ECOLOGICAL ASSESSMENT REPORT
FOREST WIND PROJECT

Report: FWH-03
Client: Forest Wind Holdings
February 2020

FOX & CO
ENVIRONMENTAL

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Executive Summary

Forest Wind Holdings Pty Limited (FWH) proposes to develop and construct a wind farm called Forest Wind (the Project) located within exotic pine plantations in Queensland Government owned Toolara, Tuan and Neerdie State Forests, situated between Gympie and Maryborough in the Wide Bay Region of Queensland.

Specifically, the Project comprises a wind farm with up to 226 wind turbines and ancillary infrastructure (herein referred to as the Wind Turbine Area (WTA)) and a 60m wide Overhead Transmission Corridor (OTC) in which a high voltage transmission line (the Transmission Line) will be located to transfer the generated electricity to an existing Powerlink Queensland (Powerlink) substation located at Woolooga to the west of Gympie. The Project will be located within the Gympie Regional Council (GRC) and Fraser Coast Regional Council (FCRC) Local Government Areas (LGAs).

The WTA is located entirely within existing operational and actively managed exotic pine plantations. The WTA (including ancillary infrastructure) is referred to as the Study Area.

An ecological assessment has been undertaken to describe the existing environment and to assess the potential impacts that the Project may have on flora and fauna, particularly Matters of State Environmental Significance (MSES) and Matters of National Environmental Significance (MNES). This information will inform the application for a Development Approval (DA) for a Material Change of Use (MCU) for a wind farm and referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Under State Code 23: Wind Farm Development, within the State Development Assessment Provisions (SDAP), wind farm development is required to ensure that risks to flora, fauna and associated ecological processes are mitigated or managed through effective siting, design and operation of the wind farm. This is addressed in this assessment and informs the development assessment process.

Preliminary ecological assessments were undertaken by O2 Ecology (2016) and Premise Environment (Premise) (2017-2019). The initial assessments informed further survey design and assessments undertaken by Premise between 2017 and 2019. As the Project has undergone design changes, additional surveys and targeted assessments have been undertaken by Fox & Co Environmental Pty Ltd (Fox & Co). This report consolidates the flora and fauna assessments undertaken, with particular reference to the occurrence of threatened and /or migratory species (EPBC Act and/or Queensland's *Nature Conservation Act 1994* (NC Act)), although native species such as Least Concern (NC Act) species have also been assessed. It identifies the potential significance of impacts from the Project on terrestrial and aquatic flora and fauna and provides management measures proposed to mitigate potential impacts on flora and fauna during construction and operation of the wind farm.

There are no world heritage properties, national heritage places, wetlands of international importance or commonwealth marine areas within the Study Area. The Study Area is not within the Great Barrier Reef Marine Park.

Key findings of the investigations to date include:

- the Project is ideally situated as the exotic pine plantations are considered of low ecological value and remnant vegetation, which provides the highest value for flora and fauna, within the plantation area will be avoided wherever possible (except some marginal works areas).
- The mosaic of remnant vegetation within the WTA provides the most valuable habitat for native species within the WTA and these areas, including waterways, will be avoided with

all infrastructure within the WTA sited within existing exotic pine plantations and not remnant vegetation.

- One (1) flora species of conservation significance was identified
  - Pineapple Zamia *(Macrozamia pauli-guilielmi*) - Endangered (EPBC Act and NC Act).
- Eight (8) fauna species of conservation significance were identified:
  - White-throated needletail (*Hirundapus caudacutus)* – Vulnerable (V), Migratory Terrestrial (MT) and Listed Marine (LM) (EPBC Act)
  - Fork-tailed swift (*Apus pacificus)* – MT (EPBC Act)
  - Rainbow bee-eater (*Merops ornatus)* – LM (EPBC Act)
  - Cicadabird (*Coracina tenuirostris)* – LM (EPBC Act)
  - Koala (*Phascolarctos cinereus)* - (V (EPBC Act and NC Act)
  - Grey-headed Flying-fox (*Pteropus poliocephalus*) – V (EPBC Act)
  - Swamp crayfish *(Tenuibranchiurus glypticus*) - Endangered (NC Act). It is not listed under the EPBC Act
  - Wallum froglet (*Crinia tinnula*) – V (NC Act). It is not listed under the EPBC Act
- Additional conservation significant flora and fauna species are considered to have at least a moderate potential to occur based on previous records in the region and potential habitat on or adjacent to the Project Area.

Potential impacts to the above identified conservation significant species, conservation significant species with at least a moderate likelihood of potentially occurring and common Least Concern species known to fly at rotor height were considered.

Mitigation measures to minimise potential impacts to all species, particularly conservation significant species are provided. Avoidance is the guiding principle to avoiding impacts on MNES and MSES as well as least concern species. Avoidance measures utilised in the Project include:

- The Project is set back a minimum of 4km from the Great Sandy Strait which is a known significant non-breeding area for EPBC listed migratory shorebirds.
- The WTA is located within an existing exotic pine plantation and avoids remnant vegetation and waterways. Remnant vegetation will not be cleared for the construction of the wind turbines.
- Only marginal clearing of remnant vegetation may occur for upgrades to existing waterway crossings to enable access to the site.
- Electrical cabling will mostly be underground along existing access tracks, or in track drains, which will further reduce the likelihood of collision and/ or electrocution of birds and bats. Some track drains may potentially provide suitable habitat for some acid frog species such as *Crinia tinnula*. Pre-clearance surveys will be undertaken prior to works in low-lying drain areas and, subject to the pre-clearance surveys, further mitigation measures may be implemented.
- Other infrastructure such as construction compounds avoid remnant vegetation and waterways and therefore avoid damage to remnant areas of natural habitat.
- Existing forestry tracks will be used to provide access within the WTA and therefore avoids disturbance to remnant vegetation and habitat associated with remnant vegetation.
- Transmission Line spans waterways and significant vegetation such as known populations of Pineapple Zamia.
- Pre-clearance/pre-construction surveys to determine if site -specific micro-siting of turbines is required to further minimise impacts.
- Clearly and accurately designate no-go areas prior to detailed design of Transmission Line to ensure sensitive areas are spanned (eg. Pineapple Zamia's, confirmed essential habitat, waterways). No-go areas to be clearly defined prior to works in roadside drains and access tracks.
- Avoid hollow bearing trees within the OTC where possible by spanning remnant areas. Pre-clearance surveys to determine density and number of hollows lost during

construction within OTC. Replace any loss of hollows at a previously agreed replacement ratio.
- Comply with existing site-specific management plans currently implemented for the operating forestry practices
- Erosion and Sediment Control Plans (ESCP) developed by a Certified Professional in Erosion and Sediment Control (CPESC).
- Storage of fuels, chemicals, wastes and other potentially contaminating substances in appropriately bunded areas and away from waterways.

Additional mitigation measures to reduce collision based impacts during operation are associated with adaptive management and reducing the risk of attracting birds and bats into the rotor swept area (RSA) of the wind farm. This includes:

- An adaptive management bird and bat monitoring program has been prepared and already commenced implementation. Should the monitoring program's results demonstrate that further mitigation is required, further assessment will be undertaken to determine appropriate mitigation or management measures. Additional measures may include deploying a radar detection and deterrent technology system.

- Spatially and temporarily replicated carcass monitoring undertaken by suitably qualified ecologists, trained detector dogs or other approved method. This will be used to identify particular turbines that may be causing excessive number of deaths. Monthly surveys to be undertaken at a stratified random representative selection of turbines. Surveys will also be timed to occur at times of flowering of eucalypt and melaleuca where possible. Should mortality be shown to exceed an acceptable mortality rate, comprehensive evaluation of risk factors will be undertaken and mitigation plans adopted until the risk of impact has been abated. Mitigation plans may include changes in operational regimes of the turbine causing impact, for example, different systems, limiting rotational speed or suspension of operation of high risk turbines in high impact periods which may be identified through detection systems (eg. departure and return flight times in evening for bats, identified with a radar).

- Trial acoustic and/or sonar to deter bats/birds. Slow rotor speeds or temporary shutdown of subject turbines during Summer period of known migratory aerial insectivores when birds may be on site.

- A Project specific Bird and Bat Management Plan has been prepared which outlines the objectives and monitoring program.

1 INTRODUCTION

Forest Wind Holdings Pty Limited (FWH) proposes to develop and construct a wind farm called Forest Wind (the Project) located within exotic pine plantations in Queensland Government owned Toolara, Tuan and Neerdie State Forests, situated between Gympie and Maryborough in the Wide Bay Region of Queensland.

Specifically, the Project comprises a wind farm with up to 226 wind turbines and ancillary infrastructure (herein referred to as the Wind Turbine Area (WTA)) and a 60m wide Overhead Transmission Corridor (OTC) in which a high voltage transmission line (the Transmission Line) will be located to transfer the generated electricity to an existing Powerlink Queensland (Powerlink) substation located at Woolooga to the west of Gympie. The Project will be located within the Gympie Regional Council (GRC) and Fraser Coast Regional Council (FCRC) Local Government Areas (LGAs).

An ecological assessment has been undertaken to describe the existing environment and to assess the potential impacts that the project may have on flora and fauna, particularly Matters of State Environmental Significance (MSES) and Matters of National Environmental Significance (MNES). This information will inform the application for a Development Approval (DA) for a Material Change of Use (MCU) for a wind farm and referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Preliminary ecological assessments were undertaken by O2 Ecology (2016) and Premise Environment (Premise) (2017-2019) (Appendix F). The initial assessments informed further survey design and assessments undertaken by Premise between 2017 and 2019. As the Project has undergone design changes, additional surveys and targeted assessments have been undertaken by Fox & Co Environmental Pty Ltd (Fox & Co). This report consolidates the flora and fauna assessments undertaken, with particular reference to the occurrence of threatened and /or migratory species. It identifies the potential significance of impacts from the Project on terrestrial and aquatic flora and fauna and provides management measures proposed to mitigate potential impacts on flora and fauna during construction and operation of the wind farm.

The Project will involve the following components:

- Up to 226 wind turbines
- Access tracks using existing forestry tracks in the WTA
- Underground electrical cables
- Operations compounds
- Substations
- Battery storage and distribution lines
- Temporary construction compounds and facilities
- High voltage transmission line

1.1 Location and Study Area

The WTA is located within an existing operational and actively managed exotic pine plantation within the Toolara, Tuan and Neerdie State Forests located in the Wide Bay Area (**Figure 1**). The WTA comprises land titles on which turbines are proposed, as follows:

- Lot 915 of Crown Plan FTY1775
- Lot 1004 of Crown Plan FTY1659
- Lot 1419 of Crown Plan FTY1697

The Project also includes a 60m wide OTC in which a high voltage transmission line (the Transmission Line) will be located to transfer generated electricity to an existing Powerlink Queensland (Powerlink) substation located at Woolooga to the west of Gympie. The WTA (including ancillary infrastructure) and the area within the Native State Forest (NSF) are referred to as the Study Area.

1.2 Plantation Management

The pine plantation is a commercial crop that is maintained accordingly by the Plantation Licensee for fire management and obligations under the *Biosecurity Act 2014*. The plantation is intensively managed to provide commercial access for silviculture and harvesting purposes.

The Plantation Licensee maintains the crop (pine) as an exotic modified landscape and the aim is to keep weed cover at a minimum to maintain access and manage the plantation as a commercial crop. It is maintained for a specific dedicated commercial purpose which includes fire management and invasive weed management.

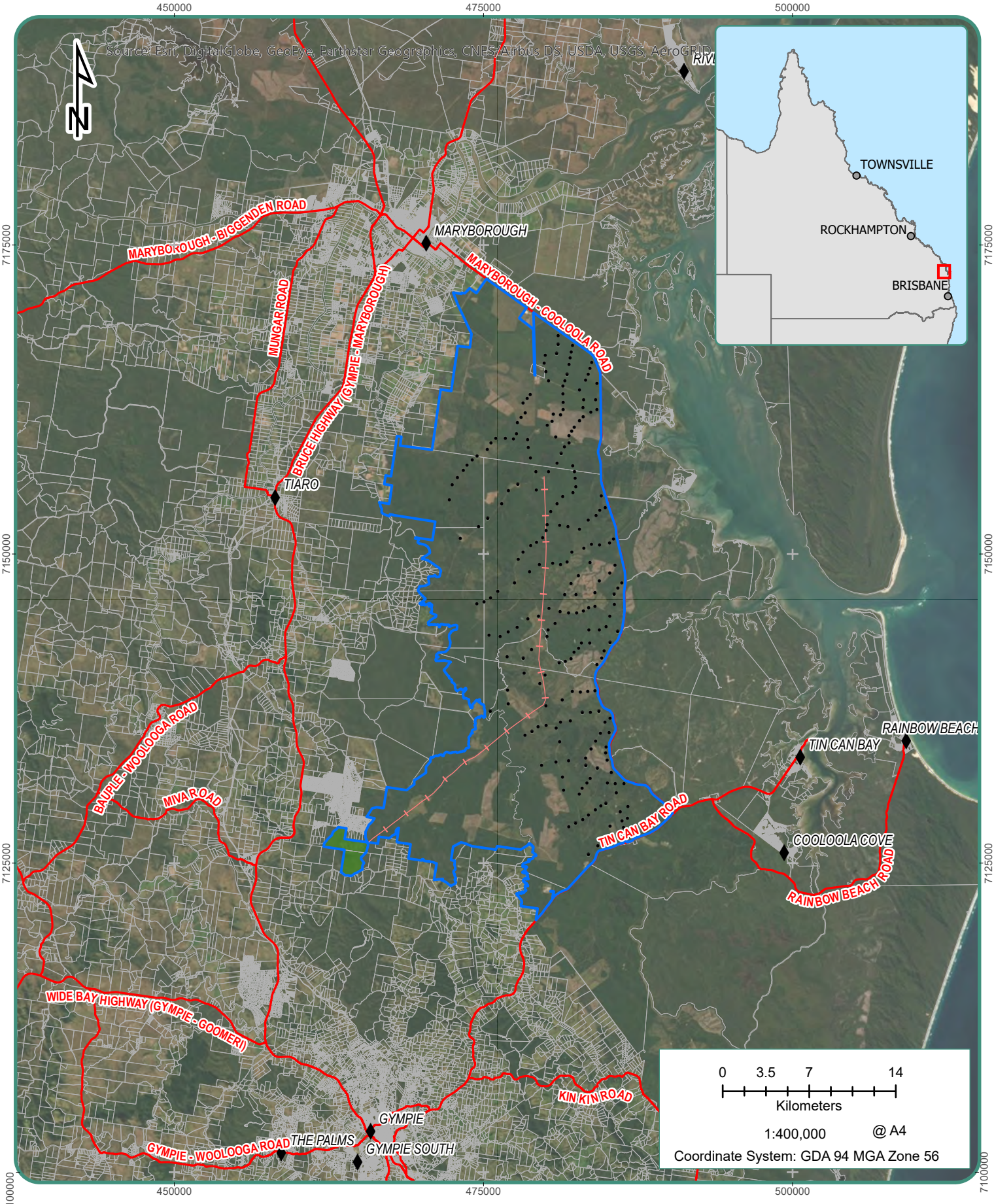
The plantation management tasks include; cultivation, weed control, prescribed burning and harvesting, and result in periodic disturbances to compartments. The Plantation Licensee undertakes the following management schedule of works on plantation compartments.

Table 1 Plantation Management Schedule

Task	Age
Preplant overall weed control for grass and woody vegetation	Year 0
Row cultivation on selected blocks	Year 0
Row herbicide treatment by band tending method #1	Year 0
Row herbicide treatment by band tending method #2	Year 0
Machine inter-row mechanical weed control	Year 2-3
Prescribed burn#1	Year 8-10 (10m high)
Prescribed burn#2 (+3yrs)	Year 11-13
Prescribed burn#3 (+3yrs or as required)	Year 14+
Thinning mechanical on compartments with higher stocking	Year 17-20
Clearfell	Year 27

Over 27 years there are 9-10 intervention events to make the plantation safe and optimise productivity. On average non-plantation woody species are treated every 3-4 years.

The proposed area of pine plantation clearing for the Project is likely to be less than 1% of the pine plantation. Approximately 3,000 ha of crop is cleared per year under the current harvesting program by the licensee.



TITLE:

Study Area and Regional Context

MAP NO: Figure 1

PROJECT: Forest Wind Holdings Pty Ltd

LEGEND

- Populated places
- FWH Turbine Locations
- State controlled roads
- High voltage transmission line
- Study area
- Property boundaries
- Native state forest

Date: 7/09/2019

Data Source:
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1.3 Aims and Objectives

The aim of the assessments was to document the flora, fauna and vegetation within and adjacent to the Study Area, with particular reference to the EPBC Act and/or *Nature Conservation Act 1994* (Qld) (NC Act) protected species. Desktop assessments and targeted flora and fauna surveys aimed to:

- determine existing environmental values of the Study Area;
- undertake likelihood of occurrence assessments of EPBC Act and/or NC Act protected species and communities which may occupy or use the Study Area;
- identify species 'at risk' to impacts which may require additional management measures to mitigate impacts during the construction and operation phase.

1.3.1 Previous Reports

During the pre-approval and pre-construction phases of the project, investigations were undertaken by O2 Ecology (2016), Premise Environment Pty Ltd (formerly O2 Ecology) (2017-2019) and Fox & Co Environmental Pty Ltd (2019). The methods and results of these investigations are included in the following reports:

- Premise Environment (October 2017). *Forest Wind, Ecological Assessment, Report No. 1701513b* (refer Appendix F).
- Fox & Co Environmental (August 2019). *Forest Wind Bird and Bat Utilisation Survey, Report FWH-01* (refer Appendix G).
- Fox & Co Environmental (August 2019). *Forest Wind Bird and Bat Management Plan, FWH-02* (refer Appendix H).

2 REGULATORY FRAMEWORK

2.1Commonwealth

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

Under the EPBC Act, actions that have, or are likely to have, a significant impact on a MNES require approval from the Australian Government Minister for the Environment. The nine matters of national environmental significance protected under the EPBC Act are:

- world heritage properties;
- national heritage places;
- wetlands of international importance (listed under the Ramsar Convention);
- listed threatened species and ecological communities;
- migratory species protected under international agreements;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mines); and
- a water resource, in relation to coal seam gas development and large coal mining development.

Other matters protected by the EPBC Act include:

- the environment, where actions proposed are on, or will affect Commonwealth land and the environment; and
- the environment, where Commonwealth agencies are proposing to take an action.

A self-assessment using the Commonwealth Department of Environment and Energy (DoEE) *Significant Impact Guidelines 1.1 - Matters of National Environmental Significance* is required to determine whether the Project will, or is likely to, have a significant impact on MNES. Anyone wanting to undertake an action that may have a significant impact on a MNES is required to submit

a referral to the federal DoEE. DoEE then makes a decision as to whether the project is deemed a 'controlled' or 'non-controlled' action.

A pre-lodgement meeting for the Project was held with the DoEE on 26 July 2019. The Project will be referred under the EPBC Act to determine whether the Project is considered a 'controlled action'.

2.2 Queensland

Matters of State Environmental Significance (MSES) are referenced in the biodiversity State interest under the State Planning Policy (SPP) and are mapped by the Queensland Government. The *Environmental Offsets Regulation 2014* also prescribes MSES for the purposes of the environmental offsets legislation in Queensland.

Many of the MSES in the *Environmental Offsets Regulation 2014* coincide with the MSES listed under the SPP, however, there are additional items listed under the *Environmental Offsets Regulation 2014* that are not listed in the SPP. The MSES mapping includes certain environmental values that are protected under Queensland legislation such as State conservation areas, marine parks, waterways and wetlands, protected habitat, fish habitat, regulated vegetation, connectivity areas and offset areas.
MSES defined under the SPP and *Environmental Offset Regulation 2014* include the following:

- protected areas (including all classes of protected area except coordinated conservation areas) under the NC Act
- marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the *Marine Parks Act 2004*
- marine plants
- areas within declared fish habitat areas that are management A areas or management B areas under the *Fisheries Regulation 2008*
- waterways providing fish passage
- threatened wildlife under the NC Act and special least concern animal under the *Nature Conservation (Wildlife) Regulation 2006*
- regulated vegetation under the *Vegetation Management Act 1999* (VM Act) that is:
    - Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems
    - Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems
    - Category R areas on the regulated vegetation management map
    - areas of essential habitat on the essential habitat map for wildlife prescribed as 'endangered wildlife' or 'vulnerable wildlife' under the NC Act
    - regional ecosystems that intersect with watercourses identified on the vegetation management watercourse map
    - regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map
- high preservation areas of wild river areas under the *Wild Rivers Act 2005*
- connectivity areas containing remnant vegetation Category B as depicted in the Environmental Offset Landscape Connectivity Assessment Tool
- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Referable Wetlands under the *Environmental Protection Regulation 2008*
- Wetlands and watercourses in high ecological value waters defined in the *Environmental Protection (Water) Policy 2009*, schedule 2
- Legally secured offset areas

2.2.1 State Development Assessment Provisions

Under State Code 16: Native Vegetation Clearing of the State Development Assessment Provisions (SDAP), operational work for clearing native vegetation should demonstrate that the development avoids impacts on vegetation that is a MSES, and where avoidance is not reasonably possible,

minimises and mitigates impacts and provides an offset for any acceptable significant residual impacts where appropriate.

The *Vegetation Management Act 1999* (VM Act) regulates clearing of native vegetation. The State Forest is exempt as per Clause 7 (1c) of the VM Act, which states:

The Act applies to all clearing of vegetation other than vegetation on –
1 (c) an area declared as a State Forest or timber reserve under the *Forestry Act 1959*.

Operational works in relation to the clearing of native vegetation within a State Forest for the Project are exempt from the provisions of the VM Act and any approvals that would be otherwise triggered by this Act are not required.

Under Code 23 of the SDAP, wind farm developments should be appropriately located, sited, designed and operated to ensure that the development avoids, or minimises and mitigates adverse impacts on the natural environment (fauna and flora) and associated ecological processes.

3 METHOD

A combination of desktop and site assessments (including flora, terrestrial and aquatic fauna) were conducted between 2016 - 2019. The desktop assessments included a review of relevant literature, mapping and database searches. The site assessments were conducted to obtain specific ecological information relevant to the Study Area. This section also outlines the terminology and nomenclature used in this report and describes the procedures and guidelines used in undertaking the assessment.

3.1 Desktop Assessment

A desktop assessment of available State and Commonwealth databases was undertaken to identify records or potential occurrences of least concern and conservation significant flora and fauna species within and adjacent to the Study Area. The desktop assessment used the below databases and documents.

The Commonwealth DoEE Protected Matters search tool (PMST) was used to identify species and vegetation communities listed under the EPBC Act that may occur within the search area. The PMST is a predictive database that identifies EPBC Act listed flora and fauna species with a Moderate Potential to Occur in each search area based on bioclimatic modelling.

Regional Ecosystems (REs) are vegetation communities that are consistently associated with a combination of geology, land form and soil in a bioregion. The Queensland Herbarium has mapped the remnant and pre-clearing extent of REs for much of the State using a combination of satellite imagery, aerial photography interpretation and on-ground studies. The current *Vegetation Management Act 1999* (VM Act) Regional Ecosystem and Remnant Map, Essential Habitat point and polygon data and Property Maps of Assessable Vegetation (PMAVs) were used to determine the extent and type of remnant or regrowth vegetation within the Study Area. REs can be used to predict the occurrence of suitable habitat.

The Department of Natural Resources, Mines and Energy (DNRME) Regulated Vegetation Management Map dataset was used to determine areas that are assessable and non-assessable under the provisions of the VM Act.

The Queensland Department of Environment and Science (DES) Biomaps Online search tool was used to identify all species that have previously been recorded within the search area and reported to DES.

The Atlas of Living Australia (ALA) database contains records of Australia's Virtual Herbarium (AVH) (Council of Heads of Australasian Herbaria, 2014) and the Online Zoological Collections of Australian Museums (OZCAM) (Council of Heads of Australian Faunal Collections, 2014) and provides information on all the known species in Australia aggregated from a wide range of data providers: museums, herbaria, community groups, government departments, individuals and universities. Database records for the Gympie Regional Council (GRC) and Fraser Coast Regional Council (FCRC) LGAs were reviewed, validated where required, and used to provide locations of any threatened species records within the area. GRC provided a list of Local Priority Species.

Refer Appendix E for search results.

The DoEE National Flying-fox Monitoring Viewer (informed by the DoEE, National Flying-fox Monitoring Program (NFFMP) – flying-fox census) was reviewed to assess the status of the flying-fox camps in the region, given that camps fluctuate over time (abundance and species present).

Figures showing MSES have been prepared since previous reporting (Premise, 2017) due to changes in design layout and potential updates in mapping layers. These are provided in Appendix A and include:

- Regional Ecosystems (Figure 8)
- Essential Habitat (Figure 9)
- Flora Survey Trigger Map (Figure 10)
- Conservation Areas (Figure 11)
- RAMSAR wetlands (Figure 12)
- MSES Wetlands (Figure 13)
- Vegetation Management Wetlands (Figure 14)
- MSES Regulated Vegetation (intersecting a watercourse) and High Ecological Value Waters (Figure 15)
- Waterway Identification (Figure 16)

3.2 Likelihood of Occurrence

An assessment was undertaken of the likelihood of occurrence for threatened fauna and flora species identified through the desktop review. The field surveys further informed and verified this likelihood of occurrence assessment.

The DoEE and DES do not have prescriptive likelihood of occurrence guidelines within their policies but rather clarify the scale of assessment required to determine the level of impact (e.g. level of assessment, previous record searches, and distribution maps). The below criteria have been developed with the aim of considering this scale of assessment to identify the likelihood of occurrence for threatened species:

- Low potential to occur – the species has not been recorded in the region (no records from desktop searches) and/or current known distribution does not encompass Study Area and/or suitable habitat is generally lacking from the Study Area.
- Moderate potential to occur – the species has been recorded in the region (desktop searches) however suitable habitat is generally lacking from the Study Area or species has not been recorded in the region (no records from desktop searches within past 10 years) however potentially suitable habitat occurs at the Study Area.
- High potential to occur – the species has been recorded in the region (desktop searches) and suitable habitat is present at the Study Area or immediately adjacent to it.
- Known to occur – the species has been within the Study Area in the recent past (i.e. last 5-10 years) and the site provides suitable habitat for it.

3.3 Collision Risk Assessment

To assess the collision risk of birds/bats with wind turbines, bird/bat utilisation studies were undertaken between 2016-2019. Birds/bats, including Least Concern (NC Act) species with a moderate – high likelihood of occurrence, or birds/bats known to occur were assessed. Refer Section 5 and Appendix D for the collision risk assessment and likelihood of occurrence.

3.4 Field Assessments

3.4.1 Survey Timing and Climatic Conditions

The field surveys of the WTA were conducted between 2016 – 2019. Initial surveys were undertaken in December 2016 and March 2017 to provide additional information during the initial feasibility stage. Subsequent field surveys were undertaken monthly between October 2018 and April 2019 (inclusive) and weekly from February 2019 through to the end of April 2019. Monthly bird utilization surveys (BUS) surveys (refer Table 2) were specifically designed to capture the migratory period of EPBC Act migratory birds arriving or leaving the RAMSAR Great Sandy Strait, in addition to other known migratory terrestrial birds identified in the initial feasibility assessments in 2016.

Table 2 summarises the climatic conditions on each bird survey.

Table 2 Weather Conditions During BUS Surveys[1]

Date	Temp °C		Rain	Evap	Radiation	Vapour Pressure	Relative humidity		Mean sea level pressure
	max	min	mm	mm	MJ/m2	hPa	min%	max%	hPa
8/12/2016	32.5	22.5	0	7.2	19	24	49.1	88.1	1012.5
15/03/2017	29.5	20	32.2	1.2	20	26	63.1	100	1013.5
23/10/2018	29	17.5	0	4.8	26	21	52.4	100	1017
24/10/2018	31	17.5	0	6	24	21	46.7	100	1017.5
29/11/2018	32.5	18	8.9	8.6	27	14	28.6	67.9	1006.5
18/12/2018	29	22.5	6.9	4	14	27	67.4	99.1	1010.5
16/01/2019	32.5	19	0	6.8	28	21	42.9	95.6	1014.5
14/02/2019	33	23.5	0.5	7.8	16	28	55.7	96.7	1010.5
20/02/2019	33.5	20.5	0	7	27	25	48.3	100	1008
27/02/2019	30	17.5	0.2	5.8	25	17	40.1	85.1	1019
4/03/2019	29	21	5.1	8.2	18	24	59.9	96.5	1019
14/03/2019	33	22.5	0.4	5.4	23	27	53.7	99.1	1014
20/03/2019	33	21	2.4	4.6	22	27	53.7	100	1012.5
25/03/2019	32	21	0	5	17	26	54.7	100	1016
10/04/2019	28.5	16.5	0.4	5.6	18	21	54	100	1017.5
17/04/2019	26.5	17	0.8	4.2	18	20	57.8	100	1020.5

[1] – Weather Station: Tuan Creek Forest Station (40207), latitude -25.6778, longitude: 152.7928, extracted 20 August 2019.

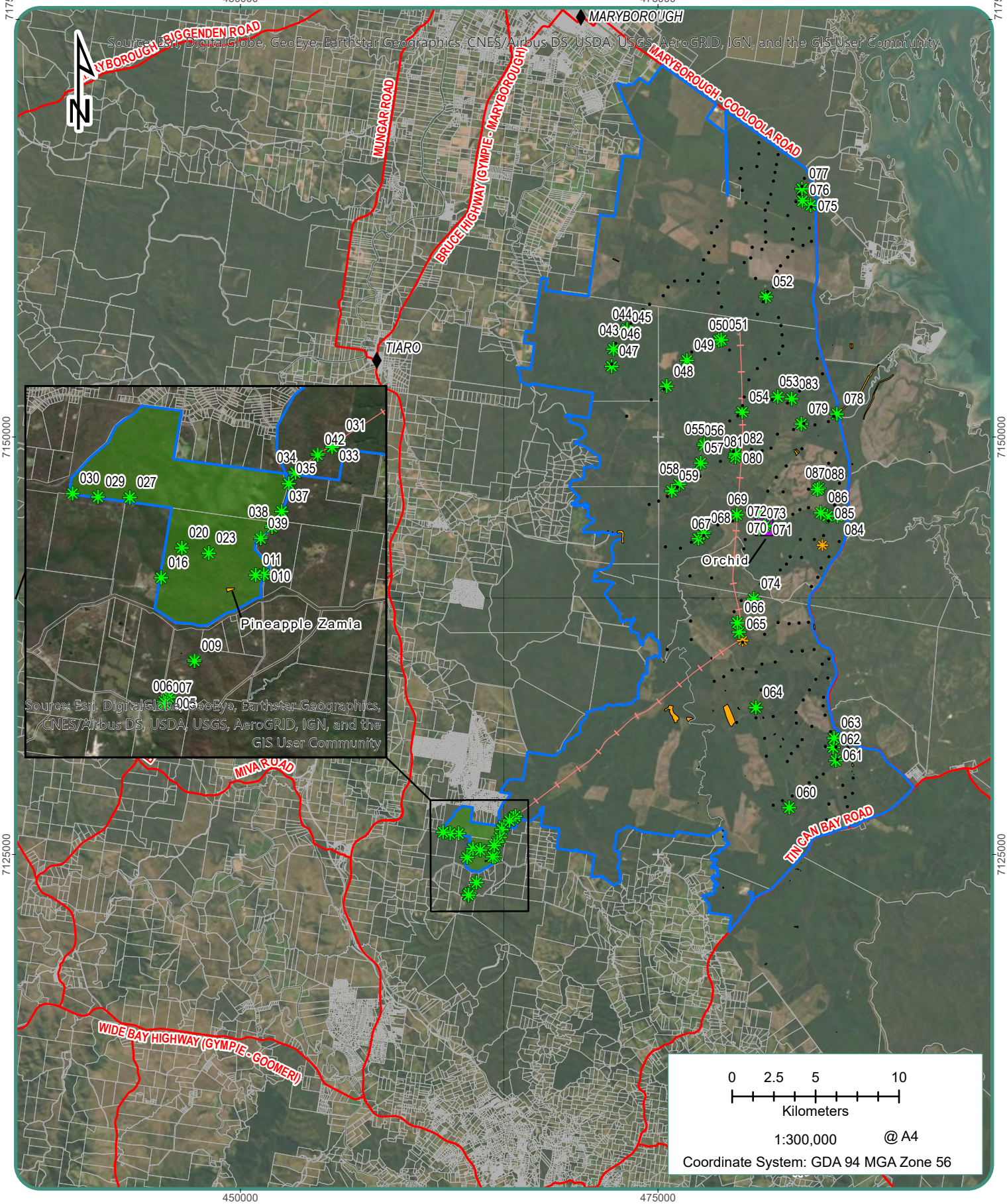
3.4.2 Flora Surveys

Flora and vegetation surveys were undertaken on:

- 2-3 April 2019 (NSF property described as 1419FTY1697);
- 17-19 June 2019 (inclusive) across the WTA.

The surveys were undertaken to ground-truth mapped RE, identify flora species, including threatened flora.
Surveys undertaken in the NSF involved meander surveys and 20 quaternary vegetation assessments. This involves collecting information on structure, canopy height, dominant and co-dominant canopy species, subdominant, associated species and additional notes such as presence of hollow bearing trees (HBT).

Forty-four (44) quaternary sites were undertaken across the WTA in remnant RE patches. Flora surveys were not undertaken within the Pine Plantations due to the commercial forestry operations and the regular management practices undertaken within the pine plantations (slashing of regrowth and herbicide treatments). Nonetheless, prior to development, pre-clearance surveys (including protected plant surveys in flora survey trigger areas) will be undertaken. Refer to Figure 2 for flora survey locations within the Study Area.



TITLE:

Flora Survey Locations

MAP NO: Figure 2

PROJECT: Forest Wind Holdings Pty Ltd

LEGEND

- Populated places
- FWH Turbine Locations
- State controlled roads
- High voltage transmission line
- Study area
- Property boundaries
- Orchid
- Flora survey points
- Pineapple Zamia
- Pineapple Zamia
- Native state forest

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Date: 7/09/2019

Data Source:
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3.4.3 Bird Utilisation Survey

139 fixed-point BUS were undertaken between 2016 and 2019. The BUS has been designed with reference to State Code 23: Wind Farm Development, Planning Guidelines (Queensland Government, June 2018). The survey was undertaken with consideration of relevant seasons (migratory period) and also a Before and After Control Impact (BACI) design, which continues during and post-construction to assess impacts. The BACI design includes reference sites placed at a sufficient distance from the proposed turbine locations to obtain data outside of the zone of influence of the turbines (State Code 23, June 2018).

The BUS are fixed-time point counts undertaken over a 20 minute period using a methodology adapted from Reynolds et al. (1980) and Biosis (2016). Point count locations are selected to provide sufficient representation of turbine locations across the entire wind farm. The following is recorded:

- Species
- Number of birds
- Height of bird above the ground
- Horizontal distance from observer to bird
- Weather conditions (cloud cover, wind direction, wind speed)

3.4.3.1 Survey Locations

Twenty-five (25) bird survey locations were established, of which seven (7) are considered reference sites. 139 fixed-point bird surveys have been undertaken. Locations were selected based on clear vantage points across the entire WTA. This was generally in elevated positions or where the pine plantation had been harvested allowing a clear view shed. Bird survey locations are shown on Figure 3. Birds were also recorded from incidental locations. These are also shown on Figure 3 if the birds recorded were at rotor height. Species observed where flight behaviour would exclude risk of impact (eg. Emu) are recorded on the general bird species list, however they are not included on Figure 3. BUS survey site numbers and dates surveyed are provided in Table 3.

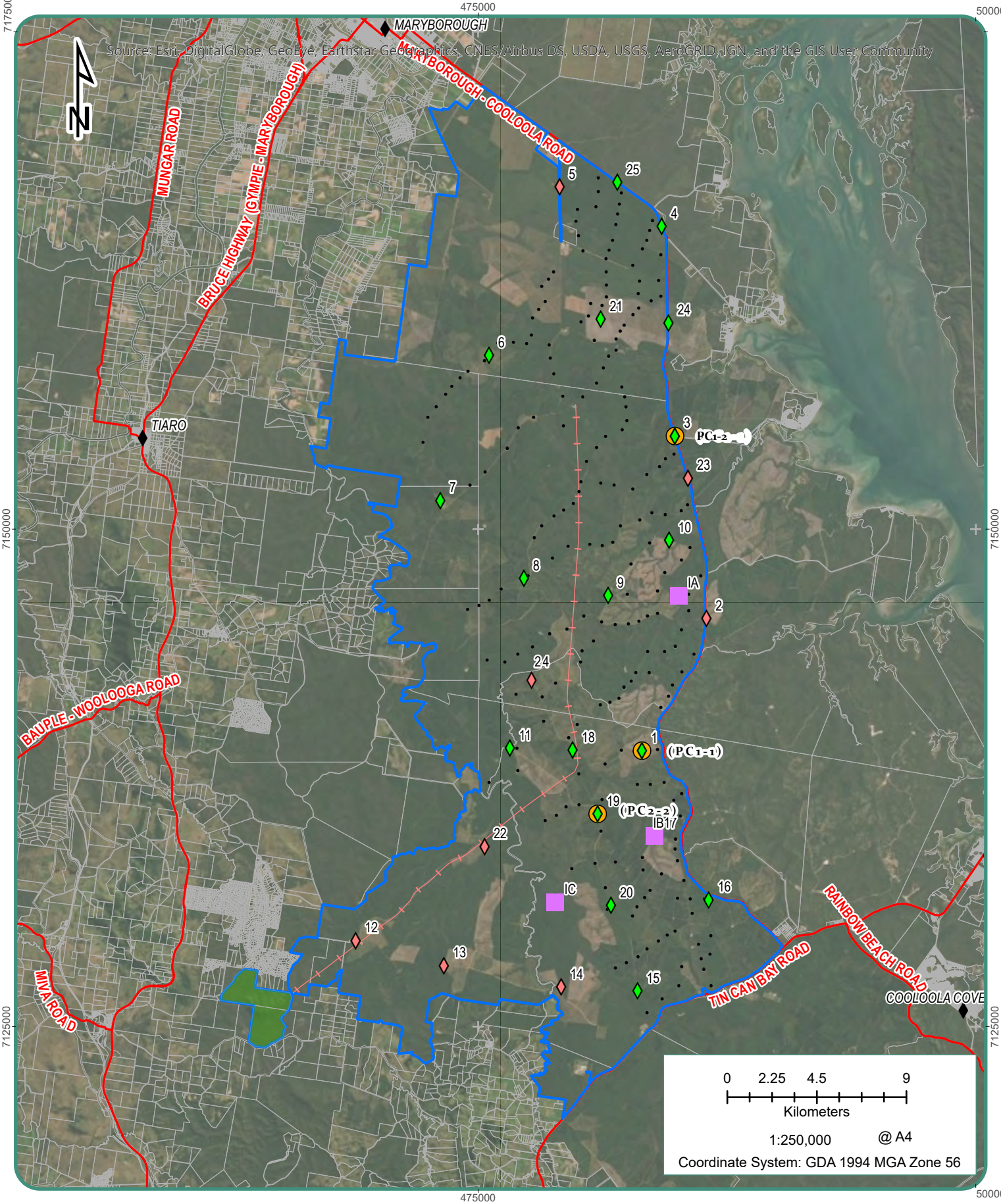
Table 3 Fixed-point BUS Surveys

Site	Date														
	2016	2017	2018			2019									
	8/12	15/3	23-24/10	29/11	18/12	16/1	14/2	20/2	27/2	4/3	14/3	20/3	25/3	10/4	17/4
1	X	X	X	X	X	X	X	X	X	X	X		X	X	X
2			X	X	X	X	X	X	X	X	X		X	X	X
3	X			X	X	X	X	X	X	X	X		X	X	X
4			X	X	X	X	X	X	X	X	X		X	X	X
5			X	X	X	X	X		X		X			X	X
6				X	X	X	X		X	X	X				
7				X	X	X	X	X	X	X	X	X			
8				X	X	X	X		X	X	X	X			
9				X	X	X			X	X			X		
10			X	X					X						
11					X	X			X		X	X			
12						X			X				X		
13					X	X	X		X		X		X		
14					X	X			X		X	X			
15						X	X	X		X				X	X
16							X	X		X	X		X	X	X
17				X											
18												X			
19		X				X									
20							X								
21			X					X							
22													X		
23								X		X		X			
24														X	X
25														X	X
Total	**2**	**2**	**6**	**11**	**12**	**15**	**12**	**9**	**14**	**11**	**12**	**6**	**9**	**9**	**9**

X = 20 minute fixed-point bird utilisation survey undertaken

= reference site

Site 1 was originally labelled PC1-1 during the initial 2016 / 2017 surveys (shown on Figure 3)
Site 3 originally labelled PC1-2 during the initial 2016 / 2017 surveys (shown on Figure 3)
Site 19 was originally labelled PC2-2 during the initial 2016 / 2017 surveys (shown on Figure 3)



TITLE:

Bird Survey Locations

MAP NO: Figure 3

PROJECT: Forest Wind Holdings Pty Ltd - Bird & Bat Utilisation Survey

LEGEND

- FWH Turbine Locations
- Bird monitoring locations
- Reference sites
- 2016/2017 surveys
- Incidental observation
- State controlled roads
- High voltage transmission line
- Study area
- Property boundaries
- Native state forest

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Date: 7/09/2019

Data Source:
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3.4.4 Bat Utilisation Survey

The echolocation calls of insectivorous bats were recorded using two (2) ultrasonic detectors (Songmeters) (SM2BAT® and SM4BAT) and stored on compact flash memory cards for later computer analysis and identification. The detector locations were selected based on:

- attempts to maximise diversity of bat species detected; and
- the degree to which the locations represent fauna habitat types within the WTA.

Detectors were placed on the ground or on trees in suitably open areas (to maximise acoustic clarity) or flyways. Detectors were deployed across the WTA between 14 February 2019 and 26 March 2019. Songmeters were moved on a weekly basis over the 6-week period, which equates to 80 nights of recording. Batteries were changed each week and data was downloaded before re-deployment. All bat calls recorded were sent to a qualified and experienced bat-call analyst (Greg Ford; Balance Consulting) for identification.

A third songmeter (SM4) was also deployed during the same period. The SM4 records acoustic sounds such as frogs, birds and flying-foxes. Thirty-four (34) nights of acoustic recording was also undertaken across 5 locations during the same 6-week period.

Table 4 identifies each site of Songmeter deployment with a brief habitat description. Refer to Figure 4 for bat monitoring locations.

A grey-headed flying-fox (GHFF) assessment was undertaken in accordance with the recommended DoEE survey approach (DoEE, 2019). Given GHFF occupies most areas in their distribution in highly irregular patterns, surveys based on animal sightings are unlikely to be reliable (DoEE, 2019). A more effective survey method is to search appropriate databases and other sources for the locations of camps, and to conduct vegetation surveys to identify feeding habitat (DoEE, 2019).

An inventory of the current status of 14 historical flying-fox camps within and near the scoping area was carried out on 7 December 2016 by Premise Australia (Premise, 2017). The locations of the flying-fox camps were informed by the DoE National Flying-fox Monitoring Viewer (DoEE, 2015) and DES flying-fox roost monitoring locations (Department of Environment and Heritage Protection, 2016a). Species present and estimated camp size were recorded. The flying-foxes were observed leaving one camp (the closest camp to the study area) for the evening to understand the general direction of travel relative to possible placement of turbines, although the dispersal direction may also be influenced by climatic conditions and food availability.

The DoEE National Flying-fox Monitoring Viewer (informed by the DoEE, National Flying-fox Monitoring Program (NFFMP) – flying-fox census) was again reviewed in 2019 to assess the status of the flying-fox camps in the region, given that camps fluctuate over time (abundance and species present). The NFFMP determines camp activity, camp size and which of the four (4) flying-fox species are utilising the camp (grey-headed flying-fox (GHFF), little red flying-fox (LRFF), Spectacled flying-fox (SFF) and black flying-fox (BFF)).

Table 4 Bat Monitoring Locations

Site	Machine ID	Start Date	End Date	Nights recorded	Lat	Long	Habitat Description	Photo Log
1	SM2BAT[1]	14/02/2019	20/02/2019	6	-25.93565	152.86038	Mature pine forest. Less than 500m from remnant patch (SM4BAT was deployed in adjacent remnant for same period to compare difference between pine/remnant within flying distance). Large black feral cat observed.	
2	SM4BAT[1]	14/02/2019	20/02/2019	6	-25.93553762	152.8518821	Remnant. Iron bark, *E. proinqua* (grey gum), *Corymbia citriodora subsp. variegata* (spotted gum), *C. intermedia* (pink bloodwood), lantana and grass trees. HBT present. Less than 1km from above pine forest and deployed over same nights to compare difference in utilisation.	
3	SM4[2]	14/02/2019	20/02/2019	6	-25.72005957	152.7239289	Logging Creek (acoustic recorder only ie. Birds, frogs and flying-fox)	

Site	Machine ID	Start Date	End Date	Nights recorded	Lat	Long	Habitat Description	Photo Log
4	SM2BAT[1]	20/02/2019	27/02/2019	7	-25.62811728	152.8205834	Mature pine plantation in northern end of site	
5	SM4BAT[1]	20/02/2019	27/02/2019	7	-25.67289676	152.8120367	Young pine planation. Proximate to above mature pine and deployed over same nights to compare utilisation between young and mature pine.	

Site	Machine ID	Start Date	End Date	Nights recorded	Lat	Long	Habitat Description	Photo Log
6	SM4[2]	20/02/2019	27/02/2019	7	-25.82897261	152.7823004	Sugarloaf Creek. Permanent creek in WTA. Deployed on paperbark.	
7	SM2BAT[1]	27/02/2019	4/03/2019	5	-25.72060523	152.7240862	Logging Creek. Permanent creek in WTA. Deployed 11:30am.	

Site	Machine ID	Start Date	End Date	Nights recorded	Lat	Long	Habitat Description	Photo Log
8	SM4BAT[1]	27/02/2019	4/03/2019	5	-25.74517199	152.7224208	Deployed in mature pine. Weedy understorey of lantana, ciratro and blue billy-goat weed. Proximate to Logging Creek (western side of site) to compare between remnant creek line and mature pine utilisation. Same nights.	
9	SM4[2]	27/02/2019	4/03/2019	5	-25.88919476	152.755775	Tinana Creek approximately 50 m upstream from Raintree Bridge. Creek appears in good condition in this area and appears to flow permanently. Pools, riffles, shaded areas, good instream structure, tanin stained. Approx 7m wide.	

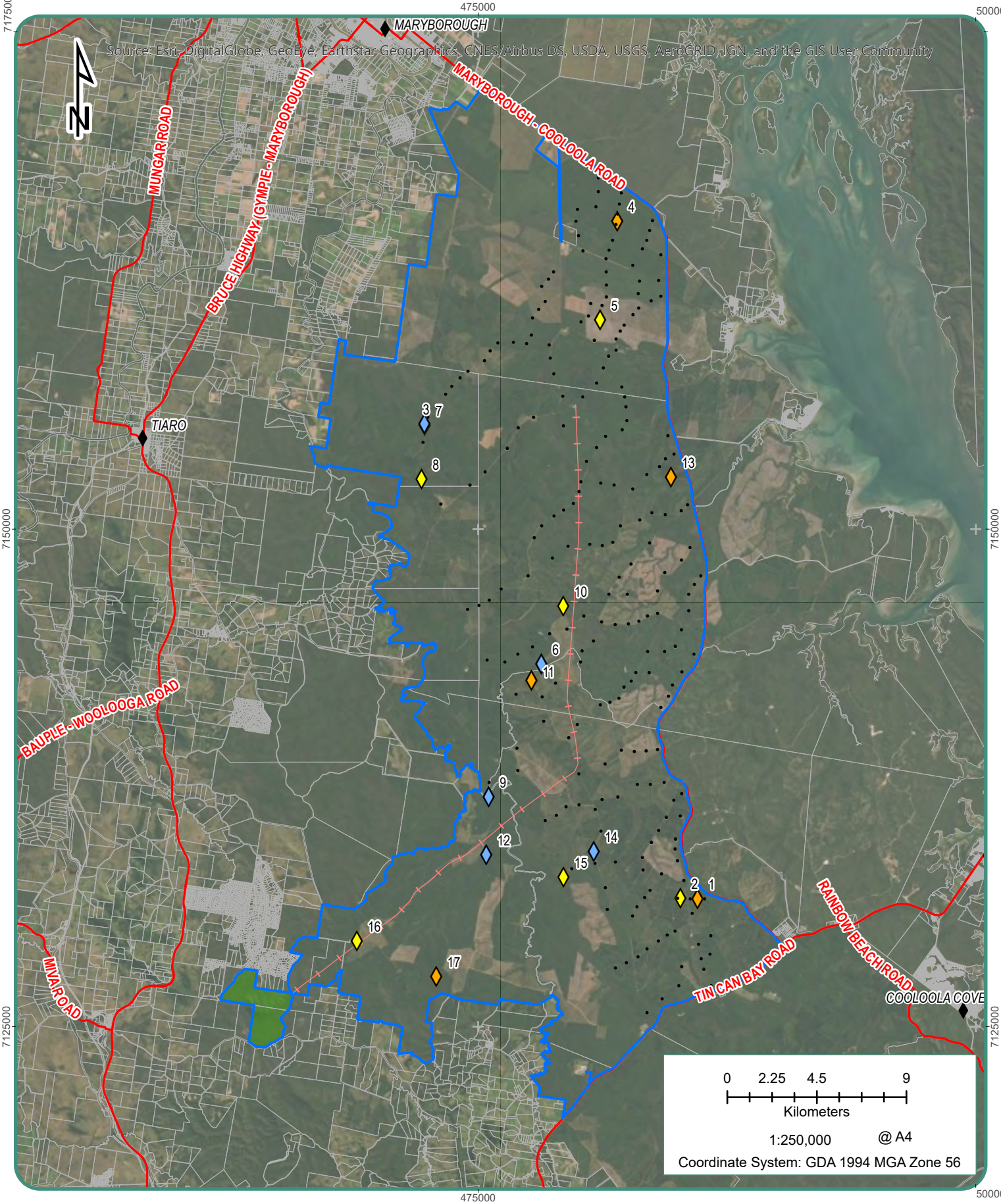
Site	Machine ID	Start Date	End Date	Nights recorded	Lat	Long	Habitat Description	Photo Log
10	SM4BAT[1]	4/03/2019	14/03/2019	10	-25.80286594	152.7933323	Remnant patch of native vegetation. corymbia's, hollows	
11	SM2BAT[1]	4/03/2019	14/03/2019	10	-25.83658447	152.7772792	Pine plantation. Pine approximately 10m tall. Bracken fern. Weedy understorey, lantana. To compare pine utilisation to above remnant. Same nights.	

Site	Machine ID	Start Date	End Date	Nights recorded	Lat	Long	Habitat Description	Photo Log
12	SM4[2]	4/03/2019	14/03/2019	10	-25.91570605	152.7544686	Sandy Creek. Permanent Creek running through WTA.	
13	SM2BAT[1]	14/03/2019	20/03/2019	6	-25.74430054	152.8473066	Semi-mature pine plantation. Bracken fern undergrowth.	

Site	Machine ID	Start Date	End Date	Nights recorded	Lat	Long	Habitat Description	Photo Log
14	SM4[2]	14/03/2019	20/03/2019	6	-25.91409343	152.8084228	Scrubber Creek. 40m west of crossing. Ephemeral. Series of pools with pine debris in some areas.	
15	SM4BAT[1]	14/03/2019	20/03/2019	6	-25.92587903	152.7931573	Remnant patch just north of Tinana Creek crossing. Large remnant area full of spotted gums HBTs. Regrowth *A.littoralis*. Corymbias. good habitat for microbats due to proximity of water and abundant small hollows.	
16	SM4BAT[1]	20/03/2019	26/03/2019	6	-25.95451283	152.6895083	Southern end of site (sw). In young pine up to approx 8m high.	

Site	Machine ID	Start Date	End Date	Nights recorded	Lat	Long	Habitat Description	Photo Log
17	SM2BAT[1]	20/03/2019	26/03/2019	6	-25.97079857	152.7293415	Young pine (1-2m high). Abundant woody debris (pine spoil from previous harvest). Weedy. No remnant vegetation proximate to location. Large open areas due to all young pine.	

[1] - SM2BAT and SM4BAT are ultrasonic recorders which specifically record echolocations of microbat species.
[2] - SM4 is an acoustic recorder which records audible sounds such as mega-bats (flying foxes), birds and frogs. This machine does not record echolocations of micro-bat species. This machine was specifically targeted in areas of potential flying-fox foraging and creek lines considered suitable for amphibian activity.



TITLE:

Bat Survey Locations

MAP NO: Figure 4

PROJECT: Forest Wind Holdings Pty Ltd - Bird & Bat Utilisation Survey

LEGEND

- FWH Turbine locations (170m Ø)
- Bat survey locations - machine IDs
  - SM2BAT1
  - SM42
  - SM4BAT1
- State controlled roads
- High voltage transmission line
- Study area
- Property boundaries

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3.4.5 Nocturnal Surveys

Nocturnal surveys were undertaken to assist with identifying flying-fox presence within the WTA. Surveys were undertaken in 2016 at the closest known flying-fox camp (at the time of survey this was Anderleigh Road Camp as Maaroom was not active in 2016) to monitor the direction of dispersal in the evening, although this may vary depending on climatic conditions and food source availability.

Targeted nocturnal surveys were undertaken by 2-personnel over a 2-night period in June 2019 within the NSF portion of the Study Area. Powerful owls and greater gliders were targeted during this survey within the NSF. Additional nocturnal surveys were undertaken by 2-personnel 1-week later using spotlights in remnant woodland habitat within the WTA over a 2-night period, also in June 2019. The timing was selected following the nocturnal survey in the NSF portion of the Study Area where GHFF were observed feeding in remnant eucalypt woodland. The NSF portion of the Study Area was able to be used as a reference site for the WTA.

3.4.6 Aquatic Surveys

Aquatic surveys were undertaken during some BUS surveys whilst traversing the site between BUS location. These rapid assessments included brief habitat assessments and dip-netting if considered possible habitat for threatened aquatic fauna.

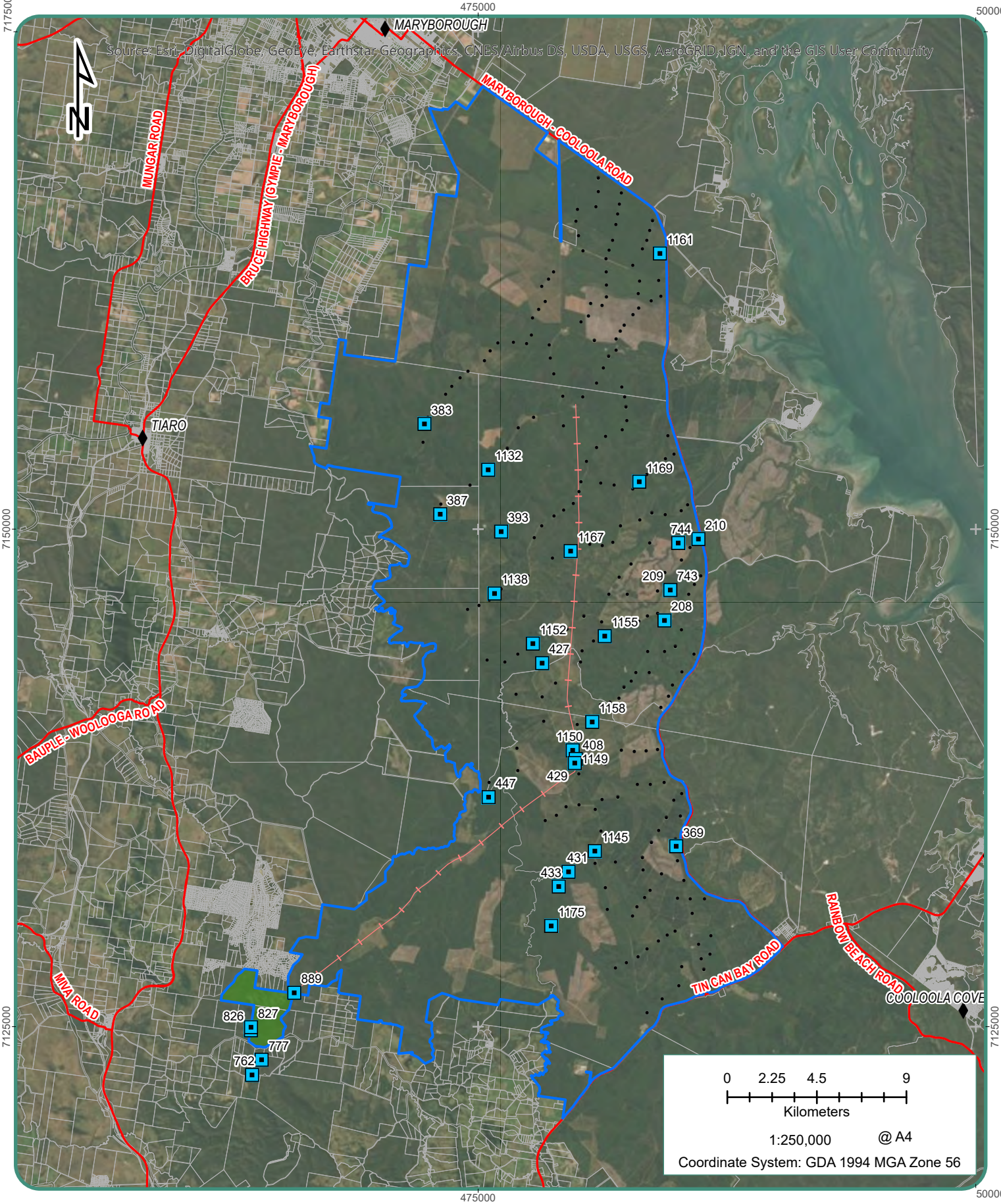
Additional aquatic assessments were undertaken on 17-19 June 2019. Aquatic assessments involved dip-netting and habitat assessments for threatened aquatic species. Refer to Figure 5 for aquatic assessment sites.

3.4.7 Koala Surveys

Koala surveys were undertaken in the NSF portion of the Study Area using a trained koala scat detector dog from the University of the Sunshine Coast (USC). A total of 20 surveys were undertaken over two (2) days on State Forest Lot 1419FTY1697. The age of koala scats is defined in Table 5.

Table 5 Koala Scat Age Category (USC, 2019)

Scat Categories	Age / Days	Characteristics
1	1 day old or less	Very fresh (covered in mucus, wet)
2	Couple of days old	Fresh (shine and odour)
3	Couple of weeks old	Medium fresh (shine or odour when broken)
4	Months old	Old (no shine, no odour)
5	More than a few months old	Very old and discoloured



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TITLE:

Aquatic Survey Locations

MAP NO: Figure 5

PROJECT: Forest Wind Holdings Pty Ltd

LEGEND

- Populated places
- FWH Turbine Locations
- Aquatic survey point
- State controlled roads
- High voltage transmission line
- Study area
- Property boundaries
- Native state forest

FOX & CO ENVIRONMENTAL

Date: 7/09/2019

Data Source:

4 RESULTS

4.1 Desktop Results

4.1.1 Likelihood of Occurrence

Desktop searches identified 12 fish species, 23 amphibians, 184 birds, 20 mammals (excluding bats), 7 bats, 23 reptiles (including 3 freshwater turtles) and 406 plant species recorded within the WTA since 1971 (refer Appendix E). Most species are least concern under the NC Act or not listed under the EPBC Act.

Not all the threatened species indicated through desktop information are expected to occur within the WTA due to the absence of suitable habitat for some species. Table 6 and Table 7 lists the threatened fauna and threatened flora species that are at least moderately likely to potentially occur within or immediately adjacent to the WTA. Further details are provided in the Likelihood of Occurrence Tables in Appendix D.

Table 6 Threatened Fauna Species Potentially Occurring in WTA

Scientific Name	Common Name	EPBC Act[1]	NC Act[2]	GRC[3]
Reptiles				
Elseya albagula	Southern (white-throated) snapping turtle	CE	E	-
Elusor macrurus	Mary River Turtle	E	E	-
Amphibians				
Adelotus brevis	Tusked Frog	-	V	-
Crinia tinnula	Wallum Froglet	-	V	-
Litoria cooloolensis	Cooloola sedgefrog	-	NT	-
Litoria freycineti	Wallum Rocketfrog	-	V	-
Litoria olongburensis	Wallum Sedge Frog	V	V	-
Mixophyes iteratus	Giant Barred Frog	E	E	-
Mammals				
Petauroides volans volans	Southern greater glider	V	V	-
Pteropus poliocephalus	Grey-headed Flying-fox	V	-	-
Phascolarctos cinereus	Koala	V	V	LPS
Ornithorhynchus anatinus	Platypus	-	SLC	LPS
Tachyglossus aculeatus	Short-beaked echidna	-	SLC	

Scientific Name	Common Name	EPBC Act[1]	NC Act[2]	GRC[3]
Xeromys myoides	Water mouse	V	V	-
Fish				
Maccullochella mariensis	Mary River cod	E	LC	LPS
Nannoperca oxleyana	Oxleyan Pygmy Perch	E	V	-
Neoceratodus forsteri	Australian lungfish	V	Not listed under NC Act however is a protected species under the *Qld Fish and Oyster Act 1914*	-
Pseudomugil mellis	Honey Blue Eye	V	V	-
Crustaceans				
Tenuibranchiurus glypticus	Swamp crayfish	-	E	
Birds				
Hirundapus caudacutus	White-throated Needletail	V, MT, LM	SLC	-
Rostratula australis	Australian painted snipe (Syn. *Rostratula benghalensis*)	E, LM, MW	V	-
Pezoporus wallicus wallicus	Ground parrot	-	V	-
Ninox strenua	Powerful owl	-	V	-
Listed Migratory Species				
Migratory Marine Birds				
Apus pacificus	Fork-tailed Swift	MM, LM	SLC	-
Migratory Terrestrial Species				
Cuculus optatus	Oriental cuckoo	MT	SLC	-
Monarcha melanopsis	Black-faced monarch	MT, LM	SLC	-
Monarcha trivirgatus (syn. Symposiachrus trivirgatus)	Spectacled Monarch	MT, LM	SLC	-
Myiagra cyanoleuca	Satin Flycatcher	MT, LM	SLC	-
Rhipidura rufifrons	Rufous Fantail	MT, LM	SLC	-
Listed Marine Species				

Scientific Name	Common Name	EPBC Act[1]	NC Act[2]	GRC[3]
Anseranas semipalmata	Magpie Goose	LM	LC	-
Ardea alba (Syn. A. modesta)	Great Egret, White Egret	LM	LC	-
Ardea ibis	Cattle egret (Syn. Bubulcus ibis)	LM	LC	-
Haliaeetus leucogaster	White-bellied sea-eagle	LM	LC	-
Merops ornatus	Rainbow bee-eater	LM	LC	-
Coracina tenuriostris	Cicadabird	LM	LC	

[1] – EPBC Act: CE – Critically endangered, E – Endangered, V – Vulnerable, MM – Migratory Marine, MT – Migratory Terrestrial Species,
[2] - MW – Migratory Wetland Species, LM – Listed Marine Species
NC Act - E – Endangered, V – Vulnerable, SLC – Special Least Concern, LC – Least Concern
[3] – Gympie Regional Council Local Priority Species (LPS)

Table 7 Threatened Flora Species Likely to Occur in the WTA

Scientific Name	Common Name	EPBC Act	NC Act
Acacia attenuata	-	V	V
Boronia rivularis	Wide Bay boronia	-	NT
Fontania rostrata	-	V	V
Macadamia integrifolia	Macadamia nut	V	V
Macrozamia pauli-guilielmi	Pineapple Zamia	E	E
Pterostylis chaetophora	-	-	E
Samadera bidwillii	Quassia	V	V
Xanthostemon oppositifolius	Southern Penda	V	V

4.1.1.1 Flying-foxes

There are three (3) species of megabats (flying-foxes) known to occur in the region.

1. Grey-headed flying-fox (GHFF) (*Pteropus poliocephalus*) – (EPBC Act – Vulnerable, NC Act – Least Concern)
2. Little red flying-fox (LRFF) (*Pteropus scapulatus*) – (EPBC Act – Not Listed, NC Act - Least Concern
3. Black flying-fox (BFF) (*Pteropus alecto*) – (EPBC Act – Not Listed, NC Act – Least Concern)

Flying-fox camps are sometimes mixed with GHFF and LRFF, and more often with GHFF and BFF with numbers and presence varying over time due to the nomadic nature of flying-foxes and food availability.

4.1.1.1.1 Grey-headed Flying-fox

There are seven (7) GHFF camps within 50km of the WTA that have been occupied by GHFF within the past 2 years.

1. Glenwood Varley Road (53)
2. Maaroom, Esplanade (209)
3. Goomboorian, Anderleigh Rd Ginger Creek (55)
4. Maryborough, Kent Street (88)
5. Maryborough, Albion Rd Wetlands (Island Plantation) (87)
6. Gympie (53)
7. Woocoo (171)

The definition of a Nationally Important GHFF Camp is defined for the management of GHFF and Spectacled Flying-fox camps, specifically relating to *in-situ* camp management. Camps that have contained ≥ 10,000 GHFF in more than one year in the last 10 years, or have been occupied by more than 2,500 GHFF permanently or seasonally every year for the last 10 years (*EPBC Policy Statement, September 2015*).

As such, the closest Nationally Important GHFF camps are Maaroom, Glenwood Varley Road, Gympie and Woocoo, which are 4km, 14km, 30km and 40km away from the nearest turbine location, respectively (refer Appendix A, Figure 7).

Additional flying-fox camps are shown on Figure 7, Appendix A. These camps have either been surveyed and no flying-foxes were found (as per the NFFMP), or are considered inactive and/or have not had any flying-fox activity for seven (7) years or more.

Table 8 provides a summary of the latest GHFF camps/counts (DoEE, NFFMP).

Table 8 Grey-headed flying-fox Camps within 50km of the WTA

Camp Name/ ID	Distance from turbines (km)		Counts/Category	Date of survey activity	Notes
	Minimum	Maximum			
Glenwood Varley Road (53)	16km	39km	16,000 – 49,000 (category 5)	August 2018	≥ 10,000 GHFF 3 times in the last 10 years (2012, 2015, 2018)
Maaroom, Esplanade (209)	4km	42km	500 – 2,499 (category 2)	May 2018	≥ 10,000 GHFF twice in the last 10 years (2015, 2017)
Goomboorian, Anderleigh Rd Ginger Creek (55)	9km	49km	2,500 – 9,999 (category 3)	August 2018	
Maryborough, Kent Street (88)	12km	51km	1-499 (category 1)	May 2018	No GHFF in November 2018

Camp Name/ ID	Distance from turbines (km)		Counts/Category	Date of survey activity	Notes
	Minimum	Maximum			
Maryborough, Albion Rd Wetlands (Island Plantation) (87)	14km	55km	10,000 – 15,999 (category 4)	May 2017	
Gympie (59)	30km	66km	500-2,499 (category 2)	February 2018	Nationally Important GHFF Colony
Woocoo (171)	40km	65km	>50,000 (category 6)	November 2018	Nationally Important GHFF Colony. Located in Woocoo National Park

4.1.1.1.2 Black Flying-fox

The black flying-fox is Least Concern under the NC Act and not listed under the EPBC Act. The black flying-fox is a migratory species that roosts in large numbers high in the tree canopy during the day. Females become pregnant before the bats disperse into generally smaller camps for the winter. They re-congregate into large camps during spring and summer, when birthing occurs (Australian museum, 2020).

Table 9 shows the black flying-fox camps within 50km. They are often mixed camps with BFF and/or GHFF and fluctuate over time. The Gympie camp has historically (since 2012) had the most numbers of BFF of the camps within 50km of the WTA. Black flying-foxes have a general home range of 15 – 30km, however can travel over 50km from their camp to a feeding area (Australian museum, 2020). The largest BFF camp in the area is 30km from the nearest point of the WTA boundary and therefore is at the extent of its general home range when dispersing to feed. Dispersal between camps in the area is unknown and will depend on food availability.

Table 9 provides a summary of the latest BFF camps/counts (DoEE, NFFMP).

Table 9 Black Flying-fox Camps within 50km of the WTA

Camp Name/ ID	Distance from turbines (km)		Counts/Category	Date of survey activity	Notes
	Minimum	Maximum			
Maryborough, Kent Street (88)	12km	51km	2,500-9,999 (category 3)	November 2018	Sometimes mixed camp with GHFF and LRFF
Maaroom, Esplanade (209)	4km	42km	10,000 – 16,000 (category 4) 2,500 – 10,000 (category 3)	May 2017 May 2018	No BFF since May 2018 census.
Gympie (59)	30km	66km	2,500-9,999 (category 3)	November 2018	Was cat 5 in Aug 2017 and Feb 2018

Camp Name/ ID	Distance from turbines (km)		Counts/Category	Date of survey activity	Notes
	Minimum	Maximum			
					(16,000 – 49,999). Often mix camp with GHFF

4.1.1.1.3 Little Red Flying-fox

Table 10 shows the little red flying-fox camps within 50km. They are often mixed camps with BFF and/or GHFF and fluctuate over time. Camps in Gayndah, Hervey Bay and Noosaville seasonally have category 6 (>50,000) camps although these also fluctuate over the years. All 3 camps are greater than 50km from the WTA. Dispersal between camps in the area is unknown and will depend on food availability.

Table 10 provides a summary of the latest LRFF camps/counts (DoEE, NFFMP).

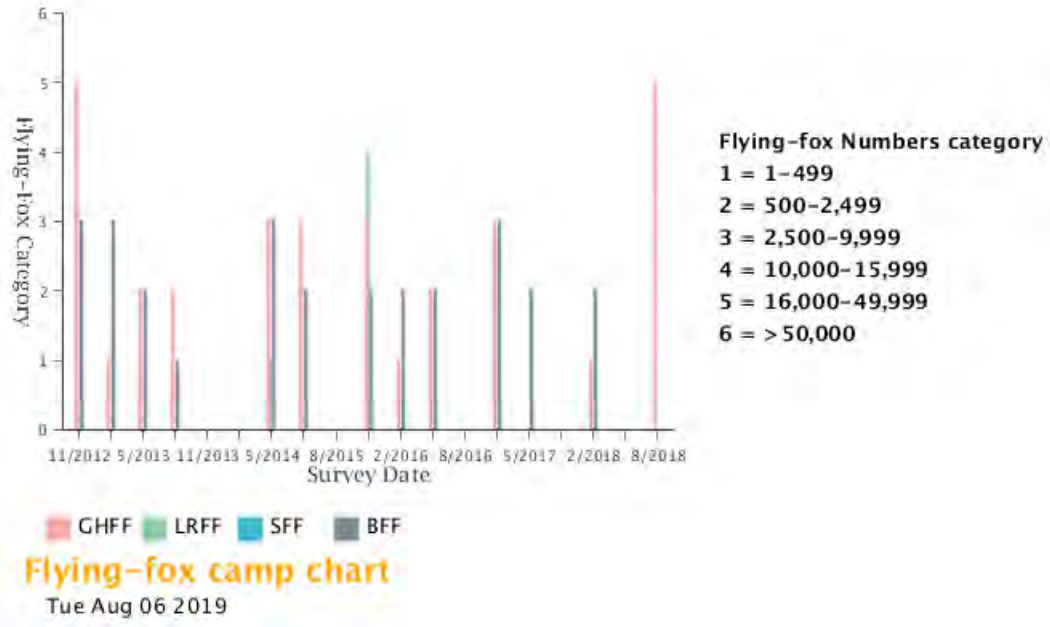
Table 10 Little Red Flying-fox Camps within 50km of the WTA

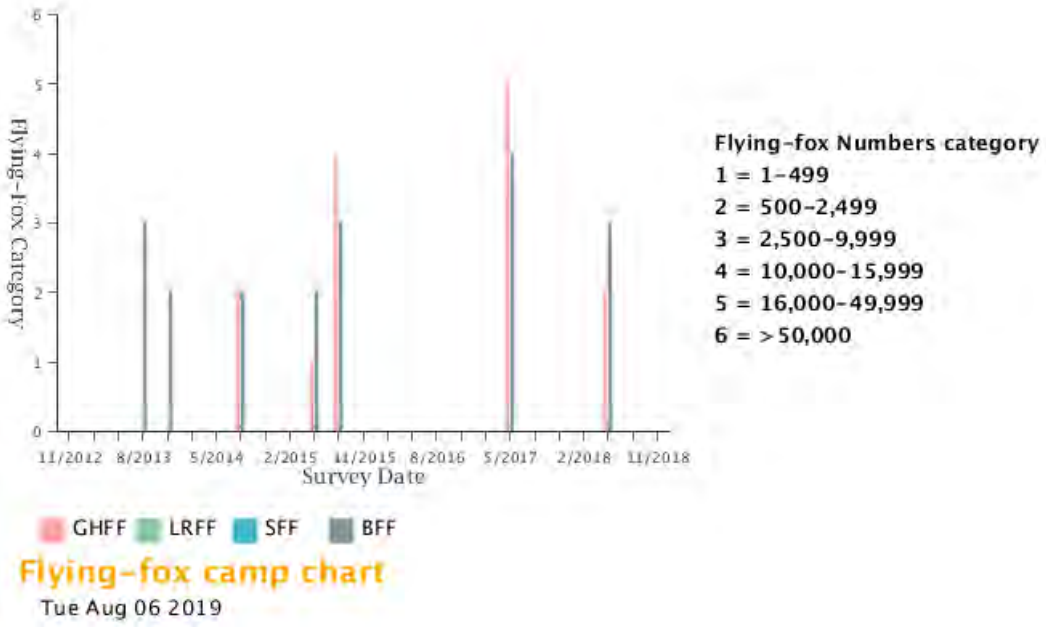
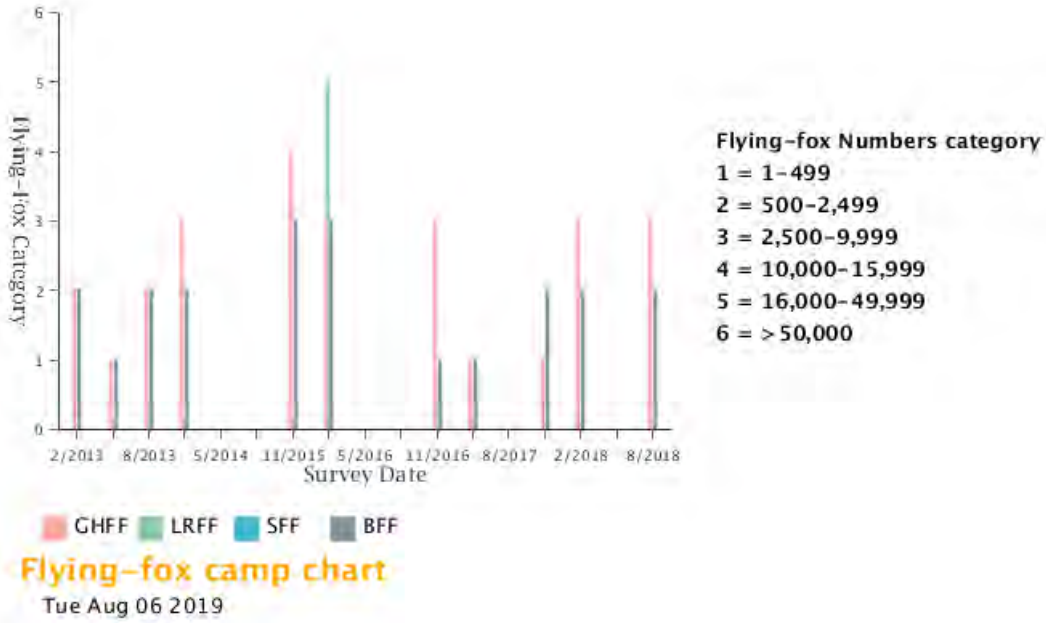
Camp Name/ ID	Distance from turbines (km)		Counts/Category	Date of survey activity	Notes
	Minimum	Maximum			
Glenwood Varley Road (53)	16km	39km	10,000 – 16,000 (category 4)	November 2015	2015 is only active presence between 2012 and 2018
Goomboorian, Anderleigh Rd Ginger Creek (55)	9km	49km	16,000 – 49,999 (category 5)	February 2016	No LRFF present in camp since 2015 census.
Gympie (59)	30km	66km	16,000 – 49,999 (category 5)	February 2016	No LRFF present in camp since 2016 census. Was Cat 6 (>50,000) in Feb 2013.
Maryborough, Kent Street (88)	12km	51km	500-2,499 (category 2) 10,000 – 16,000 (category 4)	February 2018 February 2019	No LRFF in Nov 2018 census. Active LRFF presence in camp x4 since 2012.

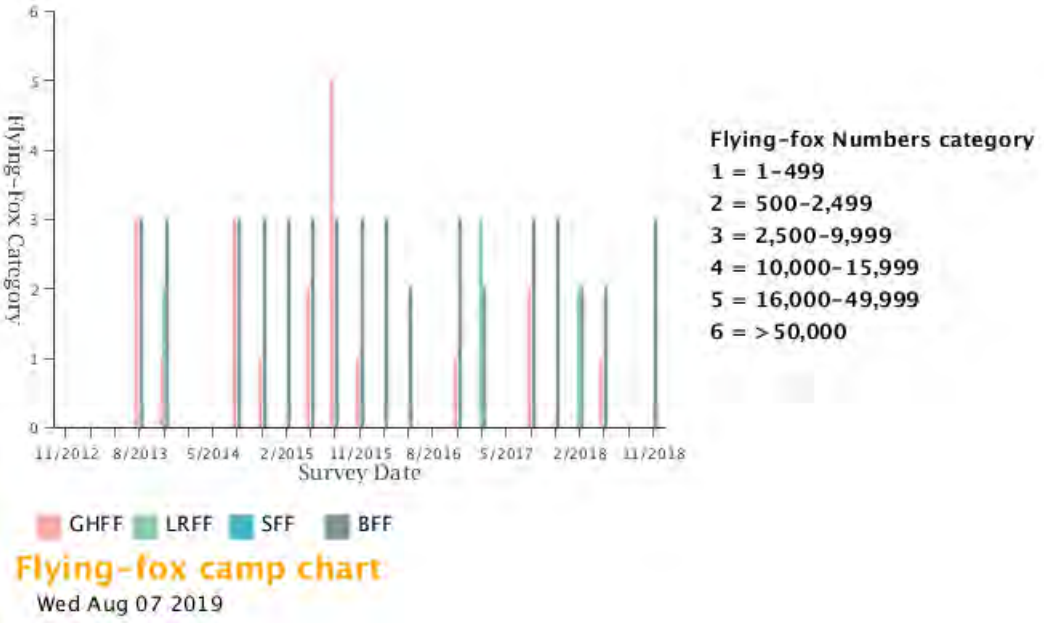
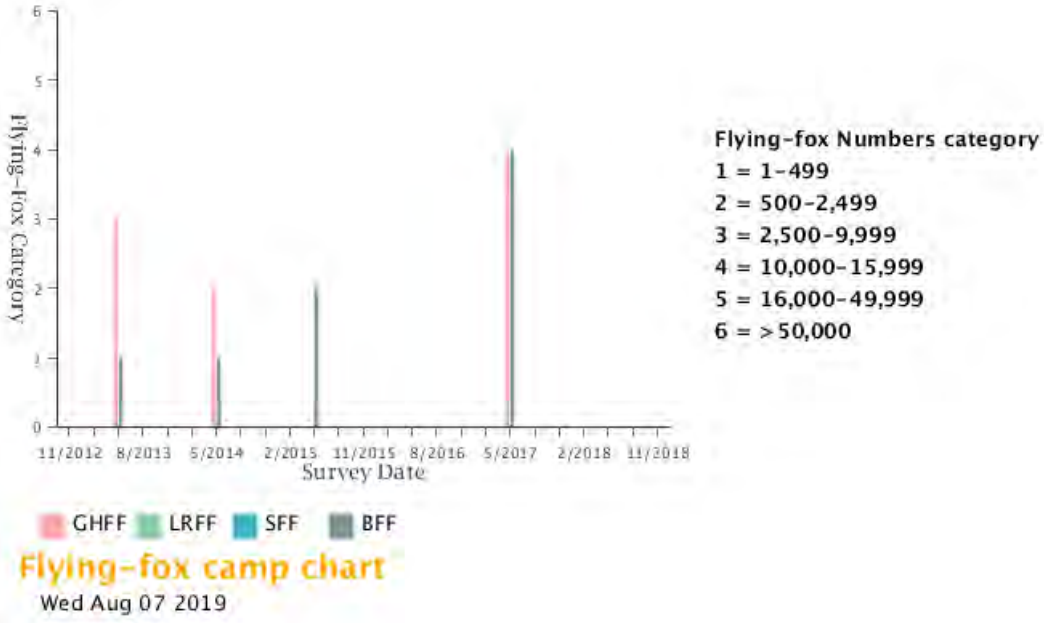
Camp Name/ ID	Distance from turbines (km)		Counts/Category	Date of survey activity	Notes
	Minimum	Maximum			
					Cat 3 (Feb 2017) Cat 2 (Nov 2013) Cat 4 (Feb 2019) Was Cat 6 (>50,000) in Feb 2013.

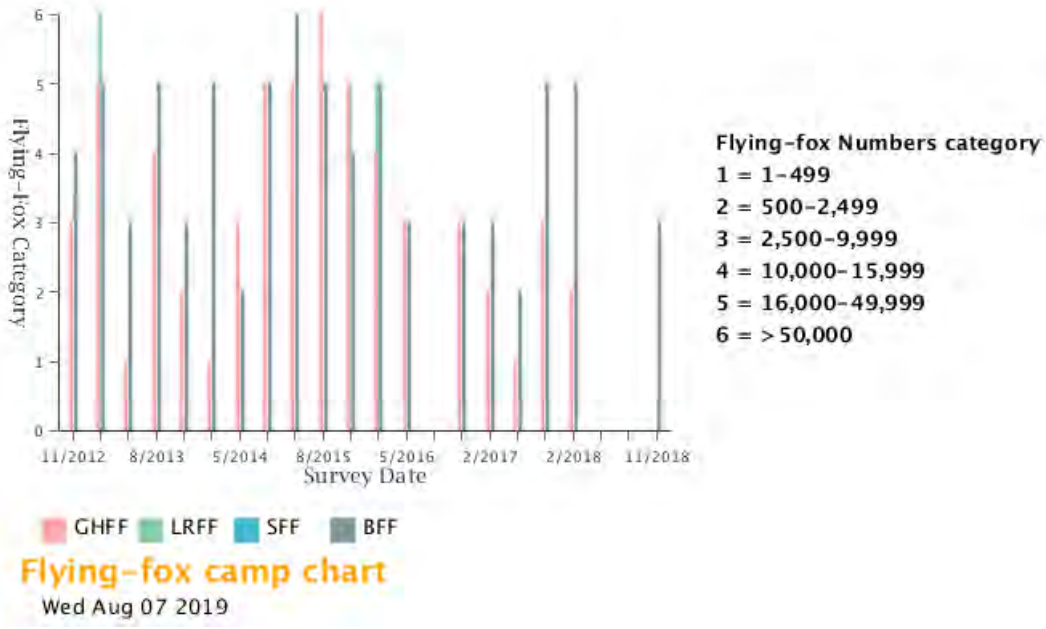
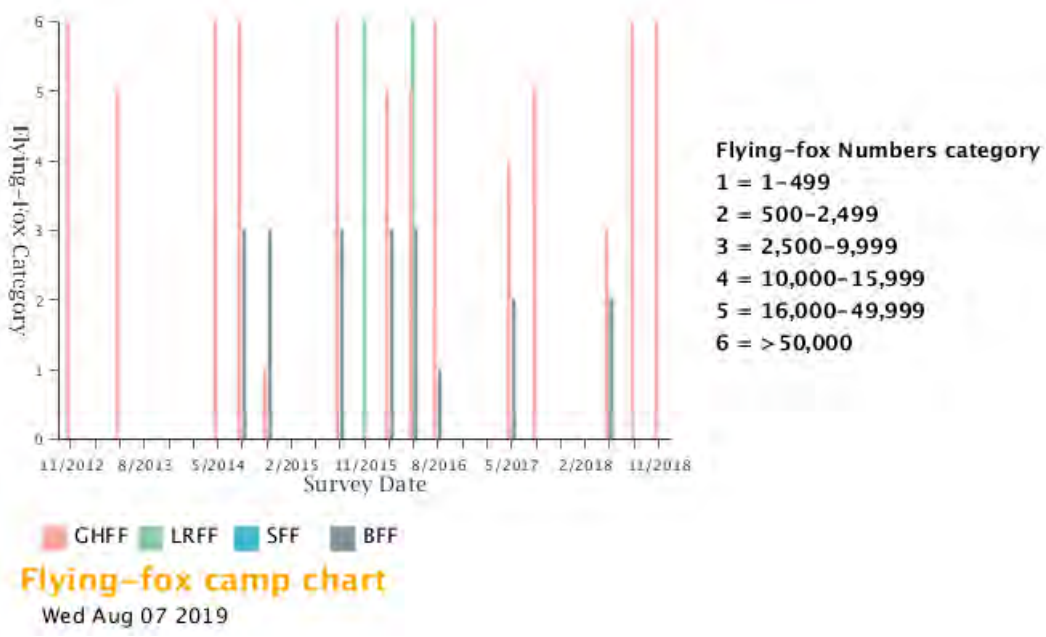
Table 11 shows the camp utilising rates of GHFF, BFF and LRFF since 2012, demonstrating the fluctuation in camp utilisation over time.

Table 11 Flying-fox Camp Utilisation (2012-2019)

Camp Details	Utilisation Rates
The Glenwood Varley Rd camp (53) is generally a mix of GHFF and BFF. As of August 2018, the camp had the highest number of GHFF recorded (category 5). Prior to 2018, the camp was generally between a category 1 and category 3.	

Camp Details	Utilisation Rates
Maaroom (209). A mix of GHFF and BFF. This camp was a category 2 in May 2018. This camp was surveyed by Premise on 7 December 2016 and was inactive. It was active the following year in 2017 as a category 5 camp and is now a category 2 camp.	
Anderleigh Rd (55) A mix of GHFF and BFF. This camp was surveyed by Premise in December 2016 and was an active category 3 camp. It was surveyed again by Premise in October 2018 and was an active category 3 camp. Inactive since bridge upgrades (March 2019) may have caused some disturbance to the camp.	

Camp Details	Utilisation Rates
Maryborough, Kent Street (88). The camp currently consistists of BFF. It was a Category 1 GHFF camp in May 2018 and prior to that fluctuated generally between a Category 1 and Category 3 GHFF camp. It was a Cateogry 5 GHFF in August 2015.	
Maryborough, Albion Rd Wetlands (Island Plantation) (87). Category 4 GHFF in May 2017. The camp is a mix of GHFF and BFF at approximately the same ratio in numbers.	

Camp Details	Utilisation Rates
Gympie (53) (Nationally Important GHFF Colony). It was a category 5 and 6 GHFF colony between August 2014 and November 2015. This colony has declined in GHFF numbers since 2016. It is a mix of GHFF and BFF. It has been a category 3 or less since May 2016.	
Woocoo (171) (Nationally Important GHFF Colony) Situated in Woocoo National Park. This camp has generally been a category 6 camp since 2012 (decrease in GHFF numbers in 2017). It has historically been a mix of GHFF, LRFF and BFF.	

4.1.2 Regional Ecosystems

There is a network of remnant RE throughout the WTA. Often it is associated with creek and drainage lines which historical and ongoing pine plantation practices have avoided. This has created a network of often disconnected remnant vegetation patches throughout the pine plantation. Within these areas twenty-seven (27) REs are mapped on DES RE mapping (Table 12). Most are in heterogenous polygons as per Table 13.
DES RE mapping is shown on Figure 8, Appendix A.

Table 12 Mapped RE within the WTA

RE	Description	VM Act Status	Biodiversity Status
12.2.11	*Corymbia tessellaris* +/- *Eucalyptus tereticornis, C. intermedia* and *Livistona decora* woodland on beach ridges in northern half of bioregion	LC	NC
12.3.4	*Melaleuca quinquenervia, Eucalyptus robusta* woodland on coastal alluvium	OC	OC
12.3.5	*Melaleuca quinquenervia* open forest on coastal alluvium	LC	NC
12.3.6	*Melaleuca quinquenervia* +/- *Eucalyptus tereticornis, Lophostemon suaveolens, Corymbia intermedia* open forest on coastal alluvial plains	LC	NC
12.3.7	*Eucalyptus tereticornis, Casuarina cunninghamiana* subsp. *cunninghamiana* +/- Melaleuca spp. fringing woodland	LC	OC
12.3.11	*Eucalyptus tereticornis* +/- *Eucalyptus siderophloia, Corymbia intermedia* open forest on alluvial plains usually near coast	OC	OC
12.3.12	*Eucalyptus latisinensis* or *E. exserta, Melaleuca viridiflora var. viridiflora* woodland on alluvial plains	LC	NC
12.3.13	Closed or wet heathland. Characteristic species include *Melaleuca thymifolia, Banksia robur, Xanthorrhoea fulva, Hakea actites, Leptospermum spp.* and *Baeckea frutescens.* Occurs on seasonally waterlogged Quaternary alluvial plains along coastal lowlands.	LC	NC
12.3.14	*Banksia aemula* low woodland on alluvial plains usually near coast	OC	OC
12.3.16	Complex notophyll to microphyll vine forest on alluvial plains	E	E
12.3.17	Simple notophyll fringing forest usually dominated by Waterhousea floribunda	OC	E
12.5.1	Open forest complex with *Corymbia citriodora subsp. variegata* on subcoastal remnant Tertiary surfaces. Usually deep red soils	LC	NC
12.5.4	*Eucalyptus latisinensis* +/- *Corymbia intermedia, C. trachyphloia* subsp. *trachyphloia, Angophora leiocarpa, Eucalyptus exserta* woodland on complex of remnant Tertiary surfaces and Cainozoic and Mesozoic sediments	LC	NC

RE	Description	VM Act Status	Biodiversity Status
12.5.6c	*Eucalyptus pilularis open forest +/- E. siderophloia, E. propinqua, Corymbia intermedia, E. microcorys, E. acmenoides, E. tereticornis, E. biturbinata, Lophostemon confertus* with *E. saligna, E. montivaga* at higher altitudes. Occurs on remnant Tertiary surfaces. Usually deep red soils	E	E
12.5.7	*Corymbia citriodora* subsp. *variegata +/- Eucalyptus portuensis* or *E. acmenoides, E. fibrosa subsp. fibrosa* open forest on remnant Tertiary surfaces. Usually deep red soils	LC	NC
12.5.9	Sedgeland to heathland in low lying areas on complex of remnant Tertiary surface and Tertiary sedimentary rocks	OC	OC
12.5.10	*Eucalyptus latisinensis* and/or *Banksia aemula* low open woodland on complex of remnant Tertiary surface and Tertiary sedimentary rocks	LC	NC
12.5.12	*Eucalyptus racemosa* subsp. *racemosa, E. latisinensis +/- Corymbia gummifera, C. intermedia, E. bancroftii* woodland with heathy understorey on remnant Tertiary surfaces	OC	OC
12.9-10.4	*Eucalyptus racemosa subsp. racemosa* woodland on sedimentary rocks	LC	OC
12.9-10.3	*Eucalyptus moluccana* open forest on sedimentary rocks	OC	OC
12.9-10.17b	*Eucalyptus acmenoides, E. major, E. siderophloia +/- Corymbia citriodora* subsp. *variegata* open fores on sedimentary rocks. (b) C*orymbia citriodora subsp. variegata* mixed open forest to woodland. Other commonly occurring canopy trees include *Eucalyptus acmenoides, Angophora leiocarpa, E. siderophloia, E. carnea, E. longirostrata and C. intermedia*. Other species that may be present locally include *Eucalyptus tereticornis, E. crebra, E. fibrosa subsp. fibrosa and E. exserta. Lophostemon confertus* (tree form and whipstick form) often present in gullies and as a sub-canopy or understorey tree. Mixed understorey of grasses and shrubs. Hills and ranges of Cainozoic and Mesozoic sediments usually with > 1000mm rainfall per annum	LC	NC
12.11.5	*Corymbia citriodora* subsp. *variegata* woodland to open forest +/- *Eucalyptus siderophloia/E. crebra, E. carnea, E. acmenoides, E. propinqua* on metamorphics +/- interbedded volcanics	LC	NC
12.12.5	*Corymbia citriodora* subsp. *variegata, Eucalyptus crebra* woodland on Mesozoic to Proterozoic igneous rocks	LC	NC
12.12.7	*Eucalyptus crebra* woodland on Mesozoic to Proterozoic igneous rocks	LC	NC
12.12.12	*Eucalyptus tereticornis, Corymbia intermedia, E. crebra +/- Lophostemon suaveolens*	OC	OC

RE	Description	VM Act Status	Biodiversity Status
	woodland on Mesozoic to Proterozoic igneous rocks		
12.12.15b	*Lophostemon confertus* open forest +/- *Eucalyptus microcorys, E. siderophloia, E. carnea, E. propinqua* and vine forest species often present in understorey. Occurs in gullies and exposed ridges on Mesozoic to Proterozoic igneous rocks often amongst vine forest	LC	NC
12.12.16	Notophyll vine forest on Mesozoic to Proterozoic igneous rocks	LC	NC
non-rem	Non-remnant areas such as pine plantations	n/a	n/a

OC = Of Concern, LC = Least Concern, NC = No Concern at Present, E = Endangered

Most REs are avoided on the WTA due to specific site selection of the wind turbines and associated infrastructure. There will be no clearing of RE for construction of the wind turbines or hardstand areas as they are all located within pine plantation areas. Clearing in riparian areas is expected to be negligible during upgrades of existing waterway crossings. A portion of the OTC runs through the centre of the WTA and through the REs listed in Table 13 below. The below areas are a worst case scenario and most RE will be avoided by spanning as much as reasonably practical for construction of the Transmission Line. 84% of the 60m wide OTC within the Study Area is non-remnant (pine plantation).

Table 13 RE Areas within 60m Wide OTC within Study Area

RE	RE Ratio	VM Act Status	Area m^2
12.3.11	100	O	40,148
12.3.11/12.3.14	80/20	O/O	450
12.3.11/12.3.16	95/5	O/E	24,618[1]
12.3.12	100	L	61,861
12.3.5/12.3.14/12.3.12	40/40/20	L/O/L	33,098
12.3.5/12.3.14/12.3.12	80/10/10	L/O/L	10,791
12.5.10/12.3.14/12.3.5	60/20/20	L/O/L	15,582
12.5.12	100	O	2,496
12.5.12/12.5.10	80/20	O/L	5,405
12.5.12/12.5.10	95/5	O/L	11,606
12.5.12/12.5.4	80/20	O/L	10,599
12.5.4/12.5.12	60/40	L/O	6,031
12.5.4/12.5.12/12.5.4a	60/40	L/O	4,346
12.9-10.17b/12.9-10.3	80/20	L/O	61,943
12.9-10.4	100	L	59,830
non-rem	100	-	1,851,716

O-dom = Of Concern (Dominant), O-subdom = Of Concern (Subdominant), LC = Least Concern
Assumes a 60m wide OTC for the Transmission Line.
[1] No clearing of endangered RE will occur (refer Section 4.1.3 below).

4.1.3 Threatened Ecological Communities

Vegetation along Tinana Creek (shown on Figure 8, *Premise, 2017*)(Appendix F) has been identified as the one (1) location within the Study Area with Lowland Rainforest of Subtropical Australia identified as 'likely to occur' by the DoEE mapping (Ecological communities of National environmental significance TEC (Nov 2016), DOE).

RE 12.3.6 is mapped along Tinana Creek and can be representative of the Threatened Ecological Community (TEC) listed under the EPBC Act – Lowland Rainforest of Subtropical Australia, where the requirements of the RE description, key diagnostic characteristics and condition thresholds are met.

The Transmission Line is proposed to span this area avoiding any disturbance.

4.1.4 Essential Habitat

Areas of EH for Wallum froglet (*Crinia tinnula*) and Wallum rocketfrog (*Litoria freycineti*) which are listed as vulnerable under the NC Act, are mapped within remnant vegetation in the Study Area. Areas of EH for koala (*Phascolarctos cinereus*) which is listed as vulnerable under the EPBC Act and NC Act, are mapped within remnant vegetation, including riparian areas in the NSF portion of the Study Area. EH for *Macrozamia pauli-guilielmi* (Pineapple Zamia) is also mapped in the NSF portion of the Study Area associated with the remnant eucalypt forests (Figure 9, Appendix A).
No turbines, operations/construction compounds or access tracks are within mapped EH. The OTC where it passes through the WTA passes over some mapped EH. These areas are proposed to be avoided.

4.1.5 Protected Plants Flora Survey Trigger Map

Some portions of the OTC within the WTA are within mapped protected plant 'flora survey trigger' areas (Figure 10, Appendix A). These mapped areas identify 'high-risk areas' where endangered, vulnerable or near threatened plants (EVNT) are present or are likely to be present. Any infrastructure within a mapped 'flora survey trigger' area will be surveyed in accordance with the Flora Survey Guidelines – Protected Plants v2.01 (Wildlife and Threatened Species Operations, Department of Environment and Science (DES) 31 May 2019).

4.2 Field Survey Results

The WTA is dominated by exotic pine plantation. Remnant Eucalypt woodland and Melaleuca forest occurs throughout the plantation as a mosaic of small remnant patches. Often these are associated with waterways and drainage lines and can easily be seen on the RE mapping (refer Figure 8, Appendix A).

Table 14 describes the habitats that occur within the WTA. The remnant areas of intact vegetation provide a range of habitats that may support a diversity of fauna species. The pine plantations, whilst considered lower value than the remnant areas also offer habitat for fauna and flora species.

Table 14 WTA Habitats

Plate 1 Pine Plantations

The pine plantations are highly modified environments and are considered low value habitat compared to the remnant vegetation remaining within the WTA.

Although the pine plantations are actively managed by the commercial forestry operations (eg. slashing and herbicide treatment between rows), they provide habitat for a range of flora and fauna species. Microbats were recorded at all pine forest sites regardless of production stage, as they feed on insects within the plantation. None of the microbat species recorded utilising the pine for foraging are listed species under the NC Act or EPBC Act. Rows of mature pine would also offer good "fly-ways" for microbat species. Whilst they are suitable for microbat foraging they are not considered suitable for roosting given the absence of hollows and other structure. Least concern species such as Eastern bearded dragons (*Pogona barbata)* and small insectivorous birds (eg. red-backed fairy wrens) were observed within the pine plantations.

Plate 2 Pine Plantations

The pine plantations are highly modified environments and are considered low value habitat compared to the remnant vegetation remaining within the WTA. Some of the mature pine forests contain thick weedy undergrowth although this is managed by existing operations. Some mature pine forests have sparse undergrowth where the weeds and regrowth have been cleared and treated (refer Plate 3).

Plate 3 Pine Plantations

The pine plantations are highly modified environments and are considered low value habitat compared to the remnant vegetation remaining within the WTA. Most mature pine forests have sparse undergrowth where the weeds and regrowth have been cleared and treated. Weeds are often less in these areas due to shading out (other than lantana which is treated)

Plate 4 Pine Plantations

Semi-mature pine that has undergone routine management of weeds and woody species.

Plate 5 Melaleuca forest

Melaleuca forest habitat values include:

- Melaleuca trees and shrubs provide food for nectar eaters and supports prey (invertebrates and small vertebrates) for small mammals, birds and reptiles
- Provide shelter and protected areas for breeding for a variety of fauna, including live vegetation and fallen woody debris
- Potential habitat for wallum froglet (*Crinia tinnula*) and other acid frog species
- *Tenuibranchiurus glypticus* (Swamp crayfish) (NC Act – E) was recorded in a small pool in this location.
- Will not be cleared for construction of the wind turbines.
- Roadside drains in pine plantations adjacent to these low-lying areas may potentially provide habitat for acid frog species such as *Crinia tinnula*.

Plate 6 *Eucalyptus racemosa, Eucalyptus latisinensis* and woodland

Woodland habitat values include:

- Woodland trees and shrubs provide food for nectar eaters and supports prey (invertebrates and small vertebrates) for small mammals, birds and reptiles
- Provide shelter and protected areas for breeding for a variety of fauna, including live vegetation and fallen woody debris
- Woodlands with HBTs are of critical importance for hollow-dependent animals (e.g. parrots, microbats)
- Will not be cleared for construction of the wind turbines.

Plate 7 ***Permanent waterways (Poona Creek)***

Some creeks remain within the pine plantation with narrow riparian areas. They provide habitat for.

- Aquatic flora and fauna species
- Amphibians
- Water source for fauna including microbats
- Wind farm infrastructure avoids these creeks
- Will not be cleared for construction of the wind turbines
- Possible trimming of vegetation may be required to upgrade some existing waterway crossings although this would be assessed on a case by case basis during detailed engineering design.

Plate 8 ***Narrow degraded ephemeral waterways***

Some creeks and drainage lines are degraded with:

- little to no riparian vegetation
- erosion and sedimentation of waterway
- weeds
- disturbance by wild horses
- These cleared low-lying areas adjacent to remnant pockets of wallum habitat may potentially provide suitable habitat for acid frog species such as *Crinia tinnula*.

Plate 9 Remnant eucalypt woodland in NSF portion of Study Area

Woodland habitat values on Lot 1419FTY1697 (NSF) include:

- Woodland trees and shrubs provide food for nectar eaters and supports prey (invertebrates and small vertebrates) for small mammals, birds and reptiles
- Provide shelter and protected areas for breeding for a variety of fauna, including live vegetation and fallen woody debris
- Although selectively logged, the eucalypt woodlands still contain HBTs which are important for hollow-dependent animals (e.g. parrots, microbats, gliders)
- Grey-headed flying-foxes were observed feeding on the flowering eucalypts within the NSF (June 2019)
- This area provides potential habitat for Pineapple Zamia.

Plate 10 Ephemeral waterways in NSF portion of Study Area

Some ephemeral waterways are present:

- Some pools may persist longer in the landscape and provide important water sources for fauna and breeding habitat for amphibians (eg. tusked frog)
- Lantana was common on the waterways on Lot 1419FTY1697 (NSF)
- Disturbance by pigs was observed in some areas

4.2.1.1 Flora and Vegetation

Field surveys identified *Macrozamia pauli-guilielmi* (Pineapple Zamia) which is endangered under the EPBC Act and NC Act. Plants were identified growing in remnant RE patches, while some were also recorded in the pine plantations. All plants were found within 10m of road edges. Refer to Figure 2 for locations of Pineapple Zamia currently identified. No other threatened flora was recorded during vegetation surveys.

An unidentified orchid was recorded in a remnant patch of *Melaleuca quinquenervia* woodland within the WTA during initial vegetation and flora surveys. It was not in flower and identification could not be verified at the time. The orchid was flowering during a brief subsequent site inspection in January 2020 and was identified as *Geodorum densiflorum* (shepherd's crook orchid). It is a Least Concern native species.

As previously discussed, wind farm infrastructure largely avoids the clearing of remnant vegetation. Nonetheless, vegetation surveys confirmed the DES RE mapping. The pine plantations are actively managed and undergo regular slashing between rows and herbicide treatment. As the management area of pine plantation is expansive, some pine plantation areas have more regrowth and weeds than others. Clearing plantation pine for Project infrastructure will also result in clearing some native regrowth species growing amongst the pine. All areas will be ground-truthed prior to clearing to ensure EVNT flora species that are tolerant to disturbance (eg. *Acacia attenuata*) are not within the area of impact. Species such as *A. attenuata* have been found in disturbed areas such as roadsides subject to vegetation control (outside of the WTA). As such, it is possible this species may occur in low-lying areas within the WTA, yet outside of remnant areas. The Plantation Licensee undertakes plantation maintenance of woody weeds every 3 – 4 years using machines and/or prescribed burning and eventually (year 27) clear fells the compartment. Nonetheless, as they are known to occur in disturbed roadside areas, it is possible *A. attenuata* may be present in the low-lying non-remnant plantation areas.

Refer to Figure 2 for vegetation survey locations, Pineapple Zamia and orchid locations and Appendix B for quaternary vegetation assessment results. Refer to Appendix D for likelihood of occurrence of EVNT flora species.

4.2.1.1.1 Weeds

Twenty-one weed species were recorded across the WTA during surveys. Two (2) are declared plants (lantana (*Lantana camara)* and groundsel bush (*Baccharis halimifolia*)) under Qld's *Biosecurity Act 2014*. Refer to Appendix B for a list of weeds recorded.

4.2.1.2 Terrestrial Fauna (nonavian)

The field surveys recorded 91 fauna species, including 64 bird species (refer Section 4.2.1.4), 8 mammal, 6 amphibian, 5 reptiles, 4 fish and 3 freshwater crustaceans.

Crinia tinnula (Wallum froglet) which are listed as vulnerable under the NC Act, were heard calling within the WTA from a roadside drain beside the main access road into the Hyne Timber Mill (Maryborough – Tuan Forest Road), proximate to BUS survey location #5. The location *Crinia tinnula* were identified was outside of mapped EH and within a non-remnant area. It is possible *Crinia tinnula* and other tolerant acid frog species such as *Litoria freycineti* are present outside of the mapped EH for these species, such as roadside drains within the low-lying plantation areas (eg. Pre-clear wallum habitat).

Koala scats were recorded within the NSF portion of the Study Area (USC, 2019) (Appendix I). Habitat utilization determined from systematic surveys is considered low at approximately between 0-6%. From the age of scats found (ranged from 2-5), this suggests variability in the time frames that koalas were present. Numerous scats approximately one (1) month old were found near Mt Eaton Creek (USC, 2019).

GHFF were observed feeding in the flowering eucalypts within the NSF portion of the Study Area during nocturnal surveys in June 2019.

Koalas and GHFF were not observed in the WTA. Koalas are listed as vulnerable under the NC Act and EPBC Act. GHFF are listed as vulnerable under the EPBC Act.

No gliders were observed during nocturnal surveys. Some areas within the OTC have not been surveyed (outside of current Project Area) although they are mapped as EH for greater gliders. No other threatened terrestrial fauna species (nonavian) were observed.

The species list is provided in Appendix B.

4.2.1.3 Aquatic Fauna

One (1) threatened aquatic species was recorded (*Tenuibranchiurus glypticus*, Swamp crayfish) which is listed as endangered under Queensland's NC Act. It is not listed under the EPBC Act. Refer to Figure 5 for the location of *T. glypticus*.

Least concern aquatic species were recorded and are provided in Appendix B. No other threatened aquatic species were recorded.

4.2.1.4 Birds

Bird surveys recorded 64 bird species across the WTA. Refer to Appendix B for the bird species list. The following four (4) species of conservation significance were recorded:

1. White-throated needletail (*Hirundapus caudacutus) – V, MT, LM (EPBC Act)*
2. Fork-tailed swift (*Apus pacificus) – MT (EPBC Act)*
3. Rainbow bee-eater (*Merops ornatus) – LM (EPBC Act)*
4. Cicadabird (*Coracina tenuirostris) – LM (EPBC Act)*

No migratory shorebirds were observed within the WTA or flying over the WTA on any of the bird surveys.

Six (6) Least Concern (NC Act) raptor species (whistling kite (*Haliastur sphenurus*), spotted harrier (*Circus assimilis*), black-shouldered kite (*Elanus axillaris*), brown falcon (*Falco berigora*), Australian hobby (*Falco longipennis*) and peregrine falcon (*Falco peregrinus macropus*) were recorded on site. None of the raptors are listed species under the EPBC Act or NC Act.

One (1) large water bird (white-necked heron (*Ardea pacifica*) was observed flying over the site. White-necked herons are not listed under the EPBC Act or NC Act.

4.2.1.4.1 Species Diversity and Abundance

The most common birds observed were Torresian crows (*Corvus orru)* and noisy friarbirds (*Philemon corniculatus)*, being recorded on all surveys across the WTA. All 64 birds recorded are shown on Figure 6 with their minimum and maximum flight height observed during surveys. Some birds recorded at heights less than the RSA height have the potential to fly at or above the RSA height and are also included in the collision risk assessment. Whilst it's important to consider conservation significant species in collision risk assessment because the consequences of mortality may be more severe, it's also important to considered common (least concern) species to provide a better understanding of species at risk which is important for mitigation and continual adaptive management. Least Concern species observed and/or likely to occur (based on previous Wildnet records) are included in the collision risk assessment provided in Section 5.2.2 and Appendix G.

White-throated needletails (*Hirundapus caudacutus)* were observed in the highest numbers. This species was recorded on 9 of the 16 survey days (22 of the 139 fixed-point BUS surveys). Seven (7) of the 22 BUS surveys they were reported in numbers greater than 10 (on 4 days of the 16 survey days)

as outlined in Table 15. The first initial BUS undertaken in December 2016 identified the greatest number of individuals, with a flock of 327 reported at 50m – 100m above ground level. One other survey (18 December 2018) reported flocks greater than 100 individuals with 165 being recorded between 30m – 200m above ground level.

Table 15 White-throated Needletails Exceeding 10 Individuals

Site	Date	Number of individuals	Height (m above ground level)
1	8 December 2016	327	50-100 m
3	8 December 2016	56	20 – 150 m
19	15 March 2017	17	60 m
7	18 December 2018	165	30 – 200 m
8	18 December 2018	16	30 m
9	18 December 2018	83	50 m
7	20 February 2019	12	50 m

[1] – at a National level, an important population is 0.1% of the total population (total population estimated at least 10,000 individuals), which equates to 10 WTN (D*raft referral guideline for 14 birds listed migratory under the EPBC Act* (DoE, 2015)).

Fork-tailed swifts were recorded on 4 of the 16 survey days (15 of the 139 fixed-point BUS surveys). One (1) survey (29 November 2018) recorded up to 51 individuals at 1 site (they were recorded at most sites surveyed during that survey). Bushfires in the Wide Bay area on the 29 November 2018 (the small township of Tinnanbar was cut off by bushfires) correlated with the highest number of FTS recorded. This is consistent with their known flight behaviour. WTN were also recorded during the same survey.

Rainbow bee-eaters were recorded on 7 of the 16 survey days (10 of the 139 fixed-point BUS surveys). Two (2) cicadabirds were observed at one location in 2016. Refer Figure 17, Appendix A for locations of conservation significant bird species.

4.2.1.4.2 Flight Heights

The risk assessment for collision based impacts has considered the likelihood of occurrence, typical flight behaviour, distribution and biology. Risk categories are:

- Low Risk: low flight behavior with the species typically foraging just above the tree canopy and below it.
- Medium Risk: has the potential to fly at RSA height and suitable habitat is present in the WTA or immediately adjacent to it
- High Risk: known to regularly fly at or above RSA height, aerial insectivore foragers and suitable habitat present on or adjacent to the site

Approximately 72% (46 of the 64) of all bird species recorded during the surveys are considered low risk of collision due to their low-flight behaviour. Most birds were recorded at less than 30m above ground level as shown on Figure 6. Some of these birds possess flight behaviour that may potentially put them within the RSA and are therefore included in the collision risk assessment.

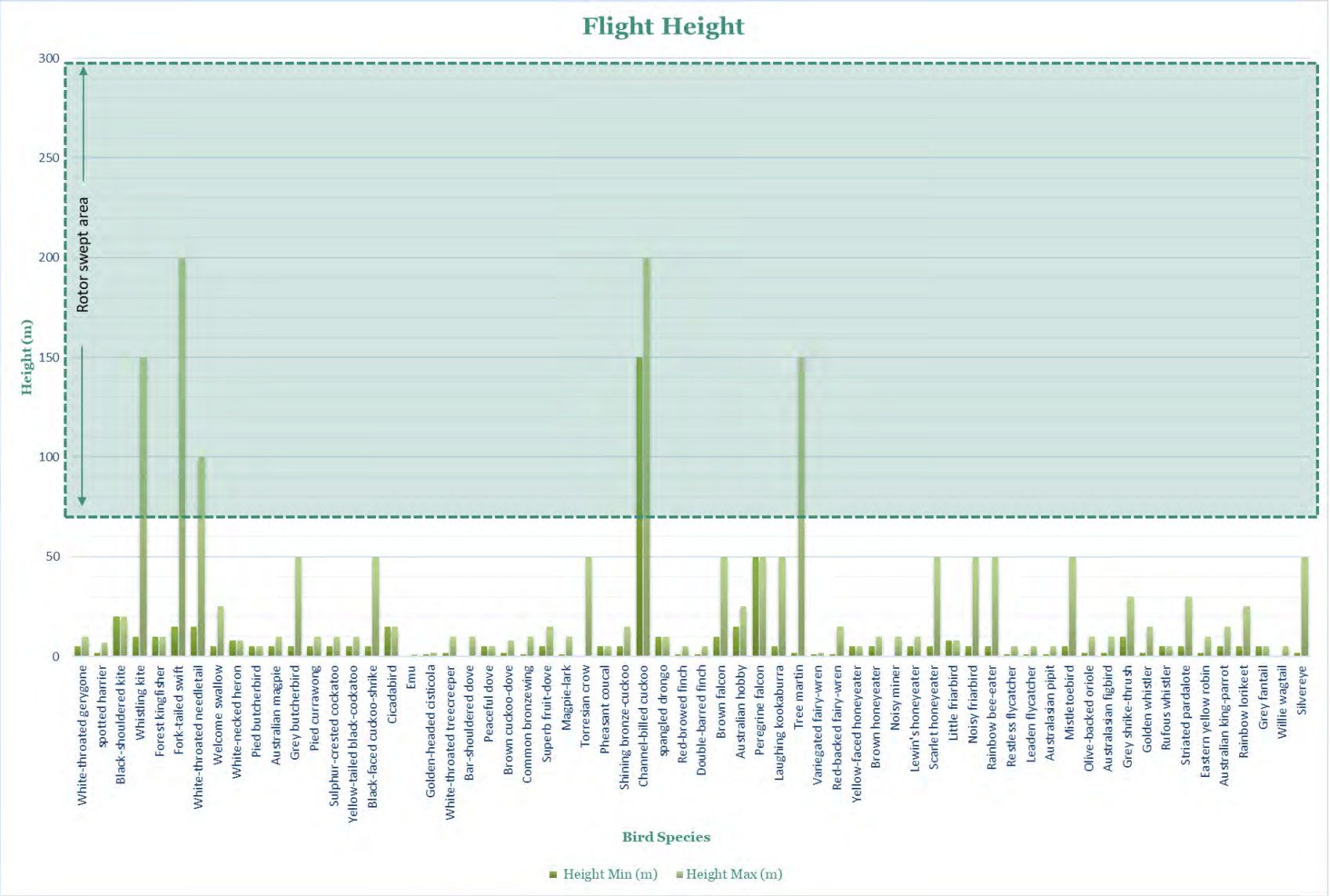


Figure 1 –Bird Flight Ranges on WTA

The following 18 birds recorded on the WTA are known to exhibit moderate to high risk flight behaviour.

1. White-throated needletail (*Hirundapus caudacutus) – V, MT, LM (EPBC Act)*
2. Fork-tailed swift (*Apus pacificus) – MT (EPBC Act)*
3. Whistling kite (*Haliastur sphenurus) – Least Concern (LC) (NC Act)*
4. Channel-billed cuckoo (*Scythrops novaehollandiae*) – *LC (NC Act)*
5. Tree martin (*Petrochelidon nigricans*) – *LC (NC Act)*
6. Spotted harrier (*Circus assimilis) – LC (NC Act)*
7. Black-shouldered kite (*Elanus axillaris) – LC (NC Act)*
8. Welcome swallow (*Hirundo neoxena) – LC (NC Act)*
9. White-necked heron (*Ardea pacifica) – LC (NC Act)*
10. Brown falcon (*Falco berigora) – LC (NC Act)*
11. Australian hobby (*Falco longipennis) – LC (NC Act)*
12. Peregrine falcon (*Falco peregrinus macropus) – LC (NC Act)*
13. Rainbow bee-eater (*Merops ornatus) –LM (EPBC Act)*
14. Cicadabird *(Coracina tenuirostris) – LM (EPBC Act)*
15. Torresian crow *(Corvus orru) – LC (NC Act)*
16. Australian magpie (*Gymnorhina tibicen) – LC (NC Act)*
17. Sulphur-crested cockatoo (*Cacatua galerita*) – *LC (NC Act)*
18. Yellow-tailed black-cockatoo (*Calyptorhynchus funereus) – LC (NC Act)*

All of the raptors are included although only whistling kite was observed flying within the RSA height. The tree martins, welcome swallows and rainbow bee-eaters were all observed below RSA height, however they have also been included as at moderate risk of impact due to being aerial insectivores and therefore influenced by atmospheric conditions and insect height. The white-necked heron was also observed below RSA height although are considered to have a moderate risk flight behaviour. Torresian crows and Australian magpies whilst observed within the WTA below 30m have been included due to their potential to fly with the RSA.

Other least concern species not recorded during surveys although have the potential to occur (based on previous Wildnet records in the WTA), with a moderate to high risk of collision include wedge tailed eagle (*Aquila audax*), Australian pelican (*Pelecanus conspicillatus*), Australian white ibis (*Threskiornis molucca*) and straw-necked ibis (*Threskiornis spinicollis*). These are also included in the risk assessment for collision based impacts in Section 5.2.2 and Appendix G.

Figure 17, Appendix A shows birds of conservation significance identified during BUS.

4.2.1.5 Bats

Up to 14 microbat species were recorded during the bat surveys. Eleven call-types were positively identified to ten unique species plus the *Nyctophilus* genus (refer Appendix C). Up to three *Nyctophilus* species potentially occur in the study area (*N. bifax, N. geoffroyi and N. gouldi),* however their calls cannot be reliably differentiated. All three (3) Nyctophilus species are least concern under the NC Act and the EPBC Act. Three other call-types were identifiable only to mixed-species groups because they had variable or intermediate pulse-characteristics. Two of those groups contained species that were otherwise reliably identified (*Chalinolobus gouldii/Ozimops ridei* and *C. nigrogriseus/Scotorepens greyii*). The third group – *Vespadelus troughtoni/Chalinolobus morio* – potentially represented two additional species that was not otherwise recorded. Where these "unresolved calls" were encountered, all members of the relevant group were listed as "probable" (refer Appendix C) unless positively identifiable calls of one or both species were also observed.

Microbat species positively identified on the WTA are listed below. All species are least concern under the NC Act and not listed under the EPBC Act.

1. Eastern horseshoe bat (*Rhinolophus megaphyllus)*
2. Gould's wattled bat (*Chalinolobus gouldii)*
3. Hoary wattled bat (*Chalinolobus nigrogriseus)*
4. *Nyctophilus sp.*
5. Little broad-nosed bat (*Scotorepens greyii)*
6. Little bent-wing bat (*Miniopterus australis)*
7. Australian bent-wing bat (*Miniopterus orianae)*
8. White-striped freetail bat (*Austronomus australis)*
9. Ride's free-tailed bat (*Ozimops ridei)*
10. Northern free-tailed bat (*Ozimops lumsdenae)*
11. Yellow-bellied sheathtail bat (*Saccolaimus flaviventris)*

Almost 95% (576) of the calls were positively identified, with 83% (504 calls) attributable to just three species: *C. nigrogriseus; O. ridei,* and *Saccolaimus flaviventris*. These three (3) species are least concern under the NC Act and EPBC Act.

No threatened microbat species were recorded. Section 5.2.2 provides a risk assessment of potential consequence of collision for all bat species identified. Refer to Appendix C for the microbat report.

4.2.1.6 Pest Species

Five (5) pest species were identified within the Study Area (*Gambusia holbrooki* (Gambusia), *Felis catus* (cat), *Rhinella marina* (cane toad), *Equus caballus* (horse (brumby)) and *Sus scrofa* (pig)). The most prevalent and noticeable were feral horses (brumbies) throughout the WTA. Disturbance caused by horses was observed in most waterways across the WTA.

4.3 Matters of State Environmental Significance

MSES within the WTA include:

- MSES wetlands, waterways and vegetation intersecting a watercourse
- Regulated vegetation (essential habitat)
- Regulated vegetation (endangered or of concern RE under the VM Act)
- Protected wildlife habitat

The Significant Residual Impact Guidelines (State of Queensland, 2014) are used to determine whether a Project will or is likely to have a Significant Residual Impact (SRI) on a MSES. Assessment frameworks for the activities to which this guideline applies have an 'avoid, mitigate, offset' obligation that requires in the first instance, avoiding impacts on prescribed environmental matters and if avoidance cannot be achieved, demonstrating that impacts have been carefully managed and minimised (mitigated). If after avoidance and mitigation, there is still an impact on prescribed environmental matters, an offset may be required where the impact is, or is likely, to be significant. If there is still an impact on the MSES after all reasonable avoidance and on-site mitigation measures for the prescribed activity have been or will be undertaken, the Significant Residual Impact Guideline (State of Queensland, 2014) is used to determine the 'significance' of the impact.

Project infrastructure has been specifically sited to avoid impacts to MSES as outlined in the sections below. Where there is a likelihood of an MSES occurring outside of an area of regulated mapping (eg. *crinia tinnula* in low-lying non-remnant areas), management measures are proposed to identify these areas during detailed design so they can be avoided, mitigated and assessed using the SRI guidelines, if required. Given that existing access tracks within the WTA are proposed to be utilised and the non-remnant pine proposed to be cleared represents less than 1% of the plantation area, and most of this is in elevated areas, the likelihood of impacts is considered low. Nonetheless, the indirect and direct impacts have been considered on these NC Act listed species that have the potential to occur outside of the non-remnant areas.

4.3.1 MSES Wetlands and Waterways

Locations of MSES wetlands and waterways, including Regulated Vegetation (intersecting a watercourse) and High Ecological Value Waters within the WTA are provided on Figures 12, 13 and 14 in Appendix A.

Mitigation measures to avoid impacts to MSES wetlands and waterways include:

- Wind turbines are not located in areas mapped as wetlands of High Ecological Significance (HES), High Ecological Value (HEV), Vegetation Management Wetlands or Regulated Vegetation (intersecting a watercourse).
- Utilise existing track network within the WTA. Track upgrades undertaken in accordance with approved project specific Environmental Management Plans (EMPs) and/or Species Management Plans (SMPs).
- Transmission Line will span mapped areas of MSES waterways and wetlands (including waterways not mapped as MSES). Access to Transmission Line towers in the WTA will be via existing forestry tracks.

4.3.2 Regulated Vegetation (Essential Habitat)

Locations of MSES Vegetation (Essential Habitat) are provided on Figure 8.

Mitigation measures to avoid impacts to MSES Essential Habitat include:

- Wind turbines are not located in areas mapped as Essential Habitat.
- Utilise existing track network within the WTA. Track upgrades undertaken in accordance with approved project specific SMPs.
- Transmission Line will span mapped areas of Essential Habitat. Access to Transmission Line towers in the WTA will be via existing forestry tracks.
- Undertake protected plant surveys in areas mapped on the protected plant flora survey trigger map, including within areas of existing pine plantation.

4.3.3 Regulated Vegetation under the VM Act

Locations of regulated vegetation under the VM Act within the WTA is provided on Figure 9.

Mitigation measures to avoid impacts to MSES regulated vegetation (remnant vegetation) include:

- Wind turbines are not located in areas mapped as remnant vegetation.
- Utilise existing track network within the WTA.
- Transmission Line will span mapped areas of regulated vegetation. Access to Transmission Line towers in the WTA will be via existing forestry tracks.

4.3.4 Protected Wildlife Habitat

Locations of threatened wildlife under the NC Act recorded within the WTA are provided on Figure 2 and 17. These include *Macrozamia pauli-guilielmi* (Pineapple Zamia), wallum froglet (*Crinia tinnula*) and swamp crayfish (*Tenuibranchiurus glypticus)*. Other NC Act listed species have previously been recorded within the WTA and are included in the Likelihood of Occurrence tables in Appendix D, with their likelihood of impact.

Mitigation measures to avoid impacts to MSES Protected Wildlife include:

- Wind turbines are not located in areas mapped as remnant vegetation which is the likely refugia habitat suitable for NC Act listed species known or likely to occur within the WTA.
- Utilise existing track network within the WTA to avoid clearing further habitat.
- Avoid waterways and riparian areas which may contain suitable habitat for NC Act protected species such as turtles, amphibians, fish and crustaceans.
- Habitat outside of remnant areas may provide suitable habitat for some frog species such as wallum froglet (*Crinia tinnula*) and wallum rocketfrog (*Litoria freycineti*) and flora species such as *Acacia attenuata*. Should preclearance surveys identify these species, then the areas would also be classified as Protected Wildlife Habitat (MSES) and a Significant Residual Impact Assessment (SRIA) may be required if avoidance measures cannot be undertaken. Any potential track upgrades, turbine locations and other ancillary infrastructure in low lying areas, including areas within pine plantations must be undertaken in accordance with an approved SMP for acid frogs.

Transmission Line will span mapped areas of remnant vegetation. Access to Transmission Line towers in the WTA will be via existing forestry tracks.

4.4 Matters of National Environmental Significance

A Significant Impact Assessment (SIA) on MNES protected under the EPBC Act, has been prepared to assess impacts on MNES (*Fox & Co Environmental (October 2019). Significant Impact Assessment Matters of National Environmental Significance, Report No. 03102019 (draft)).*

5 POTENTIAL IMPACTS

The wind turbines, meteorological masts (met masts) and operation / constructions compounds are all situated in the pine plantation and avoid remnant vegetation. Access tracks within the WTA also follow existing Forestry tracks and avoid remnant vegetation.

Approximately 36.8km of the OTC is within the WTA (within the State Forest currently operating under a Plantation Licence) and is included in the WTA assessment. Initial surveys within the NSF have been undertaken.

The construction and ongoing operation of the Project within the WTA has a low potential to impact on the nature conservation values of the area. The WTA is located within existing operational exotic pine plantations that retain small areas of fragmented remnant vegetation. The Project (i.e. project infrastructure) within the WTA avoids environmentally sensitive areas (ESA) and MSES such as remnant vegetation, essential habitat and watercourses / wetlands. There remains potential for habitat for protected species outside of the remnant areas, such as disturbance tolerant acid frog species (*crinia tinnula* (wallum froglet) and *Litoria freyceneti* (wallum rocketfrog)) and flora species such as *Acacia attenuata*. Indirect and direct impacts to these species and non-remnant habitat has been considered. Whilst the WTA is expansive, the disturbance footprint for the Project is small.

5.1Construction Phase

The construction phase of the Forest Wind project will involve construction of the wind turbines and associated infrastructure such as construction and operations compounds, substation and distribution lines.

5.1.1 Fauna

Potential impacts associated with construction of the Project that may affect fauna and fauna habitat values of the WTA are detailed below.

- Direct loss of fauna habitat and resources as a result of vegetation clearing
- Loss of connectivity (included, however is considered a 'general' construction impact, rather than a Project impact)
- Direct mortality impacts to terrestrial fauna
- Avoidance behaviour from disturbances associated with activities (e.g. impacts associated with light, dust, noise and vibration)
- Introduction of exotic weed and pest species to retained habitats

The Project infrastructure has been specifically located within exotic pine plantations and therefore the risk of potential direct and indirect impacts on least concern species, MSES and MNES fauna and fauna habitats is considered low and construction activities are not considered to pose a threat to local populations.

5.1.2 Habitat Loss

Vegetation and HBTs provide foraging habitat and roosting / nesting habitat for fauna. Hollow-bearing trees and most of the flowering vegetation (excluding regrowth and weeds within the pine plantations) are present within the remnant vegetation patches within the WTA. Infrastructure is sited away from remnant vegetation within the WTA to avoid clearing hollow-bearing trees, foraging and roosting / nesting habitat. The Transmission Line towers in the WTA can be located approximately 450m – 650m apart to span areas of remnant vegetation where necessary. Plantation pine and native vegetation regrowth within the pine forests will require clearing for the turbine tower footprints and other project construction compounds. These areas, whilst actively managed by slashing and weed management, also provide foraging and micro-habitats for fauna species, such as foraging microbat species. Less than 1% of the pine plantation area is proposed to be cleared for the Project.

5.1.3 Loss of Connectivity

Landscape fragmentation and loss of connectivity is not considered significant as the WTA consists largely of exotic pine plantations. Turbines and associated infrastructure are largely located outside of remnant vegetation and existing high value habitat.
The riparian habitats throughout the pine plantations provide the best opportunities for habitat connectivity through the plantation landscape. Clearing within riparian habitats will be avoided, other than minor trimming of vegetation for potential bridge / culvert upgrades on existing tracks/bridges. As such, there will be no loss of connectivity for least concern, MSES and MNES species.

5.1.4 Waterways and Water Quality

Least concern, MSES and MNES species may potentially occur in some waterways within the project area. Construction has the potential to impact on waterways in the local area. The activities with the highest risk of causing impacts to aquatic ecosystems / water quality include:

- Removal of topsoils from turbine locations and laydown areas and stockpiling of overburden on site resulting in sediment movement through overland flow
- Changes to water quality and quantity
- Storage of chemicals on site (e.g. hydrocarbons, detergents, degreasers, etc) during construction and operations and the movement of these to creeks
-

5.2 Operation Phase

5.2.1 Avoidance Behaviour

There is potential for least concern, MSES and MNES birds to alter their migration pathways or local flight paths to avoid wind farms which may cause displacement, also known as 'barrier effect'. It has the potential to increase energy expenditure which has potential impacts on breeding productivity and survival (visiting migratory birds to the Great Sandy Strait are here for the non-breeding season). The effect depends on several factors including type of bird (flight height and avoidance of turbines), location, layout, operational status of the wind farm, time of day, visibility, wind force and direction, topography. There are currently few (if any) examples of birds being excluded from key areas due to barrier effects, mainly because onshore wind farms are reasonably isolated from each other and suitable availability of unaffected habitat in the area or region (Gove, 2013).

The bird and bat species present occur across a wide variety of landscapes including modified and fragmented landscapes as occurs within the WTA. Whilst avoidance behaviour is difficult to predict, any avoidance behaviour displayed by the species present is unlikely to affect local and regional populations.

Although displacement is not expected due to the location of the Project, the Bird and Bat Management Plan has begun implementing a Before After Control Impact (BACI) monitoring program to monitor changes in flight behaviour of least concern and conservation significant bird and bat species

5.2.2 Collision Events

5.2.2.1 Birds

As per avoidance behavior, collision events with birds are dependent on type of bird (flight height and avoidance of turbines), location, layout, operational status of the wind farm, time of day, visibility, wind force and direction and topography. Some birds show avoidance when passing through a wind farm and others have typically low flight elevations, which reduces the likelihood of collision (Gove, 2013).

Most birds in the Study Area are small passerines and although there have been few studies on the displacement of small passerines, they are generally not considered to be particularly sensitive or

vulnerable at a population level to wind farms due to being typically short-lived with high productivity rates (Gove, 2013).

A risk assessment of potential consequence of collision has been undertaken for:

- All threatened and/or migratory birds identified in the likelihood of occurrence assessment (Refer Table 6 in Section 4.1.1 and Appendix D) – Conservation Significant Bird Risk Assessment (Table 16);
- Migratory shorebirds – Migratory Shorebird Risk Assessment (Table 17); and,
- Least concern birds considered at moderate to high risk of collision – Least Concern Bird Risk Assessment (Table 18).

The likelihood of occurrence assessment identified four (4) threatened birds, twelve (12) migratory birds and one (1) conservation significant bat species as either known to occur or having a moderate to high likelihood of occurrence (Table 6, Section 4.1.1). A further 17 least concern bird species and up to 15 least concern bat species (as there are potentially 3 *Nyctophilus* species occurring in the WTA) have also been identified as either known to occur or having a moderate to high likelihood of occurrence with a potential risk of collision. The risk assessment for collision based impacts has considered the likelihood of occurrence, typical flight behaviour, distribution and biology (such as feeding behavior). Risk categories are:

- Low Risk: low flight behavior with the species typically foraging just above the tree canopy and below it.
- Medium Risk: has the potential to fly at RSA height and suitable habitat is present in the WTA or immediately adjacent to it
- High Risk: known to regularly fly at or above RSA height, aerial insectivore foragers and suitable habitat present on or adjacent to the WTA

5.2.2.1.1 Conservation Significant Birds

Table 16 Conservation Significant Bird Risk Assessment

Species Threatened Birds	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
Threatened Birds			
White-throated Needletail *Hirundapus Caudacutus* *EPBC Act - V, MT, LM* *NC Act – SLC*	Known	Summer migrant (October – April). Occurs in high open spaces above wide range of habitats, such as oceans, ranges and headlands (Morcombe, 2003). The White-throated Needletail is widespread in eastern and south-eastern Australia (Barrett et al. 2003; Blakers et al. 1984; Higgins 1999). In eastern Australia, it is recorded in all coastal regions of Queensland and NSW, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains (DoE, 2019) There are no published estimates of the extent of occurrence of the White-throated Needletail in Australia, although the species occurs at numerous and widespread sites in eastern Australia (DoE, 2019) In Australia, the White-throated Needletail is almost exclusively aerial, from heights of	High

Species Threatened Birds	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
		less than 1 m up to more than 1000 m above the ground (DoE, 2019). They often forage in areas of updraughts, such as ridges, cliffs or sand-dunes, or in the smoke of bushfires, or in whirlwinds. They often forage along the edges of low pressure systems, which both lift their food sources and assist with their flight, and it is said that they follow these systems across Australia (DoE, 2019). Surveys demonstrated the occurrence and abundance of this species across the WTA is highly variable. The 2 survey occasions when they were recorded in flocks greater than 100 were on days associated with local bushfires or stormfronts.	
Powerful owl *Ninox strenua* *EPBC Act – not listed* *NC Act - V*	Moderate	Found in open forests and woodlands, as well as along sheltered gullies in wet forests with dense understoreys, especially along watercourses. Known to roost in sheltered groves of midstorey trees, or sometime pine plantations (Curtis et al. 2012) Mainly on the eastern side of the Great Dividing Range (Morcombe, 2003). If present, they are likely to be utilising remnant patches of native vegetation to roost (midstorey) and occasionally foraging in the logged or regenerating areas. They prey mainly on arboreal mammals (not likely in pine plantations), however are also known to prey on flying-foxes and other species such as birds. They are not likely to fly significantly above canopy height and the potential impact to this species is considered to be low.	Low
Ground Parrot *Pezoporus Wallicus wallicus* *EPBC Act – Not Listed* *NC Act - V*	Moderate	The Ground Parrot (eastern) is terrestrial. It occurs mostly in coastal heathland or sedgeland with very dense cover and a high density of the parrot's food plants. In south-east Queensland, it occurs mostly in closed, subtropical graminoid heathlands (consisting of grass-trees, with a high diversity of sedges, rushes and low shrubs), either moist or dry. Within heathlands, dry habitats are used from mid autumn to late spring, and wet habitats at other times. It is sometimes found in open Banksia woodlands with a heath understorey, in closed fernland around shallow creeks on plains, or in sedges at swamp margins (DoE, 2019) Infrequent collision based on low numbers moving through the study area and low flight behaviour.	Low

Species Threatened Birds	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
Australian painted snipe *Rostratula australis* (Syn. *Rostratula benghalensis*) *EPBC Act – E, LM, MW* *NC Act - V*	Moderate	Variety of habitats but generally requires presence of water. Inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains (Department of the Environment, 2014f). Usually remains among the cover of wetland vegetation while foraging. It feeds at night, probing the soft mud with its long bill as it walks, pecking at seeds and taking small invertebrates (Birdlife Australia) Low risk of collision due to specific habitat preferences low numbers moving through study area.	Low
Migratory Birds			
Fork-tailed Swift *Apus pacificus* *EPBC – LM, MM* *NC Act - SLC*	Known	Summer migrant (October – April). Occurs in low to very high airspace over variety of habitats including rainforest and semi-arid areas. Known to be most active in front of summer storm fronts (Morcombe, 2003). The Fork-tailed Swift is almost exclusively aerial, flying from less then 1 m to at least 300 m above ground and probably much higher (DoE, 2019). They forage along the edge of low pressure systems and for that reason are considered a precursor to unsettled weather. The low pressure system helps to lift prey, such as insects, from the ground and assists in flight (DoE, 2019) They are widespread but scattered in coastal areas from 20° S, south to Brisbane and in much of the south south-eastern region. They are more widespread west of the Great Divide, and are commonly found west of the line joining Chinchilla and Hughenden (DoE, 2019). Surveys demonstrated the occurrence and abundance of this species across the WTA is highly variable. FTS were recorded in their highest numbers (up to 51 individuals) on 29 November 2018 which was associated with severe local bushfires (same days as the WTN).	High
Rainbow bee-eater *Merops ornatus* *EPBC Act – LM* *NC Act - LC*	Known	Summer migrant (September – April) although in northern Australia they remain and breed. In recent years, they have been observed throughout the year on the Sunshine Coast (pers comment, Paul Fox). Occurs in open woodlands, semi-arid scrub, grasslands, clearing in heavier	Moderate

Species Threatened Birds	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
		forests, farmlands and coastal areas. Avoids heavy forests due to hindrance to feeding (i.e. Catching insects) (Morcombe, 2003). All birds observed during BUS surveys were foraging less than 30m above ground level. Infrequent collision based on low-flight behaviour across the pine plantation. Although observed within WTA below RSA, they are aerial insectivores and therefore considered to potentially fly within RSA.	
Cicadabird *Coracina tenuirostris* *EPBC Act – LM* *NC Act - LC*	Known	Occurs in the foliage canopy of diverse forests and woodlands as well as mangroves and paperbark swamps. A migratory visitor to south eastern Australia (Morcombe, 2003). Infrequent collision based on low numbers moving through the study area and low flight behaviour.	Low
Magpie Goose *Anseranas semipalmata* *EPBC Act – LM* *NC Act - LC*	Moderate	The species may fly at RSA height during movement inland between the coast and inland wetland habitats. None observed during surveys. Infrequent collision based on low numbers moving through the study area.	Low
Great Egret *Ardea modesta* *EPBC Act – LM, MW* *NC Act - LC*	Moderate	Widespread in Australia. Recorded in a wide range of wetland habitats including flooded pastures, dams, estuarine mudflats, mangroves and reefs and usually frequents shallow water. (Department of the Environment, 2015b; Morcombe, 2003). No records from the WTA or suitable habitat within the WTA. The species may fly at RSA height during movement inland between the coast and inland wetland habitats. None observed during surveys. Infrequent collision based on low numbers moving through the study area.	Low
Cattle egret *Ardea ibis* (Syn. *Bubulcus ibis*) *EPBC Act – LM, MW* *NC Act - LC*	Moderate	Occurs in moist pastures with tall grass, shallow open wetlands and margins and also mudflats (Morcombe, 2003). The species may fly at RSA height during movement inland between the coast and inland wetland habitats. None observed during surveys. Infrequent collision based on low numbers moving through the study area.	Low
Oriental cuckoo	Moderate	Vegetated habitats such as monsoon rainforest, wet sclerophyll forest, open woodlands and appears quite often along	Low

Species Threatened Birds	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
Cuculus optatus *EPBC Act – MT* *NC Act - SLC*		edges of forests, or ecotones between forest types. This cuckoo feeds arborealy, foraging for invertebrates on loose bark on the trunks and branches of trees, and among the foliage, including in mistletoes. It will forage from the ground, but requires shrubs or trees from which it sallies and returns to consume prey items. Infrequent collision based on low numbers moving through the study area and low flight behaviour.	
White-bellied sea-eagle *Haliaeetus leucogaster* *EPBC Act – LM* *NC Act - LC*	Moderate	Occurs in predominantly coastal areas although also occurs far inland on large pools of rivers. Mostly over islands, reefs, headlands, beaches and estuaries. Known to occur on seasonally inundated swamps, lagoons and floodplains (Morcombe, 2003). It is considered to be a common species throughout much of its range, and has an estimated global population of more than 10 000 individuals (including breeding and non-breeding adults, and immature birds). (DoE, 2019). The White-bellied Sea-Eagle generally forages over large expanses of open water; this is particularly true of birds that occur in coastal environments close to the sea-shore, where they forage over in-shore waters. However, the White-bellied Sea-Eagle will also forage over open terrestrial habitats (such as grasslands) (DoE, 2019). Breeding adult birds are generally sedentary, although they forage over large areas and are capable of undertaking long-distance movements. Home ranges occupied by the White-bellied Sea-Eagle can be up to 100 km² (DoE, 2019). Although not observed during surveys, given they are known along the Great Sandy Strait and Fraser Island and have a large home range, they may possibly fly over the site at RSA height. Infrequent collision due to low numbers moving through study area and preferred foraging habitat along the coastline.	Low
Black-faced monarch *Monarcha melanopsis*	Moderate	Found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating into the south-east during summer (Morcombe, 2003).	Low

Species Threatened Birds	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
EPBC Act – LM, MT *NC Act - SLC*		No previous records although suitable habitat maybe in the adjacent National Parks (Poona NP and Great Sandy NP). Infrequent collision based on low numbers moving through the study area and low flight behaviour.	
Spectacled Monarch *Monarcha trivirgatus (syn. Symposiachrus trivirgatus)* *EPBC Act – LM, MT* NC Act - SLC	Moderate	Resident of NE Queensland and migrates to SE Queensland. Found mainly in rainforests but also can be found in mangroves, swamps and watercourse thickets. (Morcombe, 2003). No previous records although suitable habitat maybe in the adjacent National Parks (Poona NP and Great Sandy NP). Infrequent collision based on low numbers moving through the study area and low flight behaviour.	Low
Satin Flycatcher *Myiagra cyanoleuca* *EPBC Act – MT* *NC Act - SLC*	Moderate	Satin Flycatchers are eucalypt forest and woodland inhabitants. They are particularly common in tall wet sclerophyll forest, often in gullies or along water courses. In woodlands they prefer open, grassy woodland. The diversity of occupied habitats expands during migration, with the species recorded in most wooded habitats. No previous records although suitable habitat maybe in the adjacent National Parks (Poona NP and Great Sandy NP). Infrequent collision based on low numbers moving through the study area and low flight behaviour.	Low
Rufous Fantail *Rhipidura rufifrons* EPBC Act – LM, MT NC Act - SLC	Moderate	Found in rainforest, dense wet eucalypt and monsoon forest, swamps, riverside vegetation. Found in open country on migration.(Morcombe, 2003) Infrequent collision based on low numbers moving through the study area and low flight behaviour.	Low

5.2.2.1.2 Migratory Shorebirds

Migratory shorebirds were assessed for their susceptibility to collision based impacts considering their arrival and departure from the Great Sandy Strait over the Summer months. The risk of impact is low or unlikely and is provided in Table 17 below.

The Great Sandy Strait is considered an internationally important site for seven (7) migratory species (Bamford M, Watkins D, Bancroft W, 2008). Table 17 provides an assessment of those seven (7) species, although all migratory species either known or predicted to occur were also assessed and are provided in the likelihood of occurrence table in the Appendix D.

There have been several studies on the climbing and flight speeds of coastal shorebirds when departing on long-distance migratory flights (Piersma et al. 1990 and 1997). Based on the studies,

it is understood shorebirds depart in an elongated, shallow "V" formation, termed an "echelon" in flocks of between 5 and 250 birds, with occasional observations of larger flocks. They ascend rapidly and steeply, often resulting in being lost from sight while still ascending. Estimates of climb rate vary, however larger / heavier species of shorebirds are slower to ascend (Piersma et al. 1990, 1997). Observations of flight altitude using weather radar show that during migration, shorebirds fly at between 0.5 and 6 kilometres (Piersma et al. 1990) however it is likely higher, as studies using radar from oceanic islands when the birds are in a long-flight, level pattern have reported heights ranging from 2.6km to 6 km above sea-level.

Given the absence of migratory shorebird records within and/or flying over the WTA during known Summer migratory periods over 3 Summer seasons, the known steep and rapid ascention on departure and distance of a minimum of 4km from the Great Sandy Strait, it is considered:

- migratory shorebirds present in the Great Sandy Strait during the Summer months possibly arrive or depart in a north-south direction along the coast, avoiding the WTA;
- should migratory shorebirds pass through the WTA, due to the rapid and steep rate of departure and distance of at least 4km from the Great Sandy Strait, it is unlikely shorebirds would be flying at heights low enough to be impacted by the RSA of the turbines.
- Shorebirds have specific habitat preferences and are unlikely to fly into the site.

Table 17 Migratory Shorebird Risk Assessment

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
Terek sandpiper (*Xenus cinereus)*	Unlikely in the WTA. Known to occur in the Great Sandy Strait as a Summer migrant.	Forages mostly in the open, on soft wet intertidal mudflats or in sheltered estuaries, embayments, harbours or lagoons. The species has also been recorded on islets, mudbanks, sandbanks and spits, and near mangroves and occasionally in samphire (*Halosarcia spp*.). Birds are seldom near the edge of water, however, birds may wade into the water (Department of the Environment, 2016e). There appear to be two waves of migration down the eastern coast: one in August or September and one in November (DoE, 2019). Widespread in coastal Queensland, from south-east of the Gulf of Carpentaria, north to Torres Strait and along the eastern coast to south-east Australia. Migratory shorebird of the EAA. The Great Sandy Strait is an important non-breeding site in Australia (Bamford et al., 2008). Low risk of collision due to specific habitat preferences that restrict species distribution to intertidal areas. No habitat immediately west of WTA so short flights unlikely to occur.	Low
Grey-tailed tattler (*Tringa brevipes)*	Unlikely in the WTA.	Within Australia, the Grey-tailed Tattler has a primarily northern coastal distribution and is found in most coastal regions. In Queensland it is found along	Low

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
	Known to occur in the Great Sandy Strait as a Summer migrant.	the entire coast, with small numbers located in the Gulf of Carpentaria. The Grey-tailed Tattler is often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. It can also be found at intertidal rocky, coral or stony reefs as well as platforms and islets that are exposed at low tide. It has been found around shores of rock, shingle, gravel or shells and also on intertidal mudflats in embayments, estuaries and coastal lagoons, especially fringed with mangroves (DoE, 2019). Migratory shorebird of the EAA. The Great Sandy Strait is an important non-breeding site in Australia (Bamford et al., 2008). Low risk of collision due to specific habitat preferences that restrict species distribution to intertidal areas. No habitat immediately west of WTA so short flights unlikely to occur.	
Common greenshank (*Tringa greenshank)*	Unlikely in the WTA. Known to occur in the Great Sandy Strait as a Summer migrant.	It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms (Department of the Environment, 2015s). Migratory shorebird of the EAA. The Great Sandy Strait is an important non-breeding site in Australia (Bamford et al., 2008). Low risk of collision due to specific habitat preferences that restrict species distribution to intertidal areas. No habitat immediately west of WTA so short flights unlikely to occur.	Low
Bar-tailed godwit (*Limosa lapponica baueri* and *Limosa lapponica menzbieri)*	Unlikely in the WTA. Known to occur in the Great Sandy Strait as a Summer migrant.	Inhabits mainly in coastal areas such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays, around beds of seagrass, saltmarsh, coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. Rarely found on inland wetlands or in areas of short grass, such as farmland, paddocks and airstrips (DoE, 2019; Morcombe, 2003). Breeds in eastern Russia and Alaska (Migratory Shorebirds of the East Asian – Australiasian Flyway).	Low

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
		Migratory shorebird of the EAA. Seven important non-breeding sites in Australia; one being the Great Sandy Strait. Low risk of collision due to specific habitat preferences that restrict species distribution to intertidal areas. No habitat immediately west of WTA so short flights unlikely to occur.	
Lesser sand plover (*Charadrius mongolus)*	Unlikely in the WTA. Known to occur in the Great Sandy Strait as a Summer migrant.	Recorded along most of the coastline of the Northern Territory (NT), in particular the North Arnhem coast, Mud Blue Bay, coast between Anson Bay and Murgenella creek and the Port McArthur area (Chatto, 2003). Inhabits mud and sandflats in sheltered bays, estuaries, harbours, and occasionally rocky outcrops, sandy beaches and coral reefs. Roosting occurs near foraging areas (DoE, 2019). Migratory shorebird of the EAA. Seven important non-breeding sites in Australia; one being the Great Sandy Strait. Numbers begin to increase at various sites in northern Australia between February and April (mostly March to April), suggesting that birds move along the eastern and northern coasts before they leave on their northern migration in April (DoE, 2019) Low risk of collision due to specific habitat preferences that restrict species distribution to intertidal areas. No habitat immediately west of WTA so short flights unlikely to occur.	Low
Whimbrel (*Numenius phaeopus*)	Unlikely in the WTA. Known to occur in the Great Sandy Strait as a Summer migrant.	Often found in mudflats of estuaries, particularly those with mangroves. Occasionally found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms (DoE, 2019). When they arrive, they move south along the east coast. Influxes (which are mostly temporary) occur at sites along the east coast during migration in August (north of 20° S), and in September-October (south of 20° S) (DoE, 2019). When they depart Australia, Whimbrels begin migrating from February onwards (Higgins & Davies 1996). Influxes occur at most sites in Queensland from early March to early April. The birds leave the north and north-east coasts by late April (DoE, 2019). Migratory shorebird of the EAA. Non-breeding period in Australia (Bamford et al, 2008).	Low

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
		Low risk of collision due to specific habitat preferences that restrict species distribution to intertidal areas. No habitat immediately west of WTA so short flights unlikely to occur.	
Far eastern curlew (*Numenius madagascariensis*)	Unlikely in the WTA. Known to occur in the Great Sandy Strait as a Summer migrant.	Associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sand flats (Morcombe, 2003). Migratory shorebird of the EAA. Non-breeding period in Australia (Bamford et al, 2008). Low risk of collision due to specific habitat preferences that restrict species distribution to intertidal areas. No habitat immediately west of WTA so short flights unlikely to occur.	Low

5.2.2.1.3 Least Concern Bird Species

Least concern bird species either recorded during site surveys or considered likely to occur were assessed on their susceptibility of collision. Table 18 provides least concern species identified as at risk of collision. Whilst their risk of collision is considered moderate to high, given their often wide distribution across Australia and stable populations (least concern), impacts to their populations are considered low.

Table 18 Least Concern Bird Species Risk Assessment

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
Passerine Species			
Welcome swallow *Hirundo neoxena* EPBC Act – LM NC Act - LC	Occurs	Welcome Swallows are widespread in Australia and occupy a wide variety of habitats. They were observed within the WTA flying below the RSA, although they are likely to fly within the RSA as they are known to feed with swifts, woodswallows and martins (Simpson & Day, 2004). They are aerial insectivores and are considered at risk of collision with wind turbines	High
Torresian crow *Corvus orru*	Occurs	The Torresian crow has an extensive distribution across Australia. Occurs in open forest, woodland, farms, grassland and urban areas. The Torresian crow, similarly to many corvids, is an opportunistic species and has adapted to a broad range of habitats. The population size in Australia is increasing, possibly due to urban and agricultural expansion.	High

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
		One of the reasons the Torresian crow is able to take advantage of increased urbanisation is its diet; a significant proportion of the diet of the species consists of carrion. Torresian crows are large and aggressive birds, with females displaying the more aggressive behaviour and dominating most other species. They have been observed to attack larger birds of prey, particularly wedge-tailed eagles and most owl species in defence of their nest or territory (ALA, 2020). Although not observed flying within the RSA within the WTA, they are considered at risk of collision due to their aggressive flight behavior and penchant for carrion	
Australian magpie *Gymnorhina tibicen*	Occurs	Australian magpies are common throughout Australia and are found wherever there is a combination of trees and adjacent open areas. They live in groups of up to 24 birds in territories that are defending all year around by group members. Collision mortalities have been recorded at Ararat windfarm (BL& A, 2018). They were recorded below the RSA height during BUS surveys however have the potential to fly at RSA height.	High
Tree martin *Petrochelidon nigricans* EPBC – LM (as *Hirundo nigricans)* NC Act - LC	Occurs	Tree Martins occur throughout Australia and occur in the airspace above almost every terrestrial habitat in Australia, ranging from grassy plains to forests, wetlands and built-up areas (Birdlife, 2020). Tree Martins are aerial insectivores and fly erratically in pursuit of flying insects. They often feed above the canopy and occasionally below the canopy. Their flight is agile and erratic. They are considered at risk of collision due to their flight behavior.	High
Non-passerine Species			
Channel-billed cuckoo *Scythrops novaehollandiae* EPBC Act – LM NC Act - LC	Occurs	The Channel-billed Cuckoo migrates to northern and eastern Australia from New Guinea and Indonesia between August and October each year. The birds leave Australia in February or March (Australian Museum, 2020). Channel-billed Cuckoo is found in tall open forests, usually where host species occur. They feed on native figs and native fruits,	High

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
		though some seeds, insects and baby birds are also taken. Observed flying over the WTA within the RSA and therefore are at risk of collision.	
Sulphur-crested cockatoo *Cacatua galerita* EPBC – not listed NC Act - LC	Occurs	Occupies a variety of habitat types and flocks feed on the ground (Simpson & Day, 2004). Sulphur-crested cockatoo's range extends throughout northern and eastern Australia and Tasmania. A population has established in Western Australia around Perth. Eggs are laid in a suitable hollow and both birds incubate and care for the chicks. Chicks remain with parents all year round and family groups stay together indefinitely (Australian Museum, 2020). Observed in the WTA although not within the RSA height. Considered moderate risk of collision due to observed flight behavior and feeding behaviour.	Moderate
Yellow-tailed black-cockatoo *Calyptorhynchus funereus* EPBC Act – not listed NC Act - LC	Occurs	Yellow-tailed black-cockatoo inhabits a variety of habitat types, however favours eucalypt woodland and pine plantations. Occurs in small to large flocks (Australian Museum, 2020). Yellow-tailed black-cockatoo is found in south-eastern Australia, from Eyre Peninsula, South Australia to south and central eastern Queensland. They feed on wood-boring larvae and seeds of native and introduced trees and ground plants. They are known to tear open pine cones to extract the seeds. Both sexes construct the nest, which is a large tree hollow, lined with wood chips. The female incubates the eggs, while the male supplies her with food. Usually only one chick survives, and this will stay in the care of both parents for approximately 6 months. Observed within WTA. Due to their common occurrence in pine plantation forests in south-east Queensland they are considered at risk of collision, although moderate due to observed and general flight height.	Moderate

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
Raptors			
Whistling kite *Haliastur sphenurus*	Occurs	Whistling kites are found throughout Australia. They are known to occur in open pastures, grasslands and lightly wooded areas and are typically found near water. They feed on small mammals, birds, fish, reptiles, crustaceans and insects. They will also feed on carrion. They often take prey from the ground although are also known to feed on insects from the air. Whistling kites were observed on the WTA within the RSA height and are at risk of collision.	High
Spotted harrier *Circus assimilis*	Occurs	Occurs throughout the Australian mainland, except in densly forested or wooded habitats of the coast. They occur in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands (NSW Office of Environment and Heritage, 2020). They prey on terrestrial mammals, birds, reptiles, insects and occasionally carrion (Morcombe, 2011) Although is known to soar high it is more commonly seen hunting low over vegetation. This species was recorded within the WTA however observed below the RSA height. Based on its flight behavior it is considered at low – moderate risk of collision.	Low - Moderate
Black-shouldered kite *Elanus axillaris*	Occurs	Black-shouldered kites are common throughout Australia. They usually inhabit grasslands and open habitats. They feed mainly on rodents, particularly the introduced house mouse. They prefer to hunt during the day, particularly early morning and late afternoon, often hovering with their wings held upright in a V-shape, before dropping down and grabbing prey with their talons (Birdlife Australia, 2020). Although is known to soar high it is more commonly seen hunting low over vegetation. This species was recorded within the WTA however observed below the RSA height.	Low - Moderate

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
		Based on its flight behavior it is considered at low – moderate risk of collision.	
Brown falcon *Falco berigora*	Occurs	Brown falcons are common throughout Australia. They are often observed hovering or flying back and forth over open habitats, especially grasslands and low shrublands, where they search for prey. They are opportunistic raptors, catching and eating mammals and birds, snakes and insects (Birdlife Australia, 2020). Observed within the WTA however below the RSA height during surveys. They are likely to occur within the RSA height and are therefore susceptible to collision.	High
Australian hobby *Falco longipennis*	Occurs	They are common throughout Australia. Often seen dashing past, either low to the ground or just above the treetops, the Australian Hobby is often seen hunting in vegetated urban areas, as well as in almost any lightly timbered country. Their flight varies from swift and direct with flickering wing-beats to gliding and soaring, and they regularly catch their food—small birds and insects—in the air. They sometimes eat it on the wing too, or land on a high perch (Birdlife Australia, 2020). Observed within the WTA however below the RSA height during surveys. They are likely to occur within the RSA height and are therefore susceptible to collision.	High
Peregrine falcon *Falco peregrinus macropus*	Occurs	Peregrine falcons occur throughout Australia. Peregrine Falcons mate for life and pairs defend a home range of about 20-30 km^2. Peregrine Falcons are the fastest animal in the world, with stoops recorded at speeds faster than 300 km/hr. Hunting is mainly done during the day, including around dawn and dusk. Feeding primarily on small-medium sized birds, but occasionally taking insects, such as moths, cicadas and locusts (Birdlife Australia, 2020). Observed within the WTA however below the RSA height during surveys. They are likely to occur within the RSA height and are therefore susceptible to collision.	High
Wedge tailed eagle *Aquila audax*	Likely to occur	Wedge-tailed Eagle (WTE) is Australia's largest bird of prey and is found throughout Australia. They known to soar up to altitudes of 2000m.	High

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
		Wedge-tailed eagles eat live prey and carrion. Wedge-tailed eagles occupy an area of about 30 to 35km^2. They spend most of their time either perched in trees or in the air, circling throughout their territory with a pattern of arcs and dives to signal ownership. Eagles usually nest and perch in high trees or other structures. Wedge-tailed eagles have been known to collide with wind farms in Tasmania (Hull et al. 2013) and the Ararat wind farm in Victoria (BL & A, 2018). Carcass monitoring on the Ararat windfarm reported most wedge-tailed eagles impacted by collision were young birds that would have recently fledged and left their nests. Continued monitoring on and around the Ararat wind farm has reported WTE flying in and around the wind farm without collisions suggesting the collisions were from young WTE entering the wind farm area from outside in the search of new territory (BL & A, 2018). It is assumed WTE are at risk of collision mainly due to their soaring habits and uplifting on air currents.	
Waterbird Species			
Australian pelican *Pelecanus conspicillatus*	Likely to occur	Australian pelicans live very close to water in coastal inlets, shorelines, lakes, swamps and rivers of the interior. They will reside in almost any area that supports a large abundance of fish, however their major habitat is the marine intertidal zone including sandy shoreline, sandbars and spits (Poole, 2011). They are strong, slow fliers that often glide on thermals to conserve energy. During flight they pull their head inward towards their body and rest it on their shoulders. These birds will travel very long distances in order to find food, and have been known to remain airborne for 24 hours (Poole, 2011). Australian pelicans are highly social, diurnal birds that fly together in groups which can be very large at times (Poole, 2011). Australian pelicans are of least concern because they have a very large range, their population trend is fluctuating, and their population size is very large (between 100,000 and 1,000,000 individuals) (Poole, 2011). Pelicans were not observed during BUS surveys however due to the available food resources in the Great Sandy Strait, their	High

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
		ability to soar on thermals and travel large distances, they are considered likely to pass over the WTA and therefore are at risk of collision.	
Australian white ibis *Threskiornis Molucca* straw-necked ibis *Threskiornis spinicollis*	Likely to occur	Both ibis species are found throughout Australia and have been recorded on the WTA (Wildnet), however were not recorded during BUS surveys . They mainly feed on aquatic invertebrates, insects, molluscs, fish and snakes in their natural habitat. Australian white ibis also frequently scavenge in land-fill sites and human recreation areas (ALA, 2020). They are a least concern waterbirds and are known to soar at heights within and above the RSA and therefore are considered at risk of collision.	High
White-necked heron *Ardea pacifica*	Occurs	White-necked Heron is widespread throughout most of Australia except desert areas of Western Australia and South Australia. Although White-necked Herons are sometimes seen in tidal areas, most are found in shallow fresh waters, including farm dams, flooded pastures, claypans, and even roadside ditches. They were observed on the WTA feeding in a roadside drain. They are capable of soaring within the RSA height and therefore susceptible to collision.	Moderate

5.2.2.2 Consequence of Collision (Birds)

The above assessment identified the following for conservation significant and least concern species:

- White-throated Needletail (*Hirundapus caudacutus*) – High risk of collision
- Fork-tailed Swift (*Apus pacificus*) - High risk of collision

- Rainbow bee-eater (*Merops ornatus*) - Moderate risk of collision

- Powerful owl (*Ninox strenua*) – Low risk of collision
- Ground Parrot (*Pezoporus Wallicus wallicus*) – Low risk of collision
- Australian painted snipe (*Rostratula australis) (Syn. Rostratula benghalensis)* – Low risk of collision
- Great Egret (*Ardea modesta*) – Low risk of collision
- White-bellied sea-eagle (*Haliaeetus leucogaster*) – Low risk of collision
- Black-faced monarch (*Monarcha melanopsis*) - Low risk of collision
- Spectacled Monarch (*Monarcha trivirgatus* (syn. *Symposiachrus trivirgatus*)) – Low risk of collision
- Satin Flycatcher (*Myiagra cyanoleuca*) - Low risk of collision
- Cicadabird (*Coracina tenuirostris*) - Low risk of collision

- Rufous Fantail (*Rhipidura rufifrons)* - Low risk of collision
- Oriental cuckoo (*Cuculus optatus)* – Low risk of collision
- Magpie Goose (*Anseranas semipalmata)* – Low risk of collision
- Cattle egret (*Ardea ibis* (Syn. *Bubulcus ibis*)) – Low risk of collision
- Migratory Shorebirds - Low risk of collision

Impacts to populations of Least Concern species with a moderate to high risk of collision are considered low given their stable populations and widespread distribution.

The potential consequences associated with collision based impacts to the populations of White-throated Needletail (*Hirundapus caudacutus*) and Fork-tailed Swift (*Apus pacificus*) are discussed below because they are conservation significant species with a high risk of collision.

White-throated Needletail (*Hirundapus caudacutus)*

This species is a non-breeding Summer migrant (October – April) to Australia. It occurs in high open spaces above a wide range of habitats, such as oceans, ranges and headlands (Morcombe, 2003). During the Summer months, the White-throated Needletail is widespread in eastern and south-eastern Australia. In eastern Australia, it is recorded in all coastal regions of Queensland and NSW, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains (DoEE, 2019).

Large tracts of native vegetation, particularly forest, may be a key habitat requirement for the species (DoEE, 2015). In Australia, the White-throated Needletail is almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground (DoEE, 2019).

They often forage in areas of updraughts, such as ridges, cliffs or sand-dunes, or in the smoke of bushfires, or in whirlwinds. They often forage along the edges of low pressure systems, which both lift their food sources and assist with their flight, and it is said that they follow these systems across Australia (DoEE, 2019).

There are no published estimates of the extent of occurrence of the White-throated Needletail in Australia, although the species occurs at numerous and widespread sites in eastern Australia (DoEE, 2019)

Surveys demonstrated the occurrence and abundance of this species across the WTA is highly variable. The 2 survey occasions when they were recorded in flocks greater than 100 were on days associated with local bushfires or stormfronts. The *draft referral guideline for 14 birds listed migratory under the EPBC Act* (DoEE, 2015) lists ecologically significant proportions of each species population, which is 100 individuals (international proportion) or 10 individuals (national proportion) for the WTN. A significant impact involves the loss of this many birds from the population in a year. Two (2) of the 139 BUS surveys recorded numbers greater than 100 and five (5) of the 139 surveys recorded numbers greater than 10 (3 of those 5 were less than 20 individuals).

Potential collision with wind turbines is considered of low risk to the population. This is also consistent with the DoE Conservation advice regarding the assessment of threats to the WTN (Table 1, item 2.1 of the Approved Conservation Advice, 4 July 2019).

Fork-tailed Swift (*Apus pacificus)*

This species is a non-breeding Summer migrant (October – April) to Australia. It occurs in low to very high airspace over a variety of habitats including rainforest and semi-arid areas. It is known to be most active in front of summer storm fronts (Morcombe, 2003).

The Fork-tailed Swift is almost exclusively aerial, flying from less then 1 m to at least 300 m above ground and probably much higher (DoEE, 2019). They forage along the edge of low pressure systems

and for that reason are considered a precursor to unsettled weather. The low pressure system helps to lift prey, such as insects, from the ground and assists in flight (DoEE, 2019)

They are widespread but scattered in coastal areas from 20° S, south to Brisbane and in much of the south south-eastern region. They are more widespread west of the Great Divide, and are commonly found west of the line joining Chinchilla and Hughenden (DoEE, 2019).

Surveys demonstrated the occurrence and abundance of this species across the WTA is highly variable. FTS were recorded in their highest numbers (up to 51 individuals) on 29 November 2018 which was associated with severe local bushfires. This number is less than the ecologically significant proportion for FTS (1000 and 100 for International and National proportions, respectively) individuals as described in the *draft referral guideline for 14 birds listed migratory under the EPBC Act* (DoEE, 2015).

Potential collision with wind turbines is considered of low risk to the population as numbers observed during surveys are less than the ecological significant proportion of 100 individuals.

5.2.2.3 Bats

Of the two major groups of bats (microbats and megabats) all reported fatalities of bats from wind turbines in Australia and overseas, have been microbats (Australian Bat Society Inc., 2017). Although there are no reported fatalities of megabats (eg. flying-foxes), this may be attributed to most Australian wind farms have not been in areas of flying-fox roosts or potential foraging areas. As such, they may be at risk of collision or barotrauma.
Operation of the wind farm has the potential to result in susceptibility of collision with wind turbines. A risk assessment of potential consequence of collision has been undertaken for all bat species identified within the WTA or within dispersal distances (ie flying-foxes) from the WTA (Table 19).

Table 19 Bat Risk Assessment

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
Megabats			
Grey-headed flying-fox *Pteropus poliocephalus* *EPBC – V* *NC Act – Least Concern*	High	A canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, Melaleuca swamps and Banksia woodlands (DoE, 2019). Roost sites are typically located near water, such as lakes, rivers or the coast. The Grey-headed Flying-fox is highly mobile and the national population is fluid, moving up and down the east coast in search of food (DoE, 2019). Grey-headed Flying-fox presence will be dependent on food resources. The time and location of flowering and fruiting of diet plants varies among seasons and years. In particular, drought years can have a strong influence on eucalypt flowering times. Sites noted as important in one year or period may not be visited again in the following year (DoE, 2019).	Moderate

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
		The relatively small amount of native vegetation within the pine plantation is not considered core foraging habitat compared to the surrounding native state forests, National Parks and agricultural areas, outside of the WTA. Local populations dispersing at night are also likely to be below the RSA height. Infrequent collision due to local dispersal flight height, absence of roosts within the WTA and the widespread distribution of preferred foraging habitat outside of the project area. However due to their nomadic lifestyle and likely poor maneuverability they are considered at risk of collision.	
Little red flying-fox (LRFF) *Pteropus scapulatus* *EPBC Act – Not Listed* *NC Act - Least Concern*	Moderate	Little red flying foxes are nomadic, predominately blossom feeders. They congregate in large camps, often beside water, commonly sharing camps with other flying fox species. They are found in a broad range of habitats, across the north and east of Australia. All dominant tree species are included in their diet and their nomadic lifestyle enables them to utilize an unpredictable food supply. As with other flying fox species, their presence in an area can be highly variable one year to the next, depending on the flowering of food tree species, as some eucalyptus can produce large amounts of blossoms one year and little the next (Churchill 2008) They are not very maneuverable and are often found caught in barbed wire fences (ALA, 2020). Infrequent collision due to distance from nearest camps, however due to their nomadic lifestyle and poor maneuverability they are considered at risk of collision.	Moderate
Black flying fox (BFF) *Pteropus alecto* *EPBC Act – Not Listed*		Black flying foxes are found in a wide range of habitats in tropical and subtropical woodlands, feeding predominately on the fruit and blossoms of Eucalypts, Melalueca and Turpintines. They camp in mangroves, rainforests, Melalueca, bamboo and monsoon forest, often using the same camp for many years. (Churchill 2008) They are migratory, roosting in large numbers high in the tree canopy during the day, leaving to feed at dusk. They generally disperse to	Moderate

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
NC Act – Least Concern		smaller camps over the winter and recongregate in spring, summer (Australian Museum, 2020). Infrequent collision due to distance from nearest camps, however due to their nomadic lifestyle and poor maneuverability they are considered at risk of collision.	
Microbats			
Eastern horseshoe bat *Rhinolophus megaphyllus* *EPBC Act – Not Listed* *NC Act – Least Concern*	Known to occur	Eastern horseshoe bats are cave dwellers, found in a wide variety of caves, abandoned mines and can also be found in tree hollows, roosting mostly in complete darkness. They are found in tropical and temperate rainforest along the east coast of Australia. They are much more active in mature forests than in regrowth, avoiding large cleared areas. (Churchill 2008). They hunt flying and non-flying insects and spiders, with moths being their dominant food. They have a slow, but highly maneuverable flight pattern, and can fly close to the ground to catch their prey, which is often taken to a temporary roost to be eaten. They use echolocation and are well adapted to hunting for insects in dense foliage (Churchill 2008 & Australian Museum). Eastern horseshoe bats were recorded within the WTA. Due to their flight behavior and maneuverability they are considered at low risk of collision.	Low
Gould's wattled bat *Chalinolobus gouldii* *EPBC Act – Not Listed* *NC Act – Least Concern*	Known to occur	The Gould's wattled bat's distribution is widespread and they found in almost all habitats throughout Australia. They insectivorous, feeding on bugs and moths predominately, as well as a wide variety of other insects. They fly just below or within the lower level of the tree canopy and are agile flyers. They roost most commonly in tree hollows and hollow limbs of mature trees, particularly River Red Gums and Cypress Pines. They move daily between a number of roost sites and are highly adaptable. (Churchill, 2008) Mortalities have been recorded at other Australian wind farms (BL & A, 2018 and Boothroyd, I et al. 2012). Gould's wattled bat were recorded within the WTA. Given previous mortalities at other	High

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
		wind farms and presence on the WTA, they are considered at risk of collision.	
Hoary wattled bat *Chalinolobus nigrogriseus* *EPBC Act – Not Listed* *NC Act – Least Concern*		The Hoary wattled bat is found in the north/north east of Australia, in a range of habitat types including monsoon forests, dry sclerophyll forest, littoral rainforest, river red gum riparian woodland, vine thickets, coastal scrub, sand dunes, grasslands and floodplains. They roost in primarily in hollows in eucalyptus trees. They are agile flyers and can change course quickly in response to prey movements. They are insectivores, with a preference for beetles, ants and moths but will also eat a range of other prey species. Little flight height information is available for this species, however given it is an aerial insectivore it is considered at high risk of collision.	High
Nyctophilus sp. *EPBC Act – Not Listed* *NC Act – Least Concern*	Known to occur (all may potentially occur however could not speciate beyond genus level)	Three *Nyctophilus* species are potentially present in the windfarm area. *Nyctophilus bifax*, Eastern long-eared bat *Nyctophilus geoffroyi*, Lesser long-eared bat *Nyctophilus gouldi*, Gould's long-eared bat *Nyctophilus bifax*, are found along the eastern coast of Qld to N. NSW, favouring wetter habitats, including rainforest and monsoon forests, but are also found in open woodlands, tall open forest and dry sclerophyll forests. They primarily eat moths, along with other insects including ants and click-beetles. They have been observed perch hunting, making short flights to catch prey (Churchill, 2008) *Nyctophilus geoffroyi* are widespread across Australia and are found in a broad range of habitats, from deserts to rainforests, agricultural land, urban areas, tropical to alpine woodlands and grasslands. They are highly maneuverable flyers feeding on moths, crickets and grasshoppers, primarily, but their diet also includes a range of other insects. They roost in crevices and tree hollows, often alone or in small groups (Churchill, 2008) *Nyctophilus gouldi* are found in a range of habitats across Eastern Australia and the SW of WA. They are found in wet and dry sclerophyll forests, Melaleuca, red river gum	Low

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
		waterways, woodlands and Acacia shrubland. They usually roost along creek lines, in tree hollows, fissures and under peeling bark. They generally fly in 2-5 m above the ground under the canopy of forest trees, to catch their prey, which consists mainly of moths and beetles, but as with other *Nyctophilus sp.*, a range of insects are included in their diet. (Churchill, 2008). Recorded during bat surveys on WTA. Given low flight behaviour they ae considered low risk of collision.	
Little broad-nosed bat *Scotorepens greyii* *EPBC Act – Not Listed* *NC Act – Least Concern*	Known to occur	Little broad-nosed bats are abundant in the north of Australia and are commonly caught near water. Their range of habitats include Monsoon forest, *Melaleuca* forest, tall and open forest, open woodland, mulga shrubland, mixed shrubland, escarpments, grasslands, river red gum-lined waterways and *Pandanus*. They are continuous flight foragers, with moderately fast, agile flight. Their diet consists mostly of beetles, bugs and ants. They search for insects close to tree-tops, but not usually above them. They roost in tree hollows, fence posts as well as disused buildings, in small groups usually less than 20 bats. (Churchill 2008). Recorded within the WTA during bat surveys. Given flight behavior below the canopy, they are considered low risk of impact.	Low
Little bent-wing bat *Miniopterus australis* *EPBC Act – Not Listed* *NC Act – Least Concern*	Known to occur	Little bent-wing bats are found along the east coast of Australia, in well timbered areas including rain forest, wet and dry sclerophyll forests, vine thickets, Melaleuca swamps and coastal forests. They are cave dwellers, congregating in maternity colonies in summer and dispersing in winter. Their diet consists primarily of beetles, moths, spiders and flies. They are maneuverable flyers between the shrub and canopy layers of forests. Recorded within the WTA during bat surveys. Given flight behavior below the canopy, they are considered low risk of impact.	Low
Australian bent-wing bat *Miniopterus orianae*	Known to occur	They are found east primarily east of the Great Dividing Range, along the East Coast of Australia. Their habitat includes rainforests, wet and dry sclerophyll forest, monsoon forests, open grasslands, open woodlands and Melaleuca forests. In forested areas this species flies high, above the canopy, to many times the canopy height.	High

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
EPBC Act – Not Listed *NC Act – Least Concern*		Their diet consists mostly of moths, along with other insects including flies, cockroaches and beetles. They can forage up to 65kms from their roost sites, which are predominately caves, but can be found in man-made structures, such as road culverts. Given their flight behavior many times the canopy height and feeding on aerial insects, they are considered high risk of collision.	
White-striped freetail bat *Austronomus australis* *EPBC Act – Not Listed* *NC Act – Least Concern*	Known to occur	White-striped freetail bats are broadly distributed across Southern Australia and found in a wide range of habitats from deserts, grasslands, forests, urban areas, woodlands, shrublands and open agricultural landscapes. They are a tree-dwelling species with roost colonies of up to 300 individuals. In summer they migrate south to cooler areas. Their diet includes moths, beetles and grasshoppers as well as ground dwelling insects such as ants and non-flying beetles. They are a fast flying species, but are not designed for maneuverability (Churchill 2008), which may increase their risk of colliding with turbines. Mortalities have been recorded at other Australian wind farms (BL & A, 2018 and Boothroyd, I et al 2012). Recorded within the WTA during bat surveys. Given their low maneuverability and previous collisions at other Australian wind farms, they are considered high risk of collision.	High
Ride's free-tailed bat *Ozimops ridei* *EPBC Act – Not Listed* *NC Act – Least Concern*	Known to occur	Found along the East coast of Australia in a wide range of habitats, including rainforest, *Melaleuca* forests, monsoon forests, woodlands and open forests. The bats fly predominately through trees to forage for bugs, flies and beetles. They roost mainly in tree hollows but can be found in building, cracks in fence posts and under bark. Recorded in WTA during bat surveys. Flight behaviour is predominantly below canopy, however not always, as such they are considered at moderate risk of collision.	Moderate
Northern free-tailed bat	Known to occur	Widely distributed across northern Australia from Western Australia to Queensland, extending south to the north-east corner of NSW. They are found in habitats ranging from rainforests to open forests and woodlands, and are often recorded along watercourses.	Moderate

Species	Likelihood of Occurrence	Distribution and Flight Behaviours	Susceptibility of Collision
Ozimops lumsdenae *EPBC Act – Not Listed* *NC Act – Least Concern*		They are found roosting mainly in tree hollows although relatively large colonies have also been found under house roofs in urban areas (NSW Govt. 2018) Recorded in WTA during bat surveys. Little known on flight behavior however is assumed similar to *O. ridei* and therefore considered moderate risk of collision.	
Yellow-bellied sheathtail bat *Saccolaimus flaviventris* *EPBC Act – Not Listed* *NC Act – Least Concern*	Known to occur	Yellow bellied sheathtail bats have a wide distribution across most of north eastern Australia. They are found in a broad range of habitats, from desert to grasslands, wet and dry sclerophyll forests, open woodlands, Acacia scrubland and mallee. They migrate to Southern Australia during the summer, generally January – March. They roost in large tree hollows in colonies of up to 30 individuals. They fly fast and straight, usually above the canopy, unless flying out in the open, where they will fly lower. Their diet consists mainly of beetles, however they will also eat a range of other insects including grasshoppers, crickets, leafhoppers, wasps, shield bugs and flying ants (Churchill, 2008). Recorded in WTA during bat surveys. Given their flight behavior above the canopy and diet including aerial insects, they are considered high risk of collision.	High

Nine of the 13 Least Concern (NC Act) microbat species recorded within the WTA are considered to have a moderate to high risk of collision due to their flight behaviour. Impacts to populations of Least Concern bat species with a moderate to high risk of collision are considered low given their stable populations and widespread distribution. Nonetheless, the bird and bat monitoring plan includes all bat species (including Least Concern) to ensure potential impacts are monitored and mitigated if required.

The potential consequences associated with collision based impacts to the population of GHFF (*Pteropus poliocephalus)* is discussed below as they are a conservation significant species.

5.2.2.4 Consequence of Collision (Bats)

Grey-headed flying-fox (*Pteropus poliocephalus)*

GHFF is canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, Melaleuca swamps and Banksia woodlands (DoE, 2019). Roost sites are typically located near water, such as lakes, rivers or the coast.

The Grey-headed Flying-fox is highly mobile and the national population is fluid, moving up and down the east coast in search of food (DoE, 2019). Grey-headed Flying-fox presence will be dependent on food resources. The time and location of flowering and fruiting of diet plants varies

among seasons and years. In particular, drought years can have a strong influence on eucalypt flowering times. Sites noted as important in one year or period may not be visited again in the following year (DoE, 2019).

There are seven (7) known GHFF camps within 50km of the wind turbine project area. Two (2) are Nationally Important Flying-fox Colonies (Gympie and Woocoo) which are a minimum 30km and 40km from the nearest turbine, respectively. The Gympie colony is 66km from the furthest turbine, while Woocoo is 65km from the furthest turbine. Vast areas of foraging habitat are present between the camps and project area.

The two closest camps are Anderleigh Rd (9km and 49km (closest and furthest turbine)) and Maaroom (4km and 42km). These camps are known to fluctuate over time, however surveys undertaken since 2012 for the National Flying-fox Monitoring Program indicate they generally average between 2,500 – 9,999 (category 3) individuals.

The relatively small amount of native vegetation within the pine plantation is not considered core foraging habitat compared to the surrounding native state forests and National Parks, outside of the WTA. Local populations dispersing at night are also likely to be below the RSA height.

Infrequent collision due to local dispersal flight height, absence of roosts within the WTA, camp size (category 3) and the widespread distribution of preferred foraging habitat outside of the project area is therefore considered to pose a low risk to the National population.

5.2.2.5 GHFF Foraging Resources

GHFF require foraging resources and roosting sites (DoEE, 2019). No roosts are known within the WTA however the mosaic of remnant vegetation amongst the pine plantations may occasionally provide foraging resources such as when the vegetation is in flower. GHFF usually forage up to 15km of the day roost site, although they are capable of nightly foraging flights of up to 50km from their camp as resource availability changes (DoEE, 2019). Irregular GHFF migration may also occur between camps subject to food availability.
Within these 15km and 50km foraging zones from each camp, most of the available GHFF foraging habitat (96 – 100%) is outside of the WTA (ie. 0-4% within the WTA). Refer to Figure 7, Appendix A for the foraging areas of each GHFF camp and Table 20 for the areas and proportions of available foraging habitat. This demonstrates the low likelihood of foraging bahaviour within the WTA as opposed to the available foraging habitat and associated behaviour outside the WTA.

Calculations are considered conservative as they exclude non-remnant vegetation outside the WTA which could also include orchards and regrowth vegetation (which is comparably absent from the WTA) which would provide additional foraging habitat outside of the WTA.

Table 20 GHFF Foraging Habitat Outside / Inside of WTA

GHFF Camp	Foraging radius from camp	Mapped remnant vegetation outside WTA within foraging radius (ha)	Mapped remnant vegetation inside WTA within foraging radius (ha)	Total remnant within foraging radius	% of Foraging Habitat	
					Outside WTA	Inside WTA
Glenwood	15km	35,514	142	35,657	99.60%	0.4%
	50km	394,078	8,887	402,965	97.79%	2.21%
Maaroom	15km	29,454	737	30,191	97.56%	2.44%
	50km	334,648	8,887	343,535	97.41%	2.59%
Goomborium	15km	29,488	1,281	30,769	95.84%	4.16%
	50km	349,507	8,853	358,360	97.53%	2.47%

Maryborough Albion Rd	15km	33,531	53	33,585	99.84%	0.16%
	50km	398,666	7,850	406,516	98.07%	1.93%
Gympie	15km	29,917	0	29,917	100.00%	0.0%
	50km	408,925	6,643	415,568	98.40%	1.6%
Woocoo	15km	46,740	0	46,740	100.00%	0.0%
	50km	420,312	3,404	423,717	99.20%	0.8%
Maryborough Tinana Cr	15km	29,563	197	29,760	99.34%	0.66%
	50km	400,221	8,822	409,043	97.84%	2.16%

The above table excludes non-remnant areas (which could also be foraging areas such as orchards outside of the WTA) and waterways (including oceans, estuaries and canals).

5.2.3 Terrestrial and Aquatic Flora and Fauna (non-flying)

Wind Farm infrastructure within the WTA avoids remnant vegetation by strategically placing turbines, compounds (operation and construction) within the pine plantations, therefore avoiding impacts to remnant vegetation and terrestrial and aquatic habitat within these remnant areas. Access is via existing forestry tracks.

Indirect impacts such as sediment runoff will be managed through applying strict erosion and sediment control practices.

Crinia tinnula (Wallum froglet) were identified in the northern portion of the WTA (in a roadside drain) and other low-lying remnant and non-remnant areas contain suitable habitat for this species and other threatened frog species such as *Litoria freycineti* (wallum rocketfrog). The remnant areas are avoided within the WTA and therefore impacts to amphibians in these areas are considered unlikely. Impacts outside of the remnant areas is also considered unlikely due to utilising existing access tracks.

No threatened fish or turtles were recorded although they may be present in the permanent creeks through the Project Area. Waterways and riparian areas are not impacted by the project and therefore impacts to threatened fish, reptiles (including turtles) and amphibians is considered unlikely.

The Transmission Line may require a 60m wide clearance corridor (OTC). A 60m wide clearing corridor has been assumed for reporting purposes, however remnant areas are proposed to be spanned to avoid clearing remnant habitat including HBTs. Mapped areas of EH and Pineapple Zamia will be avoided and/or spanned.

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6 MANAGEMENT MEASURES

Mitigation measures proposed are in accordance with industry standards and the mitigation recommendations provided in *Wind Farm Industry EPBC Act Policy Statement 2.3 (DoE, 2009).*

Avoidance is the guiding principle to avoiding impacts on all flora and fauna, particularly MNES and MSES within the Project area. Avoidance measures utilised in the Project include:

- The Project is set back a minimum of 4km from the Great Sandy Strait which is a known significant non-breeding area for EPBC listed migratory shorebirds.
- The WTA is located within an existing exotic pine plantation and predominantly avoids remnant vegetation and waterways.
- Only marginal clearing of remnant vegetation may occur for upgrades to existing waterway crossings.
- Electrical cabling will mostly be underground along existing access tracks which will further reduce the likelihood of collision and/ or electrocution of birds and bats.
- Other infrastructure such as construction compounds avoid remnant vegetation and waterways and therefore avoid damage to remnant areas of natural habitat.
- Existing forestry tracks will be used to provide access within the WTA and therefore avoids disturbance to remnant vegetation and habitat within remnant areas.
- Transmission Line within the OTC spans waterways and significant vegetation such as mapped EH and Pineapple Zamia. Pineapple zamia will also be avoided during the micro-siting process of the wind turbines.
- Translocation of Pineapple Zamia under an Approved Translocation Management Plan may be required if spanning and micro-siting is not feasible in some locations.
- Pre-clearance surveys undertaken prior to any track widening or clearing along roadsides or within pine plantation areas to determine if native species resilient to disturbance are present and if further avoidance measures are required.

Additional mitigation measures to reduce collision based impacts during operation are associated with adaptive management and reducing the risk of attracting birds and bats into the rotor swept area (RSA) of the wind farm. This includes:

- An adaptive management bird and bat monitoring program has been prepared and already commenced implementation. Should the monitoring program's results demonstrate that further mitigation is required, further assessment will be undertaken to determine appropriate mitigation or management measures. Additional measures may include deploying a radar detection and deterrent technology system.
- Spatially and temporarily replicated carcass monitoring undertaken by suitably qualified ecologists or trained detector dogs or other approved method. This will be used to identify particular turbines that may be causing excessive number of deaths of any species. Monthly surveys to be undertaken at a stratified random representative selection of turbines. Surveys will also be timed to occur at times of flowering of eucalypt and melaleuca where possible. Should mortality be shown to exceed an acceptable mortality rate, comprehensive evaluation of risk factors will be undertaken and mitigation plans adopted until the risk of impact has been abated. Mitigation plans may include changes in operational regimes of the turbine causing impact, for example, different systems, limiting rotational speed or suspension of operation of high risk turbines in high impact periods which may be identified through detection systems (eg. departure and return flight times in evening for bats, identified with a radar).
- Trial acoustic and/or sonar to deter bats/birds. Slow rotor speeds or temporary shutdown of subject turbines during Summer period of known migratory aerial insectivores when birds may be on site.

- A Project specific Bird and Bat Management Plan has been prepared which outlines the objectives and monitoring program.

Additional measures to reduce impacts to flora and fauna include:

- Utilise existing tracks wherever possible
- Pre-clearance/pre-construction surveys to determine if site -specific micro-siting of turbines is required to further minimise impacts
- Clearly and accurately designate no-go areas prior to detailed design of Transmission Line to ensure sensitive areas are spanned (eg. Pineapple Zamias, confirmed EH, waterways)
- Span waterways as much as reasonably practical.
- Micro-siting of wind turbines.
- Avoid HBTs where possible. OTC proposes to span remnant areas within WTA where most HBTs occur and therefore loss of hollows is expected to be minimal. Nonetheless, pre-clearance surveys to determine density and number of hollows lost during construction within OTC. Replace any loss of hollows at a previously agreed replacement ratio.
- ESCP developed by a CPESC
- Clearly and accurately designate no-go areas prior to any vegetation clearing
- Storage of fuels, chemicals, wastes and other potentially contaminating substances in appropriately bunded areas and away from waterways.

6.1Offset Strategy

Koalas and koala habitat are known to occur in the NSF. Assessment of offset requirement for koala will be undertaken once the extent of clearing is known. Similarly, once the clearing extent is known, surveys to ground-truth mapped essential habitat will be undertaken to determine offset requirements, if any. As previously mentioned, clearing native vegetation will be avoided where possible by spanning areas where practical.
Should pre-clearance surveys identify threatened species within non-remnant areas and therefore Protected Wildlife Habitat, a SRIA will be undertaken to determine offset requirements (subsequent to all avoidance and mitigation measures proposed).

6.2 Additional Permits

The following permits may be required for the Project:

- A Protected Plant Clearing Permit (Section 15 of *Nature Conservation (Administration) Regulation (2006))* may be required following additional pre-clearance surveys, including protected plant surveys within the flora survey trigger areas.
- A Riverine Protection Permit (*Water Act (2000))* may be required to upgrade existing waterway crossings.
- A Licence to Take or Interfere with Water (*Water Act (2000))* may be required to upgrade existing waterway crossings.
- A Species Management Program (Low and High Risk) (NC Act)) may be required for tampering with a protected animal breeding place
- A Permit to Clear Native Vegetation in a State Forest (Section 39 *Forestry Act 1959)* may be required to clear vegetation in a State Forest

7 CONCLUSION

This report presents the results of the flora and fauna (including bird and bat utilisation surveys), and accompanies the baseline Ecological Investigation prepared by Premise (2017). The surveys, including the bird utilisation survey has been designed to comply with State code 23: Wind farm development (the code) (Queensland Government, 2017). The potential impacts to flora and fauna, with specific consideration given to birds and bats have been assessed and specific mitigation measures to reduce the severity of potential impacts identified.

Desktop assessments and detailed field surveys have been undertaken across the WTA, including reference sites away from proposed turbine locations, since 2016. Initial surveys have been undertaken over the NSF portion of the Study Area. Key findings of the assessments include:

7.1 Birds

- 139 fixed-point bird utilisation surveys have been undertaken across the WTA (including reference sites) between December 2016 and April 2019.
- 64 bird species were recorded on the WTA
- Four (4) of the 64 bird species were of conservation significance:
  1. White-throated needletail (*Hirundapus caudacutus) – V, MT, LM (EPBC Act)*
  2. Fork-tailed swift (*Apus pacificus) – MT (EPBC Act)*
  3. Rainbow bee-eater (*Merops ornatus) – LM (EPBC Act)*
  4. Cicadabird (*Coracina tenuirostris) – LM (EPBC Act)*
- No migratory shorebirds were observed flying over the site during known migratory activity periods suggesting the movement pathways are north – south along the Queensland coastline.
- 72% of the birds are considered to have low risk flight behaviours, occurring below the RSA on all recorded occasions. 92% of all bird species were recorded below the RSA, however some of these species are still capable of flying at or above the RSA
- 18 birds recorded on the WTA are known to exhibit moderate to high risk flight behaviour and include:
  - White-throated needletail (*Hirundapus caudacutus) – V, MT, LM (EPBC Act)*
  - Fork-tailed swift (*Apus pacificus) – MT (EPBC Act)*
  - Whistling kite (*Haliastur sphenurus) – Least Concern (LC) (NC Act)*
  - Channel-billed cuckoo (*Scythrops novaehollandiae*) *– LC (NC Act)*
  - Tree martin (*Petrochelidon nigricans*) *– LC (NC Act)*
  - Spotted harrier (*Circus assimilis) – LC (NC Act)*
  - Black-shouldered kite (*Elanus axillaris) – LC (NC Act)*
  - Welcome swallow (*Hirundo neoxena) – LC (NC Act)*
  - White-necked heron (*Ardea pacifica) – LC (NC Act)*
  - Brown falcon (*Falco berigora) – LC (NC Act)*
  - Australian hobby (*Falco longipennis) – LC (NC Act)*
  - Peregrine falcon (*Falco peregrinus macropus) – LC (NC Act)*
  - Rainbow bee-eater (*Merops ornatus) –LM (EPBC Act)*
  - Cicadabird *(Coracina tenuirostris) – LM (EPBC Act)*
  - Torresian crow *(Corvus orru) – LC (NC Act)*
  - Australian magpie (*Gymnorhina tibicen) – LC (NC Act)*
  - Sulphur-crested cockatoo (*Cacatua galerita*) *– LC (NC Act)*
  - Yellow-tailed black-cockatoo (*Calyptorhynchus funereus) – LC (NC Act)*
- Five (5) of these bird species were identified during surveys flying at or above RSA which included:
  - White-throated needletail (*Hirundapus caudacutus) – V, MT, LM (EPBC Act)*
  - Fork-tailed swift (*Apus pacificus) – MT (EPBC Act)*
  - Whistling kite (*Haliastur sphenurus)* – least concern
  - Channel-billed cuckoo (*Scythrops novaehollandiae*) – least concern

  - Tree martin (*Petrochelidon nigricans*) – least concern
- The potential impact of the four (4) bird species of conservation significance was assessed.
- It was determined that although the risk of collision of some bird species (WTN and FTS) may occur, the likelihood of impacting the International and/or National population of these species is considered low. This is due to the widespread distribution of the species and the highly variable occurrence and abundance of this species across the WTA.
- Impact on populations of Least Concern (NC Act) bird species considered at risk of collision is considered low, however adaptive management strategies will be applied to all species known or likely to occur within the WTA.

7.2 Bats

- Up to 14 species of microbat were recorded during the bat surveys.
- None of the microbat species recorded are threatened species under the NC Act or EPBC Act
- There are three (3) species of flying-foxes known to occur in the region.
  - Grey-headed flying-fox (GHFF) (*Pteropus poliocephalus*) – (EPBC Act – Vulnerable, NC Act – Least Concern)
  - Little red flying-fox (LRFF) (*Pteropus scapulatus*) – (EPBC Act – Not Listed, NC Act - Least Concern
  - Black flying-fox (BFF) (*Pteropus alecto*) – (EPBC Act – Not Listed, NC Act – Least Concern)
- There are seven (7) grey-headed flying-fox camps within 50km of the WTA, which have been active over the past five (5) years. These camps are often mixed with the black-flying fox and little-red flying fox. Two (2) of the seven (7) camps are Nationally Important Grey-headed Flying-fox Colonies which are 30km and 40km from the nearest turbine. Given the distance to the site, relatively small amount of remnant vegetation (foraging habitat) on site (0-4% within foraging ranges) and significant widespread foraging areas between these camps and the site (96-100% outside WTA), significant impacts to these populations are considered unlikely.
- As above, given the large areas of intact native vegetation outside of the WTA and relatively small amount of native foraging vegetation within the WTA, and local flight behaviour, the risk of collision-based impacts on least concern flying-fox colonies and grey-headed flying-fox colonies within 50km of the turbine area is considered low.
- No daytime flying-fox roosts are known within the WTA.
- Impact on populations of Least Concern (NC Act) bat species considered at risk of collision is considered low, however adaptive management strategies will be applied to all species known or likely to occur within the WTA

7.3 Terrestrial and Aquatic Flora and Fauna

- *Macrozamia pauli-guilielmi* (Pineapple Zamia) listed as endangered under the EPBC Act and NC Act was identified in the WTA and within the NSF portion of the Study Area. The *Macrozamias* found within the OTC have helped inform the OTC layout and will be avoided. The *Macrozamias* within the WTA were found in remnant vegetation and also mature pine plantations. All plants were found within 10m of road edges. Access is proposed to utilise existing access tracks and therefore impacts to *Macrozamias* is proposed to be avoided.
- Some areas within the Study Area have been mapped within a high-risk area on the DES Protected Plants Flora Survey Trigger Map. Should clearing be required within these areas, a pre-construction survey will be required to meet the requirements of the Flora Survey Guidelines.
- Koalas are known to occur in the NSF portion of the Study Area which may require clearing of native vegetation / koala habitat. Koala habitat offsets may be required.
- No greater gliders were identified in the areas surveyed within the WTA or NSF. Some areas within the OTC have not been surveyed (outside of current Project Area) although they are mapped as EH for greater gliders. Additional assessments will be undertaken once surveys are completed.

- *Crinia tinnula* (Wallum froglet) listed as vulnerable under the NC Act was identified in a roadside drain next to the Maryborough – Tuan Forest Road (access road into Hyne Timber Mill) within the WTA. Other similar areas (ie. roadside drains in low-lying areas) within the WTA may potentially also provide suitable habitat for this species Although they are not expected to be impacted by the Project (due to utilising existing tracks, should access tracks require widening in low-lying areas, pre-clearing surveys are recommended with works undertaken in accordance with an approved Species Management Plan for acid frogs.
- No other threatened frog species were identified within the Study Area, although they may occur in remnant areas such as along Tinana Creek which is not impacted by the Project.
- No threatened fish or turtles were recorded although they may be present in the permanent creeks through the Project Area. Waterways and riparian areas are not impacted by the project and therefore impacts to threatened fish, reptiles (including turtles) and amphibians is considered unlikely.

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