NATIVE VEGETATIONCLEARING PERMIT
SUPPORTING INFORMATION

BIOMASS CALIBRATION TRANSPONDER
ESA DEEP SPACE FACILITY
10353 GREAT NORTHERN HIGHWAY
YARAWINDAH

PREPARED AND SUBMITTED ON BEHALF OF

THE EUROPEAN SPACE AGENCY
AND
STRATHAM ENGINEERING CONSULTANCY SERVICES

ENDPLAN ENVIRONMENTAL

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Native Vegetation Clearing Permit – Supporting Document
BIOMASS Calibration Transponder
ESA Deep Space Facility, 10353 Great Northern Highway, Yarawindah

Our Reference:
ECO203_07_draft

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1. BACKGROUND INFORMATION

1.1 Location

The European Space Agency (ESA) is proposing to construct a BIOMASS Calibration Transponder (BCT) at their Deep Space Facility located on Lot 11 (No. 10353) Great Northern Highway, Yarawindah. The Facility is situated approximately 8 km south of New Norcia and 100 km north-east of Perth (**Figure 1**).

In order to construct the BCT, the ESA is planning to lease a portion of Lot M1991 Great Northern Highway, Yarawindah from the current landowner. Certificates of Title for both Lot 11 (already owned by the ESA) and M1991 are included in **Appendix 1** and Authority to Act (Delegation of Powers) correspondence in favour of the ESA's project manager [redacted] (Stratham Engineering Consultancy Services) is included in **Appendix 2**.

The proposed clearing application area (**Figure 2**) comprises **8.15 ha** within a 13.468 ha development footprint and is located within a 677 ha broadscale agricultural farm in which livestock grazing (sheep and cattle) and cropping (primarily cereal grasses) has historically and is currently being undertaken.

1.2 Rationale for Clearing

The proposed construction of the BCT will enable the ESA to measure the Earth's biomass from space. While forest type and forest cover worldwide can be detected through the use of satellites, the BCT will take the information to the next level as the global mass of trees is not obtainable by ground measurement techniques. The satellite will carry the first P-band synthetic aperture radar, able to deliver accurate biomass maps of tropical, temperate and boreal forests.

The BCT will comprise an antenna subsystem, electronic subsystem that includes up/down link radio-frequency circuitry, self-calibration equipment together with an antenna positioner subsystem and will be installed within a purpose-built building.

1.3 Environmental Approval

In accordance with Part V of the *Environmental Protection Act 1986* (EP Act), clearing of native vegetation requires a permit except where an exemption applies under Schedule 6 of the EP Act or is prescribed by regulation in the *Environmental Protection (Clearing Native Vegetation) Regulations 2004*.

Clearing of native vegetation for the purpose of constructing additional infrastructure within parts of Lot 11 and M1991 will therefore require a purpose clearing permit approved by the Department of Water and Environmental Regulation (the Department).

2 APPLICATION AREA DESCRIPTION

2.1 Topography

The clearing application area is characterised by a gradual increase in height from 270 mAHD in the north increasing southwards to a mesa formation (approximately 312 mAHD) before descending to 292 mAHD in the south. The proposed BCT will be constructed at approximately 312 mAHD on the flat-topped mesa formation (**Figure 3**).

2.2 Land Systems

The clearing application area can be divided into two distinct land systems:

1) The southern portion characterised by a residual plateau that is very gently inclined with loamy gravel, some shallow gravels and sandy gravels.
2) The northern portion characterised by very gently inclined hills slopes and hillcrests; with loamy and sandy earths, loamy gravel, shallow loamy gravel over duricrust.

2.3 Wetlands

The clearing application area is situated within the Eastern Darling Range hydrological zone of the Moore River catchment which is characterised by moderately to strongly dissected lateritic plateaus over granite with eastward flowing streams located in broad shallow valleys (DBCA 2007-2020).

No wetlands or other watercourses are located within the clearing application area.

2.4 Groundwater Dependent Ecosystems

The *Groundwater Dependent Ecosystems Atlas* (Australian Government and Bureau of Meteorology 2020) indicates that the clearing application area is considered as low potential for terrestrial Groundwater Dependent Ecosystems to occur, with a GDE likelihood of low.

2.5 Environmentally Sensitive Areas

The clearing application area does not intersect with any clearing regulations Environmentally Sensitive Areas (ESA) and the nearest ESA (1362) is located approximately 800 m to the east (Government of Western Australia and Department of Water and Environmental Regulation 2020).

2.6 Conservation Lands

The clearing application area does not intersect with any Department of Biodiversity, Conservation and Attractions (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).

2.7 Historical Land use

Located within the Jarrah Forest IBRA region in the Northern Jarrah Forest subregion (JAF01), the clearing application area is characterised by land use more similar to that of the Avon Wheatbelt.

The clearing application area is located within a working farm in which livestock grazing (sheep and cattle) and cropping (primarily cereal grasses) is currently conducted. Part of the clearing application area is on rocky soil that has not been cleared of native vegetation, however, these areas have been intensively grazed and while most of the upper stratum trees remain much of the native understorey is no longer present.

2.8 Flora and Vegetation

2.8.1 May 2020 Survey

A detailed survey, conducted as a 'single-phase survey' in accordance with the *Flora and Vegetation Technical Guidance* (EPA 2016d), was undertaken by Ecoscape (Australia) Pty Ltd in May 2020. The survey area comprised approximately 37.54 ha and included the clearing application area (**Appendix 3**).

Targeted searches were conducted in areas of habitat suitable for Threatened Flora (TF) and Priority Flora (PF) that were identified during the desktop assessment and previous biological surveys conducted in the surrounding area as having the potential to occur.

As the survey was conducted outside of the period considered optimal for a primary season survey within the bioregion, a likelihood assessment was also conducted to identify whether TF and PF species have the potential to occur within survey area including the clearing application area. The likelihood of a species occurring was based on attributes as listed on *FloraBase* (WAH 1998-2020; 2020).

No conservation-listed flora was 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 a preliminary site assessment was conducted on 11 February 2020 and had determined that the entire survey area had been (or was currently) heavily grazed by livestock, with few native species in the lower strata (Ecoscape (Australia) Pty Ltd., 2020).

Within the survey area, 28 vascular flora were recorded from 16 families and 23 genera. 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* (4 taxa), *Eucalyptus* (2 taxa) and *Melaleuca* (2 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 (Ecoscape 2020).

The native vegetation within the clearing application area consists of three woodlands:

- Marri (CcW), *Corymbia calophylla* woodland over **Avena barbata* low isolated grasses (1.42 ha) (**Plate 1**)
- Wandoo (EwW), *Eucalyptus wandoo* subsp. *wandoo* woodland over *Melaleuca marginata* and *Hibbertia hypericoides* subsp. *hypericoides* mid shrubland over **Avena barbata* low isolated Grasses (6.62 ha) (**Plate 2**)

- York Gum (ElW), *Eucalyptus loxophleba* subsp. *loxophleba* woodland over **Avena barbata* low isolated grasses (0.10 ha).

PLATE 1: U+ ^*Corymbia calophylla*\^tree\7\i;G ^*Avena barbata*\^other grass\1\bi

PLATE 2: DS2005: U+ ^*Eucalyptus wandoo* subsp. *wandoo*\^tree\7\c;G ^,*Acacia shuttleworthii*\^,shrub\1\r

Vegetation within the clearing application area was assessed as being in Degraded condition (**Figure 4**).

2.8.2 Targeted Flora Survey

Following an initial submission of a NVCP application to the Department of Water and Environmental Regulation (the Department) in relation to the proposed construction of the NNO-3 Antenna and BCT (CPS 9270/1), the Department provided a Request for Further Information correspondence to the proponent (**Appendix 4**). The correspondence requested:

An additional targeted flora and vegetation survey is required for the area marked within the attached map (CPS 9270/1 – Targeted survey area) within the flowering time for threatened species Spirogardnera rubescens (T), Banksia serratuloides subsp. serratuloides (T), Melaleuca sciotostyla (T)

On the 3 September 2021, PGV Environmental conducted the targeted flora and vegetation survey at a time when all three species were within their flowering period, although at the end of the *Melaleuca sciotostyla* flowering time. *Melaleuca sciotostyla* is readily identifiable by its corky branches and fruit and does not need flowers for identification (**Appendix 5**).

No plants of either of the three Threatened species were observed during the Spring survey.

2.9 Fauna

2.9.1 May 2020 Survey

A Level 1 fauna survey, as defined by the *Technical Guidance – Sampling methods for Terrestrial vertebrate fauna* (EPA 2016f), was conducted in May 2020 by Ecoscape (Australia) Pty Ltd. The survey, which does not fall within the optimal prescribed season, consisted of a desktop study and basic ground truthing through a reconnaissance survey. The survey focused on mapping major fauna habitat types within the survey area, particularly those habitat types likely to be utilised by conservation-listed species identified during the desktop survey (**Appendix 3**).

The Level 1 field survey also comprised opportunistic surveys (active searches, scat, track and other traces surveys and bird surveys). The survey area comprised approximately 37.54 ha and included the clearing application area.

During the survey, fauna habitats present were identified and mapped. Fauna habitats were described as an area which is distinguishable from its surrounding area by its landform, 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.

One fauna habitat type, Open Woodland, was identified within the clearing application area (**Figure 5**). While the Open Woodland habitat may be suitable for some conservation-listed fauna species, it has little structural diversity other than tree canopy.

Within the survey area, 18 vertebrate fauna species were recorded (six mammals, 11 birds and one reptile), none of which are conservation-listed.

While the Carnaby's Cockatoo was assessed as being a High likelihood of occurring, anecdotally, the species has not been observed within the survey area for a significant period by the landowner, nor was it observed during the three-day field survey. Given the quality of the habitat present, it is unlikely that the species would be dependent upon the survey area if it did occur on-site. Forest Red-tailed Black Cockatoo and Peregrine Falcon were assessed as being a Medium likelihood of occurring on occasion but would not be dependent upon the resources available within the survey area (Ecoscape (Australia) Pty Ltd., 2020).

2.9.2 Additional Black Cockatoo Habitat Tree Assessment

Following an initial submission of a NVCP application to the Department in relation to the proposed construction of the NNO-3 Antenna and BCT (CPS 9270/1), the Department provided a Request for Further Information to the proponent requesting that additional black cockatoo habitat tree assessment / survey of trees (habitat trees) where not already surveyed (**Appendix 4**). The Department advised that:

> *…the survey is required to identify all trees that have a diameter, measured at 1.3 metres from the base of the tree, of 30 centimetres (for Wandoo trees) or 50 centimetres (for Corymbia calophylla) or greater that contain a hollow(s) that may be suitable for breeding by Carnaby's cockatoo. The survey must document:*
> - *the date(s) of the survey;*
> - *the GPS locations (i.e., eastings and northings or decimal degrees) of all trees identified as containing hollows which may be suitable for black cockatoos;*
> - *the methodology for determining the evidence of use of each hollow; and*
> - *a description/photo of the evidence of use.*

The additional black cockatoo habitat tree assessment was undertaken by PGV Environmental on the 3 September 2021 (**Appendix 5**).

A comparison of the Ecoscape tree survey and the area of proposed clearing on site confirmed that the survey did cover the whole clearing permit application area. PGV Environmental identified one additional Marri tree at the southern end of the site that was not included in the Ecoscape report.

- Details of the Marri tree are:
- Height – 25m
- DBH – 91cm
- Hollows – No hollows
- Co-ordinates: - 422802E 6564194N (Plate 8)

3 APPLICATION OF THE TEN CLEARING PRINCIPLES

To ensure that all potential environmental impacts resulting from the removal of native vegetation can be assessed, clearing applications are assessed against the Ten Clearing Principles outlined in Schedule 5 of the EP Act.

An examination of the Ten Clearing Principles applied against a desktop investigation and site-specific field surveys (**Appendices 3 and 5**) is provided in the table over the page.

Principle	Assessment	Conclusion
(a) Native vegetation should not be cleared if it comprises a high level of biological diversity	The May 2020 flora and fauna survey area, comprising 37.54 ha, 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 survey area corresponds with the Mogumber 4 pre-European vegetation association described as woodlands containing: Jarrah, Marri and Wandoo (i.e., *Eucalyptus marginata*, *Corymbia calophylla* and *E. wandoo*). Of the pre-European vegetation association identified from the survey area (DPIRD 2018a) approximately 197,903.81 ha (32.22 %) remain. During the flora and vegetation survey conducted in May 2020, native vegetation within the clearing application area consisted of woodlands dominated by different Eucalypt species: - CcW: *Corymbia calophylla* (Marri) woodland over *Avena barbata* low isolated grasses (1.42 ha) - EwW: *Eucalyptus wandoo* subsp. *wandoo* (Wandoo) woodland over *Melaleuca marginata* and *Hibbertia hypericoides* subsp. *hypericoides* mid shrubland over **Avena barbata* low isolated grasses (6.62 ha) - ElW: *Eucalyptus loxophleba* subsp. *loxophleba* (York Gum) woodland over **Avena barbata* low isolated grasses (0.10 ha). Vegetation condition was assessed broadly and continuously and at each quadrat using the Vegetation Condition Scale for the Southwest Botanical Provinces (EPA 2016d). All vegetation within the clearing application area was assessed as being in Degraded condition (**Figure 4**).	Due to historical land-use, extensive clearing of the canopy and understorey has taken place. As a result, the clearing application area is unlikely to represent an area of higher biodiversity in either the local or regional context. The proposed clearing of **8.15 ha** is **not likely** to be at variance with this Principle.

Principle	Assessment	Conclusion
	Within the survey area, 28 vascular flora were recorded from 16 families and 23 genera. 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 (5 taxa), Poaceae (5 taxa) and Dilleniaceae (4 taxa). The most commonly represented genera were *Hibbertia* (4 taxa), *Eucalyptus* (2 taxa) and *Melaleuca* (2 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 (Ecoscape (Australia) Pty Ltd 2020). No Threatened Flora (TF) pursuant to the *Biodiversity Conservation Act 2016* (BC Act) nor the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were recorded during the May 2020 or September 2021 surveys. No Priority Flora (PF) pursuant to State legislation were recorded during the surveys. A search of the Department of Biodiversity, Conservation and Attractions (DBCA) Threatened Fauna database using a 40 km buffer was undertaken to determine whether any species have been recorded in proximity to the survey area. The DBCA database search returned the following: - eight mammals - 17 birds - three reptiles - six invertebrates The EPBC Act *Protected Matters Search Tool* (PMST) search (Australian Government & DAWE 2020) 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'	

Principle	Assessment	Conclusion
	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' Within the survey area, 18 vertebrate fauna species were recorded (six mammals, 11 birds and one reptile), none of which are conservation-listed (Ecoscape 2020).	
(b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	A search of the DBCA's Threatened Fauna database was undertaken to establish whether species listed under the BC Act have been recorded in proximity to the site. The NatureMap Report identified 21 Threatened fauna species and four Priority species occurring within 40 km of the survey area. The EPBC Act PMST identified 25 Threatened and Migratory species that could potentially occur within or in proximity to the survey area. Given the lack of water occurring within the survey area, marine and migratory bird species are unlikely to occur. While no conservation-listed species were recorded, the clearing application 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: - 191 were assessed as Class 5 (trees without suitable hollows) - 42 were assessed as Class 4 (trees with large hollows or broken branches, but not having the features preferred by Black Cockatoos for nesting) - 22 were assessed as Class 3 (trees with potentially suitable hollows but with no evidence of use by Black Cockatoos). Importantly, no trees were assessed as Class 2 (trees with suitable hollows and evidence of use, but not currently occupied) or Class 1 (having an active nest) (**Figure 5**).	The proposed clearing of 'near low quality' foraging habitat and the absence of trees with suitable nesting hollows within the clearing application area is unlikely to contribute to a long-term reduction in the size of a significant habitat for Carnaby's Black Cockatoo. The proposed clearing of **8.15 ha** is **likely** to be at variance with this Principle.

Principle	Assessment	Conclusion
	The clearing application 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). No Black Cockatoo species have been observed in the clearing application area by the landholder for at least the previous 20 years, nor have any sightings been reported by any ESA employees or contractors since 2003 when the Facility opened. 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 the species from Seven Mile Well Nature Reserve from 2000. The fauna species that are likely to occur within the clearing application area (Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo and Peregrine Falcon) are considered to be infrequent visitors and not be dependent on the area for foraging and breeding. The availability of foraging and breeding habitat within 10 km of the clearing application area is very high, comprising 'Eucalyptus Woodlands' and 'Other Shrublands' (Beard, 1981; Shepherd et al, 2002). There is approximately 7000 ha of remnant vegetation (Beard, 1981) within 10 km of the clearing application area. A high proportion of this habitat will more than likely be potential breeding habitat and/or foraging habitat.	
(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	A detailed 'single phase' survey of the 37.54 ha survey area was conducted in May 2020 (Ecoscape (Australia) Pty Ltd). In total 28 vascular flora were recorded from 16 families and 23 genera. 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* (4 taxa), *Eucalyptus* (2 taxa) and *Melaleuca* (2 taxa). A significant portion (8%) of the flora could not be	Due to the disturbed habitat present, no conservation significant flora species were identified within the clearing application area. The proposed clearing of **8.15 ha** is **not likely** to be at variance with this Principle.

Principle	Assessment	Conclusion
	identified with certainty due to the lack of reproductive material largely due to the survey timing and intensive grazing (Ecoscape (Australia) Pty Ltd 2020). During a targeted survey for three Threatened species conducted in September 2021, no individuals of the species were found. No Threatened Flora pursuant to the BC Act nor the EPBC Act were recorded during either of the surveys, nor were any Priority Flora pursuant to State legislation recorded during the surveys.	
(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.	The 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 area, identified one EPBC-listed Threatened Ecological Community (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.	Although both State and Commonwealth database searches identified the likely presence of the *Eucalypt Woodlands of the Western Australian Wheatbelt* TEC within the search area buffer, the clearing application area is not within the Avon Wheatbelt bioregion, nor closely adjacent to it. The proposed clearing of **8.15 ha** is **not likely** to be at variance with this Principle.
(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	The survey area is located within 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 survey area corresponds with the Mogumber 4 pre-European vegetation association described as woodlands containing: Jarrah, Marri and Wandoo (i.e., *Eucalyptus marginata*, *Corymbia calophylla* and *Eucalyptus wandoo*). Of the	Due to its historical and continued land-use (broadacre farming), the condition of the native vegetation within the clearing application area has been assessed as being Degraded. However, the clearing application area represents a significant remnant of native vegetation in an area that has been extensively cleared. The proposed clearing of **8.15 ha** is **likely** to be at variance with this Principle.

Principle	Assessment	Conclusion
	Mogumber 4, pre-European vegetation association identified from the survey area (DPIRD 2018a) approximately 197,903.81 ha (32.22 %) remains. Within the Shire of Victoria Plains, approximately 14,633.44 ha (22.83 %) remains. The DPIRD Native Vegetation Extent dataset shows that approximately 7,016ha of native vegetation remains within a 10 km radius of the clearing application area.	
(f) Native vegetation should not be cleared if it is growing in, or in association with an environmental associated with a watercourse or wetland.	The survey area is situated within the Eastern Darling Range hydrological zone in the Moore River catchment (DBCA 2007-2020) which is characterised by moderately to strongly dissected lateritic plateaus over granite with eastward flowing streams located in broad shallow valleys. Detailed flora and vegetation surveying conducted within the survey area did not identify the presence of native vegetation types or flora species that are generally associated with watercourses and/or wetlands within the region. Nor were any watercourses or wetlands identified as being located within the survey area.	The flora and vegetation survey did not identify the presence of any native vegetation usually associated with a watercourse or wetland within the surrounding area or region. The proposed clearing of **8.15 ha** is **not likely** to be at variance with this Principle.
(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	The loamy and sandy gravels present within the clearing application area can be prone to water and to a greater extent wind erosion. Mapping on the DPIRD's NRinfo database[1] shows that the risk of wind erosion hazard to soils in the northern portion of the clearing application area are 10 – 30 % while in the southern portion >70 % are high extreme hazard as the slope increases in height. The DPIRD's database shows that the risk of water erosion hazard is <3 % across the northern portion of the clearing application area and 3 – 10 % in the southern portion. The design and siting of the road leading up the mesa formation to the site of the proposed BCT has taken into consideration the degree of slope and safety concerns.	The proposed expansion of the Facility and construction of the associated infrastructure will be undertaken in accordance with civil engineering standard operational controls in order to reduce the risk of appreciable land degradation. The proposed clearing of **8.15 ha** is **not likely** to be at variance with this Principle.

[1] Department of Primary Industries and Resource Development (2021) Natural Resource Information (WA) (agric.wa.gov.au)

Principle	Assessment	Conclusion
(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	The clearing application area does not intersect with any clearing regulations Environmentally Sensitive Areas (ESA) and the nearest ESA (1362) is located 800 m to the east (Government of Western Australia & Department of Water and Environmental Regulation 2020).	As the clearing application area is not near any ESAs it is unlikely that there will be direct or anticipated indirect impacts on the environmental values of any conservation areas. The proposed clearing of **8.15 ha** from is **not likely** to be at variance with this Principle.
(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	The clearing application area falls in the Moore River catchment within the Eastern Darling Range hydrological zone characterized by moderately to strongly dissected lateritic plateaus on granite with eastward flowing streams in broad shallow valleys (DBCA2007-2020). The *Groundwater Dependent Ecosystems Atlas* (Australian Government and Bureau of Meteorology 2020) indicates that the clearing application area is considered as low potential for terrestrial Groundwater Dependent Ecosystems to occur, with an IDE likelihood of low.	Detailed surveying conducted within the clearing application area indicates that no wetlands or watercourses are located within or adjacent to it. The proposed clearing of **8.15 ha** is **not likely** to be at variance with this Principle.
(j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.	The clearing application area is characterised by a gradual increase in height from 270 m Australian Height Datum (AHD) in the north increasing southwards to a mesa formation (approximately 312 mAHD) before descending to 292 mAHD in the south. The proposed BCT will be constructed at 312 mAHD on the flat-topped mesa formation.	Given the topography of the clearing application area and the absence of watercourses, it is unlikely that clearing of native vegetation within it is likely to cause, or exacerbate, the incidence or intensity of flooding within it. The proposed clearing of **8.15 ha** is **not likely** to be at variance with this Principle.

4. CLEARING OF NATIVE VEGETATION

Excluding activities that are exempt under the Clearing Regulations (Section 5 – Prescribed Clearing), all native vegetation clearing completed by the proponent will be undertaken in accordance with a Native Vegetation Clearing Permit (NVCP).

4.1 Measures to Avoid and Minimise Clearing

4.1.1 Impact Avoidance through Project Design

Information from the flora and fauna surveys has influenced the location and design layout of the proposed BCT as far as practicable. However, to ensure that low radio frequency interference to the BCT does not occur, the proposed construction will require the removal of approximately **8.15 ha** of Degraded native vegetation from within the clearing application area. The area proposed to be cleared is identified in **Figure 2**.

4.1.2 Impact Avoidance Through Environmental Management

Prior to vegetation clearing commencing, the proponent will prepare a Construction Environmental Management Plan (CEMP) to describe how the impacts of activities related to the construction phase of the Project will be managed to reduce potential direct and indirect impacts on the environment.

The CEMP will include, but not be restricted to, the following:

- Vegetation protection: prior to clearing commencing, the areas of vegetation to be retained will be clearly demarcated with star pickets, coloured tape or bunting, or fencing, and all clearing personnel will be inducted and made aware of the requirement to protect native vegetation in these areas.
- Dieback (*Phytophthora cinnamomi*): the movement of soils and plant material will be strictly managed at the site to ensure Dieback is not introduced into the surrounding vegetated areas. All clearing machinery will be washed down prior to entering and leaving the site. No Dieback or weed-affected soil, mulch or fill will be brought into the disturbance area.
- Environmental induction: all vegetation clearing, and construction personnel will be required to participate in an environmental induction toolbox session to ensure they are made aware that native fauna/flora are protected under the *Biodiversity Conservation Act 2016* and of the measures to be implemented to prevent undue environmental harm.
- Native fauna protection: any fauna injured during construction will be taken to a designated veterinary clinic or a DBCA nominated wildlife carer.
- Hydrocarbon storage: if hydrocarbons are to be temporarily stored, they will be contained within portable bunds. Precautions will be required to be taken when refuelling and a spill-response kit will be located in close proximity to any refuelling locations.

4.2 Impact Mitigation through Provision of Offsets

4.2.1 Onsite Revegetation

The proponent has identified a 2.8 ha area within Lot 11 that is currently Completely Degraded and that will be revegetated to Good condition vegetation (**Figure 7**). Prior to clearing commencing, the proponent will: prepare a comprehensive Revegetation Management Plan to the satisfaction of the Department and ensure that the revegetation site will be conserved in perpetuity.

4.2.2 Offset Funding

The proponent has offered to provide funding to the Department to enable the acquisition of an area of native vegetation in good condition that provides habitat for Carnaby's cockatoo within an extensively cleared landscape.

5. SUMMARY AND CONCLUSION

Approximately **8.15 ha** of native vegetation is proposed to be cleared. The clearing is required to enable the construction of a BCT that is integral to the expansion and functioning of the ESA's Deep Space Facility.

A desktop review of published Western Australian and Commonwealth databases pertaining to the survey area was undertaken prior to field surveying being conducted. The desktop review included data and information relating to TF, PF and TECs, Threatened and Migratory fauna species, ESAs, water and wind erosion risk, groundwater dependent ecosystems, hydrology and hydrogeology.

As outlined in this report, the flora, vegetation and fauna field surveys were conducted within a 37.54 ha survey area that included the clearing application area. Vegetation mapping assessed the clearing application area as comprising vegetation in Degraded condition. The fauna survey identified that while the clearing application area comprised an Open Woodland habitat that may be suitable for some conservation-listed fauna species, it has little structural diversity other than tree canopy.

Impacts associated with the proposed clearing to allow for the expansion of the ESA's Deep Space Facility has been considered with respect to the Ten Clearing Principles outlined in Schedule 5 of the EP Act.

It is concluded that on the basis of the information presented in this report, the proposed clearing of **8.15 ha** of native vegetation within the clearing application area is **likely** to be at variance with the following Clearing Principles:

(c) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.
(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared

In order to minimise and offset the impact of the clearing, the proponent commits to undertaking the following actions:

1. Prepare a Construction Environmental Management Plan (CEMP).
2. Prepare and implement to the satisfaction of the Department, a Revegetation Management Plan for the 2.8 ha revegetation site located within Lot 11.
3. Commit to conserving the 2.8 ha revegetation site within Lot 11 in perpetuity.
4. Provide funding to the Department to enable the acquisition of an area of native vegetation in good condition that provides habitat for Carnaby's cockatoo within an extensively cleared landscape.

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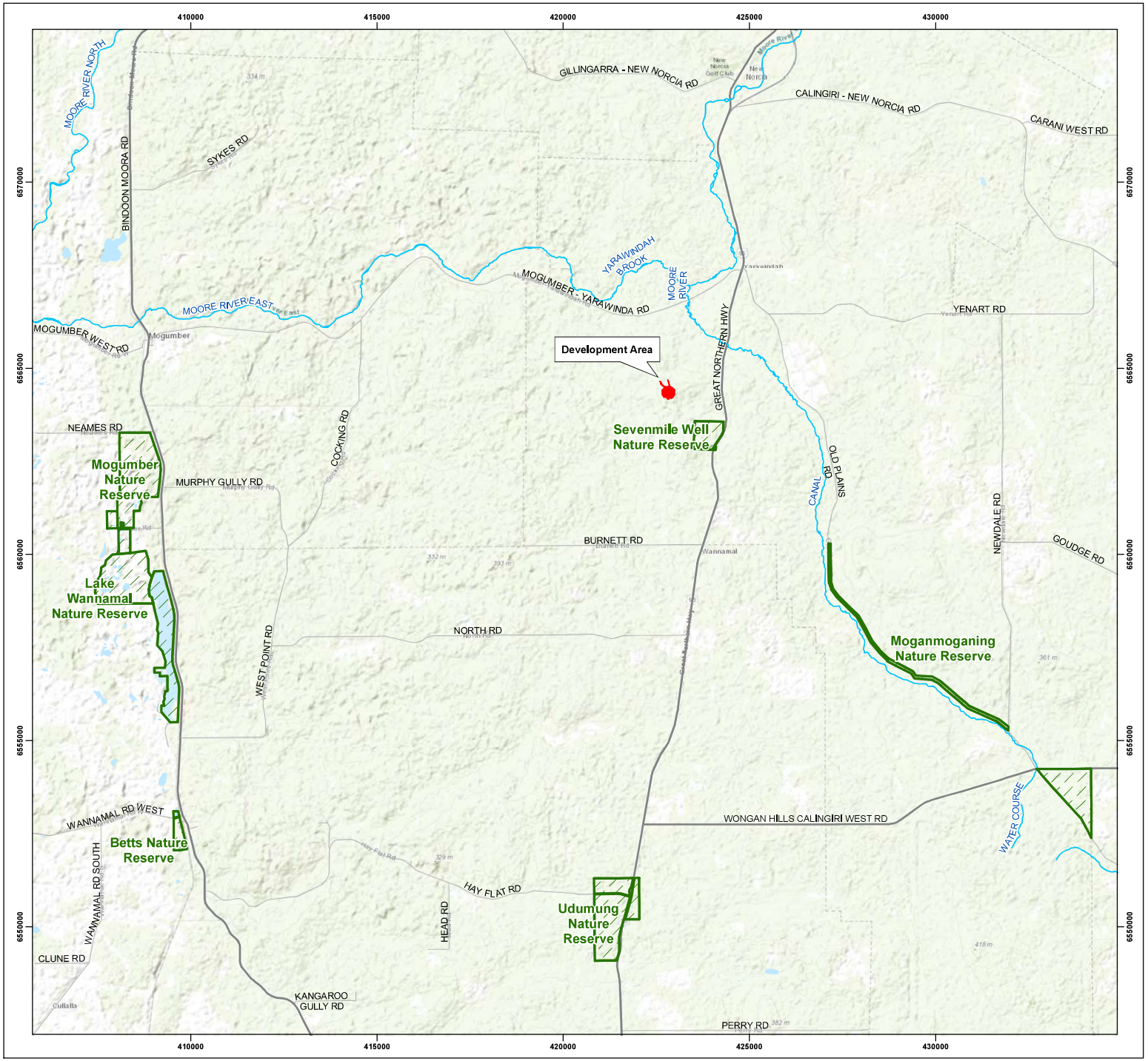
FIGURES

NATIVE VEGETATION CLEARING PERMIT - SUPPORTING DOCUMENT
BIOMASS CALIBRATION TRANSPONDER
ESA DEEP SPACE FACILITY
10353 GREAT NORTHERN HIGHWAY, YARAWINDAH



LEGEND

- Development Area
- DBCA Reserve

DATASOURCES:
BASEMAP: NATIONAL BASE MAP (GEOSCIENCE AUSTRALIA, 2020).
SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP, GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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REGIONAL LOCATION

DEEP SPACE FACILITY
BIOMASS CALIBRATION TRANSPONDER
NVCP APPLICATION

STRATHAM ENGINEERING CONSULTANCY SERVICE

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

SCALE: 1:100,000 @ A3

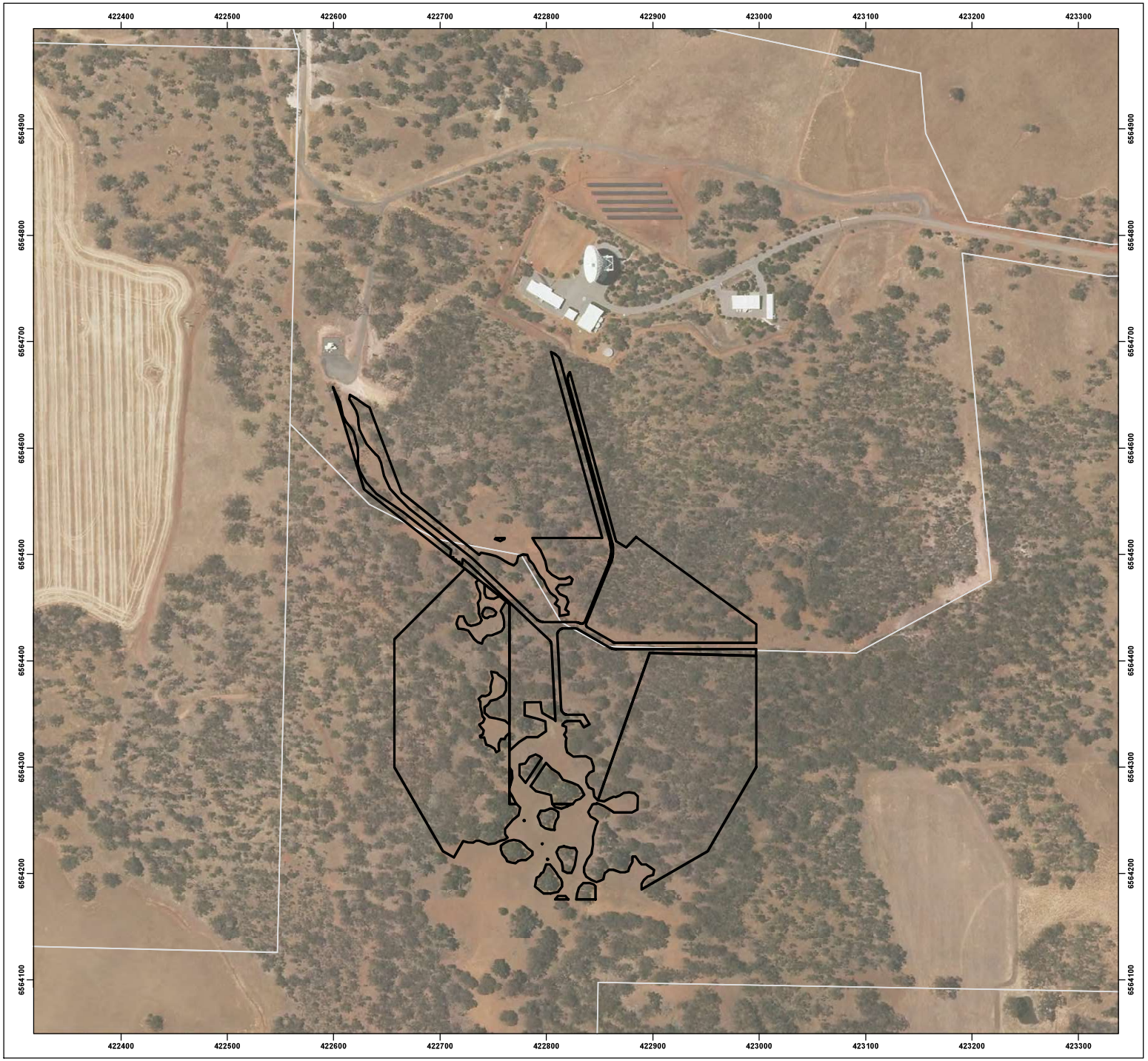
N

0 1 2 3 4 km

PROJECT NO: 4513-20

REV	AUTHOR	APPROVED	DATE
00	SMB	LJA	24/11/2020
01	SMB	BVDW	16/09/2021
02	SMB	BVDW	01/11/2021

FIGURE 1



LEGEND

- Cadastre (Landgate, 2020)
- Biomass Area (drawing ref: LCA_07_NNO3_BIOMASS) - 8.17 Ha

DATASOURCES:
AERIAL IMAGE: CHITTERING_2135_DEC_2017_MOSAIC (LANDGATE)
SERVICE LAYER CREDITS:

ecoscape

CLEARING PERMIT APPLICATION AREA

DEEP SPACE FACILITY BIOMASS CALIBRATION TRANSPONDER NVCP APPLICATION

STRATHAM ENGINEERING CONSULTANCY SERVICE

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

SCALE: 1:3,500 @ A3

N

0 50 100 150 m

PROJECT NO: 4513-20

REV	AUTHOR	APPROVED	DATE
01	SMB	BVDW	17/03/2021
02	SMB	BVDW	16/09/2021
03	SMB	BVDW	01/11/2021

FIGURE 2

LEGEND

- Cadastre (Landgate, 2020)
- Biomass Area (drawing ref: LCA_07_NNO3_BIOMASS) - 8.17 Ha

Elevation (m)

- 224 - 238.6
- 238.7 - 253.3
- 253.4 - 268.1
- 268.2 - 282.8
- 282.9 - 297.5
- 297.6 - 312.2

DATASOURCES :
AERIAL IMAGE: CHITTERING_2135_DEC_2017_MOSAIC (LANDGATE)
SERVICE LAYER CREDITS:

ecoscape

TOPOGRAPHY

DEEP SPACE FACILITY
BIOMASS CALIBRATION TRANSPONDER
NVCP APPLICATION

STRATHAM ENGINEERING CONSULTANCY SERVICE

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

SCALE: 1:3,500 @ A3

N

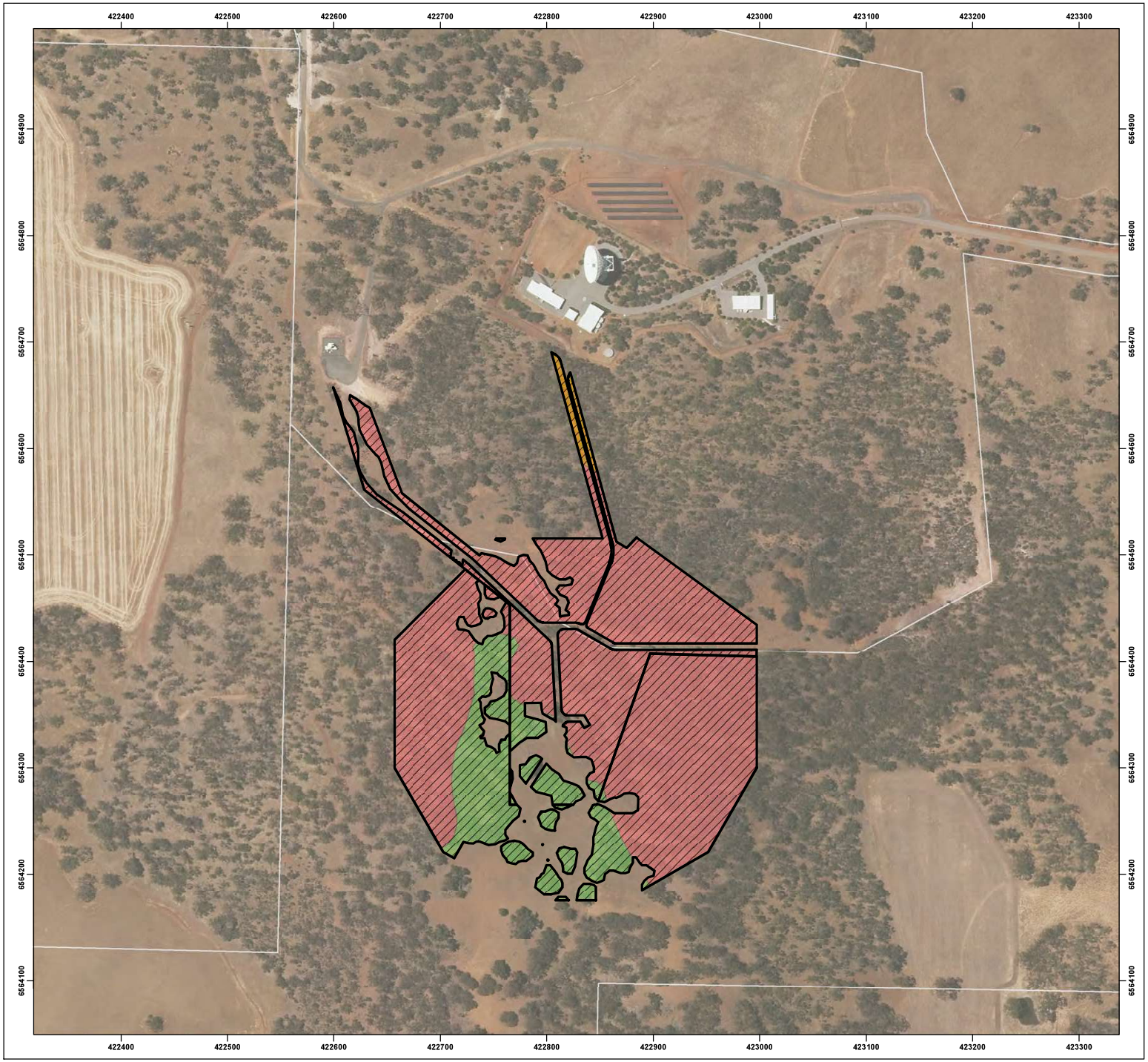
0 50 100 150 m

PROJECT NO: 4513-20

REV	AUTHOR	APPROVED	DATE
01	SMB	BVDW	17/03/2021
02	SMB	BVDW	16/09/2021
03	SMB	BVDW	01/11/2021

FIGURE

3



LEGEND

Cadastre (Landgate, 2020)

Biomass Area (drawing ref: LCA_07_NNO3_BIOMASS) - 8.15 Ha

Vegetation Condition

Degraded (8.15 Ha)

Vegetation Type

Marri (CcW), *Corymbia calophylla* woodland over *Avena barbata* low isolated grasses (1.42 Ha)

Wandoo (EwW), *Eucalyptus wandoo* subsp. *wandoo* woodland over *Melaleuca marginata* and *Hibbertia hypericoides* subsp. *hypericoides* mid shrubland over *Avena barbata* low isolated grasses (6.62 Ha)

York Gum (ElW), *Eucalyptus loxophleba* subsp. *loxophleba* woodland over *Avena barbata* low isolated grasses (0.1 Ha)

DATA SOURCES:
AERIAL IMAGE: CHITTERING_2135_DEC_2017_MOSAIC (LANDGATE)
SERVICE LAYER CREDITS:

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VEGETATION TYPE AND VEGETATION CONDITION

DEEP SPACE FACILITY BIOMASS CALIBRATION TRANSPONDER NVCP APPLICATION

STRATHAM ENGINEERING CONSULTANCY SERVICE

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

N

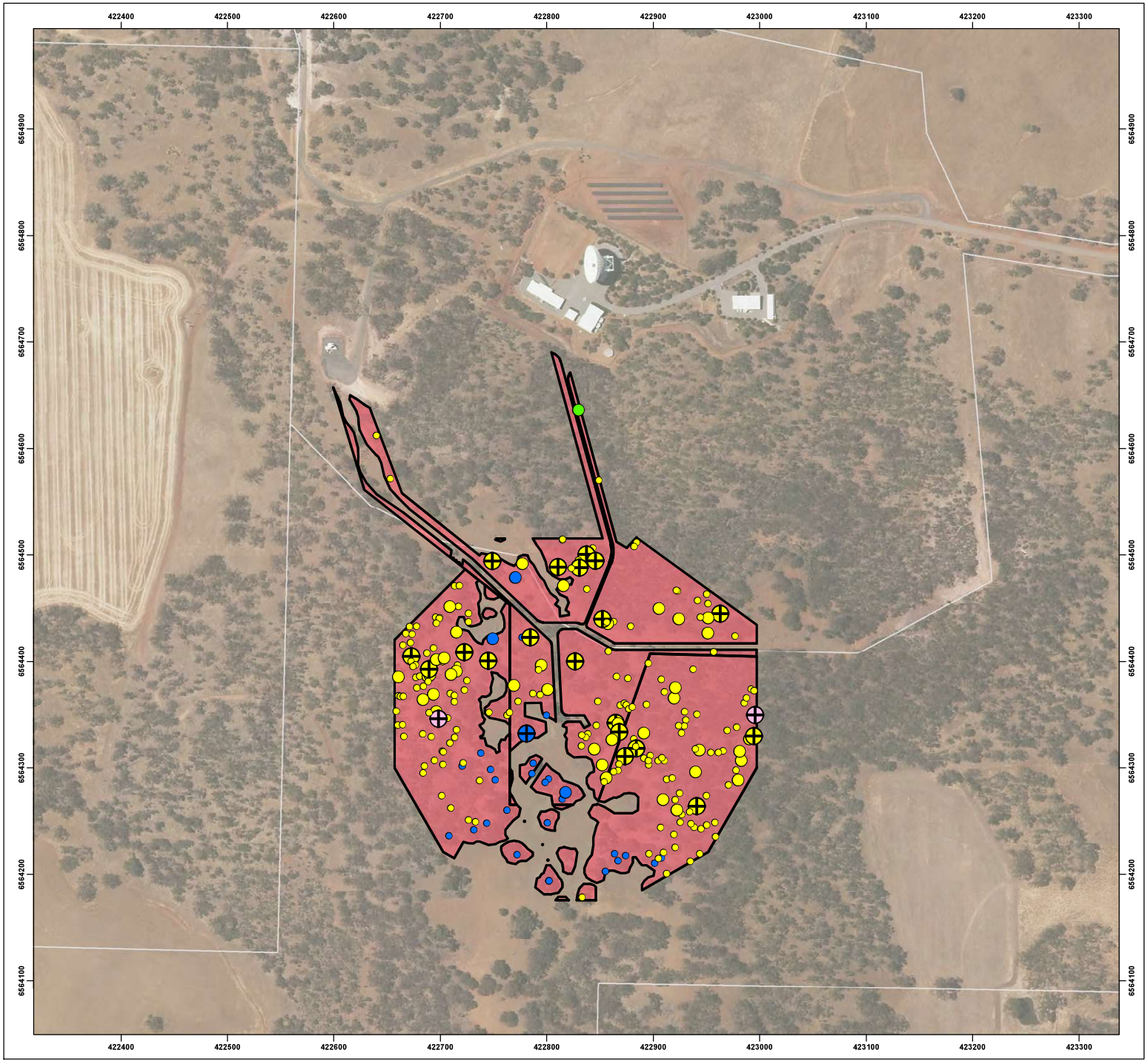
SCALE: 1:3,500 @ A3

0 50 100 150 m

PROJECT NO: 4513-20

REV	AUTHOR	APPROVED	DATE
02	SMB	BVDW	16/09/2021
03	SMB	BVDW	23/09/2021
04	SMB	BVDW	01/11/2021

FIGURE 4



LEGEND

Cadastre (Landgate, 2020)

Biomass Area (drawing ref: LCA_07_NNO3_BIOMASS) - 8.15 Ha

Fauna Habitat

Open Woodland (8.15 Ha)

Habitat Trees

Marri

Class 3 (1 tree)

Class 4 (3 trees)

Class 5 (24 trees)

Wandoo

Class 3 (19 trees)

Class 4 (38 trees)

Class 5 (167 trees)

York Gum

Class 4 (1 tree)

Dead trees

Class 3 (2 trees)

DATASOURCES
AERIAL IMAGE: CHITTERING_2135_DEC_2017_MOSAIC (LANDGATE)
SERVICE LAYER CREDITS:

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FAUNA HABITAT

DEEP SPACE FACILITY
BIOMASS CALIBRATION TRANSPONDER
NVCP APPLICATION

STRATHAM ENGINEERING CONSULTANCY SERVICE

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

N

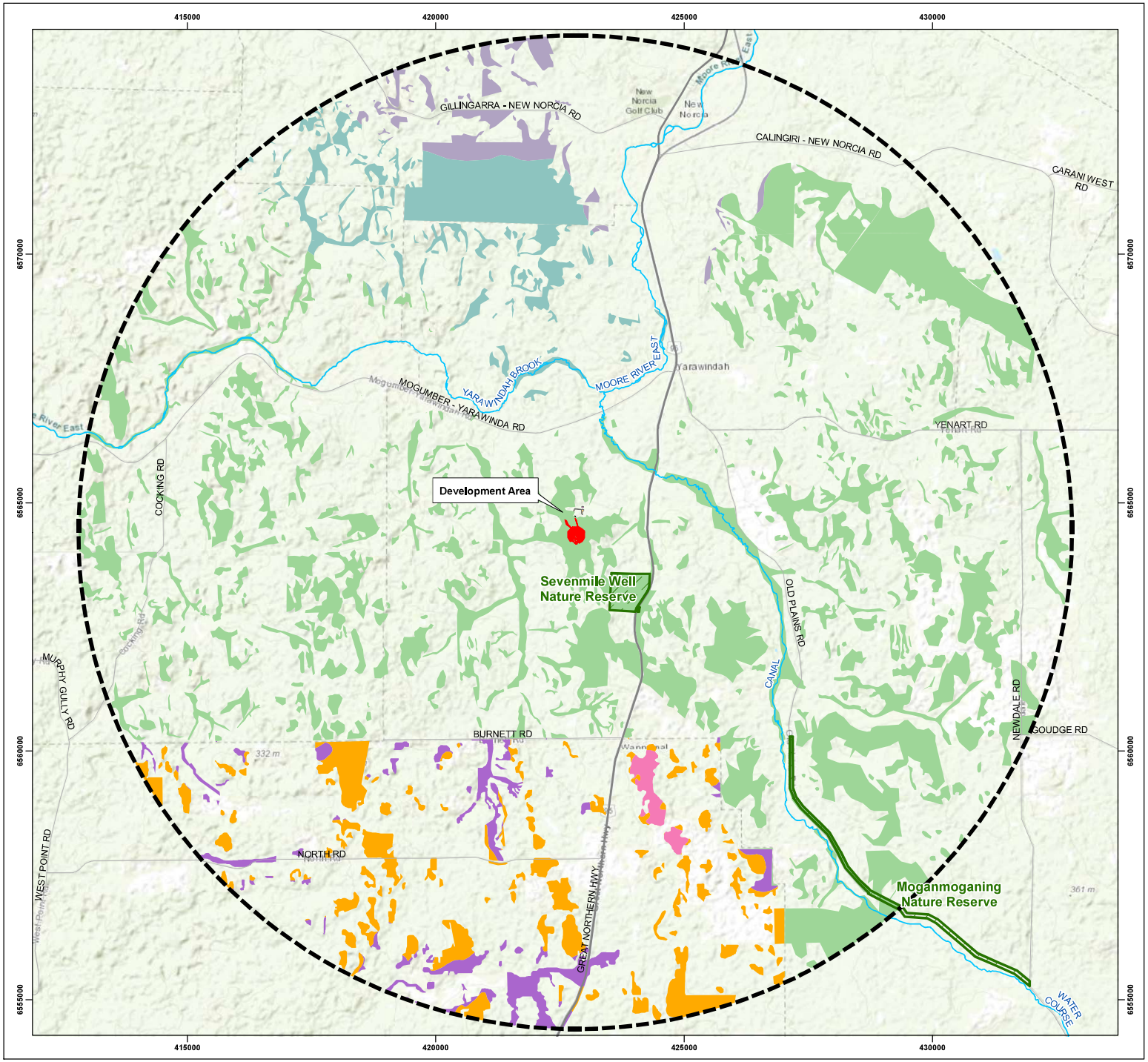
SCALE: 1:3,500 @ A3

0 50 100 150 m

PROJECT NO: 4513-20

REV	AUTHOR	APPROVED	DATE
01	SMB	BVDW	17/03/2021
02	SMB	BVDW	16/09/2021
03	SMB	BVDW	01/11/2021

FIGURE 5



LEGEND

- Clearing Area
- 10 km Buffer of Development Area
- DBCA Reserve (DBCA, 2020)

Potential Carnaby Cockatoo Feeding Habitat in the Jarrah Forest (DBCA, 2018)

- Medium woodland; York gum & wandoo
- Medium woodland; marri & wandoo
- Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* (subhumid zone) and open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla* (semiarid and arid zones) and on deeper soils adjacent to outcrops, closed heath of Myrtaceae-Proteaceae species and lithic complex on granite rocks and associated soils in all climate zones.
- Mosaic: Medium open woodland; wandoo & powderbark wandoo / Shrublands; dryandra heath
- Woodland of *Eucalyptus wandoo* with mixtures of *Eucalyptus patens*, *Eucalyptus marginata* subsp. *thalassica* and *Corymbia calophylla* on the valley slopes in arid and perarid zones.
- Woodland of *Eucalyptus wandoo-Eucalyptus accedens*, less consistently open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla* on lateritic uplands and breakaway landscapes in arid and perarid zones.

DATA SOURCES

BASEMAP: ESRI BASEMAP 2018
SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP, GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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REGIONAL BLACK COCKATOO HABITAT

DEEP SPACE FACILITY
BIOMASS CALIBRATION TRANSPONDER
NVCP APPLICATION

STRATHAM ENGINEERING CONSULTANCY SERVICE

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

SCALE: 1:75,000 @ A3

0 1 2 3 km

PROJECT NO: 4513-19

REV	AUTHOR	APPROVED	DATE
01	SMB	BVDW	17/03/2021
02	SMB	BVDW	16/09/2021
03	SMB	BVDW	01/11/2021

FIGURE 6

LEGEND

- Cadastre (Landgate, 2020)
- Biomass Area (drawing ref: LCA_07_NNO3_BIOMASS) - 8.15 Ha
- Potential Revegetation Area (2.88 Ha)

DATA SOURCES
AERIAL IMAGE: CHITTERING_2135_DEC_2017_MOSAIC (LANDGATE). LANDGATE LOCATE MOSAIC.
SERVICE LAYER CREDITS:

ecoscape

POTENTIAL REVEGETATION AREA

DEEP SPACE FACILITY
BIOMASS CALIBRATION TRANSPONDER
NVCP APPLICATION

STRATHAM ENGINEERING CONSULTANCY SERVICE

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

SCALE: 1:7,000 @ A3

N

0 100 200 300 m

PROJECT NO: 4513-20

REV	AUTHOR	APPROVED	DATE
00	SMB	BVDW	23/09/2021
01	SMB	BVDW	01/11/2021

FIGURE 7

APPENDIX 3

DEEP SPACE FACILITY FLORA AND FAUNA SURVEY

(Source: Ecoscape (Australia) Pty Ltd., 2020)

DEEP SPACE FACILITY FLORA AND FAUNA SURVEY

Stratham Engineering Consultancy Service

ecoscape

Revision	Author	QA Reviewer	Approved	Date
Draft rev0	[redacted]	[redacted] Scientist	[redacted] Scientist	29/06/2020
final	[redacted]	[redacted] Managing Director	[redacted] Managing Director	1/09/2020

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

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ACKNOWLEDGEMENTS

Ecoscape would like to acknowledge the assistance of [redacted] 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.

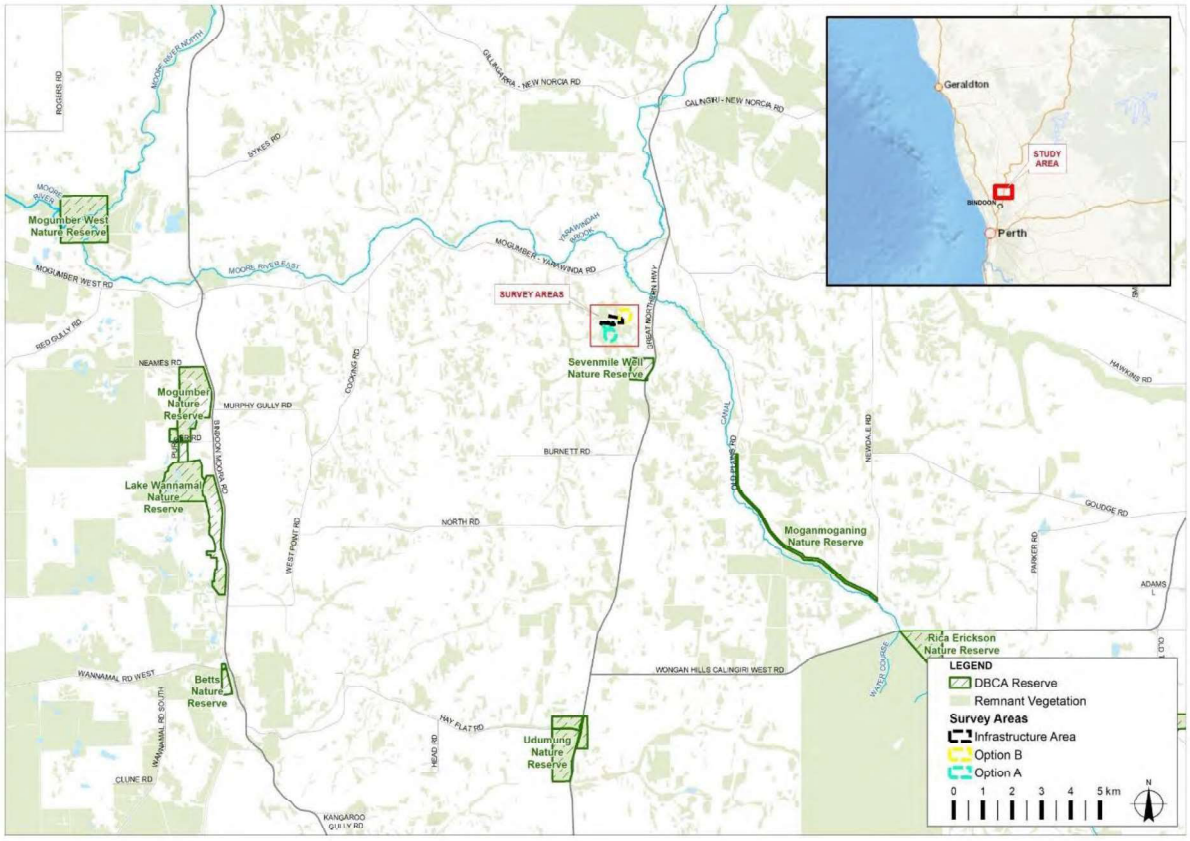


Figure 1: Survey area location

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.

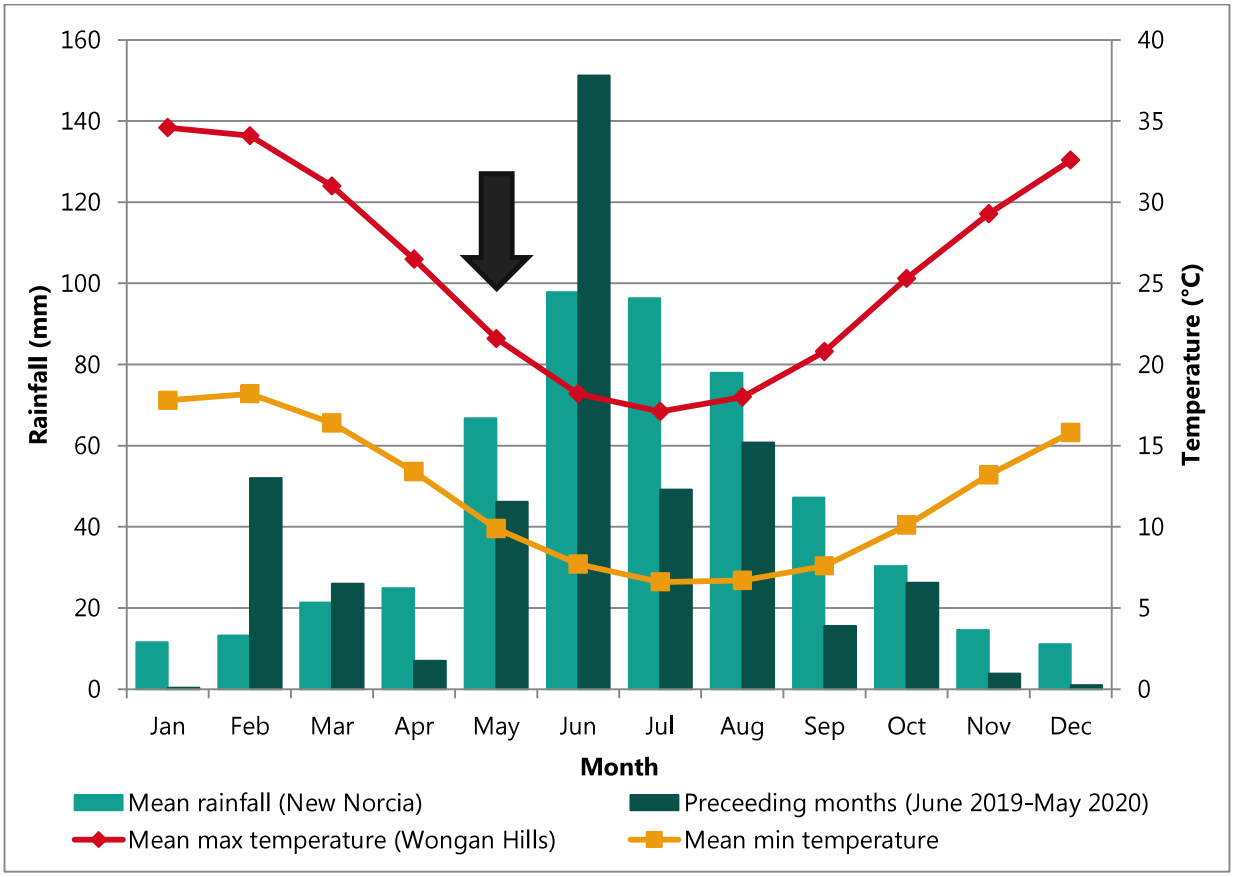


Figure 2: Rainfall and temperature data for the survey area (BoM 2020; New Norcia and Wongan Hills). The arrow indicates the survey period.

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 [redacted] (Environmental Scientist, flora licence [redacted] 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 [redacted] (Environmental Scientist/Zoologist) during 26-28 May 2020, with results checked by [redacted] (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.

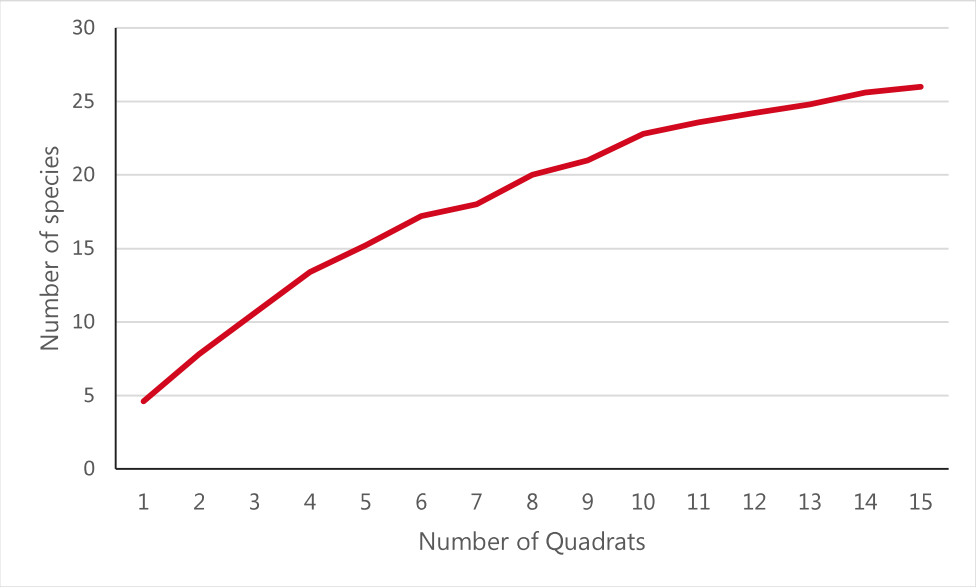


Figure 3: Species accumulation curve using quadrat data

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

4.1.2 FAUNA

The fauna survey was conducted by [redacted] 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 [redacted] 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.

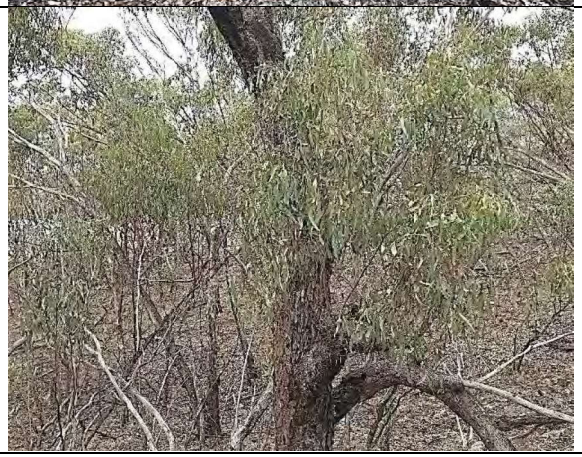
Additional detail is provided in **Table 13**.

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	**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*	0.19 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 [redacted] 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

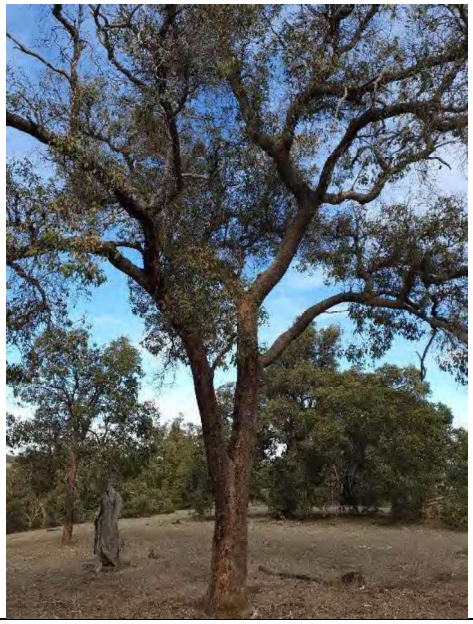
Eighteen vertebrate fauna species were recorded during the field survey over all sites (**Table 9** in **Section 4.1.3**); all, or evidence of their presence, were recorded within the Infrastructure site. None are conservation-listed.

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 [redacted] 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:

- **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
- **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 (**ElW**, **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 (**ElW** 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.

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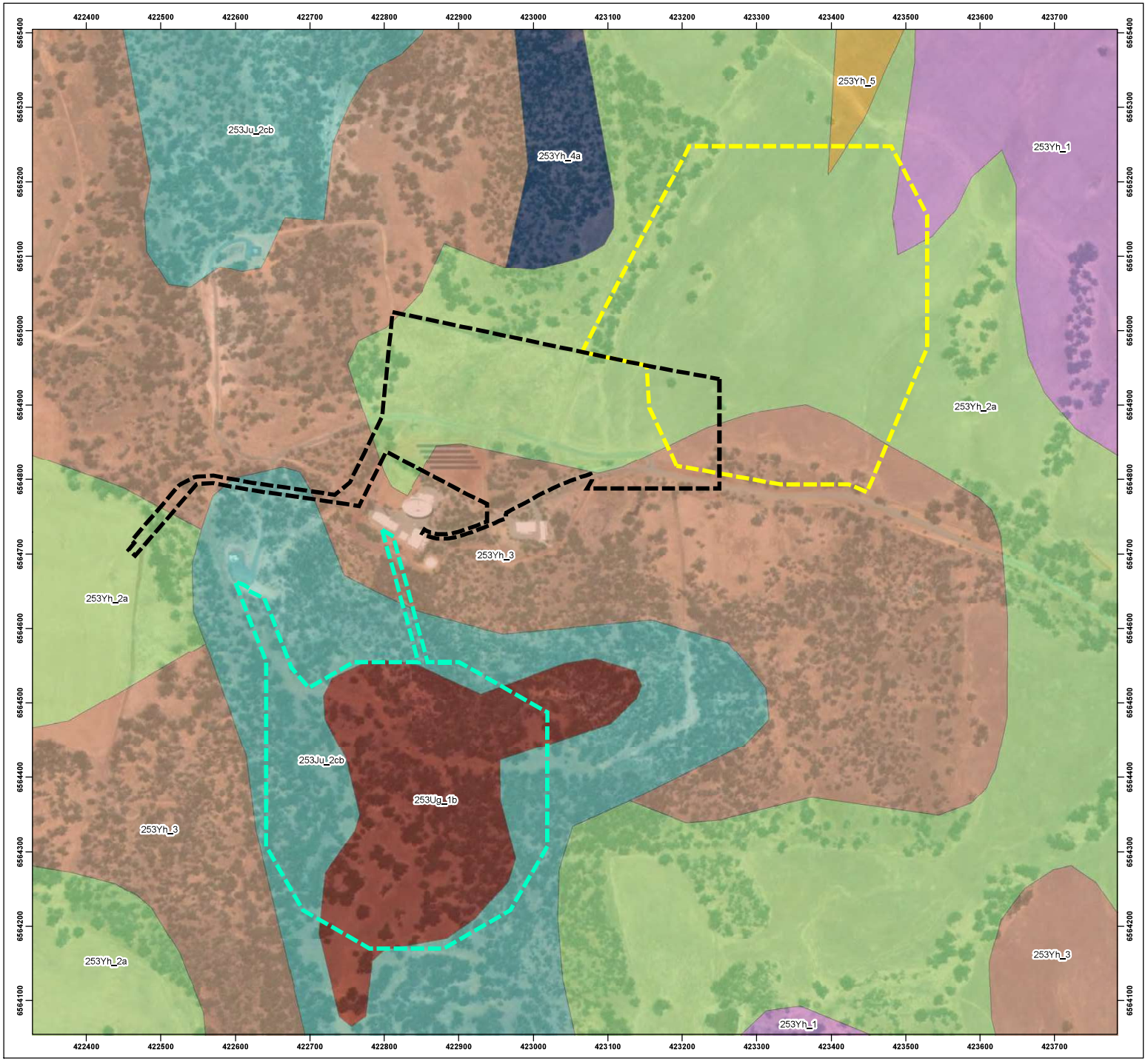
MAPS



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

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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SOIL LANDSCAPE SYSTEMS

DEEP SPACE FLORA, VEGETATION AND BLACK COCKATOO SURVEY

STRATHAM ENGINEERING CONSULTANCY SERVICE

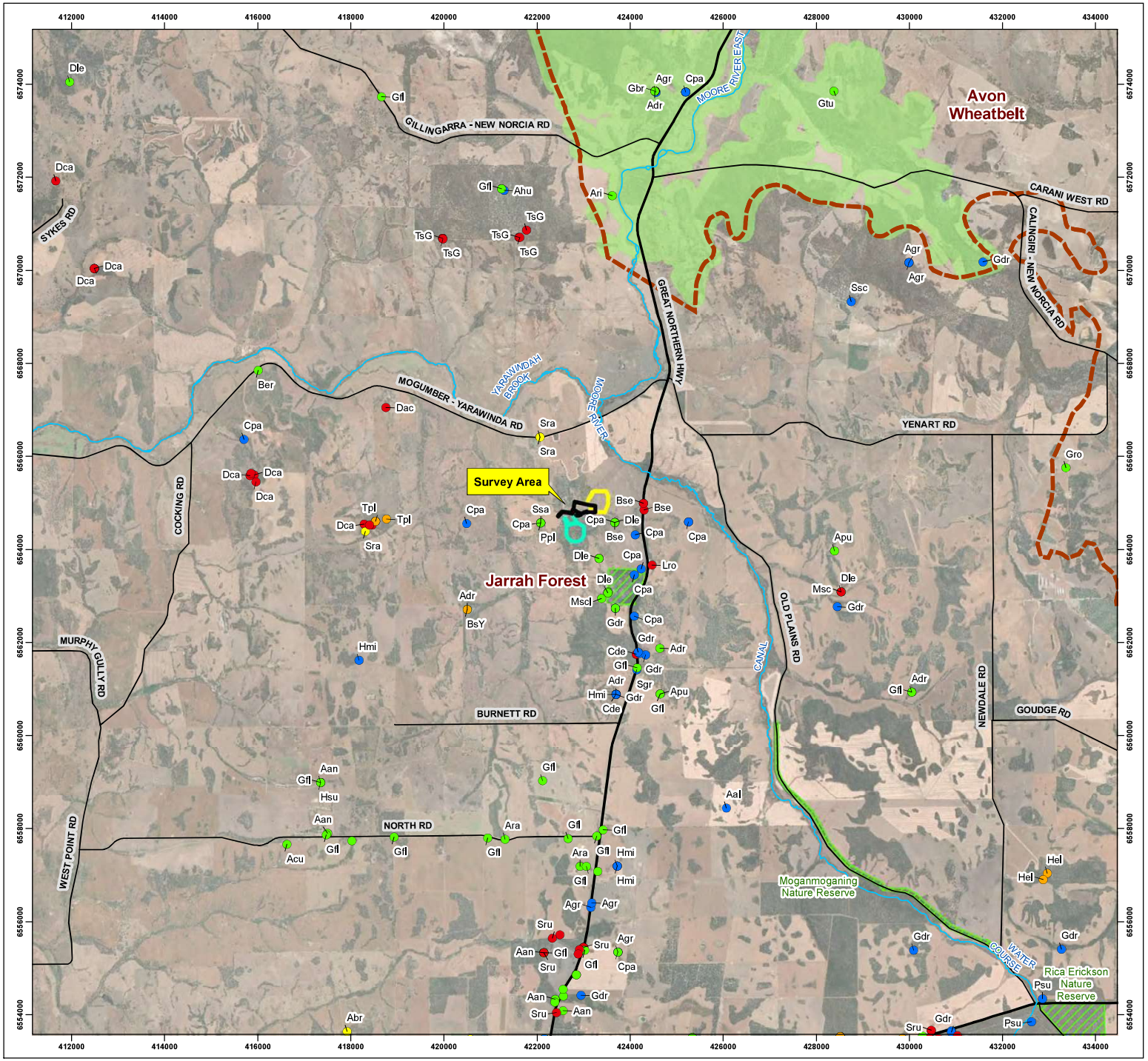
COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:5,000 @ A3

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	*Asteridea 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 minuta*	4
Hsu	*Hibbertia subglabra*	3
Lce	*Lasiopetalum cenobium*	1
Lro	*Lasiopetalum rotundifolium*	T
Msc	*Melaleuca scitostyla*	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. *ecmagis*	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

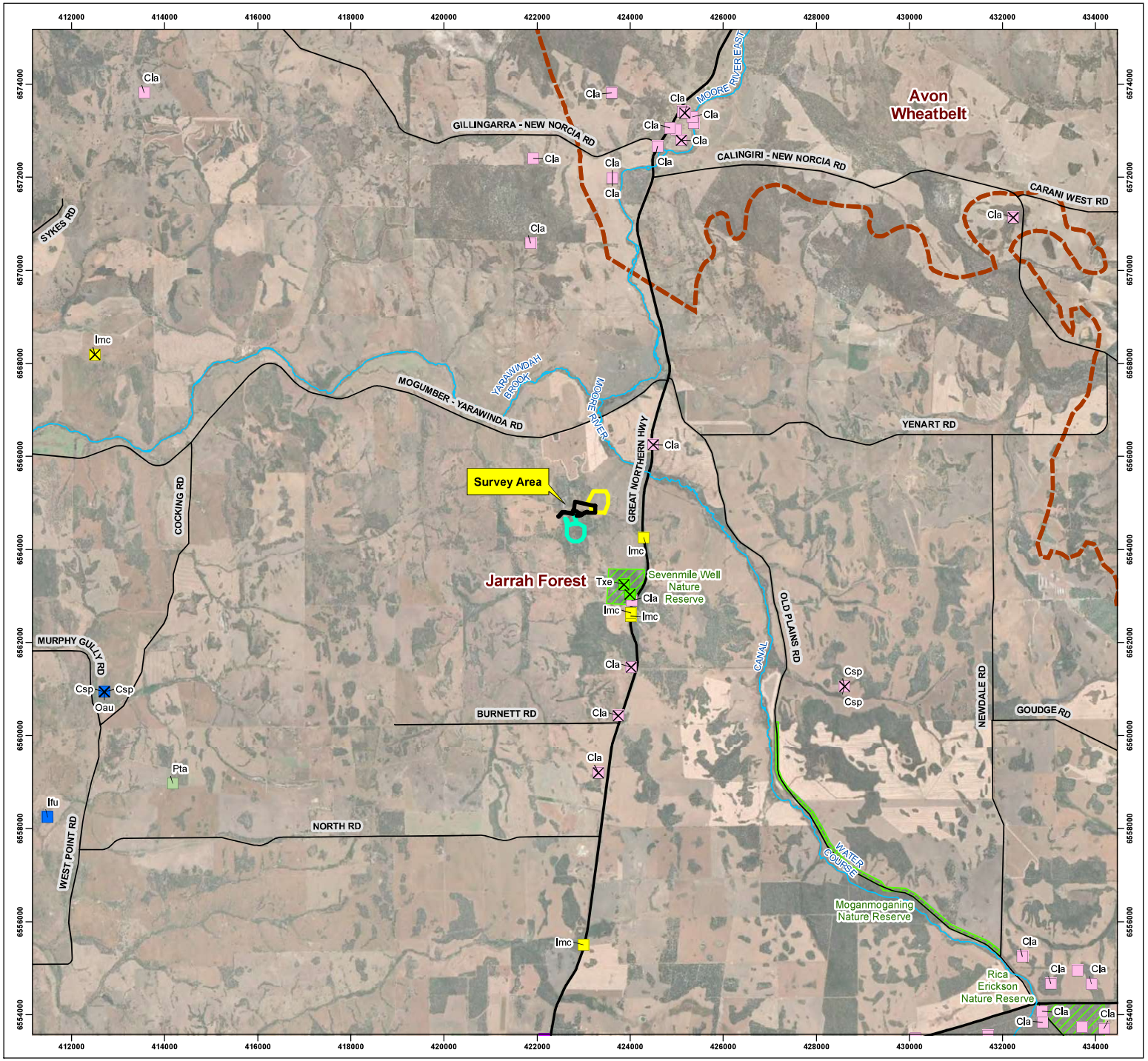
COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

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

N

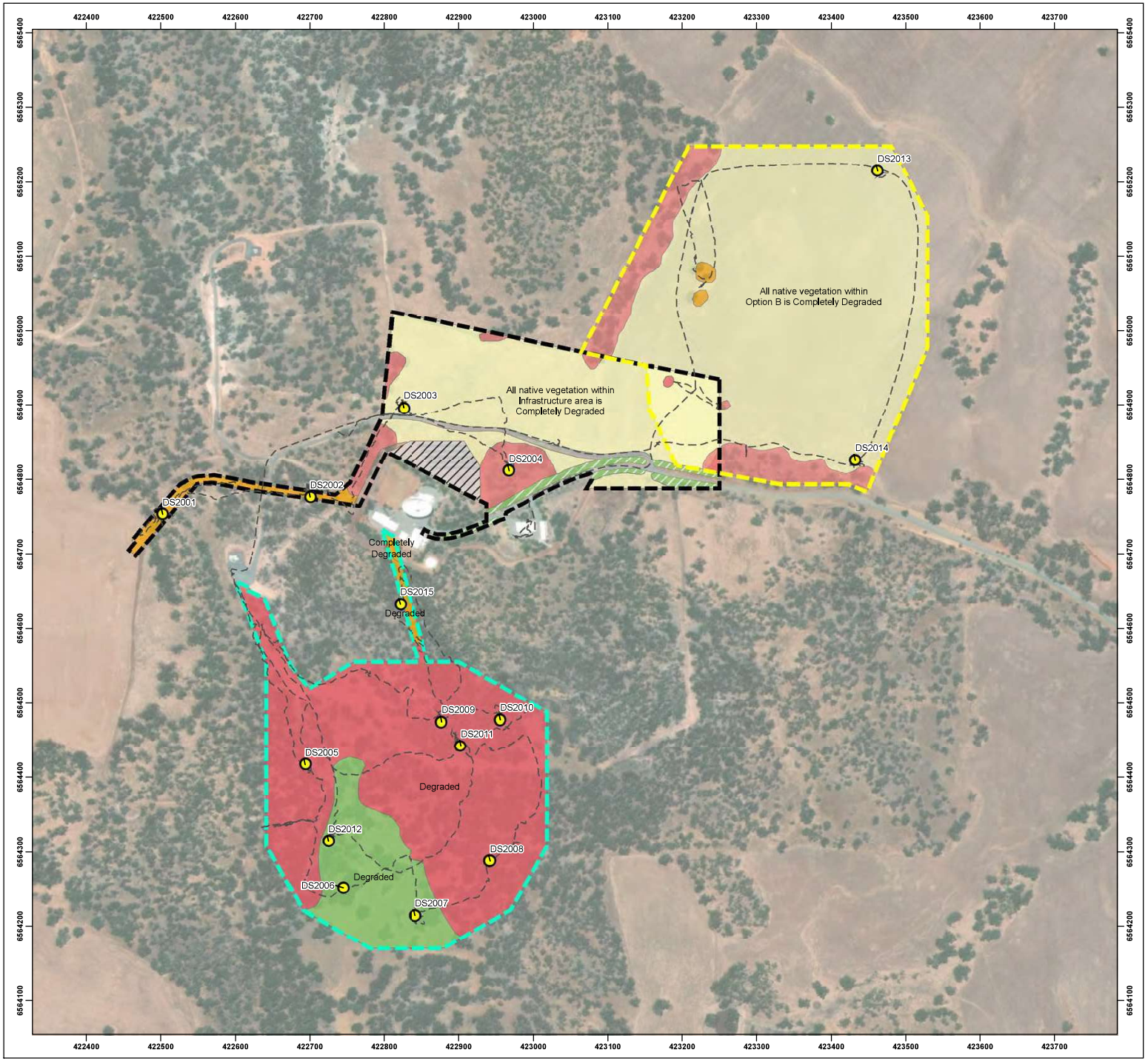
SCALE: 1:80,000 @ A3

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

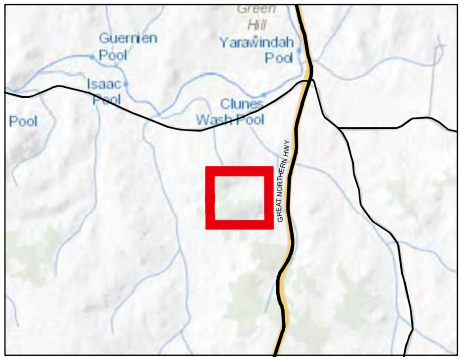
- Infrastructure Area
- Option A
- Option B

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 (EIW) - *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



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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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

N

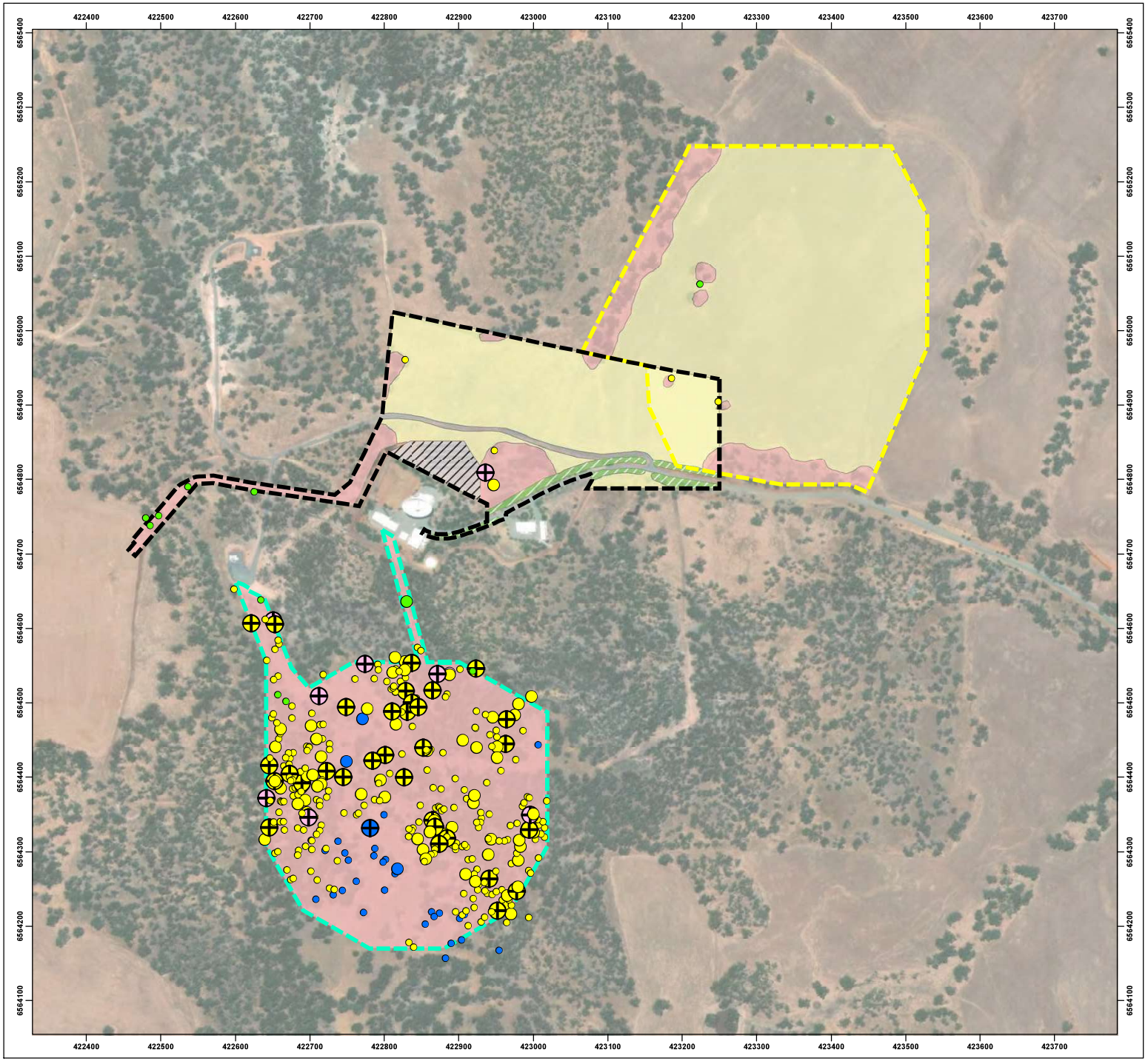
SCALE: 1:5,000 @ A3

0 50 100 150 200 m

PROJECT NO: 4502-19

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

MAP 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

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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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
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N

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

Australian Government
Department of the Environment and Energy

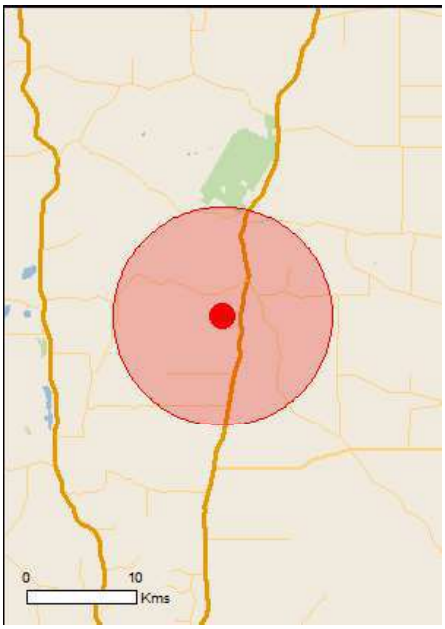
EPBC Act Protected Matters Report

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.

Report created: 05/06/20 18:11:37



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Coordinates
Buffer: 10.0Km

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
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-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
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-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

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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 [redacted] **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 [redacted] **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 [redacted] **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 [redacted] **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 [redacted] **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 [redacted] **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 [redacted] **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 [redacted] **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 [redacted] **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 [redacted] **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 [redacted] **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 [redacted] **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 [redacted] **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 [redacted] **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 [redacted] **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

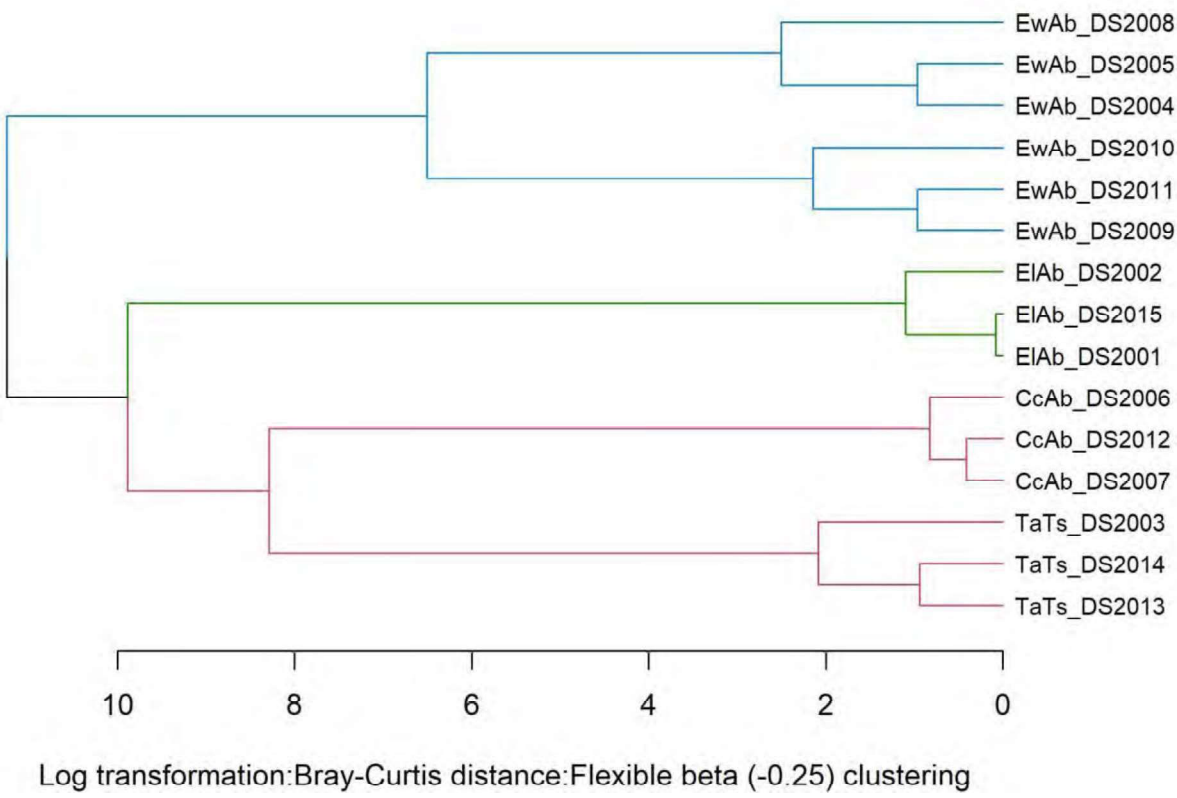

Figure 4: Floristic dendrogram. Note that the vegetation type codes indicated are preliminary.

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 Hollows


11 Wandoo 3 Hollow no chew


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Tree_288Marri5 No Hollows


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Tree_291Marri5 No Hollows


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APPENDIX 5

TARGETED FLORA SURVEY AND CARNABY'S BLACK COCKATOO ADDITIONAL INFORMATION

(Source: PGV Environmental, 2021)

pgv ENVIRONMENTAL

[redacted]

ABN 44 981 725 498
Knightside Nominees Pty Ltd

7 September 2021

[redacted]

Trustee for the Sheffield Family Trust.
Trading as Stratham Engineering Consultancy Service.
[redacted]

Dear [redacted]

RE: Deep Space Facility, New Norcia - Targeted Flora Survey and Carnaby's Black Cockatoo Additional Information

Following are the results of our targeted flora survey and Carnaby's Cockatoo habitat assessment in the footprint of the proposed Deep Space Facility near New Norcia.

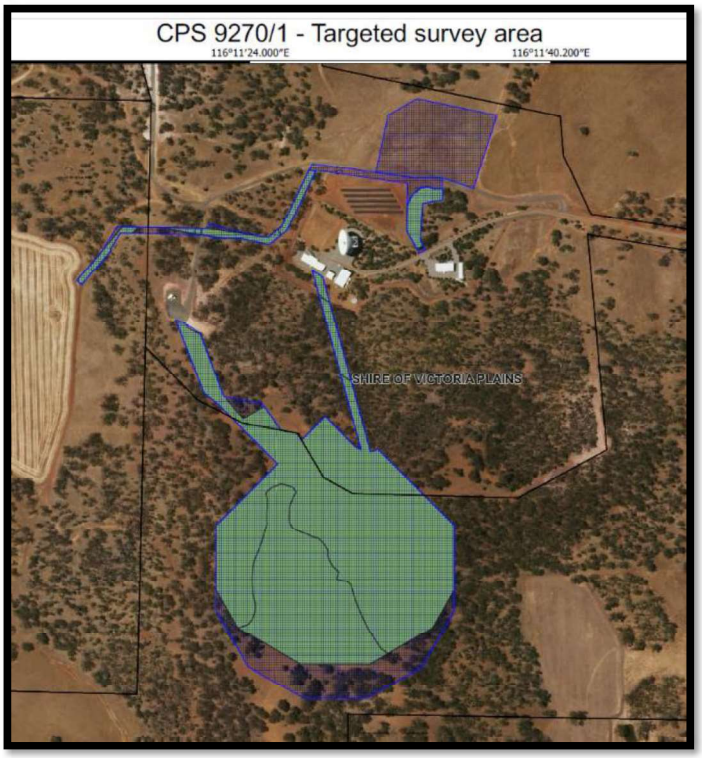
1 Background

The proposed Deep Space facility near New Norcia requires the clearing of native vegetation. The proponent has lodged a Clearing Permit Application (CPS 9720/1) to clear approximately 11.69 ha. Additional information requested by the Department of Water and Environmental Regulation (DWER) includes:

An additional targeted flora and vegetation survey is required for the area marked within the attached map (CPS 9270/1 – Targeted survey area) within the flowering time for threatened species Spirogardnera rubescens (T), Banksia serratuloides subsp. serratuloides (T), Melaleuca sciotostyla (T) (Attachment 1).

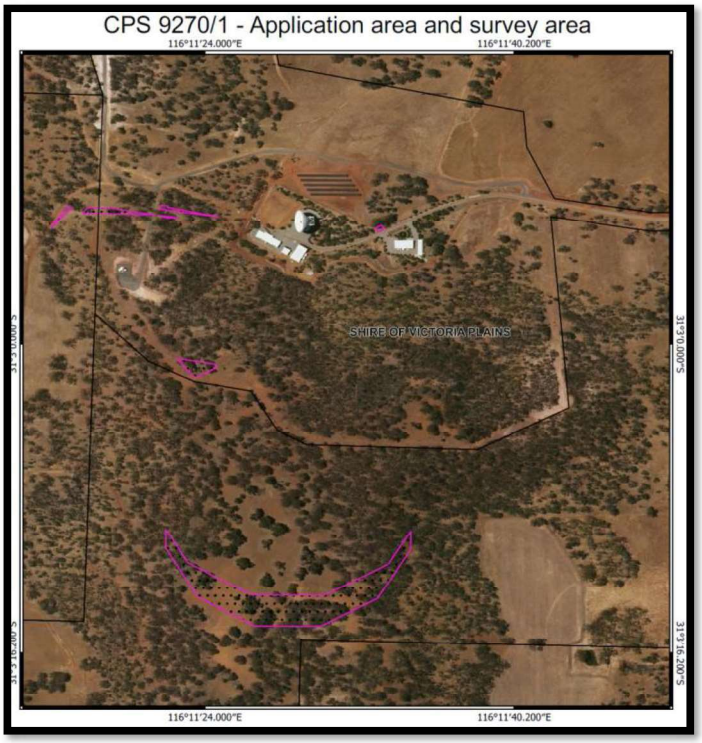
The survey areas for the targeted flora survey are the green coloured areas shown in Plate 1.

Plate 1: Targeted Flora Survey Area (green)



The preliminary assessment by DWER also noted that there are areas within the application area that have not been surveyed for Black Cockatoo Habitat (shown below outlined in pink).

Plate 2: Area deemed by DWER to require additional Carnaby's Black Cockatoo Tree survey



2 Targeted Species

A description of the three Threatened species identified by DWER for the targeted flora survey follows.

2.1 Spirogardnera rubescens

Spirogardnera rubescens also known as Spiral Bush, is an erect, open plant to 1.6 m tall, with succulent, light green flowering branches which twist in a spiral shape. There are reddish bracts on these stalks to 0.4 cm long and the flowers are arranged in sessile clusters, each with four flowers and up to 20 clusters along each stalk. The flowers are 0.2 cm long, with five perianth lobes, white on the outside and yellow-green with fine hairs on the inside. There are five stamens opposite the petals. The fruit is stalkless and succulent, surrounded by the persistent perianth segments, which become dark red with age (George, 1984). *Spirogardnera rubescens* is found in gently undulating country in a number of ecological communities.

Spirogardnera rubescens flowers between August and December (DBCA, 2021).

2.2 *Banksia serratuloides* subsp. *serratuloides*

Banksia serratuloides subsp. *serratuloides* and also known as Southern Serrate Dryandra, is a low, compact shrub, growing to 1 m tall and 1.2 m in diameter. The leaves, up to 8 cm long, are crowded on erect branches. They are paler on the underside and divided almost to the midrib, forming long flat lobes which are quite rigid. The flower heads are axillary, surrounded by lanceolate bracts which are hairless on the back and with white woolly ciliate margins that later become smooth. The yellow flowers are up to 2.5 cm long, with the outer floral whorl covered with silky hairs. The long, hairless style has a narrow, furrowed, darker coloured stigmatic end (George, 1996; Brown *et al*., 1998; Patrick & Brown, 2001).

Banksia serratuloides subsp. *serratuloides* grows in dense low heath, sometimes in open low woodland of *Eucalyptus wandoo* or *E. drummondii* or mallee eucalypt. It is found growing in lateritic gravel and brown loam on ridge tops or slopes in red-brown clay sand in lower areas (DBCA, 2021). This species flowers in July to September (DBCA, 2021).

2.3 *Melaleuca sciotostyla*

Melaleuca sciotostyla is a shrub growing up to 1.5 m tall. It has flat leaves 5–8 mm long and the inflorescence occurs at the tips of branches and usually consists of four pink/cream flowers. The fruit is barrel-shaped and papery or somewhat corky (Barlow and Cowley, 1988). Wongan Melaleuca grows in orange clayey sand with lateritic pebbles and scree slopes in dense shrubland. Associated species include *Eucalyptus erythronema, Eucalyptus obtusiflora and Eucalyptus sheathiana* (Stack *et al*., 2006).

Melaleuca sciotostyla flowers in August (DBCA, 2021).

3 Methodology

The targeted survey was undertaken on 3 September 2021 b y [redacted], a botanist with more than 30 years' experience in Western Australia. The survey was undertaken at a time when all species are within their flowering period, although at the end of the *Melaleuca sciotostyla* flowering time. *Melaleuca sciotostyla* is readily identifiable by its corky branches and fruit and does not need flowers for identification.

The targeted survey included walking parallel traverses through the main survey area on the hill and along the linear tracks that are proposed to be upgraded to access tracks and roads. As all three plants are medium sized shrubs and the understorey is very open, a spacing of 20m was considered appropriate between traverses. The track log for the survey area is shown in Attachment 2. A total of 8.4km was walked.

The Carnaby's Black Cockatoo habitat assessment was to be done as per DWER instructions being:

> *… survey is required to identify all trees that have a diameter, measured at 1.3 metres from the base of the tree, of 30 centimetres (for Wandoo trees) or 50 centimetres (for Corymbia calophylla) or greater that contain a hollow(s) that may be suitable for breeding by Carnaby's cockatoo. The survey must document:*
>
> - *the date(s) of the survey;*
> - *the GPS locations (i.e. eastings and northings or decimal degrees) of all trees identified as containing hollows which may be suitable for black cockatoos;*
> - *the methodology for determining the evidence of use of each hollow; and*
> - *a description/photo of the evidence of use.*

4 Results

4.1 Targeted Flora Search

The survey of the proposed roads and access tracks was mostly through Wandoo (*Eucalyptus wandoo*) and York Gum (*Eucalyptus loxophleba*) over an understorey of pasture and introduced species, particularly Capeweed (*Arctotheca calendula*) and Oats (*Avena fatua*), with very few to no native species (Plate 3).

Plate 3: Wandoo and York Gum over weeds.

The vegetation in the main survey area on the hill was a mixture of Wandoo on the upper slopes and hilltop and Marri (*Corymbia calophylla*) on the hill top, particularly at the southern end. Some native understorey shrubs occurred on the north-east breakaway, including *Trymalium odoratissimum* and *Melaleuca marginata* (Plate 4). Other breakaways were very sparsely vegetated (Plate 5).

Plate 4: Wandoo over *Trymalium odoratissimum* and *Melaleuca marginata* on north-east breakaway

Plate 5: Wandoo over bare understorey on western breakaway

Very few native shrubs were observed on the hilltop (Plate 6 and 7).

Plate 6: Wandoo over bare understorey on hill top

Plate 7: Marri over bare understorey on hill top

No plants of either of the three Threatened species were observed during the survey.

4.2 Carnaby's Black Cockatoo Habitat

Comparison of the Ecoscape tree survey and the area of proposed clearing on site confirmed that the Ecoscape survey did cover the whole clearing permit application area. PGV Environmental identified one additional Marri tree at the southern end of the site that was not included in the Ecoscape report. Details of the Marri tree are:

- Height – 25m
- DBH – 91cm
- Hollows – No hollows
- Co-ordinates: - 422802E 6564194N (Plate 8)

Plate 8: Additional Significant Marri Tree

5 Summary and Conclusion

The targeted flora survey did not record any Threatened species in the areas proposed to be cleared. The very open, almost bare understorey over most of the site made observations very easy.

An on-site assessment of the Ecoscape tree survey concluded that the survey covered the clearing permit application area. One additional large Marri tree was recorded at the southern end of the hill. The tree did not have any hollows.

Please contact me if you would like to discuss any aspects of this report.

Yours sincerely

[redacted]
Managing Director

6 List of Attachments

Attachment 1: DWER Request for Additional Information
Attachment 2: Track Log

7 References

Barlow BA and Cowley KJ (1988). Contributions to a Revision of *Melaleuca* (Myrtaceae): 4 6. *Australian Systematic Botany*. 1(2).

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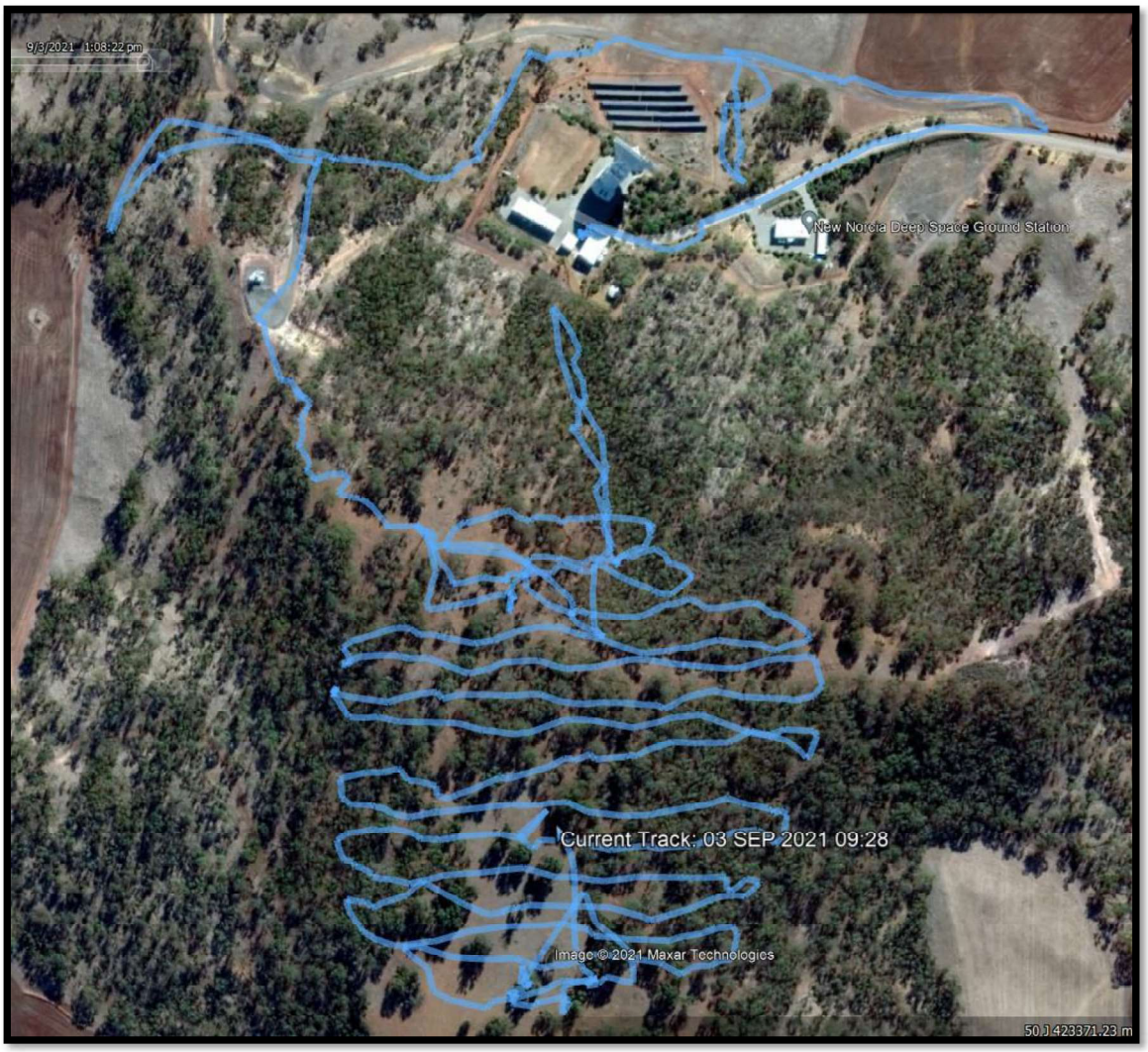
Patrick, SJ & Brown, AP, 2001, *Declared Rare and Poorly Known Flora in the Moora District*, Wildlife Management Plan No 28, Department of Conservation and Land Management, Western Australia.

Stack G, Willers N, Fitzgerald M and Brown, A (2006). *Declared rare and poorly known flora largely restricted to the Shire of Wongan-Ballidu.* Department of Conservation and Land Management, Western Australia.

ATTACHMENT 2

Track Log


9/3/2021 1:08:22 pm
New Norcia Deep Space Ground Station
Current Track: 03 SEP 2021 09:28
Image © 2021 Maxar Technologies
50 J 423371.23 m

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M:[redacted]
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