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Vegetation Community Survey Sites

Figure 4.7

- Project Area Boundary
- Turbine
- Met-mast

Clearance Envelope
- Stage 1
- Stage 2
- Vegetation Community Survey Site
- Watercourse
- Lot Boundary
- Easement

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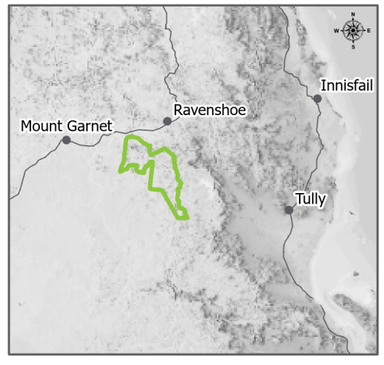

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Data Source(s):
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Protected Plants Surveys

A number of specific protected plant surveys have been carried out at discrete locations within the Project area within high-risk trigger areas (as mapped under the Queensland *Nature Conservation Act 1992* (NC Act)). All high-risk trigger mapping within the Project area relates to threatened flora species associated with the habitat type "rocky pavement shrub complex" which has been mapped along ridgelines in both properties. These ridgelines were therefore the focus of the protected plants surveys.

Where a threatened flora species (or possible threatened flora species) was recorded, a direct count (or estimate, in high-density populations) was undertaken, the population extent was mapped, and a specimen was collected for submission to the Queensland Herbarium.

September 2020

A protected plants survey was undertaken in September 2020 at the location of a proposed temporary meteorological monitoring mast on the Wooroora property. The survey was planned in accordance with the requirements set out in the Flora Survey Guidelines – Protected Plants (DES, 2020). The survey extent was defined in accordance with the guidelines and the Queensland *Nature Conservation (Plants) Regulation 2020* as the proposed disturbance area buffered by 100 m. The survey area (including the buffer) totalled approximately 11 ha and is shown in **Figure 4-8**.

The protected plants survey was conducted in accordance with the Flora Survey Guidelines, specifically Section 6.2.2 – timed 30-minute meander surveys. A pre-inspection of the site found the entire area was covered by a single habitat: eucalypt forest (mapped as RE 7.12.27c). Four separate 30-minute meanders were undertaken across the survey area.

March 2021

Protected plants surveys were undertaken at five further sites in March 2021 in accordance with the Flora Survey Guidelines – Protected Plants (DES, 2020). In each location, the survey area comprised the proposed disturbance area plus a buffer of 100 m. The number of meanders in each location was determined by the area of each habitat type, as per the Guidelines. Survey areas are shown in **Figure 4-8**.

June 2021

Protected plants surveys were undertaken at one additional location in June 2021 in accordance with the Flora Survey Guidelines – Protected Plants (DES, 2020), as shown in **Figure 4-8**.

February 2022

A two-person team undertook surveys for the aquatic plant, North Queensland lace, between 3 and 9 February 2022 (refer to **Figure 4-13**). Areas of potential habitat were first identified at a desktop level based on the ground-truthed vegetation communities fringing the watercourses that transect the Project area. Communities with rainforests understoreys (with emergent Eucalyptus) were considered to provide the light and temperature regimes most suitable for the species. Transects were undertaken along approximately 40 km of stream bank within the Project area, from both sides where possible. In some locations survey was only possible from one side due to steep banks and/or very dense infestation by lantana.

Flora Survey Limitations

Rainfall in the two months leading into the spring vegetation community survey was below average for the time of year, potentially resulting in reduced biomass of non-woody species and limited reproductive material to facilitate the identification of grasses and other understorey plants. However, these conditions had not affected established perennial woody species and the shrubs that were the target of the protected plants surveys were readily identified on site. The accuracy of the vegetation community determination and detection of woody threatened species was not compromised.

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Protected Plant Surveys

Figure 4.8

- Project Area Boundary
- Turbine
- Met-mast

Clearance Envelope

- Stage 1
- Stage 2
- Vegetation Community Survey Site
- Protected Plant Survey Area
- Watercourse
- Lot Boundary
- Easement

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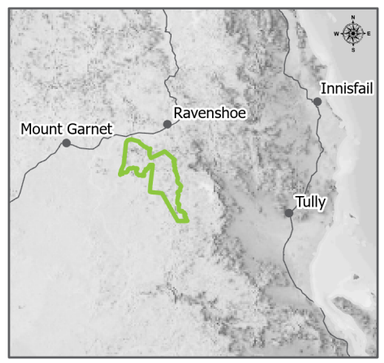

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Data Source(s):
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4.2.2.3 Fauna Surveys

Overview

Wet season fauna surveys were undertaken by three teams of two people between 18 January and 1 February 2021, whilst dry season fauna surveys were undertaken between 19 and 28 June 2021. These survey periods were undertaken in accordance with the Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al 2018) which identifies the optimal times of year for the Wet Tropics and Einasleigh Uplands bioregions as early wet season (November to January) and early dry season (May to July).

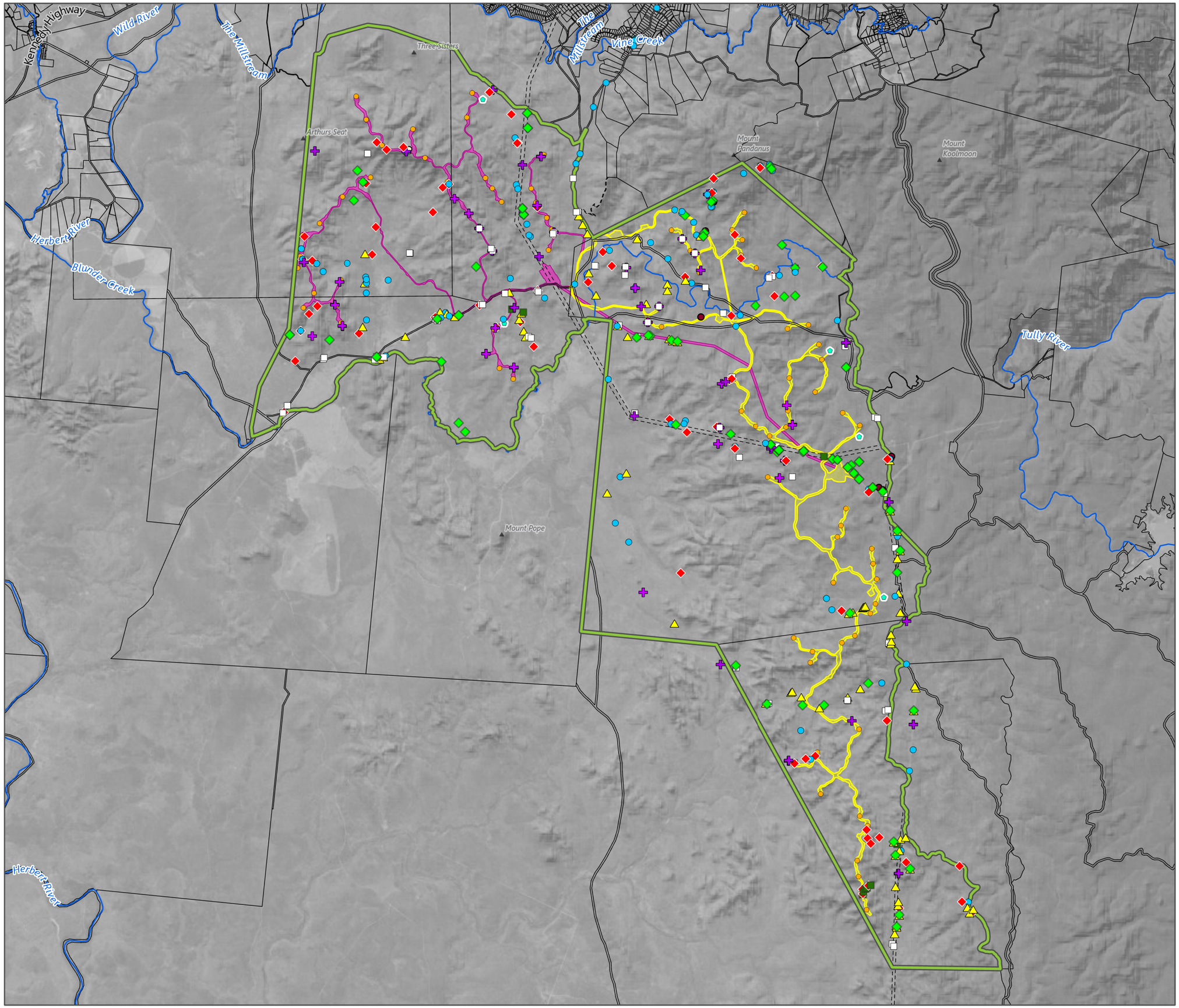
Supplementary spotlighting for amphibians was undertaken by a team of two people between 26 and 31 March 2021, immediately after a significant rainfall event. As per the Survey guidelines for Australia's threatened frogs (DEWHA, 2010c), the optimum timing for surveying for a number of the target threatened frog species (such as *Litoria nannotis* and *Pseudophryne covacevichae*) is during periods of peak activity from September to March, after but not during heavy rainfall.

Fauna surveys were designed to meet the requirements of the survey guidelines for conservation significant species with potential to occur, as detailed in the following documents:

- Queensland Terrestrial Vertebrate Fauna Survey Guidelines (Eyre et al 2018);
- Survey guidelines for Australia's threatened mammals (DSEWPC 2011a);
- Survey guidelines for Australia's threatened reptiles (DSEWPC 2011b);
- Survey guidelines for Australia's threatened bats (DEWHA 2010a);
- Survey guidelines for Australia's threatened birds (DEWHA 2010b);
- Survey guidelines for Australia's threatened frogs (DEWHA 2010c); and
- Victorian Approved Survey Standards: Greater Glider (DSE 2011).

Fauna Survey Methods

Fauna surveys comprised a combination of habitat assessments and targeted survey techniques as described in the following sections. Fauna surveys were undertaken at various sites across the Project area as shown in **Figure 4-9**. Much of the survey effort was focused on proposed access roads and turbine locations as these disturbance areas represent the highest risk for direct impacts on threatened fauna species. Preferred habitat for potentially occurring MNES fauna was also targeted. Survey sites are shown in **Figure 4-9** and a summary of survey effort for MNES species known or considered likely to occur is provided in the relevant sections for each species below. Opportunistic records of all fauna species were taken during all survey types, including during travel to and between survey sites.



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Fauna Survey Sites

Figure 4.9

- Project Area Boundary
- Turbine
- Met-mast

Clearance Envelope

- Stage 1
- Stage 2
- Active search
- Anabat
- Bird count
- Camera trap
- Habitat assessment
- Harp trap
- Observation
- Spotlighting
- Watercourse
- Lot Boundary
- Easement
- Project Area Boundary

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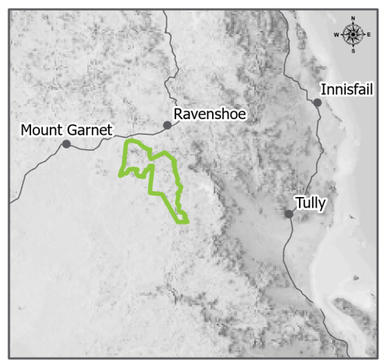

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Habitat Assessments

At each of the fauna survey sites, habitat assessments were undertaken to document the value of habitats for birds, reptiles, mammals and amphibians based on the presence of key resources and microhabitats, such as hollows, caves and rocky outcrops, leaf litter, water, etc. Key habitat features considered important for threatened species were recorded at each site.

Camera Trapping

Remote surveillance camera traps were installed at 40 sites across the Project area in January 2021, targeting areas of rocky outcrop, waterbodies, riparian corridors, natural openings and pathways through forest, and areas of fallen logs. Camera traps were baited using chicken and peanut butter, and were situated in such a way as to minimise false triggers as much as possible, such as vegetation that moves in the breeze. Habitat assessments were undertaken at camera trap sites, to ensure that the cameras targeting each species were deployed in appropriate locations. Thirty-one of the cameras were retrieved at the end of March 2021, and the photographs were analysed by a suitably qualified ecologist. The remaining nine cameras were not able to be retrieved at that time due to storm damage on the access road leading to the south of the Wooroora property; these cameras were instead retrieved as part of the dry season fauna surveys that were undertaken in June 2021. Fifteen of the cameras retrieved in March 2021 were immediately redeployed into previously inaccessible habitat to specifically target potential quoll shelter habitat (potential foraging and dispersal habitat were partially covered in the January deployment); data from these cameras was downloaded in June 2021. All cameras were re-set in June 2021 and were collected in December 2021. To date, the cameras have collectively recorded 9,270 trap nights.

Plate 4-8 Camera traps deployed within the Project area

Passive Acoustic Detection

Microbats rely on echolocation for orientation and foraging, and though the calls of almost all species are outside the range of human hearing, they can be detected by a bat detector. Anabat Swift detectors were installed along potential flyways (e.g. along an animal track or adjacent to a waterway) and set to record bat calls between dusk and dawn each night. During the wet season, six Anabats were deployed at five locations each, and for two consecutive nights at each location. During the dry season, six Anabats were deployed at three locations each, for two consecutive nights at each location. Additional Anabats were deployed at various BUS locations (see below) in April 2022, August 2022 and November 2022. In total, 174 survey nights at 63 locations were achieved using the Anabats. The resulting library of recorded calls was then processed by an experienced technician and identified to species level where possible.

Plate 4-9 Anabats deployed within the Project area

Harp Traps

During the dry season surveys, harp traps were set at seven locations in flyways, at water sources (e.g. dams and creeks) and in forest openings. Traps were deployed for three nights at each of the survey locations.

Plate 4-10 Harp trap deployed within the Project area

Spotlighting

Spotlighting and assessment of hollow-bearing trees for occupation by nocturnal mammals and owls was undertaken across the Project area. The surveys targeted masked owl, koala, northern greater glider and yellow-bellied glider.

Spotlighting involved walking or slowly driving through areas of potential habitat (i.e. native woodland or forest) with powerful spotlights and shining them into the canopy to try and identify eye-shine of active avian, mammal or reptile species. The spotlights were also periodically shone onto the ground to identify reptiles or amphibians that may be foraging on the ground surface. Six nights of spotlighting and active searching were carried out by a three-person team in January 2021, focusing on riparian areas where the vegetation is taller, more mature and more likely to support large hollows. An additional 40 person-hours of spotlighting were undertaken in March 2021, including some ridgelines in the north of the Project area. Remaining ridgelines were targeted during an additional 35 person-hours of spotlighting undertaken in June 2021.

Nocturnal Active Searches

Nocturnal active searches and call playback were undertaken on several watercourses within the Project area for frogs, including the EPBC Act listed magnificent brood frog and Australian lace-lid. A two-person team surveyed 24 locations in three broadly suitable areas over four nights after a decent rainfall event in March 2021. Additional targeted surveys for magnificent brood frog were undertaken over 5 nights June 2021, 5 nights in December 2021, 5 nights in January 2022, 5 nights in December 2022 and 2 nights in January 2023. Further surveys were attempted in January and February 2023 but site conditions were too wet and it is considered likely that any eggs or tadpoles would have been washed away. Further attempts to survey for another 10 nights will be made in March 2023, as soon as site conditions improve.

Diurnal Bird Counts

During the wet season, diurnal bird counts were undertaken at 28 fixed point, 2 ha area sites across the Project area, focusing primarily on ridgelines. Two ecologists recorded all birds seen and heard over a 20-minute period, repeated at each location in the morning and afternoon to maximise detectability of all species present. Birds were identified by call and sight, using binoculars to aid identification and a rangefinder to estimate the flight height to the nearest 10-20 m. Over the duration of the 12-day survey period, bird counts were undertaken for 37 person hours.

Bird Utilisation Surveys

During the dry season (19-28 June 2021), bird utilisation surveys (BUS) following a Before-After-Control-Impact (BACI) design were undertaken as per the requirements of State Code 23 and Appendix C of the Final PER Guidelines. BUS were undertaken at 21 locations across the Project area, comprising 17 impact sites and four control sites as shown on **Figure 4-10**.

Survey sites were distributed as evenly as possible across the Project area to maximise coverage of potential wind turbine locations. Given the large extent of the Project area and the ruggedness of the terrain, vantage-point surveys (VPS) were preferred over standard point count surveys as they maximise the observer's field of view across the Project area. The sites for each VPS were located at the highest point in the landscape, with a viewshed radius of up to 1 km, depending on visibility. Control sites were located at least 1.5 km from proposed turbine locations, outside the wind farm development footprint and in areas of similar habitat.

A spotting scope with a variable, 25x to 50x magnification was used to maximise bird detection and identification, and the survey effort was a 20-minute period at each location, repeated twice (once in the morning up to 10am and once in the afternoon after 3pm). This resulted in a survey effort of 1,680 minutes or 28 person-hours.

Bird activity was stratified into height bands to accommodate the potential Rotor Swept Area (RSA) for the turbines, which has provisionally been identified as between 40 m and 265 m. Bands were defined as:

- below the RSA: 0 m to 40 m;
- within the likely RSA: 40 m to 265 m; and
- above the RSA: > 265 m.

At each point the following information was recorded:

- survey site number;
- date;
- start and end time of the observation period;
- species or best possible identification;
- number of individuals recorded;
- distance from plot centre when first observed;
- closest distance;
- height above ground (per the bands defined above);
- activity, that is aerial pursuit of prey, aerial searching, ground pursuit, scavenging, canopy searching and feeding, ground searching and feeding, water searching and feeding, ambush predation, chasing prey from a perched location, shrub searching and feeding;
- habitat; and
- flight path.

The BUS were repeated between 5—17 October 2021, 18—25 January 2022, 6—14 April 2022, 9—17 August 2022 and 15—24 November 2022 following the approach above, adding a further bird survey effort of 140 person-hours and amounting to a total effort to date of 168 person-hours. The BUS survey report is provided in **Appendix Q**.

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Bird Utilisation Survey Sites

Figure 4.10

- Project Area Boundary
- Turbine
- Met-mast

Clearance Envelope
- Stage 1
- Stage 2

Bird Utilisation Survey Site
- Control Site
- Impact Site
- Watercourse
- Lot Boundary
- Easement

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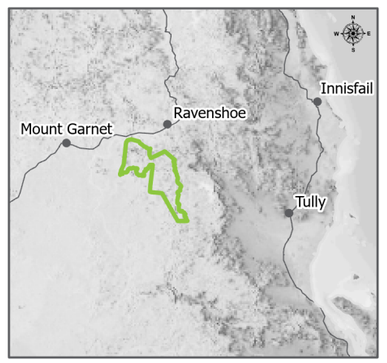

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Data Source(s):
Digital Cadastral Database - Department of Resources (2022)
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Survey of Potential Red Goshawk Nesting Habitat

A nest considered possibly belonging to red goshawk was observed in the Project area in January 2021, in riparian vegetation. The nest was unoccupied (as would be expected in late January) but appeared to have been recently built (no older than the 2019-20 breeding season). Photographs of the nest were sent to four recognised red goshawk experts; one (a QPWS ranger) stated the nest was likely to belong to the red goshawk while two others considered it was 'possibly' belonging to the red goshawk (the fourth did not respond). There are a small number of alternative raptor species that the nest could belong to. It was therefore considered necessary to actively survey appropriate areas of potential habitat during the nesting season. In northern Australia red goshawks lay eggs from July to September, and fledge young from October to December (DEWHA 2010b). The chicks are dependent on the adults until they leave the natal territory by the end of December. Surveys undertaken in the period October to December are therefore appropriate to identify nesting pairs that are actively tending to chicks. Further correspondence with avian experts indicates that the nest is highly likely to belong to the grey goshawk (*Accipiter novaehollandiae*).

The Survey guidelines for Australia's threatened birds (DEWHA 2010b) indicate that red goshawks are very secretive birds and generally silent; their presence is most likely to be detected by the location of nests. Therefore, the survey guidelines recommend that searches for their characteristic nests are undertaken within patches of the tallest forest which requires ground searches along river banks. Driving slowly through woodland tracks and scanning groups of tall trees for nests can also be effective. Soaring birds can also sometimes be located from vantage points such as mountain tops. The recommended survey effort guide is 50 hours over 8 days for a 50 ha area.

A map of potential red goshawk nesting habitat was developed for the Project area in 2021 using remotely-sensed tree height data and distance to water as key variables. This resulted in an area of approximately 7,500 ha being identified as potential red goshawk nesting habitat within the Project area. The map of potential habitat has guided targeted survey efforts for the red goshawk in 2021 and 2022.

The survey team has spent a total of 345 person hours surveying the Project area for red goshawk. Of this, 140 person hours were spent undertaking dedicated searches for red goshawk nests across the 7,500 ha area mapped as potential nesting habitat in October 2021 and December 2022, as described in **Section 4.6.3.4**. Transects were a mixture of driven and walked. An additional 205 person hours were spent undertaking visual surveys for soaring red goshawks.

Habitat Assessments for Northern Greater Glider

Targeted habitat assessments were undertaken by two ecologists from 9 to 15 December 2021 to assess northern greater glider (*Petauroides 118orter minor*) habitat quality and to determine the extent of habitat utilisation across an elevational gradient within the Project area.

Field survey methodologies were developed based on a review of published literature with respect to the habitat preferences of greater glider, as well as species specific survey guidelines in accordance with the *Survey Guidelines for Australia's Threatened Mammals* and *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (v3.0)*.

A total of 15 transects were surveyed including four up-gradient linear assessments across the Project area. Transects were positioned within areas of homogenous vegetation communities perpendicular to the slope. Transects were 100 m x 50 m within each up-gradient linear assessment located at regular intervals of at least 250 m apart. Coordinates of all sampling sites were recorded using a GPS device.

The following standard site-based habitat quality assessment parameters were recorded at each sampling site in accordance with *Queensland Habitat Quality Assessment Guide (v1.3)*:

- Number of large native trees over 30 cm diameter at breast height, DBH;
- Tree canopy height (emergent, sub-canopy and canopy);
- Recruitment of woody perennial species (in the ecologically dominant layer, EDL);

- Total per cent of tree canopy cover (emergent, sub-canopy and canopy);
- Native shrub layer % cover;
- Coarse woody debris;
- Native plant species richness for trees, shrubs, grasses and forbs;
- Non-native plant cover;
- Native perennial grass cover;
- Organic litter cover.

In addition, the Wandering Quarter Method (Kell 2006) was used to measure the distribution and densities of hollow-bearing tree (HBT) attributes and, ultimately, habitat quality for greater glider.

Collected field data for each HBT included:

- DBH and approximate tree height;
- Living condition of tree (alive or dead);
- Species of tree (if alive);
- Number of hollows, and for each hollow, the entrance diameter and entrance height from ground; and
- Signs of glider presence including feeding scars, scratches and scat.

Incidental Observations

Ecologists recorded any secondary signs encountered at each site during the survey period, or while walking between sites in the Project area. Secondary signs can lead to the positive identification of mammals, reptiles and birds. Animals often reveal their presence through tracks left in soft substrate. Similarly, arboreal animals may leave distinctive scratches on tree trunks as they climb. Some glider species leave feeding marks on tree trunks, with those of the yellow-bellied glider being particularly distinctive. Scats of many mammals can be identified, for example northern quolls use distinctive latrines and the faecal pellets of koalas at the base of trees may be an indication of their presence (noting that no koala faeces were observed during the surveys). Finally, hair, feathers bones or nests can often be identified to species level.

Fauna Survey Limitations

Wet season surveys were planned for late January 2021 in accordance with the Queensland Terrestrial Vertebrate Fauna Survey Guidelines (Eyre et al 2018). That year's wet season brought a number of cyclones / tropical storms to the region. Although there was little rainfall during the field surveys, there was considerable rainfall leading up to the surveys and conditions across the Project area were very wet. Flooding across the low-lying parts of the site cut off access to many of the ridgelines, limiting the amount of survey work that could be undertaken in proximity to proposed turbine sites. In response to this, some additional survey work was undertaken in March 2021 at the end of the wet season, specifically targeting potential habitat for northern and spotted-tailed quoll, magnificent brood frog and a number of rainforest stream frogs in areas that had not been accessible earlier in the season.

Night-time survey work was targeted towards vegetated areas that were safely accessible. Due to the terrain and the target species, most of the spotlighting surveys were undertaken from a vehicle on existing access tracks that were considered safe to drive at night.

4.3 Threatened Ecological Communities

4.3.1 Mabi Forest TEC

4.3.1.1 Threat Status, Distribution, Ecology and Diagnostics

The Mabi Forest (complex notophyll vine forest 5b) TEC is listed as Critically Endangered under the EPBC Act. Mabi Forest is also listed as Endangered in Queensland under the *Vegetation Management Act 1999* under the following two REs:

- RE 7.8.3: Complex semi-evergreen notophyll vine forest of uplands on basalt; and
- RE 7.3.37: Complex semi-evergreen notophyll vine forest of uplands on alluvium (TSSC 2002, SPRAT 2021).

This ecological community occurs on moist lowlands, foothills and uplands, on highly fertile basalt-derived soils. Annual rainfall in these areas is between 1300 mm and 1600 mm. The ecological community is heterogenous within and between remnant patches, due to the influence of position in the landscape and local topography (TSSC 2002).

Mabi Forest occurs within a restricted geographical range primarily on the Atherton Tableland, approximately 500 km southwest of Cairns, in the Wet Tropics bioregion. On the Atherton Tableland, remnants occur between the towns of Atherton, Kairi, Yungaburra and Malanda (SPRAT 2021). Prior to European settlement, Mabi Forest covered a large continuous area of the Atherton Tableland north and west of Malanda, extending from Yungaburra in the east, Kairi-Cullamungie Pocket to the north, Tolga in the west and past Wongabel State Forest in the south (SPRAT 2021). Estimates of the original extent of Mabi Forest range between 19,785 ha to just under 24,000 ha. The legacy of clearing (for timber production and agriculture) on the Atherton Tableland is a severely fragmented and modified landscape comprising remnant patches of various sizes, shapes, connectivity and condition. Sixty-two fragments have been identified and mapped, ranging in size from less than half a hectare to 271 ha (Latch 2008).

The current extent is estimated to be approximately 955 ha or 4% of the total pre-European extent, including 15.4 ha in the Ravenshoe area. Approximately 35% of Mabi Forest remaining is within the WTQWHA (Latch 2008).

Mabi Forest is characterised by an uneven canopy (25-45 m) with many tree layers. Most trees have a deep crown, often extending down between the top third and top half of the trunk. As a result, it is distinctly different to nearby simple notophyll vine forests that only have shallow crowns with a few layers. Notophylls (plants with a leaf size between 20.25-45 cm^2) are most common in the canopy, with mesophylls (plants with a leaf size 45-180 cm^2) frequently found in the lower layers. The notophylls are commonly semi-evergreen and undergo heavy leaf fall during times of moisture stress. The canopy also contains scattered deciduous trees. Epiphytes may be present (they are rare in the drier end of the community's distribution), and where they do occur, it is generally only in the upper branches of the canopy. A prominent medium to dense shrub and scrambling vine understorey occurs beneath the tall canopy, and is a unique and distinguishing feature of this type of forest. This shrub layer is partially responsible for the extensive range of bird species (up to 144 species) which use Mabi Forest for either foraging, nesting or as their main habitat (TSSC 2002). Twelve of the 13 bird species that are endemic to the WTQ are found in Mabi Forest (Latch 2008).

4.3.1.2 Known Threats

Fragmentation remains one of the most serious threats to the long-term viability of Mabi Forest as it has led to a reduction in species abundance and diversity, increased isolation of populations leading to reduced opportunities for re-colonisation and increased vulnerability to edge effects, disturbance and stochastic events (Latch 2008).

The Mabi Forest TEC is highly fragmented, and much of the remnant patches are being invaded by exotic smothering vines such as turbine vine (*Turbina 121orter121121121*). Other threats to the ecological community, such as lack of genetic diversity in the remnant forest, invasion by feral and domestic animals, invasion by weeds, and increased effect of wind damage on remnants, are typical of small remnants which are surrounded by land that is being used for agricultural purposes (TSSC 2002).

Many of the bird species present in this ecological community play key roles in pollination and seed dispersal. The southern cassowary has been identified as having a critical role in seed dispersal in rainforests of northern Australia. Fragmentation and reduction in patch size of remnant Mabi Forest has led to the local extinction of southern cassowary; the loss of this large seed dispersal vector has serious implications for the regeneration of this ecosystem, disrupting future ecological processes and the structure of this community (TSSC 2002).

The Recovery Plan for Mabi Forest (Latch 2008) lists the following threats to the ecological community:

- Clearing and fragmentation;
- Weeds;
- Loss of functionally important species;
- Incompatible land use management in the landscape;
- Feral and domestic animals;
- Roads and traffic;
- Stream bank erosion; and
- Natural catastrophic events.

SPRAT 2021 lists the following threat abatement plans as being relevant to this TEC:

- Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads (DSEWPC 2011c).

4.3.1.3 Survey Effort

Surveys to identify patches of Mabi Forest within the Project area were undertaken in October 2020, as described in **Section 4.2.2.2**.

4.3.1.4 Project Area Habitat Assessment

The Mabi Forest TEC was listed in the PMST (**Appendix B**) as likely to occur within the Project area. The Recovery Plan for Mabi Forest (Latch 2008) does not indicate any known patches of remnant Mabi Forest within the Project area, nor does the mapped pre-clearing extent of this community appear to extend as far south as the Project area.

SPRAT 2021 states that Mabi Forest remnants occur within the following reserve areas:

- Koombooloomba Forest Reserve;
- Millstream Falls National Park; and
- Tully Falls National Park.

RE mapping available from the Queensland DoR does not indicate the presence of either of the REs corresponding with the Mabi Forest TEC within the Project area but there is approximately 15.4 ha of RE 7.8.3 within the broader Study area (as indicated in **Figure 4-11**); vegetation communities within the broader Study area have not been ground-truthed and it is therefore possible that Mabi Forest is present within the WTQWHA, outside the Project area.

Vegetation surveys undertaken to ground-truth REs within the Project area did not confirm the presence of the Mabi Forest community (nor either of the constituent REs) and it is therefore considered that there is no Mabi Forest TEC within the Project area.

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Distribution of Mabi Forest TEC in the Study Area

Figure 4.11

- Project Area Boundary
- Study Area
- Turbine
- Met-mast

Clearance Envelope

- Stage 1
- Stage 2
- Mabi Forest
- Watercourse
- Lot Boundary
- Easement

Date: 15/10/2022 Author: TOD

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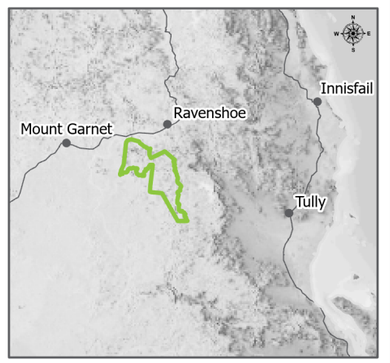

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Data Source(s):
Digital Cadastral Database - Department of Resources (2022); Regional Ecosystem Mapping, WildNet - Department of Environment and Science (2022); Atlas of Living Australia (2020) Earthstar Geographics, © State of Queensland (Department of Resources) 2022

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4.3.2 Broad Leaf Tea-tree Woodland TEC

4.3.2.1 Threat Status, Distribution, Ecology and Diagnostics

The 'Broad leaf tea-tree (*Melaleuca viridiflora*) woodlands in high rainfall north coast Queensland' TEC is listed as Endangered under the EPBC Act. It is restricted to the Wet Tropics and Central Mackay Coast bioregions where it occurs in high rainfall floodplain areas. While most occurrences are found within 20 km of the east coast, some patches of the community lie further inland, including within the Wet Tropics World Heritage Area.

Broad leaf tea-tree woodland occurs on poorly drained floodplains with a landform that is sloping to flat, and it occurs on landzones 3 (Quaternary alluvial systems) and 5 (plains and plateaus on Tertiary land surfaces). Soils are duplex with an impeded layer several centimetres below the surface which causes surface water to be present during the wet season. Inundation can persist for up to a few months (TSSC 2012a).

The ecological community is typically a woodland (but can have a forest structure in some areas) where *M. viridiflora* is dominant in the canopy and a diversity of grasses, sedges and forbs occupy the ground layer. Epiphytes are often conspicuous in the canopy and shrubs are generally sparse, although some sites have an obvious presence of grass trees in the understorey. The structure and floristics of this community vary in response to different soil types, extent of inundation in the wet season and successional responses to fire and grazing (DSEWPC 2012b).

Broad leaf tea-tree woodlands no longer exist at many sites where they were formerly present. In many cases, the loss is irreversible because sites have been permanently cleared or have undergone substantial modification that has removed their natural hydrological and biological characteristics. In other cases, the ecological community may exist in a disturbed or degraded state (TSSC 2012a).

Condition thresholds help identify a patch of the threatened ecological community. The key diagnostic characteristics for the TEC are:

- It occurs in the Wet Tropics and Central Mackay Coast bioregions in landscapes characterised by high rainfall and near coastal or floodplain locations;
- Sites are seasonally inundated during the wet season but are not permanently waterlogged;
- The tree canopy is clearly dominated (i.e. more than 50 % of canopy cover) by *Melaleuca viridiflora*;
- A shrub layer is typically absent or sparse; and
- There is a diverse ground-layer of grasses, sedges and forbs.

The listed TEC is limited to patches that meet the key diagnostic characteristics listed above and the following condition thresholds:

- Patch size must be ≥ 1 ha; AND
- A tree canopy must be present with a canopy cover of at least 15 %; AND
- The canopy must be dominated by *Melaleuca viridiflora* (broad-leaf tea-tree); AND
- At least 10 perennial native plant species are present in the understorey (shrub and ground layers, excluding juvenile canopy trees) of a patch; AND
- Perennial non-native plant species account for no more than 40 % of the total ground layer vegetation cover at any time of the year.

The ecological community has declined in extent from about 100,000 ha pre-European to 28,400 ha in 2012, a decline of approximately 71 %. It is estimated that there are approximately 2,500 patches of the ecological community remaining, of which the majority (77 %) are less than 10 ha in size. This indicates a very high degree of fragmentation across the range of the ecological community. Most Queensland REs that correspond to the ecological community (listed in **Section 4.3.2.4**) have been cleared to some extent in the past and have experienced continued decline since 1997. All substantial RE components have experienced declines of greater than 50 % in extent (TSSC 2012a).

4.3.2.2 Known Threats

The landscape within which the TEC occurs is subject to a range of land uses, including grazing and state forests. Some areas are subject to small-scale clearing for hobby farms and fire breaks (DSEWPC 2012b).

The key threats impacting the TEC are:

- Clearing and fragmentation;
- Weed invasion;
- Inappropriate grazing regimes;
- Forestry practices;
- Inappropriate fire regimes; and
- Illegal wildlife harvesting.

Myrtle rust and changes in hydrological regimes also represent potential threats to the TEC (DSEWPC 2012b).

The greatest threat to this ecological community now lies in gradual fragmentation via smaller-scale clearing for fences, roads and housing infrastructure, and the introduction of horse, goat and cattle grazing on hobby farms. As patches of the ecological community are lost and fragmentation of remaining patches increases, the resilience of the ecological community is compromised and the impacts of other threats (such as weed invasion) are exacerbated (TSSC 2021a).

4.3.2.3 Survey Effort

Surveys to identify patches of broad leaf tea-tree woodland TEC within the Project area were undertaken in October 2020, as described in **Section 4.2.2.2**.

4.3.2.4 Project Area Habitat Assessment

The broad leaf tea-tree woodland TEC was listed in the PMST (**Appendix B**) as likely to occur within the Project area.

The ecological community broadly corresponds with the following REs (TSSC 2012a):

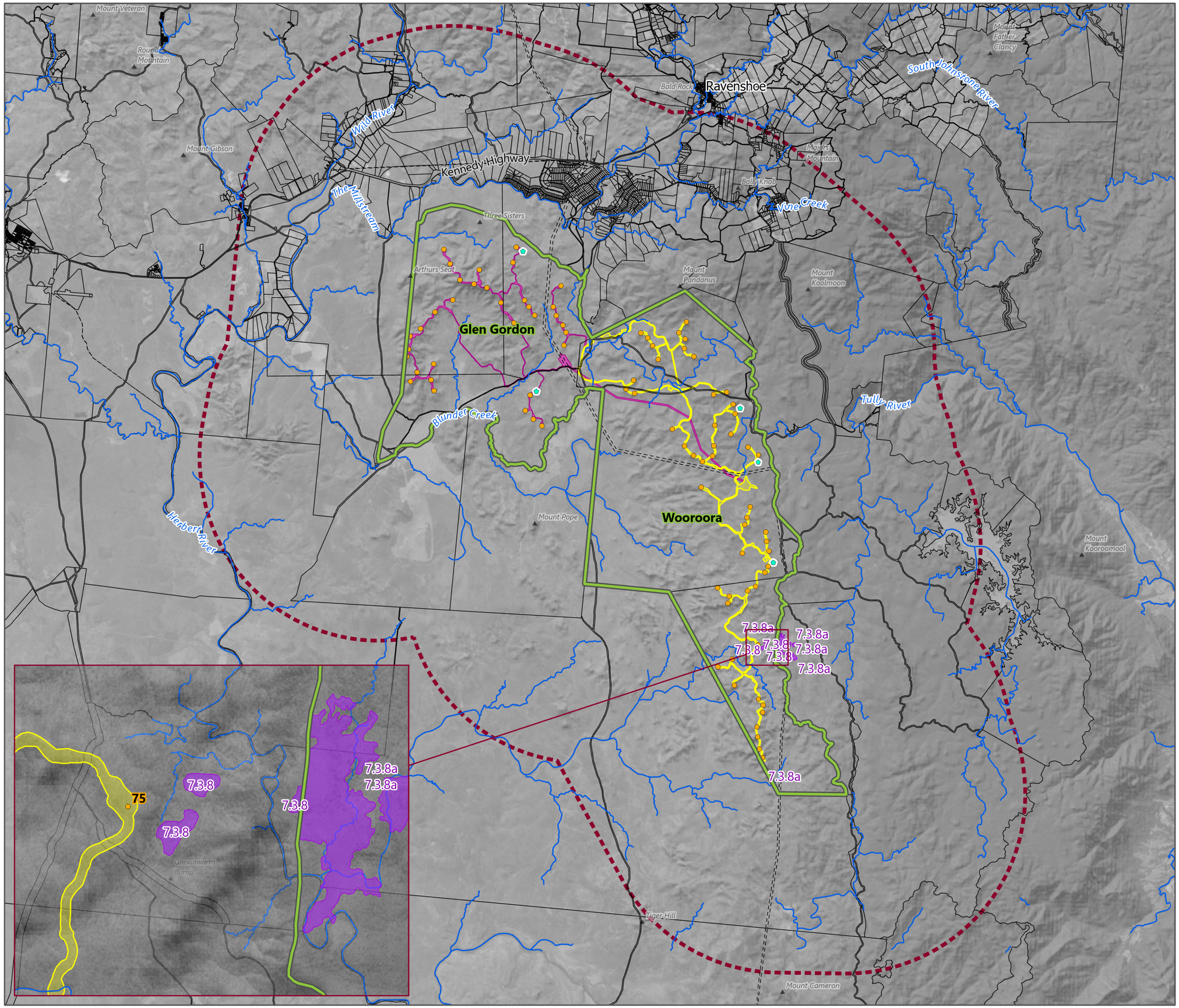
- RE 7.3.8a *Melaleuca viridiflora* open forest to open woodland, on poorly drained alluvial plains, listed as least concern under the VM Act;
- RE 7.3.8b *Melaleuca viridiflora* open forest to open woodland with eucalypt emergent or sparse eucalypt overstorey, listed as least concern under the VM Act;
- RE 7.3.8c *Melaleuca viridiflora* and *Lophostemon suaveolens* open forest to woodland on poorly drained alluvial plains, listed as least concern under the VM Act;

- RE 7.3.8d *Melaleuca viridiflora, Lophostemon suaveolens* and *Allocasuarina littoralis* open shrubland on poorly drained alluvial plains, listed as least concern under the VM Act;
- RE 7.5.4g *Melaleuca viridiflora* woodland on laterite, listed as of concern under the VM Act;
- RE 8.3.2 *Melaleuca viridiflora* woodland on seasonally inundated alluvial plains with impeded drainage, listed as endangered under the VM Act;
- RE 8.5.2a *Melaleuca viridiflora +/- Allocasuarina littoralis* woodland on Tertiary sand plains, listed as endangered under the VM Act;
- RE 8.5.2c *Melaleuca viridiflora* and *M. nervosa* woodland on Tertiary sand plains, listed as endangered under the VM Act;
- RE 8.5.6 *Melaleuca viridiflora +/- Allocasuarina littoralis* woodland on Tertiary sand plains (TSSC 2012a), listed as of concern under the VM Act.

The likelihood of whether an EPBC-listed ecological community is present or has the potential to be present at a particular site is based on an assessment of how an area meets the listing description, key diagnostic characteristics and condition thresholds of the national ecological community (as described in **Section 4.3.2.1**) (TSSC 2012a).

Three small patches of RE 7.3.8a were mapped (DoR 2021) within the southern part of the Project area (**Figure 4-12**); however, only one of these (alongside and mostly falling outside the property boundary) was ground-truthed as that RE. No quaternary points were taken in this vegetation patch (as it does not overlap the Project footprint) so it is unconfirmed whether the vegetation meets the key diagnostics of the TEC. The other two patches were ground truthed as RE 7.12.34 which is not one of the REs that is listed as potentially correlating to the TEC.

The vegetation mapping undertaken as a result of Project surveys identified two other patches of RE 7.3.8 which had been mapped as non-remnant by DoR (**Figure 4-12**). These patches did not meet the diagnostic characteristics of the TEC as in both cases the canopy was dominated by *Eucalyptus lockyeri*, with *Melaleuca viridiflora* only present in the T2 layer. It is therefore considered that there is no broad leaf tea-tree woodland TEC within the Project area.



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Broad Leaf Tea-tree Woodland TEC within the Study area

Figure 4.12

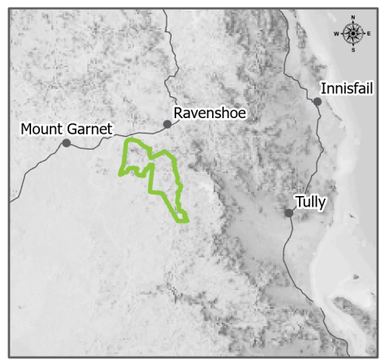
- Project Area Boundary
- Study Area
- Turbine
- Met-mast

Clearance Envelope

- Stage 1
- Stage 2
- Potential Broad-Leaf Tea-tree Woodland TEC
- Watercourse
- Lot Boundary
- Easement

Date: 15/10/2022 Author: TOD

Project: EPU-004 Reviewed: NOD



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Data Source(s):
Digital Cadastral Database - Department of Resources (2022); Regional Ecosystem Mapping, WildNet - Department of Environment and Science (2022); Atlas of Living Australia (2020) Earthstar Geographics, © State of Queensland (Department of Resources) 2022, Maxar

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4.4 Listed Threatened Flora Species

4.4.1 North Queensland Lace

4.4.1.1 Threat Status, Distribution, Population, Ecology and Habitat Preferences

North Queensland lace (*Aponogeton bullosus*) is listed as Endangered under the EPBC Act and NC Act. It has not been assessed for global threat status on the International Union for the Conservation of Nature (IUCN) Red List.

The population size of North Queensland lace is not known. The species occurs between Tully and Cairns, and west to the Ravenshoe area; its distribution overlaps with that of the Mabi Forest TEC. It has been recorded from Wooroonooran and Tully Falls National Parks (DEWHA 2008c).

North Queensland lace is a rooted, fully submerged, perennial aquatic species. Both the leaves and the flower head remain mostly submerged. It grows in cool, rapidly flowing freshwater rivers and streams in both sunny and shady positions (DEWHA 2008c).

4.4.1.2 Known Threats

The main identified threats to North Queensland lace include collecting for the aquarium trade as it is a highly saleable plant. Additional potential threats include encroachment of exotic plants from riparian zones and clearing of surrounding vegetation for farming, particularly dairying, resulting in changes to water flow and degradation of water quality (DEWHA 2008c).

As the Project area comprises private property (with locked gates in some areas) that is not easily accessible to the public, collection for the aquarium trade is unlikely to be occurring currently. Both host properties are used for cattle grazing but at relatively low density and the majority of the Project area is remnant vegetation, including riparian zones. There are some exotic species present but overall the vegetation is in good condition.

No Threat Abatement Plans have been identified as relevant for this species. There is no adopted or made Recovery Plan for this species (SPRAT 2021).

4.4.1.3 Survey Effort

Surveys to identify the presence of and potential habitat for North Queensland lace within the Project area were undertaken in February 2022, as described in **Section 4.2.2.2**. As the species flowers between the months of September and April (Calvert 2016), this survey period is considered appropriate. All semi-perennial watercourses within the Project area were surveyed, from both banks to the extent practicable given the dense coverage of Lantana in some areas. The total survey effort came to approximately 100 person hours.

4.4.1.4 Project Area Habitat Assessment

North Queensland lace was listed in the PMST (**Appendix B**) as likely to occur within the Project area. It has previously been recorded within the Bluff State Forest and the Millstream (part of the Herbert River catchment) to the north of the Study area, with the most recent record dating from 2018 (ALA). It has also been recorded from Tully Falls National Park in 2001 (ALA), which forms part of the Tully River catchment. Locations of previous records are generalized due to sensitivity concerns. North Queensland lace has not been previously recorded within the Project area.

All existing records of North Queensland lace have occurred in permanent, flowing watercourses (Dr Paul Forster, Principal Botanist, Queensland Herbarium, pers comm). The majority of mapped watercourses across the Project area

are highly ephemeral and generally dry for periods longer than the 6-8 weeks that North Queensland lace can remain as an underground tuber (Calvert 2016). These watercourses were not surveyed as they do not meet the definition of potential habitat for the species.

Targeted surveys for North Queensland lace over the course of five days did not identify its presence within the Project area. However, it was observed within the Study area and it does have the potential to occur in a small number of non-ephemeral / semi-permanent watercourses within the Project area. These watercourses are fringed with riparian vegetation that is likely to provide the necessary light and temperature regimes within the streams to support the species. Collectively these watercourse sections measure 40 km in length and flow into the Herbert River downstream of where the Millstream flows into the Herbert River. None of these watercourse sections are intersected by proposed Project infrastructure, as illustrated in **Figure 4-13**.

The species was observed near the Herbert River bridge, which may require upgrading if the Innot Hot Springs alternative route to site is established. Impacts to the species are not expected to occur (refer to **Section 5.6.2.2**).

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Observations and Habitat for North Queensland lace

Figure 4.13

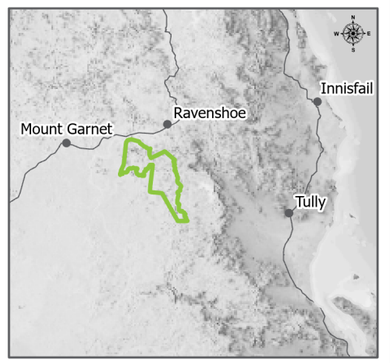
- Project Area Boundary
- Study Area
- Turbine
- Met-mast

Clearance Envelope

- Stage 1
- Stage 2
- Survey Transect
- Generalised Location of Threatened Flora record (ALA)
- Potential Habitat
- Watercourse
- Lot Boundary
- Easement

Date: 12/10/2022 Author: TOD

Project: EPU-004 Reviewed: NOD



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Scale: 1:200,000@A3

Data Source(s):
Digital Cadastral Database - Department of Resources (2022); Regional Ecosystem Mapping, WildNet - Department of Environment and Science (2022); Atlas of Living Australia (2020) Earthstar Geographics, © State of Queensland (Department of Resources) 2022

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4.4.2 Homoranthus 131orter

4.4.2.1 Threat Status, Distribution, Population, Ecology and Habitat Preferences

Homoranthus 131orter is listed as Vulnerable under the EPBC Act and NC Act. It has not been assessed for global threat status on the IUCN Red List.

The population size of *Homoranthus 131orter* is not known. It is restricted to northeast Queensland from near Mareeba southwards to near Ravenshoe, with collections having been made near Mount Emerald, Watsonville (west of Herberton), Mount Stewart (east of Herberton), Kaban, Mount Klaatsch, State Forest 754 (northwest of Ravenshoe) and State Forest Reserve 488 (south of Ravenshoe) (SPRAT 2021, DEWHA 2008b). Although anecdotal evidence suggests that *Homoranthus 131orter* is 'common' throughout the Wet Tropics, given this is its only known distribution, all populations are considered important (DEWHA 2008b). Its distribution is not known to overlap with any EPBC listed TECs (DEWHA 2008b).

Homoranthus 131orter grows on sandstone pavement, rocky outcrops, hillsides and scree slopes in open eucalypt woodland. It occurs in shallow soils on a variety of rock types (including rhyolite), usually in woodland or heath (SPRAT 2021). RPS (2011) described the species as favouring the edges of rock pavements, entirely restricted to exposed ridge topography and forming almost monospecific thickets.

4.4.2.2 Known Threats

Research is needed to identify threats to this species but habitat loss and weed infestation are likely to be considered threats (DEWHA 2008b). There are infestations of weeds throughout the Project area, including but not limited to lantana (*Lantana camara*) and Siam weed (*Chromolaena odorata*).

No Threat Abatement Plans have been identified as relevant for this species. There is no adopted or made Recovery Plan for this species (SPRAT 2021).

4.4.2.3 Survey Effort

Surveys to identify the presence of and potential habitat for *Homoranthus 131orter* within the Project area were undertaken in September 2020, March 2021 and June 2021, as described in **Section 4.2.2.2**.

4.4.2.4 Project Area Habitat Assessment

Homoranthus 131orter was listed in the PMST (**Appendix B**) as known to occur within the Project area. It has previously been recorded within the Study area (see **Figure 4-14**).

Homoranthus 131orter was recorded 30 times across four discrete locations within the Project area, with all records from the vegetation community RE 7.12.65: rock pavement or areas of skeletal soil on granite and rhyolite of dry western or southern areas +/- shrublands to closed forests of *Acacia* spp. And/or *Lophostemon suaveolens* and/or *Allocasuarina littoralis* and/or *Eucalyptus lockyeri* subsp. *Exuta*). Observations are indicated in Figure 4 14 and were from the following locations:

- In the northwest of the Glen Gordon property, in the vicinity and to the east of Arthur's Seat, within an altitude range of 830 – 860 m asl (corresponding to the same broad area where *Triplarina nitchaga* was also observed, see **Section 4.4.4.4**);

- On an adjacent ridgeline to the east of the above site, at an altitude of approximately 920 m asl. Extensive protected plants surveys were conducted along the ridgelines in this part of the Project area, with individuals occurring in discrete pockets on the rocky pavements;
- An area to the south of the existing powerline in the Wooroora property, corresponding to the area where *Prostanthera clotteniana* was also observed (see **Section 4.4.3.4**); and
- One site to the north of powerline easement in Wooroora, also corresponding to a *Prostanthera clotteniana* observation.

Habitat was mapped as rocky pavement shrubland complex on granite and rhyolite outcrops which broadly (but not exclusively) correlates to REs 7.12.57 (Broad Vegetation Group[13], BVG 9d) and 7.12.65k (BVG 29b). This habitat was initially identified and mapped across the site using stereoscopic interpretation of high-quality satellite imagery; the habitat mapping was subsequently refined on completion of the vegetation field surveys (described in **Section 4.2.2.2**).

[13] BVGs are a high-level grouping of vegetation communities across Queensland that takes into consideration floristic, structural, functional, biogeographic and landscape attributes. BVGs are ordered broadly to reflect the vegetation structure along a mesic gradient from wet closed rainforests of the coast and north east, to the arid spinifex hummock grasslands of the south west. More information is available in Neldner et al 2021.