5.0 Impact Assessment

The following sections describe and quantify the potential impacts associated with construction and operation of the Project in broad terms. Proposed safeguards and mitigation measures are described in **Section 6.0**. Significant impact assessments for each of the relevant MNES described in **Section 4.0** have been undertaken and are presented in **Section 8.0**.

The following factors were considered when assessing potential impacts:

- The magnitude of the impact, taking into account the severity and scale of the impact when compared with baseline conditions;
- The timing, duration and frequency of the impact;
- The likelihood that any given impact would occur;
- Whether any impacts are unknown, unpredictable or irreversible;
- The relevant component and stage of the project;
- Benchmarks and requirements set by statutory requirements, policies and guidelines referenced throughout; and
- The principles of Ecologically Sustainable Development, and the objects and requirements of the EPBC Act.

5.1 Project Footprint

The Project footprint for the proposed action as presented in **Section 2.0** provides a maximum disturbance extent (worst case scenario) and will be refined as the Project advances through the feasibility study process through to construction[18]. It includes permanent infrastructure such as turbines, access roads, substations, etc. and temporary disturbance such as earthworks batters that will be rehabilitated following construction. The Project footprint also accommodates required fire breaks around above-ground infrastructure such as turbines and overhead powerline poles. Some of the Project footprint will also include areas of temporary disturbance such as laydown areas that will be rehabilitated on completion of construction (as discussed further in **Section 7.0**).

The Project area (as defined by the host lots outside the WTQWHA) is 31,225 ha plus adjoining road reserves. The Project has made an industry leading commitment to rehabilitate construction disturbances and retain only the minimum footprint required for safe operations of approximately 107.2 ha (0.3 % of the Project area). In many instances, only the access track crest width (5.5 m) is required for operation of the Project which is significantly less than the batter width required for cut and fill in steep topography – these areas can be rehabilitated (see **Section 7.0**).

Further detailed design will enable micro-siting of infrastructure within the Project footprint in response to site-specific constraints such as large habitat trees.

[18] Through value engineering it is expected that the Project footprint will be reduced as the design is more thoroughly progressed. The extent of this decrease is not known at this stage (it may be in the order of 5% to 10%) and for the purposes of this PER a conservative Project footprint is assumed.

5.2 Potential Construction Impacts

Throughout the construction phase the Project has the potential to impact MNES values via the following:

- Vegetation clearing resulting in loss of habitat;
- Habitat fragmentation and reduced connectivity;
- Fauna injury or mortality during vegetation clearing and potential entrapment in trenches when installing underground powerlines;
- Fauna injury or mortality due to vehicle strike;
- Wildlife disturbance due to dust, noise, light and vibration emissions;
- Reduced water quality due to erosion and sedimentation;
- Potential spills of hazardous materials;
- Introduction or increased prevalence of pests and weeds due to increased vehicle movements and vegetation clearing;
- Increased risk of bushfire due to potential ignition sources on site associated with increased activity;
- Greenhouse gas emissions; and
- Potential disturbance of Aboriginal cultural heritage.

These are discussed in more detail in the following sections. It is important to note that proposed avoidance, minimisation and mitigation measures for these potential impacts are identified and discussed in **Section 6.0**.

5.2.1 Vegetation Clearing and Loss of Habitat

The Project area supports large areas of remnant vegetation dominated by open eucalypt woodland with small pockets of scattered rainforest communities close to the eastern boundary (i.e. closer to the WTQWHA). The Project has been designed to avoid any clearing of rainforest vegetation therefore threatened species specifically associated with these communities are not expected to be impacted.

Clearing of eucalypt woodland will reduce breeding, foraging and sheltering habitat for flora and fauna species, and the process of vegetation clearance has the potential to result in injury to or mortality of native fauna species. Some species are more sedentary and hence more susceptible to impacts than others. Conversely, more mobile species such as migratory birds are unlikely to be disturbed by vegetation clearing as they are able to disperse more easily.

The total clearing of remnant and regrowth vegetation is estimated at 1,049.6 ha, as outlined in **Table 5-1**, categorised by State conservation significance under the Queensland *Vegetation Management Act 1999* and regional ecosystem code**.** Although it is acknowledged that DCCEEW does not regulate Queensland's mapped REs, they provide a useful vegetation community and habitat classification tool for various MNES. This is acknowledged by DCCEEW in many conservation advices for MNES species and Threatened Ecological Communities. The REs are included in this PER as a scientifically recognised way of classifying vegetation community types and habitats in Queensland, which aids in discussion for each individual MNES. The RE mapping is used as a basis for this classification; however, this is not the only way through which potential and known habitat is identified for all MNES. Furthermore, as the Project team has ground-truthed the REs on the site (this demonstrated considerable differences between on-ground conditions and

the Queensland mapping layer), this PER does not rely upon the Queensland RE mapping as all vegetation communities have been classified based on ground-truthed conditions.

Table 5-2 categorises the vegetation clearing requirements based on potential MNES habitat under the EPBC Act. Potential impacts for each specific MNES are discussed and assessed for likely significance in **Section 8.0**, differentiated between potential habitat and critical habitat for each MNES.

Table 5-1 Summary of Vegetation Clearing (State classification system, ground-truthed)

RE Code	Description	Stage 1 (ha)	Stage 2 (ha)	Total (ha)
Of Concern				
7.3.26	*Casuarina cunninghamiana* woodland to open forest on alluvium fringing streams.	3.7	0.5	4.3
7.3.43	*Eucalyptus tereticornis* open forest to woodland on uplands on well-drained alluvium	3.5	0.1	3.6
7.12.52	*Eucalyptus resinifera*, *Corymbia intermedia*, *Allocasuarina littoralis*, *Syncarpia glomulifera*, *E. drepanophylla* +/- *E. reducta* woodland on granite and rhyolite in the dry to moist rainfall zone	117.6		117.6
7.12.57	Shrubland and low woodland mosaic with *Syncarpia glomulifera*, *Corymbia abergiana*, *Eucalyptus portuensis*, *Allocasuarina littoralis* and *Xanthorrhoea johnsonii* on uplands and highlands on granite.	4.4		4.4
7.12.57a	Shrubland and low woodland mosaic with *Syncarpia glomulifera, Corymbia abergiana, Eucalyptus portuensis, Allocasuarina littoralis* and *Xanthorrhoea johnsonii*. Uplands and highlands on granite and rhyolite, of the moist and dry rainfall zones.	23.9	0.7	24.6
7.12.66	*Lophostemon confertus* (brush box) low shrubland or low to medium closed forest. Exposed rocky slopes on granite and rhyolite.	0.6	22.5	23.1
Least Concern				
7.3.16	*Eucalyptus platyphylla* woodland to open forest on alluvial plains. Gently sloping to flat, moderately to poorly drained alluvial lowlands, foot slopes and piedmont fans.		1.1	1.1
7.12.27a	*Eucalyptus reducta* medium open forest and woodland. Uplands and highlands on shallow granitic and rhyolitic soils, of the moist rainfall zone.	135.7	14.6	150.2
7.12.27c	*Eucalyptus resinifera* and *Syncarpia glomulifera* open woodland. Uplands and highlands on shallow granitic and rhyolitic soils, of the moist rainfall zone.	76.6	34.3	110.9
7.12.29a	*Corymbia intermedia, Eucalyptus tereticornis, E. drepanophylla* open forest to low open forest and woodland with *Allocasuarina torulosa, A. littoralis, Lophostemon suaveolens, Acacia cincinnata, A. flavescens, Banksia aquilonia* and *Xanthorrhoea johnsonii*. Uplands, on granite and rhyolite.	11.7		11.7

RE Code	Description	Stage 1 (ha)	Stage 2 (ha)	Total (ha)
7.12.30a	*Corymbia citriodora, Eucalyptus portuensis, C. intermedia, Syncarpia glomulifera* woodland to low woodland to open forest with *Callitris intratropica, Acacia calyculata* and *Xanthorrhoea johnsonii*. Uplands and highlands, of the moist and dry rainfall zones.	24.5	28.7	53.2
7.12.34	*Eucalyptus portuensis* and/or *E. drepanophylla* +/- *C. intermedia* +/- *C. citriodora*, +/- *E. granitica* open woodland to open forest on uplands on granite	166.6	28.4	195
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*.	22.4		22.4
7.12.65k	Granite and rhyolite rock outcrop, of dry western areas, associated with shrublands to closed forests of *Acacia* spp. and/or *Lophostemon* spp. and/or *Allocasuarina* spp. In the Mount Emerald area, shrubs may include *Acacia umbellata, Melaleuca borealis, Homoranthus porteri, Leptospermum neglectum, Melaleuca recurva, Melaleuca uxorum, Grevillea glossadenia, Corymbia abergiana, Eucalyptus lockyeri, Sannantha angusta, Pseudanthus ligulatus* subsp. *ligulatus, Acacia aulacocarpa, Leptospermum amboinense, Xanthorrhoea johnsonii* and *Jacksonia thesioides*. Ground-cover species may include *Borya septentrionalis, Lepidosperma laterale, Eriachne* spp., *Cleistochloa subjuncea, Boronia occidentalis, Cheilanthes* spp., *Coronidium newcastlianum, Schizachyrium* spp., *Tripogon loliiformis, Gonocarpus acanthocarpus and Eragrostis* spp. Dry western areas. Granite and rhyolite.		4.7	4.7
9.3.15	Fringing woodland to open forest containing any combination of *Casuarina cunninghamiana*, *Eucalyptus tereticornis* and *E. platyphylla* +/- *Lophostemon suaveolens* +/- *Nauclea orientalis* +/- *Corymbia tessellaris* +/- *C. clarksoniana*. There is often a low sub-canopy layer which can include canopy species and Ficus spp. The open shrub layer contains juvenile canopy species and can include mesic species such as *Euroschinus falcatus*, *Acacia mangium* and *Syzygium sp*. The ground layer is medium to dense grassy and contains *Imperata cylindrica*, *Crotalaria sp*., *Heteropogon contortus*, *Cyperus spp*. and *Paspalum spp*. Occurs on stream banks and channels in areas of higher rainfall in the central east of the bioregion.		3.6	3.6
9.3.16	*Eucalyptus tereticornis* and/or *E. platyphylla* and/or *Corymbia clarksoniana* woodland on alluvial flats, levees and plains.		8.5	8.5
9.5.5a	Mixed woodland to open forest of *Eucalyptus crebra* (narrow-leaved ironbark), *Corymbia clarksoniana* (Clarkson's bloodwood) and *C. citriodora subsp. citriodora* (lemon-scented gum) +/- *E. portuensis* (white mahogany) with a generally open sub-canopy of canopy species +/- *Callitris intratropica* (cypress pine) and *Acacia* spp. The open shrub layer often contains juvenile canopy species, *Petalostigma pubescens* (quinine), *Acacia flavescens* (powder puff wattle) and other *Acacia* spp. *Themeda triandra* (kangaroo grass)	0.9	7.2	8.1

RE Code	Description	Stage 1 (ha)	Stage 2 (ha)	Total (ha)
	is the dominant species in a dense grassy ground layer. Occurs on Tertiary plateaus and remnants.			
9.12.2	*Eucalyptus portuensis*, *Corymbia citriodora* subsp. *citriodora*, *E. granitica* or *E. crebra*, *C. intermedia* or C. *clarksoniana* mixed woodland on steep hills and ranges on igneous hills close to Wet Tropics boundary	6.6	295.1	301.6
9.12.4	Low open woodland to woodland of *Eucalyptus shirleyi* +/- *Corymbia peltate* +/- *Callitris intratropica*. The mid layer varies from absent to a mid-dense sub-canopy and/or shrub layer and the ground layer is dense and grassy. Occurs predominantly on sandy shallow soils derived from igneous rocks on rolling low hills to hills.	0.9		0.9
Total		**599.5**	**450.1**	**1,049.6**

Vegetation clearing and habitat loss will occur sequentially, from the start of the construction phase as access tracks are developed across the Project area. Following completion of construction, only the minimum footprint required for safe operations will be retained (approximately 107.2 ha or 0.3 % of the Project area), with the balance of temporary construction disturbances available for rehabilitation. Small areas previously disturbed on site (e.g. for met masts) have demonstrated that ground cover establishes relatively quickly after clearing. This is further explained for the post-construction activities in the Preliminary Rehabilitation Plan (**Appendix K**).

Table 5-2 Clearing of MNES Habitat

MNES	Habitat description	Habitat in Project area (ha)	Area of habitat impacted (ha)	Significant residual impact	Offset required?
Threatened Ecological Community					
Mabi Forest (Complex Notophyll Vine Forest 5b) Threatened Ecological Community	Directly corresponds to REs 7.8.3 or 7.3.37	Nil	Nil	Unlikely	No
Broad leaf tea-tree (*Melaleuca viridiflora*) woodlands in high rainfall coastal north Queensland	May correspond to REs 7.3.8, 7.5.4, 8.3.2, 8.5.2 and 8.5.6 provided the vegetation meets key diagnostic characteristics	6.3 ha of RE 7.3.8	Nil	Unlikely The RE 7.3.8 vegetation was found not to meet the diagnostic characteristics of the TEC	No
Threatened Flora Species					
North Queensland lace (*Aponogeton bullosus*)	Non-ephemeral / semi-permanent watercourses with fringing riparian vegetation	189.4	3.1 ha	Unlikely Targeted surveys have not confirmed the presence of this species within the Project area	No
Homoranthus porteri	Rocky pavement shrubland complex on granite and rhyolite outcrops which broadly (but not exclusively) correlates to REs 7.12.57 (BVG 9d) and 7.12.65k (BVG 29b).	1,555.7	23.9 ha	Unlikely Targeted surveys have confirmed the absence of individuals within the Project footprint in areas of suitable habitat	No

MNES	Habitat description	Habitat in Project area (ha)	Area of habitat impacted (ha)	Significant residual impact	Offset required?
Prostanthera clotteniana	Rocky pavement shrubland complex on granite and rhyolite outcrops which broadly (but not exclusively) correlates to REs 7.12.57 (BVG 9d) and 7.12.65k (BVG 29b).	1,555.7	23.9 ha	Unlikely Targeted surveys have confirmed the absence of individuals within the Project footprint in areas of suitable habitat	No
Triplarina nitchaga	Rocky pavement shrubland complex on granite and rhyolite outcrops which broadly (but not exclusively) correlates to REs 7.12.57 (BVG 9d) and 7.12.65k (BVG 29b).	1,555.7	23.9 ha	Unlikely Targeted surveys have confirmed the absence of individuals within the Project footprint in areas of suitable habitat	No
Listed Threatened Amphibian Species					
Australian lace-lid (*Litoria dayi*)	Upland rainforest and wet sclerophyll forest alongside perennial streams	3.8	Nil	Unlikely	No
Magnificent brood frog (*Pseudophryne covacevichae*)	Potential breeding habitat for magnificent brood frog was mapped as potential seepages, and zero and first order streams on rhyolites of the Glen Gordon volcanics. Non-breeding habitat was mapped as open eucalypt forest within a 50 m buffer around the potential breeding habitat.	8,085.4	120.5 ha	**Likely**	**Yes**

MNES	Habitat description	Habitat in Project area (ha)	Area of habitat impacted (ha)	Significant residual impact	Offset required?
Mountain mistfrog (*Litoria nyakalensis*)	Upland rainforest and wet sclerophyll forest alongside perennial streams	3.8	Nil	Unlikely	No
Listed Threatened Bird Species					
Masked owl (northern) (*Tyto novaehollandiae kimberli*)	Potential nesting habitat comprises rainforest, riparian forest or open eucalypt forest containing "large trees" at a density of > 25 trees per ha (; foraging habitat is rainforest, riparian forest and open forest within a buffer area around nesting habitat based on a core range of 155 ha.	30,324.7	1,026.3 ha	**Likely**	**Yes**
Red goshawk (*Erythrotriorchis radiatus*)	Potential nesting habitat is remnant vegetation up to 1 km from a watercourse (stream order 3 or greater) and with a canopy height greater than 20 m; foraging habitat is any other non-rainforest remnant or regrowth vegetation.	30,320.3	1,031.74 ha	Unlikely[19]	No
Southern cassowary – Southern population (*Casuarius casuarius*)	Critical habitat is remnant vegetation dominated by rainforest communities and wet sclerophyll as listed in Appendix 2 of the species Recovery Plan (Latch 2007).	218	Nil	Unlikely	No

[19] The red goshawk has not been observed within the Project area. There is potential for the Project to have a significant residual impact on the red goshawk, in the event that turbine collision occurs. If a collision event leads to a significant residual impact (through exceeding an impact trigger limit), it may be necessary for the Project to offset this impact through payment into a research fund for the species.

MNES	Habitat description	Habitat in Project area (ha)	Area of habitat impacted (ha)	Significant residual impact	Offset required?
White-throated needletail (*Hirundapus caudacutus*)	No habitat mapping has been undertaken for white-throated needletail as this species could occur in any airspace over the Project area	Nil	Nil	Unlikely	No
Listed Threatened Mammal Species					
Black-footed tree-rat (*Mesembriomys gouldii rattoides*)	Potential habitat has been mapped as riparian forest (as this is more likely to support *Pandanus*, a key food species) below 700 m, buffered by 500 m as this is reportedly the species' foraging range (TSSC 2015a)	9,782.2	184.86 ha	Unlikely	No
Ghost bat (*Macroderma gigas*)	Potential roosting habitat in areas of rocky relief (as identified through analysis of LiDAR data); foraging within woodland habitats within 2 km of potential roost sites	17,926.9	655.63 ha	Unlikely	No
Koala (*Phascolarctos cinereus*)	Potential habitat is remnant and regrowth vegetation communities containing locally important koala tree species or ancillary tree species as listed per bioregion in Youngentob et al 2021.	25,231.4	843.81 ha	**Likely**	**Yes**
Large-eared horseshoe bat (*Rhinolophus robertsi*)	Potential habitat was mapped as rainforest, riparian forest and densely vegetation gullies within open eucalypt woodland	1,579.2	17.6 ha	Unlikely	No
Northern bettong (*Bettongia tropica*)	Potential habitat has been mapped as wet sclerophyll forests and vegetation communities	1,951.7	81.2 ha	Unlikely	No

MNES	Habitat description	Habitat in Project area (ha)	Area of habitat impacted (ha)	Significant residual impact	Offset required?
	dominated by *Corymbia citriodora* and *C. platyphylla*				
Northern greater glider (*Petauroides volans*)	Denning habitat comprises ground-truthed vegetation communities containing tree species characterising greater glider habitat (as listed in DES 2022) and containing "large trees" at a density of >25 trees per ha for the Wet Tropics bioregion (lower quartile of 46.5 cm DBH based on LQ = Mean – (0.65 x SD)) and >20 trees per ha for the Einasleigh Uplands bioregion. Foraging habitat comprises vegetation communities containing habitat trees species listed in DES 2022 within a buffer area around denning habitat based on a conservative home range size of 12 ha.	23,301.4	887.9 ha	**Likely**	**Yes**
Northern quoll (*Dasyurus hallucatus*)	Potential shelter habitat comprising areas of rocky relief were identified through analysis of LiDAR data; potential foraging habitat is Eucalypt woodland within 1 km of potential shelter habitat.	9006	331.84ha	Unlikely	No
Semon's leaf-nosed bat (*Hipposideros semoni*)	Potential habitat within the Project area is limited, and was mapped as rainforest, wet sclerophyll forest and riparian forest	5,034.4	143.6 ha	Unlikely	No

MNES	Habitat description	Habitat in Project area (ha)	Area of habitat impacted (ha)	Significant residual impact	Offset required?
Spectacled flying-fox (*Pteropus conspicillatus*)	Eucalypt forest and rainforest within a foraging distance of 50 km of the known Malancamp	28,890.3	976.1 ha	**Likely**[20]	**Yes**
Spotted-tailed quoll – northern subspecies (*Dasyurus maculatus gracilis*)	Upland closed forests > 900 m altitude, all notophyll, mesophyll and wet sclerophyll forest at or above this elevation has been mapped as preferred potential habitat	3,452.4	124.7 ha	Unlikely	No
Yellow-bellied glider (*Petaurus australis* Wet Tropics subspecies)	Remnant vegetation dominated by *Eucalyptus grandis* for denning or *E. resinifera* for foraging	999.9	28.14 ha	Unlikely	No
Listed Threatened Reptile Species					
Atherton delma (*Delma mitella*)	Potential habitat has been mapped as wet sclerophyll forests.	3,453	124.7 ha	Unlikely	No
Listed Threatened Migratory Species					
Black-faced monarch (*Monarcha melanopsis*)	Remnant vegetation dominated by rainforest communities	2,254.8	3.6 ha	Unlikely	No
Fork-tailed swift (*Apus pacificus*)	No habitat mapping has been undertaken for white-throated needletail as this species could occur in any airspace over the Project area	Nil	Nil	Unlikely	No

[20] There is potential for the Project to have a significant residual impact on the spectacled flying-fox through turbine collision and/or barotrauma. If such an event leads to a significant residual impact (through exceeding an impact trigger limit), it may be necessary for the Project to offset this impact through payment into a research fund for the species.

MNES	Habitat description	Habitat in Project area (ha)	Area of habitat impacted (ha)	Significant residual impact	Offset required?
Latham's snipe (*Gallinago hardwickii*)	Open, freshwater wetlands with low, dense vegetation (swamps, flooded grasslands or heathlands, bogs) or habitat with saline or brackish water during migration and have been found in modified or artificial habitats close to human activity	365	Nil	Unlikely	No
Rufous fantail (*Rhipidura rufifrons*)	Rainforest and wet sclerophyll forests	3,578.8	117.5 ha	Unlikely	No
Satin flycatcher (*Myiagra cyanoleuca*)	Eucalypt forest and woodlands at high elevations, but not rainforests	26,965	958.5 ha	Unlikely	No
Spectacled monarch (*Symposiachrus trivirgatus*)	Rainforest and moist eucalypt forest, including riparian vegetation.	3,904.1	122.01 ha	Unlikely	No

5.2.2 Habitat Fragmentation and Reduced Connectivity

Terrestrial habitat connectivity will be reduced as a result of the Project due to linear clearing, which will reduce fauna movements between areas of retained remnant vegetation. This habitat fragmentation will be more prominent where clearing widths are larger and intersect intact areas of vegetation. Clearing linear widths through habitats also has the potential to isolate plant populations by causing barriers to the dispersal of seeds and fruit, and to increase edge effects (additional light entering the forest, weed encroachment, increased feral animal abundance and increased risk of bushfire), thereby reducing the ecological functioning of those areas.

Some species are more prone to the impacts of fragmentation, such as greater gliders which are not able to traverse larger cleared areas. The maximum known gliding distance for a greater glider across the canopy is up to 100 m (DELWP 2019). Allowing for traversing canopies on steep slopes and short tree heights this is likely to correlate with a narrower horizontal distance of less than 100 m wide. Other species (such as masked owl) are less likely to be affected by clearings of this size and will disperse quite readily across access tracks and powerline easements.

Fragmentation impacts are likely to be temporary with a substantial proportion of the clearing for the access roads rehabilitated on completion of construction (subject to detailed design, this is estimated to be 70% of the Project footprint). Woodland habitats are anticipated to revegetate within approximately 20 years with habitat availability for fauna (such as foraging and sufficient cover for dispersal) increasing over the 20 year period. Further details on site rehabilitation are provided in **Section 7.0** and will be outlined in a Rehabilitation Management Plan.

5.2.3 Fauna Injury or Mortality

Direct fauna injury or mortality may occur as a result of the Project during vegetation clearing (e.g. through removal of mature trees containing hollows), vehicle collision or through entrapment in trenches; however, will be avoided through pre-clearance surveys by suitably qualified ecologists at all time in accordance with the Preliminary Fauna Management Plan (**Appendix D**).

Mortality from tree clearing is a greater risk for nocturnal arboreal mammals such as the northern greater glider, whereby mortality may occur from removal of hollow-bearing trees which provide daytime denning habitat for the species.

Excavations will be required to create trenches in which underground cables will be carried, and to allow construction of turbine pads and access roads. This will involve removal of ground vegetation, soil and rock which provide fauna habitat (e.g. denning sites in rocky areas). It is anticipated that each turbine pad may require an open excavation for an average duration of one month. During trenching activities there is potential for fauna to fall into and become trapped in open trenches, where they may perish or become subject to increased predation risk. Particularly susceptible species groups include reptiles, frogs and small mammals.

Increased traffic around the Project area throughout the construction phase has the potential to kill or injure fauna on impact. Some ground-dwelling or slow-moving species may be particularly susceptible to these impacts; however, the MNES relevant to this Project do not fall into this category.

5.2.4 Dust Emissions

Increased dust from vegetation clearing, earthworks and vehicle movements during construction has the potential to temporarily and locally impact flora and fauna values in the vicinity of the Project footprint. Excess generation of dust and subsequent deposition on leaves can impair plant photosynthesis and productivity, resulting in reduced habitat quality for fauna. Increased dust can also impact on respiratory systems of fauna, alter soil properties impacting on plant species assemblages and reduce water quality in aquatic habitats.

Dust is expected to only be a potential issue during vegetation clearing and construction. The effects of dust will be short-term and reversible particularly considering the regular rainfall that is characteristic of the Project area.

5.2.5 Noise and Vibration

Noise may adversely affect fauna by interfering with communication (e.g. territorial bird song), masking the sound of predators and prey, causing avoidance reactions and displacement from habitat. Construction noise will be generated by the Project through the use of machinery, plant and vehicles, and will vary from short intermittent noise from plant and equipment to more persistent noise from generators. The generation of construction noise may be in areas which have the potential to support threatened fauna species. Individuals that occur within the Project area may leave the area of impact. Project construction works and therefore potential noise impacts will be temporary.

Vibration from vehicles and equipment may cause temporary disturbance to fauna, and displacement or structural damage to boulder piles, rock fissures and caves which form habitat for fauna. Blasting may be required for construction of some pads and access roads depending on geological constraints, and obligate cave-dwelling bats would be particularly susceptible to vibration impacts from blasting.

5.2.6 Light Emissions

Artificial lighting from infrastructure and machinery may impact fauna within the Project area during the construction and commissioning phase. Artificial lighting can have a range of impacts which vary between species. Artificial light can disrupt patterns of both nocturnal and diurnal species by eliciting responses. Some species may avoid brightly lit areas, potentially due to the perception of there being increased risk of predation. Conversely, some species such as nocturnal reptiles, frogs and bats may congregate at artificial light sources to feed on insects attracted to light.

Other potential adverse impacts include disruption of breeding and migratory patterns, disorientation and potential collision with structures for MNES that fly within the Project area.

5.2.7 Erosion and Sedimentation

The main construction activities that could impact on water quality are excavations and earthmoving for construction of turbine pads and access roads. This may lead to erosion and sedimentation, reduction in water quality and changes to water flows, which in turn may impact MNES amphibians and more broadly the World Heritage Areas of the Wet Tropics of Queensland and the Great Barrier Reef.

During construction activities, sediment may be mobilised and transported by surface water during rainfall events, ultimately discharging into watercourses and drainage lines and potentially reducing water quality in downstream aquatic habitats. Increased suspended sediments can reduce light penetration into the water column, reducing photosynthesis of aquatic macrophytes and decreasing dissolved oxygen levels. However, the majority creek lines in the Project area are ephemeral and highly seasonal, which may reduce the magnitude of these impacts. The potential soil loss associated with the Project is quantified and discussed in the Sediment and Erosion Management Plan (**Appendix J**).

Changes in the hydrology of the Project area may occur through alteration of surface flows and stormwater runoff, including obstruction of flow. This can result in scouring or waterlogging occurring in some areas.

The accidental release of pollutants (including leaks and other uncontrolled releases) into the surrounding environment and waterways has the potential to degrade aquatic habitat quality in the Project area and impact vegetation communities and fauna utilising these areas. This includes direct toxic impacts on fauna from ingestion or

inhalation. Without mitigation, contaminants may enter waterways including oily wastewater (from heavy equipment cleaning), contaminated runoff from chemical or fuel storage areas and general washdown water.

5.2.8 Hazardous Materials

Project activities have the potential to result in accidental releases of hazardous materials, such as fuels and oils from vehicles and machinery. These hazardous materials can lead to localised soil contamination and contamination of water resources, which in turn can cause injury, reduced vigour or mortality to flora and fauna. The severity of the impact would be dependent on the location and magnitude of the release. This is generally expected to be associated with low volumes and localised on the soil that can be collected and remediated as pert standard construction projects.

5.2.9 Pests and Weeds

Project activities have the potential to increase the abundance of pest flora in the Project area and facilitate dispersal of species to previously unaffected areas. Movement of vehicles, equipment and personnel throughout the Project area is the key vector of transmission, in particular vehicles and equipment sourced from regions beyond the Project area which may introduce new species. Many weed species thrive on disturbed ground and will rapidly colonise disturbed areas in advance of native species recolonisation.

Increased pest flora abundance has adverse impacts on native vegetation and biodiversity, as well as potential negative economic effects on local land uses such as grazing activities.

Project-related activities may also increase pest fauna abundance in the Project area. This can lead to increased competition with, and predation of native fauna. In addition, habitat degradation may occur through vegetation trampling (e.g. feral pig wallowing). Creation of new access points into areas of intact vegetation may create pathways for feral fauna species to disperse, although it was noted during field surveys that pests such as feral pigs, feral cats and cane toads are already widely dispersed across the Project area. Uncontained waste sources may also attract feral fauna such as wild dogs; again, these are already widely distributed across the Project area. The defined access tracks associated with the Project are likely to enable effective monitoring and control of feral fauna.

5.2.10 Bushfire Risk

Fire is a natural part of the Australian landscape, and most vegetation communities are adapted to periodic fires. However, changes in the natural fire regime may result in changes in the species composition and / or structure of the vegetation. The increased presence of construction vehicles and personnel in the Project area may increase fire risk through use of machinery that may generate sparks, use of flammable liquids and idling vehicles being present in areas of ground vegetation. The Project will be constructed and operated in accordance with a Bushfire Management Plan (required under the State development permit), with firebreaks / asset protection zones established to ensure appropriate radiant heat flux. The linear nature of the Project will likely improve the access throughout the Project area to manage bushfire more effectively than is currently the case.

5.2.11 Greenhouse Gas Emissions

A Greenhouse Gas Assessment for the Project is provided in **Appendix L** and is summarised in **Section 13.2**. This assessment demonstrates that the construction of the Project may lead to greenhouse gas (GHG) costs predominantly through the following processes:

- Energy expended in the production of materials (i.e. embodied energy) (estimated at 838,643 t $CO_{2\text{-}e}$);

- Fuel consumed through the transportation of materials to site (estimated at 16,414 t $CO_{2\text{-}e}$); and
- Loss of carbon sequestration potential through the clearing of vegetation (estimated at 65,605 t $CO_{2\text{-}e}$).

The GHG savings associated with the Project are tied to the operational phase and relate to the production of electricity without generating GHG emissions. As described within **Appendix L** and summarised in **Section 13.2**, the GHG costs associated with the construction of the Project are expected to be fully offset within 1.5 years of operation.

5.2.12 Disturbance of Aboriginal Cultural Heritage

The Project area and surrounds contains considerable Aboriginal cultural heritage values, as described in **Section 4.10.2**. Incorrectly managed, the Project has potential to disturb these tangible and intangible values through construction activities. The Project has sought to work closely with the Jirrbal #4 People (as Traditional Owners) through Project design activities and also in accordance with the *Aboriginal Cultural Heritage Act 2003* (ACH Act) to ensure aspects of cultural heritage are managed appropriately. A Cultural Heritage Management Agreement (CHMA) was signed in October 2020 under the ACH Act. This is further described in **Section 8.10.3**.

5.3 Potential Operational Impacts

Throughout the operational phase, the Project has the potential to impact on MNES via the following:

- Fauna injury or mortality due to vehicle strike;
- Collision with turbines towers, blades and powerlines;
- Barotrauma;
- Wildlife disturbance due to noise and light emissions;
- Barrier effects;
- Potential spills of hazardous materials;
- Increased pests and weeds due to increased vehicle movements;
- Increased risk of bushfire due to potential ignition sources on site associated with increased activity; and
- Disruption of visual amenity.

These are discussed in more detail in the following sections.

5.3.1 Vehicle Strike

Increased traffic around the Project area has the potential to kill or injure fauna on impact although traffic levels will be greatly reduced from the construction phase and more geared towards light vehicles. Ground dwelling or slow-moving species may be particularly susceptible to traffic impacts. Due to the very low volumes of traffic expected during the operational phase of the Project (on average 2 movements per day, largely on defined access tracks and during daylight hours), this is considered to be a low risk. The operational vehicle movements are not expected to be materially different from the current vehicle movements associated with the grazing activities within the Project area.

5.3.2 Collision Risk

Potential impacts to threatened and migratory species, and other species groups of concern (e.g. microbats, raptors and waterfowl) may occur through direct collision with turbine towers and blades and associated powerlines, but also through flying through the "wake" behind the turbine. Many species will rarely, if ever, fly at rotor height while others will do so routinely. Different types of flight (e.g. soaring, direct flight, hovering) and different speeds of flight also will pose a different risk of collision.

Turbine siting will influence collision risk, with turbines located near wetlands likely to lead to greater risk of collision with birds and bats which congregate near wetland habitats. Turbines located on ridgelines and in valleys or other topographical features which may "funnel" birds and bats through a narrow pathway, pose a greater risk of collision. The rotor swept area (RSA) of the proposed turbines is relatively high and is located above the tree canopy, which will reduce the risk of collision for the avian species that fly at canopy and sub-canopy height.

Other factors that attract birds and bats to the proximity of turbines include an increase in perching habitat (from powerlines or the turbine structure itself), increased lighting that increases insect abundance around turbines, and the presence of carcasses around the base of turbines (attracting raptors and corvids in particular).

Generally, species at higher risk of collision are likely to comprise:

- Raptors – this group take advantage of updrafts associated with ridgelines to move around. Raptor species were reasonably well represented in the diurnal bird surveys, with observations of collared sparrowhawk, brown goshawk, grey goshawk, wedge-tailed eagle, Pacific baza, whistling kite, brown falcon and peregrine falcon.
- Migratory swifts – both white-throated needletail and fork-tailed swift were recorded in low numbers during the field surveys and will routinely fly at RSA height.
- Waterfowl (ducks, cormorants, terns, herons, etc.) – these species are generally prone to collision due to their often-direct nature of flight, flight height and lower manoeuvrability than other species. No significant wetlands are present within the Project area and this group was not well represented in the diurnal bird surveys, with a few observations of Australian wood duck, Pacific black duck, white-necked heron and white-faced heron.
- Migrating passerines and other species – migratory passerines routinely fly at RSA height. The Project area is not considered to be located in a significant corridor for passerine movement.
- High-flying or migratory/nomadic microbats – many species forage at or below canopy height, but some species forage well above canopy height (e.g. some of the freetail and sheathtail species).

5.3.3 Barotrauma

Mortality from near-contact collision in the form of barotrauma is known to primarily affect microbat species. Barotrauma is associated with low air pressure produced in the wake of moving blade-tips in the form of vertices. These vertices increase in size and decompression gradients with increasing blade velocity. The sudden change in air pressure associated with the vertices is known to damage the internal air-containing tissues of microbats (such as lungs) when entering a fast-moving turbine wake, typically causing internal haemorrhaging resulting in death. This form of mortality may account for up to 50 % of all microbat deaths associated with wind farms in locations where microbats are common. Rapid air pressure changes are largely an undetectable hazard and it is thought that microbats are more susceptible to fatal barotrauma than other groups due to particular anatomical features such as large lungs to body ratios and specialised vascular system to power high-energy flight (Baerwald et al. 2008).

5.3.4 Noise and Light Emissions

The mechanisms for operational impacts from noise and lighting are as described in **Section 5.2.5** for construction, although the potential for significant noise generating activities is greatly reduced.

Artificial lighting from infrastructure may impact fauna within the Project area during operation of the Project. In particular, artificial light can disrupt patterns of both nocturnal and diurnal species by eliciting responses. Some species may avoid brightly lit areas, potentially due to the perception of an increased risk of predation. Increased lighting of turbines may increase the presence of insects and in turn lead to an increased risk of collision with turbines for bats and birds.

5.3.5 Alienation or Barrier Effects

Once the Project is operational, the wind turbines have the potential to influence the behaviour of some fauna species, particularly birds and bats. There may be localised displacement in the area around each turbine individually (due to loss of habitat in that location) or avoidance around groups of turbines, as a barrier effect. This may prevent movements of birds and bats between breeding, foraging and roosting resources if the barrier is of a sufficient size.

The significance of barrier effects depends on the size of the wind farm, the spacing of the turbines and the degree of displacement of flying birds and bats. Wind farms where the turbines are located close together without sufficient corridors between groups of turbines are more likely to result in barrier effects.

Some species groups, such as waterfowl and shorebirds, are more likely to fly around the outside of a group of turbines instead of flying between the turbines (Hotker 2017). Neither of these groups are well represented within the Project area and hence this is not considered to be a large risk. Passerines (which form the majority of the bird assemblage within the Project area) seem to be relatively unaffected by displacement (Hotker 2017). Similarly, raptors appear to be more likely to be impacted by direct collision than by displacement (Hotker 2017).

5.3.6 Hazardous Materials

As described in **Section 5.2.8** for construction activities, operational activities have the potential to cause harm to fauna species through accidental releases of hazardous materials. The volume of such substances being used and stored on site during operation will be significantly less than during construction, with a corresponding reduction in risk.

5.3.7 Pests and Weeds

As described in **Section 5.2.9** for construction activities, operational activities have the potential to increase the abundance of pest flora and fauna in the Project area and facilitate dispersal of species to previously unimpacted areas.

5.3.8 Bushfire Risk

During operational activities, there is potential for heightened fire risk due to the increased presence of maintenance and monitoring vehicles and personnel in the Project area. This is through the use of machinery that may generate sparks, use of flammable liquids and idling vehicles being present in areas of ground vegetation.

There is also potential for the Project, through the clearing of wet sclerophyll forest vegetation, to lead to an increased risk of bushfire impacts to the rainforest areas and outstanding universal values of the WTQWHA. The wet sclerophyll

forest vegetation is known to act as a bushfire buffer and the removal of this vegetation in certain locations for the Project may lead to parts of the WTQWHA being exposed to elevated fire risk. This is further explored in **Section 8.9.2.3**.

5.3.9 Disruption of Visual Amenity and Outstanding Universal Values of the WTQWHA

Once constructed, the turbines will be visible from certain locations beyond the boundary of the Project area. Landscape impacts include physical changes to the fabric of the landscape, as well as perceptual changes in the character of the landscape. They also include impacts on areas designated for their scenic or landscape qualities at a national, regional or local level, for example National Parks, or important recreation areas. Visual impacts relate to changes in views and the appearance of a wind farm in those views. A detailed Landscape and Visual Impact Assessment (LVIA) has been undertaken for this Project and is attached as **Appendix M**. Specific assessment of the potential for the Project to affect the scenic amenity and the Outstanding Universal Values of the WTQWHA is presented in **Section 8.9** and **Section 8.10**.

5.4 Potential Decommissioning Impacts

At the end of the Project's operational life, infrastructure will be decommissioned and the site rehabilitated to facilitate continuation of the current land use (i.e. grazing). Decommissioning involves the removal of all above-ground infrastructure such as turbines, overhead transmission lines, switch stations, etc. Removal of buried infrastructure is not normally undertaken as this typically causes additional disturbance and environmental impacts. Once above-ground infrastructure is removed, the land is rehabilitated in line with specific approval conditions and landholder agreements.

Impacts during decommissioning are likely to relate primarily to vehicle movements around the Project area, potential for spread of weeds and risk of bushfire as described in the sections above. Some clearing of rehabilitated road verges may be required to facilitate the movement of large equipment, to be determined by a swept-path analysis at the time. Any clearing of rehabilitated areas would be rehabilitated again on completion of decommissioning.

5.5 Cumulative Impacts

Cumulative impacts on MNES can be defined as the additional effects caused by a proposed action in conjunction with other similar developments. A number of wind farm projects and the Northern QREZ augmentations are in operation, in construction or are being planned within the Tablelands region and have the potential to result in cumulative impacts when considered alongside the Project. These wind farms are introduced below and mapped in **Figure 5-1**.

5.5.1 Other Wind Farms in the Tablelands Region

5.5.1.1 Windy Hill Wind Farm

Windy Hill Wind Farm was the first wind farm to become operational in Queensland and has been operating since 2000. It is located approximately 4 km to the northeast of Ravenshoe and comprises 20 wind turbines over an area of 169 ha. The hub height is 46 m and the rotor diameter is 44 m, with a generating capacity of 12 MW.

As the Windy Hill Wind Farm has been operational for a long time, there is little information available on the pre-construction environmental conditions of the subject site. It is understood that the site was already cleared for

pastoral land uses prior to development of the wind farm. As such, there was likely to have minimal clearing of habitat for MNES associated with development of that project, despite its presence adjacent to the WTQWHA.

There have been no systematic bird and bat turbine collision mortality monitoring conducted at Windy Hill Wind Farm, although anecdotally mortality has been negligible (K Forde, pers comm). Similarly, there is no information available on turbine avoidance or powerline collision mortality.

The north-eastern part of the Windy Hill Wind Farm is immediately adjacent to the boundary of the WTQWHA, with the closest project infrastructure approximately 500 m from the WTQWHA. The Windy Hill Wind Farm was operational prior to the addition of the WTQ to the National Heritage List. It is important to note that the Windy Hill Wind Farm has co-existed adjacent to the WTQWHA and there is even a viewing platform and tourist attraction in recognition of its contribution to the landscape.

5.5.1.2 Mount Emerald Wind Farm

RATCH-Australia Corporation Limited developed and now operates the Mount Emerald Wind Farm (MEWF) approximately 20 km south-southwest of Mareeba on the Atherton Tablelands in north Queensland and approximately 62.5 km northwest of the proposed Chalumbin Wind Farm. The subject area is a total of 2,422 ha whilst the footprint is approximately 57 ha. MEWF involves the construction and operation of 63 wind turbines (up to 130-134 m high, with a rotor diameter of 100-108 m), associated access tracks and an electricity substation that will generate approximately 650,000 MW of renewable energy.

5.5.1.3 Kaban Green Power Hub

Neoen Australia Pty Ltd (Neoen) is currently developing the Kaban Green Power Hub, in Kaban, Queensland. It is located approximately 6 km to the northwest of Ravenshoe and 13 km northwest of the Project. The Kaban wind farm comprises 29 wind turbines with a maximum generating capacity of 160 MW. The subject site is a total of 1,330 ha whilst the footprint (i.e. total extent of disturbance) is approximately 446 ha. Ancillary infrastructure includes a substation, battery storage facility, four permanent meteorology masts, four temporary meteorology masts, two construction compounds, three laydown areas, two operational and maintenance facilities, wind turbine foundations, access tracks and underground cabling.

The Kaban Green Power Hub was referred under the EPBC Act in 2018 (EPBC 2018/8289) and was determined to be a controlled action, to be assessed by Preliminary Documentation. The Project was approved under the EPBC Act in April 2020 and is currently in the construction phase.

5.5.1.4 High Road Wind Farm

High Road Wind Farm Pty Ltd proposes to develop the High Road Wind Farm (HRWF) consisting of 18 wind turbines, with an estimated annual energy generation of approximately 100,000 MWh. The HRWF is located approximately 13 km north of Ravenshoe on the Evelyn Tablelands (part of the Atherton Tablelands) in North Queensland (approximately 20 km north of the Project). The subject site area is 395 ha, with the development footprint being approximately 8 ha.

The High Road Wind Farm project was determined to be Not a Controlled Action under the EPBC Act in December 2010. It was granted development approval by the Tablelands Regional Council in 2013 but the wind farm was not built. Ratch now intends to submit a new development application with for an updated project design. Comparison of information available on the High Road Wind Farm website (http://www.highroadwindfarm.com.au/) with that in the original referral (EPBC 2010/5721) indicates that the Project design, including proposed location of the turbines, has changed. Environmental studies are currently ongoing in relation to the new design and have identified a number

of conservation significant species on site to date, however further detail is not currently available. It is therefore not possible to analyse potential cumulative impacts for this project in **Table 5-3**.

5.5.1.5 Upper Burdekin Wind Farm

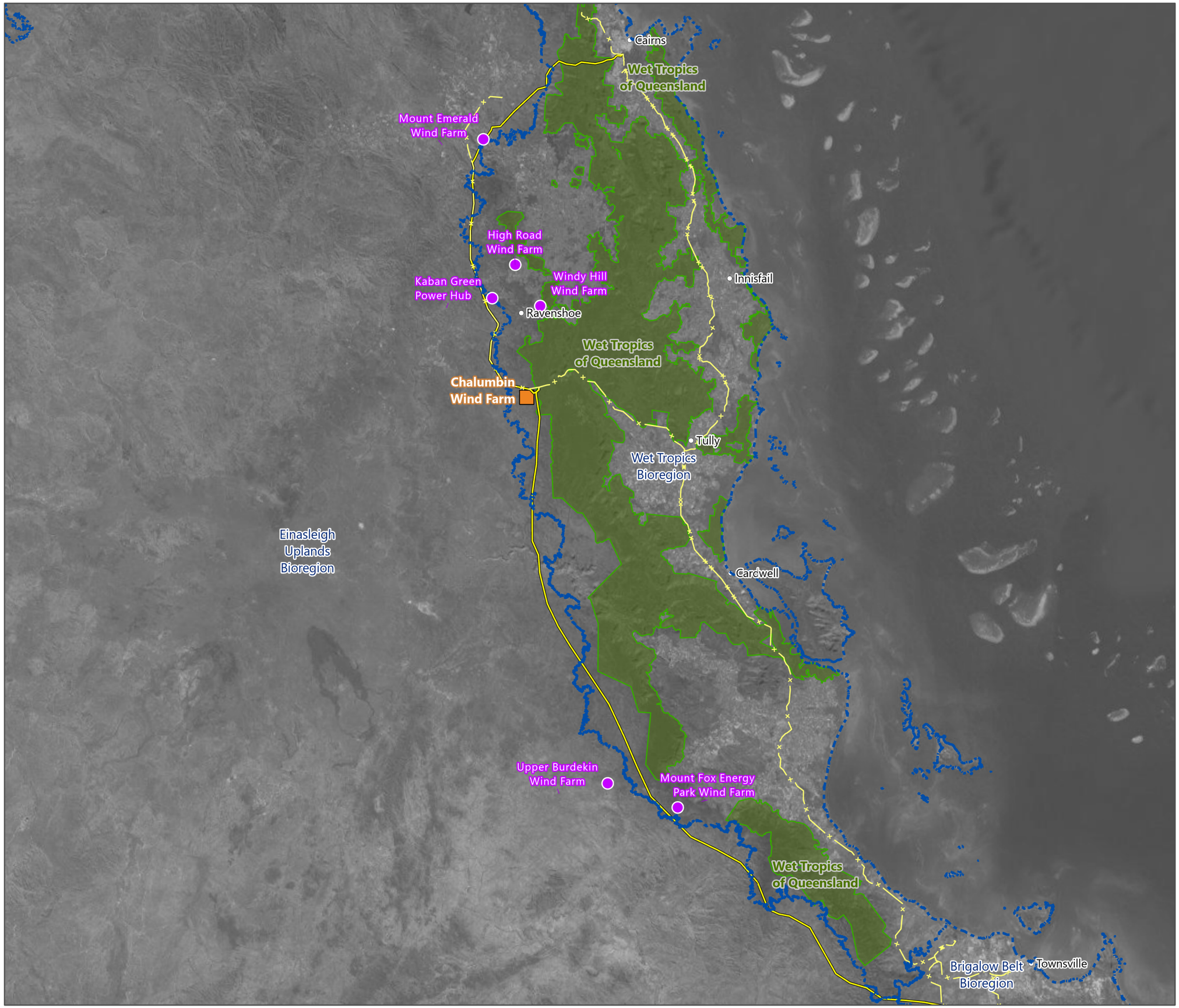
Windlab Developments Pty Ltd is proposing to build the Upper Burdekin Wind Farm (UBWF) at a site located on the Seaview Range, approximately 65 km southwest of Ingham in North Queensland, approximately 79 km southeast of the Project. The subject site is a total of 29,038 ha whilst the footprint is approximately 887 ha. The wind farm comprises up to 136 wind turbines (maximum hub height of 200 m, maximum blade length of 100 m) and ancillary infrastructure including approximately 150 km of internal access tracks.

The UBWF was referred to DCCEW (EPBC 2021/9066) and has been determined to be a controlled action, to be assessed by Public Environment Report. At the time of writing, the draft Guidelines for the PER had yet to be released.

5.5.1.6 Mount Fox Energy Park Wind Farm

Mount Fox Energy Park Pty Ltd proposes to develop Mount Fox Wind Farm approximately 35 km southwest of Ingham in North Queensland, approximately 102 km southeast of the Project. The project comprises up to 57 wind turbines (up to 147 m high) with a maximum generating capacity of 350 MW. The subject site is a total of 3,214 ha whilst the footprint is approximately 94 ha.

The Mount Fox Wind Farm was referred to DCCEEW (EPBC 2021/8910) and was determined to be a controlled action, to be assessed by Preliminary Documentation.



ARK ENERGY

Attexo

Chalumbin Wind Farm

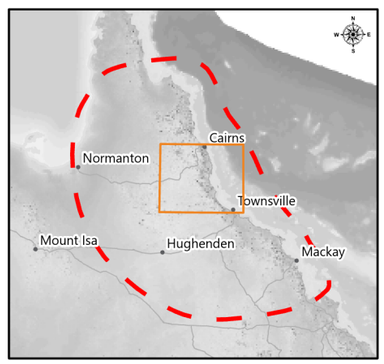
Cumulative Impact Assessment

Figure 5.1

- Chalumbin Wind Farm
- Source of Cumulative Impact
- 275 kV Transmission Line
- 132 kV Transmission Line
- Northern QREZ
- Wet Tropics World Heritage Area
- Bioregion Boundary

Date: 13/10/2022 Author: TOD

Project: EPU-004 Reviewed: NOD



0 10 20 30 40 50 Km

Scale: 1:1,000,000@A3

Data Source(s):
Digital Cadastral Database - Department of Resources (2021)
Earthstar Geographics, © State of Queensland (Department of Resources) 2022

Path: C:\Users\Tim ODonnell\Attexo Group\Attexo - Documents\Projects\Epuron\EPU-004 - Chalumbin\GIS\4.3 Cartography\11_PER_Submission\11_PER_Submission.aprx

5.5.2 Potential Cumulative Impacts – Other Wind Farms

A summary of the potential impacts of the Project and these other wind farms on the relevant MNES is provided in **Table 5-3**. Where any of these projects has the potential to impact on an MNES that is not relevant to the other wind farms (i.e. only individual project-specific impacts may occur), these MNES are not listed in the table. This applies to the following MNES relevant to the Project:

- Mabi Forest TEC;
- Broad Leaf Tea-tree TEC;
- North Queensland lace;
- *Triplarina nitchaga*; and
- Mountain mistfrog.

Potential cumulative impacts of anticipated climate change and the Project are also considered in **Section 5.5.3**.

Table 5-3 Cumulative Impact Assessment

MNES	Windy Hill Wind Farm	Kaban Wind Farm	Mt Fox Energy Park Wind Farm	Mt Emerald Wind Farm	Upper Burdekin Wind Farm	Chalumbin Wind Farm
Homoranthus porteri	As the Windy Hill site was cleared pasture land prior to development of the wind farm, it is unlikely to have supported this species, and unlikely to have resulted in any impacts.	The EPBC referral for the proposed action (EPBC 2018/8289) lists this species as highly likely to occur within the subject site. Significant residual impacts were considered unlikely.	The EPBC referral for the proposed action (EPBC 2021/8910) indicates a low likelihood of this species being present within the study site. Impacts on *H. porteri* are not anticipated.	This species was confirmed within the subject area (RPS 2014). The project was anticipated to result in a significant residual impact on the species, through a decrease in an important population; a reduction in the area of occupancy; population fragmentation; loss of habitat critical to the survival of the species; and a decline of local populations.	The EPBC referral for the proposed action (EPBC 2021/9066) lists this species as having potential to occur on the subject site.	Targeted surveys have been undertaken and have resulted in Project infrastructure being realigned to avoid all known populations of *H. porteri*. No residual impact anticipated.
Prostanthera clotteniana	As the Windy Hill site was cleared pasture land prior to development of the wind farm, it is unlikely to have supported this species, and unlikely to have resulted in any impacts.	The EPBC referral for the proposed action (EPBC 2018/8289) lists this species as highly likely to occur within the subject site. Significant residual impacts were considered unlikely.	The EPBC referral for the proposed action (EPBC 2021/8910) does not list this species. It is assumed that impacts are therefore not anticipated.	EIS listed the species as having a moderate to high likelihood of occurrence within the subject site. If present, the project is likely to result in a significant residual impact to this species.	The EPBC referral for the proposed action (EPBC 2021/9066) does not list this species. It is assumed that impacts are therefore not anticipated.	Targeted surveys have been undertaken and have resulted in Project infrastructure being realigned to avoid all known populations of *P. clotteniana*. No residual impact anticipated.
Magnificent brood frog	As the Windy Hill site was cleared pasture land prior to development of the wind farm, it is unlikely to have supported this	The species was confirmed within the subject site. The EPBC referral for the proposed action (EPBC 2018/8289)	The EPBC referral for the proposed action (EPBC 2021/8910) indicates a low likelihood of this species being present	The EIS (RPS 20140 lists this species as having a low likelihood of occurrence on the subject site. Impacts on	The EPBC referral for the proposed action (EPBC 2021/9066) lists this species as being unlikely	The Project will result in the loss of 120.5 ha of habitat for the species and is likely to represent a significant residual

MNES	Windy Hill Wind Farm	Kaban Wind Farm	Mt Fox Energy Park Wind Farm	Mt Emerald Wind Farm	Upper Burdekin Wind Farm	Chalumbin Wind Farm
	species, and unlikely to have resulted in any impacts.	indicates that significant residual impacts to the magnificent brood frog are likely.	within the study site. Impacts on magnificent brood frog are not anticipated.	magnificent brood frog are not anticipated.	to occur on the subject site.	impact to this species. Potential sedimentation impacts are likely to be avoided through the implementation of appropriate erosion and sediment control measures.
Masked owl	As the Windy Hill site was cleared pasture land prior to development of the wind farm, it is unlikely to have supported this species, and unlikely to have resulted in any impacts.	The EPBC referral for the proposed action (EPBC 2018/8289) lists this species as moderately likely to occur within the subject site. Significant residual impacts were considered unlikely.	The EPBC referral for the proposed action (EPBC 2021/8910) indicates a low likelihood of this species being present within the study site. Impacts on masked owl are not anticipated.	The EIS (RPS 20140 lists this species as having a moderate likelihood of occurrence on the subject site, foraging only. Significant impacts on masked owl are not anticipated.	This species was recorded within the subject site. The EPBC referral (EPBC 2021/9066) indicated that significant residual impacts to masked owl were unlikely.	The Project will result in the loss of 1,026 ha of habitat and is likely to represent a significant residual impact on this species.
Red goshawk	As the Windy Hill site was cleared pasture land prior to development of the wind farm, it is unlikely to have supported this species, and unlikely to have resulted in any impacts.	The EPBC referral for the proposed action (EPBC 2018/8289) lists this species as moderately likely to occur within the subject site. Significant residual impacts were considered unlikely.	The species has not been recorded within the subject site but is listed as having a moderate likelihood of occurrence. The proposed action will result in the loss of 131 ha of potential breeding and foraging habitat for red goshawk. The EPBC referral for the proposed action (EPBC 2021/8910) determined	The EIS (RPS 20140 lists this species as having a moderate likelihood of occurrence on the subject site. The project will result in the loss of 57 ha of potential foraging habitat, this was assessed as not significant.	This species was recorded within the subject site. The EPBC referral (EPBC 2021/9066) indicated a potential significant residual impact on red goshawk, including the loss of 379 ha of breeding habitat and 505 ha of foraging habitat.	The species has not been recorded on site despite targeted seasonal surveys over longer than one year. The Project will result in the loss of 1,031 ha of potential habitat. The Project is not anticipated to result in a significant residual impact on red goshawk.

MNES	Windy Hill Wind Farm	Kaban Wind Farm	Mt Fox Energy Park Wind Farm	Mt Emerald Wind Farm	Upper Burdekin Wind Farm	Chalumbin Wind Farm
			this impact to be not significant.			
Southern cassowary	As the Windy Hill site was cleared pasture land prior to development of the wind farm, it is unlikely to have supported this species, and unlikely to have resulted in any impacts.	The EPBC referral for the proposed action (EPBC 2018/8289) lists this species as unlikely to occur within the subject site.	The EPBC referral for the proposed action (EPBC 2021/8910) indicates a low likelihood of this species being present within the study site. Impacts on southern cassowary are not anticipated.	The EIS (RPS 20140 lists this species as having a low likelihood of occurrence on the subject site. Impacts on southern cassowary are not anticipated.	The EPBC referral for the proposed action (EPBC 2021/9066) lists this species as having potential to occur on the subject site.	The southern cassowary has not been confirmed within the Project area. The Project will not result in the loss of any habitat critical to the survival of the species, and is not anticipated to result in a significant residual impact on the southern cassowary.
White-throated needletail	It is possible that the Windy Hill site supported white-throated needletail prior to development, as this species can occur almost anywhere along the east coast of Australia. Significant impacts are considered highly unlikely, given the small size and scale of the development.	The EPBC referral for the proposed action (EPBC 2018/8289) lists this species as highly likely to occur within the subject site.	The species was recorded at one location within the subject area. The EPBC referral lists potential impacts to this species as not significant.	The species was confirmed on the subject site. The EIS (RPS 2014) indicates that significant impacts on the species are not anticipated.	The EPBC referral for the proposed action (EPBC 2021/9066) lists this species as having potential to occur on the subject site. Significant residual impacts to white-throated needletail were assessed as unlikely.	Six individuals have been recorded in the Project area over the course of more than a year of surveys. The Project is not anticipated to result in a significant residual impact on the white-throated needletail.
Ghost bat	As the Windy Hill site was cleared pasture land prior to development of the wind farm, it is unlikely to have supported this	The species was confirmed within the subject site. The EPBC referral for the proposed action (EPBC 2018/8289)	The EPBC referral for the proposed action (EPBC 2021/8910) indicates a moderate likelihood of this species being present	The EIS (RPS 2014) does not list this species. It is assumed that impacts are therefore not anticipated.	The EPBC referral for the proposed action (EPBC 2021/9066) lists this species as being unlikely to occur on the subject	The ghost bat has not been confirmed within the Project area. The Project will result in the loss of 1.12 ha of

MNES	Windy Hill Wind Farm	Kaban Wind Farm	Mt Fox Energy Park Wind Farm	Mt Emerald Wind Farm	Upper Burdekin Wind Farm	Chalumbin Wind Farm
	species, and unlikely to have resulted in any impacts.	determined that significant residual impacts to ghost bat were unlikely.	within the study site (foraging but not roosting). Impacts on ghost bat are not anticipated.		site. Impacts on ghost bat are not anticipated.	potential roosting habitat and 654.5 ha of potential foraging habitat. The Project is not anticipated to have a significant residual impact on the ghost bat.
Koala	As the Windy Hill site was cleared pasture land prior to development of the wind farm, it is unlikely to have supported this species, and unlikely to have resulted in any impacts.	The EPBC referral for the proposed action (EPBC 2018/8289) lists this species as moderately likely to occur within the subject site. Significant residual impacts were considered unlikely.	The EPBC referral for the proposed action (EPBC 2021/8910) indicates a moderate likelihood of this species being present within the study site, with the loss of c. 54 ha of potential habitat. The EPBC referral lists this impact as not significant.	The EIS (RPS 20140 lists this species as having a moderate likelihood of occurrence on the subject site. Significant impacts on koala are not anticipated.	This species was recorded within the subject site. The EPBC referral (EPBC 2021/9066) indicated a potential significant residual impact on koala, including the loss of 861 ha habitat.	The koala has not been confirmed within the Project area. The Project will result in the loss of 843.8 ha of habitat. The Project is anticipated to have a significant residual impact on the koala.
Northern greater glider	As the Windy Hill site was cleared pasture land prior to development of the wind farm, it is unlikely to have supported this species, and unlikely to have resulted in any impacts.	The species was confirmed within the subject site. The EPBC referral for the proposed action (EPBC 2018/8289) determined that significant residual impacts to the northern greater glider were unlikely.	The species has been recorded on site. The EPBC referral (EPBC 2021/8910) indicates the loss of c. 54 ha of greater glider habitat and lists this impact as not significant with the application of the proposed mitigation measures.	The EIS (RPS 2014) does not list this species. It is assumed that impacts are therefore not anticipated.	This species was recorded within the subject site. The EPBC referral (EPBC 2021/9066) indicated a potential significant residual impact on northern greater glider, including the loss of 853 ha of habitat.	The Project will result in the loss of 888 ha of habitat for the northern greater glider and is likely to represent a significant residual impact on this species.
Northern quoll	As the Windy Hill site was cleared pasture land prior	The EPBC referral for the proposed action (EPBC	The EPBC referral for the proposed action (EPBC	This species was confirmed within the	The EPBC referral for the proposed action (EPBC	Despite an extensive camera trapping

MNES	Windy Hill Wind Farm	Kaban Wind Farm	Mt Fox Energy Park Wind Farm	Mt Emerald Wind Farm	Upper Burdekin Wind Farm	Chalumbin Wind Farm
	to development of the wind farm, it is unlikely to have supported this species, and unlikely to have resulted in any impacts.	2018/8289) lists this species as moderately likely to occur within the subject site. Significant residual impacts were considered unlikely.	2021/8910) indicates a moderate likelihood of this species being present within the study site although it was not recorded during surveys. The potential impact area is listed as c. 77 ha. The EPBC referral lists this impact as not significant.	subject site. The EIS (RPS 2014) indicated the project would result in the loss of c. 57 ha potential foraging or denning habitat for the northern quoll. Impacts were conservatively estimated to be significant.	2021/9066) lists this species as being unlikely to occur on the subject site. Impacts on northern quoll are considered unlikely.	programme (nearly 6,000 camera trap nights over the course of 11 months), the presence of northern quoll within the Project area has not been confirmed. There is limited suitable denning habitat within the Project area, and the Project area does not support habitat critical to the survival of the species. The Project will involve the removal of c. 331.8 ha of potential foraging and dispersal habitat for the northern quoll. The Project is not anticipated to have a significant residual impact on the northern quoll.
Spectacled flying-fox	As the Windy Hill site was cleared pasture land prior to development of the wind farm, it is unlikely to have supported this species, and unlikely to have resulted in any impacts.	The species was confirmed within the subject site. The EPBC referral for the proposed action (EPBC 2018/8289) determined that significant residual impacts to the spectacled flying-fox are unlikely.	There is a high likelihood of this species occurring within the subject site. The EPBC referral (EPBC 2021/8910) lists potential impacts as not significant.	This species was confirmed within the subject site. The EIS (RPS 2014) indicates the loss of 57 ha of foraging habitat (no suitable roosting habitat is present). With the application of the	This species was recorded within the subject site. The EPBC referral (EPBC 2021/9066) indicated that significant residual impacts were unlikely.	The species has not been confirmed within the Project area. The Project will result in the loss of 976.1 ha of potential foraging habitat. The Project is not anticipated to have a significant

MNES	Windy Hill Wind Farm	Kaban Wind Farm	Mt Fox Energy Park Wind Farm	Mt Emerald Wind Farm	Upper Burdekin Wind Farm	Chalumbin Wind Farm
				proposed mitigation measures, impacts were determined to be not significant.		residual impact on the spectacled flying-fox.
Spotted-tailed quoll	As the Windy Hill site was cleared pasture land prior to development of the wind farm, it is unlikely to have supported this species, and unlikely to have resulted in any impacts.	The EPBC referral for the proposed action (EPBC 2018/8289) lists this species as unlikely to occur within the subject site.	The EPBC referral for the proposed action (EPBC 2021/8910) indicates a low likelihood of this species being present within the study site. Impacts on spotted0tailed quoll are not anticipated.	The EIS (RPS 20140 lists this species as having a low likelihood of occurrence on the subject site. Impacts on spotted-tailed quoll are not anticipated.	The EPBC referral for the proposed action (EPBC 2021/9066) lists this species as being unlikely to occur on the subject site. Significant impacts on spotted-tailed quoll are considered unlikely.	The spotted-tailed quoll has not been confirmed within the Project area. The Project will result in the loss of 124.7 ha of potential foraging and dispersal habitat. The Project is not anticipated to have a significant residual impact on the spotted-tailed quoll.
Yellow-bellied glider	As the Windy Hill site was cleared pasture land prior to development of the wind farm, it is unlikely to have supported this species, and unlikely to have resulted in any impacts.	The EPBC referral for the proposed action (EPBC 2018/8289) lists this species as moderately likely to occur within the subject site. Significant residual impacts were considered unlikely.	The EPBC referral for the proposed action (EPBC 2021/8910) does not list this species. It is assumed that impacts are therefore not anticipated.	The EIS (RPS 20140 lists this species as having a low likelihood of occurrence on the subject site. Impacts on yellow-bellied glider are not anticipated.	The EPBC referral for the proposed action (EPBC 2021/9066) does not list this species. It is assumed that impacts are therefore not anticipated.	The Project will not result in the clearing of denning habitat for the yellow-bellied glider. Approximately 28.1 ha of potential habitat will be cleared and significant residual impacts are not anticipated.
Migratory bird species: Black-faced monarch Fork-tailed swift Latham's snipe Rufous fantail	It is possible that the Windy Hill site supported fork-tailed swift prior to development, as this species can occur almost anywhere along the east	The EPBC referral for the proposed action (EPBC 2018/8289) lists fork-tailed swift and Latham's snipe as highly likely to occur within the subject	Rufous fantail has been confirmed within the subject site. Fork-tailed swift and satin flycatcher are listed as having a moderate likelihood of	Rufous fantail has been confirmed within the subject site. Fork-tailed swift and satin flycatcher were listed as having a moderate likelihood of	Satin flycatcher, rufous fantail and Latham's snipe were listed as likely to occur; fork-tailed swift, black-faced monarch and spectacled monarch were	Latham's snipe has not been confirmed within the Project area and the other species have only been recorded in low numbers, despite

MNES	Windy Hill Wind Farm	Kaban Wind Farm	Mt Fox Energy Park Wind Farm	Mt Emerald Wind Farm	Upper Burdekin Wind Farm	Chalumbin Wind Farm
Satin flycatcher Spectacled monarch	coast of Australia. Significant impacts are considered highly unlikely, given the small size and scale of the development. The subject site was unlikely to have supported the other migratory birds listed as it was cleared pasture land.	site; satin flycatcher as moderately likely to occur; and rufous fantail, black-faced monarch, spectacled monarch as unlikely to occur. Significant residual impacts were considered unlikely.	occurrence; Latham's snipe, black-faced monarch and spectacled monarch are listed as having a low likelihood of occurrence The EPBC referral lists potential impacts to migratory birds as not significant.	occurrence; Latham's snipe, spectacled monarch and black-faced monarch were listed as having a low likelihood of occurrence. The EIS (RPS 2014) lists potential impacts to migratory birds as not significant.	listed as having potential to occur. The EPBC referral for the proposed action (EPBC 2021/9066) considers that significant residual impacts to these migratory species are unlikely.	targeted seasonal surveys being carried out for more than a year. Significant residual impacts are not anticipated on these 6 migratory bird species.
Wet Tropics of Queensland World Heritage Area and National Heritage Place	Construction of this wind farm pre-dates the EPBC Act therefore the WTQWHA is not a controlling provision for the action. Nonetheless, the wind farm is immediately adjacent to the WTQWHA and is visible from established viewpoints within the WTQWHA, including the viewing platform created for the Project. The older, smaller turbines of this wind farm are much smaller than the more recent projects and are considered unlikely to have resulted in	n/a The WTQWHA is not listed as a controlling provision for this proposed action. It is therefore assumed that impacts on the visual amenity of the WTQWHA are not anticipated. In a cumulative sense, the wind turbines associated with this project may contribute to an overall increase of visual impact when considered in the context of other wind farm developments in the region west of the WTQWHA.	n/a The WTQWHA is not listed as a controlling provision for this proposed action. It is therefore assumed that impacts on the visual amenity of the WTQWHA are not anticipated. In a cumulative sense, the wind turbines associated with this project may contribute to an overall increase of visual impact when considered in the context of other wind farm developments in the region west of the WTQWHA.	The WTQWHA is approximately 14 km from the MEWF. It is possible that turbines and overhead powerlines within the wind farm are visible from viewpoints within the WTQWHA, but at this distance, impacts on visual amenity are not likely to be significant. The project will have potential impacts on two species listed as values of the WTQWHA, the northern quoll and the spectacled flying-fox; these impacts were determined in the EIS (RPS 2014) to be not	The landscape impact assessment (summarised in the EPBC referral EPBC 2021/9066) concluded that there would not be significant impacts to the landscape character types associated with the Wet Tropics, nor to aesthetic values associated with the Wet Tropics. Significant impacts on species listed as values of the WTQWHA were also considered to be unlikely.	A LVIA for the Project is presented in **Appendix M**. Whilst there will be some significant impacts for individual views obtained from selected locations within the WTQWHA, these locations are infrequent and typically difficult to reach. The dense foliage of the rainforest vegetation that is typical of the WTQWHA contributes to the fact that there are few publicly accessible vantage points providing views towards the Project from the WTQWHA.

MNES	Windy Hill Wind Farm	Kaban Wind Farm	Mt Fox Energy Park Wind Farm	Mt Emerald Wind Farm	Upper Burdekin Wind Farm	Chalumbin Wind Farm
	significant impacts to the visual amenity of the property. The Windy Hill wind farm is also unlikely to have impacted flora and fauna species listed as values of the WTQWHA due to the small scale of development on cleared pasture land.			significant with the application of the proposed mitigation measures.		When considering the potential for the Project to impact the Outstanding Universal Value (OUV) of the WTQWHA, it is important to consider these values as they apply to the WTQWHA in its entirety. In this context, the Project will have a negligible effect on the OUV of the WTQWHA.

5.5.3 Potential Cumulative Impacts – Climate Change

The potential cumulative impacts of the Project in conjunction with anticipated climate change effects (summarised in **Section 4.1.9**) are considered in **Table 5-4**.

Table 5-4 Potential Cumulative Impacts of Anticipated Climate Change Effects

Project Impact	**Climate Change Effects**			
	Increased temperatures	***More intense rainfall***	***Extreme weather events (cyclones)***	***Uncertain fire frequency***
Vegetation clearing and habitat loss	May exacerbate edge effects and change floristic composition, thus affecting the availability of habitat for species with very specific requirements	Risk of erosion in Great Barrier Reef catchment Downhill impacts from erosive forces of rain, i.e. increased sediment and nutrient load upon downhill vegetation	Increased edge-effects resulting in changes to vegetation structure, thus affecting the availability of habitat for species with very specific requirements	Reduced impact from fire due to access roads acting as fire breaks. Facilitating improved access for fire-fighting resources More frequent bushfires could increase the risk of loss of hollow-bearing trees, affecting the availability of denning habitat for species such as northern greater glider and masked owl countered by more rainfall and higher temperature which is conversely likely to increase habitat availability.
Pest and weeds	Invasive flora may outcompete native vegetation due to higher heat tolerance	The Project may exacerbate impacts from more intense rainfall due to alteration of site hydrology	No impact anticipated	Increased fire frequency may exacerbate biosecurity risk countered by increased shading from more vegetation growth due to rainfall and temperature.
Bird collision risk	Altitudinal migration due to increased temperatures may change the bird assemblage within	Reduced visibility during more frequent heavy downpours and	May result in migratory species moving inland, thus increasing collision risk countered by a	Reduced visibility from smoke during bushfire events increasing bird collision risk.

Project Impact	Climate Change Effects			
	Increased temperatures	***More intense rainfall***	***Extreme weather events (cyclones)***	***Uncertain fire frequency***
	the Project area and thus increase bird collision risk for the relatively small group of species that fly within the RSA.	potential increase in bird collision risk.	likely increase in available habitat for dispersing (due to increased rainfall and higher temperature).	

5.6 Facilitated Impacts

Facilitated impacts are those which result from actions (including actions by third parties) that are enabled by development of the Project. Examples of facilitated impacts that could feasibly be associated with a renewable energy project such as the Chalumbin Wind Farm may include:

- Construction of new high voltage powerlines by the transmission network service provider (TNSP) to convey the electricity generated by the Project to where it is used within the National Electricity Market (NEM); and
- Upgrades to the transportation network to enable delivery of large turbine components, and associated impacts to roadside vegetation/habitat.

The applicability of each of these examples is explored in more detail in the following sections. At this stage, no other potential facilitated impacts are considered reasonably associated with the Project.

5.6.1 Construction of New High Voltage Powerlines within the NEM

The NEM is a complex interconnected network of infrastructure that involves wholesale generation transported via high-voltage transmission lines from generators to large industrial energy users and to local distributors in each region (Queensland, New South Wales and Australian Capital Territory, Victoria, South Australia and Tasmania), which deliver electricity to homes and businesses (AEMO 2021b). The NEM includes approximately 40,000 km of transmission lines and cables. The transport of electricity throughout the NEM to consumers is facilitated through a spot market where the output from all generators is aggregated and scheduled at five-minute intervals to meet demand; this is managed by the AEMO in accordance with the National Electricity Law and the National Electricity Rules (AEMO 2021b). AEMO, through the use of sophisticated systems, seeks the optimal and efficient generation, transmission and distribution of electricity throughout the NEM to the consumers. Throughout the NEM, AEMO seeks to balance supply and demand.

The phased removal of large coal-fired generators from the NEM has significant implications on the patterns (geographically and diurnally) of electricity generation and transmission throughout the market. The prevalence of new renewable energy generators to replace the retired coal-fired generators is a key component of the transition that is underway within the NEM. The Northern QREZ is an example of AEMO and the Queensland Government seeking a coordinated approach to manage this rapid change within the NEM. Further information on the drivers behind this is provided in **Sections 1.5** and **3.0** of this PER.

Like any electricity generator, large-scale renewable energy generators seeking to partake in the NEM must obtain approvals from AEMO and the relevant TNSP or distribution network service provider (DNSP) to provide an agreed amount of electricity into the NEM. The capacity for the existing network to convey this electricity depends on how much electricity is produced by the generator, the specifications of the transmission infrastructure that the generator

is connecting to, and the existing (and future) generation and load throughout the NEM. This means that the ability for existing transmission infrastructure to convey electricity generated by a project such as the Chalumbin Wind Farm will depend on the characteristics of that infrastructure, the scale and magnitude of surrounding generators, and the ultimate users of the electricity. The capacity within these transmission lines is reported on an annual basis within the TNSP's Transmission Annual Planning Report (TAPR).

There are two 275 kV transmission lines that connect the Chalumbin substation to the Ross (Townsville) substation. Each of these lines are expected to have approximately 500 MW of capacity. Powerlink (the TNSP) has recently upgraded the existing Ross to Woree 132 kV line to be a 275 kV line (an upgrade delivered under the Powering North Queensland Plan); this is also expected to have approximately 500 MW of *additional* capacity. Collectively, these three transmission lines would provide approximately 1,500 MW of line capacity between Ross and Woree.

With respect to surrounding generation, the Kaban Wind Farm has a nameplate capacity of 157 MW and the complementary BESS at Kaban is 100 MW (unlikely to be discharging if wind generation is at its peak). Therefore, the existing 275 kV transmission lines between Ross and Woree contain ample capacity to connect the maximum generation output from Kaban Wind Farm (157 MW plus 100 MW) and Chalumbin Wind Farm (602 MW).

More broadly, the Northern QREZ is slated for AEMO and Powerlink investment to encourage additional renewable energy generators over time in this region. The step-change scenario within the AEMO ISP (2021a) predicts further network capacity being added to the Northern QREZ in 2031 (see **Plate 5-1**). It should be noted that these upgrades will likely occur with, or without, the Chalumbin Wind Farm.

Therefore, it can be conclusively stated that the Project will not facilitate further impacts on MNES through augmentation to existing infrastructure within the NEM.

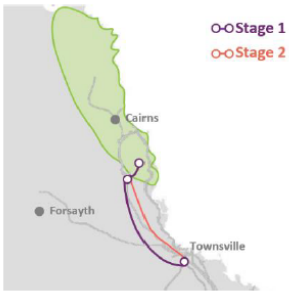
A5.5.5 Far North Queensland REZ Expansion

Summary

The Far North Queensland (FNQ) REZ is at the most northerly section of Powerlink's network. It has excellent wind and moderate solar resources and has existing wind, solar and hydroelectric power stations.

Options proposed to expand network capacity in this REZ progressively increase network capacity and allow for upgrades based on where generation develops. Due to the large amount of generation flagged for connection in this REZ, and outcomes highlighting potential need for network upgrades prior to 2034-35, co-ordination of new generation and network expansion may be required.

For this remote part of the network, reducing MLFs may act as a disincentive for generation to connect, therefore additional investigations will be completed in the final 2022 ISP to explore investment risks relating to MLFs.



Existing network capability

Maximum export capability from the FNQ REZ is limited by voltage stability for a contingency of a Ross to Chalumbin 275 kV circuit. The existing network will allow for a total of approximately 750 MW of VRE to be connected.

Output from this REZ can also be limited by network capacity further south which can result in the need for additional network augmentations. Output from this REZ is limited by downstream network capacity (refer to the 2021 Transmission Cost Report for more information†).

Augmentation sequences

Description	Status	Additional network capacity (MW)	Expected cost ($ million)	*Progressive Change*	*Step Change*	*Slow Change*	*Hydrogen Superpower*
Stage 1: • Establish a new 275 kV substation north of Millstream. • Build a 275 kV double-circuit line from Chalumbin to Millstream. • Rebuild the double-circuit Chalumbin–Ross 275 kV line at a higher capacity (possibly timed with asset replacement). • Build additional Chalumbin-Ross 275 kV double-circuit tower but string and energise as a single-circuit line.	Future	945	1,264	2037-38	2031-32	-	2028-29
Stage 2: (Pre-requisite: Stage 1) • String and energise the other Chalumbin-Ross 275 kV additional circuit.	Future	345	155	-	2039-40	-	2029-30 An additional 10,000 MW REZ network capacity required by 2049-50

Plate 5-1: North Queensland REZ expansion plans within the AEMO ISP (AEMO 2021a)

5.6.2 Upgrades to Road Network to Support Construction

Due to the oversized nature of equipment and plant involved in wind farm construction, and the large dimensions of wind turbine components delivered by road to the site, there is often a need to undertake upgrades to the existing local and State-controlled network to facilitate wind farm construction. This may include widening and resurfacing of road pavement, as well as selected removal of vegetation to allow for the large swept paths for the wind turbine blades[21]. A Transport Route Study for the Chalumbin Wind Farm is provided as **Appendix R** to this PER. This demonstrates the potential pinch points where manoeuvring the wind turbine blade will require careful management and potentially mitigation measures at these locations.

Importantly, the Project is utilising the same transport route from the Port of Cairns to the Kennedy Highway as is currently being used by the Kaban Wind Farm. Therefore, it is reasonable to conclude that the upgrades undertaken from the Port of Cairns to the Kennedy Highway (inclusive) for the Kaban Wind Farm will be sufficient to support the movements associated with the Chalumbin Wind Farm.

5.6.2.1 Northern Access (Wooroora Road)

From the point of deviation with the Kaban Wind Farm transport route, the Project's transport route involves a turn onto Tully Falls Road and then shortly after a turn onto Wooroora Road, which is proposed to be followed south into the Project area. This stretch from the Kennedy Highway to the Project area includes 14 pinch points where the modelled swept paths may require some potential impacts beyond the existing constructed road pavement (see **Appendix R** and **Figure 5-2**).

In order to determine the significance of this potential impact to MNES and associated habitat, it is necessary to analyse where the modelled swept paths intersect with mapped vegetation and mapped habitat. The modelled impacts across these 14 pinch points equate to 2.69 ha of potential removal of remnant vegetation (and no remnant wet sclerophyll vegetation removal), and 0.94 ha of potential removal of regrowth vegetation (no regrowth wet sclerophyll vegetation removal) as described in **Table 5-5**. No rainforest vegetation is predicted to be impacted by the upgrades.

Table 5-5 Summary of Potential Vegetation Clearing (State classification system) for Northern Access Road Upgrades

RE Code	Description	Remnant (ha)	Regrowth (ha)	Total (ha)
Endangered				
7.8.19	*Corymbia clarksoniana* open forest to woodland on basalt.	0.84	0.25	1.09
Of Concern				
7.3.19f	*Eucalyptus moluccana* woodland and open forest. Alluvium.	0.01	-	0.01
7.3.26a	*Casuarina cunninghamiana, Eucalyptus tereticornis, Lophostemon suaveolens, Melaleuca leucadendra, M. fluviatilis, Buckinghamia celsissima, Mallotus philippensis* woodland and	0.3	-	0.3

[21] Some upgrades/alterations to the road network may be required due to vertical dimensions associated the base tower section of the wind turbine; however, these upgrades typically relate to temporary relocation of traffic lights and low-voltage powerlines. It is invariably the wind turbine blade, as the largest horizontal dimensions, that present the largest potential impacts beyond the existing road corridor.

RE Code	Description	Remnant (ha)	Regrowth (ha)	Total (ha)
	forest with an understorey of *Melaleuca viminalis* and *Bursaria* tenuifolia. Fringing forests of larger systems.			
7.3.43a	*Eucalyptus tereticornis* open forest, tall open forest and woodland including communities ranging from those dominated by *E. tereticornis* to mixtures of that species with *Corymbia intermedia, E. drepanophylla, Lophostemon suaveolens* and *Allocasuarina torulosa*. Uplands on alluvium.	-	0.14	0.14
7.8.7a	*Eucalyptus tereticornis* open forest, tall open forest and woodland. May also include *Corymbia intermedia, E. drepanophylla, Lophostemon suaveolens* and *Allocasuarina torulosa*. Uplands and highlands on basaltic krasnozem and prairie soils, of the moist rainfall zone.	0.32	-	0.32
7.8.8b	*Eucalyptus reducta* open forest to woodland. Uplands and highlands on basalt, of the moist rainfall zone.	0.09	0.03	0.12
7.8.10a	*Eucalyptus tereticornis*, *E. drepanophylla*, *E. portuensis*, *Corymbia intermedia, C. tessellaris* woodland to open forest, with *Allocasuarina torulosa.* Uplands and highlands on basaltic euchrozem-krasnozem, of the dry rainfall zone.	0.57	0.31	0.89
7.8.10b	*Eucalyptus moluccana* woodland to open forest. Uplands and highlands on basalt, of the dry rainfall zone.	-	0.21	0.21
7.8.18d	*Lophostemon suaveolens* woodland and open forest. Basalt	0.22	-	0.22
Least Concern				
7.12.27a	*Eucalyptus reducta* medium open forest and woodland. Uplands and highlands on shallow granitic and rhyolitic soils, of the moist rainfall zone.	0.04	-	0.04
7.12.34	*Eucalyptus portuensis* and/or *E. drepanophylla* +/- *C. intermedia* +/- *C. citriodora*, +/- *E. granitica* open woodland to open forest on uplands on granite	0.57	0.01	0.58
Total		**2.69**	**0.94**	**3.63**

In terms of potential impacts on MNES from the values identified in **Table 5-5**, the minor potential clearing may lead to negligible removal of already-disturbed habitat along the existing road corridor for the following species:

- Masked owl;
- Red goshawk;
- Southern cassowary – southern population; and
- Northern greater glider.

These potential impacts are quantified and described in **Table 5-6**.

Table 5-6 Summary of Potential Habitat Clearing for Road Upgrades – northern access option

MNES	Habitat Description (from Section 4.0)	Potential Clearing (ha)
Masked owl	Remnant vegetation within landzone 3.	0.04
Red goshawk	Remnant vegetation within landzone 3.	0.04
Southern cassowary – Southern population	Remnant vegetation within RE 7.8.7.	0.32
Northern greater glider	Remnant vegetation within RE 7.3.26a	0.03

Based on the minor works potentially associated with the road upgrades at selected pinch points between the Kennedy Highway/Tully Falls Road intersection and the Project area, it is determined that potential facilitated impacts from the Project on MNES in this area will be negligible. These potential impacts are not considered to be significant in the context of the EPBC Act.

5.6.2.2 Alternative Optional Access – via Innot Hot Springs

From the point of deviation from the intersection of the Kennedy Highway and Herbert River Road, the alternative (and optional) transport route via Innot Hot Springs includes 20 pinch points where the modelled swept paths may require some potential impacts beyond the existing constructed road pavement (see **Appendix R** and **Figure 5-3**).

In order to determine the significance of this potential impact to MNES and associated habitat, it is necessary to analyse where the modelled swept paths intersect with mapped vegetation and mapped habitat. The modelled impacts across these 20 pinch points equate to 0.15 ha of potential removal of remnant vegetation (and no remnant wet sclerophyll vegetation removal), and no potential removal of regrowth vegetation as described in **Table 5-7**. No rainforest vegetation is predicted to be impacted by the upgrades.

Table 5-7 Summary of Potential Vegetation Clearing (State classification system) for Alternative Innot Hot Springs Access Road Upgrades

RE Code	Description	Remnant (ha)	Regrowth (ha)	Total (ha)
Least Concern				
9.3.15	*Eucalyptus tereticornis +/- Casuarina cunninghamiana +/- Melaleuca* spp. fringing woodland on channels and levees	0.03	-	0.04
9.5.5b	*Woodland of Eucalyptus crebra* (narrow-leaved ironbark) or *E. granitica +/- Corymbia clarksoniana* (Clarkson's bloodwood) *+/- C. dallachiana* (Dallachy's gum) *+/- C. erythrophloia* (red bloodwood) with a usually open sub-canopy and shrub layer including juvenile canopy species, *Grevillea glauca* (bushman's clothes peg), *G. parallela* (silver oak), *Acacia flavescens* (powder puff wattle), *Petalostigma pubescens*	0.02	-	0.58

RE Code	Description	Remnant (ha)	Regrowth (ha)	Total (ha)
	(quinine), *Melaleuca viridiflora* (broad-leaved paperbark) and *Denhamia cunninghamii* (yellow-berry). The grassy ground layer is dominated by *Themeda triandra* (kangaroo grass). Occurs on Tertiary plateaus and remnants. Not a Wetland.			
9.5.5c/9.3.16	Woodland to open woodland of *Eucalyptus moluccana* (gum-topped box) or *E. tereticornis* (bluegum) +/- *Lophostemon suaveolens* (swamp mahogany) +/- *Corymbia clarksoniana* (Clarkson's bloodwood). The distinct sub-canopy usually contains canopy species +/- *Melaleuca viridiflora (*broad-leaved paperbark). Scattered *M. viridiflora, Petalostigma pubescens* (quinine) and *Acacia* spp. may be found in the shrub layer. The dense grassy ground layer is often dominated by *Themeda triandra* (kangaroo grass) and *Chrysopogon fallax* (golden beard grass). Occurs on Tertiary sandplains. *Eucalyptus tereticornis* and/or *E. platyphylla* and/or *Corymbia clarksoniana* woodland on alluvial flats, levees and plains	0.1	-	
Total		**0.15**	**-**	**0.15**

In terms of potential impacts on MNES from the values identified in **Table 5-7**, the minor potential clearing may lead to negligible removal of already-disturbed habitat along the existing road corridor for MNES species.

This alternative access is via Innot Hot Springs and is currently being investigated for engineering feasibility associated with the existing bridge structure crossing the Herbert River. This bridge may need to be reinforced to support the OSOM vehicle movements that would be required as part of the Project's construction activities. Investigations of the existing environment at this location of the Herbert River indicated the presence of the EPBC Act Endangered *Aponogeton bullosus* (North Queensland Lace). Depending on detailed design, the bridge may require widening by approximately 1 m over the width of the bridge crossing of approximately 250 m. The low flow channel where North Queensland Lace occurs has a narrower combined width of 50 m. The construction disturbance may require temporary dam and by-pass channels approximately 10 m upstream and 10 m downstream, with a potential impact on the wetted area of approximately 1,000 m^2 (50 m x 20 m) or 0.1 ha. A key threatening process for the North Queensland Lace is harvesting of individuals for aquariums and the species is readily translocated. Should the bridge widening occur, any North Queensland Lace located in the footprint of disturbance would be translocated out of the temporary disturbance area and into a wetted undisturbed area, then relocated back to its original location following construction.

Based on the minor works potentially associated with the road upgrades at selected pinch points for the Innot Hot Springs access alternative between the Kennedy Highway/Herbert River Road intersection and the Project area, it is determined that potential facilitated impacts from the Project on MNES in this area will be negligible. These potential impacts are not considered to be significant in the context of the EPBC Act.

5.6.2.3 Accommodation Facility

CWF is currently investigating potential off-site accommodation facility options for 250 to 350 construction workers to support the construction of the Project. Whilst no location has yet been identified, CWF is committed to

ensuring that the facility – if established – will be sited and constructed in a manner that will not have a significant impact on MNES.

ARK ENERGY

Attexo

Chalumbin Wind Farm

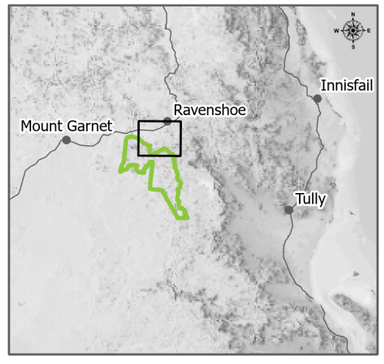
Potential Facilitated Impacts Haul Route

Figure 5.2

- Project Area Boundary
- Turbine
- Met-mast
- Stage 1
- Stage 2
- 90m blade swept path
- World Heritage Area Boundary
- Rainforest
- Wet sclerophyll forest
- Other remnant vegetation
- Watercourse
- Lot Boundary
- Easement

Date: 14/10/2022 Author: TOD

Project: EPU-004 Reviewed: NOD



0 1 2 km

Scale: 1:50,000@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)
© State of Queensland (Department of Resources) 2022, Maxar

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ARK ENERGY

Attexo

Chalumbin Wind Farm

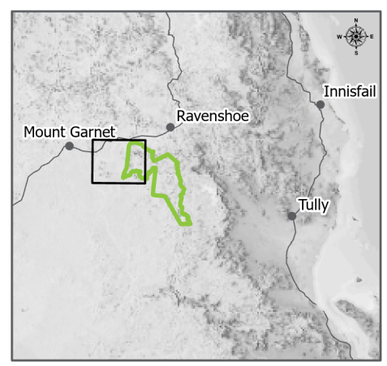
Potential Facilitated Impacts Haul Route

Figure 5.2

- Project Area Boundary
- Turbine
- Met-mast
- Stage 1
- Stage 2
- 90m blade swept path
- World Heritage Area Boundary
- Eucalypt woodlands
- Riparian habitat
- Rocky pavements and shrublands
- Watercourse
- Lot Boundary
- Easement

Date: 14/10/2022 Author: TOD

Project: EPU-004 Reviewed: NOD



0 1 2 km

Scale: 1:62,500@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, Maxar

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5.7 Water and Site Hydrology

The Project area's water and site hydrology characteristics are described in **Section 4.1.5**. A summary of the potential impacts of the Project on the broader environment (including MNES) attributable to (a) increased sediment and erosion run-off, (b) changes to hydrological regimes, and (c) changes to water quality in watercourses is provided in the Preliminary Erosion and Sediment Control Plan (**Appendix I**) and the Sediment and Erosion Management Plan (**Appendix J**).

5.8 Flood Modelling

A Flood Assessment Report for the Project area was provided in the EPBC Referral and is included as **Appendix N** to this PER. The PER Guidelines requested additional information within the flood model, specifically related to:

- Natural flood storage; and
- Drainage efficiency.

The Flood Assessment Report was prepared by consultants Water Technical with the objective of providing a comprehensive assessment of the flood risk on site as in input into the feasibility study process, in particular sighting of fixed infrastructure and the design of access roads.

Overland flooding was assessed via the TUFLOW hydraulic model prepared in accordance with industry standard guidelines referred to as The Australian Rainfall and Runoff: A guide to flood estimation (Commonwealth of Australia 2019).

A detailed direct rainfall (rain-on-grid) hydraulic modelling approach was adopted due to the scale, complexity and the numerous waterways that transect the site. In this approach, rainfall is applied directly to each grid cell within the model and overland flows move across the grid based on the site topography and catchment characteristics. In doing so, this approach takes account of natural flood storage and drainage efficiencies across each grid cell.

Topography was incorporated in the model from 1m LiDAR (resolution of approximately 30 m or 1-second of arc) sourced specifically for the project and this was supplemented by Shuttle Radar Topography Mission data.

The TUFLOW model adopted a grid size of 20 m with the inclusion of sub-grid sampling (SGS) down to a grid size of 2 m. SGS stores and uses curves representing the sub-2D-cell terrain data of the DEM used to construct the model instead of each 2D cell having one elevation. SGS allows catchment scale models, such as this one, to flow more effectively with water not being "trapped" by a coarse cell resolution.

The TUFLOW Quadtree module was also utilised to allow for a more detailed analysis, within a given area of the model, by nesting smaller cells in the model grid. This allowed detailed assessment in areas of key infrastructure such as the construction compound, batch plant and site access from Ravenshoe (10 m grid size). This approach allowed for a detailed analysis of flooding around key infrastructure.

Design rainfall temporal patterns and intensities were determined using the standard procedure in the ARR guideline. Rainfall temporal patterns and depths based on Intensity, Duration, Frequency (IFD) information were sourced from the TUFLOW plugin. Due to the large extent of the study area (~650 km^2) multiple IFDs were adopted. The study area was divided into 16 sub sections of approximately 40 km^2 and IFDs determined according to the centroid of each.

Areal reduction factors (ARF) were applied in accordance with the ARR Datahub guidance.

Rainfall losses were incorporated into the model as rainfall excesses in a TUFLOW materials file. The losses adopted for this assessment were extracted from the ARR guideline 'Datahub' and reflect a conservative approach with regards to infiltration in predominantly rural areas.

Floodplain roughness was represented in the model as shapefile polygons assigned a Manning's 'n' roughness value. The surface materials were determined from satellite imagery and the spatial location of these polygons.

The model was validated using a combination of the Rational Method (RM) and Regional Flood Frequency Estimation (RFFE). Validation was completed at the outlet of three local catchments (one larger and two smaller). The RFFE was found to overestimate peak discharge values for the larger catchment, and underestimate values for the smaller two catchments. Notwithstanding this, all TUFLOW model peak flows were found to be within the 95% confidence limits for the RFFE predicted peak flows and deemed to be reasonable.

Maximum flood depth and velocity maps for the 0.5%, 2%, 50% and 63.2% AEP events were determined including the maximum depths and velocities across the site for the 1% Annual Exceedance Probability (AEP) event. The steep terrain causes high velocities and generally well-defined drainage paths. Preliminary turbine locations are located outside any ponding areas and main flow paths. Several proposed access tracks were identified to intersect overland flow paths where the steepness of the terrain will require detailed design consideration for velocities in the range of 2 to 3 m/s to ensure protection of scour and damage to infrastructure including management practices during construction and operations (refer to the Sediment and Erosion Control Plan in **Appendix J**).

The potential for a significant impact on a MNES as a result of flooding is considered unlikely.

5.9 Groundwater

The PER Guidelines require a groundwater management plan should the water table be intersected during turbine foundation installation. Should this occur, a groundwater management plan is required to address plans for groundwater extraction and disposal.

The proposed deepest wind turbine excavation (WTG 02 – 40 m below natural ground level) and two more typical foundation excavations (WTG 06 and WTG 09 – between 5 and 20 m below natural ground level) are shown in **Plate 5-2**, **Plate 5-3** and **Plate 5-4**. Based on design drawings it is anticipated that the deepest foundation excavation would be approximately 40 m below the current ground level, with the remainder of foundation excavations being typically 5-20 m deep.

It is considered unlikely that the foundation excavations for the Project's wind turbines would intercept a homogenous groundwater aquifer, due to these areas being on high elevations and generally with the Glen Gordon Volcanics underlying them. If some of the deeper wind turbine excavations (e.g. WTG 02), pockets of localised water within fracture rock may be encountered requiring localised dewatering. These pockets are likely to be heterogenous with limited interaction during foundation construction and subsequent backfilling within one month of excavation.

Groundwater within the Project area is likely to occur close to waterways in the flatter areas as a deposition and storage area from rainfall runoff from elevated areas of the catchment. There are no proposed turbine foundations requiring excavation below the water table in the flatter areas. Given this, the potential for a significant impact on a MNES as a result of groundwater excavations within the water table is considered unlikely.

Notwithstanding, incidental rainfall collected in excavations will be managed in accordance with the Preliminary Erosion and Sediment Control Plan (refer **Appendix I**) and the Sediment and Erosion Management Plan (**Appendix J**). This includes diversion of clean stormwater around turbine excavations, minimising the duration of disturbance (turbine foundation excavations are typically open for up to 1 month) and collection and treatment of stormwater runoff from disturbance areas.

Dewatering of groundwater aquifers is not expected to be required for the Project to the extent that this would necessitate a specific Dewatering Plan or Groundwater Management Plan. Where pre-construction geotechnical investigations identify the potential for pockets of water storage in fractured rock requiring excavation, appropriate sump and pump dewatering will be included in the site-specific ESCP prepared for construction.

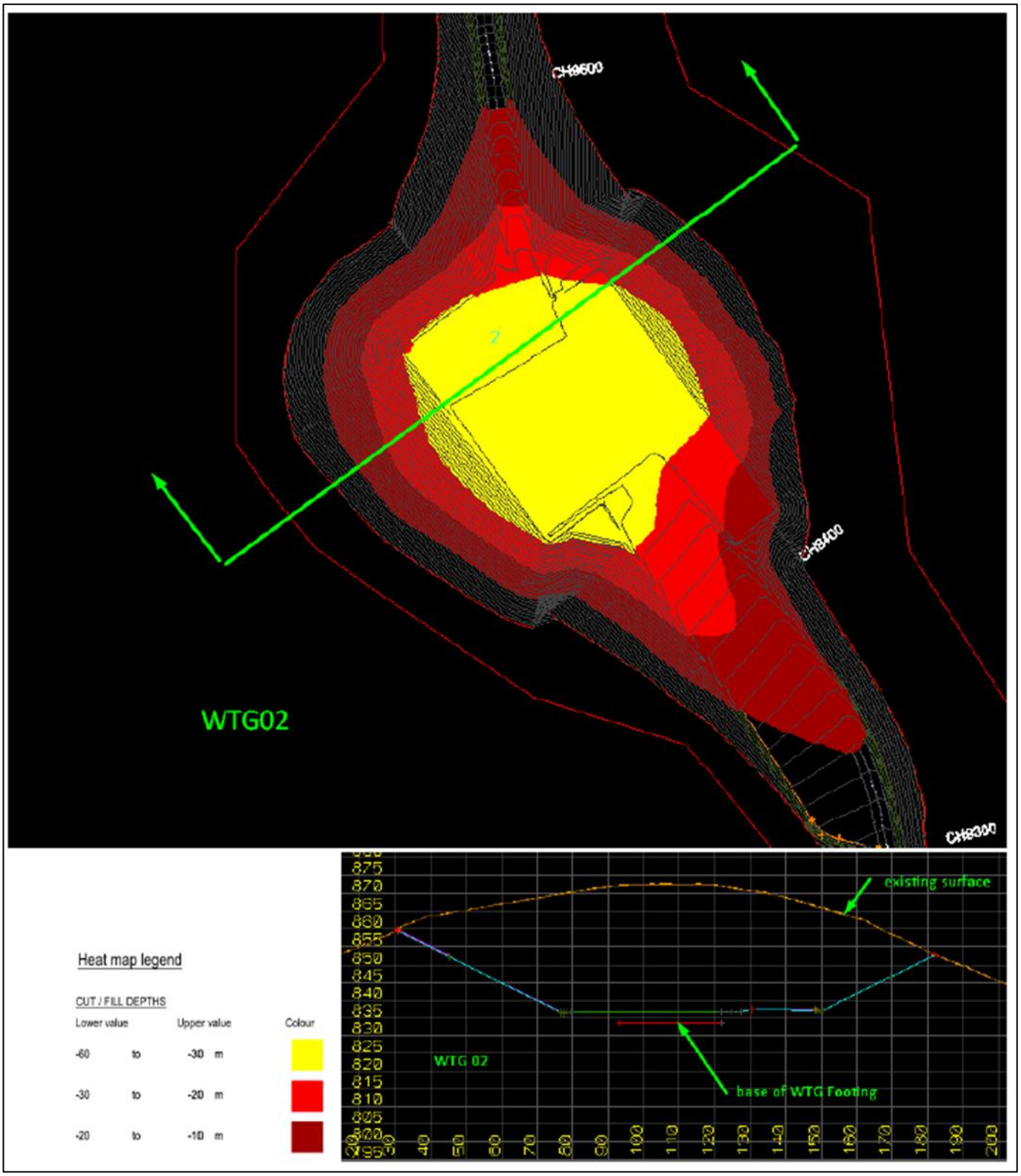

Plate 5-2 WTG 02 Plan with "heat" depth contour map and section through WTG/track and blade laydown

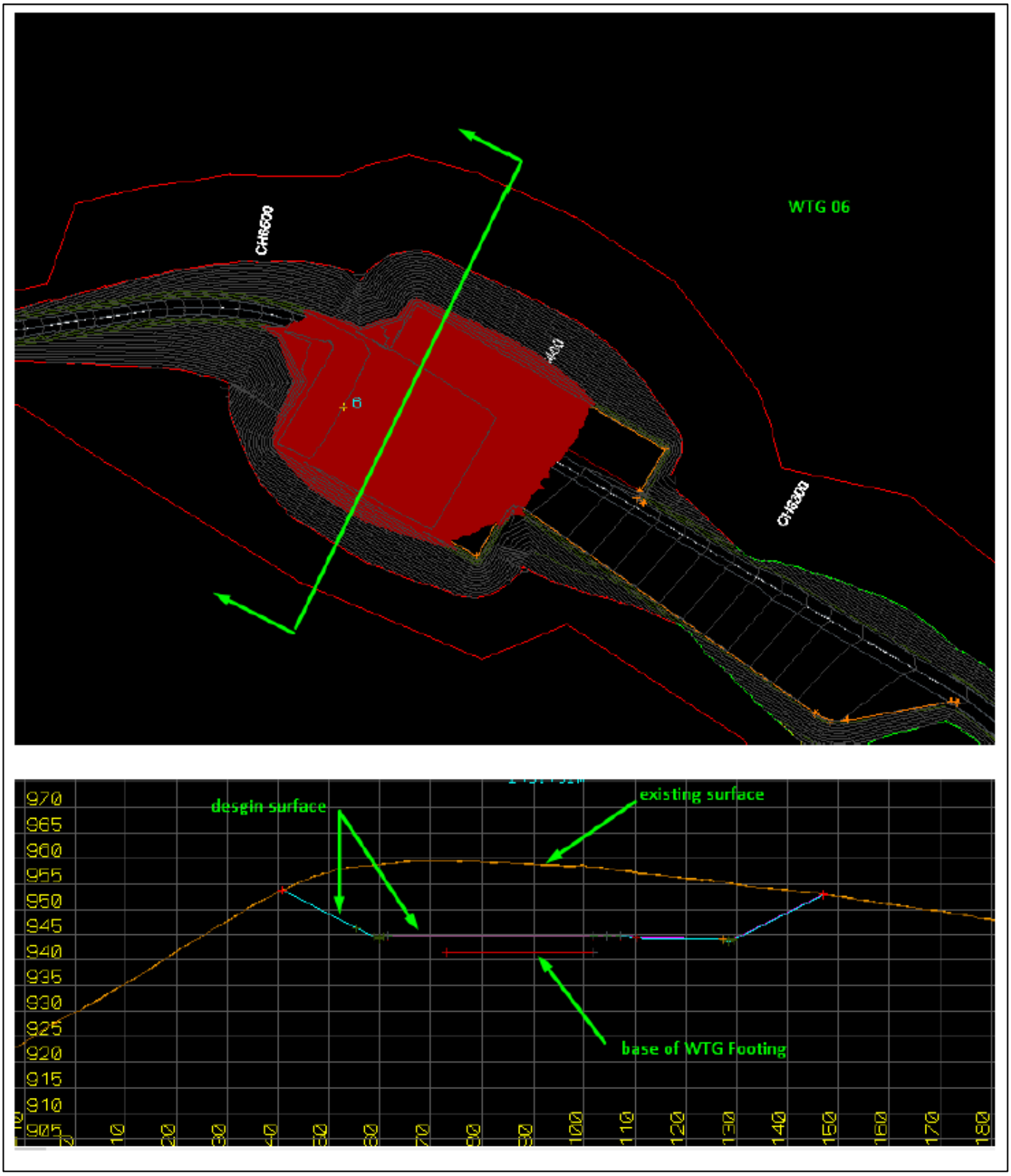

Plate 5-3 WTG06 plan with "heat" depth contour map and section through WTG/track and blade laydown

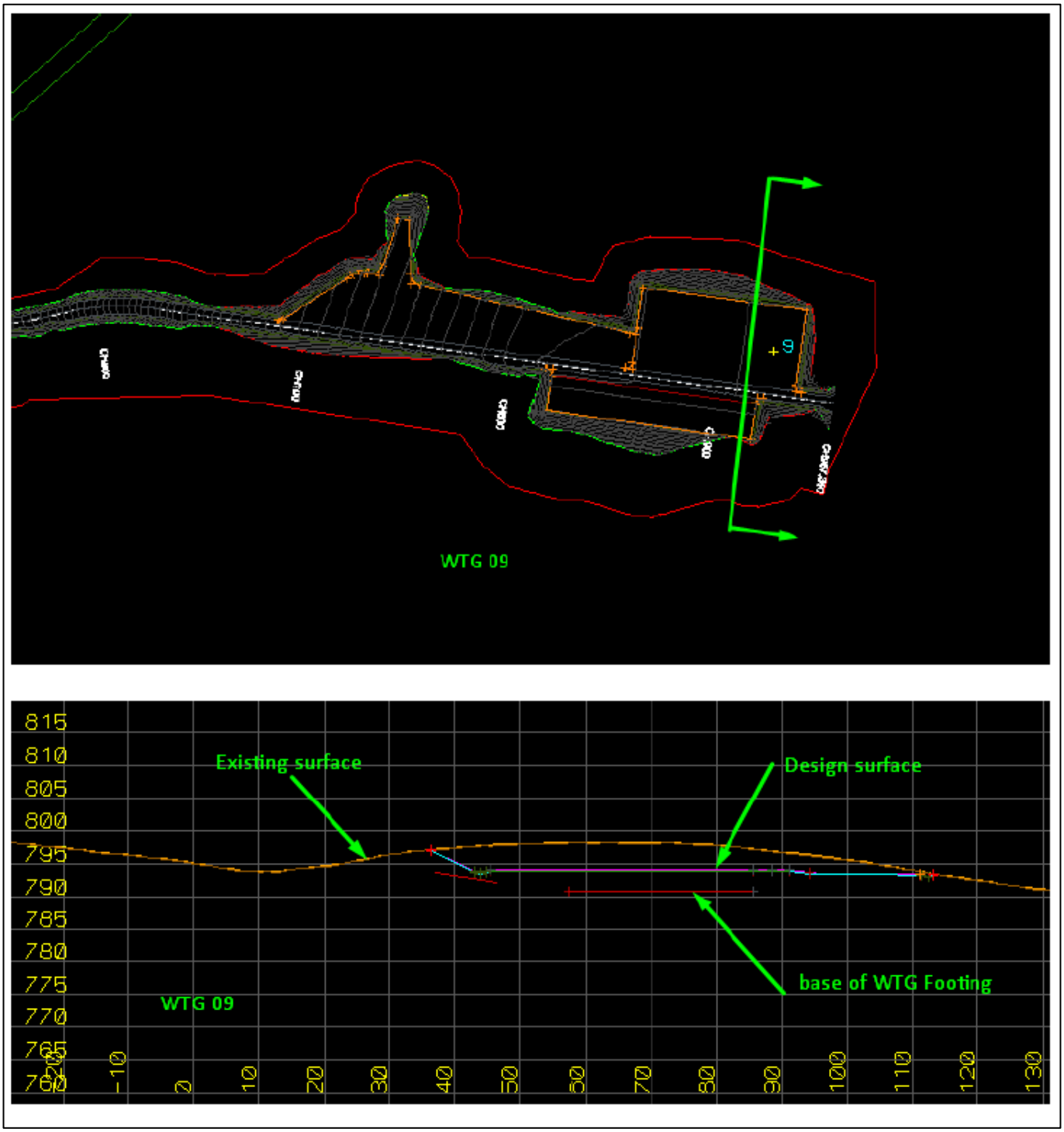

Plate 5-4 WTG09 plan with "heat" depth contour map and section through WTG/track and blade laydown