previously above.

Flora and Fauna

A Flora and Fauna study has been completed for the site (see attached report) and noted the following points.

Flora:

- No Commonwealth or Western Australian threatened flora were recorded during the field studies and no Department of Biodiversity, Conservation and Attraction priority flora was recorded either;
- The site is in an area of Western Australia that has been significantly cleared since European settlement. None of the woodland vegetation types were assessed as being better than 'degraded condition' and are not therefore considered to represent extant native vegetation;
- The woodland area does form part of an apparent vegetation network in the area, however as most of the network is in private ownership, and probably grazed, it will therefore be in a similar degraded condition. There are therefore few native flora species that could contribute to the natural gene flow in the area and aid natural regeneration should grazing cease in any part; and
- The subject site provided little in the way of habitat for flora and as it is currently zoned 'Rural' and used as part of a farming enterprise which is unlikely to improve its condition.

In conclusion, the vegetation is not significant and the report indicated that "any change to land use is unlikely to significantly contribute to habitat loss, degradation or fragmentation in the area."

Fauna:

- No fauna species recorded at the site are conservation listed, with all species recorded occurring commonly in the region;
- The woodland portion of the site forms part of a network of an apparent native vegetation link through agricultural land to the Seven Mile Well Nature Reserve to the southwest. The areas in the linking corridor however are privately owned farmland and, like the subject site, probably grazed and thus are in a similar degraded state. "They therefore, potentially, have little vegetation structure to form a corridor that could be used by native wildlife for movement."; and

- The woodland areas have potential to form habitat for Black Cockatoo however the site has virtually no foraging resources for the species and no recent history of use was noted in the site visits. The report therefore outlines that based on this not being a suitable location for foraging it is unlikely that clearing this area would have any significant impact on the Black Cockatoo species in the local region.

The report concluded that the vegetation in the area provides little in the way of habitat for both flora and fauna and this is unlikely to change due to the current and historical cropping and grazing activities.

Bushfire Management Plan

The site is within a declared bushfire prone area and the provisions of State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP3.7) apply. A Bushfire Management Plan (BMP) was prepared for the site by a suitably qualified consultant (see attached report). The proposal does not include any habitable buildings and the proposal can achieve site requirements of a location with a BAL not exceeding 29.

Clearing is required as a "functional" requirement of the Biomass calibration antenna. The area to be cleared is 150-175m from the antenna and this exceeds the requirements to achieve a BAL 29. The BMP concludes that post -development the BAL at the antenna will be BAL-3 (2 kWm^2). The operational requirements of the cleared land will also result in it being maintained in a low threat state.

The site at Lot 11 does not have reticulated water however there is an existing 240,000L tank onsite. The onsite water requirements are minimal, and the water is largely available for firefighting purposes. Additional to the existing water tanks, a separate 20,000L tank is proposed to be installed at the NNO-2 Antenna Site (located on Lot 11) to provide a dedicated firefighting water supply for the protection of the Biomass Antenna Facilities. An overall site-wide firefighting system is currently undergoing design and planning and is proposed to provide protection to all significant infrastructure and assets on the site.

The report concludes that the site complies with the requirements of SPP3.7. This is due to the clearing requirements for the operation of the antenna and the intention to maintain the site in a low threat state with no vegetation over 100mm.

Installation and Antenna Operations at the site

The antenna will be transported to the site in standard "20 foot" sea containers and a 40T cane will be used to erect the antenna. The 40T crane will be a typical dual axle "as of right" vehicle with a climbing and descending capacity suitable for a slope of 30°, which is more than double any slope on the current site or any land in the proposed installation location. The standard specification at the site for axle loadings for road construction is 12T which is suitable for the 40T crane. The appropriate California Bearing Ratio (CBR) will be adopted in the new road engineering. After installation, the engineering teams from AIRBUS, UK and the project team from ESA will only visit the site from time-to-time. The same type of 40T crane will be used to remove the infrastructure once the mission has concluded, if required.

The day-to-day maintenance of the antenna will be done by the maintenance and operations staff already at the site who currently manage the other facilities. There are also no additional staff required at the site for the operation of the antenna as this will occur remotely. It is anticipated that during the 5–10 year operational phase of the BIOMASS satellite the calibration transponder will operate only every 4-6 months. The site is currently able to suitably

accommodate all vehicles required to access the location for deliveries, which include water and fuel. There are no additional access requirements for the new infrastructure.

Currently on a normal day there are three (3) cars that access the site for the maintenance and operations staff. As no additional staff are required to operate the new calibration antenna associated with the Biomass facility, there is no anticipated increase in the current traffic movements.

5.0 CONCLUSION

The proposed Amendment will provide critical support to the BIOMASS satellite through the installation and operation of a calibration antenna without any negative environmental impacts. The subject site is well located as it is an extension of the existing SCF area to the north. Applying a 'Special Use: Satellite Communication Facility' zone will provide the land required for the antenna infrastructure and help facilitate an important, global scale project that is of significant benefit in terms of future environmental management and sustainability.

APPENDICES:

1. ESA - Bushfire Management Plan
2. Deep Space Facility Flora + Fauna Survey

PLANNING AND DEVELOPMENT ACT 2005

RESOLUTION TO AMEND LOCAL PLANNING SCHEME

SHIRE OF VICTORIA PLAINS

LOCAL PLANNING SCHEME N^0 5

AMENDMENT N^0 3

Resolved that the Local Government, pursuant to section 75 of the *Planning and Development Act 2005*, amend the above Local Planning Scheme by:

i) Rezoning portion of Lot M1991 on Diagram 14747 being No.10353 Great Northern Highway, Yarawindah from 'Rural' to 'Special Use: Satellite Communication Facility'; and

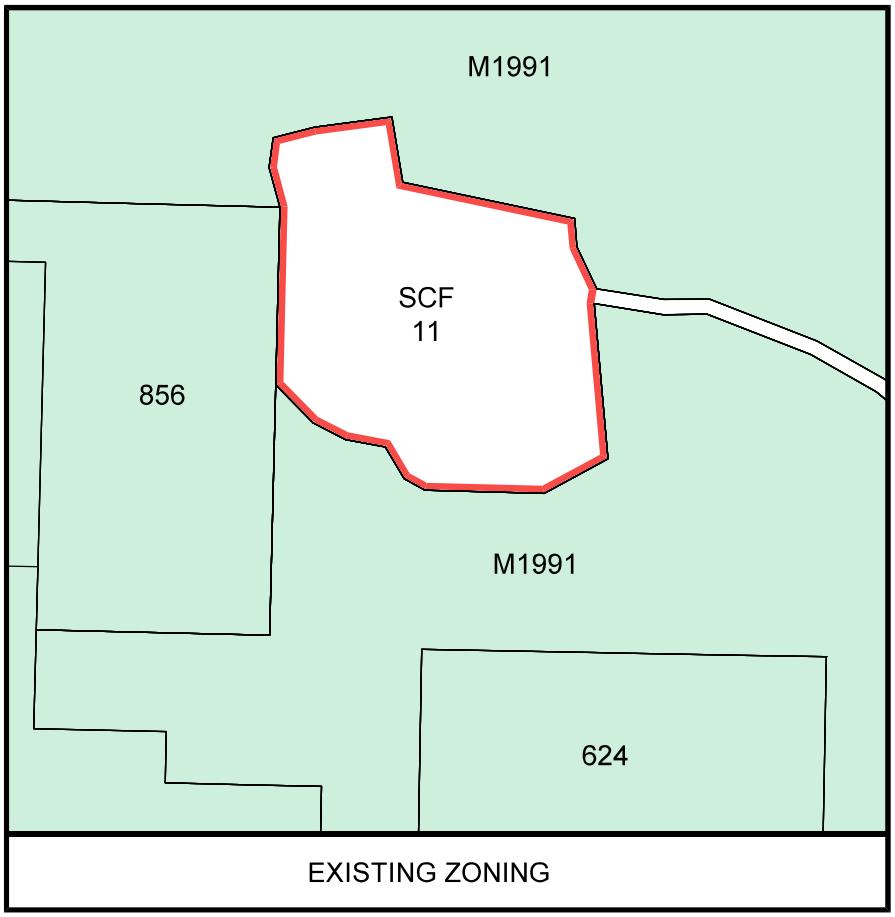
ii) Amending the Special Use Zone No.1 in Schedule 4 of the Scheme Text as follows:

No.	Description of Land	Special Use	Conditions
1.	Lot 11 on Plan 24201 and portion of Lot M1991 on Diagram 14747 being No.10353 Great Northern Highway, Yarawindah.	Satellite Communications Facility (European Space Agency)	As determined by the local government when determining all required development applications.

iii) Amending the Scheme Map accordingly.

SHIRE OF VICTORIA PLAINS
LOCAL PLANNING SCHEME No. 5

Planning and Development Act 2005



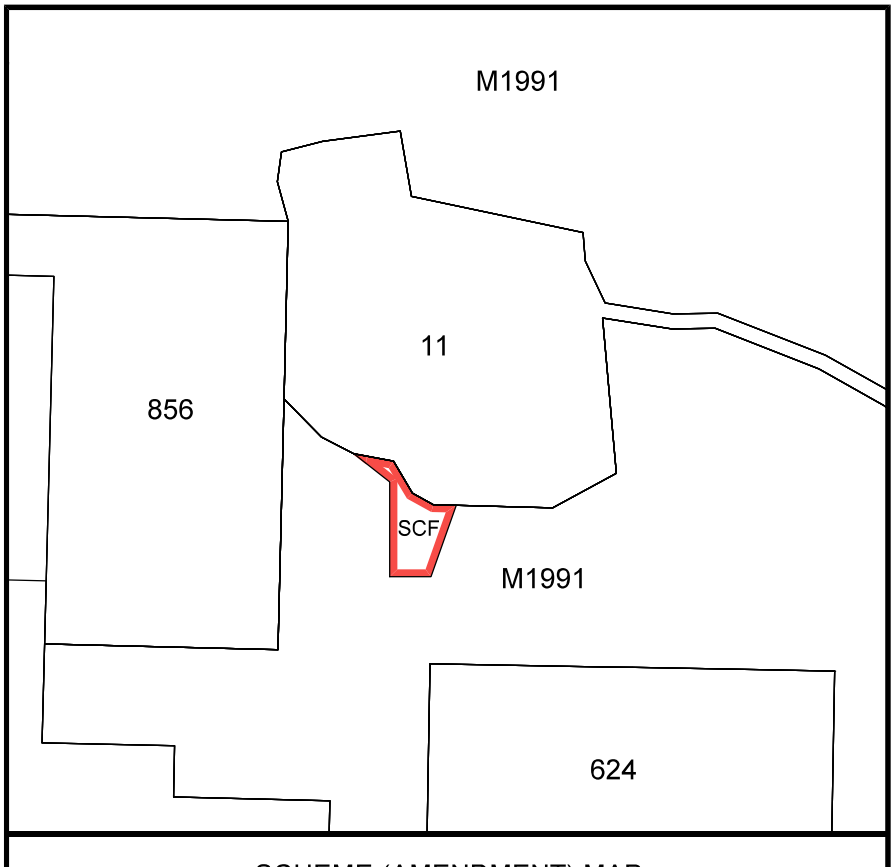
EXISTING ZONING

LEGEND

LOCAL SCHEME ZONES

RURAL

SCF — SPECIAL USE: SATELLITE COMMUNICATION FACILITY



SCHEME (AMENDMENT) MAP

N

SCALE: 1:15 000
DATE: 10.02.2021

Amendment No.

COUNCIL ADOPTION

This Standard Amendment was adopted by resolution of the Council of the Shire of Victoria Plains at the Ordinary Meeting of the Council held on the 3rd day of April 2021

_____

SHIRE PRESIDENT

_____

CHIEF EXECUTIVE OFFICER

COUNCIL RECOMMENDATION

This Amendment is recommended for approval by resolution of the Shire of Victoria Plains at the Ordinary Meeting of the Council held on the _____day of _____, 20____, and the Common Seal of the Shire of Victoria Plains was hereunto affixed by the authority of a resolution of the Council in the presence of:

_____

SHIRE PRESIDENT

_____

CHIEF EXECUTIVE OFFICER

WAPC ENDORSEMENT (r.63)

DELEGATED UNDER S.16 OF THE P&D ACT 2005

DATE

APPROVAL GRANTED

MINISTER FOR PLANNING

DATE

Bushfire management plan/Statement addressing the Bushfire Protection Criteria coversheet

Site address: Lot 11 Great Northern Hwy Yarawindah

Site visit: Yes ☑ No ☐

Date of site visit (if applicable): Day 5 Month October Year 2020

Report author or reviewer: Anthony Rowe

WA BPAD accreditation level (please circle):

Not accredited ☐ Level 1 BAL assessor ☐ Level 2 practitioner ☐ Level 3 practitioner ☑

If accredited please provide the following.

BPAD accreditation number: 36690 Accreditation expiry: Month December Year 2021

Bushfire management plan version number: v3

Bushfire management plan date: Day 11 Month December Year 2020

Client/business name: Iredale Pedersen Hook for European Space Agency

	Yes	No
Has the BAL been calculated by a method other than method 1 as outlined in AS3959 (tick no if AS3959 method 1 has been used to calculate the BAL)?		✓
Have any of the bushfire protection criteria elements been addressed through the use of a performance principle (tick no if only acceptable solutions have been used to address all of the bushfire protection criteria elements)?	✓	

Is the proposal any of the following (see SPP 3.7 for definitions)?	Yes	No
Unavoidable development (in BAL-40 or BAL-FZ)		✓
Strategic planning proposal (including rezoning applications)		✓
High risk land-use		✓
Vulnerable land-use		✓

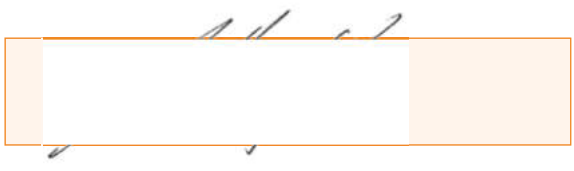
None of the above ☐

Note: Only if one (or more) of the above answers in the tables is yes should the decision maker (e.g. local government or the WAPC) refer the proposal to DFES for comment.

Why has it been given one of the above listed classifications (E.g. Considered vulnerable land-use as the development is for accommodation of the elderly, etc.)?

Performance principle for gradient.

The information provided within this bushfire management plan to the best of my knowledge is true and correct:

Signature of report author or reviewer 

Date 11 December 2020

Bushfire Management Plan

European Space Agency

Yarawindah

Client – Iredale Pedersen Hook Architects

December 2020

envision

bushfire protection

LIMITATIONS STATEMENT

This Bushfire Management Plan ('BMP') has been solely prepared for European Space Agency additional antenna (two sites) at Lot 11 Great Northern Hwy Yarawindah.

Envision Bushfire Protection

ABN: 90958370365

124 Derby Road SHENTON PARK WA 6008

P: 0439 112 179

Email: admin@envisionbp.com.au

Version Control

Lot 11 Great Northern Hwy Yarawindah			
Version	**Date**	**Author**	
V1	12/10/2020	AR	Review
V2	28/10/2020	AR	Inclusion of site power generator facility
V3	11/12/2020	AR	Reticulated water to biomass antenna and clarification of gradient to site B Revised figures

Disclaimer

In undertaking this work the authors have made every effort to accurately apply the available information **at the time of writing** following the instructions of the regulatory authorities and applying best practice as described by the Fire Protection Association Australia. Any conclusions drawn or recommendations made in the report are done in good faith and the consultants take no responsibility for how this information and the report is subsequently used.

Envision Bushfire Protection accepts no liability for a third party's use of, or reliance upon, this specific report.

Importantly the measures contained in this report cannot guarantee, human safety or an absence of harm, or that the building will not be damaged or would survive a bushfire event on every occasion. This is due to the unpredictable nature of fire behaviour (knowledge in this field continues to develop) and the unpredictable nature of extreme weather conditions.

This report has been prepared in part utilising the WALGA Environmental Planning Tool ('**EPT**'). The author agrees that at all times copyright in the material on the EPT website remains with WALGA and the Contributors as the case may be and has cited the EPT as being the source of the information and acknowledges the contributors copyright in the Information.

Scope of this report

Envision Bushfire Protection has been engaged to provide expert bushfire safety and planning advice.

The scope of the advice has been to assess the proposal for compliance with the policy measures described in State Planning Policy 3.7 and identify appropriate mitigation measures to be considered by the determining authority. This is described in a Bushfire Management Plan and prepared with regard to the Department of Planning Lands and Heritage templates.

The investigations and mitigation measures identified in the BMP, has in turn formed the basis for the preparation of a Bushfire Emergency Evacuation Plan.

Client relationship

I was engaged to provide expert bushfire safety and planning advice. My relationship with the client is a standard commercial contract and no private, personal, or other matter has influenced the content of the BMP or my findings.

STATEMENT OF CONFORMITY – PLANNING AND DEVELOPMENT ACT 2005

Anthony Rowe Level 3 - BPAD36690

Principal

The signatory declares that this Bushfire Management Plan meets the requirements of State Planning Policy 3.7 and the Guidelines for Planning in Bushfire Prone Areas V1.3.

SUMMARY

Preface

The proposal is for the location of additional antenna at two locations referred to as the NN03, including a new dish antenna and power generator (Site A) and the Biomass antenna (Site B) for the European Space Agency at Lot 11 Great Northern Hwy Yarawindah ('**the site**').

Site A is immediately north and downslope from the existing administration building and site B (biomass measuring antenna) is located upslope at a peak elevation height (346 AHD) south of the administration building.

Site A is located in historically cleared pastureland whereas Site B is located on top of a steeply sloping hill (18 degrees) presently remnant forest.

The site is within a declared bushfire prone area and State Planning Policy 3.7 *Planning in Bushfire Prone Areas* ('**SPP 3.7**') applies.

In accordance with SPP 3.7 the planning authority when determining an application in a declared bushfire prone area must first be satisfied the proposal is consistent with the policy intent, ***to preserve life and reduce the impact of bushfire on property and infrastructure***.

The proposed development does not constitute habitable buildings, and routinely, only a siting requirement - not exceeding BAL 29 applies. This can be readily achieved at both sites.

The assessment requirements for Sites A and B, are described and addressed in this BMP. This BMP has followed the investigations and the required report structure in accordance with the Department of Planning Land and Heritage template BMP Complex. The headings below follow the arrangement of the template.

2. Environmental considerations (addressed in Section 2)

An inspection of the site was undertaken on 5 October 2020 for the purpose of collecting the information required for the bushfire attack level assessment.

The purpose of the environmental considerations is to identify any potential environmental matter that may conflict with the achievement of the bushfire protection measures that will achieve the location and siting and design standard, required by SPP.3.7 and the consequence of conditions retained that are outside the site, but may affect areas within the site.

The environmental considerations in this report have considered the area that may be displaced by establishing an Asset Protection Zone sufficient to achieve BAL 29 or less, and as displaced by other required bushfire protection measures.

This BMP is assisted by an environmental flora and fauna field survey conducted by Ecoscape in May 2020.

The Ecoscape report found:

- No Commonwealth EPBC Act or Western Australian BC Act-listed Threatened Flora were recorded during the field survey, nor any DBCA-listed Priority Flora.
- No vegetation was identified as significant, to meet any of the criteria in the Flora and Vegetation Technical Guidance (EPA 2016d).
- Eighteen vertebrate fauna species were recorded during the field survey across all sites.
- No recorded fauna species is conservation-listed, and all occur commonly within the region and landscape.

In consideration of the requirement to establish an Asset Protection Zone of suitable dimension to achieve BAL 29, the BMP has reviewed the State environmental data bases and the Ecoscape report.

No clearing of regulated vegetation is required for Site A: the APZ affected area is cropland with minor modification non restricted Woodland is required south of the generator facility. Most trees in the Woodland area can be retained if the ground covers are maintained to grasses less than 100 mm high.

At site B, extensive clearing is required as a functional requirement for the Biomass antenna; the area extending from the antenna 150 m (east, south and west) and 175 m (north). This area exceeds the required distance for bushfire protection and will result in a BAL of BAL-3 (2 kWm^2) at the antenna. The Ecoscape report identified only a low structural diversity (open woodland) not considered to have significance as habitat for any conservation-listed species.

3. Bushfire assessment results (addressed in Section 3)

A Bushfire Attack Level assessment following Method 1 AS 3959:2018, and the DPLH *Visual guide for bushfire risk assessment in Western Australia*, and using an FFDI of 80, has been undertaken. A post development (after APZ) BAL contour is illustrated in Appendix 1 Figure 4A and 4B (sites A and B respectively). A routine APZ of 21 m has been applied at Site A and will result in a determined BAL of BAL-12.5 (less than BAL 29 and compliant). The antenna at Site B due to clearing required for the function of the antenna has been calculated to be BAL-3 (3 kWm2) using the FPAA Flamesol calculator and methodology provided in AS3959:2018.

4. Identification of bushfire hazard issues (addressed in Section 4)

Site A is classified as grassland and a moderate bushfire hazard level. Grassfires through slashed crops (storks and stubble not exceeding 300 mm) are short intense and fast moving and have the lowest separation requirements. The site is also downslope to vegetation and relatively flat, topography will not be a significant influence, but wind speed and direction will be. Site A is easily accessible with good visibility to the location, to take appropriate action for safety.

Site B is classed as open woodland (Ecoscape), but for the purpose of AS3959:2018 has been classified as forest due to the canopy density (>30%). The site is on a flat area on top of a steep sided hill 15^0-20^0. The site is considered an extreme bushfire hazard level and the fire behaviour with be influenced by the slope, (speed and intensity increased), and erratic winds affected by the slope will also influence the behaviour at the site. .

5. Assessment against the bushfire protection criteria (addressed in Section 5)

The proposal was compared with the four Bushfire Protection Criteria Elements: Location, Siting and Design, Access, and Water.

Acceptable Solution

Element 1 - Location

The Acceptable Solution for Element 1 requires that areas of 'extreme' bushfire hazard level be avoided. This element applies primarily to strategic considerations. Development applications such as this are guided by Element 2 and achieving compliance with the Policy Intent within the site.

Element 2 --Siting and Design

The Acceptable Solution for Element 2 requires that the development site should on completion have a BAL level not exceeding BAL 29.

Routine management to maintain grasses within 21 m of Site A, at less than 100 mm throughout the bushfire season, can achieve BAL 29.

The proposed Biomass Antenna at Site B will require a 150m to 175m radial offset to any bush area over a 360 degrees zone. The Biomass Antenna vegetation clearance will extend beyond the Method 1 AS3959:2018 measurement of 100 m. Apart from the occasional grass on an exposed mineral surface the area is expected to be low threat and excluded cl. 2.2.3.2 (f).

Element 3 - Vehicle Access

Internal roads (driveways) are compliant with the requirement for Element 3 with the exception of the grade to Site B which at 8.0^0 marginally exceeds the maximum grade of 6.0^0 (1:10) required for brigade vehicles. The provision of fire hydrant and supply pipe is to the Biomass facility will save haulage weight for Brigade vehicles.

Element 4 - Water

The site is not connected to a reticulated water supply but is serviced by 240,000 L tank which also supplies a standpipe for firefighting. The water needs at the site are modest so the tank if maintained at capacity is largely available for firefighting (structural and bushfire).

A fire hydrant and supply pipe is to provide a water supply for protection of the Biomass facility (Site B) for attending to small fires and assisting bushfire fuel reduction maintenance operations. Site B is to be cleared for the purpose of all vegetation for 167 m around the Biomass Antennas.

Additional Bushfire Management Strategies (addressed in section 5.2)

Additional management strategies, further to the Bushfire Protection Criteria, include the measures to minimise the exposure of guests to bushfire impacts.

Spatial representation of the bushfire management strategies (Figure EX 1)

The key features demonstrating compliance with the bushfire protection measures are identified on the *Spatial representation of the bushfire management strategies*.

These actions are reflected in the following *Responsibilities for implementation and management of the bushfire measures*.

Suggested conditions of planning approval

Further to the above, the following conditions of Development Approval are recommended, and the identified works are required to be undertaken before operation of the facility:

1. Within the area shown on the spatial representation of the proposed risk management measures (the APZ) all vegetation is to be retained as low threat (AS 3959:2018) or maintained in accordance with the Standards for Asset Protection Zones.
2. The requirements for private driveways Element 3, Table 6 column 3 in the Guidelines V1.3 should be applied to all new vehicle accessways associated with the proposal. An exception is to be provided for the grade to site B, which will exceed 1 in 10 (6.0^0)

Advisory notes

1. The landowner is responsible for availing themselves of any promotions and information to assist owners in preparing for and responding to a bushfire event as may be made by the Shire or the Department Fire and Emergency Services.

Spatial representation of the proposed risk management measures – Site A

Notes

1. Within the area shown on the spatial representation of the proposed risk management measures (the APZ) all vegetation within is to be retained as low threat (AS 3959:2018) or maintained in accordance with the Standards for Asset Protection Zones.
2. The private driveways are to be constructed and maintained in accordance with Guidelines for Planning in Bushfire Prone Areas, Appendices, Element 3 Table 6, including a turnaround, sufficient for a type 3.4 appliance (E3.5 and Element 4 at A4.2).

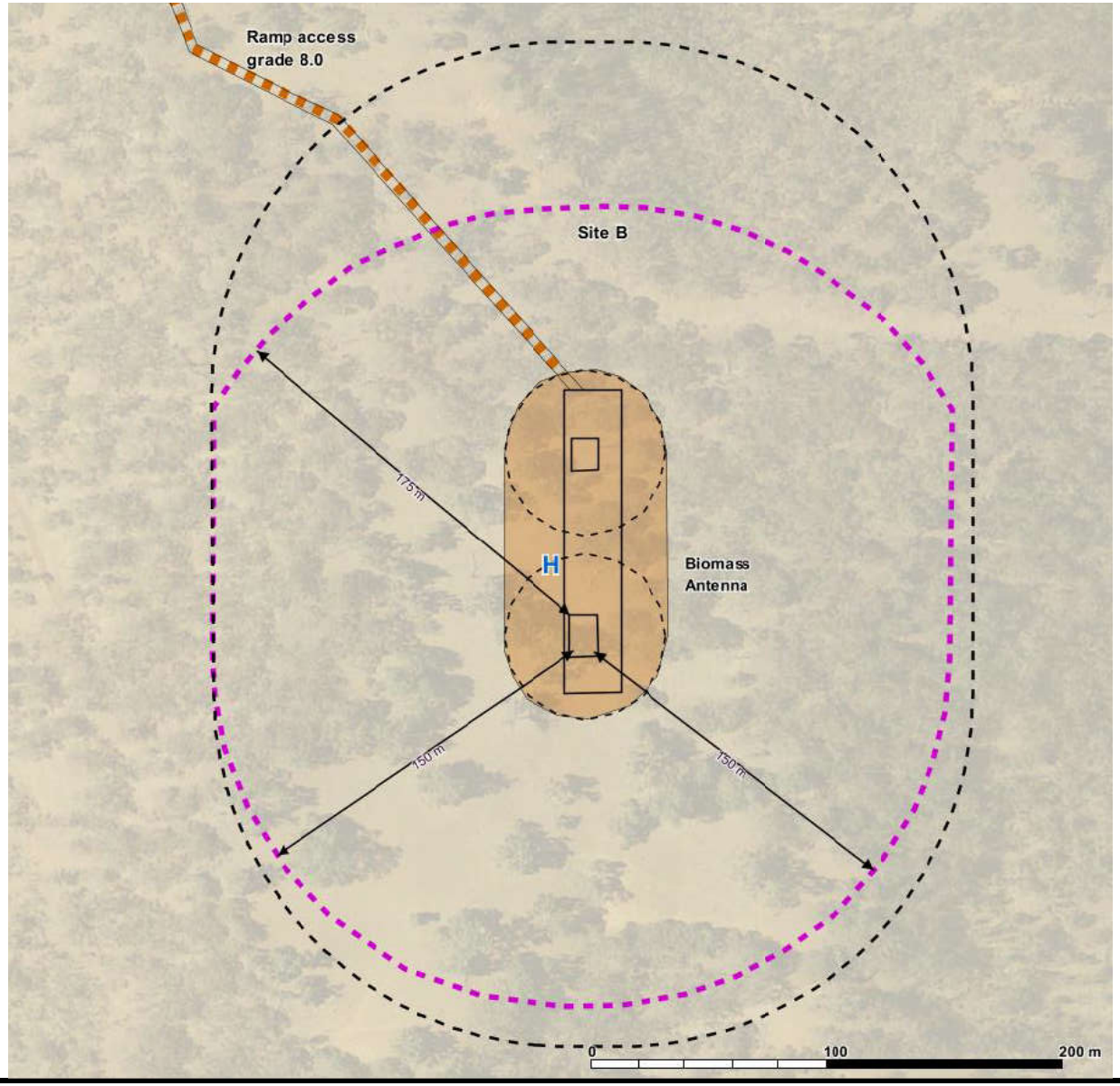
Legend

- Building Boundary
- Asset Protection Zone
- Vehicle access

Property Assessment Details

Lot 11 Great Northern Highway Yarawindah
Prepared by: Anthony Rowe
Accreditation Level: Level 3
Accreditation Number: 36690
Date: 28/10/2020

Spatial representation of the proposed risk management measures – Site B



Notes

1. Within the area shown on the spatial representation of the proposed risk management measures (the APZ) all vegetation within is to be retained as low threat (AS 3959:2018) or maintained in accordance with the Standards for Asset Protection Zones.
2. The private driveways are to be constructed and maintained in accordance with Guidelines for Planning in Bushfire Prone Areas, Appendices, Element 3 Table 6, including a turnaround, sufficient for a type 3.4 appliance (E3.5 and Element 4 at A4.2).

Legend

- Site B Area
- Asset Protection Zone
- Vehicle access
- H — Hydrant

Property Assessment Details

Lot 11 Great Northern Highway Yarawindah
Prepared by: Anthony Rowe
Accreditation Level: Level 3
Accreditation Number: 36690
Date: 10/12/2020

Table of Contents

1. PROPOSAL DETAILS

1.1 Introduction

Purpose of this Plan

Envision Bushfire Protection has been commissioned to prepare a Bushfire Management Plan, to support a development application for additional antenna, at two locations (Site A (NN03) and Site B (Biomass Antenna)), at the European Space Agency facility at Lot 11 Great Northern Highway, Yarawindah. (Plate 1).

The site is within an area identified as a 'bushfire prone area' under the state-wide Map of Bush Fire Prone Areas as prepared by the Office of Bushfire Risk Management (OBRM 2019) (Plate 2).

The aim of this Bushfire Management Plan (BMP) is to assess bushfire hazards within and nearby the site and ensure that the threat posed by any identified hazards can be appropriately mitigated and managed into the future.

This BMP has been prepared in accordance with the requirements of SPP 3.7 (WAPC 2015), the Guidelines (WAPC and DFES 2017) and Australian Standard 3959-2018 Construction of buildings in bushfire prone areas.

Site and Proposal Description

The European Space Agency facility at Lot 11 Great Northern Hwy Yarawindah is located 105 km north of the City of Perth CBD.

The locality (within 5 km) is typified as gently undulating hills slopes of $4^0 - 5^0$ predominantly grazed or cropping pasture with sections of separated trees over a grass understory, and scrub (trees less than 6 m high). Patches of native vegetation (forest) are retained in the locality on slopes not practical for farming.

The facility is located on the north of a hill side that rises from a floor of 240 AHD (immediately north of Site A) to 346 AHD (Site B) with slopes of 15^0-20^0.

Site A is to be located immediately north of the existing facility at the base of the hill. It includes a new antenna dish and building and a separate power generating facility with diesel store.

Site B is to be located south of the administration building at the hilltop. It will accommodate the mast type antennas and infrastructure (structures) but no habitable buildings. The rise to the hilltop location is steep and exceeds the normal gradient requirements for community supplied brigade firefighting equipment; as provided in the Guidelines Technical Requirements maximum of 1:10 (6.0^0).

The site is 40 ha, and the facility is located 1.5 km west of Great Northern Highway by a private sealed road. The site is a secure facility and not open to the general public.

The Great Northern Hwy is a sealed road providing destinations north (New Norcia) and South (Bindoon).

The site does not have access to a reticulated water supply but is self-sufficient. The site has a large capacity of water tanks (steel) storage, with defendable space established around habitable buildings and assets and has limited on site firefighting facilities.

The site has detailed emergency procedures for the facility including external evacuation destinations. The Great Northern Highway leads north to New Norcia and south to Bindoon, predominantly through open pasture agricultural land affording good visibility of an approaching fire.

Land Zoning

The site is zoned Special Use SCF (Satellite Communications Facility) in the Shire of Victoria Plains Local Planning Scheme No. 5.

Adjoining Land Uses

West	Pasture to Woodland, level to development site.
North	Pasture to Woodland, downslope to the facility.

East	Pasture to Woodland, level to development site.
South	Woodland, upslope to the existing facility.

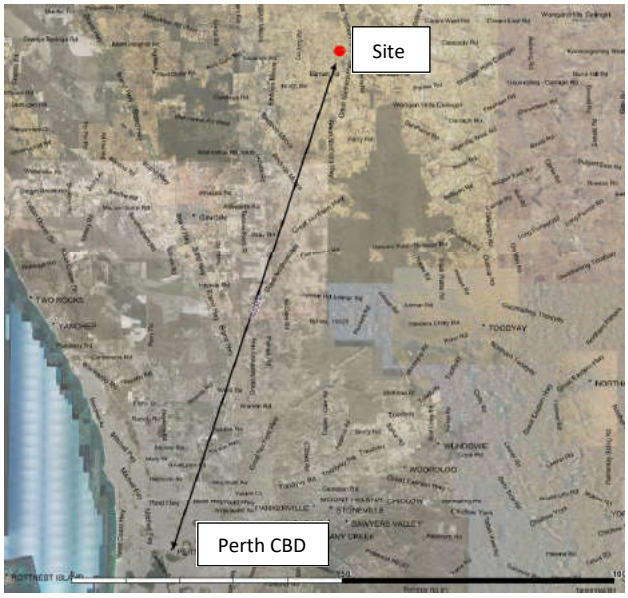


Plate 1: Locality 105 Km north of Perth

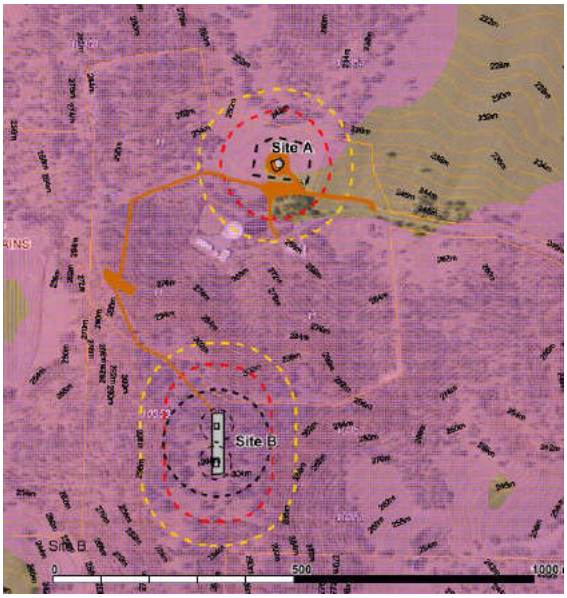


Plate 2: OBRM Bushfire Prone Area (pink area)

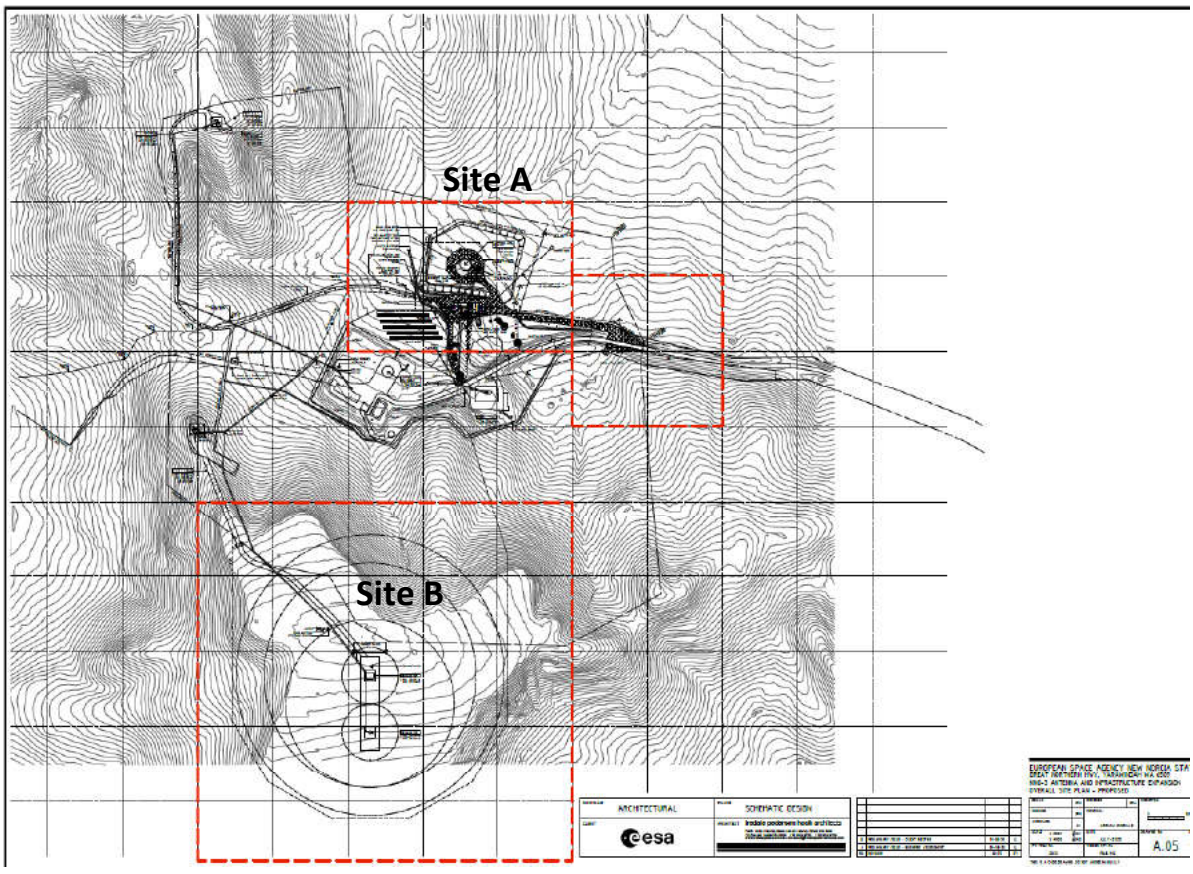


Plate 3: Proposed antenna development site

1.2 Regulatory Compliance Requirements

Planning and Development Act 2005 - SPP 3.7

On 7 December 2015 the State Government introduced, a state map of Bushfire Prone Areas by order under the *Fire and Emergency Services Act 1998* and introduced development controls in Bushfire Prone Areas through the *Planning and Development Act 2005*. These controls were authorised by State Planning Policy 3.7 (Planning in Bushfire Prone Areas) regulations introduced under Part 10A Schedule 2 of the *Planning and Development (Local Planning Scheme) Regulations 2015* and guided by the *Guidelines for Planning in Bushfire Prone Areas*.

The State Planning Policy, Regulations, and Guidelines now form the foundation for fire risk management planning in WA at a community and land development level. The Policy Intent of SPP 3.7 is ***to preserve life and reduce the impact of bushfire on property and infrastructure***.

The Building Act 2011

The *Building Act 2011*, and *Building Regulations 2012*, applies the construction standards of the Building Code of Australia where it relates to an 'applicable' building.

The Bushfire Construction requirement in the National Construction Code addressed only class 1-4, class 10, and certain class 9 buildings. They do not include construction standards for the proposed structures, however at the ***Planning and Development Act 2005,*** location and siting considerations apply.

***Bushfires Act* 1954**

Section 33 of the *Bushfires Act 1954* recognises the responsibility of all landowners to prevent the spread of bushfire. Local government at any time, may give notice in writing to an owner or occupier of land within the district of the local government.

The Notice may specify works to be undertaken including the management of grasses on the property usually to be maintained at less than 10 cm during the fire season.

It also provides that the identified works can be undertaken as a separate operation or in coordination with the neighbouring land.

This legislation applies to all landowners, including the landowner and the neighbours to maintain their land to prevent the ignition and spread of bushfire.

Environment Protection Act 1986 and Environmental Protection (clearing native vegetation) Regulation 2004

It is an offense to clear native vegetation without the authority of a permit or an exemption. The act of clearing native vegetation, requires a permit from either the Department of Water and Environmental Regulation (DWER) or the Department of Mines, Industry Regulation and Safety (DMIRS), unless an exemption applies.

Exemptions include:

Environment Protection Act 1986

- Clearing required by local Government Section 33 *Bushfire Act 1954.*
- Clearing in accordance with the terms of a subdivision approval.
- Clearing in accordance with a permit under the *Bushfires Act 1954* (prescribed burning) and clearing by a bushfire control officer.

Environmental Protection (clearing native vegetation) Regulation 2004 (exemptions do not apply in Environmentally Sensitive Areas, and clearing > than 5ha)

https://www.der.wa.gov.au/your-environment/environmentally-sensitive-areas

- Clearing to the extent necessary to construct an approved building.
- Clearing that is for fire hazard reduction burning.

- Clearing to maintain an area cleared in the last 10 years.

Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* provides for the protection of threatened species and threatened ecological communities, which can include the clearing of vegetation these species depend upon. The *Biodiversity Conservation Act 2016* recognises that activities approved under the *Environment Protection Act 1986* do not require further approval include clearing of native vegetation that is either exempt or done under the authority of a clearing permit or done in accordance with an implementation decision under Part IV of the *Environment Protection Act 1986*.

Commonwealth Environment Protection Biodiversity Conservation Act 1999

The Commonwealth Environment Protection Biodiversity Conservation Act 1999 provides for the protection of matters of national environmental significance. National environment law does not generally regulate fire prevention measures taken by state and territory governments, but no specific exemptions are provided.

2. ENVIRONMENTAL CONSIDERATIONS

2.1 Native Vegetation – Modification and Clearing

A fundamental consideration in the assessment of development under SPP 3.7 is to avoid instances where bushfire risk management measures would conflict with or be limited by other biodiversity management measures.

In accordance with the Department of Planning Lands and Heritage template (BMP template to support a BAL Contour Assessment) a review of the listed databases has been undertaken as part of this assessment to identify whether restrictions or other specific considerations may apply that would affect the implementation of any bushfire protection initiatives that may otherwise be identified.

Is the site affected by:	**Yes/No/NA**	**If yes - describe**	
Conservation Wetland or buffer (DBCA-019 DBCA-017)	No		
RAMSAR Wetland (DBCA-010)	No		
Threatened and Priority Flora (DBCA-036)	No		
Threatened and Priority Fauna (DBCA-037)	No		
Threatened Ecological Communities (DBCA-038)	No		
Bush Forever (COP-071)	No		
Environmentally Sensitive Area (DWER-046)	No		
Regionally Significant Natural Areas (DWER-070)	No		
Conservation Covenant (DPIRD-023)	No		
South West Ecological Linkages	Yes	Identified area of remnant vegetation.	
Does the proposal require the removal of restricted vegetation?		~~**Yes**~~	**No**

An Environmental flora and fauna study was conducted by Ecoscape by field survey in May 2020. It examined a broader area at site (options) A and B than required for the establishment of an Asset Protection Zone.

The Ecoscape report found:

- No Commonwealth EPBC Act or Western Australian Biodiversity Conservation Act-listed Threatened Flora were recorded during the field survey, nor any DBCA-listed Priority Flora.
- No vegetation was identified as significant, to meet any of the criteria in the Flora and Vegetation Technical Guidance (EPA 2016d).
- Eighteen vertebrate fauna species were recorded during the field survey across all sites.
- No recorded fauna species was conservation listed and all occur commonly within the region and landscape.

Site A was identified as cropland (no conservation value) and Woodland (unrestricted) and Site B as open woodland but due to the low structural diversity it is unlikely to be suitable for a large variety of native fauna species nor is it considered to have significance as habitat for any conservation-listed species.

No restricted vegetation is required to be removed to facilitate routine bushfire protection measures associated with this proposal (site A). Minor modification to the woodland area south of the generator and within the 21 m Asset Protection Zone is required. Most trees in the woodland area can be retained if the ground covers are maintained to grasses less than 100 mm high.

Site B will require an extensive area of land be cleared around the antenna, up to 150 m and 175 m to support the performance of the biomass antenna. The extent of the area cleared for the purpose of the antenna function will exceed the dimensional requirements for bushfire protection. The ground surface is to be slashed if not removed of grass by grazing animals. This constitutes low threat/excluded vegetation as defined by AS 3959:2018 cl 2.2.3.2.(e). The clearing of the vegetation will be subject to separate State and Commonwealth clearing regulations. In this instance the bushfire protection measures will be exceeded by and follow the clearing approvals for site B.

2.2 Re-Vegetation/Landscape Plans

No revegetation (offsets) or identified regeneration areas are affected by this proposal.

3. BUSHFIRE ASSESSMENT

3.1 Bushfire Attack Level Assessment (Inputs)

Bushfire Behaviour

Bushfire behaviour is the primary determinant of the bushfire risk and the design fire as a basis for identifying appropriate treatments. Bushfire behaviour is affected by three factors;

- Climate (drought and season) & weather (temperature, humidity, wind, atmospheric instability) – determines the intensity of a fire, the speed and direction and potential for advanced spotting. Measured as an FDI in AS3959.
- Topography (slope of the ground, aspect and wind influences) – fire travels faster uphill, flame length is increased uphill, landforms can channel and increase local windspeed and create turbulence. Measured as 0.0^0 or a degree down slope in AS3959 (Method 1).
- Vegetation (horizontal and vertical structure, flammability, mass and availability). Measured as a vegetation classification, or an exclusion, in AS3959 (Method 1).

It is assumed that a bushfire will achieve a steady state and be fully developed to maximum intensity over a 100 m (minimum fire run). Grassfires travel faster (GFDI) than a forest canopy fire, but a forest canopy fire can eject a higher level of embers and also eject them over a greater distance. Crown fires occur when the ground fire is intense, and conversely when ground fuels are managed the resultant fire intensity may not be sufficient to involve the crown, and a crown fire cannot be sustained. Separating the vertical structure so there is no direct connection between the ground and the crown, reduces the likelihood of a crown fire.

The arrangement of fuel has a greater affect upon the intensity of the fire than just its mass, its exposure to oxygen is referred to as its availability in a bushfire.

The following assessment has been undertaken in accordance with the methodologies described in AS3959-2018 and in accordance with the Guidelines and the Fire Protection Association accredited practitioner methodology.

All vegetation within 150 m **(context)** of the subject building has been classified (AS 3959 -2018 Clause 2.2.3) to determine the Bushfire Hazard Level at the locality;

The BAL rating has been determined through site inspection and assessment of the following parameters:

- Fire Danger Index (FDI) rating; assumed to be FDI - 80 for Western Australia;
- Separation distance between the building and the classified vegetation source(s) within 100 m (for BAL impact) the separation distance is measured from the wall face (receiver) to the unmanaged understory rather than the canopy edge (dripline) *see below*; and
- Slope of the land under the classified vegetation.

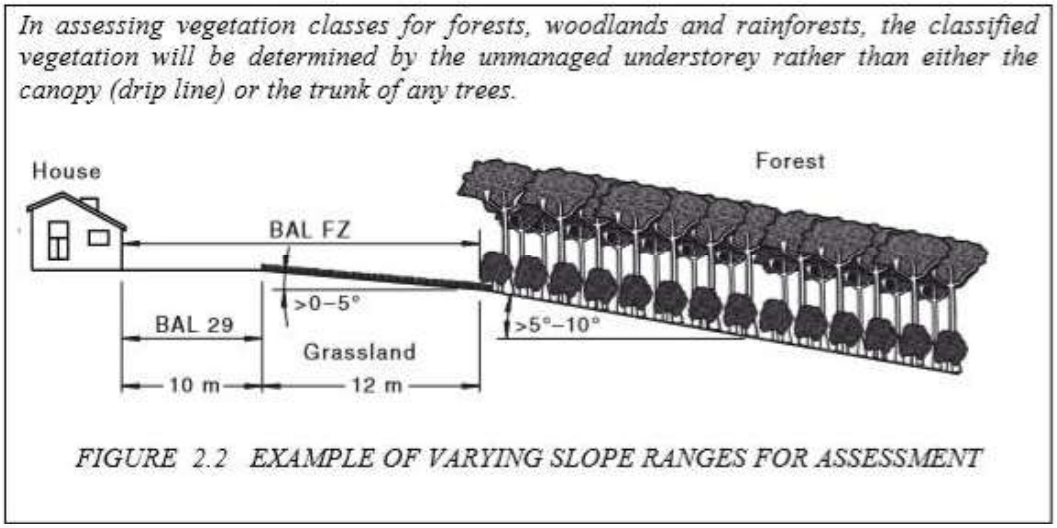


Plate 4: Arrangement of inputs for the determination of a BAL.

A site inspection was undertaken on 5 October 2020, in accordance with the FPAA Guidelines.

All vegetation within 150m of the site / proposed development was classified in accordance with Clause 2.2.2.3 ad Table 2.5 in AS 3959:2018.

A BAL assessment has been prepared in accordance with the FPAA Guidelines and is attached in Appendix A.

The site topography is illustrated in Figure 1 Appendix 1.

The recorded vegetation and photograph evidence is illustrated in Figure 2 Appendix 1.

3.2 Determined Bushfire Attack Level (Outputs)

The post development vegetation, with the establishment of a 21 m Asset Protection Zone is illustrated in Figure 3 Appendix 1.

The Bushfire Attack Level (highest BAL) for the Site A and site B has been determined in accordance with clause 2.2.6 of AS 3959-2018 and is illustrated in Figure 4 Appendix 1.

4. IDENTIFICATION OF BUSHFIRE HAZARD ISSUES

The Guidelines for preparing a Bushfire Risk Management Plan (OBRM) 2015 (Risk Management Plan Guidelines) tailors the risk management methodology identified in ISO 31000:2018. For the purpose of this BMP, the assessments of 'likelihood' and 'consequence' have been based on the Risk Management Guidelines.

The intensity of a bushfire is affected by the conditions that make up the Fire Danger Index. The Fire Danger Index (Fire Danger Rating) is a grading of conditions ranging from moderate to catastrophic. DFES issue Fire Danger Ratings daily during summer. The ratings range from 'moderate', 'high', 'very high', 'severe', 'extreme' through to 'catastrophic'.

High temperatures, strong winds and dry available fuels represent the catastrophic conditions and belie the complacency that the public may develop from witnessing fires on less severe days. It's the worst conditions that are planned for and unfortunately most fires are the result of human actions inadvertent or deliberate and the propensity increases with an increasing population. The propensity for thunderstorms in the summer months is another source.

The Fire Danger Index for Western Australia is 80, and the fire season is inclusive of December and March each year. Extreme days occur mostly in January and February.

The prevailing winds directions (particularly in Severe + FDR conditions) season are predominantly from the south and south west in the afternoons during the bushfire season, but a bushfire can come from any direction.

Areas to the north, east and west are predominantly grassland (pasture). Grassfires are short and intense but generally manageable unless conditions are extreme. Grassfires occur most frequently; they are easily ignited and accessible to machinery and human activity that may create sparks. The 'likelihood' of a fire arriving through grassland site is classed as **likely,** but the consequence in context to the management of the site (existing controls) is **minor.**

The locality of the site was affected by a bushfire incident in January 2020 m as a result of a mechanical failure on the Great Northern Highway immediately east of the site. It was extinguished before reaching the facility but it serves to draw attention to the risk.

The woodland and scrub south of the development site, upslope from the facility and extending south from site B is the largest expanse of unmanaged vegetation and presents the highest risk.

The 'likelihood' of a fire arriving through the woodland south of the site is classed as **Possible** and the consequence is **moderate, -** human exposure is avoidable, it is not a habitable structure.

Extinguishing burning embers, and any small fires against the building, immediately after the peak of the fire has passed significantly improves the survival of the building. This is assisted if convenient facilities are provided and able-bodied persons are trained to safely undertake effective fire suppression.

The overall risk is therefore determined to be **Low.**

Consequence / Likelihood	Minor	Moderate	Major	Catastrophic
Almost certain	High	Very High	Extreme	Extreme
Likely	Medium	High	Very High	Extreme
Possible	Low	Medium	High	Very High
Unlikely	Low	Low	Medium	High

Plate 5: OBRM risk rating matrix.

Site A is classified as grassland and a moderate bushfire hazard level. Grassfires through slashed crops (storks and stubble not exceeding 300 mm) are short intense and fast moving but have the lowest separation requirements. The site is also downslope to vegetation and relatively flat; topography will not be a significant influence, but wind speed and direction will be. Site A is easily accessible with good visibility to the location, to take appropriate action for safety.

Site B is presently classed as open woodland (Ecoscape), but for the purpose of AS3959:2018 has been classified as forest due to the canopy density (>30%). The site is on a flatter area on top of a steep sided hill 15^0-20^0 at 100 m from the antenna location. The site is considered an extreme bushfire hazard level and the fire behaviour will be influenced by the slope, (speed and intensity increased), and erratic winds affected by the slope will also influence the behaviour at the site.

Site B is proposed to be cleared to a radius ranging from 150 m to 175 m around the Biomass Antenna and maintained in a low threat state. It will extend over steep slopes. The associated buildings are not habitable but will also be of a high resistance to bushfire attack through the uses of non- combustible exterior materials.

The clearing requirement for the purpose of the antenna's operation will largely remove the potential for a disruptive damage to the Site B infrastructure from the potential for flame and radiant heat damage from a

bushfire attack, although the potential for strong winds that may be developed by a large scale fire should be considered.

Site B has an access gradient of 8.0^0 which exceeds the operational grade of 6.0^0 for community bushfire appliances. A hydrant is proposed to be located at the hilltop to save the water haulage weight for a brigade vehicle.

5. BUSHFIRE PROTECTION MEASURES

5.1 Bushfire Protection Criteria (Appendix 4 of the Guidelines V1.4)

For each of the elements listed within Appendix 4 of the Guidelines for Planning in bushfire-prone areas, the 'intent' must be achieved either by the proposal meeting the acceptable solutions; or where these acceptable solutions cannot be fully met, then by a performance-based solution that can achieve the 'intent.'

Table 2: Bushfire Protection Criteria assessment.

✓	Acceptable solution provided	C	An Acceptable Solution to be conditioned
N/A	Not Applicable	P	Performance Principle solution see 5.2

Bushfire Protection Criteria	Method of Compliance	AS	PP	Proposed Bushfire Management Strategies
Element 1: location To ensure that strategic planning proposals, subdivision, and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property, and infrastructure	**A1.1 Development location** The strategic planning proposal, subdivision, and development application is located in an area that is or will, on completion, be subject to either a moderate or low bushfire hazard level, or BAL–29 or below.	N/A		In accordance with the WAPC Position Statement: *Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2: Siting and design*, the consideration of the bushfire hazard level is not relevant to a development site
Element 2: Siting and Design To ensure that the siting and design of development minimises	**A2.1 Asset Protection Zone** Every habitable building is surrounded by, and every proposed lot can achieve, an APZ depicted on submitted plans, which meets the following requirements:			The Acceptable solution A2.1 requires that the development site can achieve on completion a BAL not exceeding BAL-29, by an APZ within the boundaries of the lot.

Bushfire Protection Criteria	Method of Compliance	AS	PP	Proposed Bushfire Management Strategies
the level of bushfire impact	• Width: Measured from any external wall or supporting post or column of the proposed building, and of sufficient size to ensure the potential radiant heat impact of a bushfire does not exceed 29kW/m^2 (BAL-29) in all circumstances. • Location: the APZ should be contained solely within the boundaries of the lot on which the building is situated, except in instances where the neighbouring lot or lots will be managed in a low-fuel state on an ongoing basis, in perpetuity (see explanatory notes). • Management: the APZ is managed in accordance with the requirements of 'Standards for Asset Protection Zones.' (see Schedule 1).	✓		Site A (See Figure 3) Site A (the antenna and power generator) is located within pasture grasses, and unrestricted woodland, that can be managed to achieve a BAL not exceeding BAL 29. It is recommended an APZ of 21 m be established either as hardstand or grasses, including grasses under woodland, maintained not to exceed 100 mm in height
			✓	Site B (See Figure 3) Site B is located on top of a hill with steep vegetated (forest) slopes. The proposal will clear a radius 150 m - 175 m around the Biomass Antenna. The cleared area will exceed the normal requirement to achieve a BAL of 29 (41 m). The BAL at the antenna, accounting for forest on steep land at 150 m from the antenna is approximately 3 kWm^2. Areas at the extent of the cleared area will be subject to extreme bushfire hazard levels and this would include the access to Site B, where it is outside the cleared area or near the inner boundary of the cleared area. Figure 3 indicates the fall of the BAL contour over Site B.
Element 3: Vehicular Access To ensure that the vehicular access serving a subdivision/ development is	**A3.1 Two access routes** Two different vehicular access routes are provided, both of which connect to the public road network, provide safe access and egress to two different destinations, and are available to all residents/the public at all times and under all weather conditions.	✓		The Great Northern Highway provides access to destinations north (New Norcia) and south (Bindoon).

<table>
<tr><th>Bushfire Protection Criteria</th><th>Method of Compliance</th><th>AS</th><th>PP</th><th>Proposed Bushfire Management Strategies</th></tr>
<tr><td rowspan="3">available and safe during a bushfire event</td><td>A3.2 Public road

A public road is to meet the requirements in Table 6, Column 1.

Table 6: Vehicular access technical requirements
<table><tr><th>TECHNICAL REQUIREMENTS</th><th>1 Public road</th><th>2 Cul-de-sac</th><th>3 Private driveway</th><th>4 Emergency access way</th><th>5 Fire se acce rout</th></tr><tr><td>Minimum trafficable surface (m)</td><td>6*</td><td>6</td><td>4</td><td>6*</td><td>6*</td></tr><tr><td>Horizontal clearance (m)</td><td>6</td><td>6</td><td>6</td><td>6</td><td>6</td></tr><tr><td>Vertical clearance (m)</td><td>4.5</td><td>N/A</td><td>4.5</td><td>4.5</td><td>4.5</td></tr><tr><td>Maximum grade <50 metres</td><td>1 in 10</td><td>1 in 10</td><td>1 in 10</td><td>1 in 10</td><td>1 in 10</td></tr><tr><td>Minimum weight capacity (t)</td><td>15</td><td>15</td><td>15</td><td>15</td><td>15</td></tr><tr><td>Maximum crossfall</td><td>1 in 33</td><td>1 in 33</td><td>1 in 33</td><td>1 in 33</td><td>1 in 33</td></tr><tr><td>Curves minimum inner radius (m)</td><td>8.5</td><td>8.5</td><td>8.5</td><td>8.5</td><td>8.5</td></tr><tr><td colspan="6">*Refer to E3.2 Public roads: Trafficable surface</td></tr></table></td><td>✓</td><td></td><td>The Great Northern Highway complies with column 1 in Table 6 Technical requirements.</td></tr>
<tr><td>A3.3 Cul-de-sac (including a dead-end road)

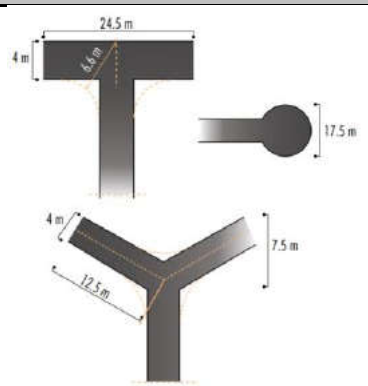
Requirements in Table 6, Column 2;

• Maximum length: 200 metres (if public emergency access is provided between cul-de-sac heads maximum length can be increased to 600 metres provided no more than eight lots are serviced and the emergency access way is no more than 600 metres); and
• Turn-around area requirements, including a minimum 17.5 metre diameter head.</td><td>N/A</td><td></td><td></td></tr>
<tr><td>A3.4 Battle-axe

Requirements in Table 6, Column 3;

• Maximum length: 600 metres; and Minimum width: six metres.</td><td>N/A</td><td></td><td></td></tr>
</table>

Bushfire Protection Criteria	Method of Compliance	AS	PP	Proposed Bushfire Management Strategies
	A3.5 Private driveway longer than 50 m Requirements in Table 6, Column 3; • Required where a house site is more than 50 metres from a public road; • Passing bays: every 200 metres with a minimum length of 20 metres and a minimum width of two metres (i.e. the combined width of the passing bay and constructed private driveway to be a minimum six metres); • Turn-around areas designed to accommodate type 3.4 fire appliances and to enable them to turn around safely every 500 metres (i.e. kerb to kerb 17.5 metres) and within 50 metres of a house; and • Any bridges or culverts are able to support a minimum weight capacity of 15 tonnes. • All-weather surface (i.e. compacted gravel, limestone or sealed)	✓		Site A is provided through an open landscape and has area to facilitate a turnaround for fire appliance. The grades are within operational limits for community firefighting appliances.

Bushfire Protection Criteria	Method of Compliance	AS	PP	Proposed Bushfire Management Strategies
	 **Figure 22:** Design requirements for a private driveway longer than 50 metres Turning areas should allow type 3.4 fire appliances to turn safely		✓	Site B is provided within a cleared area with maneuver space provided in exceeding the turn area requirement in Figure 22 of the Guidelines. The private driveway will be constructed in accordance with the requirements in Table 6, Column 3 with the exception of the gradient. **Performance Principle** The access to the development site exceeds the maximum serviceable grade for community firefighting appliances. The access slope will have a gradient of 8.0^0 which narrowly exceeds the specified acceptable gradient of 6.0^0. This gradient can be attended by the portable facilities provided onsite. In addition, it is proposed that a hydrant be provided at Site B to save the haulage weight of water that may otherwise be required at the hilltop for suppression. This may also assist the access for Brigade vehicles, saving the weight of water to be taken.
	A3.6 Emergency access way Requirements in Table 6, Column 4; • No further than 600 metres from a public road; • Provided as right of way or public access easement in gross to ensure accessibility to the public and fire services during an emergency; and • Must be signposted.	N/A		

Bushfire Protection Criteria	Method of Compliance	AS	PP	Proposed Bushfire Management Strategies
	A3.7 Fire service access routes (perimeter roads) Requirements Table 6, Column 5; • Provided as right of ways or public access easements in gross to ensure accessibility to the public and fire services during an emergency; • Surface: all-weather (i.e. compacted gravel, limestone or sealed) Dead end roads are not permitted; • Turn-around areas designed to accommodate type 3.4 appliances and to enable them to turn around safely every 500 metres (i.e. kerb to kerb 17.5 metres); • No further than 600 metres from a public road; • Allow for two-way traffic and; • Must be signposted	N/A		
	A3.8 Firebreak width,	C		Firebreaks to be maintained in accordance with the Shire annual Firebreak and Fuel Hazard Reduction Notice (*Bushfire Act 1954*).
Element 4: Water To ensure that water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire	**A4.1 Reticulated areas** The subdivision, development or land use is provided with a reticulated water supply in accordance with the specifications of the relevant water supply authority and Department of Fire and Emergency Services. **E4.1**: The Water Corporation's 'No. 63 Water Reticulation Standard' is deemed to be the baseline criterion for developments and should be applied unless local water supply authorities' conditions apply.	N/A		

Bushfire Protection Criteria	Method of Compliance	AS	PP	Proposed Bushfire Management Strategies
	A4.2 Non-reticulated areas • Volume: minimum 50,000 litres per tank; Ratio of tanks to lots: minimum one tank per 25 lots (or part thereof); • Tank location: no more than two kilometres to the furthermost house site within the residential development to allow a 2.4 fire appliance to achieve a 20 minute turnaround time at legal road speeds; • Hardstand and turn-around areas suitable for a type 3.4 fire appliance (i.e. kerb to kerb 17.5 metres) are provided within three metres of each water tank; and • Water tanks and associated facilities are vested in the relevant local government	C		A 240,000 L water tank capacity is available on site and a stand-pipe is available for firefighting, both structural and bushfire. The ESA has its own portable firefighting facility to attend to grass fires and vehicles capable of routinely traversing the steep grade to Site B. Site B is proposed to be provided with a hydrant to support fire suppression at the top of the hill, to prevent the escape of a fire from the site and attend to residual fires after the passing of the fire front, when safe to do so. The infrastructure at Site B, is separated from direct flame contact and is constructed with bushfire resistant materials. Seasonal preparation to ensure that grasses are maintained at less than 100 mm would reduce the need to attend the Biomass antenna infrastructure in a bushfire event; avoiding the need for personnel to be exposed to a bushfire and a potential harm.
	A4.3 Individual lots within non-reticulated areas (Only for use if creating 1 additional lot and cannot be applied cumulatively) Single lots above 500 square metres need a dedicated static water supply on the lot that has the effective capacity of 10,000 litres.	N/A		

5.2 Additional Bushfire Protection Measures

In addition to the measures of compliance with the Acceptable Solutions, in section 5.1 above, the following measures are recommended as appropriate treatments to the bushfire risk identified by the investigations of this BMP.

Occupant safety

The most intense bushfire is likely to arrive in the afternoon between December and March each year (fire season), although the risk can extend from November to April and a fire can arrive from any direction. The facility has a facilities emergency plan (AS 3745:2010) that includes evacuation in case of bushfire and the proposed antennas do not increase the threat of bushfire occurring at the site or the vulnerability of people at the facility who will operate mostly from the administration building.

All staff when outside the administration building are in radio contact with the administration building which is manned 24 hours a day.

The site is well prepared to resist a bushfire attack in its present condition. Separation spaces are clearly provided around the buildings, a water supply is available on site, there are onsite portable firefighting facilities and there are personnel that have been trained to address a fire emergency.

The tourist observation platform is provided near the entry but outside of the facility. Should a fire arrive from the east, i.e. from the Great Northern Highway, shelter can be provided to these people at the facility.

6.1 Spatial Representation of Bushfire Management Measures

The spatial representation of bushfire management measures provides a visual summary of the areas and works required to maintain the bushfire attack level determined to comply with the requirements of SPP 3.7.

It provides the basis for ongoing compliance with the terms of the planning approval.

A figure illustrating the Spatial Representation of Bushfire Management Measures is provided in the Executive Summary.

6. RESPONSIBILITIES FOR IMPLEMENTATION AND MANAGEMENT OF BUSHFIRE MEASURES

6.1 Owner

1.	Within the area shown on the spatial representation of the proposed risk management measures (the APZ) all vegetation is to be retained as low threat (AS 3959:2018) or maintained in accordance with the Standards for Asset Protection Zones.	Prior to occupation
2.	The requirements for private driveways Element 3, Table 6 column 3 in the Guidelines V1.3 should be applied to all new vehicle accessways associated with the proposal. An exception is to be provided for the grade to site B, which will exceed 1 in 10 (6.0^0)	Prior to occupation

6.2 The Shire of Victoria Plains

1.	Developing and maintaining district bushfire fighting services and facilities.	Ongoing
2.	Promoting education and awareness of bushfire prevention and preparation measures though the community.	Ongoing
3.	Administering the requirements of the *Planning and Development Act 2005* and the *Building Act 2011,* to apply to future development.	Ongoing

6.3 State Government

1.	Notification of Emergency Alerts - Website and Telecommunication Media	Ongoing
2.	Policing operation to minimise the outbreak of bushfires.	Ongoing

6.4 Acknowledgement

Acknowledgement - Proponent

The proponent acknowledges the responsibilities as listed above and the requirement to ensure that should the land transfer to a new owner, that the new owner is aware of the BMP and their ongoing responsibility

APPENDIX 1 - BAL Assessment

Bushfire Attack Level Assessment Report

Prepared by a BPAD Accredited Practitioner

Fire Protection Association Australia Life Property Environment

AS 3959 BAL Assessment Report

This report has been prepared by an Accredited BPAD Practitioner using the Simplified Procedure (Method 1) as detailed in Section 2 of AS 3959 – 2018 (Incorporating Amendment Nos 1, 2 and 3). FPA Australia makes no warranties as to the accuracy of the information provided in the report. All enquiries related to the information and conclusions presented in this report must be made to the BPAD Accredited Practitioner.

Property Details and Description of Works

Address Details	**Unit no**	**Street no**	**Lot no** 11	**Street name / Plan Reference** Great Northern Hwy).		
	Suburb Yarawindah				**State** WA	**Postcode** 6509
Local government area	Shire of Victoria Plains					
Main BCA class of the building	Class 8		**Use(s) of the building**		Institutional	
Description of the building or works	Construction of antenna at two sites					

Report Details

Report / Job Number	Report Version	Assessment Date	Report Date
	V3	5 October 2020	10 December 2020

BPAD Accredited Practitioner Details

Name
ANTHONY ROWE – BPAD 36690

Company Details
Envision Bushfire Protection
Ph - 0439 112 179
Email - admin@envisionbp.com.au

ABN 90958370365

I hereby declare that I am a BPAD accredited bushfire practitioner.
Accreditation No. 36690
Signature

Authorised Practitioner Stamp

Reliance on the assessment and determination of the Bushfire Attack Level contained in this report should not extend beyond a period of 12 months from the date of issue of the report. If this report was issued more than 12 months ago, it is recommended that the validity of the determination be confirmed with the Accredited Practitioner and where required an updated report issued.

Site Assessment & Site Plans

The assessment of this site / development was undertaken on 5 October 2020 by a BPAD Accredited Practitioner for the purpose of determining the Bushfire Attack Level in accordance with AS 3959 - 2018 Simplified Procedure (Method 1).

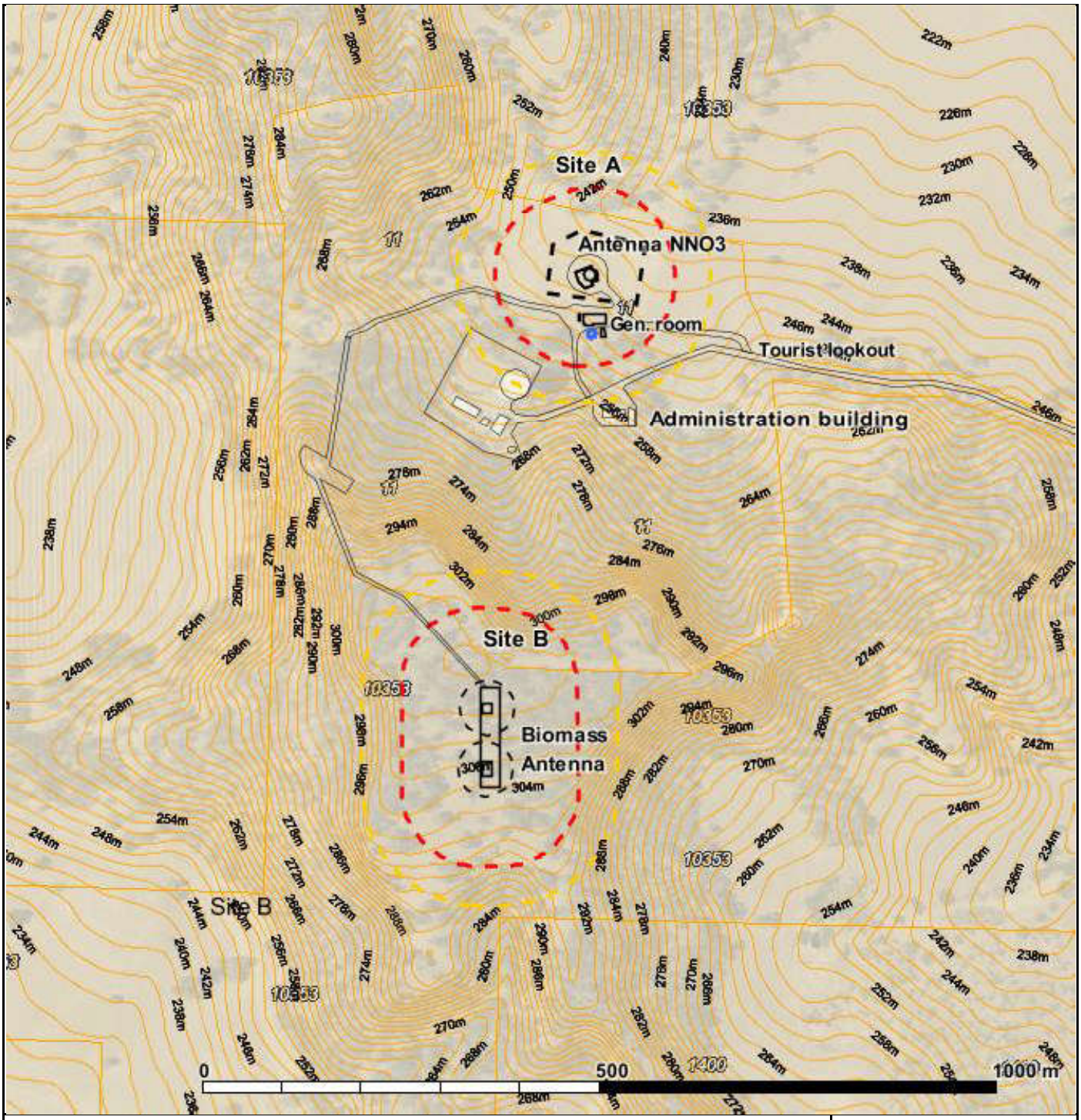


Figure 1: Location and Topography (2m contours)

Address: Lot 11 Great Northern Hwy Yarawindah

Assessment Date: 10 Dec 2020
Prepared: Anthony Rowe
Accreditation Level: BPAD L3
Accreditation Number: 36690
Accreditation Expiry: Dec 2020
FPAA FIRE MAP 2020
GADA 1994 MGA Zone 50

- Building Envelope
- Site boundary
- 100m area assessment
- 150m are assessment
- 2m AHD contour
- Class A Forest
- Class B Woodland
- Class C Shrubland
- Class D Scrub
- Class G Grassland
- Excluded

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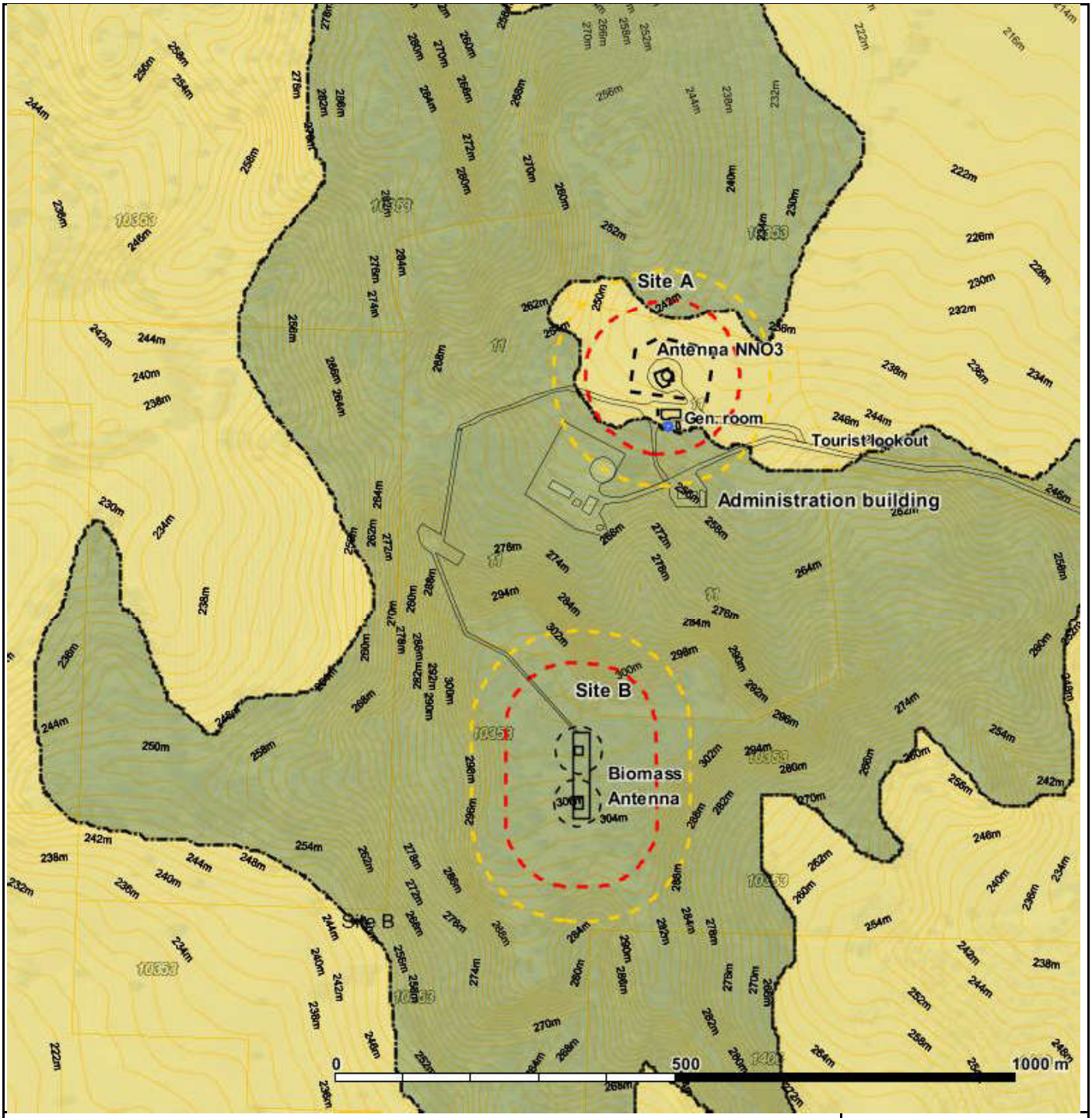

Figure 2: Vegetation Classification Biomass Antenna

Address: Lot 11 Great Northern Hwy Yarawindah

Assessment Date: 10 Dec 2020
Prepared: Anthony Rowe
Accreditation Level: BPAD L3
Accreditation Number: 36690
Accreditation Expiry: Dec 2020
FPAA FIRE MAP 2020
GADA 1994 MGA Zone 50

Building Envelope
Site boundary
100m area assessment
150m are assessment
Class A Forest
Class B Woodland
Class C Shrubland
Class D Scrub
Class G Grassland
Excluded

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bushfire protection

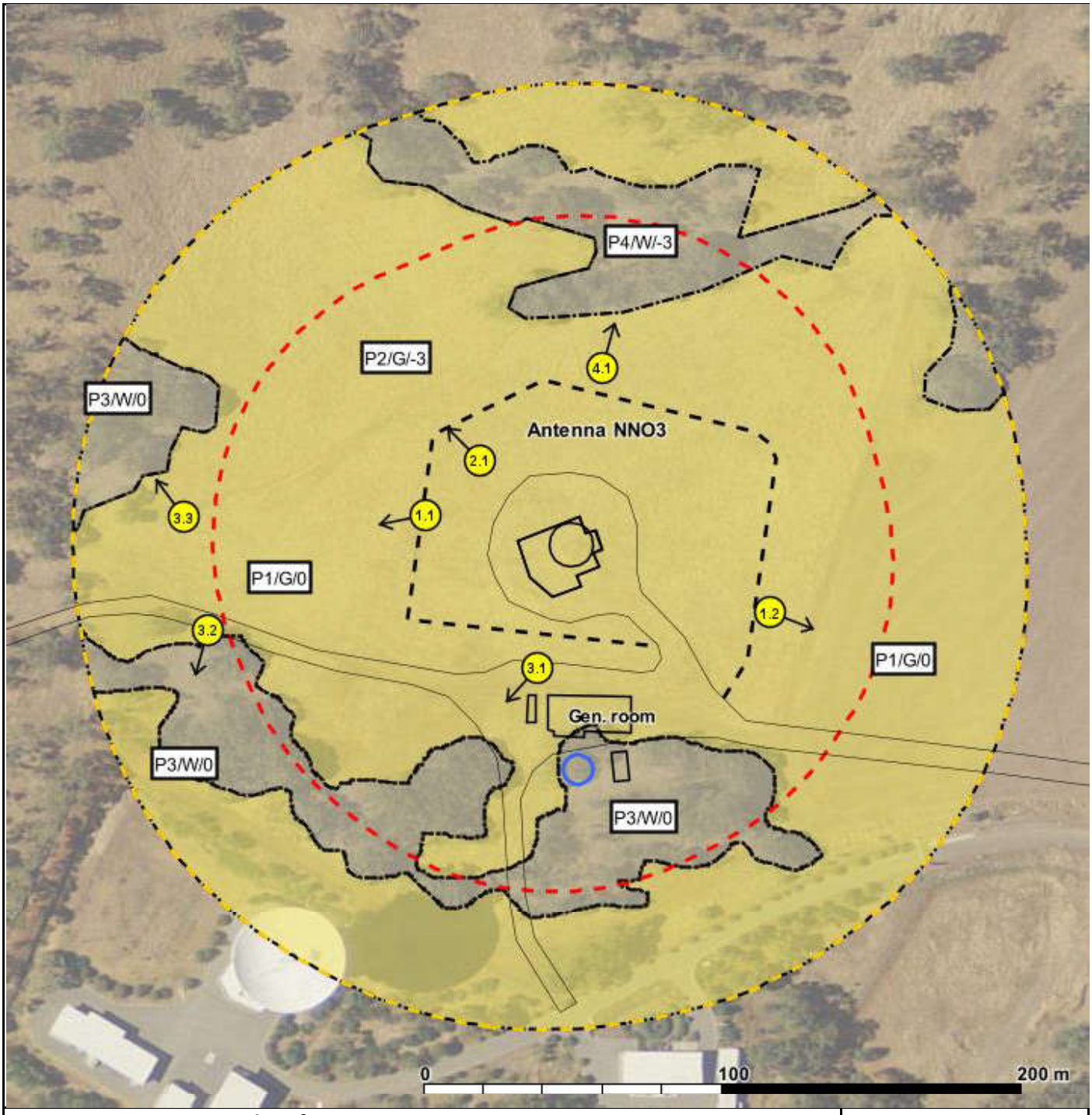

Figure 2A: Vegetation Classification NN03 Antenna

Address: Lot 11 Great Northern Hwy Yarawindah

Assessment Date: 10 Dec 2020
Prepared: Anthony Rowe
Accreditation Level: BPAD L3
Accreditation Number: 36690
Accreditation Expiry: Dec 2020
FPAA FIRE MAP 2020
GADA 1994 MGA Zone 50

Building Envelope	150m are assessment	Class A Forest	Class D Scrub
Site boundary	Photo point	Class B Woodland	Class G Grassland
100m area assessment	Plot Label Plot/Veg Class/Slope	Class C Shrubland	Excluded

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bushfire protection

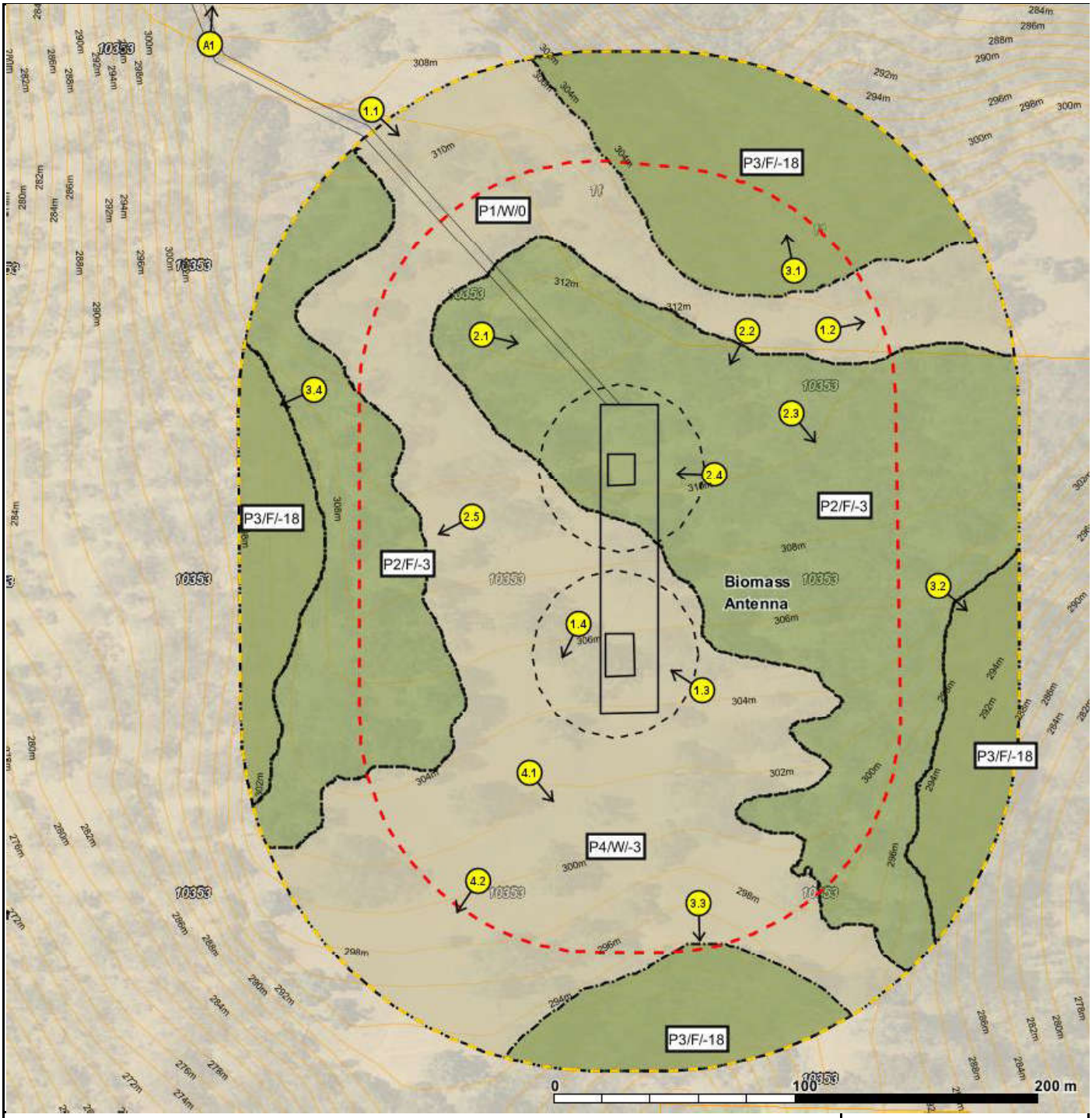

Figure 2B: Vegetation Classification Biomass Antenna

Address: Lot 11 Great Northern Hwy Yarawindah

Assessment Date: 10 Dec 2020
Prepared: Anthony Rowe
Accreditation Level: BPAD L3
Accreditation Number: 36690
Accreditation Expiry: Dec 2020
FPAA FIRE MAP 2020
GADA 1994 MGA Zone 50

Building Envelope	150m are assessment	Class A Forest	Class D Scrub
Site boundary	Photo point	Class B Woodland	Class G Grassland
100m area assessment	Plot Label Plot/Veg Class/Slope	Class C Shrubland	Excluded

envision bushfire protection

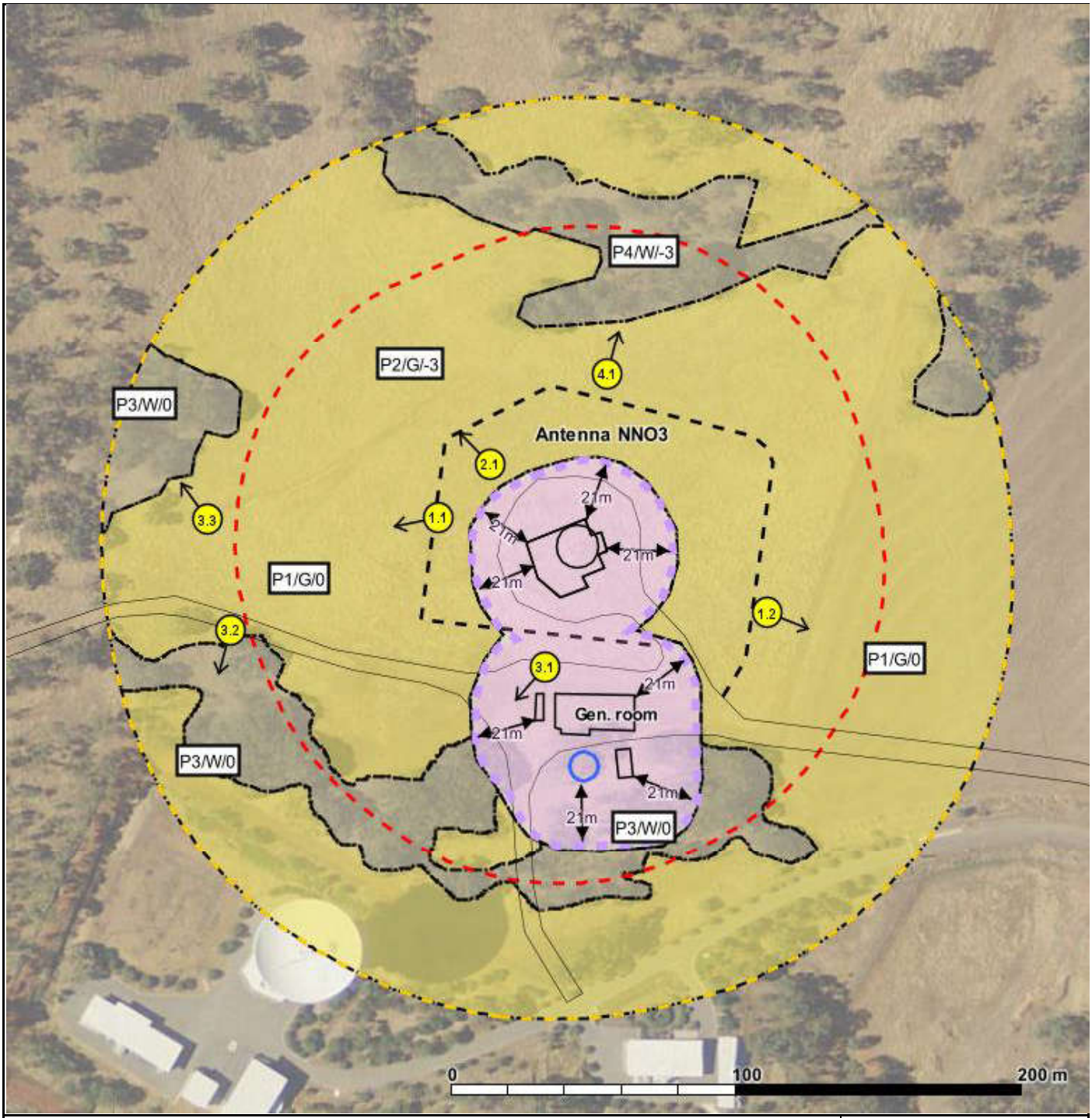

Figure 3A: Vegetation Classification NN03 Antenna (Post Development)

Address: Lot 11 Great Northern Hwy Yarawindah

Assessment Date: 10 Dec 2020
Prepared: Anthony Rowe
Accreditation Level: BPAD L3
Accreditation Number: 36690
Accreditation Expiry: Dec 2020
FPAA FIRE MAP 2020
GADA 1994 MGA Zone 50

Building Envelope	150m are assessment	Class A Forest	Class D Scrub
Site boundary	Asset Protection	Class B Woodland	Class G Grassland
100m area assessment	Plot Label Plot/Veg Class/Slope	Class C Shrubland	Excluded

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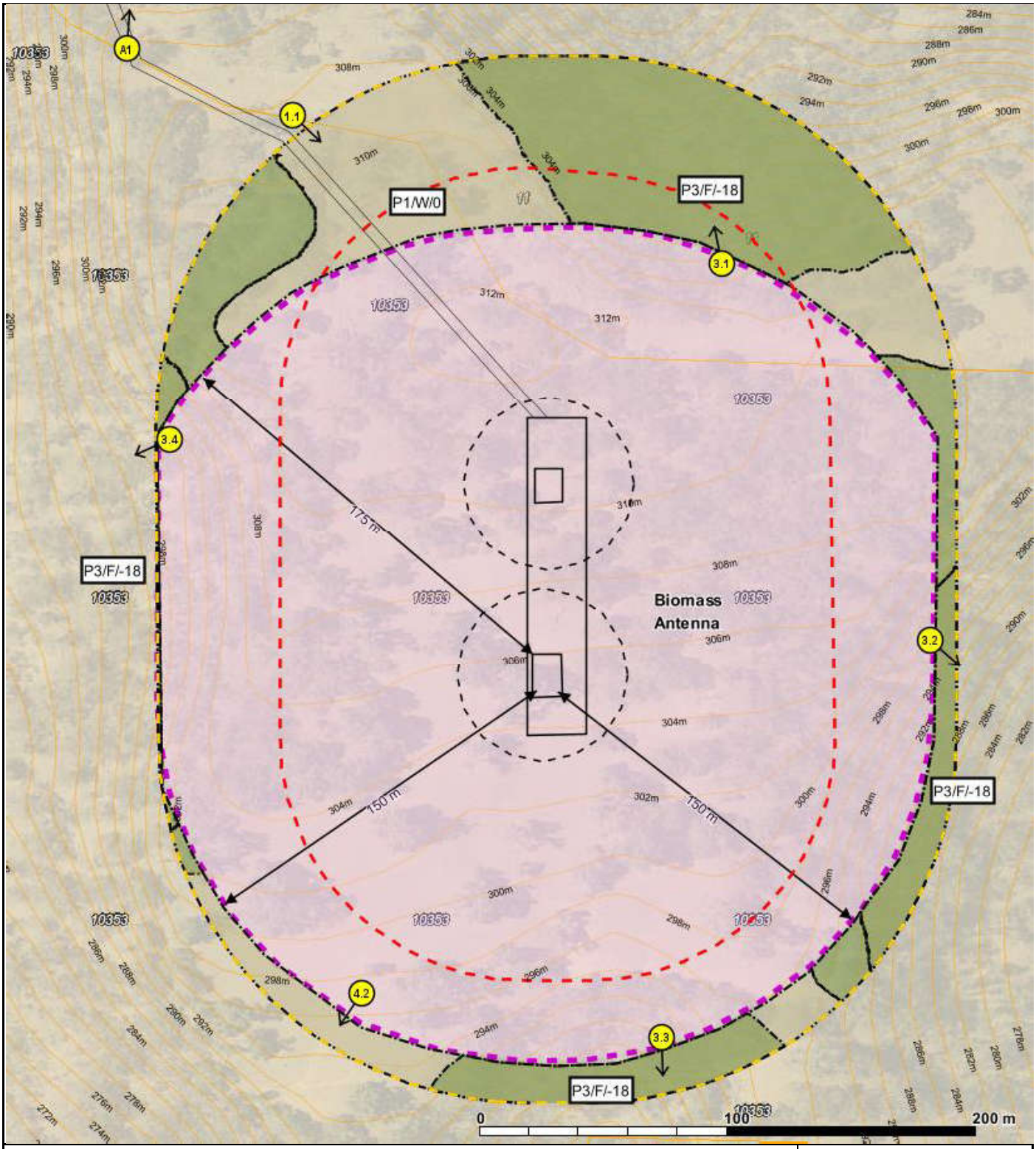

Figure 3B: Vegetation Classification Biomass Antenna (Post Development)

Address: Lot 11 Great Northern Hwy Yarawindah

Assessment Date: 10 Dec 2020
Prepared: Anthony Rowe
Accreditation Level: BPAD L3
Accreditation Number: 36690
Accreditation Expiry: Dec 2020
FPAA FIRE MAP 2020
GADA 1994 MGA Zone 50

Building Envelope	150m are assessment	Class A Forest	Class D Scrub
Site boundary	Asset Protection	Class B Woodland	Class G Grassland
100m area assessment	Plot Label Plot/Veg Class/Slope	Class C Shrubland	Excluded

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bushfire protection

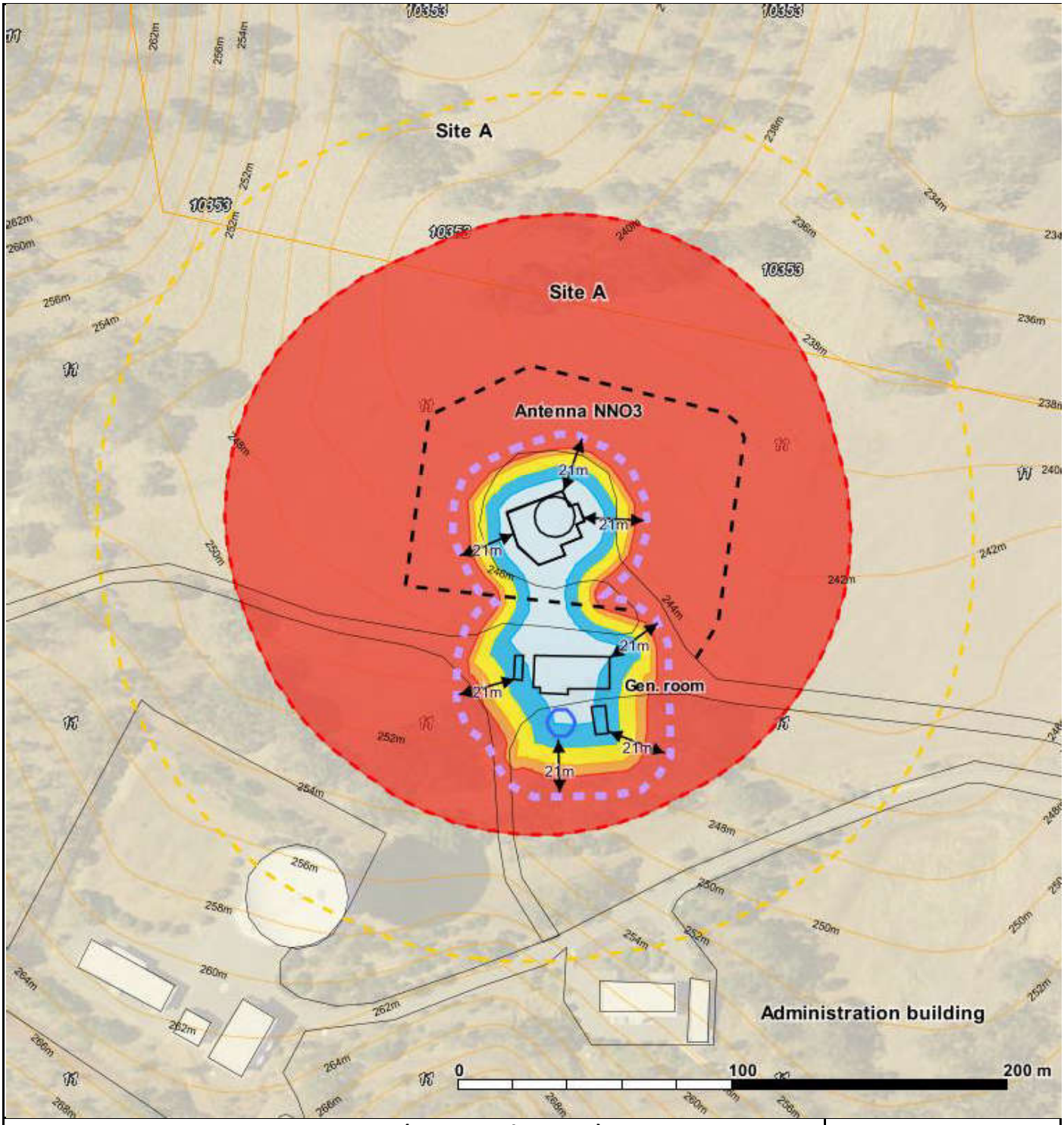

Figure 4A: BAL Contour NN03 Antenna (Post Development)

Address: Lot 11 Great Northern Hwy Yarawindah

Assessment Date: 10 Dec 2020
Prepared: Anthony Rowe
Accreditation Level: BPAD L3
Accreditation Number: 36690
Accreditation Expiry: Dec 2020
FPAA FIRE MAP 2020
GADA 1994 MGA Zone 50

Building Envelope	150m area assessment	BAL FZ	BAL 19
Site boundary	Asset Protection	BAL 40	BAL 12.5
100m area assessment		BAL 29	BAL Low

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bushfire protection

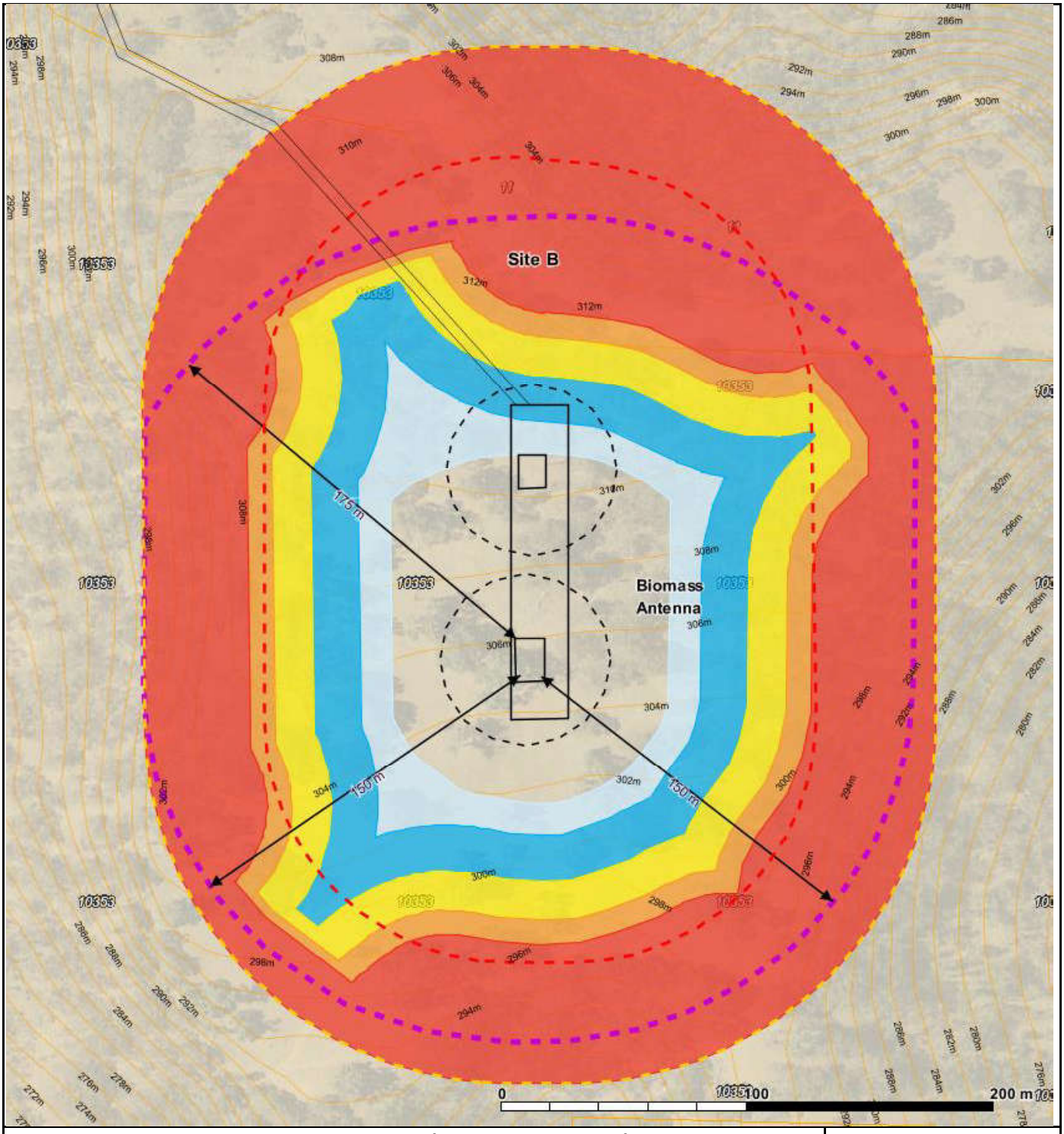

Figure 4B: BAL Contour Biomass Antenna (Post Development)

Address: Lot 11 Great Northern Hwy Yarawindah

Assessment Date: 10 Dec 2020
Prepared: Anthony Rowe
Accreditation Level: BPAD L3
Accreditation Number: 36690
Accreditation Expiry: Dec 2020
FPAA FIRE MAP 2020
GADA 1994 MGA Zone 50

Building Envelope	150m area assessment	BAL FZ	BAL 19
Site boundary	Asset Protection	BAL 40	BAL 12.5
100m area assessment		BAL 29	BAL Low

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bushfire protection

Vegetation Classification

All vegetation within 150m of the site / proposed development was classified in accordance with Clause 2.2.3 of AS 3959-2018. Each distinguishable vegetation plot with the potential to determine the Bushfire Attack Level is identified below.

<table>
<tr><th colspan="3">Site A PLOT: 1 and 2</th></tr>
<tr><td>Vegetation Classification</td><td>PHOTO ID: 1.1</td><td>PHOTO ID: 1.2</td></tr>
<tr><td>Slope</td><td> 
</td><td> 
</td></tr>
<tr><td>Description (AS3959)</td><td></td><td></td></tr>
<tr><td></td><td>PHOTO ID: 2.1</td><td></td></tr>
<tr><td>Observation/Justification for classification</td><td> 
</td><td></td></tr>
<tr><td>Post development</td><td></td><td></td></tr>
</table>

Site A PLOT: 3 and 4		
Vegetation Classification	PHOTO ID: 3.1	PHOTO ID: 3.2
		
Slope		
Description (AS3959)		
Observation/Justification for classification	PHOTO ID: 3.3	PHOTO ID: 4.1
		
Post development		

Site B PLOT: 1		
Vegetation Classification	PHOTO ID: 1.1	PHOTO ID: 1.2
		
Slope		
Description (AS3959)		
Observation/Justification for classification		
	PHOTO ID: 1.3	PHOTO ID: 1.4
		
Post development		

Site B PLOT: 2		
Vegetation Classification	PHOTO ID: 2.1	PHOTO ID: 2.2
Slope		
Description (AS3959)		
Observation/Justification for classification	PHOTO ID: 2.3	PHOTO ID: 2.4
		
Post development		

Site B PLOT: 2		
Vegetation Classification	PHOTO ID: 2.5	
		
Slope		
Description (AS3959)		
Observation/Justification for classification		
Post development		

<table>
<tr><th colspan="3">Site B PLOT: 3</th></tr>
<tr><td rowspan="2">Vegetation Classification

Slope

Description (AS3959)

Observation/Justification for classification

Post development</td><td>PHOTO ID: 3.1</td><td>PHOTO ID: 3.2</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td rowspan="2"></td><td>PHOTO ID: 3.3</td><td>PHOTO ID: 3.4</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

Site B PLOT: 4		
Vegetation Classification	PHOTO ID: 4.1	PHOTO ID: 4.2
		
Slope		
Description (AS3959)		
Observation/Justification for classification		
Post development		

Fire Danger Index

The fire danger index for this site has been determined in accordance with Table 2.1 or otherwise determined in accordance with a jurisdictional variation applicable to the site.

Fire Danger Index			
FDI 40 ☐	FDI 50 ☐	FDI 80 ☒	FDI 100 ☐
Table 2.7	*Table 2.6*	*Table 2.5*	*Table 2.4*

Potential Bushfire Impacts

The potential bushfire impact to the site / proposed development from each of the identified vegetation plots are identified below.

Determined Bushfire Attack Level (BAL)

The Determined Bushfire Attack Level (highest BAL) for the site / proposed development has been determined in accordance with clause 2.2.6 of AS 3959-2018 using the above analysis.

Plot	Vegetation classification	Effective slope	Separation Distance (AS 3959:2018 Table 2.5)	BAL
Site B Plot 3	Forest (Class A)	Downslope 18.^{0} (15-20)	< 42 m	BAL-FZ
			42- < 52 m	BAL-40
			52 - < 68 m	BAL-29
			69 - < 87 m	BAL-19
			87- < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Site B Plot 2	Forest (Class A)	Downslope 3.0^0 (0-5)	< 20 m	BAL-FZ
			20 < 27 m	BAL-40
			27 - < 37 m	BAL-29
			37- < 50 m	BAL-19
			50 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Site A Plot 4 Site B Plot 4	Woodland (Class B)	Downslope 3.0^0 (0-5)	< 103m	BAL-FZ
			13 - < 17 m	BAL-40
			17 - < 25 m	BAL-29
			25 - < 35 m	BAL-19
			235- < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Site A Plot 3 Site B Plot 1	Woodland (Class B)	Flat/upslope	< 10 m	BAL-FZ
			10 - < 14 m	BAL-40
			14 - < 20 m	BAL-29

			20 - < 29 m	BAL-19
			29 - < 50 m	BAL-12.5
			> 50 m	BAL-LOW
Site A Plot 2	Grassland (Class G)	Downslope 3.0^0	< 7 m	BAL-FZ
			7 - < 9 m	BAL-40
			9 - < 14 m	BAL-29
			14 - < 20 m	BAL-19
			20 - < 50 m	BAL-12.5
			> 50 m	BAL-LOW
Site A Plot 1	Grassland (Class G)	Flat/upslope	< 6 m	BAL-FZ
			6 - < 8 m	BAL-40
			8 - < 12 m	BAL-29
			12 - < 17 m	BAL-19
			17 - < 50 m	BAL-12.5
			> 50 m	BAL-LOW

Indicative Bushfire Attack Level

This is based upon an APZ of 21m established from Building Envelope to retained internal and external vegetation. A minimum separation from forest, APZ 21 m, is equivalent to BAL – 29. The Lot BAL is reflective of the existing distance to the nearest classified vegetation.

The following is reflective of the optimal BAL level available at the building envelopes, which is limited by the retained vegetation within and external to the site and assumes all lots otherwise are developed to an APZ standard. Where forest adjoins, or if introduced to adjoin the APZ boundary the BAL rating at 21 m separation would change to BAL 29.

Lot	BAL at building/structure
Site A	BAL -12.5
Site B	BAL - Low

Appendix 2: Additional Information / Advisory Notes

CONSTRUCTION REQUIREMENTS

AS 3959 – 2009 has six (6) levels of BAL based on the radiant heat flux exposure to the building, and identifies the relevant sections for building construction, as detailed below;

Bushfire Attack Level (BAL)	Classified vegetation within 100m of the site and heat flux exposure thresholds	Description of predicted bushfire attack levels of exposure	Construction Section (within AS 3959)
BAL-LOW	See clause 2.2.3.2	There is insufficient risk to warrant specific construction requirements	Nil (s.4)
BAL-12.5	≤12.5kW/m²	Ember Attack	3 & 5
BAL-19	>12.5kW/m² to ≤19kW/m²	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux	3 & 6
BAL-29	>19kW/m² to ≤29kW/m²	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux	3 & 7
BAL-40	>29kW/m² to ≤40kW/m²	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux with the increased likelihood of exposure to flames	3 & 8
BAL-FZ	>40kW/m²	Direct exposure to flames from the fire front in addition to heat flux and ember attack	3 & 9

BAL CONSTRUCTION LEVELS IN CONTEXT

BAL-FZ	BAL-40	BAL-29	BAL-19	BAL-12.5	BAL-LOW
Direct exposure to flames, radiant heat and embers from the fire front.	Increasing ember attack and windborne debris, radiant heat between 29 kW/m2 and 40 kW/m2. Exposure to flames from fire front likely.	Increasing ember attack and windborne debris, radiant heat between 19 kW/m2 and 29 kW/m2.	Increasing ember attack and windborne debris, radiant heat between 12.5 kW/m2 and 19 kW/m2.	Ember attack radiant heat below 12.5 kW/m2	There is insufficient risk to warrant any specific construction requirements but there is still some risk.

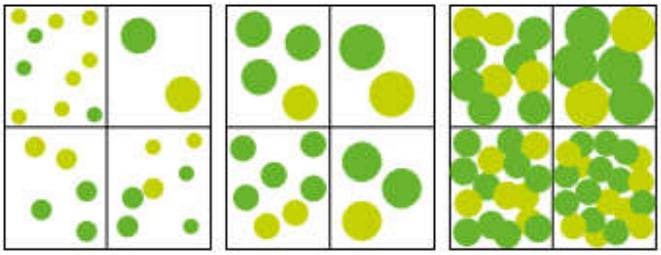
APPENDIX 2 – APZ Standard

ELEMENT 2: SITING AND DESIGN OF DEVELOPMENT

SCHEDULE 1: STANDARDS FOR ASSET PROTECTION ZONES

- **Fences:** within the APZ are constructed from non-combustible materials (e.g. iron, brick, limestone, metal post and wire). It is recommended that solid or slatted non-combustible perimeter fences are used.
- **Objects:** within 10 metres of a building, combustible objects must not be located close to the vulnerable parts of the building i.e. windows and doors.
- **Fine Fuel load:** combustible dead vegetation matter less than 6 millimetres in thickness reduced to and maintained at an average of two tonnes per hectare.
- **Trees (> 5 metres in height):** trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy.

Figure 18: Tree canopy cover – ranging from 15 to 70 per cent at maturity



- **Shrubs (0.5 metres to 5 metres in height):** should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m² in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated as trees.
- **Ground covers (<0.5 metres in height):** can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 millimetres in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs.
- **Grass:** should be managed to maintain a height of 100 millimetres or less.

APPENDIX 3 – References

GENERAL REFERENCES

Australian Building Codes Board *Bushfire Verification Methods* July 2019

Australian Fire and Emergency Service Authority Council Limited (AFAC) *Community Safety Messaging for catastrophic Bushfires, Lessons Learnt from Black Saturday Bushfire, Victoria 2009*, October 2016.

Blanchi R. Leonard J, Haynes K Opie K, James M, Kilinic M, De Oliveira F, and van den Honert – *Life and house loss database description and analysis* CSIRO December 2012.

Cheney P and Sullivan A - *Grassfires Fuel weather and fire behaviour* CSIRO 2008.

SA Department of Environment and Natural Resources, Government of South Australia, 2012 *Overall Fuel Hazard Guide for South Australia*

Standards Australia 2010, *Australian Standard AS 3745:2010 Planning for emergencies in facilities*

Standards Australia 2009, *AS 3959:2018 Construction of buildings in bushfire-prone areas*, Sydney

Standards Australian and Standards New Zealand 2009, *Australian Standard / New Zealand Standard ISO 31000:2009 Risk management – principles and guidelines*

Western Australian Department of Planning 2016*, Visual Guide for bushfire risk assessment in Western Australia*

Western Australian Planning Commission (WAPC) 2015, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*, Western Australian Planning Commission, Perth, Perth

Western Australian Planning Commission and Department of Fire and Emergency Services (WAPC and DFES) 2017, *Guidelines for Planning in Bushfire Prone Areas Version 1.3*, Western Australia

Online references

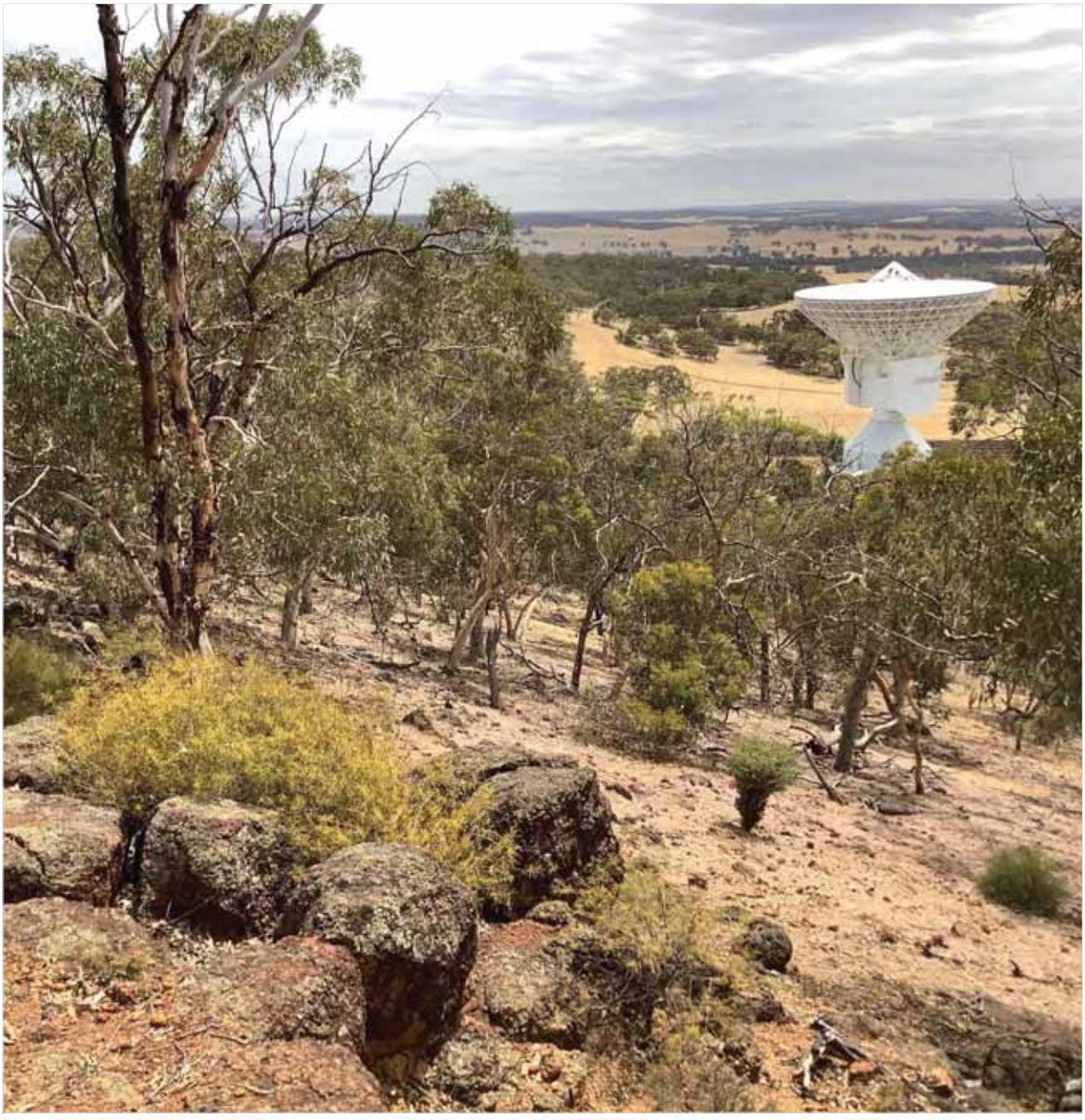
Office of Bushfire Risk management (OBRM), Map of Bush Fire Prone Areas, viewed October 2020, < https://maps.slip.wa.gov.au/landgate/bushfireprone/>

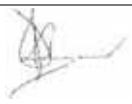
Office of Bushfire Risk Management (OBRM), Bushfire Risk Management (BRM) Plan Guidelines, viewed October 2020

DEEP SPACE FACILITY FLORA AND FAUNA SURVEY

Stratham Engineering Consultancy Service

ecoscape



Revision	Author	QA Reviewer	Approved	Date
Draft rev0	James Tsakalos Lyn Atkins	 Bruce Turner Senior Environmental Scientist	 Bruce Turner Senior Environmental Scientist	29/06/2020
final	Lyn Atkins	 David Kaesehagen Managing Director	 David Kaesehagen Managing Director	1/09/2020

Direct all inquiries to:
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9 Stirling Highway • PO Box 50 NORTH FREMANTLE WA 6159
Ph: (08) 9430 8955

TABLE OF CONTENTS

FIGURES

TABLES

MAPS

ACKNOWLEDGEMENTS

Ecoscape would like to acknowledge the assistance of Wayne Sheffield for facilitating the works. We would also like to thank the personnel at the New Norcia Ground Station for their welcome.

SUMMARY

The European Space Agency, at the New Norcia Deep Space Ground Station, is proposing to add an additional antenna and is considering further infrastructure to measure the Earth's biomass from space. Ecoscape, through Stratham Engineering Consultancy Services, was appointed to conduct environmental surveys to describe the flora, vegetation, fauna and fauna habitat values (including for Black Cockatoos) of the various site options under consideration, as well as a power line corridor to connect the site to electrical infrastructure. The survey sites are known as 'Infrastructure', Option A' and 'Option B'.

The desktop assessment identified the following significant attributes relevant to the sites:

- the pre-European vegetation association corresponding with the sites has between 32.22% and 21.99% at various scales from state-wide to local government area
- 64 conservation-listed flora, including 13 Threatened Flora (TF) have been recorded from within 15 km of the site, although none from within it: none were considered to have a high likelihood of occurring
- 28 conservation-listed vertebrate fauna species are known to occur within 40 km of the survey area, although none from within it: one fauna species was considered a high likelihood of occurring (Carnaby's Cockatoo) and two a medium likelihood (Forest Red-tailed Black Cockatoo and Peregrine Falcon) of occurring on the sites.

The field survey, conducted during May 2020, and subsequent analysis identified the following significant findings:

- 28 vascular flora species were recorded from 15 quadrats and opportunistic observations
  - none were conservation-listed with the field survey confirming that none had a high likelihood of occurring
  - at least eight were introduced species although none were Declared Pest plants or Weeds of National Significance
- three native vegetation types consisting of woodlands dominated by three different Eucalypt species:
  - **CcW**: *Corymbia calophylla* woodland (from 'Option A')
  - **EIW**: *Eucalyptus loxophleba* subsp. *loxophleba* woodland (from the 'Infrastructure', 'Option A' and 'Option B' sites)
  - **EwW**: *Eucalyptus wandoo* subsp. *wandoo* woodland (from the' Infrastructure', 'Option A' and 'Option B' sites)
- one non-native vegetation type (Wheat paddock; **TaG**: **Triticum aestivum* and **Avena barbata* grassland) in the Infrastructure and Option B sites
- all vegetation was in Degraded or Completely Degraded condition
- 18 vertebrate fauna species were recorded (six mammals, 11 birds and one reptile), none of them conservation-listed
  - Carnaby's Cockatoo was assessed as being a High likelihood of occurring not observed at the site for a significant period by the landholder (or during the 3 day field survey) and is unlikely to be dependent on the site if it did occur
  - Forest Red-tailed Black Cockatoo and Peregrine Falcon were assessed as being a Medium likelihood of occurring on occasion but would not be dependent on the resources available within the site
- three fauna habitat types: Open Woodland, Paddock and Infrastructure, with the latter two not representing natural habitat
- the Open Woodland habitat may be suitable for some conservation-listed fauna species, however, it has little structural diversity other than tree canopy

- 376 trees met the criteria to be considered as Black Cockatoo habitat trees; 41 had hollows that were considered suitable for use by Carnaby's Cockatoo although there was no evidence of use (40 of these were in the 'Option A' area)
- the Open Woodland habitat represented 'near-low quality' habitat for Carnaby's Cockatoo, with Paddock and Infrastructure habitat types not representing Carnaby's Cockatoo habitat.

ACRONYMS AND ABBREVIATIONS

Table 1: Acronyms and abbreviations

Acronyms and abbreviations	
BAM Act	**Western Australian *Biosecurity and Agriculture Management Act 2007***
BoM	Bureau of Meteorology
C1, C2, C3	Declared Pest categories under the BAM Act
CD	Conservation Dependent (fauna; specially protected species under the Western Australian BC Act)
CR	Critically Endangered (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
DAWE	Commonwealth Department of Agriculture, Water and Environment (2020-)
DBCA	Western Australian Department of Biodiversity, Conservation and Attractions
DBH	Diameter at Breast Height (1.3 m)
DEC	Western Australian Department of Environment and Conservation (2006-2013, now DBCA)
DEWHA	Commonwealth Department of the Environment, Water, Heritage and the Arts (2007-2010, now DotEE)
DotEE	Commonwealth Department of the Environment and Energy (2016-2020)
DPIRD	Western Australian Department of Primary Industries and Rural Development
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (2010-2013, now DotEE)
EN	Endangered (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
Ecoscape	Ecoscape (Australia) Pty Ltd
EP Act	Western Australian *Environmental Protection Act 1986*
EPA	Western Australian Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GDA 94	Geographic Datum of Australia 1994
GDE	Groundwater Dependent Ecosystem
GPS	Global Positioning System
ha	hectare/hectares
IBRA	Interim Biogeographic Regionalisation for Australia
km	kilometre/kilometres
m	metre/metres
NVIS	National Vegetation Inventory System
MNES	Matters of National Environmental Significance
OS	Other specially protected species (fauna; specially protected species under the Western Australian BC Act)
P; P1, P2, P3, P4, P5	Priority Flora and Fauna species rankings (P1-P4) or Priority Ecological Communities (P1-P5)
PEC	Priority Ecological Community
PF	Priority Flora
PMST	Protected Matters Search Tool (hosted by DAWE, used to search for MNES)
sp.	Species (generally referring to an unidentified taxon or when a phrase name has been applied)
subsp.	Subspecies (infrataxon)
TEC	Threatened Ecological Community
TF	Threatened Flora (formerly termed Declared Rare Flora, DRF, in Western Australia)
var.	Variety (infrataxon)
VU	Vulnerable (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
WAH	Western Australian Herbarium
WAOL	Western Australian Organism List

Acronyms and abbreviations	
WoNS	Weeds of National Significance
*	Introduced flora species (i.e. weed)

1 INTRODUCTION

1.1 BACKGROUND

The European Space Agency's (ESA) New Norcia station hosts a 35 m-wide deep space antenna, known as Deep Space Antenna 1 (DSA-1), located south of New Norcia. DSA-1 is designed for communicating with deep-space missions and provides support to spacecraft such as Mars Express, Rosetta and Gaia. The New Norcia site also hosts a smaller, more nimble 4.5 m antenna that is able to track rockets following lift-off from French Guiana.

ESA is proposing to add an additional antenna (DSA) and is considering further infrastructure to measure the Earth's biomass from space. Ecoscape, through Stratham Engineering Consultancy Services, was appointed to conduct environmental surveys to describe the flora, vegetation, fauna and fauna habitat values of the various site options under consideration, as well as a power line corridor to connect the site to electrical infrastructure. The survey and resultant report (this document) will be used in support of environmental approvals.

1.2 SURVEY AREA

The Stratham Engineering Consultancy Service project area at the New Norcia Deep Space Ground Station, known as the 'survey area' in this report, is located within the Shire of Victoria Plains in the Jarrah Forest Bioregion, approximately 100 km north east of Perth (**Figure 1**). The survey area consists of three sites: Option A (13.1 ha), Option B (16.2 ha) and an Infrastructure Area (9.7 ha) spanning 37.54 ha in total.

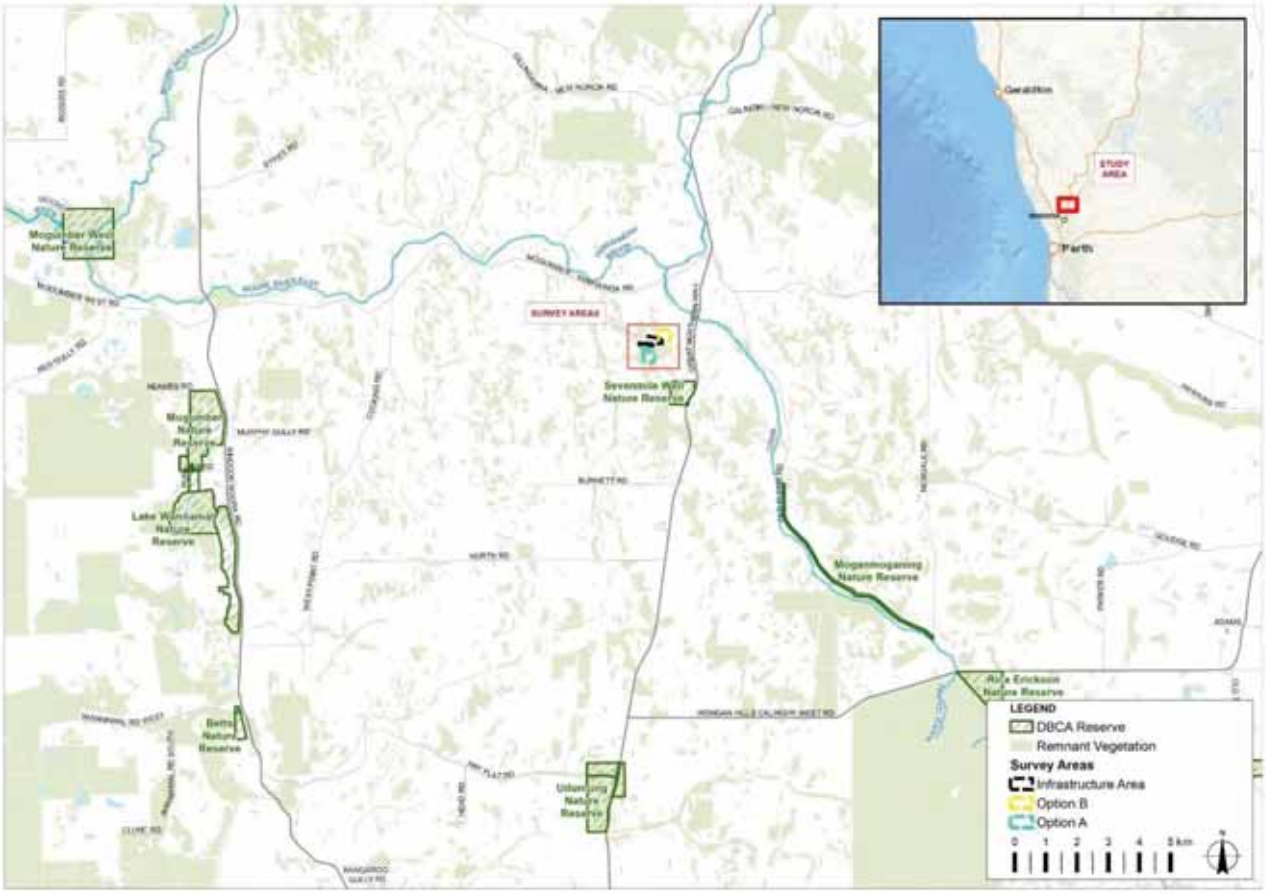


Figure 1: Survey area location

1.3 SURVEY REQUIREMENTS

The requirements of the survey were to conduct:

- a Detailed flora and vegetation survey with conservation-listed flora survey of the study area
- a Level 1 fauna and Black Cockatoo habitat assessment.

The results for each of the three survey sites are presented separately, however, the desktop assessment and methods are common to all sites.

1.4 COMPLIANCE

This environmental assessment was conducted in accordance with Commonwealth and State legislation and guidelines:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Western Australian *Environmental Protection Act 1986* (EP Act)
- Western Australian *Biodiversity Conservation Act 2016* (BC Act)
- Western Australian *Biodiversity Conservation Regulations 2018*
- Department of Environment Water Heritage and the Arts (DEWHA 2009) *Matters of National Environmental Significance. Significant impact guidelines 1.1 - Environment Protection and Biodiversity Conservation Act 1999*
- DEWHA (2010) *Survey guidelines for Australia's threatened birds*
- DSEWPaC (Department of Sustainability Environment Water Population and Communities 2012a) *EPBC Act referral guidelines 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*, known in this document as the Black Cockatoo Referral Guidelines
- Commonwealth of Australia (2017) *Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo*, known in this document as the Revised Draft Referral Guideline.
- Threatened Species Scientific Committee (TSSC 2015) *Approved Conservation Advice (including listing advice) for the Eucalypt Woodlands of the Western Australian Wheatbelt*
- TSSC (2016) *Approved conservation advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community.*

As well as those listed above, the assessment complied with Environmental Protection Authority (EPA) requirements for environmental survey and reporting in Western Australia, as outlined in:

- EPA (2016d) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*, known as the Flora and Vegetation Technical Guidance
- EPA (2016e) *Technical Guidance – Terrestrial Fauna Surveys*, known as the Fauna Technical Guidance
- EPA (2016f) *Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna*
- EPA (2016c) *Statement of Environmental Principles, Factors and Objectives*.

1.4.1 COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

At a Commonwealth level, Threatened taxa (flora and fauna) are protected under the EPBC Act, which lists species that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependant, Extinct, or Extinct in the Wild (detailed in **Table 19** in **Appendix One**).

1.4.2 WESTERN AUSTRALIAN ENVIRONMENTAL PROTECTION ACT 1986

The Western Australian EP Act was created to provide for an Environmental Protection Authority (the EPA) that has the responsibility for:

- prevention, control and abatement of pollution and environmental harm
- conservation, preservation, protection, enhancement and management of the environment
- matters incidental to or connected with the above.

The EPA is responsible for providing the guidance and policy under which environmental assessments are conducted. It conducts environmental impact assessments (based on the information provided by the proponent), initiates measures to protect the environment and provides advice to the Minister responsible for environmental matters.

1.4.3 WESTERN AUSTRALIAN BIODIVERSITY CONSERVATION ACT 2016

The Western Australian BC Act provides for the conservation, protection and ecologically sustainable use of biodiversity and biodiversity components in Western Australia. It commenced on 1 January 2019.

Threatened species (both flora and fauna) and ecological communities that meet the categories listed within the BC Act are protected under this legislation and require authorisation by the Minister to take or disturb. These are known as Threatened Flora, Threatened Fauna and Threatened Ecological Communities. The conservation categories of Critically Endangered, Endangered and Vulnerable are detailed in **Table 20** in **Appendix One**; these categories align with those of the EPBC Act.

Flora and fauna species may be listed as being of special conservation interest if they have a naturally low population, restricted natural range, are subject to or recovering from a significant population decline or reduction of range or are of special interest, and the Minister considers that taking may result in depletion of the species. Migratory species and those subject to international agreement are also listed under the Act. These are known as specially protected species in the BC Act.

The most recent flora and fauna listings were published in the *Government Gazette* on 11 September 2018 (Government of Western Australia 2018d).

1.4.4 FLORA

1.4.4.1 Threatened and Priority Flora

Conservation-listed flora species are those that are listed as TF (Threatened Flora) and (within Western Australia) as PF (Priority Flora). TF species are listed as Threatened by the Western Australian DBCA and protected under the provisions of the BC Act. Some State-listed TF are provided with additional protection as they are also listed under the Commonwealth EPBC Act.

Flora are listed as PF where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally assign them to TF categories. Whilst PF are not specifically listed in the BC Act, some may qualify as being of special conservation interest and thereby have a greater level of protection than unlisted species.

There are seven categories covering State-listed TF and PF species (DBCA 2019) which are outlined in **Table 20** in **Appendix One**. PF for Western Australia are regularly reviewed by the DBCA whenever new information becomes available, with species status altered or removed from the list when data indicates that they no longer meet the requirements outlined in **Table 20**.

1.4.4.2 Other Significant Flora

According to the *Flora and Vegetation Technical Guidance* (EPA 2016d) other than being listed as Threatened or Priority Flora, a species can be considered as significant if it is considered to be:

- locally endemic or association with a restricted habitat type (e.g. Groundwater Dependent Ecosystems, Sheet Flow Dependent Vegetation)
- a new species or has anomalous features that indicate a potential new species
- at the extremes of range, recently discovered range extensions (generally considered greater than 100 km or in a different bioregion), 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.

1.4.4.3 Introduced Flora

Introduced plant species, known as weeds, are plants that are not indigenous to an area and have been introduced either directly or indirectly (unintentionally) through human activity. Species are regarded as introduced if they are listed as 'alien' on *FloraBase* (Western Australian Herbarium [WAH] 1998-2019) and are designated with an asterisk (*) in this document.

Weeds of National Significance

At a national level there are 32 weed species listed as Weeds of National Significance (WoNS) (Australian Government & Department of the Environment and Energy [DotEE] 2018; Weeds Australia 2012). The Commonwealth *National Weeds Strategy: A Strategic Approach to Weed Problems of National Significance* (2012b) describes broad goals and objectives to manage these species.

Declared Pest Plants

The Western Australian Organism List (WAOL) details organisms listed as Declared Pests under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). Under the BAM Act, Declared Pests are listed as one of the three categories, or exempt:

- C1 (exclusion), that applies to pests not established in Western Australia; control measures are to be taken to prevent their entry and establishment
- C2 (eradication), that applies to pests that are present in Western Australia but in low numbers or in limited areas where eradication is still a possibility
- C3 (management), that applies to established pests where it is not feasible or desirable to manage them in order to limit their damage
- exempt (no category).

1.4.5 ECOLOGICAL COMMUNITIES

1.4.5.1 EPBC-listed Threatened Ecological Communities

Ecological communities are naturally occurring biological assemblages associated with a particular type of habitat (Government of Western Australia 2016). At Commonwealth level, Threatened Ecological Communities (TECs) are protected under the Commonwealth EPBC Act. An ecological community may be categorised into one of the three sub-categories:

- Critically Endangered, if it is facing an extremely high risk of extinction in the wild in the immediate future
- Endangered, if it is not critically endangered and is facing a very high risk of extinction in the wild in the near future

- Vulnerable, if it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

1.4.5.2 Western Australian Threatened Ecological Communities

Western Australian TECs are protected under the BC Act. TECs are categorised much like those of the EPBC Act, shown in **Table 21** in **Appendix One**.

Currently described TECs are listed on the DBCA website, with the most recent list endorsed by the Minister for Environment in June in June 2018 (DBCA 2018).

1.4.5.3 Western Australian Priority Ecological Communities

DBCA maintains a list of Priority Ecological Communities (PECs). PECs include potential TECs that do not meet survey criteria, or that are not adequately defined. They are not protected under legislation but are taken into consideration as part of the environmental approvals process.

Currently described PECs are listed on the DBCA website, with the most recent list dated 17 January 2019 (Species and Communities Program, DBCA 2019).

1.4.6 OTHER SIGNIFICANT VEGETATION

According to the *Flora and Vegetation Technical Guidance* (EPA 2016d), other than being listed as a TEC or PEC, vegetation can be considered as significant if it is considered to have:

- restricted distribution
- a degree of historical impact from threatening processes
- a role as a refuge
- provides an important function required to maintain ecological integrity of a significant ecosystem.

1.4.6.1 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) have frequently been considered within an environmental approvals context to be considered as significant vegetation.

GDEs are defined as ecosystems that are dependent on groundwater for their survival at some stage or stages of their lifecycle, however groundwater use cannot be equated with groundwater dependence (Eamus 2009). In some contexts, GDEs are also known as Groundwater Dependent Vegetation.

Hatton and Evans (1998) identified four types of GDEs based on their geographic setting: terrestrial vegetation (vegetation communities and dependent fauna that have seasonal or episodic dependence on groundwater), river base flow systems (aquatic and riparian ecosystems that exist in or adjacent to streams that are fed by groundwater base flow), aquifer and cave ecosystems, and wetlands.

Eamus *et al.* (2006) identified three primary classes based on type of groundwater reliance:

1. Aquifer and cave ecosystems.
2. All ecosystems dependent on the surface expression of groundwater:
    a) river base flows
    b) wetlands, swamplands
    c) seagrass beds in estuaries
    d) floodplains
    e) mound springs
    f) riparian vegetation
    g) saline discharge to lakes

h) low lying forests.

3. All ecosystems dependent on the subsurface presence of groundwater, often accessed via the capillary fringe (non-saturated zone above the water table) when roots penetrate this zone:
   a) River Red Gum (*Eucalyptus camaldulensis*) forests
   b) Banksia woodlands
   c) Riparian vegetation in the wet/dry tropics.

1.4.7 FAUNA

1.4.7.1 EPBC-listed Threatened Fauna

At a Commonwealth level, Threatened Fauna are protected under the EPBC Act, which lists species and ecological communities that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependant, Extinct, or Extinct in the Wild (detailed in **Table 19** in **Appendix One**).

Migratory species subject to international agreements are also protected under the EPBC Act. The definition of a migratory species under the Act follows that prescribed by the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention) (DotEE 2019):

> *Migratory species are the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries.*

Species listed by the following international agreements are currently protected under the EPBC Act:

- *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention)
- *China-Australia Migratory Bird Agreement* (CAMBA)
- *Japan-Australia Migratory Bird Agreement* (JAMBA)
- *Republic of Korea-Australia Migratory Bird Agreement* (ROKAMBA).

1.4.7.2 Western Australian-listed Threatened Fauna

Threatened fauna that meet the categories listed within the BC Act are protected and require authorisation by the Minister to take or disturb. The conservation categories of Critically Endangered, Endangered and Vulnerable have been aligned with those detailed in the EPBC Act.

Fauna species may be listed as being of special conservation interest if they have a naturally low population, restricted natural range, are subject to or recovering from a significant population decline or reduction of range or are of special interest, and the Minister considers that taking may result in depletion of the species. These are known as Specially Protected Species in the BC Act. The categories covering State-listed threatened fauna species are outlined in **Table 20** in **Appendix One**.

1.4.7.3 Western Australian Priority Fauna

Conservation-listed fauna species are listed by the DBCA as Priority Fauna where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally assign them to threatened fauna categories. Whilst Priority Fauna are not specifically listed in the BC Act, these have a greater level of significance than other native species. The categories covering Priority Fauna species are outlined in **Table 20** in **Appendix One**.

1.4.8 ENVIRONMENTALLY SENSITIVE AREAS

There are a number of areas around Western Australia identified as being of environmental significance within which the exemptions to the Native Vegetation Clearing Regulations do not apply. These are referred to as Environmentally Sensitive Areas (ESAs), and are declared under section 51B of the EP Act and described in the Environmental Protection (Environmentally Sensitive Areas) Notice (Government of Western Australia 2005)

1.4.9 CONSERVATION ESTATE

The National Reserve System is a network of protected areas managed for conservation under international guidelines. The objective of placing areas of bushland into the Conservation Estate is to achieve and maintain a comprehensive, adequate and representative reserve system for Western Australia. The Conservation and Parks Commission is the vesting body for conservation lands, forest and marine reserves that are managed by DBCA (Government of Western Australia 2018b).

2 DESKTOP ASSESSMENT

2.1 PHYSICAL ENVIRONMENT

2.1.1 CLIMATE

The southwest of Western Australia is generally described as having a Mediterranean-type climate of mild, wet winters and warm to hot, dry summers. The climate of the region is strongly influenced by the position of a band of high pressure known as the sub-tropical ridge. For much of the year the ridge is located to the south allowing the east or south easterly winds to prevail. During the cooler months the ridge periodically moves to the north allowing cold fronts to pass over the west coast and deliver much of the annual rainfall (Beard 1990). The survey area borders on the arid zone.

According to the Köppen-Geiger climate classification, the survey area has a temperate climate with hot, dry summers (Class Csa) (Peel *et al.* 2007). This classification is considered to represent a hot summer Mediterranean climate where average summer maximum temperatures exceed 22°C and the average coldest month maximum is between 18 and -3°C, and summer rainfall is less than one third of winter rainfall.

The closest Bureau of Meteorology (BoM) station with long term rainfall records is New Norcia (station 009033, operating since 1882; BoM 2020, accessed 11 June 2020) located approximately 9 km north of the survey area. The mean annual rainfall is 513.3 mm falling predominantly in late autumn and winter (May-August). The rainfall in the 5 month period preceding the survey in May 2020 (131.6 mm) was approximately 96% of the long-term mean for this period, although rainfall is typically low during this period.

The closest Bureau of Meteorology (BoM) station with long term temperature records is Wongan Hills (station 008137, operating since 1907; BoM 2020, accessed 11 June 2020) located approximately 52 km northeast of the survey area. January is the hottest month with a mean maximum temperature of 34.6° and minimum of 17.8°. July is the coldest month with a mean maximum of 17.1° and minimum of 6.6°.

Figure 2 shows the average rainfall and temperatures of the survey area, with rainfall for the year preceding the field survey.

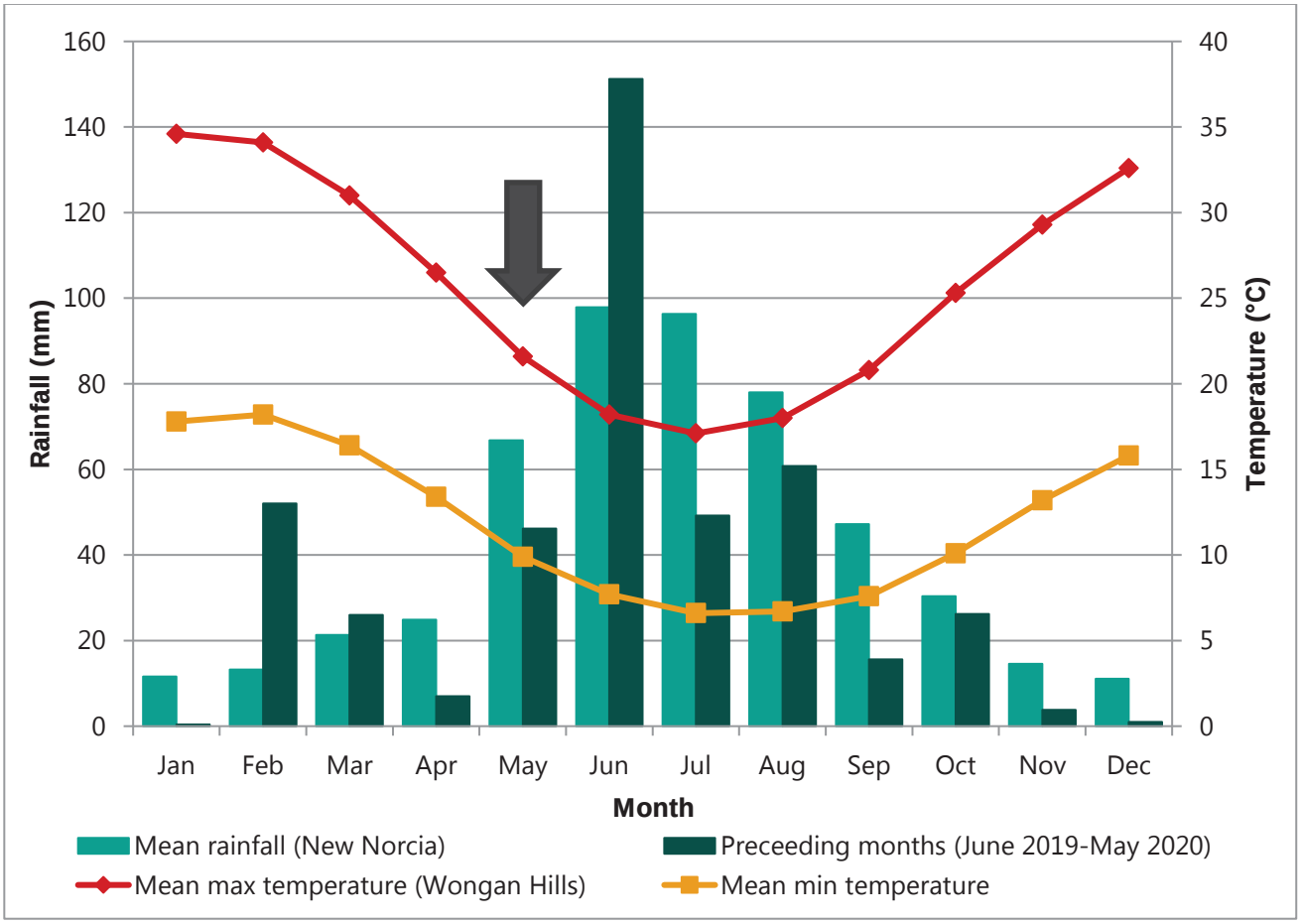


Figure 2: Rainfall and temperature data for the survey area (BoM 2020; New Norcia and Wongan Hills). The arrow indicates the survey period.

2.1.2 LAND SYSTEMS

According to Department of Primary Industries and Rural Development (DPIRD 2018b) soil landscape mapping, the following land systems correspond with the survey area (**Table 2** and **Map 1**).

Table 2: Land systems (DPIRD 2018b)

Mapping unit	Land System	Description	Extent (ha)	% site	% total area
Infrastructure Area					
253Ju_2cb	Julimar Michibin cb Phase	Gently inclined to steep breakaway slope; red to brown loamy earths and duplexes, some loamy gravel, acid duplexes and stony	0.11	1.22	0.29
253Yh_2a	Yarawindah 2a typical Phase	Very gently inclined hillslopes and hillcrests; loamy and sandy earths, loamy gravel, shallow loamy gravel over duricrust	6.71	72.28	17.39
253Yh_3	Yarawindah 3 Subsystem	Stripped very gently to gently inclined hillslopes and hillcrests, commonly includes small rises of rock such as quartzite; loamy earths, loamy stony soils, loamy gravel	2.46	26.51	6.38
Option A					
253Ju_2cb	Julimar Michibin cb Phase	Gently inclined to steep breakaway slope; red to brown loamy earths and duplexes, some loamy gravel, acid duplexes and stony	4.67	34.71	12.09
253Ug_1b	Udamong 1 plateau remnant Phase	Residual plateau, very gently inclined, small portions of Ug1a; loamy gravel, some shallow gravel and sandy gravels. Heath and mallee.	8.31	61.79	21.52
253Yh_3	Yarawindah 3 Subsystem	Stripped very gently to gently inclined hillslopes and hillcrests, commonly includes small rises of rock such as quartzite; loamy earths, loamy stony soils, loamy gravel	0.12	0.91	0.32
Option B					
253Yh_1	Yarawindah 1 Subsystem	Older colluvial slopes, very gently to gently inclined hillslopes and rarely hillcrests; loamy gravel, shallow gravel over duricrust, some loamy earths and duplexes	0.35	2.59	0.90
253Yh_2a	Yarawindah 2a typical Phase	Very gently inclined hillslopes and hillcrests; loamy and sandy earths, loamy gravel, shallow loamy gravel over duricrust	13.59	85.60	35.19
253Yh_3	Yarawindah 3 Subsystem	Stripped very gently to gently inclined hillslopes and hillcrests, commonly includes small rises of rock such as quartzite; loamy earths, loamy stony soils, loamy gravel	2.24	14.12	5.81
253Yh_5	Yarawindah 5 Subsystem	Fans, very gently inclined hillslopes and footslopes usually lower; loamy gravel, loamy earths, some loamy duplexes	0.04	0.28	0.11

2.1.3 GEOLOGY

The geology of the survey area is summarised in **Table 3** (Government of Western Australia 2018a).

Table 3: Geology of the survey area (Government of Western Australia 2018a)

Mapping unit	Description	Extent (ha)	% site	% total area
Infrastructure Area				
Alb	Quartz-mica schist, biotite generally in excess muscovite	9.26	70.69	23.98
Czl	Laterite – chiefly massive, but includes overlying pisolithic gravel and laterized sand	0.03	0.22	0.07
Option A				
Alb	Quartz-mica schist, biotite generally in excess muscovite	6.91	52.72	17.89
Czl	Laterite – chiefly massive, but includes overlying pisolithic gravel and laterized sand	6.20	47.28	16.04
Option B				
Alb	Quartz-mica schist, biotite generally in excess muscovite	15.80	120.58	40.91
Qa	Alluvium and minor colluvium developed on laterite of the Darling Range	0.43	3.24	1.10

2.1.4 WETLANDS

The survey area falls in the Moore River catchment within the Eastern Darling Range hydrological zone (DBCA 2007-2020); this area is characterized by moderately to strongly dissected lateritic plateaus on granite with eastward flowing streams in broad shallow valleys.

2.1.5 GROUND WATER DEPENDENT ECOSYSTEMS

The *Groundwater Dependent Ecosystems Atlas* (Australian Government & BoM 2020) indicates that the survey area is considered as low potential for terrestrial GDEs to occur, with an IDE likelihood of low.

2.1.6 ENVIRONMENTALLY SENSITIVE AREAS

The survey area does not intersect with any clearing regulations environmentally sensitive areas (Government of Western Australia & Department of Water and Environmental Regulation 2020). The closest ESA (1362) is located 800 m to the east.

2.1.7 CONSERVATION LANDS

The survey area does not intersect with any DBCA legislated lands and waters (including national park, nature reserve, conservation park, marine park, marine nature reserve, marine management area, State forest and timber reserves).

2.1.8 LAND USE HISTORY

The survey area is located within an area of broadscale agriculture and, whilst located within the Jarrah Forest IBRA region (see **Section 2.2.1** below), has land use more similar to that of the Avon Wheatbelt.

The survey area is located within a working farm in which livestock grazing (sheep and cattle) and cropping (primarily cereal grasses) is currently conducted. Parts of the survey area on rocky soil have not been cleared of native vegetation, however, they are intensively grazed and most of the native understory is no longer present although the upper stratum trees remain.

2.2 BIOLOGICAL ENVIRONMENT

2.2.1 BIOGEOGRAPHIC REGION

Biogeographic regions are delineated on the basis of similar climate, geology, landforms, vegetation and fauna and are defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (DotEE 2016).

The survey area is located in the Jarrah Forest IBRA region in the Northern Jarrah Forest subregion (JAF01), described as (Williams & Mitchell 2001):

> *… Duricrusted plateau of Yilgarn Craton characterised by Jarrah-Marri forest on laterite gravels and, in the eastern part, by woodlands of Wandoo - Marri on clayey soils. Eluvial and alluvial deposits support Agonis shrublands. In areas of Mesozoic sediments, Jarrah forests occur in a mosaic with a variety of species-rich shrublands. The climate is Warm Mediterranean.*

The bioregion boundary is indicated on **Map 2** and **Map 3**.

2.2.2 PRE-EUROPEAN VEGETATION

During the 1970s, John Beard and associates conducted a systematic survey of native vegetation, describing the vegetation systems in Western Australia at a scale of 1:250 000 in the south-west and at a scale of 1:1 000 000 in less developed areas.

Beard's vegetation maps attempted to depict the native vegetation as it was presumed to be at the time of settlement, and is known as the pre-European vegetation type and extent and has since been developed in digital form by Shepherd *et al.* (2002) and updated by DPIRD (2018a). Extents are updated annually by DBCA (Government of Western Australia 2019). This mapping indicates that the survey areas correspond with the Mogumber 4 pre-European vegetation association. The Mogumber 4 vegetation association is described as woodlands containing: Jarrah, marri and wandoo (i.e., *Eucalyptus marginata*, *Corymbia calophylla* and *E. wandoo*).

The pre-European vegetation association identified from the survey area (DPIRD 2018a) and its pre-European and current extents are listed in **Table 4** (Government of Western Australia 2019).

Table 4: Pre-European vegetation association representation (Government of Western Australia 2019)

Region	Vegetation association	Original extent (ha)	Current extent (ha)	% Remaining
Western Australia	4	86,712.92	19,070.40	21.99
IBRA biographic region (Jarrah Forest)	4	1,022,712.69	277,087.18	27.09
IBRA biographic sub-region (Northern Jarrah Forest)	4	614,200.82	197,903.81	32.22
LGA (Shire of Victoria Plains)	4	64,094.37	14,633.44	22.83

2.2.3 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

The *Protected Matters Search Tool* (PMST) search (Australian Government & Department of Agriculture, Water and the Environment [DAWE] 2020, search reference PMST_74QH95) using a 10 km buffer around a point approximating the centre of the survey areas, identified one EPBC-listed TEC or suitable habitat for such are likely to occur within the search area buffers.

The DBCA database search (search reference 02-0620EC using a 10 km buffer) identified one known TEC within the search area buffer but not corresponding with the survey area.

Both database searches identified the *Eucalypt Woodlands of the Western Australian Wheatbelt* TEC, however, the survey area is not within the Avon Wheatbelt bioregion, nor closely adjacent, and therefore by definition this TEC does not occur within the survey area.

2.2.4 THREATENED AND PRIORITY FLORA

The PMST search (as above) identified five EPBC-listed TF that are known to occur within the 10 km search buffer area. The PMST search also identified a further 14 EPBC-listed TF as 'species or habitat likely to occur within area' or 'species or habitat may occur within area'. The PMST is included in **Appendix Two**.

All of the PMST-listed TF identified as known to occur were also identified by the DBCA database search, detailed below.

A search of DBCA's databases was conducted (search reference 24-0520FL) using a 15 km buffer around the supplied shapefiles (TPFL List, taken from Threatened and Priority Flora Report Forms and DBCA surveys, and WA Herb, taken from vouchered specimens held in the Western Australian Herbarium). The DBCA database searches identified:

- 13 TF: *Banksia serratuloides* subsp. *serratuloides*, *Conospermum densiflorum* subsp. *unicephalatum*, *Darwinia acerosa*, *Darwinia carnea*, *Eleocharis keigheryi*, *Eremophila glabra* subsp. *chlorella*, *Eucalyptus*

pruiniramis, *Grevillea bracteosa* subsp. *bracteosa*, *Lasiopetalum rotundifolium*, *Melaleuca sciotostyla*, *Spirogardnera rubescens*, *Stylidium semaphorum*, *Thomasia* sp. Green Hill (S. Paust 1322)

- eight P1: *Baeckea* sp. Youndegin Hill (A.S. George 15772), *Daviesia localis*, *Frankenia bracteata*, *Hibbertia elegans*, *Lasiopetalum cenobium*, *Lechenaultia magnifica*, *Synaphea panhesya*, *Tetratheca plumosa*
- four P2: *Acacia browniana* var. *glaucescens*, *Stylidium glabrifolium*, *Synaphea rangiferops*, *Verticordia serrata* var. Udumung (D. Hunter & B. Yarran 941006)
- 25 P3: *Acacia anarthros*, *Acacia cummingiana*, *Acacia drummondii* subsp. *affinis*, *Acacia oncinophylla* subsp. *oncinophylla*, *Acacia pulchella* var. reflexa acuminate bracteole variant (R.J. Cumming 882), *Acacia ridleyana*, *Allocasuarina ramosissima*, *Banksia dallanneyi* subsp. *pollosta*, *Beaufortia eriocephala*, *Daviesia debilior* subsp. *sinuans*, *Desmocladus biformis*, *Dielsiodoxa leucantha* subsp. *leucantha*, *Gastrolobium rotundifolium*, *Grevillea florida*, *Guichenotia tuberculata*, *Hibbertia subglabra*, *Lasiopetalum caroliae*, *Melaleuca sclerophylla*, *Petrophile biternata*, *Petrophile plumosa*, *Stylidium cymiferum*, *Stylidium sacculatum*, *Styphelia allittii*, *Verticordia insignis* subsp. *eomagis*, *Verticordia rutilastra*
- 14 P4: *Acacia alata var. platyptera*, *Anigozanthos humilis subsp. chrysanthus*, *Asterolasia grandiflora*, *Caladenia speciosa*, *Calothamnus pachystachyus*, *Diuris recurva*, *Grevillea drummondii*, *Hibbertia miniata*, *Hydrocotyle lemnoides*, *Persoonia sulcata*, *Schoenus natans*, *Stylidium scabridum*, *Synaphea grandis*, *Verticordia paludosa*.

Information regarding these are outlined in **Table 27** in **Appendix Two**. None of those listed had been previously recorded from within the survey area.

2.2.4.1 Threatened and Priority Flora Likelihood Assessment

Ecoscape conducted a likelihood assessment to identify TF and PF species that have potential to occur within the survey area. The likelihood of a species occurring is based on the following attributes, as listed on *FloraBase* (WAH 1998-2020; 2020). The attributes taken into consideration were:

- broad soil type usually associated with the species
- broad landform usually associated with the species
- usual vegetation (characteristic species) with which the species is usually associated
- species having previously been recorded from within approximately 20 km of the survey area (considered as 'nearby') taking age of record and locational accuracy into account
- nearby recent records (i.e. records within the previous 25 years).

The likelihood rating is assigned using the categories listed in **Table 5**.

Table 5: Categories for likelihood of occurrence of TF and PF

Likelihood	Categories
Recorded	Species recorded within the survey area
High	May occur within the survey area (but has not been recorded); broadly, 2-4 of the required attributes (but always including records from nearby) are present in the survey area
Moderate	Could occur but is not expected; 1-3 of the required attributes are present in the survey area but: • it is not known from nearby, or • it is known from nearby but has no other required attributes, or • it is known from nearby but has at least one well-defined attribute that does not occur in the survey area (e.g. it is associated with a specific landform or soil type that does not occur in the survey area) • it is known from nearby but the record is old (>25 years) or the locational data is potentially inaccurate or the area has been significantly cleared at and around the location of the record and survey area and as such the habitat almost certainly no longer occurs within the survey area.
Low	The species characteristics include only one or none of the required attributes of soil, landform, associated vegetation and having previously been recorded nearby, or a critical element (often landform) is not within the survey area and as such it almost certainly does not occur.

The likelihood assessment results are included in **Table 27** in **Appendix Two**.

No conservation-listed flora were identified as having been recorded previously or having a High likelihood of occurring based on the information available during the desktop assessment, taking into consideration that Ecoscape had conducted a preliminary site assessment on 11 February and had determined that the entire area had been (or was currently) heavily grazed by livestock, with few native species in the lower strata (Ecoscape 2020).

2.2.5 THREATENED AND PRIORITY FAUNA

2.2.5.1 Protected Matters Search

The PMST search (Australian Government & DAWE 2020, search reference PMST_74QH95) using a 10 km buffer was used to identify conservation-listed fauna and/or fauna habitat suitable for such species within the search area buffer. The PMST search identified:

- two mammals: both listed as 'species or species habitat likely to occur within area'
- five birds: one 'species or species habitat known to occur within area, two 'species or species habitat likely to occur within area', two 'species or species habitat may occur within area'
- one fish: listed as 'species or species habitat likely to occur within area'
- one invertebrate: listed as 'species or species habitat known to occur within area'
- no reptiles or amphibians.

The PMST results (excluding some migratory wetland species for which no suitable habitat occurs) are incorporated in **Table 28** in **Appendix Two**, with the PMST reproduced in full in this Appendix. Not all species identified by the PMST search have DBCA/Western Australian Museum (WAM) records (*NatureMap*, see below), particularly migratory species. The PMST included in **Appendix Two** should be viewed for the complete list.

2.2.5.2 DBCA Database Searches

The DBCA database search (search reference FAUNA#6338 using a 40 km buffer) returned the following:

- eight mammals

- 17 birds
- three reptiles
- no amphibians or fish
- six invertebrates.

The full list is incorporated in **Table 28** in **Appendix Two**.

2.2.5.3 Threatened and Priority Fauna Likelihood Assessment

The likelihood of occurrence of significant fauna species identified by the database and literature searches was assessed using the following criteria:

- suitability of habitats present within the survey area
- distance between previous record of significant species and the survey area
- frequency and number of records in the region
- date of record of significant species (recent or historical.

The sufficiency of information and behavioural and ecological characteristics such as cryptic behaviours were also taken into account, as was site knowledge from the preliminary site (field) assessment (Ecoscape 2020) and the certainty of record accuracy. Using the above criteria, the categories of likelihood of occurrence are shown in **Table 6**.

Table 6: Categories for likelihood of occurrence of significant vertebrate fauna

Likelihood	Categories
Recorded	Species recorded within the survey area within a reasonable timeframe (0-25 years)
High	Species recorded in close proximity to the survey area (<5 km) within the past 25 years; and suitable habitat occurs within the survey area
Medium	Species historically recorded in close proximity (<5 km) to the survey area, more than 25 years ago; and suitable habitat may exist within the survey area
Low	Species not recorded in the proximity of the survey area or rarely recorded within 10 km of the survey area; and suitable habitat unlikely to occur within the survey area
Very Low	Species not recorded by multiple surveys/databases within 20 km of the survey area and suitable habitat does not occur within the survey area, however species or suitable habitat is listed as potentially occurring in the wider region

No species have been previously identified from within the survey area. Two are considered to have a High desktop likelihood of occurring based on the criteria above:

- *Calyptorhynchus latirostris* (Carnaby's Cockatoo)
- *Idiosoma mcclementsorum* (Julimar Shield-backed Trapdoor Spider).

The likelihood of species occurring within the survey area are indicated in **Table 28** in **Appendix Two**.

2.2.6 FAUNA HABITAT

The earlier Ecoscape survey (Ecoscape 2020) that indicated the fauna habitat consisted of uncleared but grazed woodland almost devoid of shrubs or groundcover, parkland cleared and grazed woodland (devoid of native species, with the groundcover being pasture weeds) and farmland (cropped and grazed).

2.3 LITERATURE REVIEW

The following documents were reviewed for relevance to the survey area:

- InSight Ecology (2008) *A Survey of Birds in Planted and Remnant Native Vegetation around Calingiri and New Norcia, East Moore Catchment, WA*; the number of birds recorded reflected the diversity of the available habitat, nothing that Wandoo woodland provided a range of nesting habitat particularly hollows.
- Phoenix Environmental Sciences (2019) *Flora and fauna assessment for a Calingiri study area. Great Northern Highway, Muchea to Wubin Upgrade Stage 2 Project*. The results indicated a wider diversity of habitat types than available in this survey area and commensurate increase in diversity of flora, vegetation, fauna and fauna habitat, including recording Carnaby's Cockatoo presence and nesting trees. The survey area included Great Northern Highway at the driveway to the site.
- 360 Environmental [ref 2018] *Mogumber Poultry Farm II Development Flora, Vegetation, Fauna and Black Cockatoo Assessment*; the report detailed a survey of a 275 ha that was partly the same pre-European vegetation association as this site, although none of the vegetation was similar.
- Phoenix Environmental Sciences (2016) *Flora and fauna assessment for Calingiri to Wubin study areas*; detailed a road reserve flora, vegetation and fauna assessment for Main Roads WA. The results are similar to the above 2016 report.

3 METHODS

3.1 SURVEY AIMS

The aims of the survey were to identify the flora, vegetation, fauna and fauna habitat attributes of three separate survey areas at the New Norcia Deep Space Facility. The results are to be used in support of environmental approvals, although all three sites, the field survey results for which are provided separately, are unlikely to be developed.

3.2 GUIDING PRINCIPLES

The flora and vegetation survey was conducted as a Detailed survey according to the Flora and Vegetation Technical Guidance (EPA 2016d). The EPA considers that a Detailed survey requires:

- a comprehensive survey design, including giving consideration to the survey timing that should be conducted during the primary season of survey for the bioregion and disturbance events, and the potential requirement for supplementary surveys
- a minimum of three quadrats (in proportion to the extent of the vegetation unit), located throughout each preliminary vegetation types sampled throughout its geographic range, with additional quadrats and rescoring during supplementary surveys to clarify vegetation unit boundaries
- regional surveys if there is insufficient information available (identified during the desktop assessment) to provide local and regional context
- the survey may include a number of sampling techniques including quadrats, relevés, transects and traverses, as well as opportunistic observations
- the flora inventory should be comprised of data collected from quadrats and relevés, supplemented by opportunistic observations, systematic surveys and targeted inspections of various habitat areas
- it may be appropriate to increase survey effort in areas of unusual habitat
- sampling sites that are placed at representative locations throughout the survey area considering landform, geology, elevation, slope, aspect, surface or groundwater expression and soil type, as well as vegetation structure, composition and condition.

Targeted searches were also conducted in areas of habitat suitable for TF and PF identified during the desktop assessment and previous surveys as having potential to occur.

The following were taken into account when developing the fauna survey methodology:

- EPA (2016e) Fauna Technical Guidance
- EPA (2016f) *Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna*
- background information on the survey area, fauna species and habitat likely to occur (i.e. desktop assessment, aerial imagery and other data).

The Fauna Technical Guidance recommends the following for a Level 1 fauna survey:

- desktop assessment to gather contextual information on the survey area from previous surveys, literature, database searches and map-based information
- site visit to be conducted to verify the accuracy of the desktop study, delineate and characterise the fauna and faunal assemblages present in the survey area
- survey to include low intensity sampling of fauna and faunal assemblages.

3.3 FLORA AND VEGETATION FIELD SURVEY METHODS

The methods utilised during the field survey followed those outlined in the Flora and Vegetation Technical Guidance (EPA 2016c), conducted as a single phase survey. The survey was outside of the period considered optimal for a primary season of survey within the bioregion.

Conservation criteria used in this assessment are included in **Table 19** and **Table 20** in **Appendix One.**

Survey method details are outlined below.

3.3.1 FLORISTIC QUADRATS

Floristic quadrat ('quadrat') locations were selected using aerial photography, environmental values and field observations to best represent the vegetation values existing at the site. The unmarked quadrats were 10 m x 10 m in dimension, as required according to the Flora and Vegetation Technical Guidance 2016.

The following information was collected from within each quadrat:

- observer
- date
- quadrat/site number
- GPS location (GDA94) of the northwest corner
- digital photograph (spatially referenced with a reference number), taken from the northwest corner, looking diagonally across the quadrat
- soil type and colour
- topography
- list of flora species recorded with the average height and total cover within the quadrat for each species
- vegetation description (as per below)
- vegetation condition.

At least three quadrats per vegetation type were recorded for the Detailed survey where there was sufficient extent available.

All quadrat locations are displayed on **Map 4**.

3.3.2 TARGETED SEARCHES

Threatened and Priority Flora identified during the desktop analysis and previous surveys as known or having potential to occur were targeted for searches in areas of potential habitat.

The locations of all targeted taxa collected were recorded using a handheld GPS with the following data recorded:

- observer, date and time
- reproductive status and other features such as health of plants, percentage flowering and fruiting
- local abundance/population size and/or population boundary, including outside the development envelopes where possible
- landform
- brief vegetation community description
- representative photos of each species and habitat
- collection of representative specimens.

3.3.3 INTRODUCED SPECIES

Introduced species (weeds) were recorded during the collection of the overall flora inventory.

The field survey included searches for WONS and Declared Pest plants. Their locations and numbers/extents were recorded where noted during the field survey, and each WONS or Declared Pest plant species photographed.

3.3.4 VEGETATION DESCRIPTION AND CLASSIFICATION

Vegetation was described from each of the quadrats using the height and estimated cover of dominant and characteristic species of each stratum based on the National Vegetation Information System, recorded at Level V (NVIS Technical Working Group 2017) (**Table 22** and **Table 23** in **Appendix One**). Up to three species per stratum from each stratum (upper, mid and ground) were used to formulate vegetation descriptions for each quadrat and each vegetation type.

Vegetation type descriptions were created by combining quadrat descriptions and modifying, where necessary, based on the wider vegetation. Vegetation codes for these were formulated using the characteristic species of the highest stratum within the vegetation type that had >2% cover (i.e. not scattered) if present, with the first series of letter codes referring to the component species (upper case first letter referring to the genus, lower case one or two letters referring to the species, with the upper case letters at the end referring to the stratum structure e.g. **EwW** refers to ***E****ucalyptus* ***w****andoo* subsp. *wandoo* **w**oodland.

3.3.5 VEGETATION CONDITION ASSESSMENT

Vegetation condition was assessed broadly and continuously throughout the survey area and at each quadrat using the Vegetation Condition Scale for the Southwest Botanical Provinces (EPA 2016d) (**Table 24** in **Appendix One**). As quadrats are located in the best condition parts of a vegetation type, the condition rating of the quadrat may not match that of the broader vegetation type due to the scale of mapping.

3.3.6 FIELD SURVEY TIMING

The field survey was conducted during 26 May 2020 which is not within the optimal period for a primary survey within the bioregion according the Flora and Vegetation Technical Guidance (EPA 2016d). The rainfall prior to the field survey was close to the long-term mean for this period (**Figure 2**), although it should be noted that the survey was conducted during autumn and the preceding period is typically dry.

3.3.7 STATISTICAL ANALYSIS

3.3.7.1 Floristic Analysis

Interpretation of floristic groups into recognisable and mappable on-ground units is a tool used to identify broad vegetation types. Generally, quadrats that are closely floristically related on the dendrogram form identifiable vegetation units; however, interpretation is frequently required for imperfect results. Vegetation types are therefore determined as a combination of floristic analysis and on-ground interpretation using dominant and characteristic species.

JUICE software (Tichý 2002) was used to assist in the translation of non-hierarchical data (quadrats) into a system of hierarchical floristic groups based on species co-occurrence. To that end, we applied the OptimClass (Tichý *et al.* 2010) routine (through JUICE) to achieve the following: (1) to identify the most robust choice of data transformation, resemblance measure and clustering algorithm, and (2) to assist in the selection of the optimal number of clusters. The OptimClass routine is intuitive; it promotes the choice of data transformation, resemblance measure and clustering algorithm which produces a 'robust classification'. Essentially a

classification is considered robust when the floristic groups are defined by a high number of 'diagnostic species' (i.e. species which occur at a high frequency within a floristic group and a low rate across other groups).

The application of JUICE and OptimClass is prevalent across Europe (Indreica 2012; Lengyel *et al.* 2016; Purger *et al.* 2014), Africa (Lötter *et al.* 2013) and is gaining momentum as an expert tool designed to assist ecologists in vegetation classification within Western Australia (Mucina *et al.* 2019; Mucina & Daniel 2013; Tsakalos *et al.* 2019).

Vegetation Type descriptions were developed using three main features: 'diagnostic', 'constant' and 'dominance'. The IndVal procedure as offered by Dufrêne and Legendre (1999) and presented in the R package *labdsv* (Roberts 2016) was used to identify diagnostic species ($P \leq 0.05$). Species occurring in greater than 50% of the quadrats in a vegetation type were defined as constant. Species with greater than 3% project cover abundance (%) were defined as dominant.

OptimClass identified flexible beta clustering ($\beta = -0.25$) on a resemblance generated by Bray-Curtis distance on a logarithmically transformed cover abundances as producing the most robust and ecologically meaningful clusters.

3.3.7.2 Multivariate Patterns and Drivers

To identify broad environmental drivers explaining the Vegetation Type patterns we applied a distance-based redundancy analysis (db-RDA; Legendre & Anderson M.J. 1999). Quantitative db-RDA was applied only to support the qualitative observations (i.e., elevation, soil type and colour, rock type, etc.) made during the survey. The datasets that we used included: the species x site data generated from the 149 quadrats (both existing and newly established) intersecting with the survey area and a newly defined environmental dataset.

The environmental data was collected using CSIRO's TERN soil layers (Rossel *et al.* 2015) and topographic variables (aspect, elevation and slope) derived from NASA Earth Explorer's non-void filled radar topographic mission series at a 1 arc section resolution (Farr *et al.* 2007). The Soil and Landscape Grid of Australia provides relevant, consistent, comprehensive, nation-wide data in an easily accessible format at a 90 m resolution. The specific soil variables that were used in the environmental data were:

- Bulk Density (BD; Bulk Density of the whole soil (including coarse fragments) in mass per unit volume by a method equivalent to the core method)
- Organic Carbon (C; Mass fraction of carbon by weight in the < 2 mm soil material as determined by dry combustion at 900 Celsius)
- Clay (Clay; < 2 um mass fraction of the < 2 mm soil material determined using the pipette method)
- Silt (Silt; 2-20 um mass fraction of the < 2 mm soil material determined using the pipette method)
- pH (pH; pH of 1:5 soil/0.01M calcium chloride extract)
- Available Water Capacity (AWC; Available water capacity computed for each of the specified depth increments)
- Total Nitrogen (TN; Mass fraction of total nitrogen in the soil by weight)
- Total Phosphorus (TP; Mass fraction of total phosphorus in the soil by weight)
- Effective Cation Exchange Capacity (ECEC; Cations extracted using barium chloride ($BaCl_2$) plus exchangeable H + Al)
- Depth of Regolith (DOR; Depth to hard rock. Depth is inclusive of all regolith)
- Depth of Soil (DOS; Depth of soil profile (A & B horizons)).

All calculations were conducted using the Vegan package (Oksanen *et al.* 2019) in the R statistical Program (R Core Team 2019).

3.3.7.3 Adequacy of Sampling

In order to demonstrate adequacy of sampling, a species accumulation curve was generated by the software Species Diversity and Richness (Pisces Conservation Ltd 2010) using five random selections of sample order, and using quadrat data only.

3.3.8 BOTANICAL LIMITATIONS

Survey design: Single phase, quadrat-based flora and vegetation survey with extensive traverses searching for conservation-listed flora.

Survey type: Detailed flora and vegetation survey with extensive searches for significant flora searches conducted over a single phase. All areas were adequately surveyed through the use of floristic quadrats to sample vegetation types, and targeted searches for conservation-listed flora.

Type of vegetation classification system: Vegetation classified at NVIS Level V (NVIS Technical Working Group 2017) using largely structural vegetation types defined using dominant and characteristic species and vegetation structure as recorded during the field surveys. Floristic analysis was used to identify major floristic groups and outlier groups of floristic interest.

Survey timing, which was not optimal for the bioregion, were considered to be moderate constraints. A full summary of botanical limitations is presented in **Table 7**.

Table 7: Botanical limitations

Possible limitations	Constraints (yes/no): Significant, moderate or negligible	Comment
Availability of contextual information at a regional and local scale	Negligible	There is little specific flora and vegetation information available for the local area; very few flora and vegetation surveys known to have occurred nearby. However, at a regional scale the flora and vegetation values of the area are well known, providing negligible constraint, particularly when taking the amount of disturbance (clearing, grazing) of the site into consideration.
Competency/experience of the team conducting the survey, including experience in the bioregion surveyed	No	The botanist conducting the field survey has over 5 years' experience conducting flora and vegetation surveys in Western Australia. Due to the level of disturbance, no specific bioregional experience is needed to conduct an accurate survey of the site.
Proportion of the flora recorded and/or collected, and any identification issues	No	The site was highly disturbed (clearing, grazing) and had little native vegetation remaining. Only 27 vascular flora taxa could be identified to species or genus level, however, those that could not be identified with certainty did not match the descriptions of any conservation-listed species. The inability to identify species with certainty was due to the season of survey when many species were not flowering.

Possible limitations	Constraints (yes/no): Significant, moderate or negligible	Comment
Was the appropriate area fully surveyed (effort and extent)	No	The survey area was surveyed adequately to describe the flora, vegetation types and vegetation.
Access restrictions within the survey area	No	The survey area was fully accessible.
Survey timing, rainfall, season of survey	Negligible	The survey was conducted during May which is outside of the optimal season for survey in the southwest of Western Australia. Despite this, and that many taxa were not flowering due to the survey timing, the constraints are considered negligible due to the highly disturbed nature of the site which was cleared paddock, parkland cleared woodland or heavily grazed woodland.
Disturbance that may have affected the results of the survey e.g. fire, flood, clearing	No	There were no recent disturbances that would have affected the results of the survey. The site is highly disturbed (clearing, grazing), however, this is typical for the site and the survey results provide an accurate description of the site condition as it is.

3.4 FAUNA FIELD SURVEY METHODS

A Level 1 fauna survey as defined by the *Technical Guidance – Sampling methods for Terrestrial vertebrate fauna* (EPA 2016f) consists of a desktop study and basic ground truthing through a reconnaissance survey. The survey focused on mapping major fauna habitat types within the survey areas, particularly those habitat types likely to be utilised by conservation-listed species identified as part of the desktop survey. The Level 1 field surveys also comprised of the following opportunistic surveys:

- **Active searches:** 30 minute active searches of 1 ha areas within the survey area were conducted by an experienced zoologist. Microhabitats favoured by reptiles and amphibians were searched with particular emphasis placed on cryptic species not typically recorded in trapping grids. Survey techniques include raking of leaf litter and soil under shrubs, searching in rock piles and searching under and inside fallen timber.
- **Scats, tracks and other traces surveys:** Tracks, scats and other traces of terrestrial fauna were recorded and identified where possible.
- **Bird surveys:** An opportunistic bird list was maintained for each Level 1 survey area combining the bird species lists collected during opportunistic searches as well as those species observed when travelling between sites.

Fauna species were identified opportunistically based on sightings, calls, remains, diggings and other signs. Potential habitats for conservation-listed species were identified and evaluated and their likelihood of occurrence assessed.

3.4.1 FAUNA HABITAT ASSESSMENT AND MAPPING

The fauna habitats present within the survey areas were identified and mapped during the survey. Fauna habitats were described as an area which is distinguishable from its surrounding area by its land form,

vegetation and fauna assemblage occupying the area. In addition, the likelihood to harbour specialised fauna species which are not found in adjacent areas was taken into consideration.

The following information was used to identify and map all fauna habitats within the survey area:

- previous fauna habitat mapping
- land systems
- vegetation type and condition mapping
- aerial imagery
- landforms
- soil characteristic
- fauna assemblage information.

The composition and characteristics of each fauna habitat were recorded and their extent mapped using ArcGIS v10.6.

3.4.1.1 Black Cockatoo Survey

The Revised Draft Referral Guideline (Commonwealth of Australia 2017) provides guidance on the assessment of habitat for the three listed Black Cockatoo species. Habitat assessment is the primary technique used to inform decisions on significant impact for black cockatoos and is aimed at identifying habitat used for foraging, breeding or roosting.

3.4.1.2 Black Cockatoo Foraging Habitat

The scoring tool in the Revised Draft referral Guideline (*ibid*.) was used to determine the quality of foraging habitat within the survey area (**Table 25** in **Appendix One**) during this assessment. Habitat surveys must be sufficient to complete the scoring tool and provide a score and justification for foraging habitat quality.

The elements of the scoring tool require surveys to provide information on the following:

- the presence of all plant species that provide foraging, including non-native food sources used by Black Cockatoos
- the presence of tree species used for breeding
- use as a roosting site
- the vegetation present in the surrounding area i.e. at least 12 km from the impact area, including proximity to any breeding habitat, roosting sites or watering points
- breeding habitat, such as an estimate of the number of trees with a diameter at breast height (1.3 metres from the ground) of 500 mm, or 300 mm if Salmon Gum or Wandoo
- numbers of any known nesting trees
- presence of disease, such as *Phytophthora cinnamomi* or Marri Canker (*Quambalaria coyrecup*), noting that neither of these is expected in the survey area.

3.4.1.3 Black Cockatoo Breeding Habitat

The fauna survey for Black Cockatoo habitat followed the Black Cockatoo Referral Guidelines (DSEWPaC 2012a) and the Revised Draft Referral Guideline (Commonwealth of Australia 2017). In addition, each potential nesting tree was scored for habitat value using the scoring system developed by Dr Mike Bamford (2016); the score reflects the existing value of the tree characteristics with respect to its potential to be used as a nesting tree and therefore assists in more accurately assessing the real impact of disturbance (**Table 26** in **Appendix One**).

3.4.2 TIMING OF THE FIELD SURVEY

The fauna survey was conducted during May which does not fall within the optimal prescribed season as per the Fauna Technical Guidance (EPA 2016f). Fauna surveys are optimally conducted during periods when most fauna species likely to occur, particularly conservation-listed species that are targeted for survey, are active or identifiable. May in the southwest of Western Australia is generally cool, thus reptile activity is likely to be reduced. Birds are generally active, however, do not have breeding plumage (where relevant) nor displaying (visually or calls) as little breeding occurs. Mammals are generally active and the survey timing provides no constraint to their presence, particularly for a Level 1 survey that does not include trapping.

3.4.3 FAUNA SURVEY LIMITATIONS

The fauna survey was conducted at Level 1 according to the Fauna Technical Guidance (EPA 2016f). Level 1 surveys do not require trapping and are observational only. Due to the level of disturbance, no motion cameras were deployed during the survey.

Table 8: Summary of survey limitations

Possible limitations	Constraints (yes/possible/no)	Comment
Competency/experience of the consultant conducting the survey	No	The survey was conducted by a qualified zoologist under the supervision of and with interpretation of results by a senior zoologist with over 30 years of relevant experience.
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	No	The survey was required to identify the significant fauna and fauna attributes of the site, including Black Cockatoo habitat. There were no constraints in relation to the survey requirements. Due to the cool and wet weather during the field survey it is likely that some species that are usually present were not identifiable, however, it is highly unlikely that any were of significance.
Proportion of fauna identified, recorded and/or collected.	No	Due to the disturbed nature of the site there were few fauna species present. All species that were recorded could be identified.
Sources of information (previously available information as distinct from new data).	No	Whilst there is little local information available, or survey reports from nearby, there are unlikely to be any constraints in relation to this lack of information due to the disturbed nature of the site.
The proportion of the task achieved and further work which might be needed.	No	No additional work is expected to be required as the site is now described in sufficient detail to accurately inform environmental approvals.
Timing/weather/season/cycle.	Negligible	Whilst the weather was cool and wet it is unlikely to have significantly affected the survey results due to the poor habitat quality present on the site.
Disturbances which affected results of the survey (e.g. fire, flood, accidental human intervention).	No	There were no new disturbances that would have temporarily affected the survey results.
Intensity (in retrospect was the intensity adequate).	No	The entire site was covered in detail.
Completeness (e.g. was relevant area fully surveyed), remoteness and/or access problems	No	The entire site was fully accessed.

Possible limitations	Constraints (yes/possible/no)	Comment
Resources (e.g. degree of expertise available in animal identification to taxon level).	No	All species were identified to sufficient extent to enable accurate determination of conservation significance.

4 RESULTS

The flora and vegetation field survey was conducted by Dr James Tsakalos (Environmental Scientist, flora licence FB62000163) during 26 May 2020. The survey was conducted as a Detailed flora and vegetation survey in accordance with requirements of the Flora and Vegetation Technical Guidance (EPA 2016d).

The fauna field survey was conducted by Hugh Osborne (Environmental Scientist/Zoologist) during 26-28 May 2020, with results checked by Bruce Turner (Senior Environmental Scientist/Zoologist). The survey was conducted as a Level 1 fauna survey in accordance with the requirements of the Fauna Technical Guidance (EPA 2016e)

All three survey sites were assessed as if a single survey. The results are presented combined (overview) and, as much as possible, separately for each site in the following report sections. Where there was sufficient extent, a total of at least three floristic quadrats were recorded per vegetation type (15 quadrats in total) across the entire site for the flora and vegetation survey component, although not all may have been located within a single survey site.

Note that there was some overlap in extents between the Infrastructure and Option B sites thus the total extent of the survey area is not the same as the sum of individual extents.

4.1 RESULTS SUMMARY (OVERVIEW)

4.1.1.1 Flora

Fifteen quadrats were established during the field survey; four in the Infrastructure area, nine within Option A and two in Option B. The site by species matrix showing all quadrats and opportunistic observations are in **Table 29** in **Appendix Three**. Quadrat data is presented in **Appendix Four**.

Twenty eight vascular flora were recorded from 16 families and 23 genera were recorded from the quadrats and opportunistic observations. At least eight of the recorded taxa were introduced, representing at least 28.6% of all recorded taxa.

The most commonly represented families were Myrtaceae with 5 taxa, Poaceae (5 taxa) and Dilleniaceae (4 taxa). The most commonly represented genera were *Hibbertia* with four taxa, *Eucalyptus* (two taxa) and *Melaleuca* (two taxa). A significant portion (8%) of the flora could not be identified with certainty due to the lack of reproductive material largely due to the survey timing and intensive grazing.

The number of species per quadrat ranged from three (quadrats DS2014 and DS2015) to seven (quadrats DS2006 and DS2010). The average species diversity per quadrat was five which, based on other surveys in the bioregion, is considered low. The most frequently recorded taxa were **Avena barbata* (from 12 quadrats), *Trifolium subterraneum* (seven) and *Arctotheca calendula* (six).

No conservation-listed flora (i.e. TF or PF) were recorded during the field survey, nor were any anticipated to occur based on the long history of grazing over the area and past clearing. No recorded species were considered to have any other significance according to the criteria outlined in the Flora and Vegetation Technical Guidance (EPA 2016d).

4.1.1.2 Vegetation

Four vegetation types (shown on **Map 4**) were recorded over the entire survey area, as follows:

- **CcW**: *Corymbia calophylla* woodland over **Avena barbata* low isolated grasses, on the lateritic upland and slopes
- **ElW**: *Eucalyptus loxophleba* subsp. *loxophleba* woodland over **Avena barbata* low isolated grasses, on the lower slopes
- **EwW**: *Eucalyptus wandoo* subsp. *wandoo* woodland over *Melaleuca marginata* and *Hibbertia hypericoides* subsp. *hypericoides* mid shrubland over **Avena barbata* low isolated grasses, on the lateritic upland
- **TaG**: **Triticum aestivum* and **Avena barbata* grassland (Wheat paddock; not native vegetation).

The floristic analysis, as described in **Section 3.3.7.1**, supported the vegetation types as they had been recognised in the field i.e. based on characteristic species in the uppermost stratum. The floristic analysis dendrogram is included in **Figure 4** in **Appendix Five**.

None of the vegetation is similar to any currently described TECs or PECs, nor does it meet any other criteria to be considered of significance according to the Flora and Vegetation Technical Guidance (EPA 2016d).

All vegetation was in Degraded or Completely Degraded condition as a result of past clearing and/or past and current grazing. Vegetation type **TaG** (Wheat paddock) is considered as being not native vegetation with respect to vegetation condition.

4.1.1.3 Adequacy of Survey

Adequacy of survey can be demonstrated using a species accumulation curve; if the curve has reached (or almost reached) an asymptote it is considered that most species are likely to have been recorded from the survey area.

Species accumulation curves were generated using quadrat data (**Figure 3**). Opportunistic observations, which increase the number of species recorded, are not included in the analysis.

The species accumulation curve suggests that additional survey would have recorded additional species. However, the Bootstrap estimate of species richness is 30.54 which, when taking opportunistic observations into account, is slightly more than the number of species recorded (28). This indicates that most species present at the time of survey were recorded, although it would be anticipated that more ephemeral taxa would be identifiable if the survey had been conducted during spring.

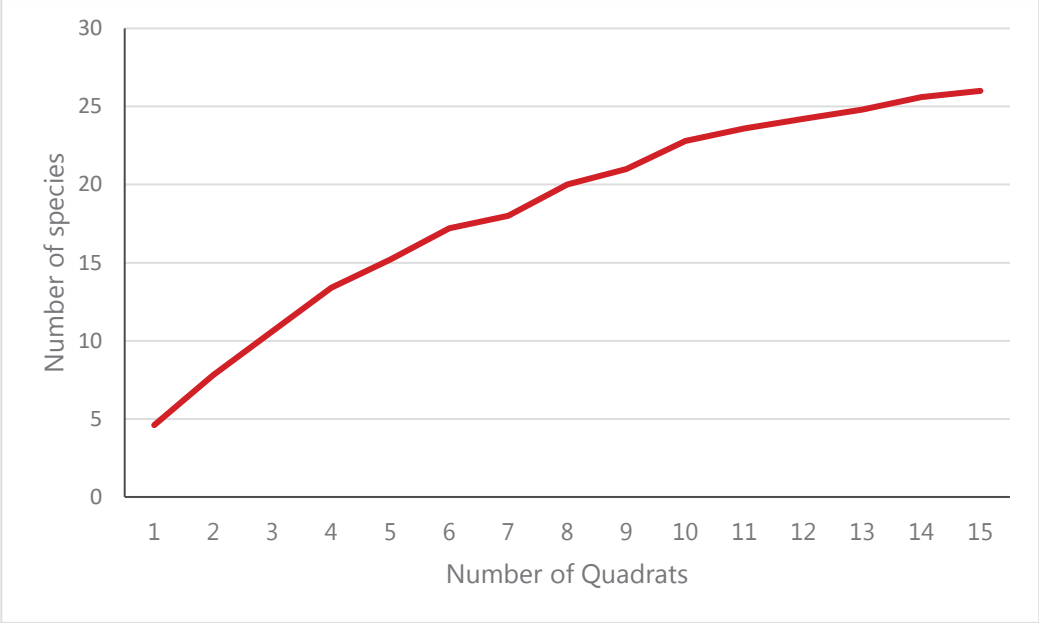


Figure 3: Species accumulation curve using quadrat data

The average species richness per quadrat recorded during this survey was 4.9.

4.1.2 FAUNA

The fauna survey was conducted by Hugh Osborn during 26-28 May 2020. The survey was conducted as a Level 1 survey according to the requirements outlined in the *Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna* (EPA 2016f).

4.1.3 FAUNA ASSEMBLAGE

Eighteen vertebrate fauna species were recorded during the survey, consisting of six mammals, 11 birds and one reptile (**Table 9**). None are conservation-listed. Two are domesticated farm animals (Cattle and Sheep) and three are introduced (Laughing Kookaburra that is native to the east of Australia but naturalised in Western Australia, Rabbit and Fox). The Galah, although native to Western Australia, is not native to the agricultural region (Department of Environment and Conservation 2009). All are commonly encountered within the bioregion and from farmland and areas of native bushland within largely agricultural areas (farm remnants).

Survey site locations are provided in **Table 31** in **Appendix Six**.

Table 9: Fauna species recorded (all sites)

Species	Common name	EPBC Act ranking	BC Act /DBCA ranking
Mammals			
Bos taurus	European Cattle	Introduced (domestic cattle)	
Macropus fuliginosus	Western Grey Kangaroo	-	-
Oryctolagus cuniculus	Rabbit	Introduced	
Ovis aries	Sheep	Introduced (domestic sheep)	
Tachyglossus aculeatus	Short-beaked Echidna	-	-
Vulpes vulpes	Red Fox	Introduced	
Birds			
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	-	-
Cacatua roseicapilla	Galah	-	-
Corvus coronoides	Australian Raven	-	-
Cracticus tibicen	Australian Magpie	-	-
Dacelo novaeguineae	Laughing Kookaburra	Naturalised exotic	
Petroica goodenovii	Red-capped Robin	-	-
Platycercus zonarius	Australian Ringneck	-	-
Rhipidura albiscapa	Grey Fantail	-	-
Rhipidura leucophrys	Willie Wagtail	-	-
Smicrornis brevirostris	Weebill	-	-
Zosterops lateralis	Grey-breasted White-eye	-	-
Reptiles			
Hesperoedura reticulata	Reticulated Velvet Gecko	-	-

4.1.3.1 Conservation-listed Fauna

No conservation-listed fauna were recorded. The likelihood of these occurring (see **Section 2.2.5.3** and **Table 28** in **Appendix Two**) was re-evaluated following the field survey when the habitat present at the site was better understood and taking survey effort into consideration. Two species retained their Medium likelihood of occurring (*Calyptorhynchus banksii naso*; Forest Red-tailed Black Cockatoo and *Falco peregrinus*; Peregrine Falcon) and one species retained its High likelihood of occurring (*Calyptorhynchus latirostris*; Carnaby's Cockatoo).

No Black Cockatoo species have been observed on the site by the landholder for at least the previous 20 years nor been reported by any European Space Agency employees or contractors since 2003 when the facility opened, although the landholder has observed Carnaby's Cockatoo in the nearby Seven Mile Well Nature Reserve, approximately 1.5 km to the southeast recently (undefined). The DBCA database search includes a record of this species from this reserve from 2000.

4.1.4 FAUNA HABITAT

Three fauna habitat types were recorded: Open Woodland, Paddock and Infrastructure. Fauna use of habitat within each site is discussed separately in the following sections.

The Paddock habitat type is unlikely to be suitable for any conservation-listed fauna species, except during traverses. The Infrastructure habitat type has some planted flowering species that provides a food source and shelter for some fauna species. Neither of these habitat types represents habitats approximating those found prior to European habitation.

The Open Woodland habitat may be suitable for use by conservation-listed species including Threatened Black Cockatoo species which are discussed below and separately for each site. Suitability of habitat for other

conservation-listed species is in the Discussion section later in the report (see **Section 5.3.2**), however, there is little structural diversity or food sources present which limits this habitat's ability to support many species, including conservation-listed fauna.

4.1.4.1 Black Cockatoos and Associated Habitat

The Open Woodland habitat has potential to be used by conservation-listed species, including for nesting by Black Cockatoo species particularly Carnaby's Cockatoo. A survey to identify the number and location of trees that may be used by Black Cockatoos, and a classification of suitability for breeding was conducted and resulted in a total of 376 trees that met the criteria to be considered suitable or potentially suitable for nesting (according to the criteria outlined in DSEWPaC 2012a). Of these trees:

- 271 were assessed as Class 5 (trees without suitable hollows)
- 64 were assessed as Class 4 (trees with large hollows or broken branches, but not having the features preferred by Black Cockatoos for nesting)
- 41 were assessed as Class 3 (trees with potentially suitable hollows but with no evidence of use by Black Cockatoos)
- none were assessed as Class 2 (trees with suitable hollows and evidence of use, but not currently occupied) or Class 1 (having an active nest; noting that the survey was not conducted during a period when this would have been evident).

Table 26 in **Appendix One** describes these classes (according to Bamford 2016) in more detail. The results for each site should be viewed for more detail.

The habitat available in the survey area was also assessed for its suitability for foraging for Carnaby's Cockatoo according to the criteria in the Revised Draft Referral Guideline (Commonwealth of Australia 2017).

The Paddock habitat and Infrastructure habitat do not meet the criteria for breeding (which is generally woodland or forest), night roosting (tall trees near riparian environments or water sources) or foraging (native shrubland, heathland or woodland with suitable seed or insect larvae sources) according to the Revised Draft Referral Guideline (*ibid.*). Using the scoring tool for foraging habitat (**Table 25** in **Appendix One**) and breeding and roosting locations indicated on SLIP (Government of Western Australia & Department of Water and Environmental Regulation 2020), the Paddock and Infrastructure habitats are not considered as foraging habitat according to the score as follows:

- Starting score 1 ('low quality'; few foraging plants)
- Additions: (none)
- Subtractions: -2 (no evidence of foraging)
  -1 (>12 km from known breeding location)
  -1 (>12 km from known roosting site)
  -1 (no watering points within 2 km)
- **TOTAL: -4** (i.e. negative 4, not foraging habitat).

The Open Woodland habitat potentially meets the requirements to be considered as breeding habitat (as above), but is not near water sources or has significant amounts of preferred foraging plants. Using the scoring system as above, the Open Woodland habitat is considered as 'quality' to 'low quality' foraging habitat according to the score as follows:

- Starting score 5 ('quality': it does not meet the descriptive criteria for high quality due to the lack of foraging species)

- Additions: +3 (has trees with suitable nest hollows)
  +2 (has trees that can potentially be used for breeding)
- Subtractions: -2 (no evidence of foraging)
  -1 (>12 km from known breeding location)
  -1 (>12 km from known roosting site)
  -1 (no watering points within 2 km)
- **TOTAL: 5** ('quality' to 'low quality' foraging habitat; here-in simplified to 'near-low quality').

4.2 SURVEY RESULTS: INFRASTRUCTURE

The Infrastructure survey area (also known as 'site') includes a Western Power corridor to the west of the existing buildings. Ecoscape understands that an underground power line is to be installed along this corridor and is required to kept clear of vegetation that, if uprooted, may lift and damage the cables.

4.2.1 FLORA AND VEGETATION SURVEY

4.2.1.1 Flora

Four quadrats were established during the May 2020 field survey in the Infrastructure survey site.

Nine vascular flora taxa were recorded from six families and eight genera, noting that additional species were likely to have been recorded if the survey had been conducted later in the year when additional species would be recognisable as many annuals had only recently germinated. Two thirds (six taxa) were introduced.

The most commonly represented families were Poaceae with three taxa and Myrtaceae (two taxa). All species could be identified to species level.

The number of species per quadrat ranged from four (quadrats DS2002 and DS2004) to six (quadrat DS2003). The average species diversity per quadrat was 4.75 which is considered low.

The combined flora inventory is presented in **Table 29** in **Appendix Three**. Quadrat data is presented in **Appendix Four**.

4.2.1.2 Conservation-listed Flora

No Commonwealth EPBC Act or Western Australian BC Act-listed Threatened Flora were recorded during the field survey, nor any DBCA-listed Priority Flora.

Following field survey, when additional information is available regarding actual habitat availability and searches have been conducted, the likelihood of conservation-listed flora occurring in the survey area was revised. This revised likelihood, that took into account vegetation condition, grazing and other disturbances, actual habitat availability and search effort, is included in **Table 27** in **Appendix Two**.

No conservation-listed flora were considered likely to occur i.e. none had a high likelihood of occurring as the area has been historically (and is currently, in part) grazed and at least partly cleared.

4.2.1.3 Other Significant Flora

No recorded flora species had any other significance according to the criteria outlined in the Flora and Vegetation Technical Guidance (EPA 2016d).

4.2.1.4 Introduced Flora

Six introduced flora species (weeds), representing 66.7% of the total flora species, were recorded during the field survey. **Arctotheca calendula* (Cape Weed) and **Avena barbata* (Bearded Oat/Wild Oat) were the most commonly recorded introduced species occurring in all four quadrats.

None of the recorded introduced species are Declared Pest plants or WONs species.

4.2.2 VEGETATION

Three vegetation types were recorded from the Infrastructure survey area, as follows:

- **ElW**: *Eucalyptus loxophleba* subsp. *loxophleba* woodland over **Avena barbata* low isolated grasses, on the lower slopes
- **EwW**: *Eucalyptus wandoo* subsp. *wandoo* woodland over *Melaleuca marginata* and *Hibbertia hypericoides* subsp. *hypericoides* mid shrubland over **Avena barbata* low isolated grasses, on the lateritic upland and slopes
- **TaG**: **Triticum aestivum* and **Avena barbata* grassland (paddock; not native vegetation).

Additional detail is provided in **Table 10**.

The floristic analysis, as described in **Section 3.3.7.1**, supported the vegetation types as they had been recognised in the field i.e. based on characteristic species in the uppermost stratum. The floristic analysis dendrogram is included in **Figure 4** in **Appendix Five**.

The extents of the vegetation types and representative quadrat locations are shown on **Map 4**.

Table 10 Vegetation types (Infrastructure)

Note: representative quadrat in the photo is in **bold** font; quadrats within the vegetation type but not within the site are in parentheses.

Landform	Mapping Unit	Vegetation Type	Floristic Quadrats	Representative Photograph	Characteristic Species (all areas)	Area (ha) and Extent (%) of Survey Area
Lower Slopes	**ElW**	*Eucalyptus loxophleba* subsp. *loxophleba* woodland over **Avena barbata* low isolated grasses	DS2001 **DS2002** (DS2015)		Diagnostic: *Eucalyptus loxophleba* subsp. *loxophleba, *Avena barbata* Constant: **Avena barbata, Eucalyptus loxophleba* subsp. *loxophleba*	0.44 ha 4.78%
Slope	**EwW**	*Eucalyptus wandoo* subsp. *wandoo* woodland over *Melaleuca marginata* and *Hibbertia hypericoides* subsp. *hypericoides* mid shrubland over **Avena barbata* low isolated grasses Note: the above vegetation description is from the entire survey area and the mid stratum is not relevant for the Infrastructure site.	**DS2004** (DS2005 DS2008 DS2009 DS2010 DS2011)		Diagnostic: *Eucalyptus wandoo* subsp. *wandoo, Melaleuca marginata* Constant: *Eucalyptus wandoo* subsp. *wandoo, *Avena barbata, Hibbertia hypericoides* subsp. *hypericoides, Melaleuca marginata*	1.03 ha 11.11 %

Landform	Mapping Unit	Vegetation Type	Floristic Quadrats	Representative Photograph	Characteristic Species (all areas)	Area (ha) and Extent (%) of Survey Area
Paddock on upper slopes	TaG	**Triticum aestivum* and **Avena barbata* grassland Note: this vegetation type represents paddock thus is not native vegetation	**DS2003** (DS2013 DS2014)		Diagnostic: **Triticum aestivum* Constant: **Triticum aestivum, *Trifolium subterraneum, *Arctotheca calendula, *Avena barbata, Dysphania pumilio, *Erodium botrys*	6.02 ha 64.83%
	Not vegetated (excluding TaG)					1.79 ha 19.28%
	TOTAL					9.29 ha

4.2.2.1 Floristic Analysis

The floristic analysis dendrogram (**Figure 4** in **Appendix Five**) supports the structural vegetation types as identified during the field survey.

4.2.2.2 Vegetation Significance

None of the existing vegetation has any formal conservation significance i.e. none is considered representative of any currently described TEC or PEC.

4.2.2.3 Vegetation Condition

The remaining vegetation of the survey area was in Completely Degraded condition (**Table 11**, **Map 4**), noting that vegetation type **TaG** represents the paddock thus is not considered as native vegetation. The main factors influencing vegetation condition were clearing, including for cropping, and past and present grazing.

Table 11: Vegetation condition extents (Infrastructure)

Vegetation condition	Extent (ha)	Extent (%)
Pristine	-	-
Excellent	-	-
Very Good	-	-
Good	-	-
Degraded	-	-
Completely Degraded	1.48	15.89
N/A (not native vegetation)	7.81	84.11
TOTAL	**9.29**	**100.00**

4.2.2.4 Adequacy of Survey

See **Section 4.1.1.3** for adequacy of survey over the entire survey area.

4.2.3 VERTEBRATE FAUNA SURVEY

The fauna survey was conducted by Hugh Osborn during 26-28 May 2020. The survey was conducted as a Level 1 survey according to the *Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna* (EPA 2016f).

4.2.3.1 Fauna Assemblage

Eighteen vertebrate fauna species were recorded during the field survey (**Table 9** in **Section 4.1.3**); all are anticipated to occur within the Infrastructure site. None are conservation-listed.

Because of its proximity to existing infrastructure gardens, fauna species (particularly birds) utilising the garden plants that include flowering *Grevillea* and *Callistemon* species and cultivars, will also be present in the adjacent area included in this survey site.

Survey site locations are provided in **Table 31** in **Appendix Six**.

4.2.3.2 Fauna Habitat

Two fauna habitat types were recorded within the Infrastructure survey area; Open Woodland and Paddock (**Table 12**; **Map 5**).

Both habitat types are common within the region.

Table 12: Fauna habitat types (Infrastructure)

Habitat type	Description	Photo
Paddock	**Cultivated farmland used for cropping and livestock grazing, with isolated trees.** Habitat generally unsuitable for breeding or shelter for any fauna species but may be used during traverses by all recorded mammals and overflown by most birds, particularly larger species. Habitat unlikely to be used by smaller birds including (recorded elsewhere) Yellow-rumped Thornbill, Weebill, Grey-breasted White-eye, or Reticulated Velvet Gecko. Provides forage (seeds) for avian granivores (Galah, Australian Ringneck) and grazing for domestic livestock, Rabbits and Western Grey Kangaroo. **Extent:** 6.19 ha; 66.64%	
Open Woodland	**Medium sized trees with virtually no understorey.** Habitat generally unsuitable for breeding or shelter for most species but may be used during traverses by all recorded species. Has small hollows in some trees that may be used for hollow-breeding birds (none-recorded) or shelter by reptiles including Reticulated Velvet Gecko. Leaf-gleaning birds including Yellow-rumped Thornbill, Weebill, Grey-breasted White-eye, as well as larger birds, would visit this habitat for foraging. **Extent:** 1.48 ha; 15.89%	
Infra-structure	**Planted gardens and other infrastructure** For the purposes of describing the fauna habitat for the purposes of a clearing permit, like 'Paddock' above planted gardens are not considered as native vegetation. They do, however, provide habitat and additional resources for a number of native fauna species particularly birds. 'Infrastructure' also includes the solar panels that do not provide fauna habitat, except perhaps shade for small, mobile species. **Extent:** 1.62 ha; 17.47%	 

4.2.3.3 Black Cockatoos and Associated Habitat

While no conservation-listed species were recorded, the survey area is within the mapped breeding range of Carnaby's Cockatoo (DSEWPaC 2012a) thus a Black Cockatoo habitat assessment was conducted including a tree assessment.

Potential breeding trees (according to the Bamford 2016 grading system) were recorded within the Infrastructure site as follows (**Map 5**):

- nine were assessed as Class 5 (trees without suitable hollows); four Wandoo and five York Gums
- one was assessed as Class 4 (trees with large hollows or broken branches, but not having the features preferred by Black Cockatoos for nesting); Wandoo
- one was assessed as Class 3 (trees with potentially suitable hollows but with no evidence of use by Black Cockatoos); dead (species not determined)
- none were assessed as Class 2 (trees with suitable hollows and evidence of use, but not currently occupies) or Class 1 (having an active nest).

Photographs of each tree are included in **Appendix Seven**.

The majority of the Infrastructure site was Paddock habitat and Infrastructure, which are not considered as foraging habitat, with the Open Woodland habitat representing 'near-low quality' foraging habitat according to the scoring tool in the Draft Revised Referral Guideline (Commonwealth of Australia 2017).

4.3 SURVEY RESULTS: OPTION A

The Option A survey area (also known as 'site') includes a power corridor to the existing infrastructure and track access. The majority of the area, if the development proceeds, will require clearing ('clutter free zone') or, around the perimeter, will also require clearing although low regrowth to less than 60 cm high may be permitted although it would require trimming to maintain this height ('preferred clutter free zone).

The tree survey took into consideration the current height of trees as some trees outside of the survey area may require trimming to maintain the 'line of sight' of the proposed antenna. These trees were assessed for suitability for Black Cockatoo habitat.

4.3.1 FLORA AND VEGETATION SURVEY

4.3.1.1 Flora

Nine quadrats were established during the May 2020 field survey in the Option A survey site.

Including opportunistic observations, 25 vascular flora (including a single entity identified only to family level that may include several species) were recorded from 14 families and at least 21 genera. Additional species were likely to have been recorded if the survey had been conducted later in the year when additional species would be recognisable as many annuals had only recently germinated. Six (not including the entity only identified to family level that is most likely to consist of introduced species), representing 24% of all taxa were introduced.

The most commonly represented families were Myrtaceae with five taxa and Dilleniaceae (four taxa); Poaceae has at least three taxa although additional species are likely to have been included in the entity herein identified as Poaceae species. The most commonly represented genera were *Hibbertia* with four taxa and *Eucalyptus* and *Melaleuca* (two taxa each). A significant portion (8%) of the flora could not be identified with certainty due to the lack of reproductive material largely due to the season of survey and grazing.

The number of species per quadrat ranged from three (quadrat DS2015) to seven (quadrats DS2006 and DS2010). The average species diversity per quadrat was 5.11 which, based on other surveys in the bioregion, is considered low. The most frequently recorded taxa were **Avena barbata* (from eight quadrats) and *Eucalyptus wandoo* subsp. *wandoo* (five quadrats).

The combined flora inventory is presented in **Table 29** in **Appendix Three**. Quadrat data is presented in **Appendix Four**.

4.3.1.2 Conservation-listed Flora

No Commonwealth EPBC Act or Western Australian BC Act-listed Threatened Flora were recorded during the field survey, nor any DBCA-listed Priority Flora.

Following field survey, when additional information is available regarding actual habitat availability and searches have been conducted, the likelihood of conservation-listed flora occurring in the survey area was revised. This revised likelihood, that took into account vegetation condition, grazing and other disturbances, actual habitat availability and search effort, is included in **Table 27** in **Appendix Two**.

No conservation-listed flora were considered likely to occur i.e. none had a high likelihood of occurring.

4.3.1.3 Other Significant Flora

No recorded flora species had any other significance according to the criteria outlined in the Flora and Vegetation Technical Guidance (EPA 2016d).

4.3.1.4 Introduced Flora

Six introduced flora species (weeds), representing 24% of the total flora species, were identified during the field survey. **Avena barbata* (Bearded Oat/Wild Oat) was the most commonly recorded introduced species occurring in eight of nine quadrats.

No Declared Pest plants or WONs species were recorded.

4.3.2 VEGETATION

Three vegetation types were recorded over the Option A survey area, as follows:

- **CcW**: *Corymbia calophylla* woodland over **Avena barbata* low isolated grasses, on the lateritic upland
- **ElW**: *Eucalyptus loxophleba* subsp. *loxophleba* woodland over **Avena barbata* low isolated grasses, on the lower slopes
- **EwW**: *Eucalyptus wandoo* subsp. *wandoo* woodland over *Melaleuca marginata* and *Hibbertia hypericoides* subsp. *hypericoides* mid shrubland over **Avena barbata* low isolated grasses, on the lateritic upland.

Additional detail is provided in **Table 13**.

The floristic analysis, as described in **Section 3.3.7.1**, supported the vegetation types as they had been recognised in the field i.e. based on characteristic species in the uppermost stratum, noting that there were two floristic subgroups within vegetation type **EwW**, being quadrats without a midstratum and quadrats with a shrubby midstratum (the mid stratum is included in the description). The floristic analysis dendrogram is included in **Figure 4** in **Appendix Five**.

The extents of the vegetation types and representative quadrat locations are shown on **Map 4**.

Table 13 Vegetation types (Option A)

Note: representative quadrat in the photo is in **bold** font; quadrats within the vegetation type but not within the site are in parentheses.

Landform	Mapping Unit	Vegetation Type	Floristic Quadrats	Representative Photograph	Characteristic Species (all areas)	Area (ha) and Extent (%) of Survey Area
Upper Slope	**CcW**	*Corymbia calophylla* woodland over **Avena barbata* low isolated grasses	DS2006 DS2007 **DS2012**		Diagnostic: *Corymbia calophylla* Constant: *Corymbia calophylla*, **Avena barbata*, *Hibbertia commutata*, **Trifolium subterraneum*	2.74 ha 20.93%
Lower Slopes	**EIW**	*Eucalyptus loxophleba* subsp. *loxophleba* woodland over **Avena barbata* low isolated grasses	(DS2001 DS2002) **DS2015**		Diagnostic: *Eucalyptus loxophleba* subsp. *loxophleba*, **Avena barbata* Constant: **Avena barbata*, *Eucalyptus loxophleba* subsp. *loxophleba*	0.19 ha 1.41%

Landform	Mapping Unit	Vegetation Type	Floristic Quadrats	Representative Photograph	Characteristic Species (all areas)	Area (ha) and Extent (%) of Survey Area
Crest/Slope	**EwW**	*Eucalyptus wandoo* subsp. *wandoo* woodland over *Melaleuca marginata* and *Hibbertia hypericoides* subsp. *hypericoides* mid shrubland over **Avena barbata* low isolated grasses	(DS2004) **DS2005** DS2008 **DS2009** DS2010 DS2011		Diagnostic: *Eucalyptus wandoo* subsp. *wandoo, Melaleuca marginata* Constant: *Eucalyptus wandoo* subsp. *wandoo, *Avena barbata, Hibbertia hypericoides* subsp. *hypericoides, Melaleuca marginata*	10.17 ha 77.65%
	Not vegetated					nil
	TOTAL					13.10 ha

4.3.2.1 Floristic Analysis

The floristic analysis dendrogram (**Figure 4** in **Appendix Five**) supports the structural vegetation types as identified during the field survey, noting that vegetation type **EwW** had two subgroups corresponding with quadrats without a shrubby mid stratum (quadrats DS2005 and DS2008; upper representative photo in **Table 13**) and quadrats with a shrubby mid stratum (quadrats DS2009, DS2010 and DS2011; lower representative photo in **Table 13**).

4.3.2.2 Vegetation Significance

None of the existing vegetation has any formal conservation significance i.e. none is considered representative of any currently described TEC or PEC.

4.3.2.3 Vegetation Condition

The vegetation of the survey area was in Degraded and Completely Degraded condition (**Table 14**, **Map 4**). The entire area has been grazed for approximately 100 years resulting in highly reduced mid and ground strata, with mid stratum shrubs only recorded from more steeply sloped areas of the breakaway that are likely to be less heavily grazed.

Table 14: Vegetation condition extents (Option A)

Vegetation condition	Extent (ha)	Extent (%)
Pristine	-	-
Excellent	-	-
Very Good	-	-
Good	-	-
Degraded	13.06	99.66
Completely Degraded	0.04	0.4
N/A (not vegetated)	-	-
TOTAL	**13.10**	**100**

4.3.2.4 Adequacy of Survey

See **Section 4.1.1.3** for adequacy of survey over the entire survey area.

4.3.3 VERTEBRATE FAUNA SURVEY

The fauna survey was conducted by Hugh Osborn during 26-28 May 2020. The survey was conducted as a Level 1 survey according to the *Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna* (EPA 2016f).

4.3.3.1 Fauna Assemblage

Eighteen vertebrate fauna species were recorded during the field survey over all sites (**Table 9** in **Section 4.1.3**); all, or evidence of their presence, were recorded within the Infrastructure site. None are conservation-listed.

Survey site locations are provided in **Table 31** in **Appendix Six**.

4.3.3.2 Fauna Habitat

One fauna habitat type (Open Woodland) was recorded within the Option A survey area (**Table 15**; **Map 5**). Most of the Open Woodland was on the lateritic upland, although part was on the breakaway slopes under the caprock. There are minor habitat differences between these areas, which are separated into subtypes as below.

Table 15: Fauna habitat types (Option A)

Habitat type	Description	Photo
Open Woodland (habitat subtype: upland)	**Medium sized trees with no understorey.** The Open Woodland habitat forms a contiguous area of trees on lateritic caprock upland (largely with Wandoo trees) and on parkland cleared grazing land (with Marri trees). Both portions are largely without significant shrub or canopy shelter at ground level, although there are fallen logs and timber on the ground that would provide shelter for small ground-dwelling animals. The lack of understorey shelter restricts this habitat type's suitability for many fauna groups. **Extent:** 12.10 ha; 92.35%	 

Habitat type	Description	Photo
Open Woodland (habitat subtype: breakaway slopes)	**Medium sized trees with patchy understorey and rocky slope (breakaway).** The Open Woodland habitat type also includes an area along the northern part of the Option A site that, in places, has some areas of shrubs on and near the breakaway slope. This area differs slightly in terms of habitat values as there is shelter in the shrubby area for small birds and reptiles (and, if present although not recorded) mammals, and potentially hollows within the rocky areas, particularly for reptiles. The small birds recorded in the survey area (Yellow-rumped Thornbill, Weebill and Grey-breasted White-eye) are likely to be regularly found in the shrubby area. The Reticulated Velvet Gecko is associated with smooth-barked trees and is likely to occur throughout the Open Woodland habitat in Wandoo woodland, but is unlikely to occur in York Gum or Marri woodlands. **Extent:** 1.00 ha; 7.65%	 

4.3.3.3 Conservation-listed Fauna and Associated Habitat

While no conservation-listed species were recorded, the survey area is within the mapped breeding range of Carnaby's Cockatoo (DSEWPaC 2012a) thus a Black Cockatoo habitat assessment was conducted including a tree assessment.

Potential breeding trees (according to the Bamford 2016 grading system) were recorded within the Option A site as follows (**Map 5**):

- 259 were assessed as Class 5 (trees without suitable hollows); 227 Wandoo, 28 Marri and four York Gum
- 63 were assessed as Class 4 (trees with large hollows or broken branches, but not having the features preferred by Black Cockatoos for nesting); 58 Wandoo, three Marri, one York Gum and one dead (species not determined)
- 40 were assessed as Class 3 (trees with potentially suitable hollows but with no evidence of use by Black Cockatoos); 32 Wandoo, one Marri and seven dead (species not determined)
- none were assessed as Class 2 (trees with suitable hollows and evidence of use, but not currently occupies) or Class 1 (having an active nest).

Photographs of each tree are included in **Appendix Seven**.

The entire survey area has been assessed as being Open Woodland that is considered to be 'near-low quality' foraging habitat according to the scoring tool in the Draft Revised Referral Guideline (Commonwealth of Australia 2017).

4.4 SURVEY RESULTS: OPTION B

Option B is located within a paddock currently used for cereal cropping and livestock grazing rotation. Within the paddock are a few isolated trees, however, the western and southern edges of the paddock also have upper stratum trees, although the understorey in these treed parts is the only agricultural weeds.

4.4.1 FLORA AND VEGETATION SURVEY

4.4.1.1 Flora

Two quadrats were established during the field survey in the Option B survey site. Additional quadrats within the relevant vegetation types were recorded from the other sites during the survey.

Seven vascular flora were recorded from six families and seven genera. However, some areas also had trees present but not within quadrats, with the ground stratum was similar (excluding **Triticum aestivum*; Wheat) to the paddock. Taking the fringing and isolated trees into consideration, an additional genus (*Eucalyptus*) and two species are added to the total flora taxa occurring within the Option B site.

The most commonly represented families were Poaceae and Myrtaceae with two taxa each. The most commonly represented genus is *Eucalyptus* with two taxa. All flora could be identified with certainty.

The number of species per quadrat were three (quadrat DS2014) and six (quadrat DS1013) with an average species diversity per quadrat of 4.5 which, based on other surveys in the bioregion, is considered very low. The most frequently recorded taxa were **Triticum aestivum* and **Trifolium subterraneum* recorded from both quadrats.

The combined flora inventory is presented in **Table 29** in **Appendix Three**. Quadrat data is presented in **Appendix Four**.

4.4.1.2 Conservation-listed Flora

No Commonwealth EPBC Act or Western Australian BC Act-listed Threatened Flora were recorded during the field survey, nor any DBCA-listed Priority Flora.

Following field survey, when additional information is available regarding actual habitat availability and searches have been conducted, the likelihood of conservation-listed flora occurring in the survey area was revised. This revised likelihood, that took into account vegetation condition, grazing and other disturbances, actual habitat availability and search effort, is included in **Table 27** in **Appendix Two**. No conservation-listed flora were considered likely to occur i.e. none had a high likelihood of occurring.

4.4.1.3 Other Significant Flora

No recorded flora species had any other significance according to the criteria outlined in the Flora and Vegetation Technical Guidance (EPA 2016d).

4.4.1.4 Introduced Flora

Six introduced flora species (weeds), representing 66.7% of the total flora species, were recorded during the field survey. **Triticum aestivum* and **Trifolium subterraneum* were the most commonly recorded introduced species occurring in both quadrats. **Triticum aestivum* (Wheat) has been planted as part of the crop rotation; **Trifolium subterraneum* may have been deliberately planted as a fodder crop or may have been introduced through livestock faeces.

No Declared Pest plants or WONs species were recorded.

4.4.2 VEGETATION

Three vegetation types were recorded over the Option B survey area, as follows:

- **ElW**: *Eucalyptus loxophleba* subsp. *loxophleba* woodland over **Avena barbata* low isolated grasses, on the lower slopes
- **EwW**: *Eucalyptus wandoo* subsp. *wandoo* woodland over *Melaleuca marginata* and *Hibbertia hypericoides* subsp. *hypericoides* mid shrubland over **Avena barbata* low isolated grasses, on the lateritic upland
- **TaG**: **Triticum aestivum* and **Avena barbata* grassland (paddock; not native vegetation).

Additional detail is provided in **Table 16**.

The floristic analysis, as described in **Section 3.3.7.1**, supported the vegetation types as they had been recognised in the field i.e. based on characteristic species in the uppermost stratum. The floristic analysis dendrogram is included in **Figure 4** in **Appendix Five**.

The extents of the vegetation types and representative quadrat locations are shown on **Map 4**. Representative photos have been provided for the two Woodland vegetation types as no quadrats were recorded from within this site (representative quadrats have been recorded elsewhere in the

Table 16 Vegetation types (Option B)

Note: representative quadrat in the photo is in **bold** font; quadrats within the vegetation type but not within the site are in parentheses.

Landform	Mapping Unit	Vegetation Type	Floristic Quadrats	Representative Photograph	Characteristic Species (all areas)	Area (ha) and Extent (%) of Survey Area
Lower Slopes	**ElW**	*Eucalyptus loxophleba* subsp. *loxophleba* woodland over **Avena barbata* low isolated grasses	(DS2001 DS2002 DS2015 none in Option B; photo is not a quadrat)		Diagnostic: *Eucalyptus loxophleba* subsp. *loxophleba, *Avena barbata* Constant: **Avena barbata, Eucalyptus loxophleba* subsp. *loxophleba*	0.10 ha 0.61%
Slope	**EwW**	*Eucalyptus wandoo* subsp. *wandoo* woodland over *Melaleuca marginata* and *Hibbertia hypericoides* subsp. *hypericoides* mid shrubland over **Avena barbata* low isolated grasses Note: the above vegetation description is from the entire survey area and the mid stratum is not relevant for the Option B site.	(DS2004 DS2005 DS2008 DS2009 DS2010 DS2011 none in Option B; photo is not a quadrat)		Diagnostic: *Eucalyptus wandoo* subsp. *wandoo, Melaleuca marginata* Constant: *Eucalyptus wandoo* subsp. *wandoo, *Avena barbata, Hibbertia hypericoides* subsp. *hypericoides, Melaleuca marginata*	1.83 ha 11.28 %

Landform	Mapping Unit	Vegetation Type	Floristic Quadrats	Representative Photograph	Characteristic Species (all areas)	Area (ha) and Extent (%) of Survey Area
Paddock on upper slopes	**TaG**	**Triticum aestivum* and **Avena barbata* grassland Note: this vegetation type represents paddock thus is not native vegetation, although occasional isolated trees	(DS2003) DS2013 **DS2014**		Diagnostic: **Triticum aestivum* Constant: **Triticum aestivum*, **Trifolium subterraneum*, **Arctotheca calendula*, **Avena barbata*, *Dysphania pumilio*, **Erodium botrys*	14.30 ha 88.11%
	Not vegetated (excluding TaG)					Nil
	TOTAL					16.22 ha

4.4.2.1 Floristic Analysis

The floristic analysis dendrogram (**Figure 4** in **Appendix Five**) supports the structural vegetation types as identified during the field survey.

4.4.2.2 Vegetation Significance

None of the existing vegetation is considered representative of any currently described TEC or PEC.

4.4.2.3 Vegetation Condition

The vegetation of the survey area was assessed as being in Completely Degraded condition or not native vegetation, including paddock (**Table 17**, **Map 4**). The main factors influencing vegetation condition was previous clearing and current and past grazing that has removed almost all native ground and mid stratum species.

Table 17: Vegetation condition extents (Option B)

Vegetation condition	Extent (ha)	Extent (%)
Pristine	-	-
Excellent	-	-
Very Good	-	-
Good	-	-
Degraded	-	-
Completely Degraded	1.93	11.89
N/A (not vegetated)	14.30	88.11
TOTAL	**16.22**	**100**

4.4.2.4 Adequacy of Survey

See **Section 4.1.1.3** for adequacy of survey over the entire survey area.

4.4.3 VERTEBRATE FAUNA SURVEY

The fauna survey was conducted by Hugh Osborn during 26-28 May 2020. The survey was conducted as a Level 1 survey according to the *Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna* (EPA 2016f).

4.4.3.1 Fauna Assemblage

Eighteen vertebrate fauna species were recorded in total from all sites during the field survey (**Table 9** in **Section 4.1.3**); all are anticipated to occur within the Option B site although few would be resident due to the lack of habitat diversity and food sources available.

No conservation-listed fauna was recorded.

Survey site locations are provided in **Table 31** in **Appendix Six**, although none were located within Option B.

4.4.3.2 Fauna Habitat

Two fauna habitat types were recorded within the Option B survey area; Open Woodland and Paddock (**Table 18**; **Map 5**).

Both habitat types are common within the region.

Table 18: Fauna habitat types (Option B)

Habitat type	Description	Photo
Paddock	**Cultivated farmland used for cropping and livestock grazing, with isolated trees.** Habitat generally unsuitable for breeding or shelter for any fauna species but may be used during traverses by all recorded mammals and overflown by most birds, particularly larger species. Habitat unlikely to be used by smaller birds including (recorded elsewhere) Yellow-rumped Thornbill, Weebill, Grey-breasted White-eye, or Reticulated Velvet Gecko. Provides forage (seeds) for avian granivores (Galah, Australian Ringneck) and grazing for domestic livestock, Rabbits and Western Grey Kangaroo. **Extent:** 14.30 ha; 88.11%	
Open Woodland	**Medium sized trees with virtually no understorey.** Habitat generally unsuitable for breeding or shelter for most species but may be used during traverses by all recorded species. Has small hollows in some trees that may be used for hollow-breeding birds (none-recorded) or shelter by reptiles including Reticulated Velvet Gecko (although this species is unlikely to inhabit isolated trees). Leaf-gleaning birds including Yellow-rumped Thornbill, Weebill, Grey-breasted White-eye, as well as larger birds, would visit this habitat on the edges for foraging. **Extent:** 1.93 ha; 11.89%	

4.4.3.3 Conservation-listed Fauna and Associated Habitat

While no conservation-listed species were recorded, the survey area is within the mapped breeding range of Carnaby's Cockatoo (DSEWPaC 2012a) thus a Black Cockatoo habitat assessment was conducted including a tree assessment.

Potential breeding trees (according to the Bamford 2016 grading system) were recorded within the Option B site as follows (**Map 5**):

- three were assessed as Class 5 (trees without suitable hollows); two Wandoo and one York Gum

- none were assessed as Class 4 (trees with large hollows or broken branches, but not having the features preferred by Black Cockatoos for nesting), Class 3 (trees with potentially suitable hollows but with no evidence of use by Black Cockatoos), Class 2 (trees with suitable hollows and evidence of use, but not currently occupies) or Class 1 (having an active nest).

Photographs of each tree are included in **Appendix Seven**.

The majority of the Option B site was Paddock habitat, which is not considered as foraging habitat, with the Open Woodland habitat representing 'near-low quality' foraging habitat according to the scoring tool in the Draft Revised Referral Guideline (Commonwealth of Australia 2017).

5 DISCUSSION

5.1 FLORA SIGNIFICANCE

Twenty eight vascular flora species recorded from 15 floristic quadrats and opportunistic searches. At least eight (28.6%) of these were introduced species. Two could not be identified with certainty to genus level due to lack of diagnostic reproductive material; neither were similar to any currently described conservation-listed species. An additional taxon could only be identified to family level and may represent a number of taxa, however, all are likely to be introduced species (weed grasses).

The species accumulation curve (see **Section 4.2.2.4**) indicates that additional quadrats may have resulted in additional flora species being recorded; this is unsurprising when taking the survey timing into consideration as the survey was conducted during May when annual species had only recently germinated thus were most likely under-recorded. However, due to the Degraded-Completely Degraded condition of the native vegetation due to clearing and current and past grazing, and the significant portion that was not native vegetation, it is highly unlikely that any conservation-listed flora occur in any part of the site. Therefore, the lower than anticipated flora diversity is not considered a constraint to identifying the flora of any part of the survey area.

There are few relevant surveys that have published information available for comparison (see **Section 2.3**), however, those that are available indicate far higher species diversity than that recorded from the survey areas (which averaged 4.92) e.g. Phoenix (2019) recorded 47 quadrats and relevés resulting in 296 plant taxa in their road verge survey area that included Great Northern Highway approximately 1 km east of this survey area. Although individual quadrat data is not readily available a raw calculation indicates approximately 15-16 species per quadrat (recorded during over multiple years, with most survey conducted during spring, which is optimal for survey. The low species diversity is a result of the previous clearing and current and past grazing that has resulted in virtually no ground or mid strata except for three quadrats that had some shrubs remaining (species richness of these quadrats was 5.67), except agricultural weeds.

5.1.1 RECORDED CONSERVATION-LISTED FLORA

No TF species listed for protection under the Commonwealth EPBC Act or Western Australian BC Act were recorded from the survey area.

No PF listed by the DBCA were recorded.

5.1.2 OTHER CONSERVATION-LISTED FLORA

Sixty four conservation-listed flora species were identified by the database searches from nearby; none were considered a High likelihood of occurring within the survey area based on their known distribution, habitat as described on *FloraBase* and in specimen records (WAH 1998-2020; 2020), and having potentially suitable habitat available within the survey area, which had been identified by a preliminary site survey during February 2020.

Due to the poor vegetation condition within the survey area, and taking into consideration the available habitat and survey effort (indicated by the track log shown on **Map 4**), the desktop likelihood assessment results were confirmed, with no species considered likely to occur.

5.1.3 INTRODUCED FLORA

At least eight introduced flora (28.6% of all recorded species) were recorded during the field survey although more are likely to occur and would have been detected if the survey had been conducted during late winter or spring when reproductive material would be present.

None are Declared Pest plants or WoNS species.

5.2 VEGETATION SIGNIFICANCE

Four vegetation types were recorded as occurring in the survey area although one did not represent native vegetation. The three native vegetation types were:

- **EIW**: *Eucalyptus loxophleba* subsp. *loxophleba* woodland over **Avena barbata* low isolated grasses, on the lower slopes
- **EwW**: *Eucalyptus wandoo* subsp. *wandoo* woodland over *Melaleuca marginata* and *Hibbertia hypericoides* subsp. *hypericoides* mid shrubland over **Avena barbata* low isolated grasses, on the lateritic upland
- **CcW**: *Corymbia calophylla* woodland over **Avena barbata* low isolated grasses, on the lateritic upland and slopes.

The non-native vegetation type was **TaG**: **Triticum aestivum* and **Avena barbata* grassland (paddock; not native vegetation). This vegetation type was included in the descriptions to clearly identify areas of paddock. It has no significance as a vegetation type.

The three woodland vegetation types above (**EIW**, **EwW** and **CcW**) are all broadly common within the region and represent vegetation types common in the IBRA bioregion (**EwW** and **CcW**) and broadly defined agricultural region (**EIW** and **EwW**), based on their characteristic upper stratum species. However, all are in Degraded or Completely Degraded condition which, in most circumstances, is not considered to represent extant native vegetation. Overall, the vegetation has little significance due to its poor condition as a result of clearing and long-term grazing.

5.2.1 SIGNIFICANT ECOLOGICAL COMMUNITIES

No TECs or PECs correspond with the survey area. The nearest TEC is represented by a number of occurrences of the *Eucalypt Woodlands of the Western Australian Wheatbelt* TEC, however, the survey area is not within the definitive bioregions, nor closely adjacent, thus by definition this TEC cannot occur within the survey area (TSSC 2015).

5.2.2 OTHER SIGNIFICANT VEGETATION

The vegetation does not meet any of the criteria in the Flora and Vegetation Technical Guidance (EPA 2016d) to be considered as significant.

5.2.3 LOCAL AND REGIONAL SIGNIFICANCE

The vegetation, being all commonly occurring types and in poor (Degraded and Completely Degraded) condition, is unlikely to have any significance at any scale.

5.2.4 VEGETATION CONDITION

The native vegetation within the survey area has been assessed as being in Degraded or Completely Degraded condition as a result of previous clearing and current and past grazing. The European Space Agency site was

excised from an operating farm prior to construction, and much of this survey area is part of the still-operating farming enterprise.

Clearing and grazing has resulted in low native flora species diversity, and very low numbers of ground (herbs, grasses, sedges, low shrubs) or mid (shrubs) stratum species being present.

5.3 FAUNA SIGNIFICANCE

5.3.1 FAUNA ASSEMBLAGE

Eighteen vertebrate fauna species were recorded during the field survey across all sites.

No recorded fauna species is conservation-listed and all occur commonly within the region and landscape.

Six mammal species were recorded, however, only two were native species: *Macropus fuliginosus* (Western Grey Kangaroo) and *Tachyglossus aculeatus* (Short-beaked Echidna). Both occur commonly in agricultural areas. Due to the lack of shelter and low diversity of food sources it is unlikely that many other native mammal species would be resident in the bushland of the survey area.

Eleven bird species were recorded, two of which are not native to the area. Although it is likely that more birds occur than were recorded, partly as a result of the weather conditions during the survey period, it is unlikely that any that require shrub or groundcover (as shelter or for food sources) would be more than transient visitors to the site.

Only one reptile was recorded although more likely to occur in the Open Woodland habitat in Option A, particularly on the breakaway slopes where shelter amongst rocks occurs and trampling from livestock is less likely.

The field survey was conducted over three days in late May, during which the weather was cool and at least partly raining. Small birds and, particularly, reptiles may have been sheltering and may not have been recorded thus providing a constraint to the survey results. However, it is unlikely that any would be conservation-listed thus the constraint is considered negligible.

5.3.2 OTHER CONSERVATION-LISTED FAUNA

No conservation-listed fauna species were recorded.

The post-survey likelihood assessment identified three species as having a Medium or High likelihood of occurring based on the habitat available in the survey area; these are discussed below.

Calyptorhynchus banksii naso (Forest Red-tailed Black Cockatoo; EPBC Act and BC Act listed VU) was considered, due to recent records of its occurrence from nearby, a Medium likelihood of occurring although the survey area is not within the species' modelled distribution according the Black Cockatoo Referral Guidelines (DSEWPaC 2012a). It may occur within the survey area on occasion, however, is unlikely to be a frequent visitor or nest due to the distance from its usual distribution. It is highly unlikely to breed within the survey area or be dependent on any resources present within the survey area.

Falco peregrinus (Peregrine Falcon; specially protected by DBCA) was considered a Medium likelihood of occurring. However, its favoured habitats are coastal and areas with cliffs although it may occasionally occur, however, the lack of rocky cliffs or significant rocky outcrops preferred for breeding (Simpson & Day 2004) indicates that this species is unlikely to be resident.

Calyptorhynchus latirostris (Carnaby's cockatoo; EPBC Act and BC Act EN) was considered a High likelihood of occurring due to nearby records of occurrence; the survey area is within the modelled breeding range for this species (DSEWPaC 2012a). Nesting habitat (trees) occurs within the survey area (see **Section 5.3.3.1** below), however, there are no significant food sources and the foraging habitat has been assessed as being 'near-low quality' (see **Section 4.1.4.1**). The landholder and European Space Agency personnel have not observed Carnaby's Cockatoo within the survey area in over 20 years, although they have been observed nearby in Seven Mile Well Nature Reserve, approximately 1.5 km southeast. None of the tree hollows recorded had evidence of use, nor was there evidence of foraging recorded. Ecoscape's assessment of the survey area is that Carnaby's Cockatoo may occur on the site on occasion, although there was no evidence of recent occurrence. However, it is unlikely to be resident due to the lack of food sources and the availability of better quality habitat nearby, including the above mentioned Nature Reserve, and to the west where the sandplain vegetation is more likely to support the proteaceous species that are favoured for food. For these reasons, Carnaby's Cockatoo, if it occurs on site, is likely to be transient and unlikely to be dependent on the site for foraging or breeding.

While invertebrate survey was not within the scope of the survey, *Idiosoma mcclementsorum* (Julimar Shield-backed Trapdoor Spider) was identified from nearby by the DBCA database search and was considered to have a High desktop likelihood of occurring. Its habitat is described as being sandy substrates overlying laterite (Rix *et al.* 2018); whilst the soil of the survey area is lateritic, including lateritic caprock, the substrate is generally clay loam and not sandy. Given the lack of suitable soil and trampling of burrows (if they had ever been present) due to livestock grazing, there is Very Low likelihood of this species occurring in any of the survey sites.

5.3.3 SIGNIFICANT FAUNA HABITAT TYPES

Three habitat types were recorded within the survey area: Open Woodland, Paddock and Infrastructure. Each of these habitat types supports a suite of birds, mammals and reptiles some of which have specific requirements unique to a particular habitat, however, neither of the last two listed habitat types is representative of any habitat that would have been present prior to European settlement. The Open Woodland habitat consisted of trees, however, there was little in the way of shelter or food resources other than the trees themselves or fallen timber.

Due to the low structural diversity present in all of these habitat types they are unlikely to be suitable for a large variety of native species, with all of those recorded being common within the agricultural matrix (although some are likely to only occur in vegetated patches within the matrix). None of these habitat types are likely to be considered to have significance as habitat for a wide range of species, or for species having specific habitat requirements, or for any conservation-listed species.

5.3.3.1 Black Cockatoo Habitat

The Paddock and Infrastructure habitat types are not considered as foraging habitat for Black Cockatoo species, nor are there any significant nesting resources although there are some isolated paddock trees within Paddock habitat type.

The survey area had 376 trees that met the criteria to be considered suitable or potentially suitable for nesting (according to the criteria outlined in DSEWPaC 2012a). Of these trees (according to the Bamford 2016 grading system):

- 271 were assessed as Class 5 (trees without suitable hollows)

- 64 were assessed as Class 4 (trees with large hollows or broken branches, but not having the features preferred by Black Cockatoos for nesting)
- 41 were assessed as Class 3 (trees with potentially suitable hollows but with no evidence of use by Black Cockatoos)

None were assessed as Class 2 (trees with suitable hollows and evidence of use, but not currently occupied) or Class 1 (having an active nest), although the latter class was not assessable due to the survey timing that did not correspond with the nesting period.

Option A had 362 of the potential Black Cockatoo habitat trees, including 40 Class 3 trees that had potentially suitable hollows, but with no evidence of use. Although there is no recent evidence of Black Cockatoos occurring on site, and in particular evidence of use of nesting trees, Option A is the site with the highest potential for use by Black Cockatoos.

6 CONCLUSIONS

6.1 FLORA AND VEGETATION FACTOR CONSIDERATIONS

Considerations for EIA for the factor *Flora and Vegetation* (EPA 2016a) include, but are not necessarily limited to:

- application of the mitigation hierarchy to avoid and minimise impacts to flora and vegetation, where possible
- the flora and vegetation affected by the proposal
- the potential impacts and the activities that will cause them, including direct and indirect impacts
- the implications of cumulative impacts
- whether surveys and analyses have been undertaken to a standard consistent with guidance
- the scale at which impacts to flora and vegetation are considered
- the significance of the flora and vegetation, and the risk to the flora and vegetation
- the current state of knowledge of flora and vegetation and the level of confidence underpinning the predicted residual impacts
- whether proposed management and mitigation approaches are technically and practically feasible
- whether the proposal area will be revegetated in a manner that promotes biological diversity and ecological integrity.

Various issues are frequently of significance within the environmental impact assessment process. These issues, and the potential impact from the proposed works, are summarised below.

6.1.1 HABITAT LOSS, DEGRADATION AND FRAGMENTATION

The survey area, inclusive of all sites, is in a part of Western Australia that has been significantly cleared with the pre-European vegetation association present having between 21.99% and 32.22% of the original extent remaining at State to local government area scales (the local government area has 22.83% remaining); see **Section 2.2.2**.

Vegetation type **TaG** (Wheat paddock), present in the Infrastructure and Option B sites, and areas mapped as not native vegetation, present in the Infrastructure site, have virtually no native species and virtually no vegetation structure to be considered as native vegetation. These areas occupied 84.11% of the Infrastructure site and 88.11% of the Option B site.

None of the woodland vegetation types (**CcW** in Option A, **ElW** in Infrastructure, Option A and Option B and **EwW** in Infrastructure, Option A and Option B) were assessed as being in better than Degraded condition, and therefore are not, in most circumstances, considered to represent extant native vegetation (i.e. all was Degraded to Completely Degraded condition). Option A was entirely woodland vegetation types.

The Woodland portions of the survey areas form part of a network of apparent native vegetation, linking the sites to Seven Mile Well Nature Reserve to the southeast and to other areas of apparently uncleared vegetation that is not within the conservation estate. However, most of these other areas in the linking corridors are privately owned farmland and probably grazed, thus are likely to be in similar condition to the survey areas. Therefore there are likely to be few native flora species that could contribute to the natural gene flow in the area or provide propagules to aid natural regeneration, should grazing cease in any part.

In conclusion, the vegetation in the survey area provides little in the way of habitat for flora and is unlikely to improve its condition as it is currently part of a farming enterprise where grazing is an established and accepted land use. Any changes to land use are unlikely to significantly contribute to habitat loss, degradation or fragmentation in the area.

6.1.2 INVASIVE SPECIES

Overall, 84.11% of the Infrastructure site and 88.11% of the Option B site did not have native vegetation, being Wheat paddock, planted gardens around infrastructure, cleared (bare) or buildings, roads or other infrastructure. The remaining areas were apparent native vegetation i.e. woodlands, although in Degraded or Completely Degraded condition. All areas had weeds, with over a quarter of all recorded flora taxa being introduced (28.6%). However, all were common species found in the agricultural landscape and while they all have the ability to invade native bushland, and have done so, none are Declared Pest plant species or WoNS species. Any changes to land use are unlikely to result in significant changes to the value of the vegetation as a result of invasive flora species.

6.1.3 FIRE REGIMES

Fire occurs naturally in the landscape as a result of lightning strike and Australian vegetation has evolved to recover rapidly. Any changes to land use are likely to alter the fire regimes in the area and, due to the requirement to protect the current and proposed infrastructure, any fires with potential to affect the site are a high priority to be suppressed, with fire fighting equipment on site.

6.1.4 CHANGING CLIMATE

Climate change impacts on native flora and vegetation may be of importance as a cumulative impact when taking all changing factors into account, however, on its own, climate change is unlikely to be to be a significant factor in the survey area.

6.1.5 STATE OF KNOWLEDGE

All flora species are well known and common in the area (including those that could not be named to species level) and it is unlikely that any flora knowledge gaps of the survey areas are likely to be of significance.

It is unlikely that any knowledge gaps relating to the vegetation of the survey areas are likely to be of significance.

It is considered the 'application of general ecological principles' are likely to be a reasonable guide to understanding the flora and vegetation of the survey area.

6.2 FAUNA FACTOR CONSIDERATIONS

Considerations for EIA for the factor Terrestrial Fauna (EPA 2016b) include, but are not necessarily limited to:

- application of the mitigation hierarchy to avoid and minimise impacts to terrestrial fauna, where possible
- the terrestrial fauna affected by the proposal
- the potential impacts and the activities that will cause them, including direct and indirect impacts
- the implications of cumulative impacts
- whether surveys and analyses have been undertaken to a standard consistent with EPA technical guidance
- the scale at which impacts terrestrial fauna are considered
- the significance of the terrestrial fauna and the risk to those fauna

- the current state of knowledge of the affected species/assemblages and the level of confidence underpinning the predicted residual impacts
- whether proposed management and mitigation approaches are technically and practically feasible.

Various issues are frequently of significance within the environmental impact assessment process. These issues, and the potential impact from the proposed works, are summarised below.

6.2.1 HABITAT LOSS, DEGRADATION AND FRAGMENTATION

The Woodland portions of the survey areas form part of a network of apparent native vegetation, linking the sites to Seven Mile Well Nature Reserve to the southeast and to other areas of apparently uncleared vegetation that is not within the conservation estate. However, most of these other areas in the linking corridors are privately owned farmland and probably grazed, thus are likely to be in similar condition to the survey areas. They therefore, potentially, have little vegetation structure to form a corridor that could be used by native wildlife for movement. In addition, it may be counterproductive to provide a corridor from areas of good habitat (i.e. the Nature Reserve) to areas of poor habitat if dispersing fauna are more likely to be predated due to the lack of shelter or find little in the way of resources in the areas they expand into.

The woodland areas, particularly in Option A, have potential to form habitat for threatened Black Cockatoo species, particularly Carnaby's Cockatoo, which is known to occur in the area. Option A has 362 trees that meet the requirements to be considered Black Cockatoo habitat trees (40 with hollow that are suitable for use although without any evidence of use), however, the entire site has virtually no other resources (e.g. foraging species) and no recent history of Carnaby's Cockatoo's visiting the site. Therefore it is unlikely that clearing this (Option A) or any other area would have any significant impact on the persistence of Black Cockatoo species in the local region.

In conclusion, the vegetation in the survey area provides little in the way of habitat for flora or fauna and is unlikely to improve its condition as it is currently part of a farming enterprise where grazing is an established and accepted land use. Although connected to other vegetated areas, the linking vegetation is likely to be similar in condition and provide little in the way of habitat or resources as either a corridor for fauna movement, or as an area for fauna residence. Any changes to land use are unlikely to significantly contribute to habitat loss, degradation or fragmentation in the area.

6.2.2 FIRE REGIMES

Fire occurs naturally in the landscape as a result of lightning strike and vegetation has evolved to recover rapidly. Any changes to land use are likely to alter the fire regimes in the area and, due to the requirement to protect the current and proposed infrastructure, any fires with potential to affect the site are a high priority to be suppressed, with fire fighting equipment on site.

6.2.3 INVASIVE SPECIES

Invasive, or feral, pest species occur across the State at varying levels of density, with higher densities usually associated with human habitation (Frank *et al.* 2014). Invasive pests are impacting native fauna species ability to persist in the landscape.

Red fox was recorded during the field survey and, although not recorded, feral cats are also likely to be present on the site. Due to the lack of shelter i.e. few low shrubs, native fauna species (if present) are vulnerable to predation by these species.

Rabbits were also recorded and browse on low-growing native flora, as well as crops and weeds, and would restrict any natural regeneration of vegetation.

However, any changes to land use are unlikely to alter the number of invasive fauna species present on site.

6.2.4 CHANGING CLIMATE

Changing climate has the potential to affect the fauna corresponding with the survey areas, however, any potential works are not of sufficient scale to affect climate.

6.2.5 SHORT RANGE ENDEMISM

No recorded species are considered as short range endemics (SRE). Invertebrate species were outside the scope of the project, however, due to the low structural diversity present including potential shelter for SRE species, and taking into consideration the trampling effect of stock, it is unlikely that any occur on site.

6.2.6 STATE OF KNOWLEDGE

It is considered the 'application of general ecological principles' are likely to be a reasonable guide to understanding the fauna of the survey area.

REFERENCES

Australian Government. *Environment Protection and Biodiversity Conservation Act 1999.*

Australian Government & Bureau of Meteorology. 2020. *Groundwater Dependent Ecosystems Atlas*. Available from: http://www.bom.gov.au/water/groundwater/gde/map.shtml.

Australian Government & Department of Agriculture Water and the Environment. 2020. *EPBC Act Protected Matters Report (Protected Matters Search Tool)*. Available from:

Australian Government & Department of the Environment and Energy. 2018. *Weeds of National Significance*. Available from: http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html.

Bamford, M. pers. comm. 2016

Beard, J.S. 1990. *Plant life of Western Australia* Kenthurst, N.S.W, Kangaroo Press.

Bureau of Meteorology. 2020. *Climate Data Online*. Available from: http://www.bom.gov.au/climate/data/.

Commonwealth of Australia. 2017. *Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo*. Available from: https://www.environment.gov.au/system/files/consultations/1a21997c-5542-4cd6-ace9-561865bbff29/files/draft-revised-referral-guideline-black-cockatoos.pdf.

Department of Biodiversity Conservation and Attractions. 2007. *NatureMap: Mapping Western Australia's Biodiversity*. Available from: https://naturemap.dbca.wa.gov.au/.

Department of Biodiversity Conservation and Attractions. 2018. *List of Threatened Ecological Communities (TECs) endorsed by the Western Australian Minister for Environment (28 June 2018)*. Available from: https://www.dpaw.wa.gov.au/images/plants-animals/threatened-species/threatened_ecological_communities_endorsed_by_the_minister_for_the_environment_june_2018.pdf.

Department of Biodiversity Conservation and Attractions. 2019. *Conservation codes for Western Australian Flora and Fauna (3 January 2019)*. Available from: https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Conservation%20code%20definitions.pdf.

Department of Environment and Conservation. 2009. *Fauna notes No. 21 Galah*. Available from: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiKqKLD6pvqAhXn93MBHYZ4DD8QFjAMegQIAxAB&url=https%3A%2F%2Flibrary.dbca.wa.gov.au%2Fstatic%2FFullTextFiles%2F922916.pdf&usg=AOvVaw1FH1gX2FVxTDBvs_4nu3HJ.

Department of Environment and Conservation. 2013. *Definitions, categories and criteria for Threatened and Priority Ecological Communities*. Available from: https://www.dpaw.wa.gov.au/images/plants-animals/threatened-species/definitions_categories_and_criteria_for_threatened_and_priority_ecological_communities.pdf.

Department of Environment Water Heritage and the Arts 2009, *Matters of National Environmental Significance. Significant impact guidelines 1.1 - Environment Protection and Biodiversity Conservation Act 1999*, Australian Government.

Department of Primary Industries and Regional Development. 2018a. *Pre-European Vegetation (DPIRD-006) Spatial Dataset*. Available from: https://catalogue.data.wa.gov.au/dataset/pre-european-dpird-006.

Department of Primary Industries and Regional Development. 2018b. *Soil Landscape Mapping - Rangelands (DPIRD-063)*. Available from: https://catalogue.data.wa.gov.au/dataset/soil-landscape-mapping-rangelands.

Department of Primary Industries and Regional Development. 2019. *Climate projections for Western Australia*. Available from: https://www.agric.wa.gov.au/climate-change/climate-projections-western-australia.

Department of Sustainability Environment Water Population and Communities 2012a, *EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (Calyptorhynchus latirostris), Baudin's cockatoo (Calyptorhynchus baudinii), Forest red-tailed black cockatoo (Calyptorhynchus banksii naso)*, Department of Sustainability Environment Water Populations & Communities, Canberra.

Department of Sustainability Environment Water Population and Communities. 2012b. *Species Profile and Threats Database*. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl. [May 2012b].

Department of the Environment and Energy. 2016. *Australia's bioregions (IBRA)*. Available from: https://www.environment.gov.au/land/nrs/science/ibra. [July 2016].

Department of the Environment and Energy. 2019. *SPRAT EPBC Migratory Species Lists in Species Profiles and Threats Database*. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicshowmigratory.pl.

Department of the Environment Water Heritage and the Arts. 2010. *Survey guidelines for Australia's threatened birds*. Available from: https://www.environment.gov.au/system/files/resources/107052eb-2041-45b9-9296-b5f514493ae0/files/survey-guidelines-birds-april-2017.pdf.

Dufrene, M. & Legendre, P. 1999. Species assemblages and indicator speciesL the need for a flexible asymmetrical approach. *Ecological Monographs*, vol. 67, pp. 345-366

Eamus, D. 2009. *Identifying groundwater dependent ecosystems: a guide for land and water managers*. Available from: http://lwa.gov.au/files/products/innovation/pn30129/pn30129_1.pdf.

Eamus, D., Froend, R., Loomes, R., Hose, G., & Murray, B. 2006. A functional methodology for determining the groundwater regime needed to maintain the health of groundwater-dependent vegetation. *Australian Journal of Botany*, vol. 54, pp. 97-114

Ecoscape (Australia) Pty Ltd 2020, *Deep Space Facility Preliminary Environmental Survey and Advice*, Report prepared for Stratham Engineering Consultancy Service.

Environmental Protection Authority. 2016a. *Environmental Factor Guideline: Flora and Vegetation*. Available from: http://epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Guideline-Flora-Vegetation-131216_4.pdf.

Environmental Protection Authority. 2016b. *Environmental Factor Guideline: Terrestrial Fauna*. Available from: http://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-terrestrial-fauna.

Environmental Protection Authority. 2016c. *Statement of Environmental Principles, Factors and Objectives*. Available from: http://www.epa.wa.gov.au/statement-environmental-principles-factors-and-objectives; http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Statement%20of%20Environmental%20Principles%2C%20factors%20and%20objectives_29062018.pdf.

Environmental Protection Authority. 2016d. *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment*. Available from: http://www.epa.wa.gov.au/policies-guidance/technical-guidance-flora-and-vegetation-surveys-environmental-impact-assessment.

Environmental Protection Authority. 2016e. *Technical Guidance - Terrestrial Fauna Surveys*. Available from: http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Tech%20guidance-%20Terrestrial%20Fauna%20Surveys-Dec-2016.pdf.

Environmental Protection Authority. 2016f. *Technical Guidance: Sampling methods for terrestrial vertebrate fauna*. Available from: http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Tech%20guidance-%20Sampling-TV-fauna-Dec2016.pdf.

Farr, T.G., Rosen, P.A., & Caro, E. 2007. The shuttle radar topoggraphy mission. *Review of Geophysics*, vol. 45, pp. 1-33

Frank, A.S.K., Johnson, C.N., Potts, J.M., Fisher, A., Lawes, M.J., Woinarski, J.C.Z., Tuft, K., Radford, I.J., Gordon, I.J., Collis, M.-A., & Legge, S. 2014. Experimental evidence that feral cats cause local extirpation of small mammals in Australia's tropical savannas. *Journal of Applied Ecology*, vol. 51, no. 6, pp. 1486-1493

Government of Western Australia. *Environmental Protection Act 1986.*

Government of Western Australia. *Environmental Protection (Environmentally Sensitive Areas) Notice 2005.*

Government of Western Australia. *Biosecurity and Agriculture Management Act 2007.*

Government of Western Australia. *Biodiversity Conservation Act 2016.*

Government of Western Australia, 2018a. *1:250,000 Geological series map - Perth-Ledge Point (SH5014)*,

Government of Western Australia. 2018b. *About the Conservation and Parks Commission*. Available from: https://www.conservation.wa.gov.au/.

Government of Western Australia. *Biodiversity Conservation Regulations 2018c.*

Government of Western Australia. 2018d. *Government Gazette No. 135, 11 September 2018*. Available from: https://www.slp.wa.gov.au/gazette/gazette.nsf/searchgazette/EF556EEFA23C70FA482583040013E0FC/$file/Gg135.pdf.

Government of Western Australia. 2019. *2018 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of March 2019*. Available from: https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics.

Government of Western Australia & Department of Water and Environmental Regulation. 2020. *Shared Land Information Portal (SLIP)*. Available from: https://maps.slip.wa.gov.au/landgate/locate/.

Hatton, T. & Evans, R. 1998, *Dependence of ecosystems on groundwater and its significance to Australia*, Land and Water Research and Development Corporation (Australia), Occasional Paper No. 12/98, Canberra, ACT.

Indreica, A. 2012. Vegetation classification of acidophytic oak forests of Romania. *Phytocoenologia*, vol. 42, pp. 221-230

InSight Ecology 2008, *A Survey of Birds in Planted and Remnant Native Vegetation around Calingiri and New Norcia, East Moore Catchment, WA*, Report prepared for Moore Catchment Council.

Legendre, P. & Anderson M.J. 1999. Distance-based redundancy analysis: testing multispecies responses in multifactorial ecological experiments. *Ecological Monographs*, vol. 69, pp. 1-24

Lengyel, A., Illyés, E., Bauer, N., Csiky, J., Király Botond, G., Purger, D., & Botta-Dukát, Z. 2016. Classification and syntaxonomical revision of mesic and semi-dry grasslands in in Hungary= Klasifikace a syntaxonomická revize mezických a polosuchých trávníku v Madarsku. *Preslia*, vol. 88, pp. 201-228

Lötter, M., Mucina, L., & Witkowski, E.T.F. 2013. The classification conundrum: species fidelity as leading criterion in search of a rigorous method to classify a complex forest data set. *Community Ecology*, vol. 14, pp. 121-132

Mucina, L., Tsakalos, J. L., & Macintyre, P. D. 2019, "Ecology, biodiversity and mining: science and solving the challenges," in *Proceedings of the 13th International Conference on Mine Closure*, Australian Centre for Gemechanics, Perth, pp. 19-34.

Mucina, L. & Daniel, G. 2013. *Vegetation Mapping in The Northern Kimberley Western Australia* Perth, Western Australia, Curtin University Press.

NVIS Technical Working Group 2017, *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 7.0*, Department of the Environment and Energy, Canberra.

Oksanen, J., Blanchet, F. G., Friendly, M., Kindt, R., Legendre, P., McGlinn, D., Minchin, P. R., O'Hara, R. B., Simpson, G. L., Stevens, M. H., Szoecs, E., & Wagner, H. 2019. *vegan: Community ecology package. R package version 2.5-4.* Available from: https://CRAN.R-project.org/package=vegan. [November 2019].

Peel, M.C., Finlayson, B.L., & McMahon, T.A. 2007. Updated world map of the Köppen-Geiger climate classification. *Hydrology and Earth System Sciences*, vol. 11, pp. 1633-1644

Phoenix Environmental Sciences 2016, *Flora and fauna assessment for Calingiri to Wubin study areas*, Prepared for Muchea to Wubin Integrated Project Team.

Phoenix Environmental Sciences 2019, *Flora and fauna assessment for a Calingiri study area. Great Northern Highway, Muchea to Wubin Upgrade Stage 2 Project*, Report prepared for Muchea to Wubin Integrated Project Team (Main Roads WA, Jacobs and Arup).

Pisces Conservation Ltd. 2010. Species Diversity and Richness IV. Hampshire, UK.

Purger, D., Lengyel, A., Kevey, B., Lendavi, G., Horváth, A., Tomic, Z., & Csiky, J. 2014. Numerical classification of oak forests on loess in Hungary, Croatia and Serbia. *Preslia*, vol. 87, pp. 47-66

R Core Team. 2019. R: A Language and Environment for Statistical Computing. Vienna, Austria, R Foundation for Statistical Computing.

Rix, M.G., Huey, J.A., Cooper, S.J.B., Austin, A.D., & Harvey, M.S. 2018. Conservation systematics of the shield-backed trapdoor spiders of the *nigrum*-group (Mygalomorphae, Idiopidae, *Idiosoma*): integrative taxonomy reviels a diverse and threatened fauna from south-western Australia. *ZooKeys*, vol. 756, pp. 1-121. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5956031/

Roberts, D.W. 2016. labdsv: Ordination and multivariate analysis for ecology. R package version 1.8.0. *R package version 1.8.0*

Rossel, R.V., Chen, C., Grundy, M.J., Searle, R., Clifford, D., & Campbell, P.H. 2015. The Australian three-dimensional soil grid: AustraliaΓÇÖs contribution to the GlobalSoilMap project. *Soil Research*, vol. 53, no. 8, pp. 845-864

Shepherd, D.P., Beeston, G.R., & Hopkins, A.J.M. 2002. Native Vegetation in Western Australia: Extent, Type and Status. *Resource Management Technical Report 249*

Simpson, K. & Day, N. 2004. *Field Guide to the Birds of Australia, 7th Edition* Camberwell, Victoria, Penguin Group.

Species and Communities Program Department of Biodiversity Conservation and Attractions. 2019. *Priority Ecological Communities for Western Australia Version 28; 17 January 2019*. Available from: https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Priority%20ecological%20communities%20list%20_Jan%202019.pdf.

Threatened Species Scientific Committee. 2015. *Approved Conservation Advice (including listing advice) for the Eucalypt Woodlands of the Western Australian Wheatbelt*. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/128-conservation-advice.pdf.

Threatened Species Scientific Committee. 2016. *Approved conservation advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community*. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=131&status=Endangered.

Tichý, L. 2002. JUICE, software for vegetation classification. *Journal of Vegetation Science*, vol. 13, pp. 451-453

Tichý, L., Chytrý, M., Hájek, M., Talbot, S.S., & Botta-Dukát, Z. 2010. OptimClass: using species-to-cluster fidelity to determine the optimal partition in classification of ecological communities. *Journal of Vegetation Science*, vol. 21, pp. 287-299

Tsakalos, J.L., Renton, M., Dobrowolski, M.D., Veneklaas, E.J., Macintyre, P.D., Broomfield, S.J., & Mucina, L. 2019. Composition and ecological drivers of the kwongan scrub and woodlands in the northern Swan Coastal Plain, Western Australia. *Austral Ecology*, vol. 44, pp. 906-916

Walker, J. & Hopkins, M. 1990, "Vegetation," in *Australian Soil and Land Survey. Field Handbook.*, 2nd edn, R. McDonald et al. eds., Inkata Press, Melbourne.

Weeds Australia. 2012. *Weeds of National Significance*. Available from: http://www.weeds.org.au/WoNS/.

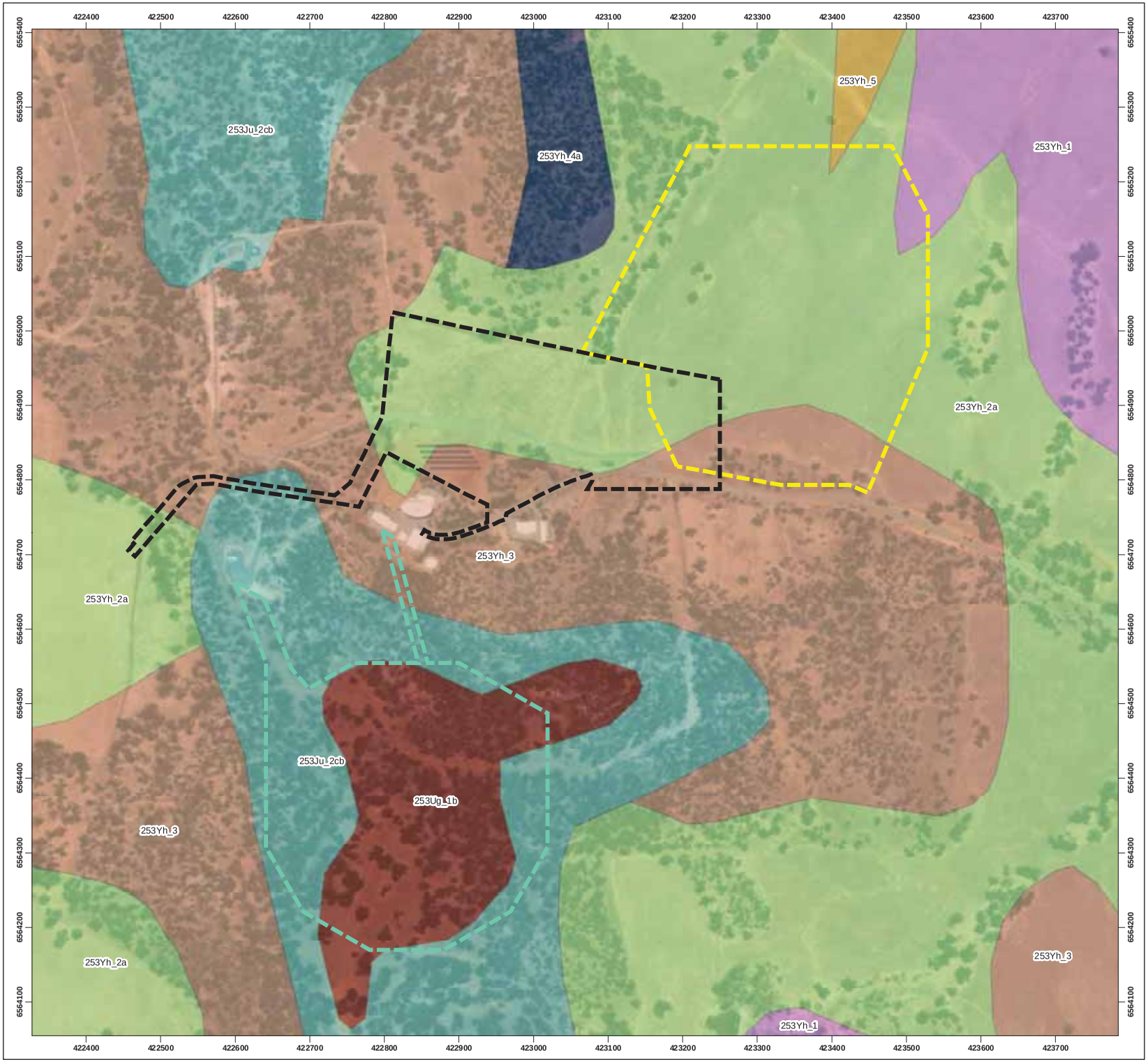
Western Australian Government. 2012. *Adapting to our changing climate*. Available from: https://www.der.wa.gov.au/images/documents/your-environment/climate-change/adapting-to-our-changing-climate-october-2012.pdf.

Western Australian Herbarium. 1998. *FloraBase - the Western Australian Flora. Department of Biodiversity, Conservation and Attractions*. Available from: https://florabase.dpaw.wa.gov.au/.

Western Australian Herbarium. 2020. *Descriptions by the Western Australian Herbarium, Department of Biodiversity, Conservation and Attractions*. Available from: https://florabase.dpaw.wa.gov.au/search/advanced.

Williams, K. & Mitchell, D. 2001, "Jarrah Forest 1 (JF1 - Northern Jarrah Forest)," in *A Biodiversity Audit of Western Australia's 53 Biographical Subregions in 2002*, N. L. McKenzie, J. E. May, & S. McKenna eds., Department of Conservation and Land Management, Perth, pp. 369-381.

MAPS



LEGEND

Survey Areas

- Infrastructure Area
- Option A
- Option B

Soil Land Systems (DPIRD, 2018)

- 253Ju: gently inclined to steep breakaway slope; red to brown loamy earths and duplexes, some loamy gravel, acid duplexes and stony
- 253Ug: Residual plateau, very gently inclined, small portions of Ug1a; loamy gravel, some shallow gravel and sandy gravels. Heath and mallee.
- 253Yh: fans, very gently inclined hillslopes and footslopes usually lower; loamy gravel, loamy earths, some loamy duplexes
- 253Yh: gently inclined hillcrests; rock outcrops, loams, loamy earths on rock
- 253Yh: older colluvial slopes, very gently to gently inclined hillslopes and rarely hillcrests; loamy gravel, shallow gravel over duricrust, some loamy earths and duplexes
- 253Yh: stripped very gently to gently inclined hillslopes and hillcrests, commonly includes small rises of rock such as quartzite; loamy earths, loamy stony soils, loamy gravel
- 253Yh: very gently inclined hillslopes and hillcrests; loamy and sandy earths, loamy gravel, shallow loamy gravel over duricrust

DATASOURCES:
BASEMAP: ESRI BASEMAP 2018
SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

ecoscape

SOIL LANDSCAPE SYSTEMS

DEEP SPACE FLORA, VEGETATION AND BLACK COCKATOO SURVEY

STRATHAM ENGINEERING CONSULTANCY SERVICE

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

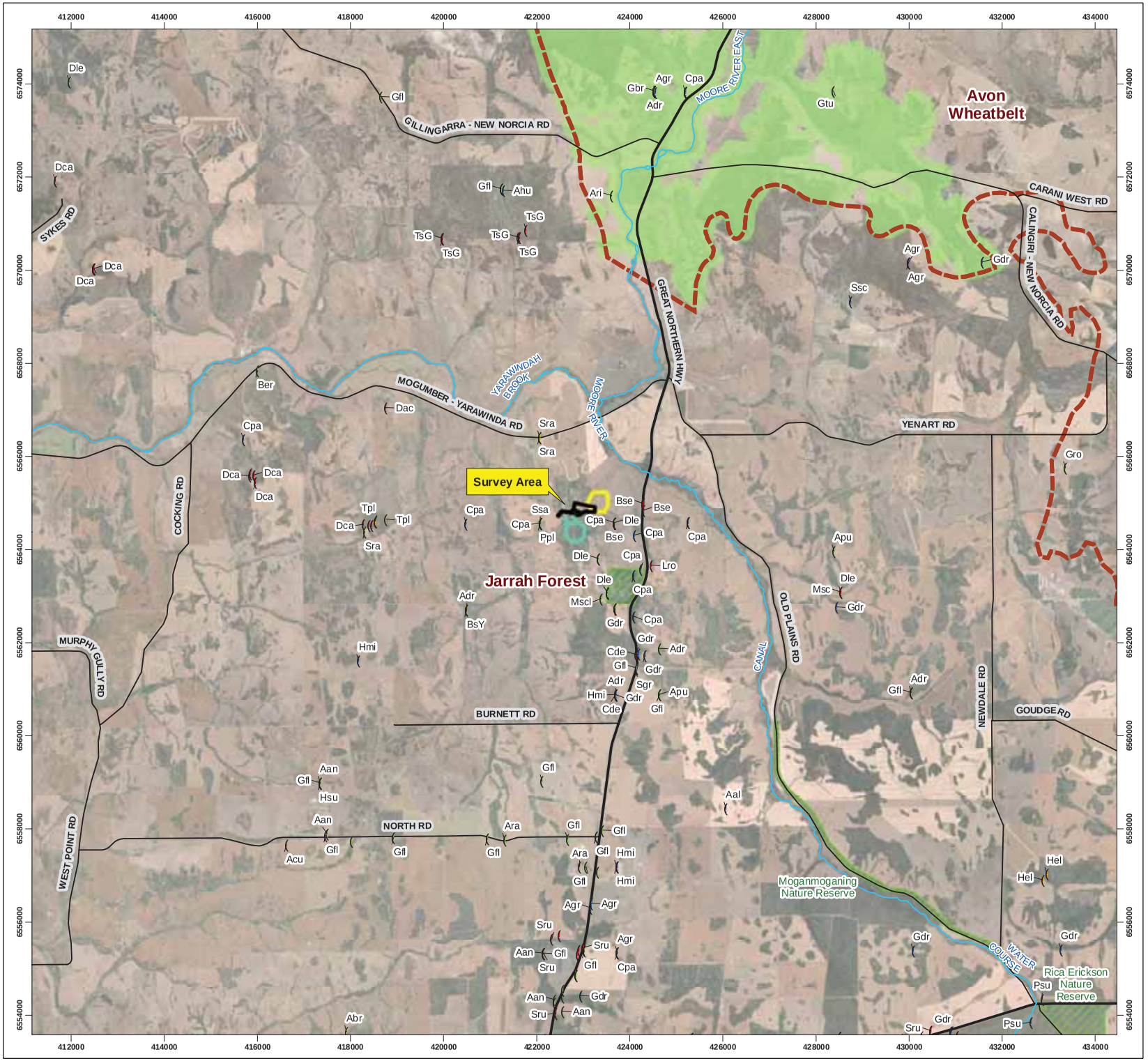
SCALE: 1:5,000 @ A3

0

PROJECT NO: 4502-19

REV	AUTHOR	APPROVED	DATE
SK	SMB	LJA	17/06/2020

MAP 1



LEGEND

Conservation Significant Flora (DBCA, 2020)

- Threatened
- Priority 1
- Priority 2
- Priority 3
- Priority 4
- Eucalypt woodlands of the WA Wheatbelt (DBCA, 2020)
- IBRA Subregions v7 (DotEE, 2018)
- DBCA Legislated Lands and Waters

Survey Areas

- Infrastructure Area
- Option A
- Option B

Label	Taxon	Status
Aal	*Acacia alata* var. *platyptera*	4
Aan	*Acacia anarthros*	3
Abr	*Acacia browniana* var. *glaucescens*	2
Acu	*Acacia cummingiana*	3
Adr	*Acacia drummondii* subsp. *affinis*	3
Apu	*Acacia pulchella* var. *reflexa* acuminate bracteole variant (R.J. Cumming 882)	3
Ari	*Acacia ridleyana*	3
Ara	*Allocasuarina ramosissima*	3
Ahu	*Anigozanthos humilis* subsp. *chrysanthus*	4
Agr	*Asterolasia grandiflora*	4
BsY	*Baeckea* sp. Youndegin Hill (A.S. George 15772)	1
Bse	*Banksia serratuloides* subsp. *serratuloides*	T
Ber	*Beaufortia eriocephala*	3
Cpa	*Calothamnus pachystachyus*	4
Cde	*Conospermum densiflorum* subsp. *unicephalatum*	T
Dac	*Darwinia acerosa*	T
Dca	*Darwinia carnea*	T
Dle	*Dielsiodoxa leucantha* subsp. *leucantha*	3
Gro	*Gastrolobium rotundifolium*	3
Gbr	*Grevillea bracteosa* subsp. *bracteosa*	T
Gdr	*Grevillea drummondii*	4
Gfl	*Grevillea florida*	3
Gtu	*Guichenotia tuberculata*	3
Hel	*Hibbertia elegans*	1
Hmi	*Hibbertia miniata*	4
Hsu	*Hibbertia subglabra*	3
Lce	*Lasiopetalum cenobium*	1
Lro	*Lasiopetalum rotundifolium*	T
Msc	*Melaleuca sciotostyla*	T
Mscl	*Melaleuca sclerophylla*	3
Psu	*Persoonia sulcata*	4
Pbi	*Petrophile biternata*	3
Ppl	*Petrophile plumosa*	3
Sru	*Spirogardnera rubescens*	T
Ssa	*Stylidium sacculatum*	3
Ssc	*Stylidium scabridum*	4
Sgr	*Synaphea grandis*	4
Sra	*Synaphea rangiferops*	2
Tpl	*Tetratheca plumosa*	1
TsG	*Thomasia* sp. Green Hill (S. Paust 1322)	T
Vin	*Verticordia insignis* subsp. *eomagis*	3

DATASOURCES:
BASEMAP: ESRI BASEMAP 2018
SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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DBCA DATABASE SEARCH RESULTS FLORA AND COMMUNITIES

DEEP SPACE FLORA, VEGETATION AND BLACK COCKATOO SURVEY

STRATHAM ENGINEERING CONSULTANCY SERVICE

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

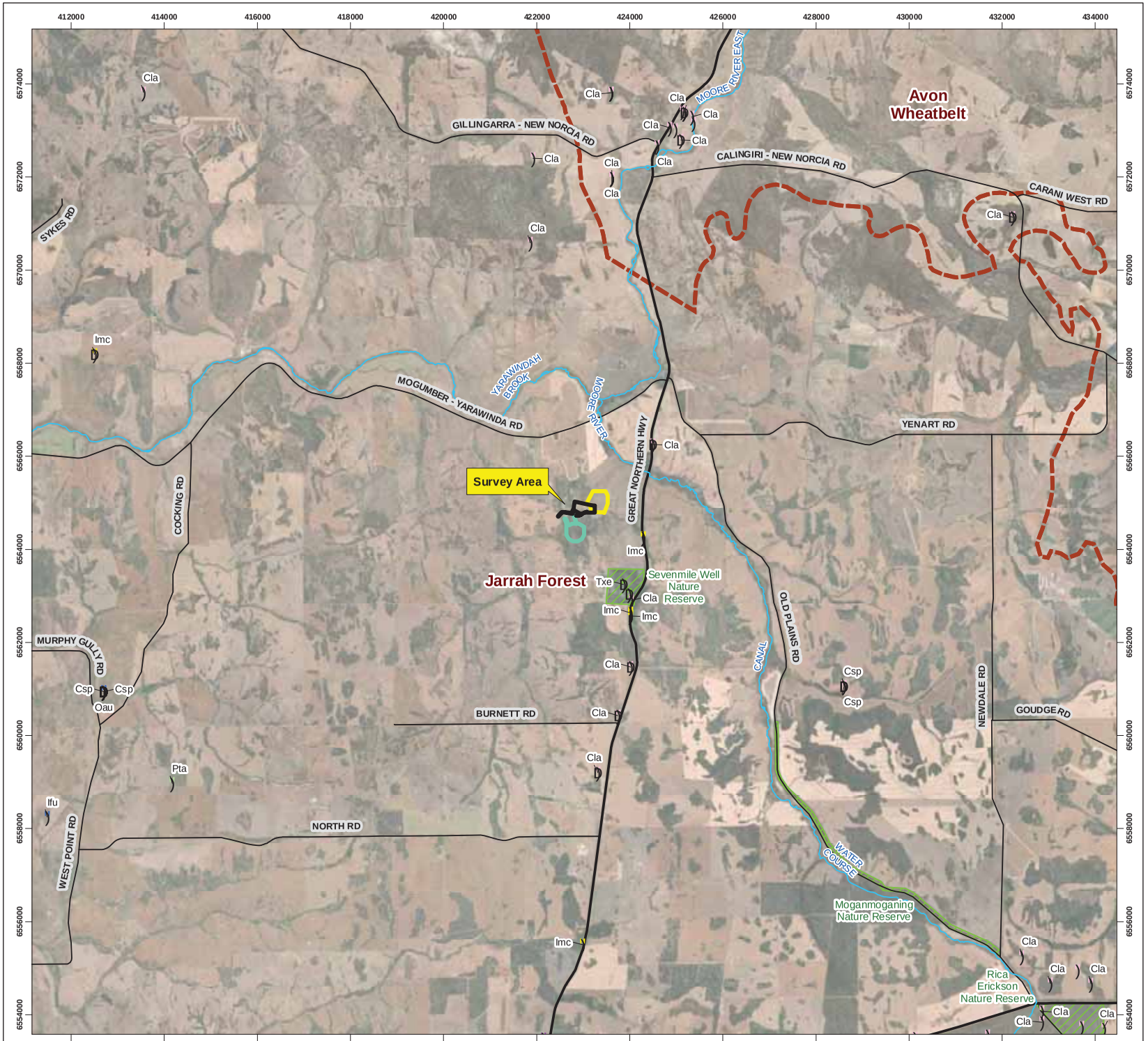
SCALE: 1:80,000 @ A3

0 1 2 3 km

PROJECT NO: 4502-19

REV	AUTHOR	APPROVED	DATE
SK	SMB	LJA	18/06/2020

MAP 2



LEGEND

Conservation Significant Fauna (DBCA, 2020)

- Endangered
- Vulnerable
- Conservation Dependent
- Priority 2
- Priority 3
- Priority 4
- Observation date > 20 years
- IBRA Subregions v7 (DotEE, 2018)
- DBCA Legislated Lands and Waters

Survey Areas

- Infrastructure Area
- Option A
- Option B

LABEL	TAXON	COMMON NAME	Status
Pta	*Phascogale tapoatafa wambenger*	South-western brush-tailed phascogale	CD
Imc	*Idiosoma mcclementsorum*	Julimar shield-backed trapdoor spider	P2
Csp	*Calyptorhynchus* sp. 'white-tailed black cockatoo'	White-tailed black cockatoo	EN
Oau	*Oxyura australis*	Blue-billed duck	P4
Cla	*Calyptorhynchus latirostris*	Carnaby's cockatoo	EN
Txe	*Throscodectes xederoides*	Mogumber bush cricket	P3
Ifu	*Isoodon fusciventer*	Quenda	P4

DATA SOURCES:
BASEMAP: ESRI BASEMAP 2018
SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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DBCA DATABASE SEARCH RESULTS FAUNA

DEEP SPACE FLORA, VEGETATION AND BLACK COCKATOO SURVEY

STRATHAM ENGINEERING CONSULTANCY SERVICE

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

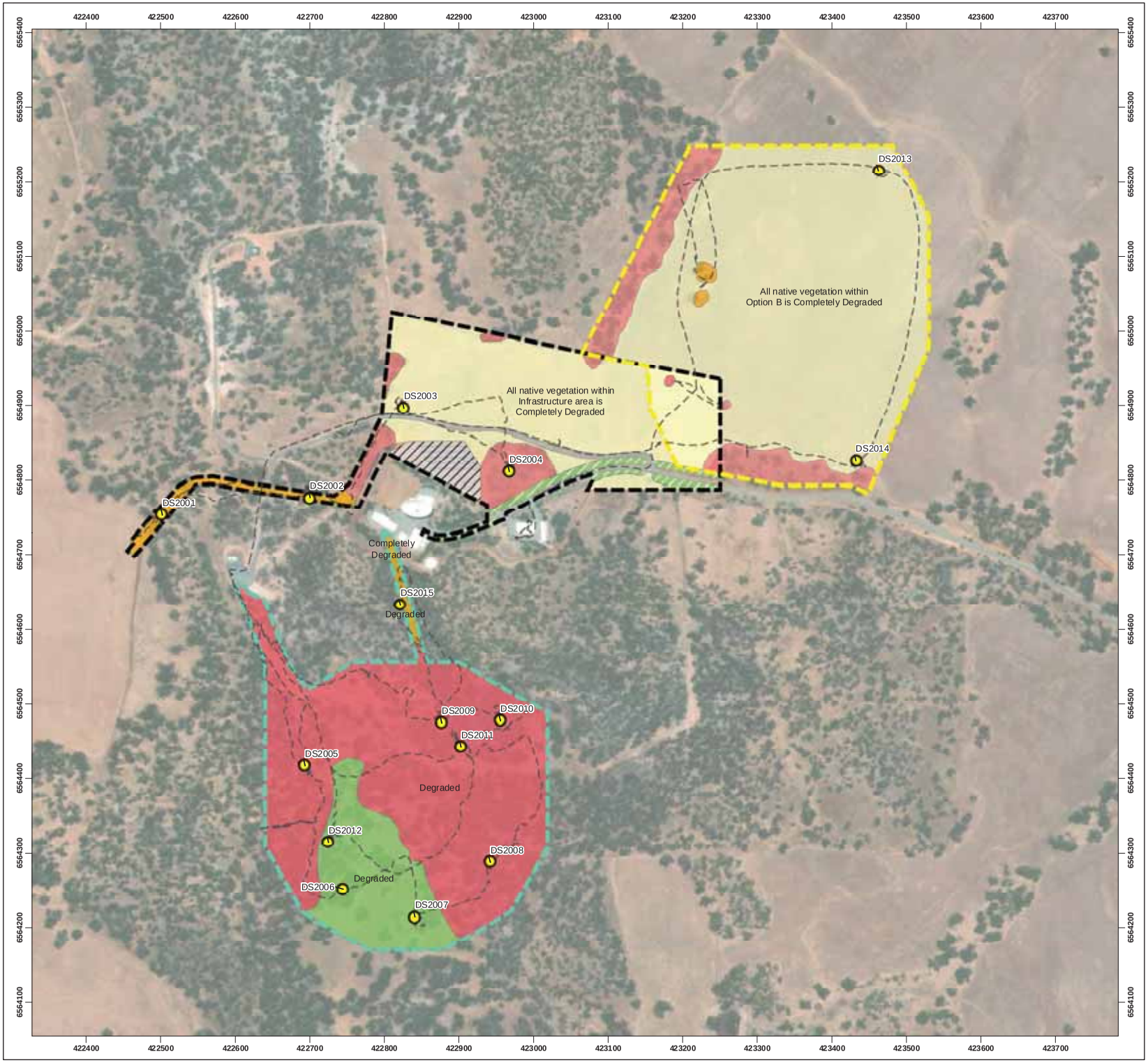
SCALE: 1:80,000 @ A3

0 1 2 3 km

PROJECT NO: 4502-19

REV	AUTHOR	APPROVED	DATE
SK	SMB	LJA	18/06/2020

MAP 3



LEGEND

- Quadrat Locations (Ecoscape, May 2020)
- Survey Tracks (Ecoscape, May 2020)

Survey Areas

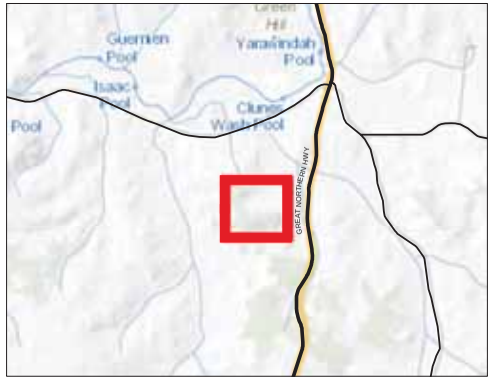
- Infrastructure Area
- Option A
- Option B

Vegetation Type

- Marri (CcW) - *Corymbia calophylla* woodland over *Avena barbata* low isolated grasses
- Wandoo (EwW) - *Eucalyptus wandoo* subsp. *wandoo* woodland over *Melaleuca marginata* and *Hibbertia hypericoides* subsp. *hypericoides* mid shrubland over *Avena barbata* low isolated grasses
- York Gum (ElW) - *Eucalyptus loxophleba* subsp. *loxophleba* woodland over *Avena barbata* low isolated grasses

Not native vegetation

- Triticum (TaG), *Triticum aestivum* and *Avena barbata* grassland (Paddock)
- Infrastructure
- Planted



DATASOURCES:
BASEMAP: ESRI BASEMAP 2018
SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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VEGETATION TYPE AND CONDITION

DEEP SPACE FLORA, VEGETATION AND BLACK COCKATOO SURVEY

STRATHAM ENGINEERING CONSULTANCY SERVICE

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

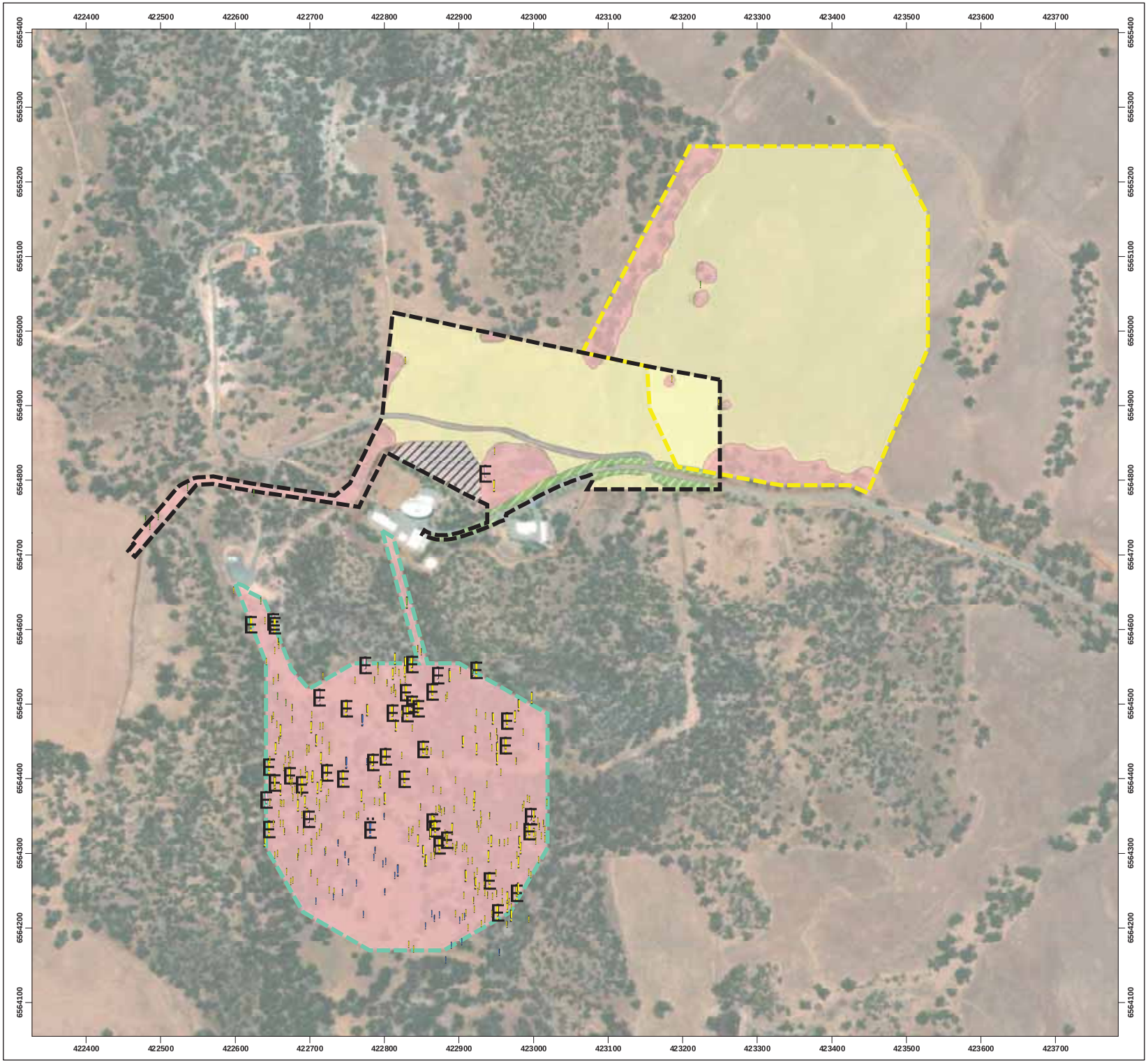
SCALE: 1:5,000 @ A3

0 0 50 100 150 200 m

PROJECT NO: 4502-19

REV	AUTHOR	APPROVED	DATE
SK	SMB	LJA	25/06/2020

MAP 4



LEGEND

Habitat Trees

Marri
- Class 3
- Class 4
- Class 5

Wandoo
- Class 3
- Class 4
- Class 5

York Gum
- Class 4
- Class 5

Dead trees
- Class 3
- Class 4

Survey Areas
- Infrastructure Area
- Option A
- Option B

Fauna Habitat
- Open Woodland
- Paddock

Not Habitat
- Infrastructure
- Planted

DATASOURCES:
BASEMAP: ESRI BASEMAP 2018
SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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FAUNA HABITAT

DEEP SPACE FLORA, VEGETATION AND BLACK COCKATOO SURVEY

STRATHAM ENGINEERING CONSULTANCY SERVICE

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:5,000 @ A3

0 50 100 150 200 m

PROJECT NO: 4502-19

REV	AUTHOR	APPROVED	DATE
SK	SMB	LJA	25/06/2020

MAP 5

APPENDIX ONE DEFINITIONS AND CRITERIA

Table 19: EPBC Act categories for flora and fauna

EPBC Act category	Definition
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CE)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	A native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long-term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Table 20: Conservation codes for Western Australian flora and fauna (DBCA 2019)

Conservation Codes for Western Australian Flora and Fauna	
Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such. **The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.** **Categories of Threatened, Extinct and Specially Protected fauna and flora are:**	
T	**Threatened species** Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act). Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna. Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.
CR	**Critically endangered species** Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*". Listed as critically endangered undersection 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.
EN	**Endangered species** Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.
VU	**Vulnerable species** Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*". Listed as vulnerable undersection 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.
Extinct species **Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.**	
EX	**Extinct species** Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.
EW	Extinct in the wild species Species that "*is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25of the BC Act). Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.
Specially protected species **Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.** **Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.**	

Conservation Codes for Western Australian Flora and Fauna	
MI	**Migratory species** Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
CD	**Species of special conservation interest (conservation dependent fauna)** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14of the BC Act). Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018.*
OS	**Other specially protected species** Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18of the BC Act). Published as other specially protected fauna under schedule 7of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018.*
P	**Priority species** Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.
1	**Priority 1: Poorly-known species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
2	**Priority 2: Poorly-known species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
3	**Priority 3: Poorly-known species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
4	**Priority 4: Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Conservation Codes for Western Australian Flora and Fauna

[1] **The definition of flora includes algae, fungi and lichens.**

[2] **Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).**

Table 21: DBCA definitions and criteria for TECs and PECs (DEC 2013)

Criteria	Definition
Threatened Ecological Communities	
Presumed Totally Destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): A. Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or B. All occurrences recorded within the last 50 years have since been destroyed
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i. geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii. modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii. there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; iii. there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C): A. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i. the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); ii. modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years); ii. there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes; iii. there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.

Criteria	Definition
	The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C): A. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. B. The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. C. The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.
Priority ecological communities	
Priority One	*Poorly known ecological communities* Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. 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 Two	*Poorly known ecological communities* Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, state forest, unallocated Crown land, water reserves, etc.) and not under imminent threat 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 Three	*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 of habitat destruction or degradation or; 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 may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, 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 Four	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. i. Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change These communities are usually represented on conservation lands. ii. Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. iii. Ecological communities that have been removed from the list of threatened communities during the past five years.

Criteria	Definition
Priority Five	*Conservation Dependent Ecological Communities* Ecological Communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Table 22: NVIS structural formation terminology, terrestrial vegetation (NVIS Technical Working Group 2017)

	Cover characteristics							
	Foliage cover *	70-100	30-70	10-30	<10	» 0 (scattered)	0-5 (clumped)	unknown
	Cover code	d	c	i	r	bi	bc	unknown
Growth Form	**Height Ranges (m)**	**Structural Formation Classes**						
tree, palm	<10,10-30, >30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	tree, palm
tree mallee	<3, <10, 10-30	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	tree mallee
shrub, cycad, grass-tree, tree-fern	<1,1-2,>2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrub, cycad, grass-tree, tree-fern
mallee shrub	<3, <10, 10-30	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrub
heath shrub	<1,1-2,>2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrub
chenopod shrub	<1,1-2,>2	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrub
samphire shrub	<0.5,>0.5	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrub
hummock grass	<2,>2	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grass
tussock grass	<0.5,>0.5	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grass
other grass	<0.5,>0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grass
sedge	<0.5,>0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedge
rush	<0.5,>0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rush
herb	<0.5,>0.5	closed herbland	herbland	open herbland	sparse herbland	isolated herbs	isolated clumps of herbs	herb
fern	<1,1-2,>2	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	fern
bryophyte	<0.5	closed bryophyte-land	bryophyte-land	open bryophyteland	sparse bryophyteland	isolated bryophytes	isolated clumps of bryophytes	bryophyte
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichen
vine	<10,10-30, >30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vine

Table 23: NVIS height classes (NVIS Technical Working Group 2017)

Height		Growth form				
Height Class	Height Range (m)	Tree, vine (M & U), palm (single-stemmed)	Shrub, heath shrub, chenopod shrub, ferns, samphire shrub, cycad, tree-fern, grass-tree, palm (multi-stemmed)	Tree mallee, mallee shrub	Tussock grass, hummock grass, other grass, sedge, rush, forbs, vine (G)	Bryophyte, lichen, seagrass, aquatic
8	>30	tall	NA	NA	NA	NA
7	10-30	mid	NA	tall	NA	NA
6	<10	low	NA	mid	NA	NA
5	<3	NA	NA	low	NA	NA
4	>2	NA	tall	NA	tall	NA
3	1-2	NA	mid	NA	tall	NA
2	0.5-1	NA	low	NA	mid	tall
1	<0.5	NA	low	NA	low	low

Source: (based on Walker & Hopkins 1990)

Table 24: Vegetation Condition Scale for the South West and Interzone Botanical Provinces (EPA 2016d)

Condition 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.

Table 25: Commonwealth Black Cockatoo Foraging Quality Scoring Tool (Commonwealth of Australia 2017)

Starting Score	Foraging habitat for Carnaby's Cockatoo	Foraging habitat for Baudin's Cockatoo	Foraging habitat for Forest Red-tailed Black cockatoo
10 (Very high quality)	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10
7 (High quality)	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as Banksia spp. (including Dryandra spp.), Hakea spp. and Grevillea spp., as well as native eucalypt woodland and forest that contains foraging species, including along roadsides. Does not include orchards, canola, or areas under a RFA	Native eucalypt woodlands and forest, and proteaceous woodland and heath, particularly marri, including along roadsides. Does not include orchards or areas under a RFA	Jarrah and marri woodlands and forest, and edges of karri forests, including wandoo and blackbutt, within the range of the subspecies, including along roadsides. Does not include areas under a RFA
5 (Quality)	Pine plantation or introduced eucalypts	Pine plantation or introduced eucalypts	Pine plantation or introduced eucalypts
1 (Low quality)	Individual foraging plants or small stand of foraging plants	Individual foraging plants or small stand of foraging plants	Individual foraging plants or small stand of foraging plants
Additions	**Context adjustor - attributes improving functionality of foraging habitat**	**Context adjustor - attributes improving functionality of foraging habitat**	**Context adjustor - attributes improving functionality of foraging habitat**
+3	Is within the Swan Coastal Plain (important foraging area).	Is within the known foraging area (see map).	Jarrah and/or marri show good recruitment (i.e. evidence of young trees).
+3	Contains trees with suitable nest hollows	Contains trees with suitable nest hollows	Contains trees with suitable nest hollows
+2	Primarily contains marri	Primarily contains marri	Primarily contains marri and/or jarrah
+2	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo)	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo)	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo)
+1	Is known to be a roosting site	Is known to be a roosting site	Is known to be a roosting site

Starting Score Subtractions	Foraging habitat for Carnaby's Cockatoo Context adjustor - attributes reducing functionality of foraging habitat	Foraging habitat for Baudin's Cockatoo Context adjustor - attributes reducing functionality of foraging habitat	Foraging habitat for Forest Red-tailed Black cockatoo Context adjustor - attributes reducing functionality of foraging habitat
-2	No clear evidence of feeding debris	No clear evidence of feeding debris	No clear evidence of feeding debris
-2	No other foraging habitat within 6 km	No other foraging habitat within 6 km	No other foraging habitat within 6 km
-1	Is > 12 km from a known breeding location	Is > 12 km from a known breeding location	Is > 12 km from a known breeding location
-1	Is > 12 km from a known roosting site	Is > 12 km from a known roosting site	Is > 12 km from a known roosting site
-1	Is > 2 km from a watering point	Is > 2 km from a watering point	Is > 2 km from a watering point
-1	Disease present (e.g. *Phytophthora cinnamomi* or marri canker	Disease present (e.g. *Phytophthora cinnamomi* or marri canker)	Disease present (e.g. *Phytophthora cinnamomi* or marri canker)

Table 26: Grading system for the assessment of potential nest trees for Black Cockatoos (Bamford 2016)

Class	Description of tree and hollows/activity
1	Active nest observed; adult (or immature) bird seen entering or emerging from hollow.
2	Hollow of suitable size and angle (i.e. near-vertical) visible with chew marks around entrance.
3	Potentially suitable hollow visible but no chew marks present; or potentially suitable hollow present (as suggested by structure of tree, such as large, vertical trunk broken off at a height of >10m).
4	Tree with large hollows or broken branches that might contain large hollows but hollows or potential hollows are not vertical or near-vertical; thus a tree with or likely to have hollows of sufficient size but not to have hollows of the angle preferred by Black Cockatoos.
5	Tree lacking large hollows or broken branches that might have large hollows; a tree with more or less intact branches and a spreading crown.

APPENDIX TWO DESKTOP ASSESSMENT RESULTS

Table 27: Flora database search results (DBCA database search), likelihood and flora survey records

Species name	Habitat (from *FloraBase*, WAH 1998-2020)	Distance from survey area	Likelihood of occurrence	
			Desktop	Post-survey
Threatened Flora				
Banksia serratuloides subsp. *serratuloides*	Loam or clay loam over laterite, sandy gravel, sometimes moist areas	2.5	Medium	Low
Conospermum densiflorum subsp. *unicephalatum*	Clay; low-lying areas	9.9	Low	Low
Darwinia acerosa	Clay, sandy loam. Emergent in freshwater: creeks, claypans.	10.1	Low	Low
Darwinia carnea	Skeletal soils over sandstone or laterite. Rocky hillslopes.	8.5	Medium	Low
Eleocharis keigheryi	Clay or sandy loam; emergent in freshwater	14.1	Low	Low
Eremophila glabra subsp. *chlorella*	Gravelly clayey sand. Hill.	13.8	Medium	Low
Eucalyptus pruiniramis	Orange clayey sand with lateritic pebbles. Scree slopes.	10.7	Medium	Low
Grevillea bracteosa subsp. *bracteosa*	Laterite, sand over laterite, loam.	11.7	Medium	Low
Lasiopetalum rotundifolium	Lateritic gravelly soils. Hill summits.	1.7	Medium	Low
Melaleuca sciotostyla	Rocky rises.	5.6	Medium	Low
Spirogardnera rubescens	Loam or clay loam over laterite, sandy gravel.	12.2	Medium	Low
Stylidium semaphorum	Clay soils. Low-lying areas.	14.2	Low	Low
Thomasia sp. Green Hill (S. Paust 1322)	Sand, loam, often moist soils. Granite outcrops, road verges.	6.5	Medium	Low
Priority 1				
Baeckea sp. Youndegin Hill (A.S. George 15772)	Yellow sand, red sandy clay, laterite. Along road verges.	2.8	Medium	Low
Daviesia localis	Sandy loam in the understory of Jarrah-Marri forest	13.3	Low	Low
Frankenia bracteata	Small, spreading shrub. Winter wet depressions.	11.4	Low	Low
Hibbertia elegans	Ironstone gravel	12.4	Medium	Low
Lasiopetalum cenobium	Insufficient information available.	9.0	Low	Low
Lechenaultia magnifica	Brown, grey, yellow or white sand, brown sandy loam, laterite. Slopes and flats.	13.3	Medium	Low
Synaphea panhesya	Gravelly loam & sandy gravel.	13.2	Medium	Low
Tetratheca plumosa	Upland position at the base of low lateritic breakaways in and on the edge of Eucalyptus wandoo/ Corymbia calophylla woodland	3.9	Medium	Low
Priority 2				
Acacia browniana var. *glaucescens*	Lateritic gravelly soils.	12.9	Medium	Low
Stylidium glabrifolium	Grey brown clay loam over laterite. Hillslopes or gullies. Wandoo woodland.	11.4	Medium	Low
Synaphea rangiferops	Sandy loam, gravel.	7.9	Medium	Low

Species name	Habitat (from *FloraBase*, WAH 1998-2020)	Distance from survey area	Likelihood of occurrence	
			Desktop	Post-survey
Verticordia serrata var. Udumung (D. Hunter & B. Yarran 941006)	Jarrah/Marri woodland; on sand	13.4	Low	Low
Priority 3				
Acacia anarthros	Lateritic gravelly soils. Slopes.	11.7	Medium	Low
Acacia cummingiana	Grey or yellow sand, lateritic gravel. Sandplains, lateritic breakaways.	9.1	Medium	Low
Acacia drummondii subsp. *affinis*	Lateritic gravelly soils.	8.1	Medium	Low
Acacia oncinophylla subsp. *oncinophylla*	Granitic soils.	13.1	Medium	Low
Acacia pulchella var. reflexa acuminate bracteole variant (R.J. Cumming 882)	Sandy loam or sandy clay over laterite. Woodland.	9.0	Medium	Low
Acacia ridleyana	Grey or yellow/brown sand, gravelly clay, granitic loam.	10.1	Medium	Low
Allocasuarina ramosissima	Lateritic soils, gravel.	7.3	Medium	Low
Banksia dallanneyi subsp. *pollosta*	Grey/yellow sand. Flats, lateritic rises.	13.9	Medium	Low
Beaufortia eriocephala	Lateritic sandy soils. Slopes.	9.1	Medium	Low
Daviesia debilior subsp. *sinuans*	Gravelly lateritic clay.	14.8	Medium	Low
Desmocladus biformis	Sand, sandy clay, lateritic soils. Dry sites.	13.4	Medium	Low
Dielsiodoxa leucantha subsp. *leucantha*	Open woodland. Breakaways, often with white soils and quartz and/or lateritic gravel.	4.5	Medium	Low
Gastrolobium rotundifolium	Heavy clay or loam soils, granite, sandstone, quartzite. Low rises, breakaways.	10.1	Medium	Low
Grevillea florida	Sand, sandy clay, gravel, laterite. Sandplain, slopes, road verges.	8.0	Medium	Low
Guichenotia tuberculata	Sand clay over laterite, sand.	9.9	Low	Low
Hibbertia subglabra	Sand over laterite on slopes and in gullies, in kwongan heath with scattered eucalypts.	7.7	Low	Low
Lasiopetalum caroliae	Mid-slope on yellow-brown, sandy loam and lateritic gravel soils in *Eucalyptus accedens* woodlands or in patches of scrubland or heath.	13.2	Low	Low
Melaleuca sclerophylla	Gravelly sand, clayey sand. Granite outcrops, rises.	5.4	Medium	Low
Petrophile biternata	Yellow/grey sand & gravel, laterite, quartzite soils. Lateritic ridges, plains.	6.7	Medium	Low
Petrophile plumosa	Red/brown laterite, loam. Sandplains, hills.	0.4	Low	Low
Stylidium cymiferum	Brown loam over laterite. Uplands, Wandoo woodland.	12.7	Medium	Low
Stylidium sacculatum	Clayey sand or sand. Lower slopes and flats. Open Wandoo or Marri woodland, Allocasuarina shrubland.	5.4	Low	Low
Styphelia allittii	Sand over gravel.	13.2	Low	Low
Verticordia insignis subsp. *eomagis*	Sandy soils over laterite. Sandplains, rocky rises.	9.0	Low	Low
Verticordia rutilastra	Sand & lateritic gravel. Hills.	10.9	Medium	Low

Species name	Habitat (from *FloraBase*, WAH 1998-2020)	Distance from survey area	Likelihood of occurrence	
			Desktop	Post-survey
Priority 4				
Acacia alata var. *platyptera*	Clay, gravelly sandy clay. Lateritic ridges, clay flats.	6.9	Low	Low
Anigozanthos humilis subsp. *chrysanthus*	Grey or yellow sand.	13.8	Low	Low
Asterolasia grandiflora	Lateritic soils, clay over granite. Breakaways, hills.	10.7	Medium	Low
Caladenia speciosa	White, grey or black sand.	13.2	Low	Low
Calothamnus pachystachyus	Lateritic soils, often gravelly. Ridges, road verges.	4.0	Medium	Low
Diuris recurva	Loam. Winter-wet areas.	12.4	Low	Low
Grevillea drummondii	Lateritic soils (sandy clay, gravel, loam, sand), sand over granite. Rocky hillsides, boulders, granite outcrops.	8.2	Medium	Low
Hibbertia miniata	Lateritic gravelly soils.	8.5	Medium	Low
Hydrocotyle lemnoides	Aquatic, floating annual, herb. Swamps.	14.1	Low	Low
Persoonia sulcata	Lateritic or granitic soils.	13.6	Medium	Low
Schoenus natans	Aquatic annual. Winter-wet depressions.	14.1	Medium	Low
Stylidium scabridum	Open woodland or heath.	7.0	Medium	Low
Synaphea grandis	Laterite.	5.5	Medium	Low
Verticordia paludosa	White/grey sand. Winter-wet flats.	14.0	Low	Low

Table 28: Combined vertebrate fauna database results and likelihood assessment

Species	Common name	Conservation status			DBCA database	PMST	Likelihood	
		EPBC Act	BC Act	DBCA			Desktop	Post-survey
Mammals								
Dasyurus geoffroii	Chuditch, western quoll	VU	VU	-	x	x	Very Low	Very Low
Isoodon fusciventer	Quenda, southwestern brown bandicoot	-	-	P4	x	-	Low	Low
Leporillus conditor	Greater stick-nest rat, wopilkara	-	-	CD	x	-	Very Low	Very Low
Macrotis lagotis	Bilby, dalgyte, ninu	VU	VU	-	x	-	Very Low	Very Low
Notamacropus eugenii derbianus	Tammar wallaby	-	-	P4	x	-	Very Low	Very Low
Notamacropus irma	Western brush wallaby	-	-	P4	x	-	Low	Low
Parantechinus apicalis	Dibbler	EN	EN	-	x	-	Very Low	Very Low
Phascogale tapoatafa wambenger	South-western brush-tailed phascogale, wambenger	-	-	CD	x	x	Very Low	Very Low
Phascogale calura	Red-tailed Phascogale	VU	EN	-	-	x	Very Low	Very Low
Birds								
Calidris acuminata	Sharp-tailed sandpiper	IA	IA	-	x	x	Very Low	Very Low
Calidris ferruginea	Curlew Sandpiper	CR	CR	-	x	x	Very Low	Very Low
Calidris melanotos	Pectoral Sandpiper	IA	IA	-	x	x	Very Low	Very Low
Calidris ruficollis	Red-necked stint	IA	IA	-	x		Very Low	Very Low
Calidris subminuta	Long-toed Stint	IA	IA	-	x		Very Low	Very Low
Calyptorhynchus banksii naso	**Forest red-tailed black cockatoo**	**VU**	**VU**	**-**	**x**		**Medium**	**Medium**
Calyptorhynchus latirostris	**Carnaby's cockatoo**	**EN**	**EN**	**-**	**x**	**x**	**High**	**High**
Falco peregrinus	**Peregrine falcon**	**-**	**-**	**OS**	**x**		**Medium**	**Medium**
Hydroprogne caspia	Caspian Tern	IA	IA	-	x		Very Low	Very Low
Leipoa ocellata	Malleefowl	VU	VU	-	x	x	Very Low	Very Low
Limosa limosa	Black-tailed godwit	IA	IA	-	x		Very Low	Very Low
Oxyura australis	Blue-billed duck	-	-	P4	x		Very Low	Very Low
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	CR	-	-	-	x	Very Low	Very Low
Pandion haliaetus	Osprey	IA		-		x	Very Low	Very Low
Plegadis falcinellus	Glossy ibis	IA	IA	-	x		Very Low	Very Low
Rostratula australis	Australian Painted Snipe	EN	-	-	-	x	Very Low	Very Low
Thinornis rubricollis	Hooded plover, hooded dotterel	-	-	P4	x		Very Low	Very Low
Tringa glareola	Wood sandpiper	IA	IA	-	x		Very Low	Very Low
Tringa nebularia	Common greenshank, greenshank	IA	IA	-	x		Very Low	Very Low
Reptiles								
Aspidites ramsayi (southwest subpop.)	Woma (southwest subpop.)	-	-	P1	x		Very Low	Very Low
Egernia stokesii badia	Western spiny-tailed skink	VU	VU	-	x		Very Low	Very Low
Pseudemydura umbrina	Western swamp tortoise	CR	CR	-	x		Very Low	Very Low
Fish								
Nannatherina balstoni	Balston's Pygmy Perch	VU		-		x	Very Low	Very Low

Species	Common name	Conservation status			DBCA database	PMST	Likelihood	
		EPBC Act	BC Act	DBCA			Desktop	Post-survey
Invertebrates								
Glacidorbis occidentalis	Jarrah forest freshwater snail	-	-	P3	x		Very Low	Very Low
Idiosoma dandaragan	Dandaragan Plateau shield-backed trapdoor spider	-	-	P2	x		unknown	unknown
Idiosoma mcclementsorum	Julimar shield-backed trapdoor spider	-	-	P2	x		High	Very Low
Idiosoma nigrum	Shield-backed trapdoor spider	EN	EN	-	x		Low	Low
Throscodectes xederoides	Mogumber bush cricket, Northern Throsco	-	-	P3	x		Low	Low
Westralunio carteri	Carter's freshwater mussel	VU	VU	-	x		Very Low	Very Low

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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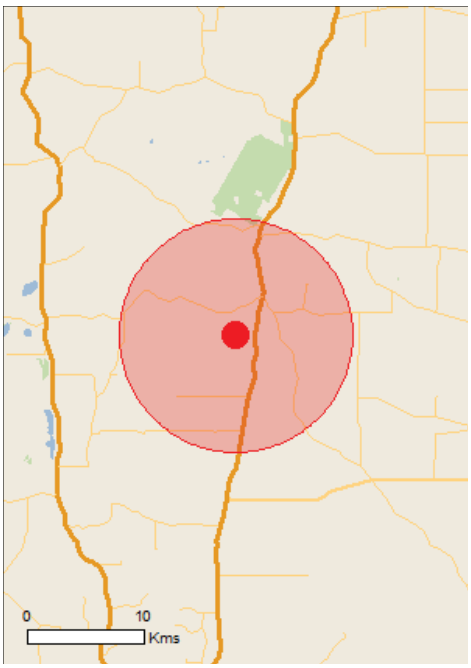

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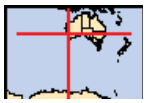

Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	28
Listed Migratory Species:	8

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	14
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	2
Regional Forest Agreements:	1
Invasive Species:	18
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

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

Name	Status	Type of Presence
Eucalypt Woodlands of the Western Australian Wheatbelt	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Fish		
Nannatherina balstoni Balston's Pygmy Perch [66698]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Phascogale calura Red-tailed Phascogale, Red-tailed Wambenger, Kenngoor [316]	Vulnerable	Species or species habitat likely to occur within area
Other		
Idiosoma nigrum Shield-backed Trapdoor Spider, Black Rugose Trapdoor Spider [66798]	Vulnerable	Species or species habitat known to occur within area
Plants		
Acacia cochlocarpa subsp. cochlocarpa Spiral-fruited Wattle [23877]	Endangered	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Acacia splendens Splendid Wattle, Dandaragan Wattle [81510]	Endangered	Species or species habitat may occur within area
Asterolasia nivea Bindoon Starbush [8225]	Vulnerable	Species or species habitat likely to occur within area
Banksia serratuloides subsp. serratuloides Southern Serrate Dryandra [82768]	Vulnerable	Species or species habitat known to occur within area
Conospermum densiflorum subsp. unicephalatum One-headed Smokebush [64871]	Endangered	Species or species habitat known to occur within area
Darwinia acerosa Fine-leaved Darwinia [9004]	Endangered	Species or species habitat known to occur within area
Darwinia carnea Mogumber Bell, Narrogin Bell [9736]	Endangered	Species or species habitat likely to occur within area
Diplolaena andrewsii [6601]	Endangered	Species or species habitat may occur within area
Eremophila scaberula Rough Emu Bush [16729]	Endangered	Species or species habitat likely to occur within area
Eucalyptus pruiniramis Midlands Gum, Jingymia Gum [56403]	Endangered	Species or species habitat likely to occur within area
Gastrolobium hamulosum Hook-point Poison [9212]	Endangered	Species or species habitat likely to occur within area
Grevillea pythara Pythara Grevillea [64525]	Endangered	Species or species habitat may occur within area
Hemiandra gardneri Red Snakebush [7945]	Endangered	Species or species habitat may occur within area
Melaleuca sciotostyla Wongan Melaleuca [24324]	Endangered	Species or species habitat known to occur within area
Spirogardnera rubescens Spiral Bush [15667]	Endangered	Species or species habitat known to occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area
Thomasia sp. Green Hill (S.Paust 1322) Green Hill Thomasia [64542]	Endangered	Species or species habitat likely to occur within area
Verticordia staminosa subsp. staminosa Wongan Featherflower [55825]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Moganmoganing	WA
Sevenmile Well	WA

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Carrichtera annua Ward's Weed [9511]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

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

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

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

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

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

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

Coordinates

-31.04846 116.19119

Acknowledgements

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

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

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

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

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APPENDIX THREE FIELD SURVEY RESULTS

Table 29: Flora inventory (site x species)

Family	Species	Naturalised	Infrastructure				Option A										Option B	
			DS2001	DS2002	DS2003	DS2004	DS2005	DS2006	DS2007	DS2008	DS2009	DS2010	DS2011	DS2012	DS2015	Opp	DS2013	DS2014
Amaranthaceae	*Ptilotus drummondii*						X											
Asteraceae	*Arctotheca calendula*	*	X	X	X	X		X									X	
Brassicaceae	*Brassica tournefortii*	*															X	
Chenopodiaceae	*Dysphania pumilio*		X		X												X	
Dilleniaceae	*Hibbertia commutata*							X		X				X				
	Hibbertia hibbertioides var. *hibbertioides*															X		
	Hibbertia hypericoides subsp. *hypericoides*										X	X	X					
	Hibbertia lasiopus															X		
Dioscoreaceae	*Dioscorea hastifolia*							X										
Fabaceae	*Acacia shuttleworthii*						X											
	Trifolium subterraneum	*		X	X	X		X						X			X	X
Geraniaceae	*Erodium botrys*	*			X				X								X	
Hemerocallidaceae	*Dianella revoluta*									X								
Lauraceae	*Cassytha ?pomiformis*										X	X						
Loranthaceae	*Amyema miquelii*													X				
Myrtaceae	*Corymbia calophylla*							X	X					X				
	Eucalyptus loxophleba subsp. *loxophleba*		X	X								X			X			
	Eucalyptus wandoo subsp. *wandoo*					X	X			X	X	X	X					
	Melaleuca concreta											X						
	Melaleuca marginata										X	X	X					
Poaceae	*Austrostipa elegantissima*												X					
	Avena barbata	*	X	X	X	X	X	X	X	X		X	X	X	X			X
	Eragrostis curvula	*	X												X			
	Poaceae sp.										X							
	Triticum aestivum	*			X												X	X

Family	Species	Naturalised	Infrastructure				Option A										Option B	
			DS2001	DS2002	DS2003	DS2004	DS2005	DS2006	DS2007	DS2008	DS2009	DS2010	DS2011	DS2012	DS2015	Opp	DS2013	DS2014
Rhamnaceae	*Trymalium odoratissimum* subsp. *odoratissimum*						X											
Solanaceae	*Solanum nigrum*	*							X									
Xanthorrhoeaceae	*Xanthorrhoea* sp.							X		X								

Table 30: Recorded fauna species

Species	Common name	EPBC ranking	BC Act /DBCA ranking
Native Mammals			
Macropus fuliginosus	Western Grey Kangaroo	-	-
Tachyglossus aculeatus	Short-beaked Echidna	-	-
Introduced Mammals			
Bos taurus	European Cattle	-	-
Oryctolagus cuniculus	Rabbit	-	-
Ovis aries	Sheep	-	-
Vulpes vulpes	Red Fox	-	-
Birds			
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	-	-
Cacatua roseicapilla	Galah	-	-
Corvus coronoides	Australian Raven	-	-
Cracticus tibicen	Australian Magpie	-	-
Dacelo novaeguineae	Laughing Kookaburra	-	-
Petroica goodenovii	Red-capped Robin	-	-
Platycercus zonarius	Australian Ringneck	-	-
Rhipidura albiscapa	Grey Fantail	-	-
Rhipidura leucophrys	Willie Wagtail	-	-
Smicrornis brevirostris	Weebill	-	-
Zosterops lateralis	Grey-breasted White-eye	-	-
Reptiles			
Hesperoedura reticulata	Reticulated Velvet Gecko	-	-

APPENDIX FOUR FLORISTIC QUADRAT DATA

DS2001

Staff JLT **Date** 26/05/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location 8.5 km South of New Norcia along the Great Northern Hwy

MGA Zone 50 422502 **mE** 6564753 **mN** **Lat.** -31.0484 **Long.** 116.1878

Habitat Lower-Slope

Aspect SW **Slope** Gentle

Soil Type Brown clay loam with granite scree

Rock Type Granite

Loose Rock 10-20 % cover; 60-200 mm in size **Litter** 60 % cover ; <1 cm in depth

Bare ground 1 % cover **Weeds** 60 % cover

Vegetation U+ ^*Eucalyptus loxophleba* subsp. *loxophleba*\^tree\7\i;G ^*Avena barbata*\^other grass\1\i

Veg. Condition Completely Degraded

Disturbance

Fire Age >10 years

Notes No lower stratum, York gum regrowth

Species	WA Cons.	Height (m)	Cover (%)	Count
**Arctotheca calendula*		.05	<1	
**Avena barbata*		.25	12	
Dysphania pumilio			<1	
**Eragrostis curvula*		0.2	<1	
Eucalyptus loxophleba subsp. *loxophleba*		20	23	

DS2002

Staff JLT **Date** 26/05/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location 8.5 km South of New Norcia along the Great Northern Hwy

MGA Zone 50 422701 **mE** 6564776 **mN** **Lat.** -31.0482 **Long.** 116.1899

Habitat Mid-Slope

Aspect NE **Slope** Gentle

Soil Type Brown clay loam

Rock Type Granite

Loose Rock 2-10 % cover; 2-6 mm in size **Litter** 70 % cover ; 1-2 cm in depth

Bare ground 3 % cover **Weeds** 70 % cover

Vegetation U+ ^*Eucalyptus loxophleba* subsp. *loxophleba*\^tree mallee\7\i;G ^*Avena barbata*\^other grass\1\c

Veg. Condition Completely Degraded

Disturbance

Fire Age >10 years

Notes Signs of cattle and rabbits

Species	WA Cons.	Height (m)	Cover (%)	Count
**Arctotheca calendula*			<1	
**Avena barbata*		.3	30	
Eucalyptus loxophleba subsp. *loxophleba*		20	30	
**Trifolium subterraneum*		.25	<1	

DS2003

Staff JLT **Date** 26/05/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location 8.5 km South of New Norcia along the Great Northern Hwy

MGA Zone 50 422826 **mE** 6564896 **mN** **Lat.** -31.0471 **Long.** 116.1912

Habitat Flat

Aspect N/A **Slope** N/A

Soil Type Brown clay

Rock Type Mixed

Loose Rock 2-10 % cover; 2-6 mm in size **Litter** 60 % cover ; 1-2 cm in depth

Bare ground 20 % cover **Weeds** 55 % cover

Vegetation G+ ^*Avena barbata*\^other grass\1\d

Veg. Condition Completely Degraded

Disturbance

Fire Age <1 year

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Arctotheca calendula*			<1	
**Avena barbata*		.1	5	
Dysphania pumilio			<1	
**Erodium botrys*			<1	
**Trifolium subterraneum*			<1	

**Triticum aestivum*	.2	30

DS2004

Staff JLT **Date** 26/05/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location 8.5 km South of New Norcia along the Great Northern Hwy

MGA Zone 50 422967 **mE** 6564811 **mN** **Lat.** -31.0479 **Long.** 116.1927

Habitat Lower-Slope

Aspect E **Slope** Very Gentle

Soil Type Brown silty clay

Rock Type Granite

Loose Rock <2 % cover; 20-60 mm in size **Litter** 70 % cover ; 1-2 cm in depth

Bare ground 2 % cover **Weeds** 60 % cover

Vegetation U+ ^*Eucalyptus wandoo* subsp. *wandoo*\^tree mallee\6\i;G ^*Avena barbata*\^other grass\1\r

Veg. Condition Completely Degraded

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Arctotheca calendula*		.05	<1	
**Avena barbata*		.2	10	
Eucalyptus wandoo subsp. *wandoo*		10	26	
**Trifolium subterraneum*		.05	<1	

DS2005

Staff JLT **Date** 26/05/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location 8.5 km South of New Norcia along the Great Northern Hwy

MGA Zone 50 422694 **mE** 6564417 **mN** **Lat.** -31.0514 **Long.** 116.1898

Habitat Upper-Slope

Aspect E **Slope** Gentle

Soil Type Orange clay

Rock Type Laterite outcrop and scree

Loose Rock 20-50 % cover; 2-6 mm in size **Litter** 70 % cover ; 1-2 cm in depth

Bare ground 30 % cover **Weeds** 5 % cover

Vegetation U+ ^*Eucalyptus wandoo* subsp. *wandoo*\^tree\7\c;G ^,*Acacia shuttleworthii*\^,shrub\1\r

Veg. Condition Good

Disturbance

Fire Age >10 years

Notes Signs of grazing

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia shuttleworthii		.3	1	
**Avena barbata*		.25	5	
Eucalyptus wandoo subsp. *wandoo*		28	35	
Ptilotus drummondii		.2	<1	
Trymalium odoratissimum subsp. *odoratissimum*		.6	<1	

DS2006

Staff JLT **Date** 26/05/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location 8.5 km South of New Norcia along the Great Northern Hwy

MGA Zone 50 422745 **mE** 6564251 **mN** **Lat.** -31.0529 **Long.** 116.1903

Habitat Crest

Aspect E **Slope** Very Gentle

Soil Type Orange clay

Rock Type Laterite outcropping

Loose Rock 50-90 % cover; 2-6 mm in size **Litter** 80 % cover ; 2-3 cm in depth

Bare ground <1 % cover **Weeds** 3 % cover

Vegetation U+ ^*Corymbia calophylla*\^tree\7\i;

Veg. Condition Good

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Arctotheca calendula*			<1	
**Avena barbata*		.2	<1	
Corymbia calophylla		25	24	
Dioscorea hastifolia		.2	<1	
Hibbertia commutata		.3	<1	

**Trifolium subterraneum*	.2	<1
Xanthorrhoea sp.	.4	<1

DS2007

Staff JLT **Date** 26/05/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location 8.5 km South of New Norcia along the Great Northern Hwy

MGA Zone 50 422841 **mE** 6564214 **mN** **Lat.** -31.0533 **Long.** 116.1913

Habitat Flat

Aspect NE **Slope** Very Gentle

Soil Type Orange clay

Rock Type Laterite

Loose Rock 20-50 % cover; 2-6 mm in size **Litter** 70 % cover ; 2-3 cm in depth

Bare ground 2 % cover **Weeds** 2 % cover

Vegetation U+ ^*Corymbia calophylla*\^tree\7\i;G ^*Avena barbata*\^other grass\1\bi

Veg. Condition Good

Disturbance

Fire Age >10 years

Notes Winter bulb with purple flowers

Species	WA Cons.	Height (m)	Cover (%)	Count
**Avena barbata*		.2	1	
Corymbia calophylla		21	23	
**Erodium botrys*		.05	<1	
**Solanum nigrum*		.5	<1	

DS2008

Staff JLT **Date** 26/05/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location 8.5 km South of New Norcia along the Great Northern Hwy

MGA Zone 50 422942 **mE** 6564287 **mN** **Lat.** -31.0526 **Long.** 116.1924

Habitat Crest

Aspect NE **Slope** Very Gentle

Soil Type Orange clay

Rock Type Laterite

Loose Rock 10-20 % cover; 2-6 mm in size **Litter** 60 % cover ; 2-3 cm in depth

Bare ground 30 % cover **Weeds** 1 % cover

Vegetation U+ ^*Eucalyptus wandoo* subsp. *wandoo*\^tree\7\c;

Veg. Condition Good

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Avena barbata*		.1	<1	
Dianella revoluta		.4	<1	
Eucalyptus wandoo subsp. *wandoo*		23	30	
Hibbertia commutata		.4	.5	
Xanthorrhoea sp.		.4	<1	

DS2009

Staff JLT **Date** 26/05/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location 8.5 km South of New Norcia along the Great Northern Hwy

MGA Zone 50 422877 **mE** 6564474 **mN** **Lat.** -31.0509 **Long.** 116.1917

Habitat Mid-Slope

Aspect SW **Slope** Gentle

Soil Type Orange clay

Rock Type Laterite

Loose Rock 20-50 % cover; 2-6 mm in size **Litter** 20 % cover ; <1 cm in depth

Bare ground 35 % cover **Weeds** <1 % cover

Vegetation U+ ^*Eucalyptus wandoo* subsp. *wandoo*\^tree\7\i;M ^*Melaleuca marginata*,^*Hibbertia hypericoides* subsp. *hypericoides*\^shrub\3\c;

Veg. Condition Very Good

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Cassytha ?pomiformis			<1	
Eucalyptus wandoo subsp. *wandoo*		18	23	
Hibbertia hypericoides subsp. *hypericoides*		1.2	3	
Melaleuca marginata		1.5	30	
Poaceae sp.		.2	<1	

DS2010

Staff JLT **Date** 26/05/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location 8.5 km South of New Norcia along the Great Northern Hwy

MGA Zone 50 422956 **mE** 6564477 **mN** **Lat.** -31.0509 **Long.** 116.1926

Habitat Mid-Slope

Aspect SW **Slope** Moderate

Soil Type Orange clay

Rock Type Laterite

Loose Rock 20-50 % cover; 2-6 mm in size **Litter** 5 % cover ; <1 cm in depth

Bare ground 20 % cover **Weeds** <1 % cover

Vegetation U+ ^*Eucalyptus wandoo* subsp. *wandoo*,^*Eucalyptus loxophleba* subsp. *loxophleba*\^tree\7\i;M ^^*Melaleuca marginata*,*Hibbertia hypericoides* subsp. *hypericoides*,*Melaleuca concreta*\^shrub\3\c;

Veg. Condition Very Good

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Avena barbata*		.2	0.1	
Cassytha ?pomiformis		1	0.5	
Eucalyptus loxophleba subsp. *loxophleba*		20	1	
Eucalyptus wandoo subsp. *wandoo*		18	23	

Hibbertia hypericoides subsp. *hypericoides*	1.2	8
Melaleuca concreta	1.8	2
Melaleuca marginata	1.5	18

DS2011

Staff JLT **Date** 26/05/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location 8.5 km South of New Norcia along the Great Northern Hwy

MGA Zone 50 422903 **mE** 6564442 **mN** **Lat.** -31.0512 **Long.** 116.1920

Habitat Upper-Slope

Aspect N **Slope** Gentle

Soil Type Orange clay

Rock Type Laterite

Loose Rock 20-50 % cover; 2-6 mm in size **Litter** 5 % cover ; <1 cm in depth

Bare ground 40 % cover **Weeds** <1 % cover

Vegetation U+ ^*Eucalyptus wandoo* subsp. *wandoo*\^tree\7\i;M ^*Melaleuca marginata*,^,*Hibbertia hypericoides* subsp. *hypericoides*\^shrub\3\c;G ^*Avena barbata*\^other grass\1\bi

Veg. Condition Very Good

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Austrostipa elegantissima		.4	<1	
**Avena barbata*		0.2	1	
Eucalyptus wandoo subsp. *wandoo*		18	16	
Hibbertia hypericoides subsp. *hypericoides*		1	1.5	
Melaleuca marginata		1.2	42	

DS2012

Staff JLT **Date** 26/05/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location 8.5 km South of New Norcia along the Great Northern Hwy

MGA Zone 50 422725 **mE** 6564314 **mN** **Lat.** -31.0524 **Long.** 116.1901

Habitat Crest

Aspect N/A **Slope** N/A

Soil Type Orange clay

Rock Type Laterite

Loose Rock 2-10 % cover; 2-6 mm in size **Litter** 70 % cover ; 2-3 cm in depth

Bare ground 30 % cover **Weeds** 1 % cover

Vegetation U+ ^*Corymbia calophylla*\^tree\7\i;G ^*Avena barbata*\^other grass\1\bi

Veg. Condition Degraded

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Amyema miquelii		20	<1	
**Avena barbata*		.25	1	
Corymbia calophylla		21	20	
Hibbertia commutata			0.5	
**Trifolium subterraneum*		.05	<1	

DS2013

Staff JLT **Date** 26/05/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location 8.5 km South of New Norcia along the Great Northern Hwy

MGA Zone 50 423462 **mE** 6565215 **mN** **Lat.** -31.0443 **Long.** 116.1979

Habitat Flat

Aspect NW **Slope** Gentle

Soil Type Brown clay loam

Rock Type Laterite

Loose Rock 2-10 % cover; 2-6 mm in size **Litter** 55 % cover ; <1 cm in depth

Bare ground 45 % cover **Weeds** 55 % cover

Vegetation G+ ^*Triticum aestivum*\^other grass\1\c

Veg. Condition Completely Degraded

Disturbance

Fire Age <1 year

Notes Harvested annually

Species	WA Cons.	Height (m)	Cover (%)	Count
**Arctotheca calendula*		.05	<1	
**Brassica tournefortii*		.25	<1	
Dysphania pumilio		.05	<1	
**Erodium botrys*		.05	<1	
**Trifolium subterraneum*		.05	<1	

**Triticum aestivum*	.2	40

DS2014

Staff JLT **Date** 26/05/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location 8.5 km South of New Norcia along the Great Northern Hwy

MGA Zone 50 423432 **mE** 6564826 **mN** **Lat.** -31.0478 **Long.** 116.1976

Habitat Flat

Aspect N **Slope** Very Gentle

Soil Type Brow clay

Rock Type Laterite

Loose Rock 2-10 % cover; 2-6 mm in size **Litter** 40 % cover ; <1 cm in depth

Bare ground 70 % cover **Weeds** 30 % cover

Vegetation G+ ^*Triticum aestivum*\^other grass\1\i

Veg. Condition Completely Degraded

Disturbance

Fire Age <1 year

Notes Harvesting instead of fire

Species	WA Cons.	Height (m)	Cover (%)	Count
**Avena barbata*		0.1	<1	
**Trifolium subterraneum*		0.15	<1	
**Triticum aestivum*		.2	15	

DS2015

Staff JLT **Date** 19/06/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location Very minor creek

MGA Zone 50 422821 **mE** 6564633 **mN** **Lat.** **Long.**

Habitat

Aspect NW **Slope** Very Gentle

Soil Type Brown Clay

Rock Type Granite

Loose Rock <2 % cover; 2-6 mm in size **Litter** 20 % cover ; <1 cm in depth

Bare ground 70 % cover **Weeds** 1 % cover

Vegetation U+ ^*Eucalyptus loxophleba* subsp. *loxophleba*\^tree\7\i;G ^*Avena barbata*\^other grass\1\i

Veg. Condition Completely Degraded

Disturbance

Fire Age >5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Avena barbata*		0.15	12	
**Eragrostis curvula*		0.2	<1	
Eucalyptus loxophleba subsp. *loxophleba*		10	25	

APPENDIX FIVE FLORISTIC ANALYSIS DENDROGRAM

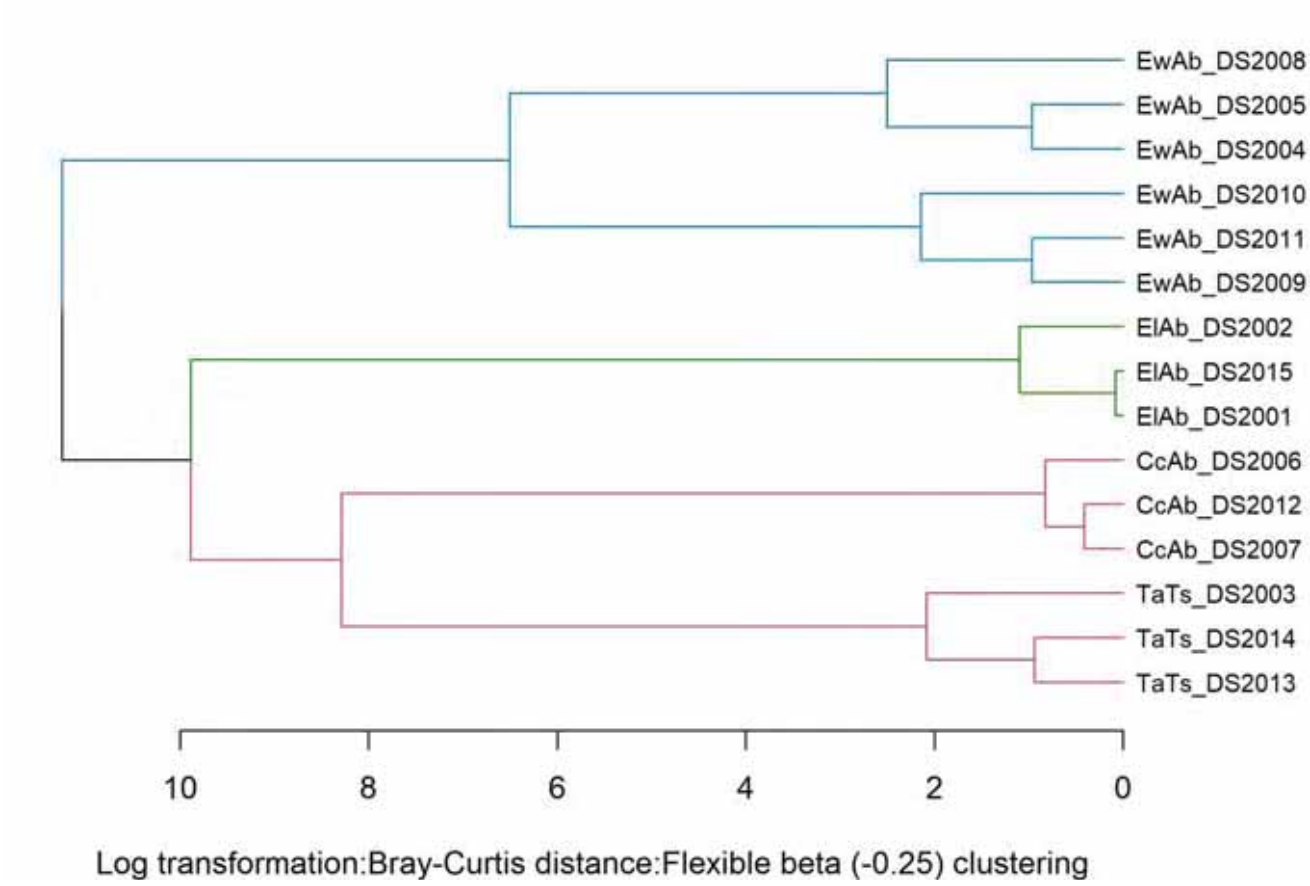

Figure 4: Floristic dendrogram. Note that the vegetation type codes indicated are preliminary.

OptimClass identified flexible beta clustering (β = -0.25) on a resemblance generated by Bray-Curtis distance on a logarithmically transformed cover abundances as producing the most robust and ecologically meaningful clusters.

Note that the vegetation types indicated in **Figure 4** uses preliminary codes. The equivalent codes used elsewhere in the report are:

- **ElAb = ElW**: *Eucalyptus loxophleba* subsp. *loxophleba* woodland over **Avena barbata* low isolated grasses, on the lower slopes
- **TaTs = TaG**: **Triticum aestivum* and **Avena barbata* grassland (paddock; not native vegetation)
- **EwAb = EwW**: *Eucalyptus wandoo* subsp. *wandoo* woodland over *Melaleuca marginata* and *Hibbertia hypericoides* subsp. *hypericoides* mid shrubland over **Avena barbata* low isolated grasses, on the lateritic upland
- **CcAb = CcW**: *Corymbia calophylla* woodland over **Avena barbata* low isolated grasses, on the lateritic upland.

APPENDIX SIX FAUNA SURVEY LOCATIONS

Table 31: Fauna sites (GDA94, Zone 50)

Site Name	Site	Site Type	Easting	Northing
DSHA2001	Infrastructure area	Fauna: Habitat Assessment	422786.794	6564857.51
DSHA2002	Option A	Fauna: Habitat Assessment	422656.842	6564566.945
DSHA2003	Option A	Fauna: Habitat Assessment	422913.686	6564533.238
DSHA2004	Option A	Fauna: Habitat Assessment	422937.425	6564378.793
DSHA2005	Infrastructure area	Fauna: Habitat Assessment	422816.371	6564963.132

APPENDIX SEVEN BLACK COCKATOO TREE PHOTOS


Tree_ 4 Wandoo 5 No Hollows


Tree_ 5 Wandoo 5 No Hollows


Tree_ 6 Wandoo 5 No Hollows


_ 8 Wandoo 4 Hollows not suit


9 Wandoo 3 Hollow no chew


Tree_ 10 Wandoo 5 No Hollow


11 Wandoo 3 Hollow no chew


Tree_ 13 Wandoo 5 No Hollow


Tree_ 15 Wandoo 5 No Hollow


Tree_ 16 Wandoo 5 No Hollow


Tree_ 17 Wandoo 5 No Hollow


Tree_ 19 Wandoo 5 No Hollow


Tree_ 20 Wandoo 5 No Hollow


Tree_ 22 Wandoo 5 No Hollow


Tree_ 23 Wandoo 5 No Hollow


Tree_ 24 Wandoo 5 No Hollow


_ 25 Wandoo 4 Hollows not su


Tree_ 26 Wandoo 5 No Hollow


_ 27 Wandoo 4 Hollows not su


Tree_ 28 Wandoo 5 No Hollow


_ 29 Wandoo 4 Hollows not su


30 Wandoo 3 Hollow no chew


_ 31 Wandoo 4 Hollows not su


Tree_ 32 Wandoo 5 No Hollow


Tree_ 33 Wandoo 5 No Hollow


Tree_ 34 Wandoo 5 No Hollow


Tree_ 35 Wandoo 5 No Hollow


Tree_ 36 Wandoo 5 No Hollow


Tree_ 37 Wandoo 5 No Hollow


38 Wandoo 3 Hollow no chew


Tree_ 39 Wandoo 5 No Hollow


_ 40 Wandoo 4 Hollows not su


41 Wandoo 3 Hollow no chew


Tree_ 43 Wandoo 5 No Hollow


44 Wandoo 3 Hollow no chew


ree_44 Wandoo 5 No Hollow


45 Wandoo 3 Hollow no chew


ree_46 Wandoo 5 No Hollow


47 Wandoo 3 Hollow no chew


ree_48 Wandoo 5 No Hollow


ree_49 Wandoo 5 No Hollow


_51 Wandoo 4 Hollows not su


ree_53 Wandoo 5 No Hollow


55 Wandoo 3 Hollow no chew


ree_56 Wandoo 5 No Hollow


ree_57 Wandoo 5 No Hollow


59 Wandoo 3 Hollow no chew


ree_60 Wandoo 5 No Hollow


ree_61 Wandoo 5 No Hollow


_62 Wandoo 4 Hollows not su


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ree_77 Wandoo 5 No Hollow


ree_78 Wandoo 5 No Hollow


ree_79 Wandoo 5 No Hollow


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ree_94 Wandoo 5 No Hollow


ree_95 Wandoo 5 No Hollow


_96 Wandoo 4 Hollows not su


ree_96 Wandoo 5 No Hollow


97 Wandoo 3 Hollow no chew


ree_98 Wandoo 5 No Hollow


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ee_102 Wardoo 5 No Hollow


ee_103 Wandoo 5 No Hollow


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107 Wandoo 4 Hollows not su


ee_108 Wandoo 5 No Hollow


109 Wandoo 4 Hollows not su


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112 Wandoo 4 Hollows not su


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18 Wandoo 3 Hollow no chew


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ee_150 Wandoo 5 No Hollow


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155 Wandoo 4 Hollows not su


56 Wandoo 3 Hollow no chew


157 Wandoo 4 Hollows not su


ee_158 Wandoo 5 No Hollow


ee_159 Wandoo 5 No Hollow


60 Wandoo 3 Hollow no chew


ee_161 Wandoo 5 No Hollow


162 Wandoo 4 Hollows not su


63 Wandoo 3 Hollow no chew


164 Wandoo 4 Hollows not su


65 Wandoo 3 Hollow no chew


ee_166 Wandoo 5 No Hollow


167 Wandoo 4 Hollows not su


ee_168 Wandoo 5 No Hollow


ee_169 Wandoo 5 No Hollow


170 Wandoo 4 Hollows not su


171 Wandoo 4 Hollows not su


ee_172 Wardoo 5 No Hollow


ee_173 Wandoo 5 No Hollow


ee_174 Wandoo 5 No Hollow


ee_175 Wardoo 5 No Hollow


176 Wandoo 4 Hollows not su


77 Wandoo 3 Hollow no chew


ee_178 Wandoo 5 No Hollow


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ee_207 Wandoo 5 No Hollow


ee_208 Wandoo 5 No Hollow


ee_209 Wandoo 5 No Hollow


:10 Wandoo 3 Hollow no chew


ee_211 Wandoo 5 No Hollow


212 Wandoo 4 Hollows not su


:13 Wandoo 3 Hollow no chew


ee_214 Wandoo 5 No Hollow


:16 Wandoo 3 Hollow no chew


ee_217 Wandoo 5 No Hollow


ee_218 Wandoo 5 No Hollow


:19 Wandoo 3 Hollow no chew


220 Wandoo 4 Hollows not su


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222 Wandoo 4 Hollows not su


:24 Wandoo 3 Hollow no chew


ee_225 Wandoo 5 No Hollow


ee_226 Wandoo 5 No Hollow


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242 Wandoo 3 Hollow no chew


243 Wandoo 4 Hollows not su


ee_245 Wandoo 5 No Hollow


ee_246 Wandoo 5 No Hollow


ee_247 Wandoo 5 No Hollow


248 Wandoo 3 Hollow no chew


ee_250 Wandoo 5 No Hollow


ee_251 Wandoo 5 No Hollow


ee_253 Wandoo 5 No Hollow


ee_254 Wandoo 5 No Hollow


ee_255 Wandoo 5 No Hollow


ee_256 Wandoo 5 No Hollow


257 Wandoo 4 Hollows not su


ee_258 Wandoo 5 No Hollow


259 Wandoo 4 Hollows not su


260 Wandoo 3 Hollow no chew


261 Wandoo 4 Hollows not su


262 Wandoo 4 Hollows not su


ee_263 Wandoo 5 No Hollow


ee_264 Wandoo 5 No Hollow


ee_265 Wandoo 5 No Hollow


ee_266 Wandoo 5 No Hollow


ee_267 Wandoo 5 No Hollow


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277 Wandoo 3 Hollow no chew


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283 Wandoo 4 Hollows not su


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329 Wandoo 4 Hollows not su


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'ee_ 362 Wandoo 5 No Hollow


'ee_ 363 Wardoo 5 No Hollow


'ee_ 364 Wandoo 5 No Hollow


'ee_ 365 Wardoo 5 No Hollow


'ee_ 366 Wandoo 5 No Hollow


ee_367 Wandoo 5 No Hollow


368 Wandoo 4 Hollows not su


ee_400 Wandoo 5 No Hollow


Tree_0York Gum5 No Hollows


Tree_1York Gum5 No Hollows


Tree_2York Gum5 No Hollows


Tree_3York Gum5 No Hollows


Tree_4York Gum5 No Hollows


_7Other3 Hollow no chew ma


ree_12York Gum5 No Hollows


_140ther3 Hollow no chew m


_180ther3 Hollow no chew m


_210ther3 Hollow no chew m


_500ther3 Hollow no chew m


e_52Other4 Hollows not suita


ree_54York Gum5 No Hollows


_58York Gum4 Hollows not sui


Tree_66Marri5 No Hollows


_720ther3 Hollow no chew m


Tree_129Marri5 No Hollows


Tree_130Marri5 No Hollows


Tree_133Marri5 No Hollows


Tree_134Marri5 No Hollows


Tree_135Marri5 No Hollows


Tree_136Marri5 No Hollows


Tree_137Marri5 No Hollows


Tree_138Marri5 No Hollows


Tree_139Marri5 No Hollows


Tree_140Marri5 No Hollows


Tree_215Marri5 No Hollows


e_223Marri4 Hollows not suita


ree_227York Gum5 No Hollow


ree_228York Gum5 No Hollow


_244Other3 Hollow no chew m


e_278Marri4 Hollows not suita


Tree_285Marri5 No Hollows


Tree_286Marri5 No Hollows


e_287Marri4 Hollows not suita


Tree_288Marri5 No Hollows


Tree_289Marri5 No Hollows


Tree_290Marri5 No Hollows


Tree_291Marri5 No Hollows


Tree_292Marri5 No Hollows


Tree_293Marri5 No Hollows


Tree_294Marri5 No Hollows


Tree_295Marri5 No Hollows


_296Marri3 Hollow no chew m


Tree_297Marri5 No Hollows


_321Other3 Hollow no chew m


Tree_335Marri5 No Hollows


Tree_338Marri5 No Hollows


Tree_339Marri5 No Hollows


Tree_340Marri5 No Hollows


Tree_343Marri5 No Hollows