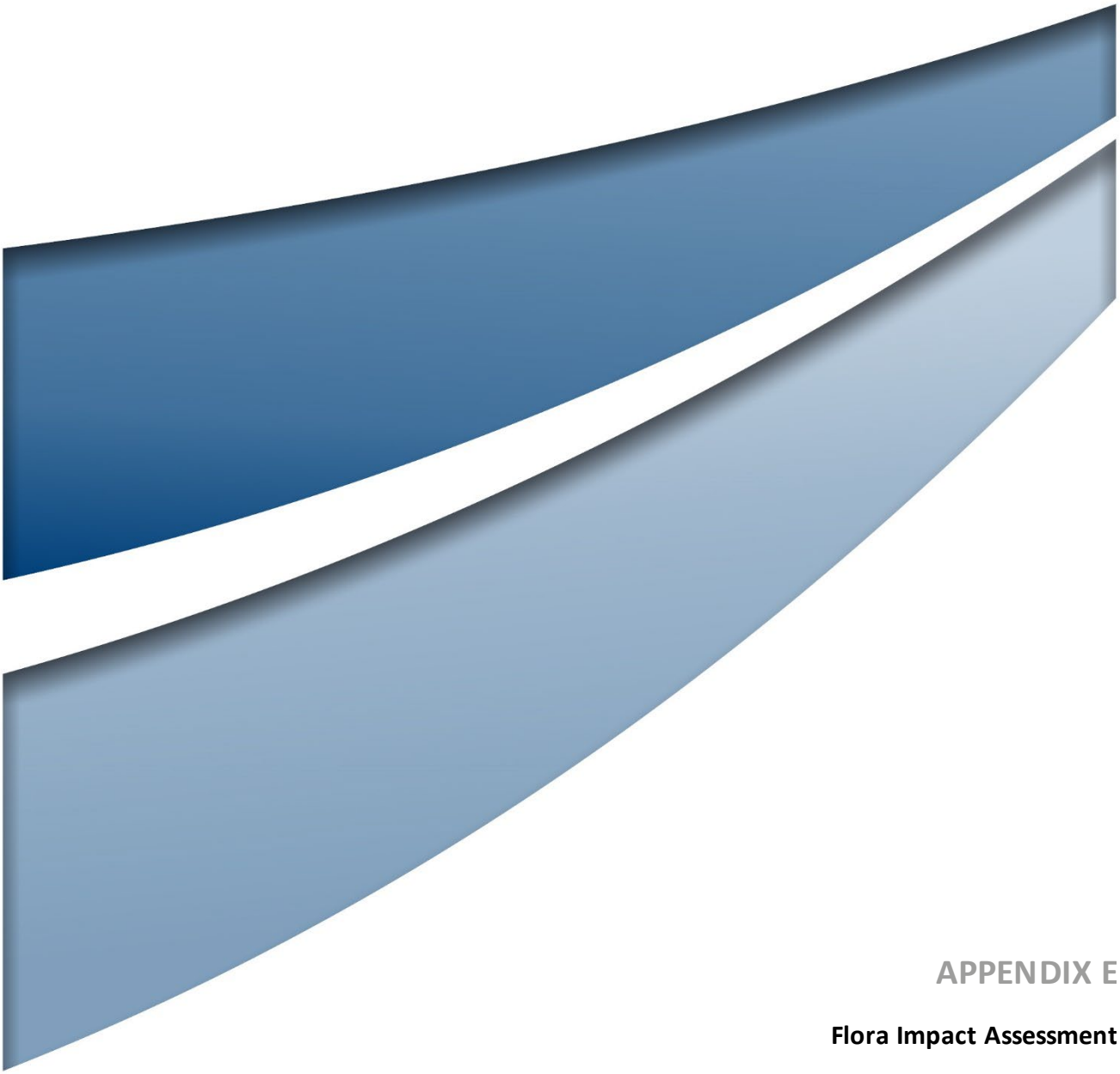

APPENDIX E

Flora Impact Assessment

umwelt
Environmental & Social Consultants

NEOEN

TERRESTRIAL FLORA ASSESSMENT

Mount Hopeful Wind Farm

FINAL

May 2023

TERRESTRIAL FLORA ASSESSMENT

Mount Hopeful Wind Farm

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
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Report No. 7053/R03
Date: March 2023

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This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

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Appendices

1.0 Introduction

Umwelt (Australia) Pty Ltd (Umwelt) has prepared this terrestrial flora and vegetation assessment report on behalf of Neoen Australia Pty Ltd (Neoen) in support of a Development Application (DA) for the proposed Mount Hopeful Wind Farm (the Project).

The Project will involve the construction and operation of up to 63 wind turbine generators and ancillary wind farm infrastructure, located approximately 45 kilometres (km) south of Rockhampton and 65 km west of Gladstone within the Central Queensland Region (**Figure 1.1**). The Project is expected to have a maximum generation capacity of approximately 400 megawatts (MW) and will supply energy to the future Queensland Renewable Energy Zone (QREZ).

Subject to conditions, the Project was granted approval by the Queensland State Assessment and Referral Agency (SARA) on 17 June 2022 (SARA Reference 2109-24892 SDA). However, the Project scope and design underwent further refinement in late 2022. This report, which was originally submitted as part of the DA, has been updated to reflect the latest Project design current as of 2023.

The Project is also currently in the process of attaining approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Project was referred to the Commonwealth in 2021 (EPBC Reference 2021/9137) and deemed a controlled action. It is undergoing further assessment via Preliminary Documentation.

1.1 Project Areas

Four distinct areas / boundaries are relevant to the Project and this assessment, described in the subsequent sections.

1.1.1 Study Area

The Project is proposed over 17 land parcels and numerous road reserves, which cover an area of 16,758 hectares (ha), collectively referred to as the Study Area (**Figure 1.1**). **Table 1.1** details the lot plan identifiers for land parcels contained within the Study Area. The Study Area occurs across two local government areas: The Banana Shire Council and the Rockhampton Regional Council (**Figure 1.1**).

Table 1.1 Study Area Land Parcels

Lot and Plan		
100 SP289441	2057 RAG4059	24 RN34
148 DS151	21 RN1345	25 RN25
15 RN1089	21 RN46	30 RN72
1933 RAG4058	2345 DT4077	33 DT40123
2039 RAG4056	23 RN25	38 DT40131
2420 DT4077	50 DT40144	-

1.1.2 Ground-truthed Mapping Extent

The Ground-truthed Mapping Extent covers approximately 12,924 ha and represents the limit of the vegetation mapped within the Study Area. Due to the dynamic nature of the Project, some areas surveyed no longer fall within the Study Area boundary, and within the Study Area, not all areas of each land parcel were entirely surveyed. It should be noted that this boundary does not represent the spatial bounds in which all Project field surveys have been conducted (this area being larger and including areas outside of the Study Area).

1.1.3 Development Corridor

The Development Corridor is a 'buffered' version of the indicative Project layout, covering approximately 1,347 ha. This area represents the maximum spatial extent where disturbance may occur within the Study Area and includes areas required for temporary and permanent Project infrastructure, equipment and materials laydown, installation and access.

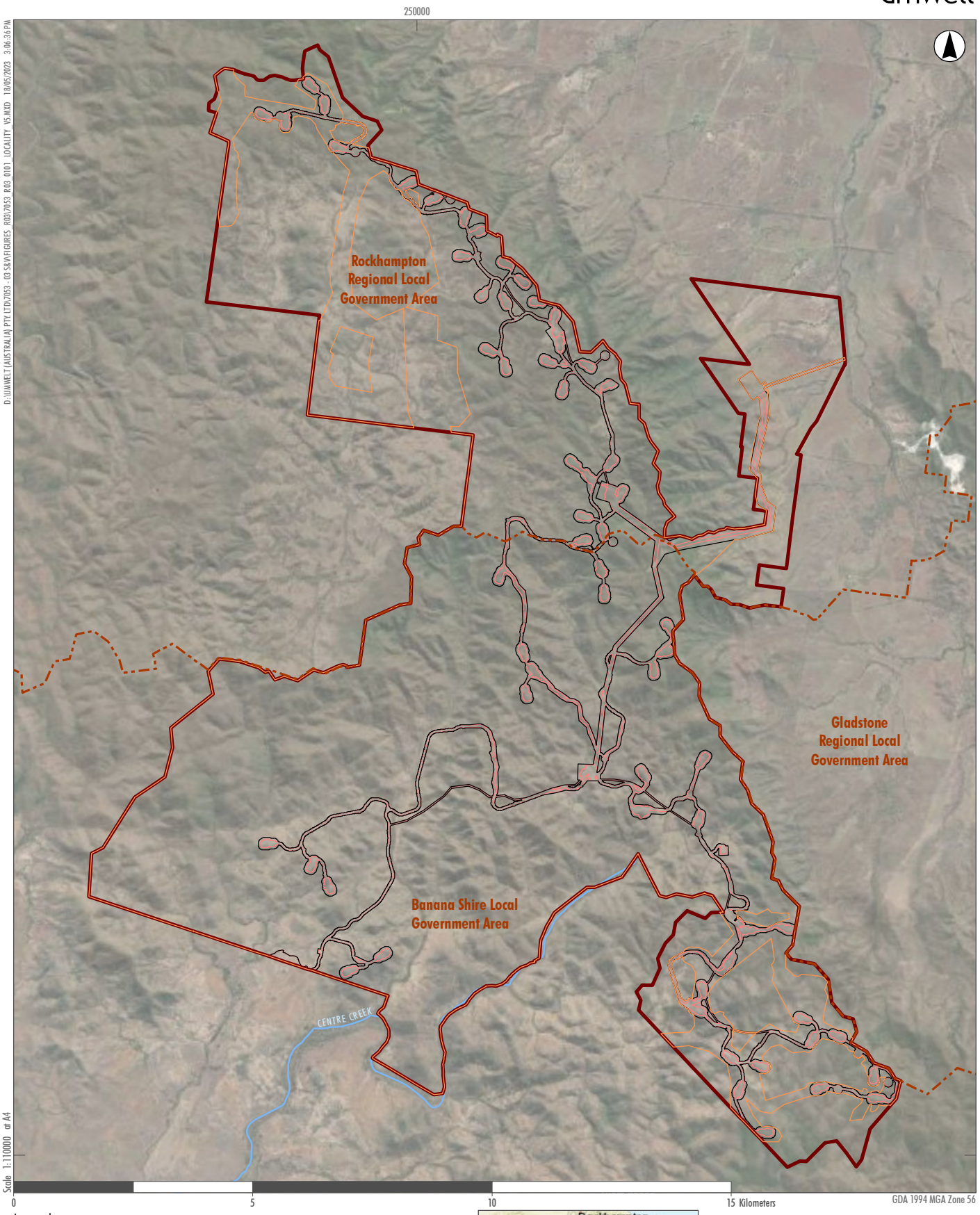
1.1.4 Disturbance Footprint

The Disturbance Footprint covers approximately 877.5 ha and represents the maximum extent of clearing works and the indicative locations of Project infrastructure. It is a 'worst-case' scenario in terms of the extent of clearing works. The impact assessment on flora values refers to clearing areas that are based on the Disturbance Footprint. As infrastructure will be micro-sited within the Development Corridor, the final clearing areas are anticipated to be lower than detailed in this assessment (described further in **Section 5.0**).

1.2 Aim and Scope of Works

The aim of the assessment was to identify and characterise the terrestrial flora and vegetation values within the Study Area and undertake an assessment of potential impacts resulting from the Project on those values. The following scope of work has been completed to identify and assess these values:

- Literature and database review of available resources relating to flora and vegetation values within the Study Area.
- Flora and vegetation surveys to confirm the values identified during the literature review and to:
    - further define the presence and diversity of terrestrial flora
    - determine the presence or likely presence of conservation significant flora species and associated habitat
    - describe and map the vegetation communities across the Study Area, ground-truth the State Regional Ecosystem mapping and identify and map the presence of any threatened ecological communities
    - identify the occurrence of introduced flora species.
- Address the requirements of the State Development Assessment Provisions (SDAP) Code 16 and 23.
- Identify any significant residual impacts on terrestrial flora values in the context of relevant legislation.
- Recommend measures to avoid or mitigate potential impacts on terrestrial flora and vegetation values at the design, construction, and operational phases of the Project.



Legend

- Study Area
- Ground Truthed Survey Extent
- Development Corridor
- Disturbance Footprint
- Local Government Area (LGA)
- Town
- Road

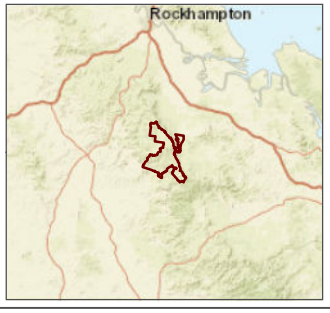


FIGURE 1.1

Study Area and Ground Truthed Survey Extent

Image Source: ESRI Basemap (2021) Data source: Queensland Spatial (2020)

2.0 Legislation

Table 2.1 Flora Legislation

Relevant Legislation	Governing Agency	Summary	Project Relevance
Commonwealth Legislation			
Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Department of Agriculture, Water, and the Environment (DAWE)	The EPBC Act is Australia's key piece of environmental legislation. It outlines nine Matters of National Environmental Significance (MNES). Actions that adversely affect MNES may be deemed to be a controlled action under the EPBC Act.	The following MNES is relevant to the Project: • Threatened Species and Ecological Communities
State Legislation			
Nature Conservation Act 1992 (NC Act)	Department of Environment and Science (DES)	The purpose of the NC Act is to conserve biodiversity by creating and managing protected areas, managing and protecting native wildlife, and managing the spread of non-native wildlife. *Flora survey trigger map* The flora survey trigger map identifies high-risk areas where endangered, vulnerable or near threatened native plants are present or are likely to be present. The map is used to determine requirements to be considered before clearing native plants.	Where a proposed development will result in impacts to flora and or fauna protected under the NC Act, authorisation from the Director General of the DES is required. The following values under the NC Act are relevant to the Project: • Threatened flora species, and • High-risk areas for protected plants.

Relevant Legislation	Governing Agency	Summary	Project Relevance
Vegetation Management Act 1999 (VM Act)	Department of Resources (DoR)	The purpose of the Vegetation Management act is to regulate the clearing of vegetation in a way that conserves Regional Ecosystems (REs), to prevent the loss of biodiversity and maintain ecological processes. REs are vegetation communities in a bioregion that are consistently associated with a combination of geology, landform, and soil (Sattler and Williams, 1999). Under the VM Act, REs are assigned a conservation status based on an assessment of the pre-clearing and remnant extent of each RE.	The Vegetation Management Act will be referred to prior to the development stage to conserve and minimise the impact to remnant and threatened ecosystem. The Project is required to obtain approval under section 22A of the VM Act. The following values under the VM Act are relevant to the Project: • Endangered and Of Concern regional ecosystems. • Remnant vegetation within the defined distance of a watercourse. • Essential Habitat for protected wildlife.
Biosecurity Act 2014	Department of Agriculture and Fisheries	The *Biosecurity Act 2014* lists fauna and flora pest species as either a prohibited or restricted biosecurity matter.	The *Biosecurity Act 2014* defines specific requirements for notification and management actions for all listed biosecurity matters, including specific requirements for the disposal of restricted matters.
Environmental Offsets Act 2014	Department of Environment and Science (DES)	An environmental offset condition may be imposed under certain Queensland legislation that applies to development assessment where the activity is a prescribed activity under the *Environmental Offsets Act 2014.* Activities which have an impact on a Matter of State Environmental Significance (MSES) may require offsetting under the Act.	Consideration of offsetting requirements for the Project will need to be determined once a fixed design for the Project is completed. Requirements will also need to be considered in conjunction with overlapping EPBC Act requirements.
State Development Assessment Provisions	Department of Infrastructure, Local Government and Planning	State code 23 is contained within the State Development Assessment Provisions (SDAP) and applies to a material change of use for a new or expanding wind farm. Development that is a material change of use for a wind farm should demonstrate compliance with 13 performance outcomes (PO) and associated acceptable outcomes within the code.	This Project relates to two matters of interest in SDAP State Code 16 and State Code 23.

3.0 Methods

3.1 Desktop Assessment

Literature and database resources were accessed that related to the flora and vegetation values within the Study Area, with initial reviews conducted in 2019. Subsequent reviews occurred in 2021, 2022 and 2023. These sources included information regarding bioregions, geology, topography, watercourses, connectivity features, vegetation mapping, flora species and conservation significant flora records and habitat. The following key resources were used to prepare this report:

- EPBC Act Protected Matters Search Tool (PMST) for Matters of National Environmental Significance (MNES) (Department of Agriculture Water and the Environment 2022).
- Species Profile and Threats (SPRAT) database for MNES species information (Department of Agriculture Water and the Environment 2023).
- Atlas of Living Australia (ALA) and WildNet database for species records (Australian Government 2021; Queensland Government 2022).
- Queensland Spatial Catalogue (QSpatial) datasets (Queensland Government 2023):
    - Bioregions of Queensland
    - Detailed surface geology of Queensland
    - Vegetation Management Watercourses and Wetlands (Version 6.0 and Version 8.05 respectively)
    - Vegetation Management Regulated Vegetation map (Version 6.05)
    - Vegetation Management Regional Ecosystem map (Version 12.02)
    - Vegetation Management Essential Habitat map (Version 11.05)
    - Matters of State Environmental Significance series
    - Flora Survey Trigger Map for Clearing Protected Plants (Version 9.0).
- Digital imagery (aerial photographs).
- *Methodology for surveying and mapping regional ecosystems and vegetation communities in Queensland* (Version 5.1) (Neldner et al. 2020).
- The Queensland Herbarium Regional Ecosystem Description Database (REDD) for current Regional Ecosystem (RE) descriptions and geological and land zone descriptions.
- *Technical Descriptions of Regional Ecosystems of the Northern Brigalow Belt* (Queensland Herbarium 2018b).

When undertaking the PMST and species database searches, a 10 km search buffer was applied to the Study Area boundary.

The information collected from these sources informed field survey scope and planning, including to determine appropriate survey locations and techniques, as well as the assessment of flora values.

3.2 Field Survey

3.2.1 Timing and Weather Conditions

Field surveys targeting flora values were undertaken across four main survey periods, detailed in **Table 3.1** along with the weather conditions leading up to the surveys. Supplementary floristic data was also collected during an initial site scoping survey between 9–12 June 2019 as well as during fauna surveys undertaken in February, March, and May 2020 (primarily opportunistic observations).

Two additional field surveys were conducted during 2022 relevant to flora. One survey collected BioCondition and habitat quality information to inform Commonwealth offset investigations and the other quantitatively assessed the presence and abundance of *Cycas megacarpa* within the Disturbance Footprint.

Table 3.1 Field Survey Timing and Weather Conditions

Field survey	Survey dates	Survey length (days)	Rainfall in preceding 3 months (mm)*	Temperature (°C) *	
				Min	Max
Flora survey	6-12 August 2019	7	37.3	1.6	26.7
Flora survey	2-7 June 2020	6	144.3	3.9	24.3
Flora survey	7-11 November 2020	5	139.1	14.7	32.4
Flora survey	20-24 January 2021	4	191	18.3	32.5
BioCondition and Habitat Quality Assessment	24 – 28 October 2022	5	37.4	17.1	33.7
Targeted *Cycas megacarpa* Population Survey					

*Data extracted from the DES SILO weather model (Queensland Government, 2021) using the central coordinates of the Study Area (-23.85, 150.55).

3.2.2 Flora and Vegetation

The flora and vegetation surveys were undertaken to identify and record vascular flora species and classify and map vegetation communities. The sampling of flora and vegetation was undertaken using the *Methodology for the Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Neldner et al. 2020). Representative examples of each RE were sampled using twenty 'Secondary' plots and 648 Quaternary plots as defined by Neldner et al. (2020). The locations of the survey plots are shown on **Figure 3.1**. Incidental flora species observed during the survey were also recorded to provide a more comprehensive species list.

Specimens of any plant taxa that could not be identified in the field were collected, pressed and dried in accordance with the requirements of the Queensland Herbarium (Bean 2016). Dried specimens were then identified through reference books and keys and through comparison with named species. Nomenclature used in this report follows that of Brown and Bostock (2019). Introduced species are denoted by an asterisk in the text (*).

3.2.2.1 Threatened Ecological Communities

The field validation of threatened ecological communities (TECs) identified as potentially occurring in the desktop assessment was undertaken via a two-step process. The first step involved the identification of analogous REs. Where an analogous REs was located, the vegetation composition and structure were evaluated against TEC condition thresholds and key diagnostic characteristics to determine if the community meets the TEC requirements. Condition thresholds and key diagnostic criteria used in the assessment reflect those detailed in the TEC's respective Conservation or Listing Advice.

3.2.2.2 Targeted *Cycas megacarpa* Survey

During the initial scoping visit to the Study Area in June 2019, it was discovered that the threatened plant *Cycas megacarpa* was present and abundant in the area. Based on this finding a targeted survey methodology was developed in consultation with the Queensland Herbarium to record and quantify individuals across the Study Area.

The presence and abundance of *Cycas megacarpa* was assessed throughout the flora field survey program detailed in **Table 3.1.** In October 2022, a targeted *Cycas megacarpa* field survey was conducted across the Development Corridor to increase the understanding of presence and abundance in this area. The methodology for the targeted *Cycas megacarpa* assessments included the following methods:

- individual point counts (single individuals were recorded with a GPS unit)
- visual counts within a 25 metre (m) radius (a centre point was marked with a GPS and all individuals within a 25 m radius from that point were recorded)
- visual counts within a 50 x 50 m plot (a centre point was marked with a GPS and all individuals within a 50 x 50 m plot were recorded)
- detailed counts within a 50 x 10 m plot (a 50 x 10 m plot was marked out using a 50 m tape and all individuals within 5 m either side of the tape were recorded).

A plot-based sampling approach was used, with 0.25 ha plots established for actual counts or used to categorise populations as part of visual density estimates. At each of the plot-based sites the age class structure (e.g., development class) was recorded for each individual using the following classification:

- Juvenile (<50 cm)
- Sub-adult (0.5–1 m)
- Adult (>1–5 m)
- Large adult (>5 m).

Using this approach, an actual count of individuals was obtained for each point record.

For all the plot-based sample sites (i.e. 25 m, 50 x 50 m and 50 x 10 m) the age class structure (e.g. development class) was also recorded for each individual using the following classification:

- juvenile (<50 cm)
- sub-adult (0.5–1 m)
- adult (>1–5 m)
- large adult (>5 m).

3.2.3 Survey Limitations

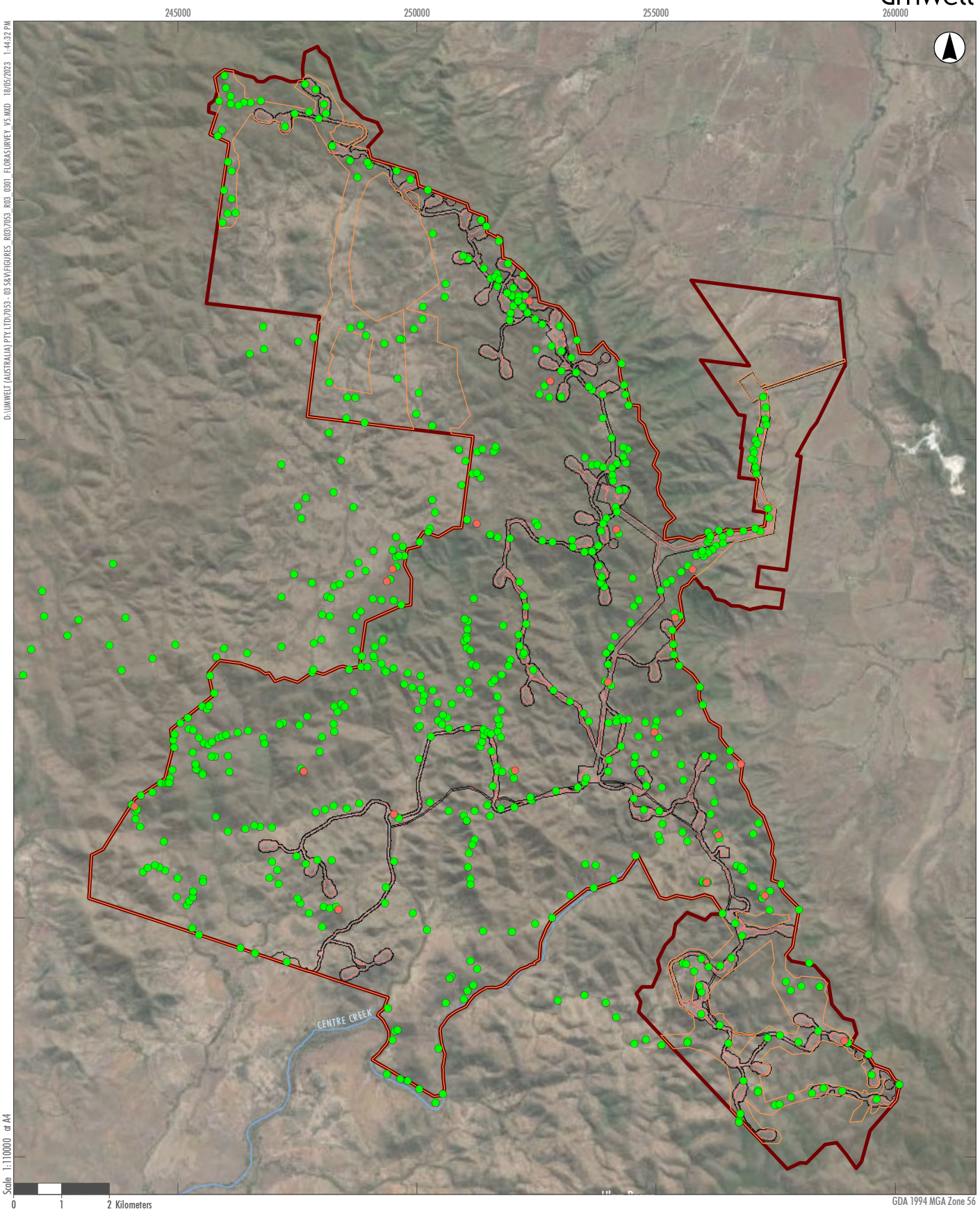
This assessment has been completed using a combination of field-validated data, desktop information and reasonably extrapolated field survey results. As such, the results are subject to the level of accuracy and detail associated with this information.

Land access was a key limitation throughout the field survey program, and particularly affected surveys that required the use of remote locations such as vantage points. Terrain was difficult with tracks generally highly eroded, overgrown, or poorly established, resulting in limited safe access into more remote areas. Potential safety issues as a result of inclement weather also occasionally limited access.

Eucalypt woodland community types were well sampled; however, the semi-evergreen vine thicket communities were less represented due to the thick vegetation and steep slopes. This lack of coverage has been considered when undertaking the likelihood of occurrence assessment (**Section 3.3**).

The flora survey undertaken between 6-12 August 2019 was undertaken in late winter after a long period of extended drought. There was a noticeable lack of species diversity in the ground layer (e.g. grasses and herbs). The following surveys were undertaken in seasons that provided a good representation of grass and herb species.

While the flora field survey method quantitatively measured *Cycas megacarpa* across the Development Corridor, the site coverage was not systematic (i.e. parallel line searches) and whilst extensive, did not cover the full extent of the habitat available. For this reason, the actual numbers recorded from density plots or species record points, represent the lower bound estimate of the population size within the Ground-truthed Mapping Extent. However, the application of density information was used to project the upper limit of *Cycas megacarpa* individuals using a combination of habitat extent mapping (as verified in the field) and spatial interpolation methods.



Legend

- Study Area
- Ground Truthed Survey Extent
- Development Corridor
- Disturbance Footprint
- Quaternary Sites
- Secondary Sites

FIGURE 3.1

Flora Survey Locations

Image Source: ESRI Basemap (2021) Data source: Queensland Spatial (2020)

3.3 Likelihood of Occurrence Assessment

A likelihood of occurrence assessment was completed for all threatened flora species identified during the desktop assessment. The likelihood assessment considered the known distribution, preferred habitat and ecological requirements of the threatened species and compared these against the vegetation communities and habitat identified during the field survey. Each species is assessed against the criteria specified in **Table 3.2**.

Table 3.2 Likelihood of Occurrence Assessment Criteria

Likelihood of Occurrence Categories	Definition
Known	All species recorded during the field survey program
High	Species with historical records within the Study Area or have been recorded in the immediate vicinity. The Study Area contains preferred habitat which may support a population of the species.
Moderate	The species is known from the broader area (desktop search extent) and some of the preferred habitat is present within the Study Area.
Low	The Study Area supports some suitable habitat, often marginal.
Unlikely	The Study Area offers limited or no potential habitat and/or is outside their known range.

This process is used as a guide to inform the impact assessment. A conservative approach is adopted when making determinations, noting that field surveys are not exhaustive, and results are subject to limitations. The likelihood of occurrence assessment results do not indicate species presence or absence other than where observed presence is indicated.

3.4 Mapping and Data Analysis

Following the completion of the likelihood of occurrence assessment and the mapping of vegetation communities and habitat, mapping for the known and potentially occurring threatened flora values was completed.

'Modelling criteria' developed for relevant threatened flora values were primarily based on habitat requirements as specified by SPRAT. As required, other publicly available datasets were also reviewed to inform the modelling rules including the DES Species Profile database, relevant species recovery plans (where available), referral guidelines, approved conservation advice and listing advice, management plans and peer-reviewed journal articles. Habitat assessments collected during the field surveys, species records (public and survey records), and Project vegetation mapping were the primary inputs used to map the potential habitat according to the modelling criteria. For some habitats or habitat features (i.e. hilly rocky areas and dense vegetation), mapping delineation was completed manually using additional mapping datasets including watercourse and 10-metre contours in conjunction with high-quality Queensland Globe aerial imagery.

3.4.1 Cycas megacarpa

3.4.1.1 Density and Distribution Estimation

Using *Cycas megacarpa* presence/absence and abundance field data, an estimation of the distribution and density of *Cycas megacarpa* within the Study Area was undertaken using a spatial interpolation model. Interpolation models can be used to predict values for cells in a raster from a limited number of sample data points. The underlying assumption that makes interpolation a viable option is that spatially distributed objects are spatially correlated, thereby assuming that things that are close together tend to have similar characteristics.

The interpolation selected for this analysis was the Inverse Distance Weighted method (IDW). IDW is a method of interpolation that estimates cell values by averaging the values of sample data points in the vicinity of each processing cell. The closer a data point is to the centre of the cell being estimated, the more influence, or weight, it has in the averaging process. This method assumes that the variable being mapped decreases in influence with distance from its sampled location.

The interpolation was conducted using ESRI GIS mapping software ArcGIS Pro. To provide a visual aid, the resultant output was categorised and styled into density categories, comprising High (25-50 plants per 0.25 ha), Moderate (10-25 plants per 0.25 ha), Low (0.5 -10 plants per 0.25 ha), Absent (0-0.5 plants per 0.25 ha). The output was analysed against locations of actual counts and habitat extent mapping. To enhance the accuracy of the model, and where available, the IDW outputs were clipped to known habitat (confirmed and suspected) areas.

Noting that a targeted *Cycas megacarpa* field survey was completed across the Development Corridor in October 2022, calculated densities are expected to be most accurate in this area as a result of a greater number of sample data points relative to the surrounding Study Area.

3.4.1.2 Habitat Mapping

Based on feedback from DCCEEW regarding the habitat assessment of *Cycas megacarpa*, habitat for the species has been mapped into the following three categories:

- **Known habitat (confirmed)**; an 80 m buffer on confirmed *Cycas megacarpa* records, to reflect the latest population research which indicates most individuals disperse within 80 m of mature female plants (Etherington et al. 2018; James 2016 PhD thesis). Mapping has not been limited to certain REs noting the species was also recorded within non-remnant vegetation within the Study Area (see **Section 4.2.2.1**).

- **Known habitat (suspected)**; includes areas of the Development Corridor for which known habitat (confirmed) does not overlap, however based on adjacent records and connective habitat, *Cycas megacarpa* presence is presumed or reasonably suspected.

- **Nil detected**; includes areas of the Development Corridor which have been confirmed (via field survey) to not support *Cycas megacarpa*. Nil recorded habitat also includes areas where reasonable extrapolation to edges of the Development Corridor has been applied, based on nearby 'absence' records, absence of connective habitat and field derived opinions of ecologists.

Cycas megacarpa habitat mapping has been limited to the Development Corridor, given the complexity of mapping and large amount of input data requiring interrogation.

3.5 Significant Residual Impact Assessment

An assessment against the *Significant Residual Impact Guideline: For matters of state environmental significance and prescribed activities under the Sustainable Planning Act 2009* (The Department of State Development, Infrastructure and Planning, 2014) has been undertaken to determine whether the Project is likely to have a significant residual impact on a relevant Matter of State Environmental Significance (MSES) (i.e. prescribed environmental matter).

If after all reasonable avoidance and mitigation measures have been taken by the Project, if there is still a significant residual impact on an MSES, an offset may be required.

4.0 Results

4.1 Desktop Assessment

4.1.1 Landform and Geology

The Study Area ranges in elevation from 500 metres (m) Australian Height Datum (AHD), with the lowest elevation occurring in association with the valleys at 190 m AHD (**Figure 4.1**).

The surface geology of the Study Area mostly comprises sedimentary geologies with intrusive volcanics including granitoids and rhyolites as well as a small area in the south eastern corner of the Study Area comprising Quaternary alluvium (**Figure 4.1**). The dominant geologies and their lithographic summaries are provided as follows:

- Raspberry Creek Formation (Dcr): Predominantly basaltic and andesitic volcaniclastic sandstone and conglomerate with minor silicified siltstone and fossiliferous limestone.
- Mount Hoopbound Formation (Dh): Granule to boulder andesitic to dacitic volcaniclastic breccia and conglomerate, locally fossiliferous, lithic to feldspatholithic sandstone, porphyritic andesitea, lapilli to ash tuff, tuffaceous sandstone.
- Ginger Creek Member (Dcrg): Volcanoclastic sandstone and conglomerate, rare fossiliferous limestone and peperite.
- Balaclava Formation (DCb): Rhyolitic volcanoclastic sandstone and conglomerate, minor ignimbrite, rare rhyolite, siltstone and oolitic limestone.
- Alluvium (Qa-QLD): Clay, silt, sand and gravel; floodplain alluvium.

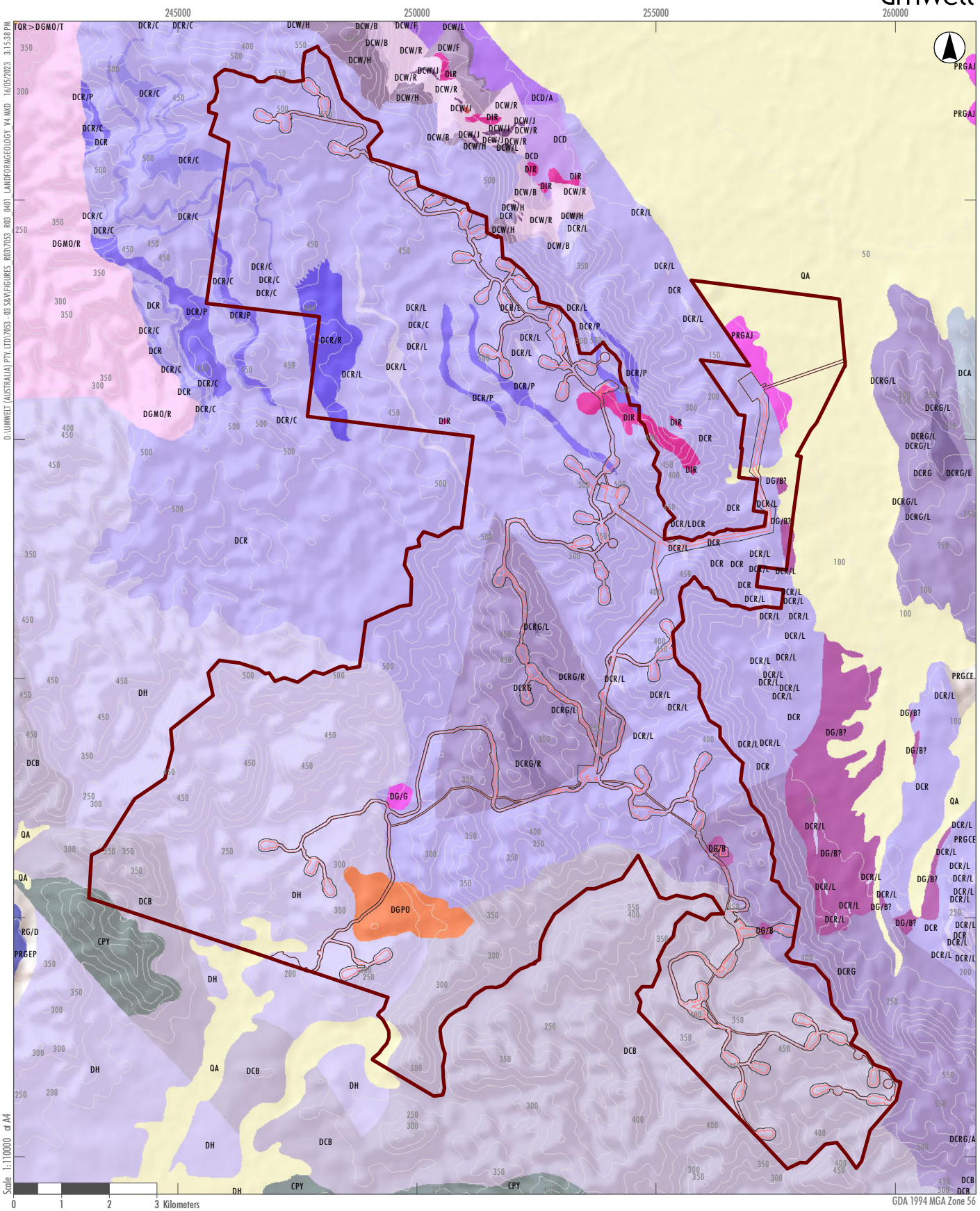
4.1.2 Wetlands and Waterways

The Study Area does not occur within a DES wetland protection area nor does it contain any wetlands of High Ecological Significance (HES). Wetlands mapped under the *Vegetation Management Act 1999* (VM Act) are also absent from the Study Area.

Watercourses are present across the Study Area as identified from the *Vegetation Management Watercourse and Drainage Feature Map*. Details of these are provided in **Table 4.1** and shown on **Figure 4.2**. However, no watercourses within the Study Area are considered High Ecological Value (HEV).

Table 4.1 VM Act Watercourse Features Within the Study Area

Stream Order	Number of Mapped Watercourse Features
One	153
Two	88
Three	33
Four	8



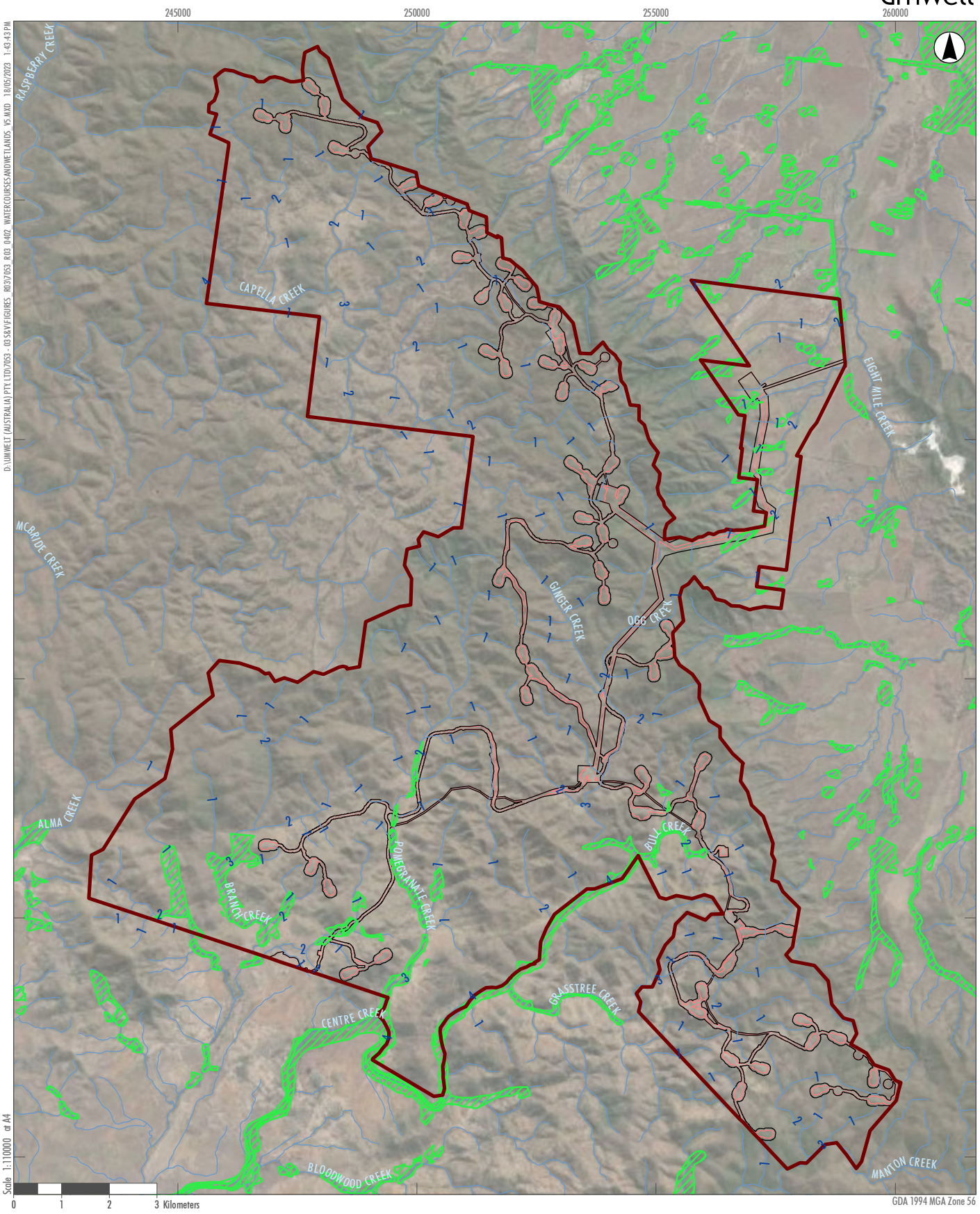
Legend

- Study Area
- Development Corridor
- Disturbance Footprint
- Surface Contours (50m)
- Bajool Quartz Diorite (PRgaj)
- Balaclava Formation (DCb)
- Dg/b-YARROL/SCAG (Dg/b)
- Dg/b?-YARROL/SCAG (Dg/b?)
- Dg/g-YARROL/SCAG (Dg/g)
- Dir-YARROL/SCAG (Dir)
- Eulogie Park Gabbro (PRgep)
- Ginger Creek Member (Dcrg)
- Ginger Creek Member/a (Dcrg/a)
- Ginger Creek Member/l (Dcrg/l)
- Ginger Creek Member/r (Dcrg/r)
- Mount Alma Formation (DCa)
- Mount Dick beds (Dcd)
- Mount Dick beds/a (Dcd/a)
- Mount Hoopbound Formation (Dh)
- Mount Morgan Trondhjemite/r (Dgmo/r)
- Mount Warner Volcanics/b (Dcw/b)
- Mount Warner Volcanics/f (Dcw/f)
- Mount Warner Volcanics/h (Dcw/h)
- Mount Warner Volcanics/j (Dcw/j)
- Mount Warner Volcanics/l (Dcw/l)
- Mount Warner Volcanics/r (Dcw/r)
- Pg/b-YARROL/SCAG (Pg/b)
- Pomegranate Tonalite (Dgpo)
- Qa-QLD (Qa)
- Raspberry Creek Formation (Dcr)
- Raspberry Creek Formation/c (Dcr/c)
- Raspberry Creek Formation/l (Dcr/l)
- Raspberry Creek Formation/p (Dcr/p)
- Raspberry Creek Formation/r (Dcr/r)
- TQr-QLD > Mt Morgan Trondhjemite (TQr > Dgmo/t)
- Youlambie Conglomerate (CPy)

FIGURE 4.1

Landform and Geology

Image Source: ESRI Basemap Data source: QLD DNRM Statewide Detailed Geology (2018)



Legend

- Study Area
- Development Corridor
- Disturbance Footprint
- Watercourses & Drainage Features (Stream Orders labelled)
- Wetlands

FIGURE 4.2

Watercourses and Wetlands

Image Source: ESRI Basemap Data source: QLD Government (2020)

4.1.3 Bioregional Description

The Study Area is located on the Ulam Range between Mount Hopeful (on the Dee Range) and Mount Alma (on the Mount Alma Range) (**Figure 4.3**).

The Study Area is located within the Brigalow Belt bioregion (**Figure 4.3**), which is characterised by the tree *Acacia harpophylla* (brigalow) which forms forest and woodland on clay soils. Other large areas in the bioregion are characterised by eucalypt forests and woodland, grassland, dry rainforest, cypress pine woodland and riparian communities (Sattler and Williams 1999).

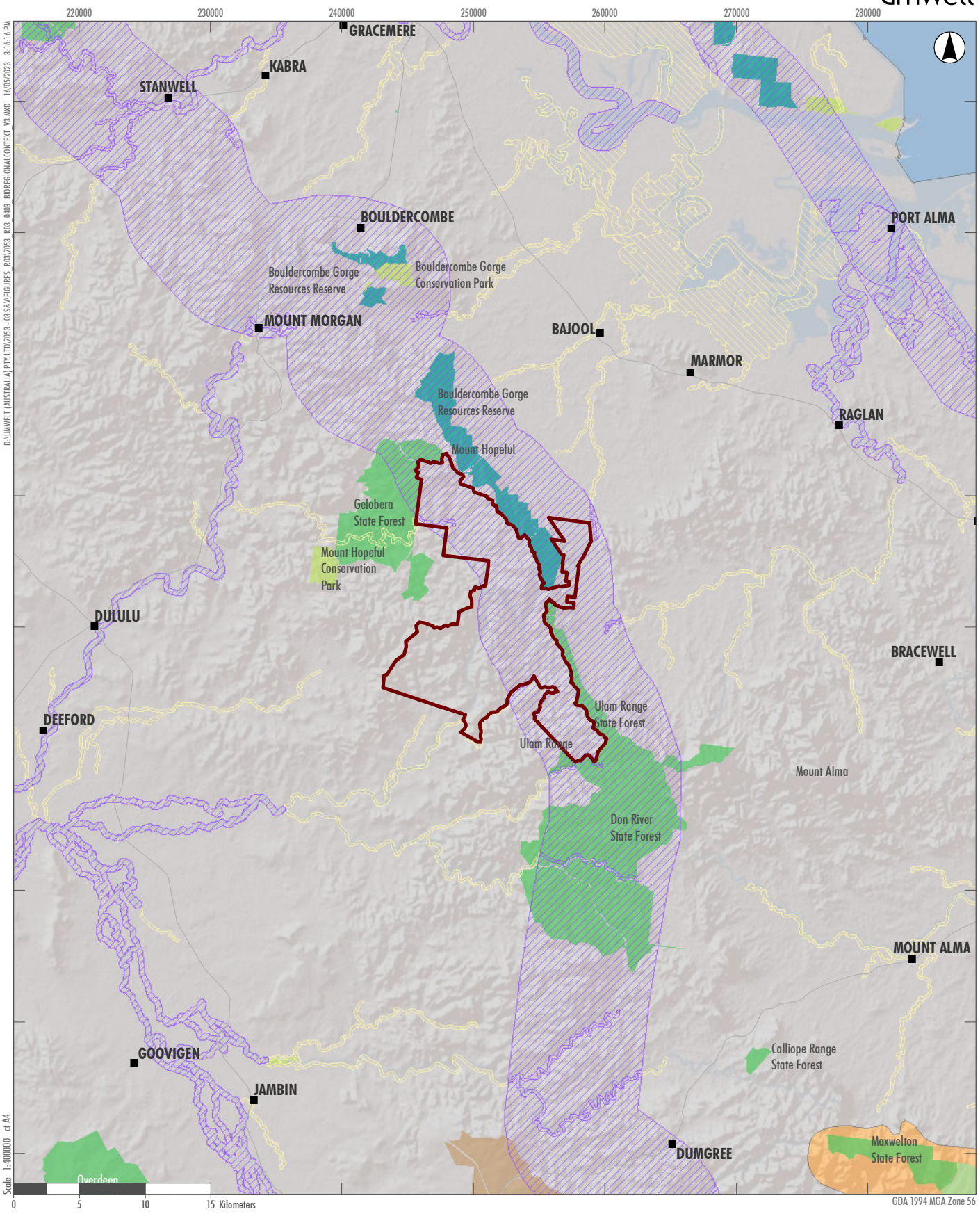
The Study Area is located across two subregions: The Mount Morgan Ranges subregion covers much of the mountainous parts of the Study Area, while the Marlborough Plains subregion covers just the north eastern corner. The Mount Morgan Ranges subregion is a rugged and hilly province formed on the Paleozoic rocks of the coastal ranges. The dominant rock types are volcanics, with areas of igneous rocks and small areas of folded metasediments. The vegetation is dominated by *Eucalyptus crebra* (narrow-leaf ironbark) with *Corymbia erythrophloia* (red bloodwood) and *Corymbia citriodora* (spotted gum) on the rugged slopes and woodlands of *Eucalyptus melanophloia* (silver-leaved ironbark) on erosional lower slopes. On the colluvial slopes *Eucalyptus moluccana* (gum-topped box) forms a woodland. On the alluvial soils *Eucalyptus tereticornis* (forest red gum) and *Corymbia tessellaris* (Moreton Bay ash) can be found (Sattler and Williams 1999).

The Marlborough Plains subregion, covering the north eastern corner of the Study Area is an undulating hilly province with complex geology. The subregion is dominated by alluvial plains and colluvial slopes, usually with a woodland of *Eucalyptus platyphylla* (poplar box), *Corymbia dallachiana* (ghost gum), *Eucalyptus tereticornis* and *Melaleuca* spp. (tea tree). Low rises have *Eucalyptus crebra* and hillier areas with open forest or woodland of *Corymbia citriodora*, *Corymbia* spp. and *Eucalyptus crebra* (Sattler and Williams 1999).

4.1.4 Protected Areas

The Study Area does not occur within any protected areas or reserves. The Ulam Range State Forest borders the south eastern edge of the Study Area, which links within the Don River State Forest to the south. To the north, the Bouldercombe Gorge State Reserve, which includes Mount Hopeful, borders the north eastern side of the Study Area, with the Gelobera State Forest and Mount Hopeful Conservation Park occurring to the north west (**Figure 4.3**).

The eastern half of the Study Area forms part of a Statewide Biodiversity corridor, which incorporates the protected areas and reserves along the eastern side of the Study Area (**Figure 4.3**). For further information about Biodiversity corridors, see the Mount Hopeful Wind Farm Terrestrial Fauna Assessment (Umwelt, 2023).



Legend

- Study Area
- Conservation Park
- National Park
- Resources Reserve
- State Forest
- Timber Reserve
- Brigalow Belt
- Southeast Queensland

Statewide Corridors Of Significance

- Regional
- State

FIGURE 4.3

Bioregional Context

Image Source: Data source: QSpatial (2021); QLD DES (2019)

4.1.5 Regulated Vegetation

The Department of Resources (DoR) Regulated Vegetation Management map (Version 6.05) identifies four categories of regulated vegetation present within the Study Area (**Figure 4.4** and **Table 4.2**). Category B vegetation occurs across approximately 41% of the Study Area and generally comprises large, connected patches. In contrast, Category C and Category R vegetation is uncommon with only sporadic, small linear patches mapped, largely associated with mapped watercourses and drainage areas. Category X (non-remnant) vegetation dominates the Study Area, occurring extensively across the northern and southern extents.

Table 4.2 Regulated Vegetation Mapped Within the Study Area

Regulated Vegetation Category	Area (ha) Within the Study Area
Category B - Remnant vegetation	6,890.3
Category C - High-value regrowth	49.6
Category R - Regrowth within 50 m of a watercourse or drainage feature in the Great Barrier Reef catchment	24.1
Category X - Exempt clearing work on Freehold, Indigenous and Leasehold land	9,793.5

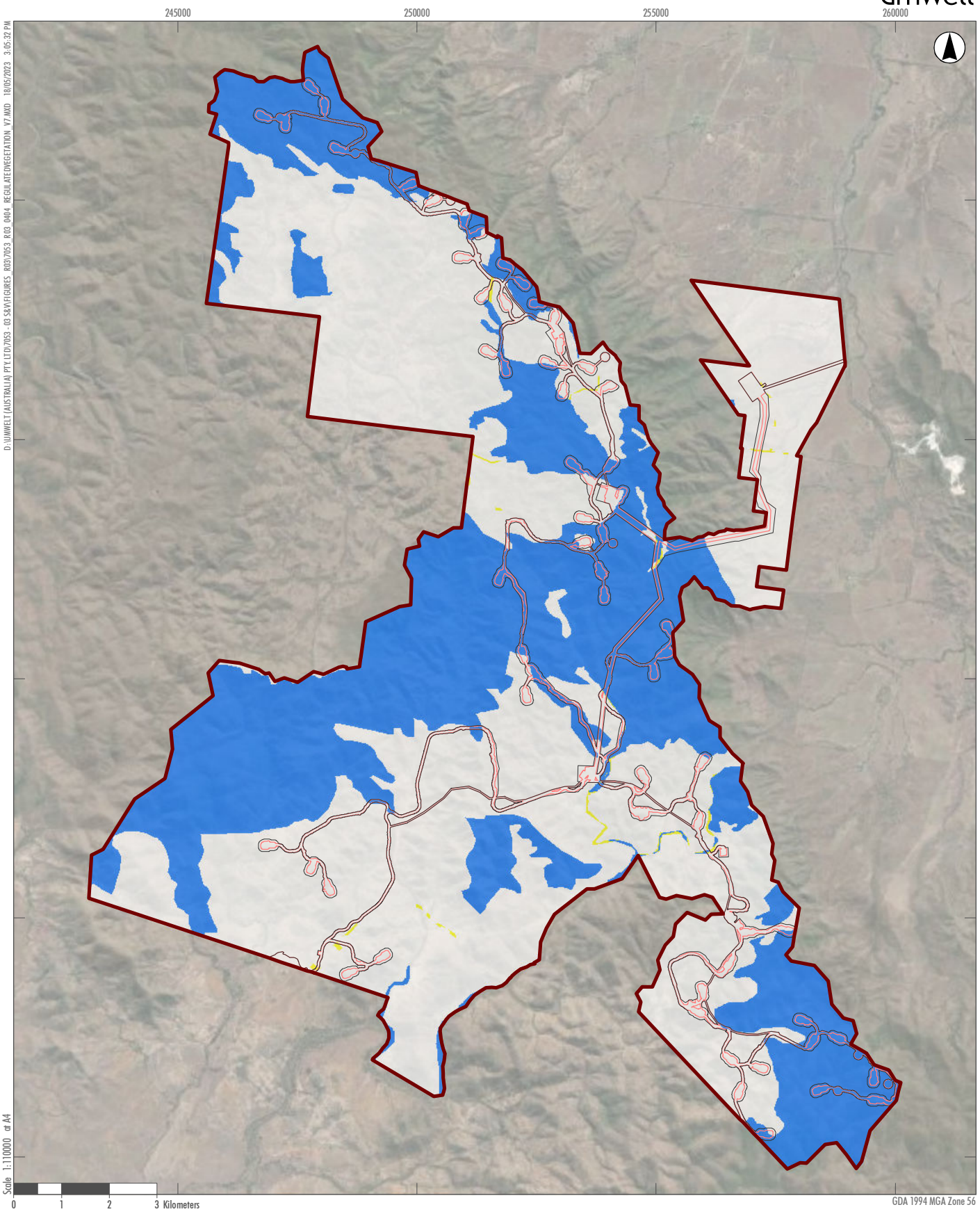
4.1.6 Regional Ecosystems

As per the Department of Environment and Science (DES) Vegetation Management Regional Ecosystem map (Version 12.02), the Study Area contains up to eleven REs, which are listed in **Table 4.3** and illustrated on **Figure 4.5**. Based on classifications under the VM Act, two REs are listed as 'Of Concern' and nine are 'Least Concern'.

Table 4.3 Regional Ecosystems Mapped Within the Study Area

RE	REDD Description[1]	VM Act Class
11.11.15	*Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics	Least Concern
11.11.3	*Corymbia citriodora, Eucalyptus crebra, E. acmenoides* open forest on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges	Least Concern
11.11.4c	*Eucalyptus moluccana* dominated woodland.	Least Concern
11.11.5	Microphyll vine forest +/- *Araucaria cunninghamii* on old sedimentary rocks with varying degrees of metamorphism and folding	Least Concern
11.12.1	*Eucalyptus crebra* woodland on igneous rocks	Least Concern
11.12.4	Semi-evergreen vine thicket and microphyll vine forest on igneous rocks	Least Concern
11.12.6	*Corymbia citriodora* open forest on igneous rocks (granite)	Least Concern
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	Of Concern
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Least Concern
11.3.26	*Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains	Least Concern
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on alluvial plains	Of Concern

[1] *Description of REs as contained in the REDD Version 11.1 (Queensland Herbarium 2018a).*



Legend

Study Area

- Study Area
- Development Corridor
- Disturbance Footprint

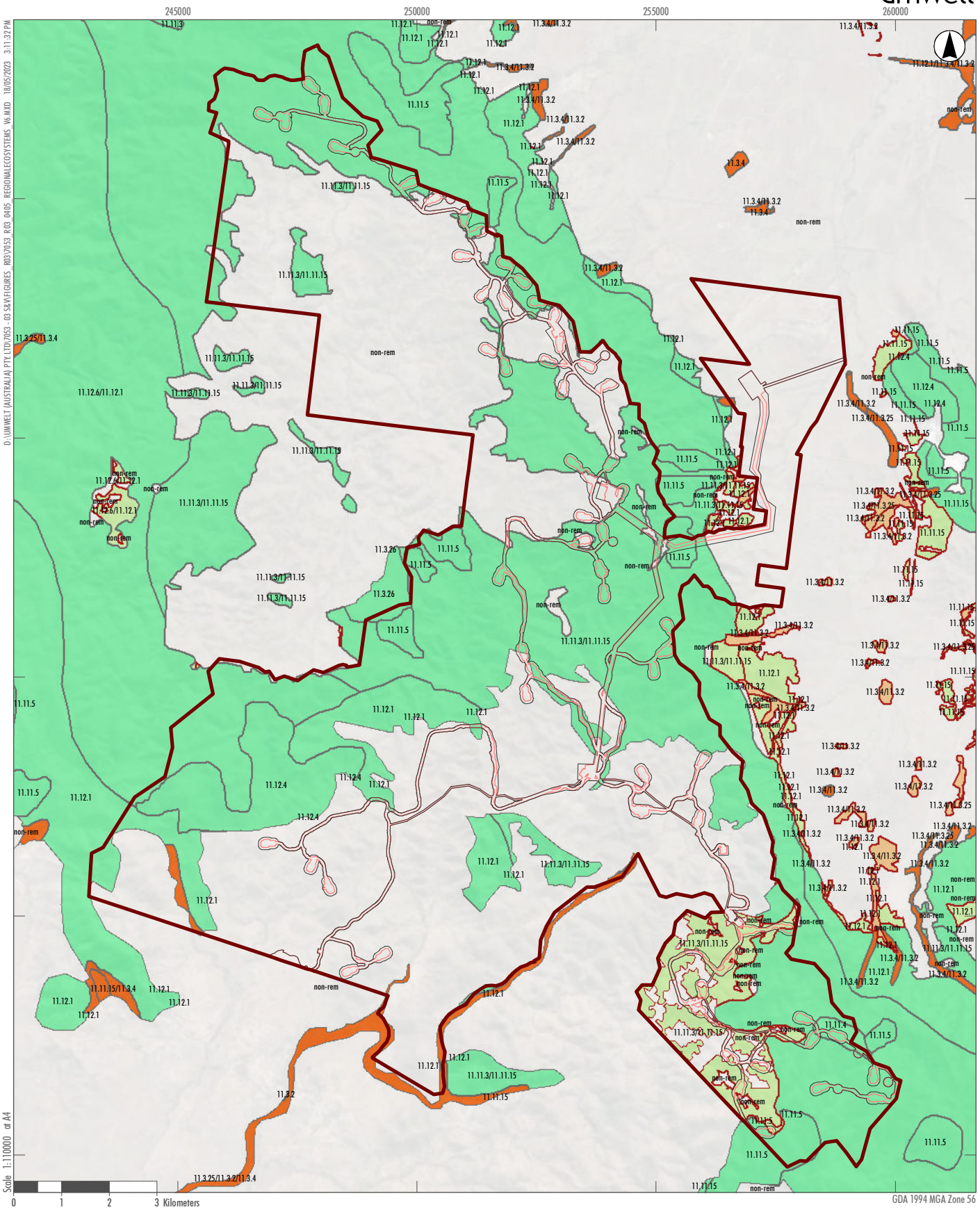
Regulated Vegetation Management Map

- Category B area
- Category C area
- Category R area
- Category X area

Image Source: ESRI Basemap Data source: QLD Government (2020)

FIGURE 4.4

Regulated Vegetation



Legend

- Study Area
- Development Corridor
- Disturbance Footprint

Regional Ecosystems - Vegetation Management Supporting Map

- Category A or B area containing of concern
- Category A or B area that is least concern
- Category C area containing of concern
- Categrory C area that is of least concern
- Non-remnant

FIGURE 4.5

Regional Ecosystems

Image Source: ESRI Basemap Data source: QLD Government (2020)

4.1.7 Threatened Ecological Communities

Six TECs were identified as potentially occurring within or in proximity to the Study Area based on desktop search results. The TECs are listed in **Table 4.4** as well as the REs which correspond to these communities.

Table 4.4 Potential TECs within the Study Area

TEC	EPBC Act Status	[1]Corresponding REs within the Brigalow Belt Bioregion
Brigalow (*Acacia harpophylla* dominant and codominant)	Endangered	11.3.1, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.5.16, 11.9.1, 11.9.5, 11.11.14, 11.12.21
Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community	Endangered	12.1.1, 12.3.20
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	11.3.3, 11.3.15, 11.3.16, 11.3.28, 11.3.37
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	11.3.2, 11.3.17, 11.4.7, 11.4.12
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	11.3.11, 11.4.1, 11.5.15, 11.8.13, 11.9.4, 11.11.18, 11.2.3, 11.8.3, 11.8.6, 11.9.8
Weeping Myall Woodlands	Endangered	11.3.2, 11.3.28

[1] These REs can form part of or align with the TECs if the key diagnostic characteristics and condition thresholds specified as part of the Commonwealth listing advice are also met.

Based on the State RE mapping, there is the potential for two TECs to occur within the Study Area, including:

- Poplar Box Grassy Woodland on Alluvial Plains (represented by RE 11.3.2).
- Weeping Myall Woodlands (represented by 11.3.2).

The Poplar Box Grassy Woodland on Alluvial Plains community is typically a grassy woodland with a canopy dominated by *Eucalyptus populnea* with an understorey of mostly grasses and herbs. The community occurs on a wide range of alluvial soils in gently undulating to flat landscapes. The poplar box grassy woodland may include a low density of shrubs, however this community generally lacks a substantial mid layer, and shrubby forms of the poplar box woodland are not part of the ecological community (Department of the Environment and Energy 2019).

The Weeping Myall Woodlands community occurs on the inland alluvial plains west of the Great Dividing Range and is an open woodland to woodland in which *Acacia pendula* trees are the sole or dominant overstorey species. Other vegetation may also occur in the ecological community, though not as a dominant species. Some examples of other species present include *Eucalyptus populnea*, *Alectryon oleifolius* subsp. *oleifolius* or *Eucalyptus largiflorens*. The understorey of the weeping myall community often includes an open shrub layer over an open ground layer of grasses and herbs (Threatened Species Scientific Committee 2009).

Threatened Flora

A total of 16 threatened flora species were identified from desktop database sources as occurring or having the potential to occur within or in proximity to the Study Area. These species and their respective conservation status under the EPBC Act and NC Act are detailed in **Table 4.5.** Records of threatened species from the ALA database are illustrated on **Figure 4.6**. No desktop records of threatened species were identified within the Study Area; however, two species were identified within the 10 km search radius. These species are *Cycas megacarpa* and *Hernandia bivalvis*.

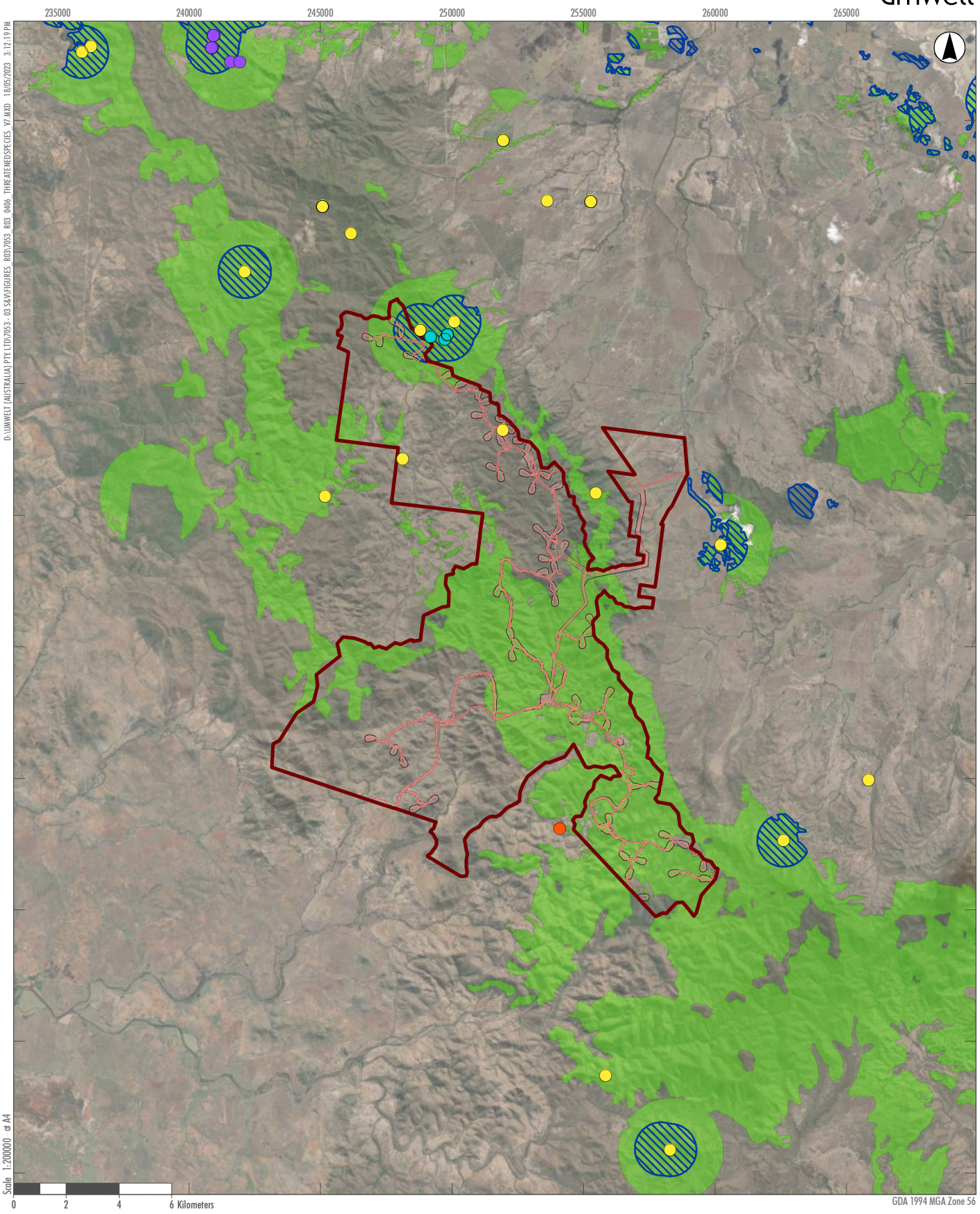
High-risk areas for protected plants have been identified within the north, central and south-eastern portions of the Study Area (**Figure 4.6**). These high-risk areas are likely triggered by records of *Hernandia bivalvis* and *Cycas megacarpa*.

Table 4.5 Database Results for Threatened Species

Family	Species	EPBC Act Status	NC Act Status
Apocynaceae	*Marsdenia brevifolia*	Vulnerable	Vulnerable
Cycadaceae	*Cycas megacarpa*	Endangered	Endangered
	Cycas ophiolitica	Endangered	Endangered
Hernandiaceae	*Hernandia bivalvis*	-	Near Threatened
Myrtaceae	*Decaspermum struckoilicum*	Endangered	Endangered
	Eucalyptus raveretiana	Vulnerable	Least Concern
Orchidaceae	*Bulbophyllum globuliforme*	Vulnerable	Near Threatened
Poaceae	*Arthraxon hispidus*	Vulnerable	Vulnerable
	Dichanthium setosum	Vulnerable	Least Concern
Rutaceae	*Bosistoa transversa*	Vulnerable	Least Concern
Sapindaceae	*Cossinia australiana*	Endangered	Endangered
	Cupaniopsis shirleyana	Vulnerable	Vulnerable
Simaroubaceae	*Samadera bidwillii*	Vulnerable	Vulnerable
Solanaceae	*Solanum dissectum*	Endangered	Endangered
	Solanum johnsonianum	Endangered	Endangered
Surianaceae	*Cadellia pentastylis*	Vulnerable	Vulnerable

4.1.8 Essential Habitat

As per the DoR Vegetation Management Essential Habitat map (Version 11.05), two overlapping areas of Essential Habitat occur within the northern Study Area (**Figure 4.6**). These Essential Habitat areas correspond with desktop records of *Hernandia bivalvis* and *Cycas megacarpa*, which have been recorded within 1 km of the Study Area. Mapped Essential Habitat areas within the Study Area potentially provide habitat for these species.



Legend

- Study Area
- Development Corridor
- Disturbance Footprint
- Protected Plants Trigger Area
- Essential Habitat on the Vegetation Management Map

Threatened Species Records (ALA, 2020)

- *Cossinia australiana*
- *Cycas megacarpa*
- *Decaspermum struckoilicum*
- *Hernandia bivalvis*

FIGURE 4.6

Threatened Species, Protected Plant Trigger Areas and Essential Habitat

Image Source: ESRI Basemap Data source: QLD Government (2020), ALA (2020)

4.2 Flora and Vegetation Survey

4.2.1 Study Area Characteristics

The Study Area occurs within a mountainous area that is sparsely settled and mostly used for light grazing and livestock production (**Plate 4.1**). Large areas of the Study Area have been historically cleared and currently support regrowing eucalypt communities and areas of cleared land. The dominant regrowth and remnant vegetation communities across the Study Area are eucalypt woodland and forest dominated by *Eucalyptus crebra*, *Corymbia citriodora* and *Eucalyptus acmenoides.* On the lower colluvial slopes, *Eucalyptus moluccana* and *Eucalyptus tereticornis* are present with the creek lines supporting *Melaleuca fluviatilis* and *Casuarina cunninghamiana*. Vine thicket communities are also scattered throughout the Study Area, often centred around drainage lines.

Plate 4.1 General view of the Study Area

4.2.2 Flora Diversity

The field survey identified a total of 207 flora species from 56 families and 134 genera. The plant families representing the most taxa were Poaceae (32 taxa), Myrtaceae (24 taxa), Fabaceae (16 taxa), Mimosaceae (10 taxa) and Asteraceae (10 taxa). The survey also identified 32 introduced species, which represents 15.5% of the total flora recorded. The weed species present are further discussed in **Section 4.2.2.2**.
The full list of flora species identified within the Ground-truthed Mapping Extent is provided as **Appendix A**.

4.2.2.1 Threatened Flora

The field surveys recorded one threatened flora species, *Cycas megacarpa* (**Plate 4.2**), which is listed as Endangered under the EPBC Act and NC Act. Four additional threatened flora species, while not recorded during the field survey program, were determined to have a 'Moderate' or 'High' likelihood of occurring within the Study Area (**Section 4.3**).

Cycas megacarpa

This species was recorded extensively across the Study Area and was the subject of targeted surveys in 2022 to ensure population estimates were robust. The number of *Cycas megacarpa* individuals within the Study Area based on data interpolation is 159,915 across an area of 16,757.5 ha. (**Figure 4.7**). Within the Disturbance Footprint, a total of 4,131 individuals are estimated to occur.

During the field survey program, *Cycas megacarpa* was recorded within a variety of vegetation communities, including within regrowth and non-remnant areas. The primary habitat for the species (i.e. where the species was most consistently recorded and abundant) is woodland to open forest on upper slopes and crests consisting of *Corymbia citriodora*, *Eucalyptus crebra*, *Eucalyptus melanophloia, Corymbia intermedia* and *Eucalyptus tereticornis* on metamorphosed sediments and volcanic geologies at altitudes of between 200 and 500 m AHD. Primary habitat for *Cycas megacarpa* corresponds to REs 11.12.1, 11.12.6, 11.11.3 and 11.11.15. A typical example of a primary open forest habitat is shown as **Plate 4.3**.

Other field-verified habitat for *Cycas megacarpa* includes eucalypt communities dominated by *Eucalyptus acmenoides* (RE 11.11.4c), eucalypt communities occurring on lower colluvial slopes (RE 11.11.3c, 11.11.4b), communities on alluvial soils (RE 11.3.25b and 11.3.4), vine thickets (REs 11.11.5, 11.12.4) and areas of regrowth and non-remnant vegetation. The species was recorded within all these communities, although not consistently and in lower numbers.

Based on the *Cycas megacarpa* survey points and recorded densities, a map was created using a spatial interpolation method (**Section 3.2.2.2**) to predict the density distribution of the species across the Study Area (**Figure 4.7**). Predicted densities of *Cycas megacarpa* across the different Project Areas is detailed below (**Table 4.6**).

Table 4.6 Predicted Density and Distribution of *Cycas megacarpa* within the Project Areas

Density of *C. megacarpa* (0.25 ha)	Study Area[1]	Development Corridor[2]	Disturbance Footprint
High (25-50 plants)	74.9 ha	0.9 ha	0.7 ha
Moderate (10-25 plants)	960.8 ha	29.6 ha	16.8 ha
Low (1-10 plants)	5,365.7 ha	301.5 ha	195.7 ha

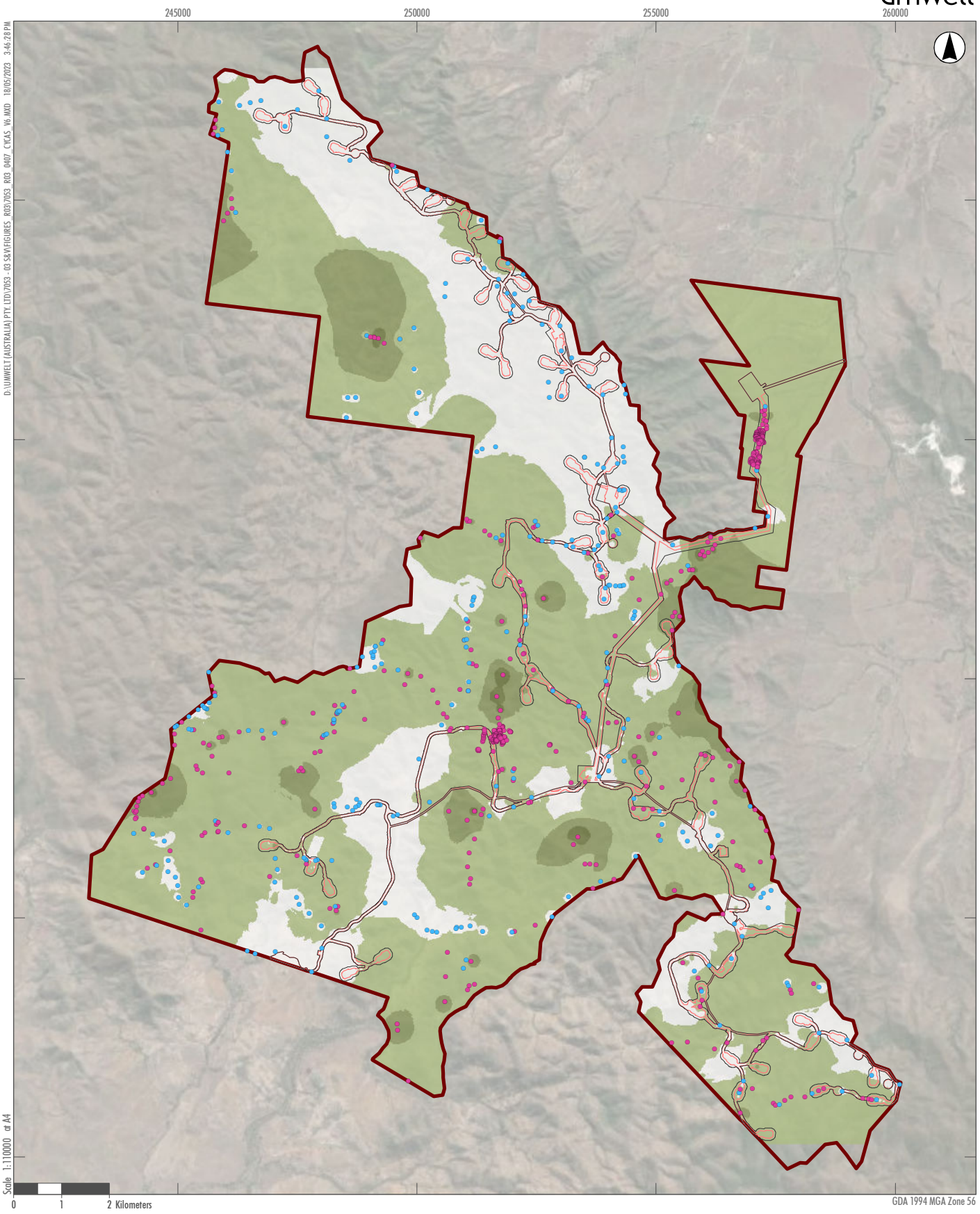
[1] Study Area values have been corrected by a factor of 0.5-0.7 to provide contextual comparison with development corridor, for which IDW outputs have been clipped to the known (confirmed) and known (suspected) habitat area.
[2] IDW outputs clipped to areas of mapped known (confirmed) and known (suspected) habitat area

Based on the species records and habitat mapping rules outlined in **Section 3.4.1.2,** suitable habitat for *Cycas megacarpa* within the Disturbance Footprint is as follows (mapping is provided in **Appendix C**):

- 147.1 ha of Known (confirmed).
- 88.6 ha of Known (suspected).
- 639.0 ha of Nil recorded.

Plate 4.2 The Endangered species *Cycas megacarpa* (Female)

Plate 4.3 Primary habitat for *Cycas megacarpa* consisting of an open forest of *Corymbia citriodora* and *Eucalyptus crebra*



Legend

- Study Area
- Development Corridor
- Disturbance Footprint

Surveyed Locations

- *Cycas megacarpa* Absent
- *Cycas megacarpa* Present

Predicted Distribution and Density of *Cycas megacarpa* (per 50m²)

- Absent (0 - 1)
- Low (1 - 10)
- Moderate (10 - 25)
- High (25-50)

FIGURE 4.7

Cycas megacarpa Locations and Predicted Distribution and Density

Image Source: ESRI Basemap (2021) Data source: Queensland Spatial (2020)

4.2.2.2 Introduced Flora

A total of 32 introduced flora were identified during the survey (**Appendix A**). Of these 32 species, five are identified as Category 3 restricted plants in Queensland under the *Biosecurity Act 2014* as well as Weeds of National Significance (WoNS). WoNS are weed species that have been agreed by Australian governments using an assessment process that prioritised these weeds based on their invasiveness, potential for spread and environmental, social, and economic impacts. These five species are listed as followed:

- Lantana (**Lantana camara*)
- Prickly pear (**Opuntia stricta*)
- Velvety pear (**Opuntia tomentosa*)
- Rubber vine (**Cryptostegia grandiflora*)
- Parthenium (**Parthenium hysterophorus*).

The restricted plant that was most common across the Ground-truthed Mapping Extent was lantana, which was recorded within all vegetation communities including areas of regrowth and non-remnant. Prickly pear (**Plate 4.4**) and velvety pear were recorded as scattered individuals within the eucalypt dominated communities (REs 11.11.3, 11.12.1 and 11.12.6) as well as within creek line communities on alluvial soils (REs 11.3.4 and 11.3.26) and within non-remnant areas. Rubber vine was most common within the creek line communities on alluvial soils (RE 11.3.25b) as well as in the vine thicket communities (REs 11.12.4 and 11.11.5a), however was also recorded as a scattered occurrence within the eucalypt communities (REs 11.12.1, 11.11.3 and 11.11.15) and non-remnant areas. Parthenium was most common in lower lying and disturbed non-remnant areas. Balloon bush (**Gomphocarpus physocarpus*) was a common (non-restricted) introduced flora recorded across the site, particularly within non-remnant areas (**Plate 4.5**).

Plate 4.4 Prickly pear (Opuntia stricta*) within an area of non-remnant paddock**

Plate 4.5 Balloon bush (Gomphocarpus physocarpus*) growing along a fence line**

4.2.3 Vegetation Communities

4.2.3.1 Threatened Ecological Communities

No TECs were identified during the field survey program. The State mapped RE 11.3.2 identified during the database review, which can correspond to the Poplar Box and Weeping Myall TECs was not identified during the field surveys. No additional TECs, or REs that are known to correspond to a TEC, were identified during the field surveys either. As such, no TECs are considered likely to occur within the Ground-truthed Mapping Extent or wider Study Area.

4.2.3.2 Regional Ecosystems

Following the completion of the field survey program, a total of 15 REs were identified and mapped within the Ground-truthed Mapping Extent (**Figure 4.9**). Of the 15 confirmed REs, 11 occur within the Disturbance Footprint and Development Corridor in remnant condition. These REs are described in **Table 4.7**, with areas detailed corresponding only to the extent of the RE in remnant condition.

As per the field-validated vegetation mapping, one confirmed RE does not occur within the Disturbance Footprint or Development Corridor: RE 11.12.4. REs that occur within the Disturbance Footprint and Development Corridor but in regrowth form include REs 11.3.25, 11.11.5 and 11.12.1.

Table 4.7 Remnant Regional Ecosystems Confirmed Within the Disturbance Footprint and Development Corridor

11.3.25b	**Woodland to open forest of *Melaleuca fluviatilis* and *Casuarina cunninghamiana* over low open woodland of *Melaleuca bracteata* over an open shrubland of *Casuarina cunninghamiana* and *Melaleuca viminalis* over a sparse herbland of **Cenchrus ciliaris*, *Brunoniella australis*, **Malvastrum americanum* and **Sida acuta*.**	
VM Act Status	Least Concern	
EPBC Act Status	NA	
Area in the Ground-truthed Mapping Extent (ha)	176.4	
Area in Disturbance Footprint (ha)	3.3	
Structure (m)	T1 (14-20) T2 (8-12) S1 (2-5) S2 (<2) G (<0.5)	
Significant species	Habitat for *Cycas megacarpa*	

11.3.4	***Eucalyptus tereticornis* and/or *Corymbia tessellaris* and *Angophora floribunda* woodland to open forest on alluvial plains. Other tree species occur sporadically including *Lophostemon suaveolens*, *Eucalyptus crebra*, *Corymbia clarksoniana* and *Casuarina cunninghamiana*. Where present, the shrub layer is generally dominated by *Lantana camara**.**	
VM Act Status	Of Concern	-
EPBC Act Status	NA	
Area in the Ground-truthed Mapping Extent (ha)	19.0	
Area in Disturbance Footprint (ha)	0.4	
Structure (m)	T1 (16-25) S1 (2-5) S2 (<2) G (<0.5)	
Significant species	-	
RE 11.11.3	**Open forest of *Corymbia citriodora*, *Eucalyptus crebra*, *Eucalyptus tereticornis* and *Corymbia intermedia* over a low open woodland of *Corymbia citriodora*, *Eucalyptus crebra*, *Allocasuarina torulosa* and *Angophora floribunda* over an open shrubland of *Macrozamia macleayi*, *Xanthorrhoea johnsonii* and *Cycas megacarpa* over an open tussock grassland of *Themeda triandra*, *Heteropogon contortus*, *Aristida latifolia* and *Lomandra* spp.**	
VM Act Status	Least Concern	
EPBC Act Status	NA	
Area in the Ground-truthed Mapping Extent (ha)	1,416.9	
Area in Disturbance Footprint (ha)	160.2	
Structure (m)	T1 (18-27 m) T2 (8-12 m) S1 (1-2 m) G (<0.5 m)	
Significant species	Habitat for *Cycas megacarpa*	

<table>
<tr><td>11.11.3c</td><td colspan="2">Woodland of Eucalyptus moluccana, Eucalyptus acmenoides, Eucalyptus crebra and Corymbia citriodora over a low woodland of Lophostemon suaveolens, Allocasuarina torulosa and Lophostemon confertus over an open shrubland of Xanthorrhoea johnsonii, Macrozamia spp., Jacksonia scoparia and Breynia oblongifolia over an open tussock grassland of Heteropogon contortus, Themeda triandra, Arundinella nepalensis, Gahnia aspera and *Stylosanthes scabra.</td></tr>
<tr><td>VM Act Status</td><td>Least Concern</td><td rowspan="5">  </td></tr>
<tr><td>EPBC Act Status</td><td>NA</td></tr>
<tr><td>Area in the Ground-truthed Mapping Extent (ha)</td><td>152.5</td></tr>
<tr><td>Area in Disturbance Footprint (ha)</td><td>23.8</td></tr>
<tr><td>Structure (m)</td><td>T1 (16-19)
T2 (8-12)
S1 (2-5)
S2 (1-2)
G (<0.5)</td></tr>
<tr><td>Significant species</td><td colspan="2">Habitat for Cycas megacarpa</td></tr>
<tr><td>11.11.4a</td><td colspan="2">Open forest of Eucalyptus tereticornis, Eucalyptus acmenoides and Corymbia intermedia over a low woodland of Allocasuarina torulosa and Lophostemon confertus over a shrubland of Lophostemon confertus, Xanthorrhoea johnsonii and *Lantana camara tussock grassland of Heteropogon contortus, Arundinella nepalensis, Lomandra confertifolia, Gahnia aspera, Imperata cylindrica and Dianella caerulea.</td></tr>
<tr><td>VM Act Status</td><td>Least Concern</td><td rowspan="5">  </td></tr>
<tr><td>EPBC Act Status</td><td>NA</td></tr>
<tr><td>Area in Ground-truthed Mapping Extent (ha)</td><td>54.6</td></tr>
<tr><td>Area in Disturbance Footprint (ha)</td><td>14.1</td></tr>
<tr><td>Structure (m)</td><td>T1 (12-19)
T2 (5-8)
S1 (1-3)
G (<0.5)</td></tr>
<tr><td>Significant species</td><td colspan="2">Habitat for Cycas megacarpa</td></tr>
</table>

<table>
<tr><td>11.11.4b</td><td colspan="2">Open forest of Eucalyptus acmenoides, Eucalyptus crebra and Eucalyptus moluccana over a low open woodland of Eucalyptus acmenoides, Eucalyptus crebra and Allocasuarina torulosa over an open shrubland of Acacia leiocalyx over an open tussock grassland of Themeda triandra, Heteropogon contortus, Cymbopogon refractus, Aristida latifolia, Arundinella nepalensis, Lomandra confertifolia and Glycine tomentella</td></tr>
<tr><td>VM Act Status</td><td>Least Concern</td><td rowspan="5">  </td></tr>
<tr><td>EPBC Act Status</td><td>NA</td></tr>
<tr><td>Area in the Ground-truthed Mapping Extent (ha)</td><td>642.9</td></tr>
<tr><td>Area in Disturbance Footprint (ha)</td><td>40.4</td></tr>
<tr><td>Structure (m)</td><td>T1 (12-17 m)
T2 (5-8 m)
S1 (1-2 m)
G (<0.5 m)</td></tr>
<tr><td>Significant species</td><td colspan="2">Habitat for Cycas megacarpa</td></tr>
<tr><td>11.11.4c</td><td colspan="2">Woodland to open forest of Eucalyptus moluccana, Eucalyptus crebra and Corymbia citriodora over an open woodland of Eucalyptus moluccana and Corymbia citriodora over an open shrubland of Macrozamia macleayi over an open tussock grassland of Heteropogon contortus, Chrysopogon fallax and Glycine tomentella</td></tr>
<tr><td>VM Act Status</td><td>Least Concern</td><td rowspan="5">  </td></tr>
<tr><td>EPBC Act Status</td><td>NA</td></tr>
<tr><td>Area in the Ground-truthed Mapping Extent (ha)</td><td>85.2</td></tr>
<tr><td>Area in Disturbance Footprint (ha)</td><td>29.6</td></tr>
<tr><td>Structure (m)</td><td>T1 (12-18)
T2 (5-8)
S1 (1-2)
G (<0.5)</td></tr>
<tr><td>Significant species</td><td colspan="2">Habitat for C. megacarpa</td></tr>
</table>

<table>
<tr><td>11.11.5a</td><td colspan="2">Closed forest of Euroschinus falcatus var. falcatus, Dysoxylum gaudichaudianum, Polyscias elegans and Ficus spp. over a tall shrubland of Mallotus mollissimus, Polyscias elegans and Glochidion lobocarpum over an open scrub of Alyxia ruscifolia, Pittosporum spinescens, Cassinia laevis, Jasminum didymum, Jasminum simplicifolium, *Lantana camara, Smilax australis, Geitonoplesium cymosum, Strychnos psilosperma over an open herbland of Adiantum atroviride, *Solanum seaforthianum and Gahnia aspera.</td></tr>
<tr><td>VM Act Status</td><td>Least Concern</td><td rowspan="5">  </td></tr>
<tr><td>EPBC Act Status</td><td>NA</td></tr>
<tr><td>Area in the Ground-truthed Mapping Extent (ha)</td><td>50.7</td></tr>
<tr><td>Area in Disturbance Footprint (ha)</td><td>8.4</td></tr>
<tr><td>Structure (m)</td><td>T1 (10-14)
T2 (6-8)
S1 (2-4)
S2 (0.5-1.5)
G (<1)</td></tr>
<tr><td>Significant species</td><td colspan="2">Habitat for Cycas megacarpa
Potential habitat for Hernandia bivalvis, Decaspermum struckoilicum, Cossinia australiana and Samadera bidwillii</td></tr>
<tr><td>11.12.6</td><td colspan="2">Woodland of Corymbia citriodora and Eucalyptus crebra over a low woodland of Corymbia citriodora, Eucalyptus crebra and Eucalyptus exserta over a tall shrubland of Lophostemon confertus over an open shrubland of Acacia leiocalyx, Lophostemon confertus, Acacia disparrima, Jacksonia scoparia and Alphitonia excelsa over an open tussock grassland of Chrysopogon fallax, Heteropogon contortus, Aristida latifolia, Gahnia aspera and Desmodium rhytidophyllum</td></tr>
<tr><td>VM Act Status</td><td>Least Concern</td><td rowspan="5">  </td></tr>
<tr><td>EPBC Act Status</td><td>NA</td></tr>
<tr><td>Area in the Ground-truthed Mapping Extent (ha)</td><td>3,497.3</td></tr>
<tr><td>Area in Disturbance Footprint (ha)</td><td>75.0</td></tr>
<tr><td>Structure (m)</td><td>T1 (14-19)
T2 (6-12)
S1 (2-5)
S2 (0.5-1.5)
G (<0.5)</td></tr>
<tr><td>Significant species</td><td colspan="2">Habitat for Cycas megacarpa</td></tr>
</table>

11.11.4	**Woodland to open forest of *Eucalyptus crebra* and *Corymbia citriodora* over a low open woodland of *Eucalyptus crebra* over an open shrubland of *Macrozamia macleayii* over a tussock grassland of *Heteropogon contortus*, *Glycine tomentella* and *Indigofera pratensis*.**	
VM Act Status	Least Concern	
EPBC Act Status	NA	
Area in the Ground-truthed Mapping Extent (ha)	14.9	
Area in Disturbance Footprint (ha)	6.0	
Structure (m)	T1 (12-16) T2 (3-5) S1(1-2) G (<0.5)	
Significant species	Habitat for *Cycas megacarpa*	
11.11.15	**Woodland to open woodland of *Eucalyptus crebra* over an open sub-canopy of *Corymbia erythrophloia* and *Euroschinus falcatus* over a sparse shrub layer comprising *Acacia decora, Alphitonia excelsa, Santalum lanceolatum.* Ground layer species include *Chrysopogon fallax, Evolvulus alsinoides, Gahnia aspera, Malvastrum americanum var. americanum* , Melinis repens* and *Sida hackettiana***	
VM Act Status	Least Concern	
EPBC Act Status	NA	
Area in the Ground-truthed Mapping Extent (ha)	46.6	
Area in Disturbance Footprint (ha)	10.9	
Structure (m)	T1 (8–18) S1 (1-4) G (<0.5)	
Significant species	Habitat for *Cycas megacarpa*	

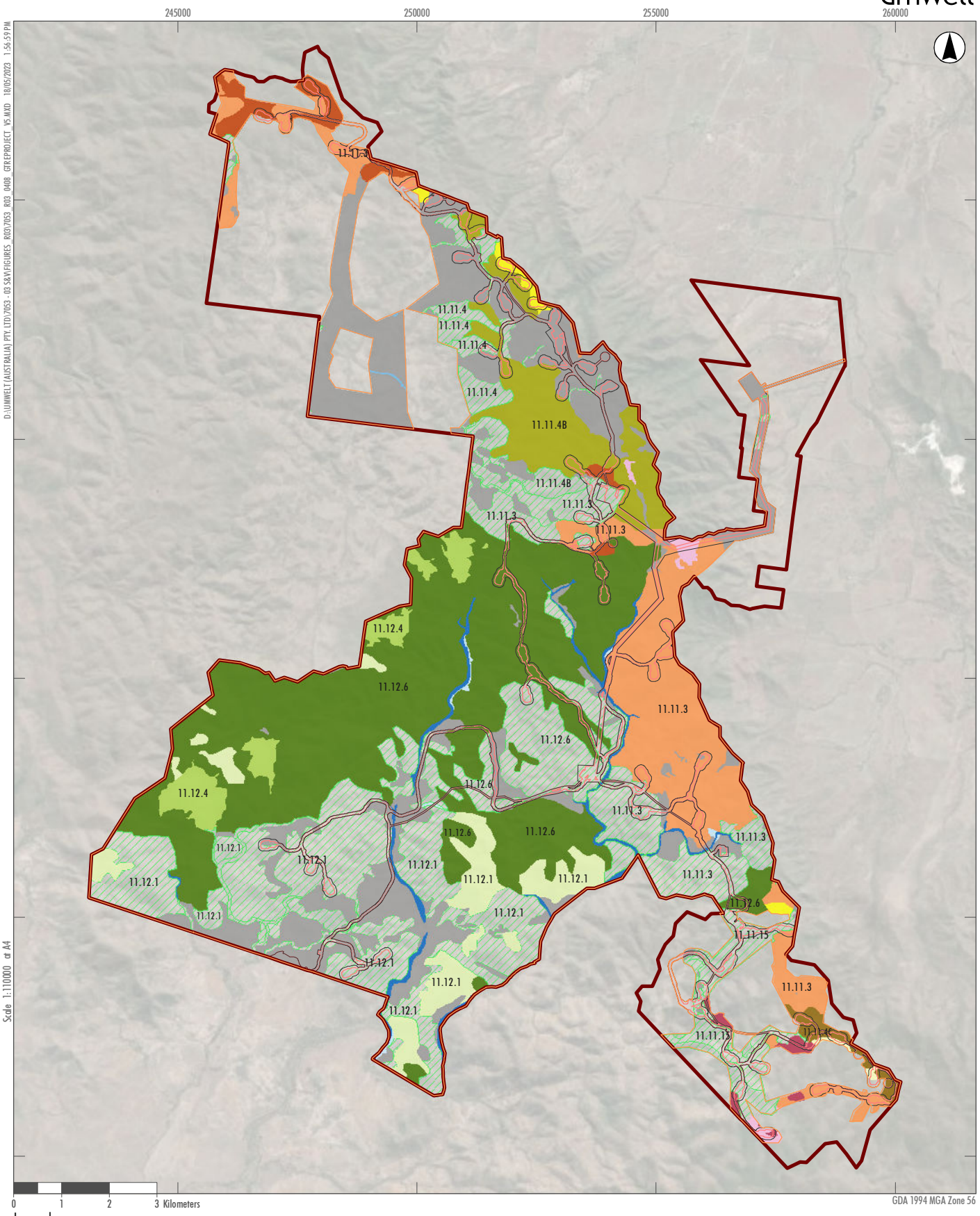


FIGURE 4.8

Field Verified Regional Ecosystems

Image Source: ESRI Basemap Data source: Umwelt (2021)

4.3 Likelihood of Occurrence Assessment

The results of the likelihood of occurrence assessment identified one threatened flora species as 'known' to occur (identified during the field surveys), one species as having a 'high' potential for occurrence and four species having a 'moderate' potential for occurrence (**Table 4.8**). No TECs were considered likely to occur within the Study Area. Threatened species and communities assigned an 'unlikely' or 'low' likelihood of occurrence have been excluded from further assessment.

The full likelihood of occurrence assessment is provided in **Appendix B**.

Table 4.8 Key Likelihood of Occurrence Assessment Results

Family	Species	EPBC Act Status	NC Act Status
Known			
Cycadaceae	*Cycas megacarpa*	Endangered	Endangered
High			
Hernandiaceae	*Hernandia bivalvis*	Not Listed	Near Threatened
Moderate			
Myrtaceae	*Decaspermum struckoilicum*	Endangered	Endangered
Sapindaceae	*Cossinia australiana*	Endangered,	Endangered
Simaroubaceae	*Samadera bidwillii*	Vulnerable	Vulnerable
Combretaceae	*Dansiea elliptica*	Not Listed	Near Threatened

4.4 Threatened Flora Habitat Mapping

Habitat mapping was completed for four flora species listed as Endangered or Vulnerable under the EPBC Act or NC Act that are known or have a moderate or high likelihood of occurring within the Study Area. Ground-truthed regional ecosystems mapped within the Study Area were used to characterise threatened species habitat. Particular habitat requirements of each species were used to further refine habitat mapping. **Table 4.9** below details the habitat criteria used for each threatened species occurring and potentially occurring within the Study Area. Habitat mapping for Endangered and Vulnerable species is provided in **Appendix C**.

Table 4.9 Habitat Mapping Rules for Known and Potentially Occurring Threatened Flora Species

Family	Species	Habitat Mapping Criteria
Cycadaceae	*Cycas megacarpa*	Remnant and regrowth REs and non-remnant areas. See Section 3.4.1.2 for description on how known habitat has been mapped, which in places (confirmed) is limited to 80 m buffer on recorded individuals. For the predicted density distribution see **Figure 4.7**.
Myrtaceae	*Decaspermum struckoilicum*	REs 11.11.5a, 11.12.4 in remnant condition, below 300 m AHD.
Sapindaceae	*Cossinia australiana*	REs 11.11.5a, 11.12.4 in remnant condition where they occur at elevations between 20 m and 520 m AHD.
Simaroubaceae	*Samadera bidwillii*	All remnant forest and woodland communities below 510 m AHD.

4.5 Matters of State Environmental Significance

The following MSES, as described in Schedule 2 of the Environmental Offset Regulation 2014, that relate to flora and vegetation are mapped and/or have been identified through the field survey program within the Disturbance Footprint and Development Corridor:

- Regulated vegetation (within a Category B area on the Regulated Vegetation Management map) that is:
    - Remnant vegetation comprising an Of Concern or Endangered RE
    - Remnant vegetation within a defined distance from the defining bank of a watercourse
    - Essential Habitat as identified on the Essential Habitat map (*Cycas megacarpa* and *Hernandia bivalvis*) (**Figure 4.6**).
- Protected wildlife habitat or potential wildlife habitat for a plant that is 'endangered wildlife' or 'vulnerable wildlife':
    - *Cycas megacarpa* (Known to occur)
    - *Decaspermum struckoilicum* (Moderate likelihood of occurrence)
    - *Cossinia australiana* (Moderate likelihood of occurrence)
    - *Samadera bidwillii* (Moderate likelihood of occurrence).

The MSES outlined above are considered the relevant prescribed matters for Projects requiring approval under the State *Planning Act 2016*. An assessment of Project impacts on these MSES values against the *Significant Residual Impact Guidelines* has been undertaken to determine whether a significant residual impact is anticipated (**Appendix C**).

It should be noted that other MSES values also occur within the Disturbance Footprint and Development Corridor (i.e. protected wildlife habitat comprising an area/s that is shown as a high risk area on the flora survey trigger map), however these do not require assessment as per the *Significant Residual Impact Guidelines* (The Department of State Development, Infrastructure and Planning, 2014).

5.0 Potential Impacts

Potential impacts to flora and vegetation values may occur during both the construction and operation/maintenance phases of the Project, and may be either direct impacts (e.g. through direct vegetation loss) or indirect impacts (e.g. through introduction of weeds).

The Disturbance Footprint, which occupies a subset of the Disturbance Footprint, has been used as the assessment unit when undertaking the assessment of direct impacts. The extent of clearing represented by the Disturbance Footprint is considered to be a 'worst-case' scenario. When assessing potential indirect impacts resulting from the Project, the Disturbance Footprint and the wider surrounding area have been considered. This area, along with the Project's Development Corridor and supporting infrastructure layout is provided in **Figure 5.1.**

5.1 Construction Impacts

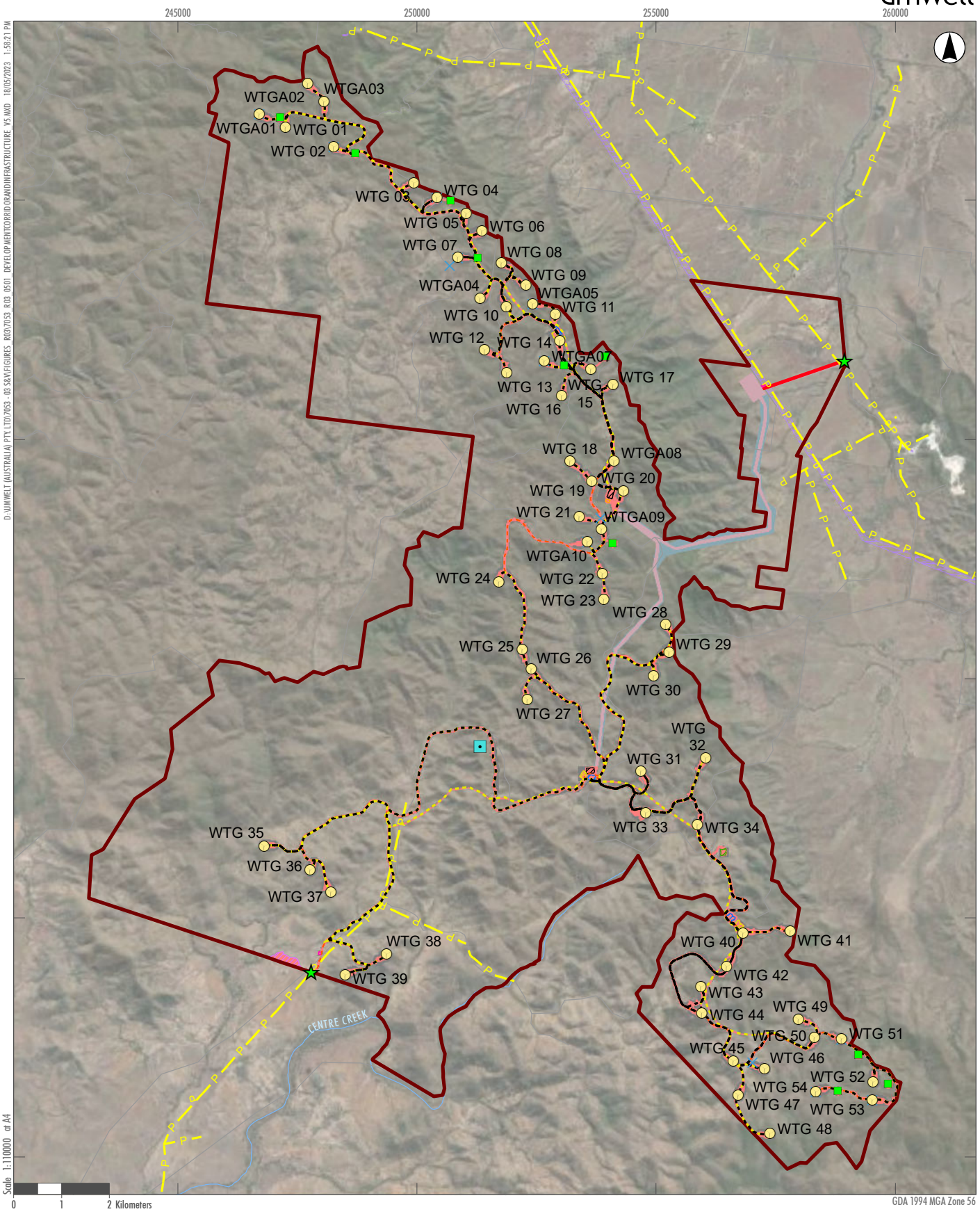
The construction phase of the Project will involve the installation of the wind turbines, access tracks, underground cables, and other associated infrastructure. It is the phase when the most significant impacts to flora and vegetation values will occur, as it involves the direct removal of individual flora species and habitat.

5.1.1 Direct Impacts

5.1.1.1 Vegetation Clearance

Based on the current Disturbance Footprint and field-validated vegetation mapping, the Project will result in the disturbance of up to 377.7 ha of remnant vegetation. Through a preliminary ecological constraint's analysis (**Section 6.1.1**) the majority of RE 11.3.4 (the only Of Concern RE verified within the Ground-truthed Mapping Extent) was able to be avoided with the remaining remnant 10 REs predicted to be impacted listed Least Concern. **Table 5.1** identifies the potential extent of disturbance to each RE (in remnant condition only). All REs to be directly impacted are Least Concern under the VM Act except one (RE 11.3.4) and none correspond to a TEC under the EPBC Act.

While the clearance of remnant vegetation is unavoidable within the Disturbance Footprint, there are a range of measures that will be implemented to minimise the magnitude of impact from clearing. Clearing will be staged and completed only be completed as strictly necessary. To maximise avoidance and minimisation opportunities, Project infrastructure will be micro-sited within the Development Corridor, guided by the results of pre-clearance surveys and a Project Vegetation Management Plan (**Section 6.2**). For the full range of avoidance, mitigation and management measures, see **Section 6.2.**



Legend

- Study Area
- Project Site (Development Corridor)
- Disturbance Footprint
- HV Electricity Network
- Easements

Proposed Project Infrastructure

- Site Access
- Access Road
- Overhead Line
- Underground Line
- Compound
- Concrete Batching Plant
- Construction Camp
- Laydown
- Operation and Maintenance Area
- Site Entry
- Substation
- Transmission Infrastructure
- Grid Connection Easement
- Access
- Temporary Met Masts
- Permanent Met Masts
- Turbines

Existing Project Infrastructure

- Existing Met Mast

FIGURE 5.1

Development Corridor and Infrastructure Layout

Image Source: ESRI Basemap (2021) Data source: Queensland Spatial (2020)

Table 5.1 Potential Impact to REs in Remnant Condition as per Field-validated Vegetation Mapping

Regional Ecosystem	VM Act Status	Area (ha) in Disturbance Footprint	Area (ha) in Development Corridor
11.3.25b	Least Concern	3.3	4.1
11.3.4	Of Concern	0.4	0.6
11.11.3	Least Concern	160.2	249.7
11.11.3c	Least Concern	23.8	38.6
11.11.4	Least Concern	6.0	11.3
11.11.4a	Least Concern	14.1	22.5
11.11.4b	Least Concern	40.4	69.4
11.11.4c	Least Concern	29.6	44.6
11.11.5a	Least Concern	8.4	20.9
11.11.15	Least Concern	10.9	15.7
11.12.6	Least Concern	75.0	116.6
Total Area		**372.0**	**594.0**

5.1.1.2 Regulated Vegetation

The regulated vegetation categories and respective areas within the Disturbance Footprint and Development Corridor as per the Regulated Vegetation Management map (Version 6.05) are provided below in **Table 5.2**.

Table 5.2 Potential Impacts to Regulated Vegetation

Regulated Vegetation Categories	Area (ha) within the Disturbance Footprint	Area (ha) within the Development Corridor
Category B – Remnant vegetation	323.9	519.9
Category C – High value regrowth	3.5	4.1
Category R – Regrowth within 50 m of a watercourse or drainage feature in the Great Barrier Reef catchment	3.6	5.6
Category X - Exempt clearing work on Freehold, Indigenous and Leasehold land	546.5	817.7

5.1.1.3 Threatened Species

Cycas megacarpa

The field surveys targeted habitat for *Cycas megacarpa* and conducted plot-based counts of individuals as well as rapid density visual estimates. Using this approach, an actual count of individuals is obtained (recognised as lower bound) and allows for an estimation of distribution, undertaken spatially using an IDW interpolation algorithm (see **Section 3.4.1**).

The results of this assessment are summarised below in **Table 5.3** and **Table 5.4.**

Table 5.3 *Cycas megacarpa* Individuals

Project Area	Projected Count (Individuals)
Study Area	159,915
Development Corridor	6,709
Disturbance Footprint	4,131

Table 5.4 *Cycas megacarpa* Density Summary

Density Category (per 0.25 ha)	Study Area[1]	Development Corridor[2]	Disturbance Footprint[2]
High (25-50 individuals)	74.9 ha	0.9 ha	0.7 ha
Moderate (10-25 individuals)	960.8 ha	29.6 ha	16.8 ha
Low (1-10 individuals)	5,365.7 ha	301.5 ha	195.7 ha

[1] Study Area values have been corrected by a factor of 0.5-0.7 to provide contextual comparison with development corridor, for with IDW outputs have been clipped to the known (confirmed) and known (suspected) habitat area.
[2] IDW outputs clipped to areas of mapped known (confirmed) and known (suspected) habitat area

The habitat mapping identified a total of 360.7 ha of known habitat within the Disturbance Footprint comprising 213.0 ha of known (confirmed) and 147.7 ha of known (suspected) habitat.

The Disturbance Footprint will require vegetation clearing to allow for construction of the Project. However, a number of mitigation measures for this species specifically including but not limited to, translocation, are proposed to ensure not net loss of individuals (see **Section 6.2**). Nonetheless, it is acknowledged that approximately 360.7 ha of known (confirmed and suspected) habitat for the species will be removed.

The population of *Cycas megacarpa* within the Study Area is considered an 'important population' and the habitat 'critical to the survival of the species'. A Significant Residual Impact (SRI) assessment has been completed (**Appendix C**) and after avoidance, mitigation and management measures have been considered (**Section 6.2.2**) it is considered 'Likely' that the Project will have a SRI on this species.

Species with a High to Moderate Likelihood of Occurring

Four additional threatened species have a High to Moderate likelihood of occurring within the Disturbance Footprint. The potential habitat and extent of disturbance for these species is provided in **Table 5.5**.
It should be noted that habitat mapping criteria have been updated from the original submission due to DCCEEW mapping requirements for the Preliminary Documentation. As such, the extent of potential habitat for these flora species has been updated accordingly.

Significant Residual Impact (SRI) assessments for these species have been completed (**Appendix C**) and after avoidance and mitigation measures have been considered (**Section 6.2.2**) it is considered 'Unlikely' that the Project will have a SRI on these species.

Table 5.5 Potential Impact to Threatened Flora Habitat

Species	Status[1] (EPBC Act, NC Act)	Identified Suitable Habitat	Area (ha) of Habitat Within the Ground Truthed Mapping Extent	Area (ha) of Habitat Within the Development Corridor	Area (ha) of Habitat Within the Disturbance Footprint
High					
Hernandia bivalvis	-, NT	REs 11.11.5a, 11.12.4 in remnant condition	330.3	20.4	8.3
Moderate					
Dansiea elliptica	-, NT	REs 11.11.5a, 11.12.4 in remnant condition	330.3	20.4	8.3
Decaspermum struckoilicum	E, E	REs 11.11.5a, 11.12.4 in remnant condition, below 300 m AHD.	39.1	6.0	2.1
Cossinia australiana	E, E	REs 11.11.5a, 11.12.4 in remnant condition where they occur at elevations between 20 m and 520 m AHD.	330.3	20.4	8.3
Samadera bidwillii	V, V	All remnant forest and woodland communities below 510 m AHD.	6,681.9	462.1	284.0

[1] V = Vulnerable, E = Endangered, NT = Near Threatened (NC Act only)

5.1.2 Indirect Impacts

5.1.2.1 Introduction and/or Spread of Weeds

Introduction and/or spread of weeds is a major indirect impact that can impact the integrity of remaining vegetation, increase the intensity and/or frequency of fires, as well as threaten the long-term survival of threatened flora species.

Within the Study Area weed species are common within the cleared and regrowth areas of the site as well as sporadically throughout the remnant vegetation. The weed species that pose the biggest threat to flora and vegetation values are the Category 3 'restricted' species listed under the Biosecurity Act, WoNS, as well as high-biomass grass species. High-biomass grass species can out-compete native vegetation as well as reduce the germination of native species. The high-biomass of these species also increases the intensity and/or frequency of fires.

The weed species that pose the biggest threat to flora and vegetation values are:

Category 3 restricted weed species:

- Lantana (*Lantana camara*)
- Prickly pear (*Opuntia stricta*)
- Velvety pear (*Opuntia tomentosa*)
- Rubber vine (*Cryptostegia grandiflora*)
- Parthenium (*Parthenium hysterophorus*).

High-biomass grass species:

- Green panic (*Megathyrsus maximus* var. *maximus*)
- Buffel grass (*Cenchrus ciliaris*).

Actively removing and managing these species within the Development Corridor and preventing the introduction of additional weed species may prevent indirect impacts to flora and vegetation values. Weed management measures are discussed in **Section 6.2.3**.

5.1.2.2 Edge Effects

Edge effects in ecology are identified as any difference in environment between the edge and interior of a particular vegetation patch (Murcia 1995). Environmental characteristics which differ across edges cover many components of the environment including atmosphere (e.g. microclimate), vegetation (e.g., structure, composition, functioning), fauna and their habitat and soil (Murcia 1995).

Edges and their effects can be created through clearing of vegetation, such as new edges created by roads. The distance the effect spreads from the edge, known as edge permeability, can be highly variable and depends upon many factors such as vulnerability of the ecosystems, degree of change in land use, intensity of this use and chance events (Murcia 1995).

The main environmental impacts to new edges created by the Project are considered to include:

- Modification of microclimate where new edges are created due to greater penetration of light and wind into the vegetation. Temperature extremes are greater, and humidity of air is generally less at the edge than in the interior of vegetation. This effect is known to increase in size if vegetation is dense or cover is high.
- Physical disturbance to vegetation at the edge. Ongoing damage to the edge of vegetation may occur due to grading and weed control of road edges and vehicle use. Similarly, unsealed tracks can facilitate an increase incident of fire ignitions.
- Changes to soil properties including compaction of the soil, less organic matter and more erodible.
- Introduction of weeds and pathogens through mud and dirt which falls off vehicles.
- Changes to vegetation through the above listed impacts.

Many of these potential environmental impacts including introduction of weeds and physical disturbance to vegetation can be managed through good site practices and vehicle restrictions. Rehabilitation of areas no longer used for construction activities will further reduce potential impacts. Measures to manage potential impacts are provided in **Section 6.2.**

The vine thicket communities are considered particularly sensitive to edge effects due to a dense community structure. For these communities it is recommended that a vegetated buffer of up to 5 m be retained to reduce potential impacts of edge effects.

5.1.2.3 Soil Erosion and Sedimentation

Removal of vegetation and disturbance to the soil profile through clearing and construction activities can lead to soil erosion, which in turn can lead to increased input of sediment into waterways. Increased sediment in waterways can lead to siltation of watercourses and a reduction in water quality of creeks, rivers, and coastal areas.

Through erosion, important topsoil can be lost, leading to exposure of subsoil, which often has poor physical and chemical properties.

5.1.2.4 Dust Impacts

Soil exposed through vegetation clearance can lead to dust generation, which in turn settles on adjacent vegetation. Dust impacts to vegetation are understudies, but are dependent on the type of vegetation, type of dust (chemical properties, grain size) and total dust load settling on the vegetation.

Dust impacts from the Project are expected to be restricted to vegetation directly adjacent to the access tracks where soil is exposed and can be disturbed through vehicle movement. The dust will be chemically inert, and as such, any potential impacts will be physical in nature, such as blocking of plant stomata and reduction in light penetration to the leaf surface, potentially reducing photosynthetic capacity. This may lead to a reduction in the health and vigour of vegetation directly adjacent to the road.

5.2 Operation/Maintenance Impacts

Impacts to flora and vegetation values associated with maintenance and access of the infrastructure during the operation and maintenance phases of the Project are expected to be minimal and relate primarily to the following indirect impacts:

- Weed introduction and spread
- Edge effects
- Erosion and sedimentation
- Dust impacts.

It is expected that these impacts can be managed through the mitigation and management measures provided in **Section 6.20**.

6.0 Avoidance, Mitigation and Management

The hierarchy of avoid, minimise, and mitigate has been applied to the design process for the Project, with the field survey findings incorporated into the Development Corridor design. This section describes the avoidance, mitigation and management measures proposed to reduce the potential Project on flora values. Where significant residual impacts remain following implementation of mitigation measures, these impacts will need to be offset.

6.1 Avoidance

6.1.1 Ecological Constraint Analysis

The Development Corridor as shown within this report, has been subject to an ecological constraint analysis, the purpose of which was to identify flora and fauna values of high ecological significance to be avoided as part of the Development Corridor. The ecological constraints analysis was largely structured around the legislative status of each ecological value.

The main priority flora value that was considered as part of this process was areas of high-density *C. megacarpa*, with the risk rating of all values shown in **Table 6.1**. Through this process, most (96%) of the high-density *C. megacarpa* areas have been avoided and it is considered through the micro-siting process that this impact can be further reduced. Areas of the Of Concern RE 11.3.4 were also avoided through this process.

Table 6.1 Constraint Risk Categories

Constraint	Constraint Value	Constraint Category
Cycas megacarpa	High density	Very High
	Moderate density	High
	Low density	Moderate
Regional Ecosystems (REs)	Of Concern	Moderate
	Least Concern	Low
	Non-remnant	Limited
High Value Regrowth REs	Of Concern	Low
	Least Concern	Limited

Constraint	Constraint Value	Constraint Category
Essential Habitat	Essential habitat	High
Protected Plants	High-risk trigger area	High

6.1.2 Micro-siting

Project infrastructure will be micro-sited within the Development Corridor based on the location of on-ground constraints including threatened species individuals and habitat. Additional field surveys specific to terrestrial ecology (as well as other types of constraints) will be conducted prior to construction, including pre-clearance surveys. This data will allow for increased accuracy and detail in mapped terrestrial ecological values within the Development Corridor. Ground-truthed ecological field data will strongly influence the final design of the Project, with the avoidance hierarchy principles in place. Future refinement of the Project will seek to avoid threatened species individuals and habitat, particularly species where significant impacts may occur.

Infrastructure micro-siting will aim to avoid or further minimise disturbance to:

- Habitat features required by fauna species including hollow bearing trees and stags, trees with diameter at breast height (DBH) >30 cm, large hollow logs and complex boulder piles.
- Large reproductive-age and mature female *Cycas megacarpa* individuals.
- Breeding habitat for threatened and migratory fauna species.
- Vine thicket communities.
- Riparian zones, including avoiding placement of turbines within 50 m of waterways.

Infrastructure micro-siting will prioritise the avoidance of threatened species and other conservation significant values not pre-approved for impact or translocation including, but not limited to, potentially occurring threatened flora. However, where a threatened flora species not previously known to the Study Area is encountered, the pre-clearance surveys constraints protocol will be enacted (see **Section 7.1.3**).

6.1.3 Pre-clearance Survey Constraint Protocol

This section defines an adaptive management response which is to be engaged if a threatened species not already known to occur within the Study Area is encountered during pre-clearance surveys or any other surveys undertaken prior to construction. The trigger to undertake the pre-clearance surveys constraint protocol is the observation of one or more individual of a flora species listed as threatened under the EPBC Act within the Disturbance Footprint during future surveys or construction. If either are to be found, the constraints protocol below will then be followed.

STEP 1: Halt construction/clearing activities in the area (i.e. adjacent areas within the Disturbance Footprint where suitable habitat is present – to be determined by a suitably qualified ecologist).

STEP 2: Undertake investigation into potential impacts on the species. This should include:

- Updating of habitat mapping.
- Updating of Significant Impact Assessment.
- Determination of avoidance and mitigation strategies.

STEP 3: Communicate outcomes with DCCEEW and DES as appropriate to determine next steps.

Where threatened species (NC Act or EPBC Act) and weed species have been identified then the following information will be recorded:

- GPS location.
- Collector, date and time.
- Species (scientific and common name).
- Number or density of individuals.
- Habit.
- Vegetation community in which it was recorded.
- General notes on the feature identified.
- Collect a reference specimen.

It is noted that should a threatened species listed only under the NC Act be encountered, potential impacts to this species will be managed in consultation with DES via the Protected Plants assessment process outlined in the Nature Conservation (Plants) Regulation 2020.

6.2 Mitigation and Management

Throughout the life of the Project, potential impacts on flora and vegetation values will be directly or indirectly managed via Project Management Plans. All mitigation and management measures will be captured in one or multiple of the Project Management Plans, listed below:

- Health, Safety and Environment Management Plan (HSE Plan)
- Construction Environmental Management Plan (CEMP)
- *Cycas megacarpa* Species Management Plan (SMP)
- Vegetation Management Plan (VMP)
- Erosion and Sediment Control Plan (ESCP)
- Decommissioning Management Plan

- *Cycas megacarpa* Translocation Management Plan
- Weed and Pest Management Plan (WPMP)
- Rehabilitation Management Plan (RMP)
- Bushfire Management Plan (BMP).

All plans will be finalised prior to construction commencing.

6.2.1 Vegetation Clearance

To reduce impacts to remnant vegetation as a result of vegetation clearance, the Project will utilise a VMP which will be prepared prior to construction commencing. Vegetation management measures will include:

- Site preparation must include the demarcation of areas to be cleared as well as 'no-go' zones to avoid inadvertent clearing.
- Pre-clearance surveys in areas of potential threatened flora habitat will include targeted searches for these species.
- Micro-siting of Project infrastructure will maximise the use of existing breaks in vegetation and areas of previously cleared land as much as practical.
- Micro-siting of Project infrastructure will aim to retain a vegetated buffer around the vine thicket communities up to 5 m, to limit edge effects. In cases where the final Disturbance Footprint intersects the vine thicket communities, a 5 m buffer will not be possible.
- Where watercourses intersect linear areas of the Project (i.e., access tracks and reticulation cabling) the clearing width will be reduced to 25 m or less wherever it is feasible. The full implementation of this measure is subject to final design and safe transport of Project components.
- To minimise further loss of vegetation, trees will be felled away from areas of retained vegetation where practicable. Where trees unavoidably fall into retained areas, they will be left in-situ to mimic natural tree fall and provide habitat for ground-dwelling fauna.
- Dust suppression measures will be implemented as required i.e., on high wind days during extended dry periods.

6.2.2 Threatened Species

Several measures will be put in place to reduce the impact to threatened species, these include:

- Where clearing is proposed in areas of mapped potential habitat, pre-clearance surveys will include searches for the respective potentially occurring threatened flora species. If any individuals or populations are located during the targeted surveys, a detailed account of their occurrence must be recorded including number of individuals, GPS location and extent. The plants or population area including a 5 m buffer must be demarcated. The pre-clearance survey constraints protocol (see **Section 6.1.3**) will then be followed to ensure any potential impacts on the species (which are also listed under the EPBC Act) are avoided or managed appropriately.

- The Nature Conservation (Plants) Regulation 2020 outlines the regulatory requirements for managing potential impacts on a protected plant. Should direct impacts be anticipated as a result of the Project within 100 m of high risk trigger areas or protected plant individuals, a protected plants permit will be required. The permit application will need to be supported by a protected plants assessment and survey in accordance with the guidelines, and if necessary an impact management plan will be developed and implemented.
    - A protected plants clearing permit for *Cycas megacarpa* has been acquired for the proposed geo-technical investigations.

For *Cycas megacarpa*, measures include:

- Pre-clearance surveys for *Cycas megacarpa* will occur across the Disturbance Footprint plus a 5 m buffer to confirm the location, extent, numbers, and age class of the population within the clearing extent, with all efforts made to avoid impacts via micro-siting to high-density areas and large reproductive-age individuals.
- A pre-approved *Cycas megacarpa* SMP will be implemented through all Project phases. This plan will provide detailed information regarding:
    - Species information including a description to aid identification.
    - Mitigation and management methods, including corrective actions.
    - Vegetation clearing requirements and methods to reduce impacts to surrounding individuals and their habitat.
    - Specific weed management measures to reduce impacts on the long-term integrity of the remaining habitat and population including high-biomass weeds.
    - Erosion, sedimentation, and dust management requirements specific to the species.
    - A pre-approved translocation plan will be implemented for individuals that would otherwise be removed through clearing for the Project. The plan will specify pre and post monitoring requirements, translocation and propagation methods and protocols and reporting requirements and performance criteria.

6.2.3 Weed Management

Management of the spread or introduction of weeds is a major indirect potential impact of the Project, which can impact the integrity and longevity of vegetation communities and threatened species. It is considered that the risk of these potential impacts can be appropriately mitigated and managed through appropriate site management practices.

A WPMP will be developed and implemented that includes the following measures:

- Identification and location of restricted weeds and high-biomass grasses within the Development Corridor.
- Removal and/or treatment of restricted weeds and high-biomass grasses from the Development Corridor prior to ground disturbance.

- The origin of construction materials, machinery and equipment will be identified to mitigate introduction of weed species.
- Vehicles and machinery must follow hygiene protocols to prevent introduction of new weed species.
- Staff and contractors must be equipped with information on the location of biosecurity threats.
- Management methods to control spread of weeds considered to be Restricted Matters must be in keeping with regional management practice or Queensland Department of Agriculture and Fisheries pest control prescriptions.
- Promote the awareness of weed management, by inclusion of weed issues, pictures, and procedures into the Project's site induction program.
- Appropriate weed monitoring to identify spread of existing weeds and any new incidence of weeds.
- Reporting requirements and performance measures.

6.2.4 Other

- To minimise soil loss, best practice erosion and sediment control measures will be implemented during construction via the Preliminary Erosion and Sediment Control Plan (Attachment H of the Preliminary Documentation):
    - Disturbed areas will be assessed and progressively rehabilitated in accordance with the VMP and / or RMP.
    - Disturbed areas will be assessed and progressively rehabilitated in accordance with the RMP (to be developed in response to the State approval) and/or the Preliminary VMP.
    - Batters and embankments will be stabilised as soon as practical after construction.
- Undertake refuelling and chemical storage in designated containment areas and follow emergency response procedures in the event of a spill. Containment areas will be designed and managed in accordance with relevant regulatory requirements and standard.
- Threat of wildfire caused by Project activities will be minimised through maintenance of firebreaks around ignition sources as appropriate according to the BMP which will be prepared prior to construction.
- Where a watercourse crossing must be established, the crossing site will be the most direct route (i.e., 90 ± 10-degree angle to the watercourse) that maximises the use of existing vegetation breaks and minimises clearing.

6.3 Rehabilitate

The Disturbance Footprint includes a number of linear sections associated with access tracks and supporting ancillary infrastructure such as communication and power cable lines. Linear sections of the Disturbance Footprint vary in width but in some locations span approximately 100 m; these widths have been deemed necessary for the safe transport and installation of turbine infrastructure. Excluding established access tracks and fire safety Asset Protection Zones, which at all times will need to remain free of vegetation, previously cleared, linear areas will be reclaimed and rehabilitated. Further to this, all areas of temporary ancillary infrastructure will also be subject to rehabilitation efforts including:

- Laydown areas
- Concrete batching plants
- Construction compound
- Temporary workers accommodation camp.

Prior to construction commencing, a RMP will be developed and approved which outlines the specific objectives and plan for rehabilitation. With current design details, it is estimated approximately 20% of the total Disturbance Footprint (i.e. the area that will be cleared for the Project) may be able to be rehabilitated following construction. This equates to approximately 180 ha of native vegetation being rehabilitated. Rehabilitation will include the planting of native species known to the region, consistent with the characteristics of surrounding retained vegetation.

7.0 Significant Residual Impact Assessment

SRI assessments were undertaken for the MSES that occur within the Disturbance Footprint (**Appendix C**). This assessment identified that, after avoidance and mitigation measures were considered, the Project is 'Likely' to have a SRI on the following flora / vegetation values:

- Regulated vegetation containing Essential Habitat for *Cycas megacarpa* and *Hernandia bivalvis.*
- Protected wildlife habitat for *Cycas megacarpa*.

It should be noted, that while Essential Habitat is mapped for both *Cycas megacarpa* and *Hernandia bivalvis*, the field survey did not identify any appropriate habitat for *H. bivalvis* within the mapped Essential Habitat extent that covers the Study Area.

7.1 Offset Requirements

To compensate for significant residual impacts on two MSES values (regulated vegetation containing Essential Habitat areas and Protected Wildlife Habitat for *Cycas megacarpa*), offsets are likely to be required.

Cycas megacarpa is listed as Endangered under the Commonwealth EPBC Act and is therefore considered a MNES. The Project, including a description of the potential impacts to *Cycas megacarpa*, has been referred to the Commonwealth for assessment under the EPBC Act and is currently in the final stages of Preliminary Documentation assessment. In this assessment, it was determined that a significant impact on *Cycas megacarpa* was likely to occur as a result of habitat loss and as such Commonwealth offsets are required. Under this scenario, offsets relating to *Cycas megacarpa* protected wildlife habitat will not be required under the State *Environmental Offsets Act 2014*.

Regardless of the Project's determination under the EPBC Act, offset requirements for the State matter of regulated vegetation containing Essential Habitat areas will need to be considered under the State *Environmental Offsets Act 2014*.

7.1.1 Offset Pathways

The provision of offsets under the *Environmental Offsets Act 2014* can take various forms, including financial settlement offsets, proponent driven offsets or a combination of the two. These offset pathways are explained in the context of the Project below.

7.1.1.1 Financial Settlement

To offset the loss of Essential Habitat and *Cycas megacarpa* individuals and its habitat, a payment must be made to the Queensland Government's Offset Account. The financial settlement cost must be calculated using the Financial Settlement Offset Calculator. The following offset delivery forms must be submitted to DES:

- EOD1—Environmental Offsets Delivery Form 1: Notice of Election.
- EOD4—Environmental Offsets Delivery Form 4: Financial Settlement Details.

The Queensland Government is then responsible for delivering a conservation outcome from the financial settlement offset payment.

7.1.1.2 Proponent Driven Offset

A proponent driven offset is undertaken through a land-based offset, direct benefit management plan, or a combination of both. The land-based offset requirement is calculated using a 4x multiplier derived from the DES Land-based Offset Multiplier Calculator.

The suitability of a proposed offset site is measured by undertaking a Habitat Quality Assessment in accordance with the *Guide to Determining Terrestrial Habitat Quality* (version 1.3) (DES 2020) or an alternative approach approved by DES. The proponent driven offset must be undertaken in accordance with an approved Offset Delivery Plan.

The following offset delivery forms must be submitted to DES with the Offset Delivery Plan:

- EOD1—Environmental Offsets Delivery Form 1: Notice of Election.
- EOD2—Environmental Offsets Delivery Form 2: Offset Delivery Plan Details.
- EOD3—Environmental Offsets Delivery Form 3: Offset Area Details.
- EOD5—Environmental Offsets Delivery Form 5: Habitat Quality Details.

8.0 Conclusion

This report documents the findings of a flora and vegetation field survey program undertaken between 2019 and 2022 for the proposed Mount Hopeful Wind Farm Project. Findings from the field survey program identified the following floristic values within the Development Corridor and Disturbance Footprint:

- Fifteen REs including one (RE 11.3.4) which is listed Of Concern under the VM Act.
- One threatened flora species considered 'Known' to occur: the Endangered *Cycas megacarpa*, which was recorded within a variety of vegetation communities including areas of regrowth and non-remnant vegetation.
- Five threatened flora species with a 'High' to 'Moderate' likelihood of occurrence, including:
    - *Hernandia bivalvis* (-, NT)
    - *Dansiea elliptica* (-, NT)
    - *Decaspermum struckoilicum* (E, E)
    - *Cossinia australiana* (E, E)
    - *Samadera bidwillii* (V, V).
- Five 'Category B' restricted weed species under the Biosecurity Act, including:
    - Lantana (**Lantana camara*)
    - Prickly pear (**Opuntia stricta*)
    - Velvety pear (**Opuntia tomentosa*)
    - Rubber vine (**Cryptostegia grandiflora*)
    - Parthenium (**Parthenium hysterophorus*).
- Prescribed environmental matters (MSES) including:
    - Regulated vegetation containing Endangered or Of Concern REs
    - Regulated vegetation within a defined distance of a watercourse
    - Regulated vegetation containing mapped areas of Essential Habitat (*Cycas megacarpa* and *Hernandia bivalvis*)
    - Protected wildlife habitat for *Cycas megacarpa*, *Hernandia bivalvis*, *Decaspermum struckoilicum*, *Cossinia australiana* and *Samadera bidwillii.*

Based on the findings of the impact assessment, the following are considered the main impacts from the Project:

- Removal of up to 372.0 ha of ground-truthed remnant vegetation, of which 0.4 ha comprises Of Concern RE 11.3.4, with the remaining area comprising Least Concern REs as per the field validated vegetation mapping.

- Removal of up to 323.9 ha of remnant vegetation located within a Category B area on the Regulated Vegetation Management map, of which a maximum of 0.1 ha is associated with Of Concern REs (RE 11.3.4 and 11.3.2). The outcome of the SRI for Of Concern or Endangered RE indicates the Project is **Unlikely** to have a SRI on this value.

- Removal of up to 3.5 ha of Category C (high value regrowth) and 3.6 ha of Category R (Riverine) regulated vegetation identified on the Regulated Vegetation Management Map.

- Removal of up to 10.7 ha of remnant vegetation (within a Category B area) within the defined distance of a watercourse as per the Regulated Vegetation Management map. The outcome of the SRI for Remnant Vegetation Within the Defined Distance of a Watercourse indicates the Project is **Unlikely** to have a significant impact on this value.

- Removal of 22.5 ha of regulated vegetation containing mapped Essential Habitat for *Cycas megacarpa* and *Hernandia bivalvis*. The outcome of the SRI indicates the Project is **Likely** to have a SRI on *Cycas megacarpa* Essential Habitat.

- Disturbance to individuals and habitat of the Endangered *Cycas megacarpa.* The outcome of the SRI indicates the Project is **Likely** to have a SRI on this species.

- Disturbance to potential habitat of four threatened species considered to have a High-Moderate likelihood of occurring. The outcome of a SRI for the 'Vulnerable' and 'Endangered' species indicated that the Project is **Unlikely** to have the SRI on these species.

The hierarchy of avoid, minimise, and mitigate has been applied to the design process for the Project. The following avoidance, mitigation and management measures are proposed to further reduce potential impacts from the Project:

Avoid

Infrastructure micro-siting will aim to avoid or further minimise disturbance to:

- Habitat features required by fauna species including hollow bearing trees and stags, trees with diameter at breast height (DBH) >30 cm, large hollow logs and complex boulder piles.

- Large reproductive-age and mature female *Cycas megacarpa* individuals.

- Breeding habitat for threatened and migratory fauna species.

- Vine thicket communities.

- Riparian zones, including avoiding placement of turbines within 50 m of waterways.

Within the Development Footprint, pre-clearance surveys will be undertaken within suitable habitat for potentially occurring threatened species.

Mitigate and Manage

- A Preliminary VMP has been prepared to provide guidance on the requirements of vegetation management and protection.
- Where clearing is proposed in areas of mapped potential habitat, pre-clearance surveys will include searches for the respective potentially occurring threatened flora species. If any individuals or populations are located during the targeted surveys, a detailed account of their occurrence must be recorded including number of individuals, GPS location and extent. The plants or population area including a 5 m buffer must be demarcated. The pre-clearance survey constraints protocol (see **Section 6.1.3**) will then be followed to ensure any potential impacts on the species (which are also listed under the EPBC Act) are avoided or managed appropriately.
- The Nature Conservation (Plants) Regulation 2020 outlines the regulatory requirements for managing potential impacts on a protected plant. Should direct impacts as a result of the Project be anticipated within 100 m of high risk trigger areas or protected plant individuals, a protected plants permit will be required. The permit application will need to be supported by a protected plants assessment and survey in accordance with the guidelines, and if necessary an impact management plan will be developed and implemented.
- Pre-clearance surveys for *Cycas megacarpa* will occur across the Disturbance Footprint plus a 5 m buffer to confirm the location, extent, numbers, and age class of the population within the clearing extent, with all efforts made to avoid impacts via micro-siting to high-density areas and large reproductive-age individuals.
- A pre-approved *Cycas megacarpa* SMP will be implemented through all Project phases. This plan will provide detailed information regarding:
    - species information including a description to aid identification
    - mitigation and management methods, including corrective actions
    - vegetation clearing requirements and methods to reduce impacts to surrounding individuals and their habitat
    - specific weed management measures to reduce impacts on the long-term integrity of the remaining habitat and population including high-biomass weeds
    - erosion, sedimentation, and dust management requirements specific to the species.
- A pre-approved *Cycas megacarpa* Translocation Management Plan will be implemented for individuals that would otherwise be removed through clearing for the Project. The plan will specify pre and post monitoring requirements, translocation and propagation methods and protocols and reporting requirements and performance criteria.
- A WPMP will be prepared that documents the weed management requirements and protocols for the Project.
- An ESCP will be developed to prevent erosion and sedimentation from disturbed areas into waterways.

Offsets

For the MSES values that returned a **Likely** SRI, it is anticipated that offsets will be required to compensate for this residual impact. For State matters, offsets can be in the form of either financial offsets or proponent driven offsets. The requirement for offsets will be determined following the detailed design of the Project and will be administered in accordance with the *Environmental Offsets Act 2014*.

Cycas megacarpa is listed as Endangered under the Commonwealth EPBC Act and is therefore considered a MNES. The Preliminary Documentation assessment used to inform the EPBC Act approval, although not yet finalised, states that a significant impact on *Cycas megacarpa* is likely to occur as a result of habitat loss. As such, Commonwealth offsets are likely to be required and a preliminary Offset Strategy has been developed. To avoid duplication of offsets between the two jurisdictions, offsets for impacts relating to *Cycas megacarpa* protected wildlife habitat are unlikely to be required under the State *Environmental Offsets Act 2014*.

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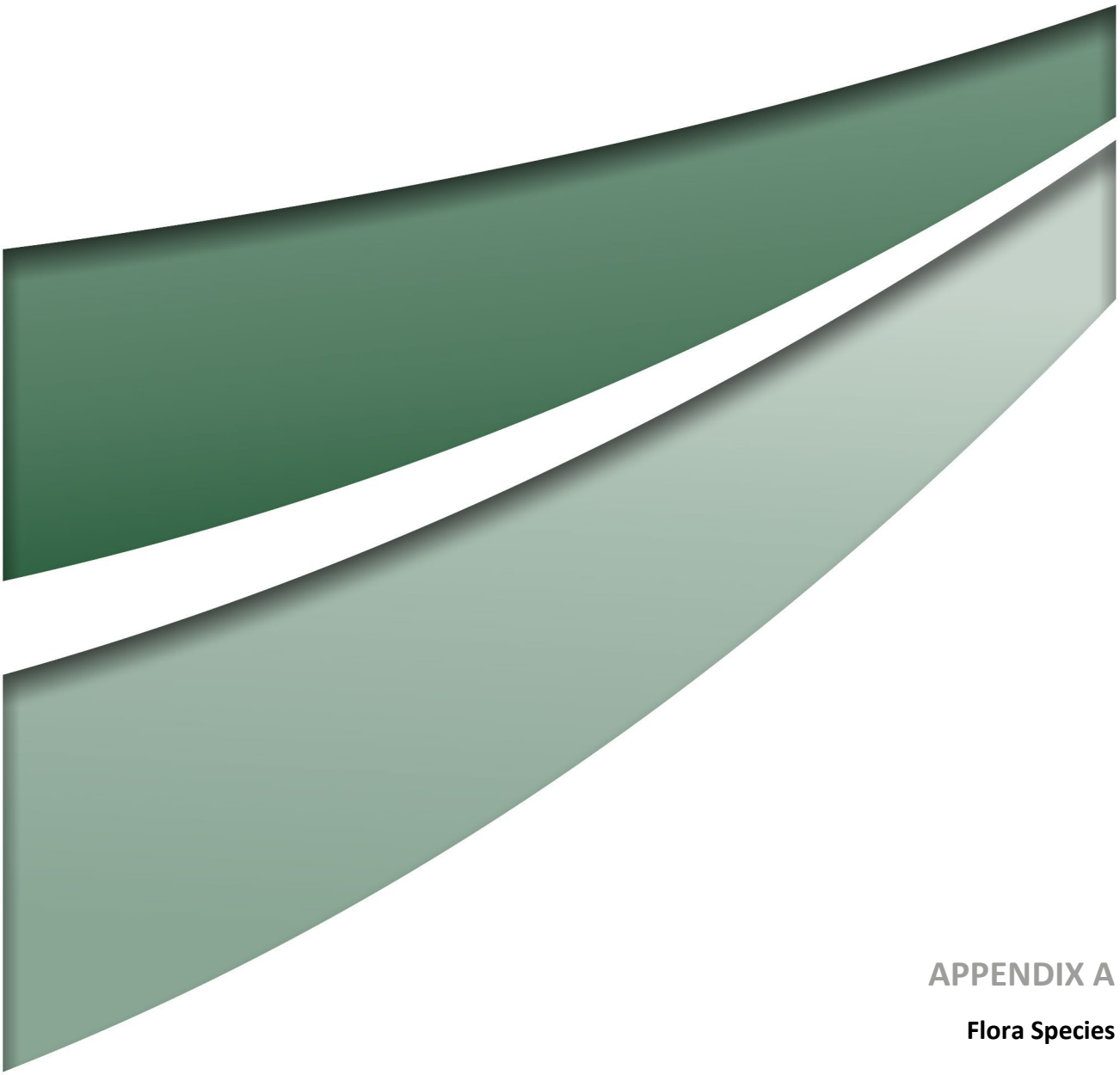


APPENDIX A

Flora Species

Table A.1 Flora species recorded during the field survey program

Family	Species	Common name	[1]Introduced Status	[2]NC Act Status	[3]EPBC Act Status
Acanthaceae	*Brunoniella australis*	blue trumpet		C	-
Amaranthaceae	*Achyranthes aspera*	-		C	-
	Alternanthera nana	hairy joyweed		C	-
Anacardiaceae	*Euroschinus falcatus* var. *falcatus*	-		C	-
	Pleiogynium timorense	Burdekin plum		C	-
Apocynaceae	*Alyxia ruscifolia*	-		C	-
	Cryptostegia grandiflora	rubber vine	*, C3, WoNS	-	-
	Gomphocarpus physocarpus	balloon cottonbush	*	-	-
Araliaceae	*Polyscias elegans*	celery wood		C	-
	Schefflera actinophylla	umbrella tree		C	-
Arecaceae	*Livistona decora*	-		C	-
Asteraceae	*Ageratum conyzoides* subsp. *conyzoides*	-	*	-	-
	Apowollastonia spilanthoides	-		C	-
	Bidens pilosa var. *pilosa*	-	*	-	-
	Cassinia laevis	-		C	-
	Cirsium vulgare	spear thistle	*	-	-
	Emilia sonchifolia	-	*	-	-
	Ozothamnus cassinioides	-		C	-
	Parthenium hysterophorus	parthenium	*, C3, WONS	-	-
	Pterocaulon sphacelatum	applebush		C	-
	Sonchus oleraceus	common sowthistle	*	-	-
	Sonchus sp.	-	*	-	-
Bignoniaceae	*Pandorea jasminoides*	-		C	-
Cactaceae	*Opuntia stricta*	-	*, C3, WoNS	-	-
	Opuntia tomentosa	velvety tree pear	*, C3, WoNS	-	-

Family	Species	Common name	[1]Introduced Status	[2]NC Act Status	[3]EPBC Act Status
Capparaceae	*Capparis* sp.	-		C	-
	Capparis canescens	-		C	-
	Capparis loranthifolia var. *loranthifolia*	-		C	-
Casuarinaceae	*Allocasuarina littoralis*	-		C	-
	Allocasuarina torulosa	-		C	-
	Casuarina cunninghamiana subsp. *cunninghamiana*	-		C	-
Celastraceae	*Denhamia celastroides*	broad-leaved boxwood		C	-
	Denhamia cunninghamii	-		C	-
	Denhamia disperma	-		C	-
Combretaceae	*Terminalia* sp.	-		C	-
Cycadaceae	*Cycas megacarpa*	-		E	E
Cyperaceae	*Fimbristylis dichotoma*	common fringe-rush		C	-
	Gahnia aspera	-		C	-
	Lepidosperma sp.	-		C	-
	Scleria brownii	-		C	-
Ebenaceae	*Diospyros geminata*	scaly ebony		C	-
Euphorbiaceae	*Acalypha eremorum*	soft acalypha		C	-
	Macaranga tanarius	macaranga		C	-
	Mallotus discolor	white kamala		C	-
	Mallotus mollissimus	-		C	-
	Mallotus philippensis	red kamala		C	-
	Phyllanthus virgatus	-		C	-
Fabaceae	*Desmodium gunnii*	-		C	-
	Desmodium macrocarpum	-		C	-
	Desmodium rhytidophyllum	-		C	-
	Desmodium varians	slender tick trefoil		C	-
	Erythrina vespertilio subsp. *vespertilio*	-		C	-

Family	Species	Common name	[1]Introduced Status	[2]NC Act Status	[3]EPBC Act Status
	Flemingia parviflora	flemingia		C	-
	Galactia tenuiflora	-		C	-
	Glycine cyrtoloba	-		C	-
	Glycine sp.	-		C	-
	Glycine tomentella	woolly glycine		C	-
	Hardenbergia violacea	-		C	-
	Indigofera pratensis	-		C	-
	Jacksonia scoparia	-		C	-
	Macroptilium atropurpureum	siratro	*	-	-
	Stylosanthes scabra	-	*	-	-
Goodeniaceae	*Goodenia glabra*	-		C	-
Goodeniaceae	*Goodenia rotundifolia*	-		C	-
Hemerocallidaceae	*Dianella caerulea*	-		C	-
	Dianella revoluta	-		C	-
	Geitonoplesium cymosum forma *album*	-		C	-
Juncaceae	*Juncus usitatus*	-		C	-
Lamiaceae	*Coleus australis*	-		C	-
Lauraceae	*Cryptocarya triplinervis* var. *triplinervis*	-		C	-
Laxmanniaceae	*Eustrephus latifolius* subforma *fimbriatus*	-		C	-
	Lomandra confertifolia subsp. *pallida*	-		C	-
	Lomandra hystrix	-		C	-
	Lomandra longifolia	-		C	-
	Lomandra multiflora subsp. *multiflora*	-		C	-
Lecythidaceae	*Planchonia careya*	cockatoo apple		C	-
Loganiaceae	*Strychnos psilosperma*	strychnine tree		C	-
Malvaceae	*Hibiscus heterophyllus*	-		C	-
	Malvastrum americanum var. *americanum*	-	*	-	-

Family	Species	Common name	[1]Introduced Status	[2]NC Act Status	[3]EPBC Act Status
	Sida acuta	spinyhead sida		-	-
	Sida cordifolia	-	*	-	-
	Sida hackettiana	spiked sida		C	-
Meliaceae	*Dysoxylum gaudichaudianum*	ivory mahogany		C	-
	Melia azedarach	white cedar		C	-
	Turraea pubescens	native honeysuckle		C	-
Mimosaceae	*Acacia decora*	pretty wattle		C	-
	Acacia disparrima subsp. disparrima	-		C	-
	Acacia fasciculifera	scaly bark		C	-
	Acacia implexa	lightwood		C	-
	Acacia leiocalyx subsp. *leiocalyx*	-		C	-
	Acacia penninervis var. *penninervis*	-		C	-
	Acacia salicina	Doolan		C	-
	Acacia sp.	-		C	-
	Archidendropsis basaltica	red lancewood		C	-
	Vachellia bidwillii	-		C	-
Moraceae	*Ficus coronata*	creek sandpaper fig		C	-
	Ficus obliqua	-		C	-
	Ficus opposita	-		C	-
	Ficus racemosa var. *racemosa*	-		C	-
	Ficus rubiginosa forma *glabrescens*	-		C	-
	Ficus virens var. *virens*	-		C	-
Myrsinaceae	*Myrsine variabilis*	-		C	-
Myrtaceae	*Angophora floribunda*	rough-barked apple		C	-
	Corymbia citriodora subsp. *citriodora*	spotted gum		C	-
	Corymbia clarksoniana	-		C	-
	Corymbia dallachiana	-		C	-

Family	Species	Common name	[1]Introduced Status	[2]NC Act Status	[3]EPBC Act Status
	Corymbia erythrophloia	variable-barked bloodwood		C	-
	Corymbia intermedia	pink bloodwood		C	-
	Corymbia sp.	-		C	-
	Corymbia tessellaris	Moreton Bay ash		C	-
	Corymbia trachyphloia subsp. *trachyphloia*	-		C	-
	Eucalyptus acmenoides	-		C	-
	Eucalyptus crebra	narrow-leaved red ironbark		C	-
	Eucalyptus exserta	Queensland peppermint		C	-
	Eucalyptus melanophloia subsp. *melanophloia*	-		C	-
	Eucalyptus moluccana	gum-topped box		C	-
	Eucalyptus portuensis	-		C	-
	Eucalyptus tereticornis subsp. *tereticornis*	-		C	-
	Lophostemon confertus	brush box		C	-
	Lophostemon suaveolens	swamp box		C	-
	Melaleuca bracteata	-		C	-
	Melaleuca fluviatilis	-		C	-
	Melaleuca leucadendra	broad-leaved tea-tree		C	-
	Melaleuca linariifolia	snow-in summer		C	-
	Melaleuca viminalis	-		C	-
	Waterhousea floribunda	Weeping lilly pilly		C	
Oleaceae	*Chionanthus ramiflorus*	northern olive		C	-
	Jasminum didymum subsp. *didymum*	-		C	-
	Jasminum simplicifolium subsp. *australiense*	-		C	-
Orchidaceae	*Cymbidium canaliculatum*	-		C	-
Oxalidaceae	*Oxalis corniculata*	creeping wood sorrel	*	-	-
Passifloraceae	*Passiflora foetida*	-	*	-	-
	Passiflora subpeltata	white passionflower	*	-	-

Family	Species	Common name	[1]Introduced Status	[2]NC Act Status	[3]EPBC Act Status
Phyllanthaceae	*Breynia oblongifolia*	-		C	-
	Bridelia leichhardtii	-		C	-
	Glochidion lobocarpum	-		C	-
Pittosporaceae	*Bursaria incana*	-		C	-
	Pittosporum spinescens	-		C	-
Poaceae	*Alloteropsis semialata*	cockatoo grass		C	-
	Amphibromus sp.	-		C	-
	Aristida calycina var. *calycina*	-		C	-
	Aristida latifolia	feathertop wiregrass		C	-
	Aristida leptopoda	white speargrass		C	-
	Aristida sp.	-		C	-
	Arundinella nepalensis	reedgrass		C	-
	Bothriochloa bladhii subsp. *bladhii*	-		C	-
	Bothriochloa decipiens var. *decipiens*	-		C	-
	Bothriochloa ewartiana	desert bluegrass		C	-
	Bothriochloa pertusa	-	*	-	-
	Cenchrus sp.	-	*	-	-
	Chloris gayana	rhodes grass	*	-	-
	Chrysopogon fallax	-		C	-
	Cymbopogon ambiguus	lemon grass		C	-
	Cymbopogon bombycinus	silky oilgrass		C	-
	Cymbopogon refractus	barbed-wire grass		C	-
	Dichanthium sericeum subsp. *sericeum*	-		C	-
	Eriochloa crebra	spring grass		C	-
	Enneapogon polyphyllus	leafy nineawn		C	-
	Eriachne mucronata	-		C	-
	Heteropogon contortus	black speargrass		C	-

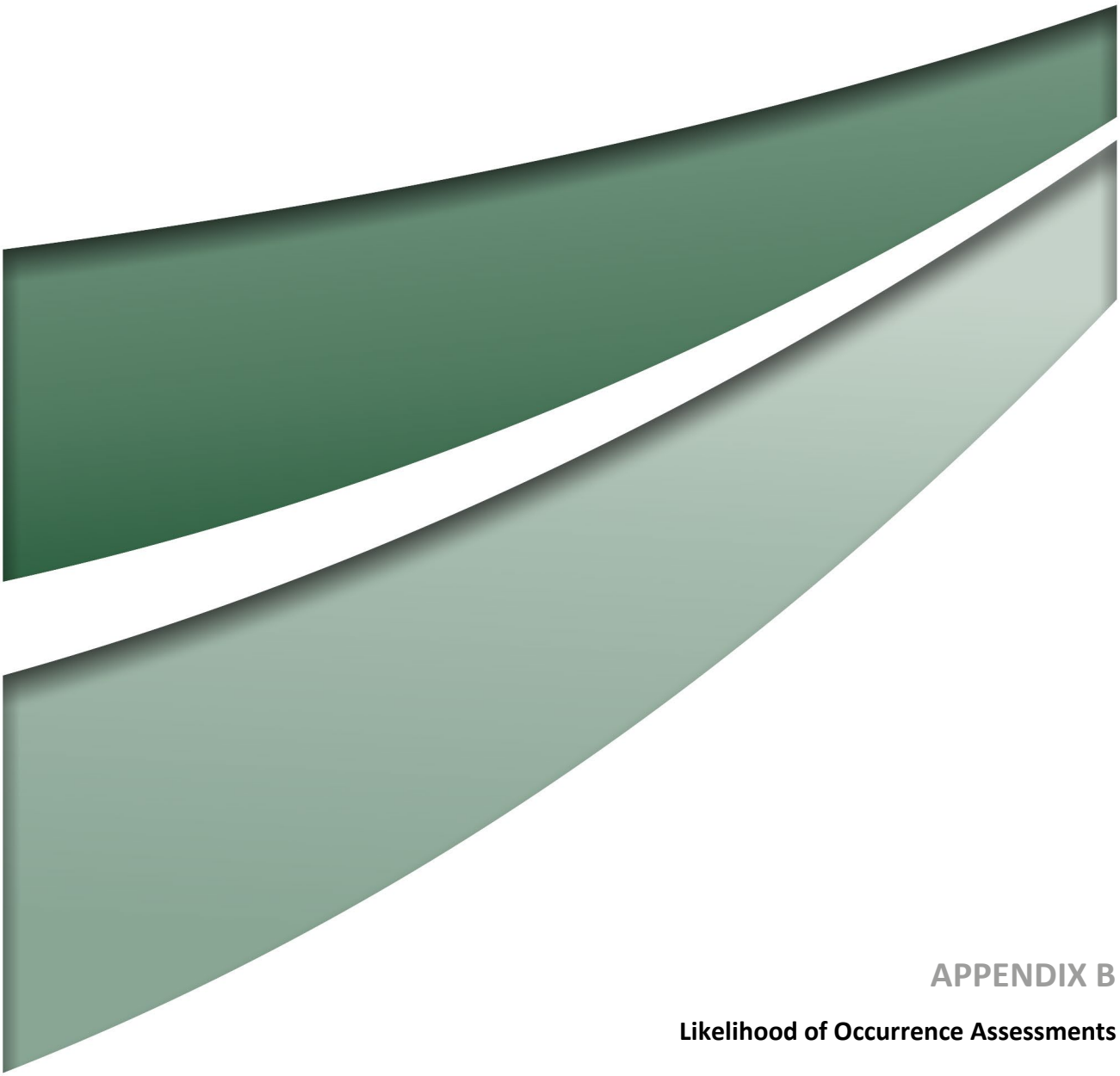
Family	Species	Common name	[1]Introduced Status	[2]NC Act Status	[3]EPBC Act Status
	Hyparrhenia rufa subsp. *rufa*	-	*	-	-
	Imperata cylindrica	blady grass		C	-
	Megathyrsus maximus var. *maximus*	-	*	-	-
	Melinis repens	red natal grass	*	-	-
	Panicum decompositum var. *decompositum*	-		C	-
	Panicum effusum	hairy panic		C	-
	Panicum simile	-		C	-
	Sporobolus creber	-		C	-
	Themeda triandra	kangaroo grass		C	-
Pteridaceae	*Adiantum atroviride*	-		C	-
Putranjivaceae	*Drypetes deplanchei*	grey boxwood		C	-
Rhamnaceae	*Alphitonia excelsa*	soap tree		C	-
	Ventilago viminalis	supplejack		C	-
Rubiaceae	*Psydrax lamprophylla* forma *lamprophylla*	-		C	-
	Psydrax odorata	-		C	-
	Psydrax oleifolia	-		C	-
	Spermacoce brachystema	-		C	-
Rutaceae	*Acronychia laevis* var. *leucocarpa*	-		C	-
	Flindersia australis	crow's ash		C	-
	Geijera salicifolia	brush wilga		C	-
Santalaceae	*Exocarpos cupressiformis*	native cherry		C	-
	Exocarpos latifolius	-		C	-
	Santalum lanceolatum var. *venosum*	-		C	-
Sapindaceae	*Alectryon subdentatus*	-		C	-
	Arytera divaricata	Coogera		C	-
	Cupaniopsis anacardioides	tuckeroo		C	-
	Dodonaea lanceolata var. *lanceolata*	-		C	-

Family	Species	Common name	[1]Introduced Status	[2]NC Act Status	[3]EPBC Act Status
	Harpullia pendula	-		C	-
Scrophulariaceae	*Eremophila debilis*	winter apple		C	-
Smilacaceae	*Smilax australis*	barbed-wire vine		C	-
Solanaceae	*Solanum ellipticum*	potato bush		C	-
	Solanum seaforthianum	Brazilian nightshade	*	-	-
Sparrmanniaceae	*Grewia latifolia*	dysentery plant		C	-
	Grewia retusifolia	-		C	-
Sterculiaceae	*Brachychiton australis*	broad-leaved bottle tree		C	-
	Brachychiton bidwillii	little kurrajong		C	-
	Brachychiton populneus subsp. *populneus*	-		C	-
Ulmaceae	*Trema tomentosa* var. *tomentosa*	-		C	-
Verbenaceae	*Glandularia aristigera*	-	*	-	-
	Lantana camara	lantana	*, C3, WoNS	-	-
Xanthorrhoeaceae	*Xanthorrhoea johnsonii*	-		C	-
Zamiaceae	*Macrozamia douglasii*	-		C	-
	Macrozamia macleayi	-		C	-
Zingiberaceae	*Alpinia arundelliana*	-		C	-

[1] ** - Introduced, C3 - Category 3 Restricted plant under the Biosecurity Act, WoNS - Weed of National Significance.*

[2] *C –Least Concern, E – Endangered under the NC Act.*

[3] *E – Endangered under the EPBC Act.*



APPENDIX B

Likelihood of Occurrence Assessments

Table C.1 Likelihood of Occurrence Assessment – TECs

Community	EPBC Act Status	Description	Likelihood of Occurrence
Coolibah – Black Box Woodland of the Darling Riverine Plains and Brigalow Belt South Bioregions	E	This TEC is associated with floodplains and drainage areas of the Darling Riverine Plains and Brigalow Belt South IBRA bioregion. This community is represented by eucalypt woodland where *Eucalyptus coolabah* subsp. *coolabah* and/or *Eucalyptus largiflorens* are the dominant canopy species and where the understorey tends to be grassy. The following REs form part of, or align with this TEC: RE 11.3.3, 11.3.15, 11.3.16, 11.3.28 and 11.3.37.	**Unlikely to occur** No REs were recorded within the Study Area that align with this TEC.
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	E	This TEC occurs in coastal catchments, mostly at elevations of less than 20 m AHD which are typically found within 30 km of the coast. It is found on Quaternary age unconsolidated sediments, including alluvium. The forest to woodland community is dominated by *Casuarina glauca* (swamp oak) with a lower canopy layer of smaller swamp oak and other species including *Melaleuca* spp. or *Eucalyptus* spp. The following REs form part of, or align with this TEC: RE 12.1.1, 12.3.2	**Unlikely to occur** No REs were recorded within the Study Area that align with this TEC
Poplar Box Grassy Woodland on Alluvial Plains	E	This TEC occurs on alluvial soils and is typically a grassy woodland with a canopy dominated by Eucalyptus populnea with an understorey of mostly grasses and herbs. The following REs correspond to this TEC: 11.3.2, 11.3.17, 11.4.7, 11.4.12, 12.3.10.	**Unlikely to occur** No REs were recorded within the Study Area that align with this TEC
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and the Nandewar Bioregion	E	This TEC is an extreme form of dry seasonal subtropical rainforest and is generally characterised by the prominence of trees with microphyll sized leaves and the frequent presence of bottle trees (*Brachychiton* spp.) as emergents from the vegetation. The following REs correspond to this TEC: 11.2.3, 11.3.11, 11.4.1, 11.5.15, 11.8.3, 11.8.6, 11.8.13, 11.9.4, 11.9.8, 11.11.18.	**Unlikely to occur** No REs were recorded within the Study Area that align with this TEC
Weeping Myall Woodlands	E	This TEC occurs on the inland alluvial plains west of the Great Dividing Range in NSW and Queensland. This community is an open woodland to woodland in which weeping Myall (*Acacia pendula*) trees are the sole or dominant overstorey species. The following REs correspond to this TEC: 11.3.2 and 11.3.28.	**Unlikely to occur** No REs were recorded within the Study Area that align with this TEC

Table C.2 Likelihood of occurrence assessment – Threatened Flora

Family	Species	Status (EPBC Act, NC Act)	Distribution and Preferred Habitat	Likelihood of Occurrence
Apocynaceae	*Marsdenia brevifolia*	V, V	*Marsdenia brevifolia* occurs in north and central Queensland where it is known from localities near Townsville, Springsure and north of Rockhampton. North of Rockhampton, *Marsdenia brevifolia* grows on serpentine rock outcrops or crumbly black soil derived from serpentine in eucalypt woodland, often with broad-leaf ironbark (*Eucalyptus fibrosa*) and *Corymbia xanthope*. At Hidden Valley near Paluma, plants grow in woodland on granite soils and on Magnetic Island the species occurs in open forest on acid agglomerate soils.	**Low** No records of this species are known from the search area, with the closest records of this species occurring north of Rockhampton. Habitat for this species within the site is considered marginal, as some records of this species have been recorded on granite soils, which are present within the Study Area.
Cycadaceae	*Cycas megacarpa*	E, E	*Cycas megacarpa* is endemic to south-east Queensland and its range extends from Woolooga in the south to Bouldercombe in the north. *Cycas megacarpa* occurs in spotted gum (*Eucalyptus citriodora*) and narrow-leaved ironbark (*Eucalyptus crebra*) woodland and open forest with a grassy understorey. It has also been recorded on rainforest margins. The species usually grows on hill tops and steep slopes. It is found on varying topsoils; commonly sandy loams or shallow clay loams which are often stony. *C. megacarpa* occurs at altitudes of 40-600 m above sea level.	**Known to occur** Previous records of the species occur within and adjacent to the Study Area identified through Wildlife online and ALA, as well as many individuals recorded during the field survey.
	Cycas ophiolitica	E, E	*Cycas ophiolitica* is endemic to Queensland and occurs between Marlborough and Rockhampton in central-eastern Queensland. Cycas ophiolitica inhabits eucalypt open forest and woodland communities with a grassy understorey. They occur on hill tops or steep slopes, at altitudes of 80-620 m above sea level. It grows on shallow, stony, red clay loams or sandy soils.	**Low** No records of this species occur within the search area of the Study Area. While suitable habit exists onsite, extensive targeted surveys did not identify this species within the Study Area.

Family	Species	Status (EPBC Act, NC Act)	Distribution and Preferred Habitat	Likelihood of Occurrence
Combretaceae	*Dansiea elliptica*	-, NT	The species is known to occur in several localities within Queensland including within Dinden National Park, Wooroonooran National Park, Rundle State Forest and Deep Water National Park. The area of occupancy in Queensland is less than 40 square km in total. Habitat for the species includes lowland dry rainforest and vine thicket on substrates derived from rhyolite, basalt and greywacke. Species associated with *Dansiea elliptica* include *Flindersia australis, Casuarina cristata, Gossia bidwillii, Drypetes deplanchei, Planchonella cotinifolia, Pleiogynium timorense, Terminalia porphyrocarpa, Polyscias elegans, Flindersia spp., Elaeocarpus eumundi, Synima, Cryptocarya mackinnoniana* and *Cryptocarya vulgaris.*	**Moderate** Two records of this species occur within 20 km of the Study Area. Some suitable habitat for this species occurs within the Study Area as semi-evergreen vine thicket as species often recorded in association to the species are known to the Study Area.
Hernandiaceae	*Hernandia bivalvis*	-, NT	*Hernandia bivalvis* occurs in Queensland from Brisbane to south of Rockhampton. Records have also been identified from Proserpine. *Hernandia bivalvis* grows in drier rainforest on lowlands or hills.	**High** Records for *Hernandia bivalvis* occur immediately north of the Study Area within microphyll vine forest, a community type which is present within the Study Area.
Myrtaceae	*Decaspermum struckoilicum*	E, E	*Decaspermum struckoilicum* is only known from two populations in Queensland, both about 8 km east of Mount Morgan, in the area known as Struck Oil. The species occurs in semi-evergreen vine thicket on brown or reddish soil. The northern population comprises only a single plant, where the northern population possibly 17. Both populations occur in remnant vegetation.	**Moderate** The two known populations of this species occur approximately 15 km north west of the Study Area. Semi-evergreen vine thicket vegetation (RE 11.12.4 and 11.11.a5) has been mapped within the Study Area, and while the vegetation survey did not identify this species, there is still a Moderate chance that it occurs within the Study Area.

Family	Species	Status (EPBC Act, NC Act)	Distribution and Preferred Habitat	Likelihood of Occurrence
	Eucalyptus raveretiana	V, LC	The species usually grows along watercourses, to a lesser extent river flats or open woodland at 0-300 m asl in sub-tropical climates. Soil varies from sand to heavy clays. The species does not occur in pure stands, but is co-dominant with species including *Melaleuca leucadendra, M. fluviatilis, Eucalyptus tereticornis, Corymbia tessellaris,* and occasionally in semi evergreen vine thicket.	**Low** The species has been recorded from the broader region. Extensive surveys did not record this conspicuous species.
Orchidaceae	*Bulbophyllum globuliforme*	V, NT	*Bulbophyllum globuliforme* occurs in the McPherson Range of north-east NSW, south-east Queensland and in the Calliope Range Inland from Gladstone. The species grows only on hoop pines (*Araucaria cunninghamii*), colonising the upper mature branches in upland rainforest	**Low** No records of this species occur within the search area of the Study Area and no hoop pines were recorded as part of the surveys.
Poaceae	*Arthraxon hispidus*	V, V	*Arthraxon hispidus* occurs in Queensland and NSW. In Queensland it occurs as far north as Port Douglas, and west to disjunct occurrences around mound springs in Carnarvon National Park. However, most occurrences occur south of Noosa. *Arthraxon hispidus* occurs in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps.	**Low** No records of this species occur within the search area of the Study Area and habitat is marginal.
	Dichanthium setosum	V, LC	*Dichanthium setosum* occurs in Queensland and NSW. In Queensland it occurs in the Leichardt, Morton, North Kennedy and Port Curtis regions. It occurs in the Mistake Range, in Main Range National Park and possibly Glen Rock National Park. It occurs on heavy basaltic black soils and stony red-brown hard-setting loam with clay subsoil.	**Low** No records of this species occur within the search area of the Study Area and habitat is marginal.
Rutaceae	*Bosistoa transversa*	V, LC	The species grows in wet sclerophyll forest, dry sclerophyll forest and rainforest up to 300 m in altitude. It is associated with *Argyrodrendon trifoliolatum*, *Syzygium hodgkinsoniae*, *Endiandra pubens*, *Dendrocnide phoinphylla*, *Amena ingens*, *Diploglottis australis* and *Diospyros mabacea*.	**Low** No records of this species occur within the desktop search extent and habitat in the Study Area is marginal.

Family	Species	Status (EPBC Act, NC Act)	Distribution and Preferred Habitat	Likelihood of Occurrence
Sapindaceae	*Cossinia australiana*	E, E	*Cossinia australiana* is known from fragmented relict patches of Araucarian vineforests or vine thickets on fertile soils in central and southern Queensland. It is distributed from Rockhampton in the north Kingaroy in the south-west.	**Moderate** Records of this species have been recorded from the broader Study Area (within 25 km of the Study Area) and suitable vine thicket habitat occurs within the Study Area.
	Cupaniopsis shirleyana	V, V	*Cupaniopsis shirleyana* occurs in south-east Queensland between Brisbane and Curtis Island. It occurs in dry rainforest and scrubby urbanised areas on moderate to very steep slopes, screeslope gullies and rocky stream channels at elevations of 60 to 550 m above sea level.	**Low** No records of this species occur within the vicinity of the Study Area. The closest record occurs approximately 100 km south west at Turkey Beach. Some suitable habitats in the form of vine thickets occur within the Study Area.
Simaroubaceae	*Samadera bidwillii*	V, V	*Samadera bidwillii* is endemic to Queensland and is currently known in several locations between Scawfell Island near Mackay, and Goomboorian, north of Gympie. *Samadera bidwillii* occurs in lowland rainforest or on rainforest margins, but it can be found in other forest types such as open forest and woodland.	**Moderate** There are several records of this species within a 25-50 km radius of the Study Area occurring within the ecotone between vine thicket and eucalypt woodland. Some suitable vine thicket communities occur within the Study Area.
Solanaceae	*Solanum dissectum*	E, E	*Solanum dissectum* is endemic to Queensland and found within a region bounded by the towns of Blackwater to Bauhinia to Thangool to Dululu, which is centred about 150 km west of Gladstone. It is restricted to very small, localised areas where populations exist. It is found in open forest and woodland habitats where brigalow (Acacia harpophylla) and/or lapunyah (Eucalyptus thozetiana) characterise the dominant vegetation types on solodic soils.	**Low** No suitable habitat occurs within the Study Area.

Family	Species	Status (EPBC Act, NC Act)	Distribution and Preferred Habitat	Likelihood of Occurrence
	Solanum johnsonianum	E, E	*Solanum johnsonianum* is endemic to Queensland and found in a region bounded by the town of Rolleston to Theodore to Biloela to Dululu, which is centred about 160 km west of Gladstone. It may be found in very small, localised areas on heavy cracking clays soils where brigalow (Acacia harpophylla) dominates or co-dominates. Other associated species include lapunyah (*Eucalyptus thozetiana*) and an understorey of wilga (*Geijera parviflora*).	**Low** No suitable habitat occurs within the Study Area.
Surianaceae	*Cadellia pentastylis*	V, V	*Cadellia pentastylis* occurs in NSW and Queensland. In Queensland it occurs from the southern border to the Canarvon Range and Callide Valley, south-west of Rockhampton. *Cadellia* grows in dry rainforest, semi evergreen vine thickets and sclerophyll ecological communities, often locally dominant or as an emergent.	**Low** The closest records of *Cadellia pentastylis* occur greater than 50 km from the Study Area and generally occur to the west of the Study Area.

APPENDIX C

Significant Residual Impact Assessment

umwelt
Environmental & Social Consultants

NEOEN

SIGNIFICANT RESIDUAL IMPACT ASSESSMENT

Mount Hopeful Wind Farm

FINAL

May 2023

1.0 Matter of State Environmental Significance (MSES) within the Disturbance Footprint

A Significant Residual Impact (SRI) on a MSES that is also a prescribed environmental matter is defined under the Queensland EO Act, Section 8 and includes:

"an adverse impact, whether direct or indirect, of a prescribed activity on all or part of a prescribed environmental matter that:

a. Remains, or will or is likely to remain, (whether temporarily or permanently) despite on-site avoidance and mitigation measures for the prescribed activity; and

b. Is, or will or is likely to be, significant"."

The following MSES relate to flora and vegetation and occur (or are likely to occur) within the Disturbance Footprint:

- Regulated vegetation:
    - Of Concern Res.
    - Remnant vegetation within the defined distance of a watercourse identified on the vegetation management watercourses map.
    - Essential Habitat (EH) as identified on the essential habitat map.
- Protected wildlife habitat.

After all reasonable avoidance, mitigation and management measures for the Project have been or will be undertaken (**Section 6.0**), the Project may still impact on MSES. Therefore, an assessment in accordance with the *Significant Residual Impact Guideline* (Department of State Development, Infrastructure and Planning, 2014) has been completed to determine if the Project may have a SRI on these values.

1.1 Regulated Vegetation

1.1.1 Endangered and Of Concern REs

As per the DES Regional Ecosystem map (Version 12.02), the Disturbance Footprint contains remnant vegetation in the form of homogeneous and heterogeneous polygons analogous to a maximum of eight REs, within a Category B area. No Endangered REs are identified within this area. However, one polygon to be impacted is a heterogeneous polygon of REs 11.3.25/11.3.4/11.3.2. REs 11.3.4 and 11.3.2 are both listed as Of Concern under the VM Act. The remaining six REs predicted for impact are Least Concern under the VM Act.

Impact areas that correspond to the DES Regional Ecosystem map are detailed in **Table C.1** below.

Based on the assessment detailed in **Table C.2**, it is considered **Unlikely** that a SRI to remnant vegetation comprising an Endangered or Of Concern RE will occur.

Table C.1: Of Concern Regional Ecosystems within Disturbance Footprint

RE	Polygon Percentage	VM Act Status	Direct Impact (ha)
11.3.25	60	Least Concern	0.042
11.3.2	20	Of Concern	0.014
11.3.4	20		0.014
11.3.25 / 11.3.2 / 11.3.4	100	Least Concern / Of Concern	0.07

Table C.2: SRI criteria of regulated vegetation – Endangered and Of Concern REs

Impact Criteria	Assessment
An action is LIKELY to have an SRI on remnant vegetation comprising an Endangered or Of Concern RE if the action will result in:	
Clearing of more than 5 ha of an Endangered or Of Concern RE vegetation.	Approximately 0.03 ha of remnant vegetation comprising an Of Concern RE will be cleared (see **Table C.1**). Based on this criterion, it is considered unlikely that the Project will have a SRI on Regulated Vegetation comprising an OF Concern RE.
Clearing that results in an overall area (not confined to property boundaries) of Endangered or Of Concern RE vegetation of less than 5 ha.	Within the Study Area, RE 11.3.4 and RE 11.3.2 in remnant condition occupy a total of 35.3 ha. Following vegetation clearing required for construction of the Project, 35.27 ha (substantially greater than 5 ha) of remnant vegetation analogous to RE 11.3.4 and RE 11.3.2 will remain within the Study Area. Based on this criterion, it is considered unlikely that the Project will have a SRI on Of Concern RE Regulated Vegetation.
Clearing that results in the physical separation of Endangered or Of Concern RE communities within and on adjoining sites.	Clearing required for the Project is linear and will be limited to the edge of a polygon containing an Of Concern RE. The community occurs as a narrow polygon, connected to Least Concern vegetation (Category B and C) but predominantly surrounded by Category X vegetation. Therefore, clearing will not result in physical separation of relevant communities and a SRI on Of Concern REs is unlikely.

1.1.2 Remnant vegetation within the defined distance of a watercourse

A large number of watercourses mapped under the VM Act intersect the Disturbance Footprint, ranging from Stream Order 1 to 4. The total area of regulated vegetation within the determined distance from the defining bank of each watercourse is provided in **Table C.3**. Impacts to regulated vegetation within these zones are limited to tracks to access the wind farm infrastructure. Under the SRI guidelines, only impacts to remnant vegetation (within a Category B area) are considered.

Based on the assessment detailed in **Table C.4**, it is considered **Unlikely** that a SRI to remnant vegetation with a defined distance to a watercourse will occur.

Table C.3: Regulated vegetation within a defined distance from the defining bank of a watercourse (non-coastal bioregions and subregions) within the Disturbance Footprint

Watercourse Stream Order	Distance from the Defining Bank (m)	[1]Category B Vegetation (ha)
1	25	6.3
2		0.6
3	50	3.9
4		0.0
	Total	**10.7**

[1]based on State regional ecosystem mapping

Table C.4: SRI criteria of regulated vegetation - Remnant vegetation within the define distance of a watercourse

Impact Criteria	Assessment
An action is LIKELY to have an SRI on remnant vegetation within the defined distance of a watercourse if the action will result in:	
Permanent removal of vegetation within the defined distance of a stream order 2 or higher where no rehabilitation is proposed	The permanent removal of 4.5 ha of remnant vegetation within the defined distance of a stream order 2 and 3 watercourse may occur based on the 'worst-case' scenario that all vegetation within the Disturbance Footprint will be cleared. Works within these areas will be confined to access tracks and cabling and no windfarm infrastructure will be located in proximity to a watercourse. Where possible and practical, clearing associated with watercourse crossings will be reduced to 25 m or less and erosion and sediment control measures will be employed. Rehabilitation is proposed to occur primarily within linear areas of the Disturbance Footprint including tracks and reticulation lines. Rehabilitation will include the planting of native species known to the region, consistent with the characteristics of surrounding retained vegetation. With current design details, it is estimated approximately 20% of the total Disturbance Footprint will be rehabilitated. However, the specific locations of rehabilitation will not be determined until detailed design of the Project has been completed. Efforts will be made to complete rehabilitation in cleared areas of remnant regulated vegetation within a defined distance of a watercourse, that are no longer needed for operation and maintenance of the Project. Mitigation and management measures are detailed in **Section 6.2** of the main report. Based on this criterion, it is considered unlikely that the Project will have a SRI on Regulated Vegetation.
Building of an online detention basin greater than 1 ha in size or other similar works that result in the clearing of vegetation which fragments up and downstream remnant areas on any stream order	No detention basins are proposed to be created. Impacts to remnant vegetation associated with streams within the Disturbance Footprint relate to crossing of creeks for access tracks to the turbines only. Based on this criterion, it is considered unlikely that the Project will have an SRI on Regulated Vegetation.
Permanent clearing of more than 0.5 ha of an endangered or of concern RE, within the defined distance of a watercourse	Remnant vegetation within a defined distance of a watercourse (within an category B area) analogous to REs 11.3.25/11.3.4/11.3.2 will be cleared for the Project. REs 11.3.4 and 11.3.2 are listed Of Concern under the VM Act. A total of 0.07 ha is predicted for impact, which is well below the specified threshold of 0.5 ha. Based on this criterion, it is considered unlikely that the Project will have an SRI on Regulated Vegetation.

1.1.3 Essential Habitat

Essential habitat, for protected wildlife, means an area of vegetation shown on the Regulated Vegetation Management map:

1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database. Essential habitat factors are comprised of - regional ecosystem (mandatory for most species), vegetation community, altitude, soils, position in landscape; or

2) in which the protected wildlife, at any stage of its life cycle, is located.

Regulated vegetation containing mapped areas of Essential Habitat for two species (*Hernandia bivalvis* and *Cycas megacarpa*) is mapped within the Study Area and Disturbance Footprint (**Figure 4.6**), covering a total combined area of 140.7 ha and 22.5 ha respectively. Essential Habitat areas are associated with records of two species (a buffer of 1.1 km), as indicated by the Vegetation Management Reports for the relevant lot and plans. However, RE is considered a mandatory Essential Habitat factor for both species. Noting this, the approximate areas of Essential Habitat for each species has been determined Using the DES Regional Ecosystem mapping.

The mapped Essential Habitat area is associated with a heterogeneous polygon (90/10 percentage spilt) of REs 11.11.3 (suitable for *Cycas megacarpa* only) and 11.11.5 (suitable for *Hernandia bivalvis* only). As per REDD, RE 11.11.3 has a mid-dense structure and RE 11.11.5 has a dense structure.

Based on the assessment outlined below in **Table C.5,** it is considered **Likely** that the Project will have a SRI on Essential Habitat for *Cycas megacarpa* and *Hernandia bivalvis*. However, it should be considered that the verified vegetation communities within the mapped Essential Habitat area for *H. bivalvis* did not identify suitable habitat for this species.

Table C.5: SRI criteria for regulated vegetation - Essential habitat for *C. megacarpa* and *H. bivalvis*

Impact Criteria	Assessment
An action is LIKELY to have an SRI on essential habitat if the action will result in:	
Clearing of EH exceeding the thresholds specified in Table 1, SDAP Module 8, and resulting in a greater than 10% permanent reduction in the extent of EH mapped on site	***Cycas megacarpa*** The total area of Essential Habitat mapped for *Cycas megacarpa* within the Study Area is approximately 126.6 ha and the area within the Disturbance Footprint is 20.25 ha. This exceeds the thresholds specified in Table 1, SDAP Module 8, and results in a greater than 10% permanent reduction in the extent of EH mapped within the Study Area. Based on these criteria the Project is likely to have a SRI on Essential Habitat for *C. megacarpa*.
	Hernandia bivalvis The total area of Essential Habitat mapped for *Hernandia bivalvis* within the Study Area is approximately 14.1 ha and the area within the Disturbance Footprint is 2.25 ha. This exceeds the thresholds specified in Table 1, SDAP Module 8, and results in a greater than 10% permanent reduction in the extent of EH mapped within the Study Area. Based on these criteria the Project is likely to have a SRI on Essential Habitat for *H. bivalvis.* It should be noted however, that verified vegetation communities within the EH for *H. bivalvis* within the Study Area, did not identify suitable habitat for this species.

1.2 Protected Wildlife Habitat

1.2.1.1 Threatened Flora – 'Known to Occur'

- *Cycas megacarpa* – Endangered under the NC Act

The field surveys targeted habitat for *Cycas megacarpa* and conducted plot-based counts of individuals as well as rapid density visual estimates. Using this approach, an actual count of individuals is obtained (recognised as lower bound) and allows for an estimation of distribution, undertaken spatially using an inverse distance weighted (IDW) interpolation algorithm. A detailed description of the IDW interpolation algorithm method and how it has been applied is provided in **Section 3.4.1** of the overarching report.

The results of this assessment are summarised below in **Table C.6** and **Table C.7.**

Table C.6 *Cycas megacarpa* Individuals

Item	Study Area	Development Corridor	Disturbance Footprint
Individual records of *Cycas megacarpa*	159,915	6,709	4,131

Table C.7 *Cycas megacarpa* Density Summary

Density Categories	Study Area[1]	Development Corridor[2]	Disturbance Footprint[2]
High (25–50 plants per 0.25 ha)	74.9 ha	0.9 ha	0.7 ha
Moderate (10–25 plants per 0.25 ha)	960.8 ha	29.6 ha	16.8 ha
Low (1–10 plants per 0.25 ha)	5,365.7 ha	301.5 ha	195.7 ha

[1] Study Area values have been corrected by a factor of 0.5-0.7 to provide contextual comparison with development corridor, for with IDW outputs have been clipped to the known (confirmed) and known (suspected) habitat area.
[2] IDW outputs clipped to areas of mapped known (confirmed) and known (suspected) habitat area.

Cycas megacarpa habitat has been categorised as follows:

- Known habitat (confirmed).
- Known habitat (suspected).
- Nil recorded.

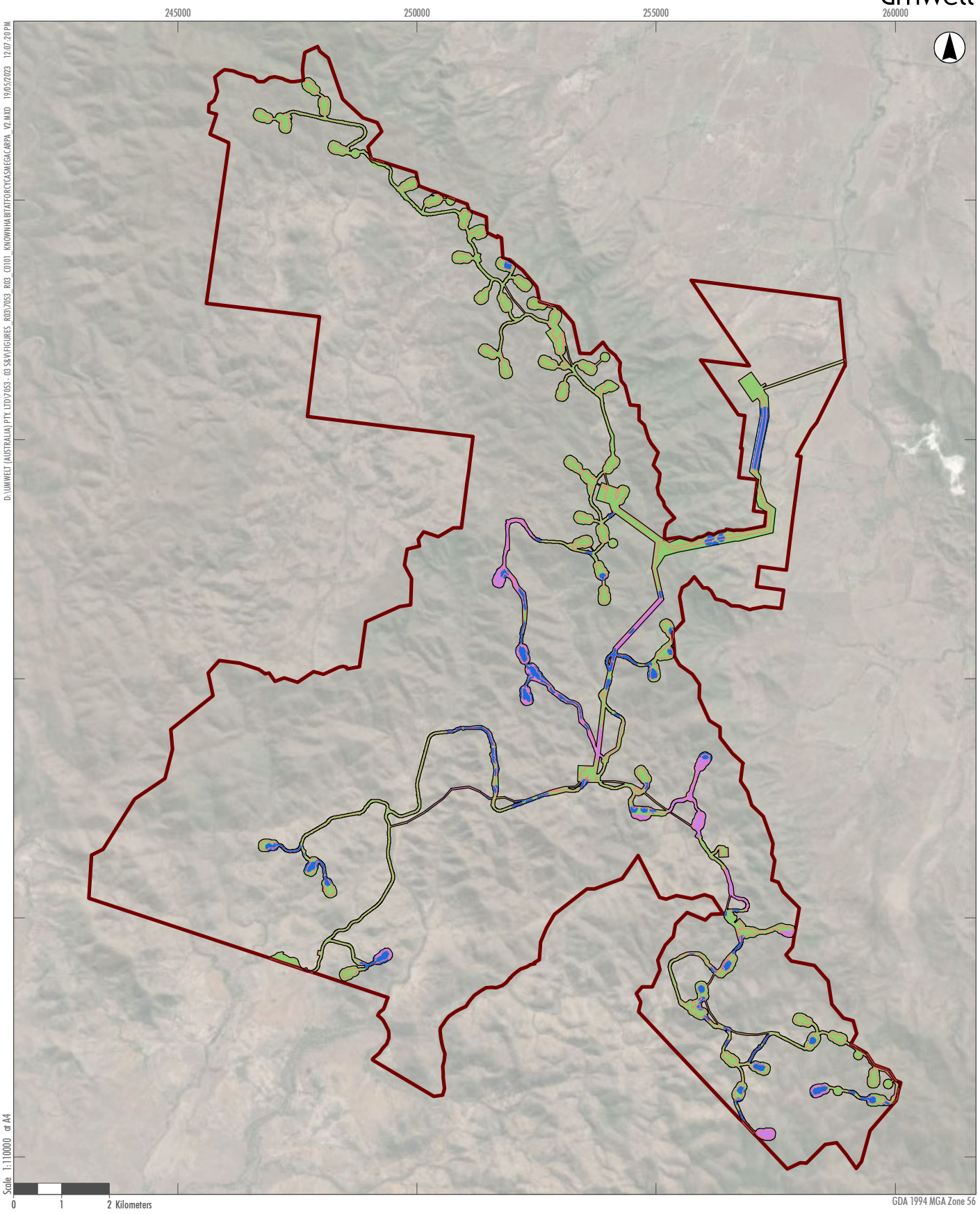
The criteria used to define these categories as well as the extent that habitat is mapped throughout the Development Corridor is provided in **Table C.8**.

Cycas megacarpa habitat mapping is provided in **Figure C.1.**

Table C.8 Habitat Extent and Justification for *Cycas megacarpa*

Habitat Criteria	Mapping Justification	Extent within Development Corridor (ha)	Extent within Disturbance Footprint (ha)
Known habitat (confirmed)	An 80 m buffer on confirmed *Cycas megacarpa* records, to reflect the latest population research which indicates most individuals disperse within 80 m of mature female plants (Etherington et al. 2018; James 2016 PhD thesis). Mapping has not been limited to certain REs noting the species was also recorded within non-remnant vegetation within the Study Area.	213.0	147.1
Known habitat (suspected)	Includes areas of the Development Corridor for which known habitat (confirmed) does not overlap, however based on adjacent records and connective habitat, *Cycas megacarpa* presence is presumed or reasonably suspected.	147.7	88.6
Known habitat (total)	**Combined areas of confirmed and suspected habitat**	**360.7**	**235.7**
Nil detected	Includes areas of the Development Corridor which have been confirmed (via field survey) to not support *Cycas megacarpa*. Nil recorded habitat also includes areas where reasonable extrapolation to edges of the Development Corridor has been applied, based on nearby 'absence' records, absence of connective habitat and field derived opinions of ecologists.	984.7	639.0

Based on the assessment in **Table C.9**, it is considered **Likely** that the Project will have a SRI on the habitat and population of *Cycas megacarpa*.



Legend

- Study Area
- Development Corridor
- Disturbance Footprint

Known *Cycas megacarpa* Habitat

- Known (confirmed)
- Known (suspected)
- Nil Recorded

FIGURE C1.1

Known Habitat for Cycas megacarpa

Image Source: ESRI Basemap (2021) Data source: Queensland Spatial (2020)

Table C.9: SRI criteria for Plants - Protected wildlife habitat - *Cycas megacarpa*

Impact Criteria	Assessment
An action is UNLIKELY to have an SRI on a plant that is 'endangered' or 'vulnerable' wildlife if the action will result in:	
Clearing of plants that are threatened wildlife and not located within a natural setting (i.e., does not meet the definition of 'in the wild' under the *Nature Conservation Act 1992*) where the proposal includes translocation	The habitat for *Cycas megacarpa* within the Disturbance Footprint meets the definition of 'in the wild' under the NC Act. Therefore, this criterion does not apply for this species.
Clearing of up to 10% of the total number of plants that are threatened wildlife occurring on a site where the proposal results in 90% of all plants that are threatened wildlife being retained and protected as a reserve or similar	Based on the interpolation of species records collected during the field survey program, the total number of *Cycas megacarpa* individuals within the Study Area is 159,915 plants and within the Disturbance Footprint is 4,131 plants. Based on these figures, direct impacts are anticipated to approximately 3% of the total population recorded within the Study Area (although an extensive translocation program has been proposed). Individuals to be retained within the Study Area are not proposed to be retained in a reserve or similar, as the involved land parcels are active rural properties. Therefore, this criterion does not apply for this species
Clearing of regenerating plants that are threatened wildlife which have previously been cleared within the last 5 years and that are historically maintained through slashing or grazing	Although some *Cycas megacarpa* individuals occur in historically cleared areas, the *Cycas megacarpa* population within the Study Area is not considered to comprise 'regenerating plants which have previously been cleared in the last five years and that are historically maintained through slashing or grazing'. Therefore, this criterion does not apply for this species.
The proposed relocation of an area of plants that are threatened wildlife less than 1000 m^2 not occurring in a relatively natural ecological situation (e.g., bushland), to a permanent retention area via an approved management plan	Although a translocation plan will be developed and enacted for the Project to ensure there is no net loss of *Cycas megacarpa* individuals as a result of Project works, the plants requiring relocation occur in a relatively natural ecological situation. Given the approximately 4,131 individuals occur within the Disturbance Footprint and occupy an area >1000m^2. The area of known habitat (confirmed and suspected) for *Cycas megacarpa* to be cleared within the Disturbance Footprint is 235.7 ha (although it is noted this includes an 80 m buffer on recorded individuals to reflect seed dispersal as per DCCEEW advice). This covers areas of high, medium, and low-density area occurring in remnant, regrowth and non-remnant areas. Therefore, this criterion does not apply for this species.

1.2.1.2 Threatened Flora – Moderate likelihood of Occurring

- *Decaspermum struckoilicum* – Endangered under the NC Act
- *Cossinia australiana* – Endangered under the NC Act
- *Samadera bidwillii* – Vulnerable under the NC Act

These three threatened species have been determined to have a 'Moderate' likelihood of occurring within the Study Area. The assessment of these species is presented in **Table C.11**.

Within the Disturbance Footprint, pre-clearance surveys for these species will be undertaken within suitable habitat prior to construction. If any of the above potentially occurring threatened species are identified within the Disturbance Footprint, the pre-clearance survey constraints protocol outlined below will be enacted.

STEP 1: Halt construction/clearing activities in the area (i.e. adjacent areas within the Disturbance Footprint where suitable habitat is present – to be determined by a suitably qualified ecologist)

STEP 2: Undertake investigation into potential impacts on the species. This should include:

- Updating of habitat mapping
- Updating of Significant Impact Assessment
- Determination of avoidance and mitigation strategies.

STEP 3: Communicate outcomes with DCCEEW and DES to determine next steps.

As all three species are also listed under the EPBC Act, the protocol places emphasis on the Commonwealth approval pathway noting the stricter requirements for offsets (i.e. must be land based). However, all plants are also considered 'protected plants' based on their listings under the NC Act and are therefore regulated under the Nature Conservation Regulation (Plants) 2020. As such, the protected plants assessment process will need to be followed should direct impacts occur within 100 m of an individual.

Whilst the occurrence of these species within the Disturbance Footprint is considered unlikely given the large amount of survey effort within this area (albeit subject to some limitations), the protocol allows for an appropriate and adaptive management response to be implemented. By doing so, the intent is that adverse impacts on threatened species not already proposed for translocation and/or offsets are mitigated.

Based on the above, it is considered **Unlikely** that there will be a significant residual impact on these species. Further mitigation and management measures are provided in **Section 6.2** of this report.

The extent and habitat mapping justification for Endangered and Vulnerable flora species with a moderate likelihood of occurrence is provided in **Table C.10** below while potential habitat mapping within the Study Area is provided in **Figure C.2.**

Table C.10: Habitat Extent and Justification for Endangered and Vulnerable Species with a Moderate Likelihood of Occurrence

Species	NC Act Status	Habitat Mapping Justification	Area (ha) of Habitat Within the Disturbance Footprint
Decaspermum struckoilicum	Endangered	REs 11.11.5a, 11.12.4 in remnant condition, below 300 m AHD.	2.1
Cossinia australiana	Endangered	REs 11.11.5a, 11.12.4 in remnant condition where they occur at elevations between 20 m and 520 m AHD.	8.3
Samadera bidwillii	Vulnerable	All remnant forest and woodland communities below 510 m AHD.	284

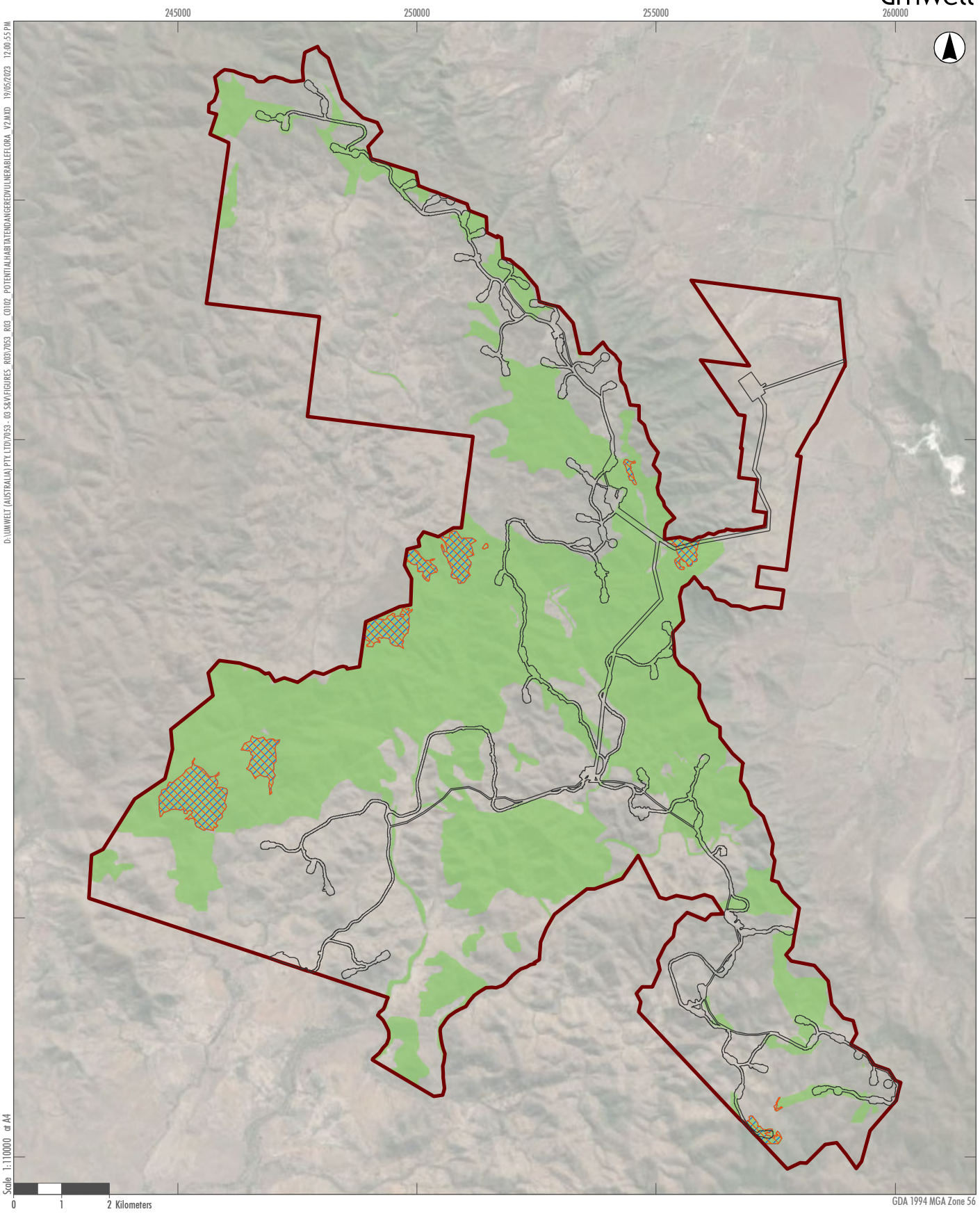


FIGURE C1.2

Potential Habitat for Endangered or Vulnerable Flora – Moderate Likelihood

Image Source: ESRI Basemap (2021) Data source: Queensland Spatial (2020)

Table C.11 SRI criteria for Plants - Protected wildlife habitat - *Decaspermum struckoilicum, Cossinia australiana* and *Samadera bidwillii*

Impact Criteria	Assessment
An action is UNLIKELY to have an SRI on a plant that is 'endangered' or 'vulnerable' wildlife if the action will result in:	
Clearing of plants that are threatened wildlife and not located within a natural setting (i.e., does not meet the definition of 'in the wild' under the Nature Conservation Act 1992) where the proposal includes translocation.	No individuals have been recorded within the Study Area. However, if they were present, it is likely that they would meet the definition of 'in the wild'. Pre-clearance surveys will be undertaken within suitable habitat prior to any disturbance, and if individual/s are recorded all effort would be made to avoid them. If avoidance is not possible, consultation will first occur with DCCEEW and then DES if required. The protected plants assessment process will be followed if direct impacts are predicted to occur within 100 m of an individual. Mitigation and management measures are provided in **Section 6.2** of this report.
Clearing of up to 10% of the total number of plants that are threatened wildlife occurring on a site where the proposal results in 90% of all plants that are threatened wildlife being retained and protected as a reserve or similar.	No evidence of the three species with a Moderate likelihood of occurrence has been recorded within the Study Area. Pre-clearance surveys will be undertaken within suitable habitat prior to any disturbance, and if individuals were recorded all effort would be made to avoid them. If avoidance is not possible, consultation will first occur with DCCEEW and then DES if required. The protected plants assessment process will be followed if direct impacts are predicted to occur within 100 m of an individual. Consideration would be given to threatened wildlife being retained and protected as a reserve or similar.
Clearing of regenerating plants that are threatened wildlife which have previously been cleared within the last 5 years and that are historically maintained through slashing or grazing.	The individuals of this species, if present, would unlikely be regenerating plants which have previously been cleared in the last five years and that are historically maintained through slashing of grazing.
The proposed relocation of an area of plants that are threatened wildlife less than 1000 m^2 not occurring in a relatively natural ecological situation (e.g., bushland), to a permanent retention area via an approved management plan.	This criterion is unlikely to be the case for these species. However, if individuals are identified as part of the pre-clearance surveys, translocation and/or propagation and planting of individuals would be proposed if required through the protected plants assessment process.

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