Mount Emerald Wind Farm, Herberton Range North Queensland

Environmental Impact Statement - Executive Summary (EPBC 2011/6228)

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Approval for Issue

Name	Signature	Date
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1.0 Introduction

RPS East (Australia) has been commissioned by RATCH Australia Corporation Limited (RACL) to prepare this Environmental Impact Statement (EIS) to accompany a project application under the Sustainable Planning Act 2009, for the proposed Mount Emerald Wind Farm (MEWF). The project was referred under the *Environment, Protection and Biodiversity Conservation Act 1999* (the EPBC Act), to the Minister for Sustainability, Environment, Water, Population and Communities (now the Department of the Environment or DotE) on 21 December 2011. A delegate for the Minister determined on 24 January 2012 that the proposed development constituted a controlled action under the provisions of the EPBC Act, as the action has the potential to have a significant impact on a number of matters of National Environmental Significance. The controlling provisions for the proposal under the EPBC Act were:

- World Heritage properties (sections 12 & 15A);
- National Heritage places (sections 15B & 15C);
- Listed threatened species and communities (sections 18 & 18A); and
- Listed migratory species (sections 20 & 20A).

On the same date, a delegate of the Minister determined that the proposed activity be assessed by an Environment Impact Statement (EIS).

This EIS has been prepared in accordance with the requirements disclosed in the EIS Guidelines (EPBC 2011/6228, February 2012) and provides information about the action and its relevant impacts, to allow the Minister to make an informed decision on whether or not to approve, under Part 9 of the EPBC Act, the taking of the action for the purposes of each controlling provision (refer **Appendix 2**).

2.0 The Project

2.1 Project Description Summary

The Mount Emerald Wind Farm (MEWF) was initially conceived in 2010 to comprise 75 wind turbines on an elevated site approximately 20 km SSW of Mareeba on the Atherton Tablelands in north Queensland **(Figure 1**). Due to a number of environmental, social and technical constraints, the layout of the wind farm has undergone subsequent revisions; and as at the time of publication of this EIS, the number of turbines has been reduced to 63 on the basis of detailed impact assessment and logistical criteria discussed below.

The site where the wind turbines, interconnecting tracks and associated infrastructure are proposed to be established is on land formally described as Lot 7 on SP235224, which encompasses an area of 2,422 ha. This land forms the terminus of the Herberton Range and is contiguous with Mount Emerald (proper) at its southern boundary. Virtually all the wind farm project area is covered by remnant and relatively undisturbed vegetation, where the only land modification is associated with the existing 275 kV transmission line infrastructure and its series of access tracks. Kippen Drive at the base of the site is severely degraded in most zones adjacent to the unsealed road, and weeds are conspicuous.

The wind farm site has been selected on the basis that it represents an excellent wind resource because of its elevated position and series of high ridges. The elevation range of the site is between 540 m up to 1089 m above sea level (ASL). The highest ridges south of the existing 275 kV transmission line hold the most significant value in terms of flora and represent an important tract of land with functional connectivity to other regional nodes of high biodiversity importance. Land to the north of the transmission line, which includes the landmark of Walsh Bluff, possesses lower floristic diversity, but is recognised for its value as habitat for the endangered Northern Quoll (which is also expected to occur south of the transmission line).

The wind farm project estimates to deliver in the order of 650,000 megawatt hours of renewable energy, which is predicted to meet the annual needs of approximately 75,000 north Queensland homes over a 20 year period.

The wind farm will be connected to the existing Chalumbin –Woree 275 kV transmission line via a substation, which is to be located within the site. The 275 kV transmission line infrastructure that traverses the site was established in 1998 and represents a pre-existing disturbance footprint which the proposed wind farm will take advantage of in order to minimise the area of new impacts to the environment.

From a constructability perspective the northern sector of the site has more undulating landforms and fewer dissected ridges with precipitous drop offs. There also appears to be a higher proportion of former landscape disturbance in the northern sector and across the east-facing slopes on the Walkamin side.

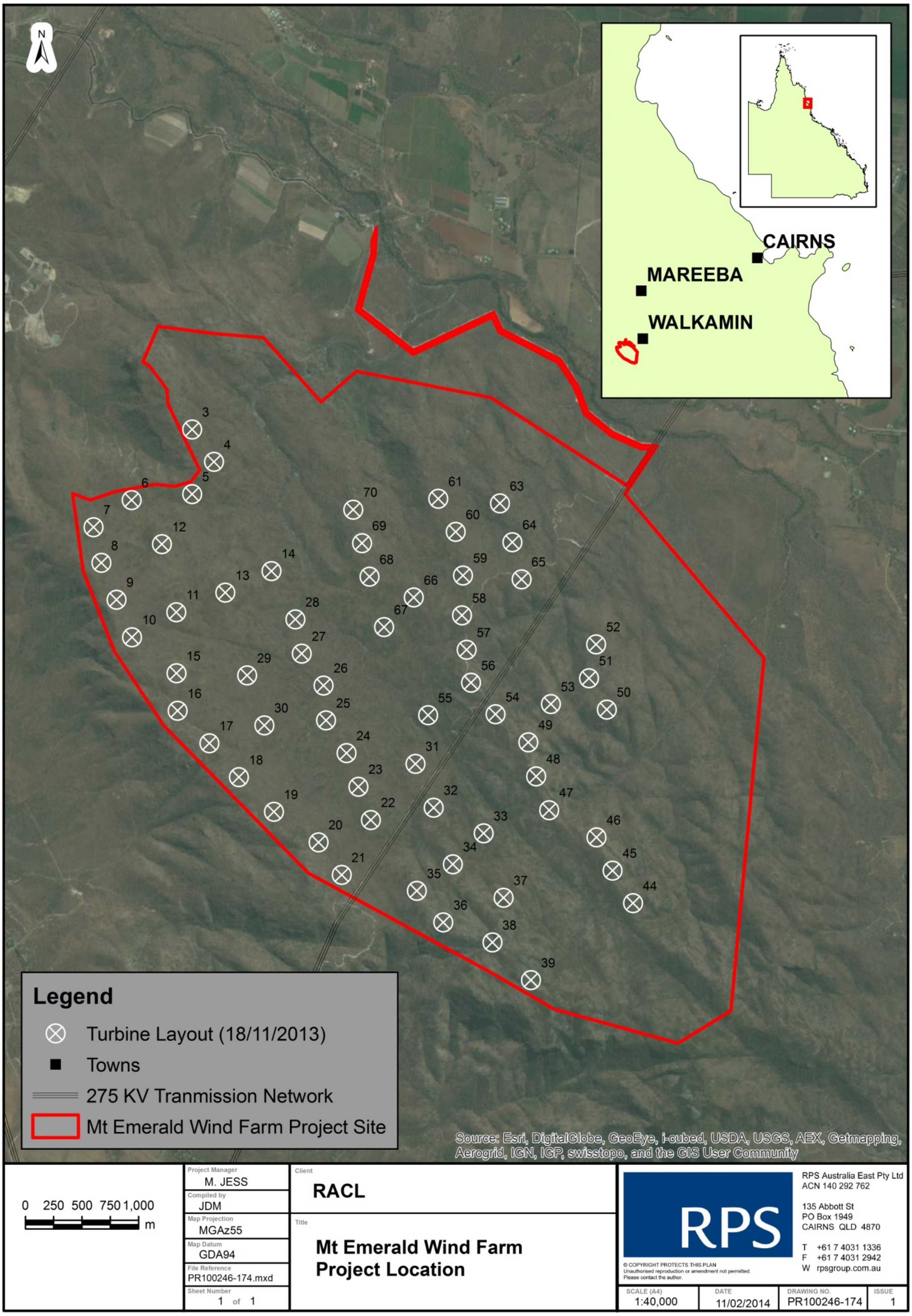

Figure 1 Project Site Location

Access to the site will be via Kennedy Highway, onto Hansen Drive and then into the site at a realigned Springmount Road - Kippen Drive intersection. Kippen Drive is currently unsealed. A series of access and interconnecting tracks will need to be constructed within the wind farm site, and will take advantage of existing transmission line infrastructure tracks wherever possible. A number of new tracks will need to be constructed to an initial cleared width of 10 m. The interconnecting tracks will form the routes for the inter-turbine underground cabling - expected to be buried in trenches at approximately 1 m deep.

Each turbine construction pad is expected to occupy an area in the order of 40m (long) x 60 m (wide). The substation and associated compound will be in the order of 200 m x 200 m or similar configuration and will be located close to the existing 275 kV transmission line which crosses the site.

Wind turbines are proposed to be "micro-sited" - a technique which involves selecting a position in the landscape where the least environmental impact is expected to occur. As part of this procedure, comprehensive ground surveys will be undertaken of each site to ensure impacts to conservation significant species and other matters of importance are minimised or avoided.

A wind farm operations building will be constructed adjacent to the substation, which will house monitoring and communications equipment. Other associated internal infrastructure will include car parking areas, construction compound and machinery area. Depending on the outcomes of relevant approvals, a batching plant may be temporarily constructed within the site.

The Mount Emerald Wind Farm project has been broadly categorised into four phases: pre-construction, construction, operation and maintenance and decommissioning. Rehabilitation and impact mitigation will be actively practiced throughout these stages and will be informed by respective plans and strategic documents.

In preparing the EIS, several specialist investigations were undertaken and accompanying technical reports prepared. These include the disciplines of flora, fauna, general environmental reporting and offsets plan; town planning; aeronautical assessment; transport and traffic assessment; shadow flicker, electromagnetic interference, and energy yield; geotechnical; visual and landscape aesthetics; noise mapping; cultural heritage; community consultation; and social and economic assessment.

Several strategic and site-based plans will be compiled to facilitate the delivery of mitigation measures. These will include the Environmental Management Plan (EMP). The EMP is to be supported by a number of plans including: a Rehabilitation Plan, Weed Management Plan, Rare and Threatened Species Management Plans and Fire Management Plan. These plans will have an effective life span to include the decommissioning phase and will be revised periodically to reflect ongoing changes and improvements.

2.2 Surrounding Land Use

Land surrounding the subject site is utilised for a diverse array of land uses, as a result of the changing nature of the agricultural industry, the size of surrounding land holdings, topography and soil characteristics. While the majority of the area surrounding the project site has been extensively cleared and is historically used for livestock grazing and agricultural pursuits, a number of recent approvals issued upon adjacent properties reflect the changing land uses in the area, from passive agricultural and pastoral uses to more intensive farming practices and other industrial and agribusiness practices.

Figure 2 shows the location of these uses in proximity to the project site, including:

- Outdoor Sport and Entertainment Facility (Drag strip) - Lot 13 on SP103361, Springmount Road, Arriga which includes the potential use of the site for intensive motor racing uses;
- Hard Rock Quarry (greater than 100,000 tonnes per year) and Concrete Batching Plant approval associated with the existing processing activities which have occurred on site for a number of years - Lot 3 on RP741713, Springmount Road and Borzi Road, Arriga;
- Tablelands Sugar Mill over Lot 1 on SP100452, Springmount Road, Arriga, located approximately 3 km from the site;
- Ethanol Distillery (Tablelands Sugar Mill) located on Lot 1 on SP100452, Springmount Road, Arriga; and
- Peanut Shell storage approved over Lot 141 on SP123888, located at Channel/Hansen Road, Walkamin (Lot 141 on SP123888).

Concurrently, there has also been an increase in the intensity of existing farming operations over a number of Lots on Oakey Creek Road, including change from grazing livestock to sugar cane production, as a direct result of the Arriga Sugar Mill increasing its capacity.

Other uses which are currently established within the immediate vicinity of the site, on Channel Road, which highlight the diversity of rural uses in the area, and include:

- A large poultry farm (Lot 6 on SP101513);
- Diverse nursery/farming operation with workers accommodation (rural workers accommodation) located on Lot 1 on RP717403 and Lot 291 on SP219087;
- Intensive organic farming on Lot 407 on NR4480;
- Banana farm (Lot 1 on RP719462); and
- Nursery (Lot 289 on NR7038 and Lot 407 on NR 4480).

In addition, the existing Springmount Waste Management Facility (Lot 13 on SP103361), located to the north-west of the site on Springmount Road, Arriga has been operating for a number of years and contributes significantly to use of the adjacent roads by heavy vehicle traffic.

The Lotus Glen Correctional Centre property comprises an area of approximately 800 ha and is located approximately 1.5 km to the north of the project area on Hansen Road / Chettle Road. However, the actual prison facility is located well within the site boundary, with the distance between the wind farm boundary and the low security facility approximately 3 km and the high security facility 3.6 km. Mt Uncle Distillery, located approximately 5 km from the project site boundary, contains a cafe, retail shop and fruit plantations, and generates a number of tourist vehicle movements to the area, seven days a week, throughout the year.

In addition to the mix of rural, semi-industrial, community and other institutional uses, a number of adjoining sites are also utilised as lifestyle lots, with no farming being undertaken, and primarily used for residential purposes.

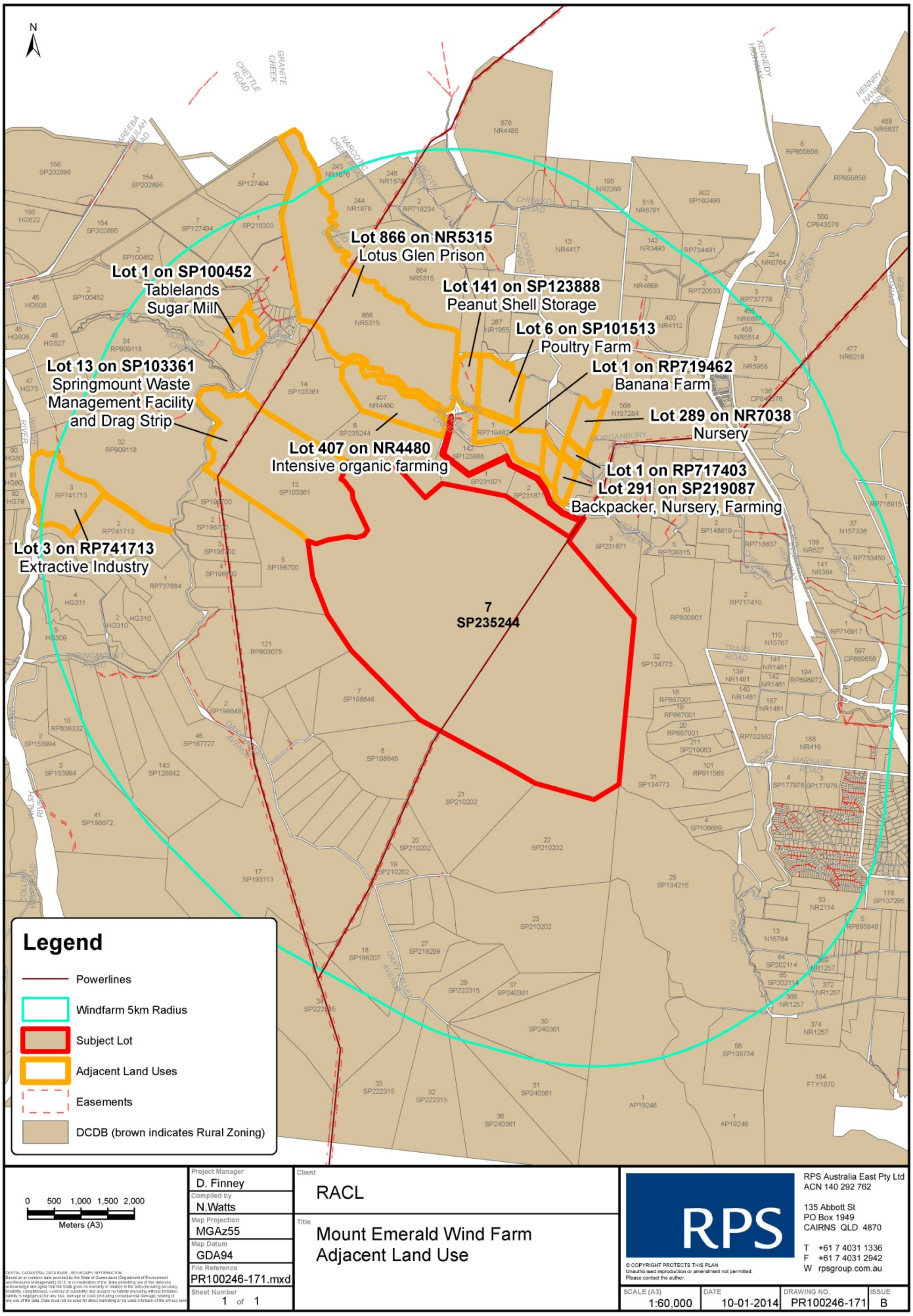

Figure 2 Adjacent Land Uses

2.3 Justification of the Project

The site has been selected as it displays an excellent wind resource and is well placed in terms of access to existing electricity transmission infrastructure. Monitoring of the wind resource at this location has been undertaken at two sites within the project area. Each monitoring tower measures wind speed and direction at various heights above ground, as well as recording other standard weather observations.

Two monitoring towers (ID 9530 & 9531) were approved by Council in November 2009 and subsequently established on site in May 2010 and are located approximately 3.6 km apart, at heights of 80m and 50m respectively. Each monitoring tower includes instruments, at varying heights, to obtain representative wind data across the site.

Tower 9530 recorded an average wind speed of 10.03 m/s and tower 9531 recorded 8.1 m/s (correlated) and long term adjusted average of 9.7 m/s and 7.9 m/s respectively. These records and long-term assessments suggest an excellent wind resource is available at this location.

2.3.1 Economic Assessment

Expenditure required for construction and operation of the Mt Emerald Wind Farm would have a positive economic contribution to output, value added, employment and household income in the local and regional study areas and the broader Queensland and domestic economy. The magnitude of these impacts was estimated using Jacobs' (2014) in-house regional Input-Output (IO) model. Overall, the impact assessment found:

- Total domestic expenditure for construction is anticipated to be around $188.7 million, 60 percent of which would be spent in the Far North Queensland region.
- Total expenditure (for the entire project life cycle) in the regional area would be around $426.2 million, with a resultant total output impact of around $939.7 million.
- This would have an associated direct value-added impact of around $161.5M for Far North Queensland and a total value-added impact of around $386.7 million.
- The total household income impact is estimated to be around $177.2 million for the entire project life cycle, for the regional study area.
- The direct average annual employment impact expected in the construction phase is around 51 FTEs for Far North Queensland.
- Peak employment during the Construction Phase can be expected to rise to 155 jobs for all of Queensland.
- The 25 year operational phase would result in an average of 11 direct annual jobs to the regional study area. The total employment impact for the region during the operations phase is estimated to be 19 FTEs. RATCH-Australia is committed to maximising local employment opportunities and a significant proportion of operational positions are expected to be by local residents.

Direct job creation in geographically diverse areas, such as Mareeba, contributes to the development of skills and expertise in a growing industry and thereby stimulates rural economies generally.

There will be economic efficiency gains in meeting government objectives, by replacing fossil fuel electricity supply in areas where long transmission distances from generation sources lead to extra costs due to transmission loss and susceptibility to power disruptions.

There are also intangible benefits associate with wind farms, and renewable energy generally such as:

- Avoidance of greenhouse gas emissions associated with conventional fossil fuel generation;
- Insulates electricity market from fluctuations in fuel prices by increasing the diversity of the energy system (that is, wind can assist in times of peak demand); and
- Wind farm electricity generation requires comparatively little natural inputs such as water consumption.

It is acknowledged there are greenhouse gas emissions associated with the manufacture, construction, operation and decommissioning of a wind farm. The carbon abatement period, or time it takes to generate sufficient electricity (without any greenhouse gas emissions) to offset the emissions created in the creation and installation of the facility has been the focus of many studies over the past 15 years.

The payback period and carbon abatement for the proposed MEWF has been estimated at 0.91 year or just under 11 months., A detailed assessment of the Carbon Abatement, which estimates the energy balance for the proposed wind farm from the 'cradle to grave' including five phases of the project is provided in **Table 1**.

- Phase 1 – **Construction** – comprise the extraction of raw materials (concrete, aluminium, steel, glass fibre, etc.) needed to manufacture the tower, nacelle, hub, blades, foundation, grid connection and cables.
- Phase 2 – **Assembly** – work of erecting the wind turbine
- Phase 3 – **Transport** – includes transport of raw materials to produce different components, transport of turbine components to site and during operation.
- Phase 4 – **Operation** – activities related to maintenance including oil changes, lubrication and transport for maintenance
- Phase 5 – **Dismantling** – dismantling the turbines, and transport from site. Assumes recycling of some components.

Table 1 Carbon Abatement

ACTIVITY	ENERGY USE (MWh)	ACTIVITY	ENERGY USE (MWh)
Manufacturing WTG		**Transport**	
Steel	131,597	Blades and rotor	15,485
Stainless Steel	9,001	Tower	848
Cast Iron	19,579	Nacelle	1,538
Copper	6,176	Machining	2
Aluminium	20,958	Control System	18
Carbon Fibre	60,378	**Sub-total**	**17,891**
Epoxy	24,703	**Operation and Maintenance**	
Plastic	7,424	Vehicle	1,996
Oil	854	Refurbish	1,603
Sub-total	**280,670**	Lubrication	8,921
Manufacturing Foundation		**Sub-total**	**12,520**
Concrete	43,851	**Dismantling and Scrapping**	
Reinforcing Bar	49,758	Dismantle turbines	665
Excavator	2	Transport	529
Small truck	179	**Sub-total**	**1,194**
Dump truck	5,513	**Recycling**	
Semi-trailer	170	Steel	-5,657
Concrete truck	447	Stainless Steel	1,336
Pump	134	Cast Iron	5,059
Front-end Loader	89	Copper	-869
Truck for Crane	103	Aluminium	-6,735
Crane	13	Carbon Fibre	-2,709
Sub-total	**100,259**	Epoxy	-1,544
Preparatory Works		Plastic	-599
Road construction	21,622	Oil	-189
Level hardstand areas	8,649	**Sub-total**	**-11,907**
Excavation for cables	295		
Cables/Connection	95,725		
Sub-total	**126,291**		
Total MEWF Energy Usage (MWh)			***526,918***
MEWF 1 Year Energy Production (MWh)			***579,870***

This report has provided an assessment of a range of economic changes that may occur as a result of the Mount Emerald Wind Farm project. In particular, the report considered concerns raised in submissions during the public notification phase for the Mount Emerald Wind Farm EIS, relating to:

- Socio-economic background and baseline;
- Economic impact and assessment of the project;
- Agricultural economic impacts from changes to local bat populations and aerial spraying;
- Tourism;

- Local property prices; and
- Energy supply and costs.

Fossil fuel sources are most expensive in real terms in those remote areas not in a grid and those areas furthest removed from fossil fuel generation sources that experience transmission losses. The electricity grid in the Far North Queensland region is among those areas furthest removed from fossil fuel generation sources. The closest coal fired base load generation at Collinsville is comparatively inefficient with high carbon emissions and has been subject to negotiations to close it down. The base load power stations from which most of the region's power is derived, are located in Central Queensland over 1000 km away. Substantial transmission losses are involved and the economic cost of replacing this power with a non fossil source, are lower.

The second economic efficiency is related. Long transmission lines are more prone to being affected by disruptions. The whole area from Central Queensland to the Far North is cyclone prone with the area of highest cyclone frequency along the coast from Bowen to Townsville being in the centre of transmission routes. Local sources of generation enhance power security in the Far North Queensland region.

In relation to various forms of non-fossil fuel power generation, the indications from the information available are that wind power in suitable locations is generally cheaper than solar power.

2.3.2 Alternatives to the Proposal

The most critical aspects in the development of any energy generation project are access to both a fuel source and an electricity network. The amount of available energy in the wind increases cubically with an increase in wind speed, thus selecting a site with as good a wind resource as possible is highly preferential. While a site may have an extremely good wind resource and can produce a very high amount of electricity, it is useless unless the power can be transmitted and used. To this end, proximity to an electricity network capable of accepting and being able to transport the electricity generated to a customer base is of the utmost importance.

A review of the wind speeds through the country **(Figure 3)** show the better wind resources to be available in some of the more remote and less populated parts of the country. This contrasts with the majority of the population being located along the eastern seaboard and hence this is where the strongest parts of the electricity network are located.

The region of the Atherton Tablelands in Far Northern Queensland is one area where wind speeds are comparable with some of the best wind resources in the country. For this reason the Tablelands is home to one of the earliest commercial wind farms built in Australia, being Windy Hill, which commenced operating in 2000.

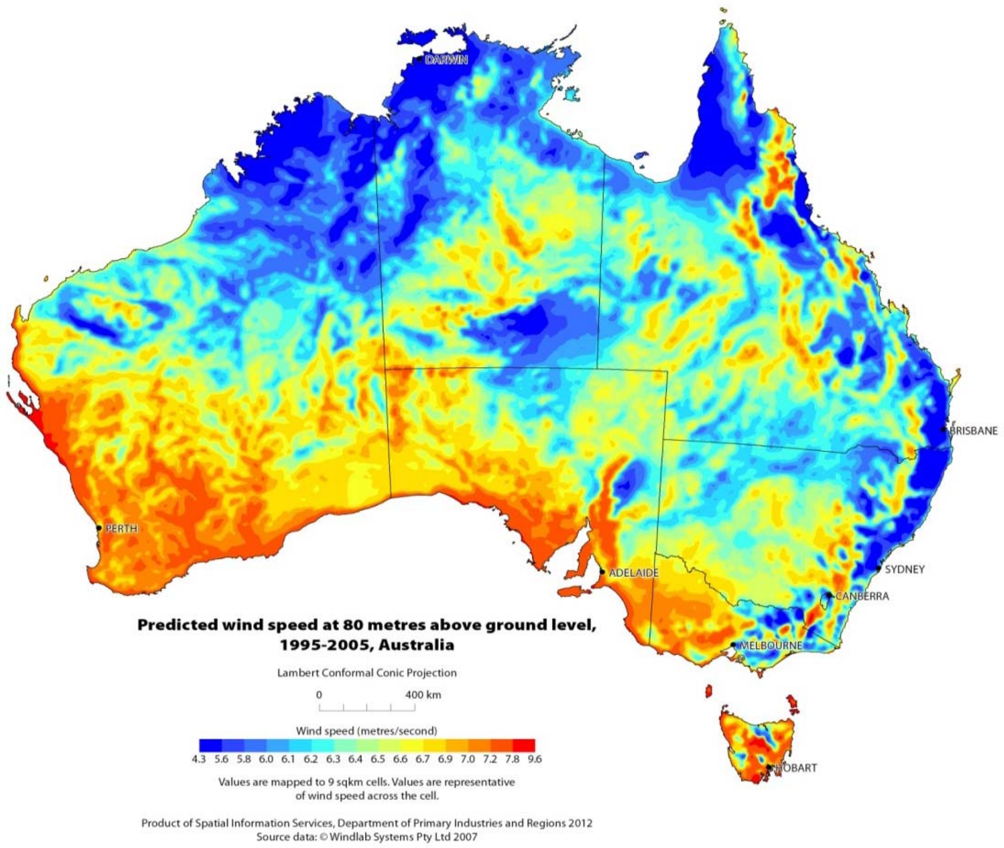

Figure 3 Mean Wind Speed at 80 m Above Ground Level (1995-2005)

(Source: Spatial Information Services, Department of Primary Industries and Regions 2012. Source data Windlab Systems Pty Ltd 2007)

The subject land was considered to be a more favourable option for development due to:

- Transmission - access to the 275 kV electricity transmission line which traverses through the centre of the property.
- Constructability – the high wind resource area to the southwest of the subject land would seem to be more rugged and require additional civil costs to construct and have a larger disturbed area.
- Site access – closer proximity to Kennedy Highway council sealed roads. Additional road upgrades would be required to access areas to the southwest.

2.3.3 Wind Farm Design - Reduction of Impacts

A variety of design options were considered during the conceptual stage of the wind farm development. The overall objective at this time was to identify the layout of the project to maximise electricity generation and deliver significant savings in greenhouse gas emissions whilst being commercially viable and socially and environmentally responsible.

An initial turbine layout was produced allowing for the orientation of the prevailing winds and turbine spacing relative to the size of the turbines chosen at the time, to maximise the generation of the land available. The turbine used for this concept shared common characteristics of a 90 m rotor and a 2 MW capacity as generally available to the market at the time.

Following consultation with surrounding residents amendments were made to the turbine layout to reduce both the noise and the visual impact at the respective homes. Most notably this included:

- Moving the turbines off the top of the western ridgeline to further within the property to screen a significant portion of the turbine from views to landowners to the west of the site;
- Removal of turbines in the northeast of the site at the request of owners within this view shed; and
- Removal of turbines in the southeast corner to significantly reduce the size of turbines visible to the residents of Rangeview.

The result of these modifications provided for a preferred project layout incorporating 75 wind turbines. Consistent with the commercial market for wind turbines in Australia and internationally, larger 3 MW class wind turbines are now the most common being installed. These turbines have rotor diameters above 100 m and as such require additional spacing between turbines, thus reducing the overall number of turbines on site. While the overall tip height of turbines would increase by 5 m to 10 m the reduction in number and increased spacing is thought to reduce the visual aspect of the wind farm. The use of larger turbines reduced the preferred layout to a total of 70 wind turbines.

Following detailed environmental investigations the wind turbine layout design has been further modified to a currently preferred total of 63 turbines.

In developing this layout a number of factors were taken into consideration including:

- Ecological considerations;
- The project site extent, comprising the cadastral boundaries of the involved landowners;
- The location of non-involved residences in the vicinity of the project site;
- Site topography; wind speed data collected from two monitoring towers over a three-year period;
- Turbine spacing;
- Compliance with noise criteria; and
- Telecommunications paths from nearby installations.

In the preliminary planning stages, the layout of the wind farm was determined to produce the maximum amount of energy production across the site. During the development of MEWF the original layout (of approximately 100 turbines) has been changed to accommodate provisions such as:

- Noise – turbines removed to keep noise levels below goals set by applicable standards;
- Visual – turbines have been moved or deleted to reduce the views from surrounding areas. Turbines along the western ridgeline were moved further into the site to reduce their visible prominence to residents to the west. Turbines were also removed altogether due to proximity to residents to the east of the site;
- Flora and fauna – potential to remove turbines in particular areas of known avian activity; avoid areas of high flora significance; and
- Constructability – areas of very rugged terrain to the south deemed too difficult to access and construct.

The individual wind turbine locations may still be subject to minor adjustments, or ‘micro-siting’, prior to construction in response to various factors including:

- Environmental constraints, such as avoidance of significant vegetation, quoll denning habitat(as part of a number of preconstruction and construction ecological programs discussed below);

- Prevailing geotechnical conditions;
- Final wind speed and energy yield analysis;
- Detailed site survey and geotechnical/civil engineering considerations;
- Turbine manufacturers recommendations; and
- Resource and cost-efficiency.

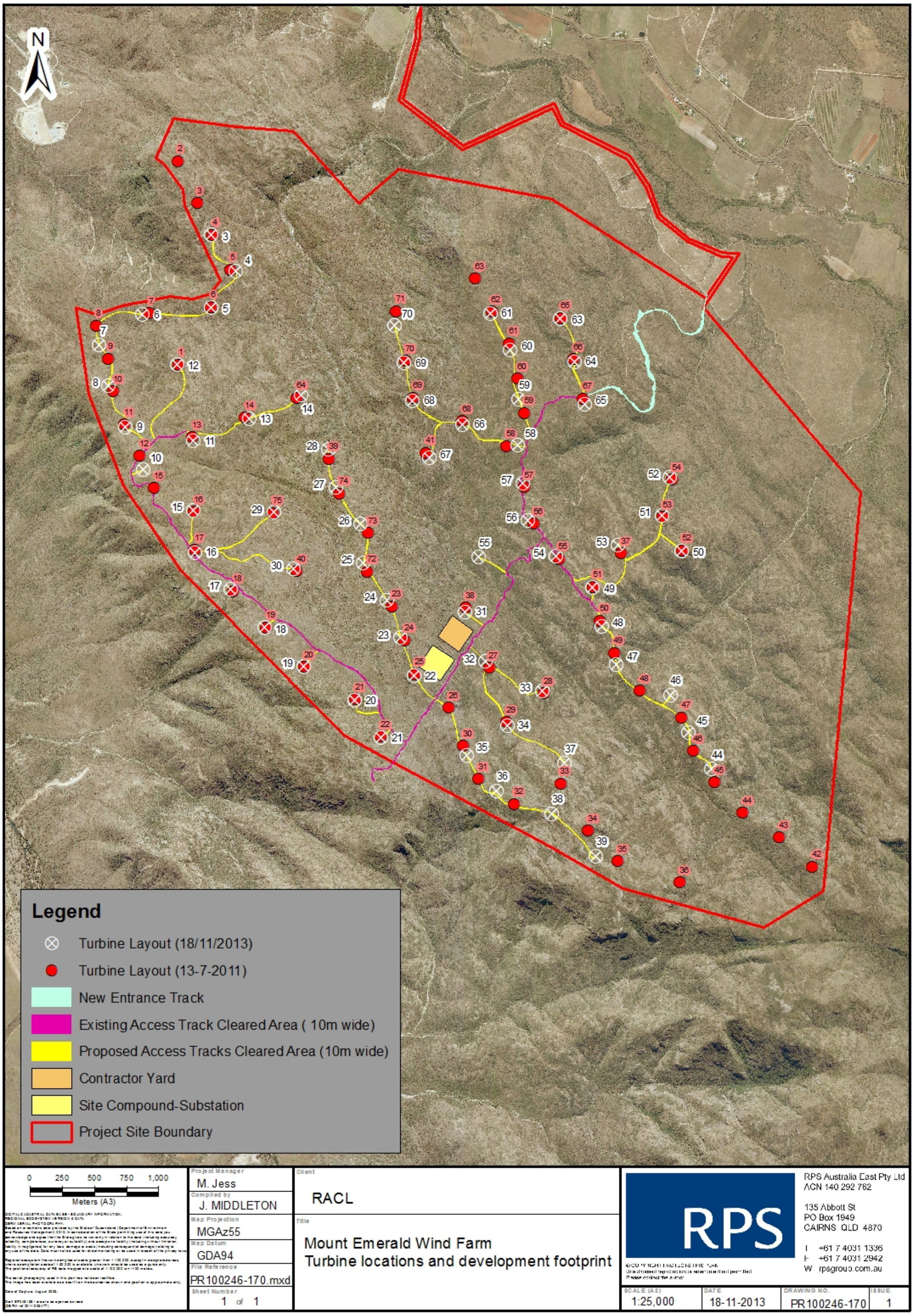

Figure 4 Current Wind Turbine Layout

2.3.4 Construction Phase

Wind turbines are manufactured in separate components and sections and will be assembled on the site according to the following broad stages:

- Turbines will be constructed from a hardstand area located at the base of each turbine location.
- Each unit will be installed in a sequential process following the formation of the footing and hardstand areas. Each wind turbine tower will be erected on a concrete and steel footing. Footings will be of either a gravity or rock-anchor type, depending on the geotechnical conditions at each site.
- The installation process will generally take up to one week for each turbine depending on weather conditions.
- Turbine erection commences with the initial tower section bolted to a stub section embedded within the concrete footing. Subsequent sections are raised by crane and bolted to the section below. The nacelle is then lifted to the top of the tower and secured, followed by fixing the rotor and blade assembly.
- Once the turbine is constructed, it is subjected to a detailed checking process as part of its commissioning before it can commence unrestricted operation.
- Power output from each turbine will be directed to 33 kV underground cabling (~1 m deep x 0.5-0.75m wide) which link each turbine to a new proposed substation located centrally within the site. The cables will generally follow the site access roads within the project area.
- A new substation will provide a connection to the existing 275 kV transmission line which traverses the project area.

The construction and operation of the wind farm will require the installation of a number of temporary and permanent facilities, such as:

- Permanent administration, maintenance and storage building for operations;
- Temporary buildings for construction;
- Laydown and holding areas for equipment and components during construction; and
- Car parking.

2.3.4.1 Access Roads

Access to the site will be gained from the Kennedy Highway via Hansen Road, then the realigned Springmount Road/Kippen Drive intersection, across a new road within Lot 905, along Kippen Drive and then across Easements A & C to Lot 7.

Access to the individual turbine sites will be provided by a series of tracks used for both construction and operation activities. These roads will comprise a formed roadway 5m with additional clearance of 1m each side for shoulders and drainage. For disturbance area estimates a width of 10m has been applied to all site roads to allow for the formed road, drains and batters. Roads have been designed to reduce the amount of steep terrain and as such it is thought reasonable to assume an overall 10m clearance width for all internal roads. The required road gradient for transport and cranes (as per wind turbine supplier specifications) is 11 to 15% without the use of a push/pulling unit. For circumstances where gradients do exceed this requirement, push/pulling units will be used.

An internal road layout has been provisionally determined, and is shown in the proposed site layout shown in **Figure 4.** Ultimately the road layout will be dependent upon the final location of the turbines and subject to engineering, environmental and cultural heritage factors.

2.3.5 Operation Phase

Once operational, the wind farm predominantly operates remotely and does not require full-time staff to be in attendance on the site at all times. These staff will be on site during normal working hours unless they are 'called out' under emergency circumstances. Each individual turbine undergoes a regular maintenance regime, which includes maintenance approximately every six months, which requires the turbine to be out of service during this period. Maintenance of the substation and associated facilities will also be required regularly, but relatively infrequently with no heavy machinery generally required once established. Four wheel drive vehicles or vans which carry the required tools and equipment will be used to provide access to the turbines during operation. Where non-scheduled maintenance is carried out due to irregular equipment failures, a hardstand area beside each turbine is proposed to be maintained to allow access for heavy machinery, as needed without further disturbance to the environment.

2.3.6 Decommissioning Phase

The project economics are based on a wind farm design life of up to 25 years, after which Mt Emerald Wind Farm Pty Ltd (under RACL) will either; continue generating power from the existing turbines, upgrade the turbines or remove the infrastructure and decommission the site.

Decommissioning the site would involve the following:

- Dismantling the turbines;
- Removing towers and replacing soil over foundations;
- Removing all material from site for recycling;
- Where tracks are of no use to the land owner, the land would be actively revegetated;
- Underground cabling would be removed if at risk of impact, but otherwise, this cabling will remain underground to reduce additional impacts caused by ground disturbance. All above ground lines would be removed; and
- The substation and associated buildings would be removed.

The requirement to decommission and restore the site according to the Rehabilitation Plan and environmental indicator criteria is a key component of the long-term lease agreement between the wind farm and the landowner, which would be registered against the land title to ensure continuity should the land be sold. A site Rehabilitation Plan will be prepared to provide strategic guidance and advice, and outline performance criteria for landscape restoration.

2.3.7 Wind farm Development Program

After planning and approval is finalised, the following proposed project phases will be developed:

- Pre-construction;
- Construction;
- Operation and maintenance and;
- Decommissioning.

The estimated duration of each phase is shown in **Table 2**, and the main activities associated with each phase are described in the following sections.

Table 2 Project Phase Duration

Project Phase	Duration
Pre-construction	12 months
Construction	24 months
Operation and Maintenance	20-25 years
Decommissioning	12 months

3.0 Impact Assessment

3.1 Landscape and Visual Impact

A detailed Landscape and Visual Impact Assessment (LVIA) undertaken by Green Bean Design (GBD) involved a comprehensive evaluation of the landscape character in which the proposed Mount Emerald Wind Farm and ancillary structures would be located, and an assessment of the potential landscape and visual impacts that could result from the construction and operation of the MEWF, taking into account appropriate mitigation measures.

The LVIA concluded that the MEWF project would have an overall low to medium visual significance on the majority of uninvolved residential view locations within the viewshed as well as public view locations (from sections of local roads and amenity areas within urban localities).

Although some mitigation measures are considered appropriate to minimise the visual effects for a number of the elements associated with the wind farm, it is acknowledged that the degree to which the wind turbines would be visually mitigated is limited by their scale and position within the landscape relative to surrounding view locations.

3.2 Noise

Detailed noise assessments have been carried out during the MEWF concept design phase by Noise Mapping Australia and more recently Marshall Day Acoustics, with the aim of producing a site layout that minimises operation phase impacts on nearby properties. The current conceptual layout referred to in this document reflects earlier consideration of offsite noise impacts through repositioning and reduction in number of turbines. Assessment of noise impact from the current layout has included detailed background noise investigations and initial modelling by NMA which has been further refined including an assessment of noise characteristics of a viable candidate list of turbine models, including RePower 3XM104, Siemens SWT-3.0-101 and Siemens SWT-3.0-108 models. The final turbine model will be confirmed during the detailed design phase.

Predicted noise levels experienced at surrounding residences are expected to be below nuisance standards. However, potential mitigation measures during wind farm operation phase have been considered and could include landscaping of residences and access tracks and acoustic shielding of residences to reduce internal noise levels.

RACL has engaged in ongoing consultation with local residents and made adjustments to the location of individual turbines and associated infrastructure to minimise visual impacts where possible.

3.3 Traffic and Transport

Sinclair Knight Merz (SKM) was commissioned by RACL to undertake a traffic impact assessment for the project.

The transport of materials and equipment to the site during the construction phase would involve a temporary increase in the local traffic volume and the transport of oversize loads.

The turbine components would include the tower sections, nacelles, blades, turbines, transformers, steel reinforcing (for the foundations), and substation components.

The nature of site traffic generated during the decommissioning phase and its potential traffic and transport impacts will be similar to the construction phase of the Proposal. It is expected that traffic volumes will comprise floats to and from site of construction plant and haulage of decommissioned WTG equipment and demolition materials for offsite disposal or storage.

The operation phase of the Proposal is not expected to generate significant volumes of traffic. The number of permanent staff on site is not expected to exceed 15 people, with approximately 8 trips assumed for residential purposes.

3.4 Community Consultation

RACL have conducted an extensive consultation program with local, state and federal government and community stakeholders including adjoining landholders since May 2009 during which a broad range of environmental concerns and issues were canvassed.

The following organisations have been identified as having a vested interest in the outcome of the proposed MEWF:

- Tablelands Regional Council
- Landholders
- Communities in Atherton Tablelands area, most notably Mareeba, Atherton and Tolga
- Bar Barrum and Muluridji People
- North Queensland Land Council
- Near neighbours
- Department of Employment, Economic Development and Innovation (DEEDI) includes Mines and Energy
- Department of Environment and Resource Management (DERM) includes Environment Protection Authority (EPA)
- Local Rural Fire Brigade
- Civil Aviation Safety Authority, Mareeba Airport and Aerial Agriculture companies
- Tourism Queensland
- Department of Transport and Main Roads
- Network Service Provider ("NSP") operating in the region of the proposed project area - Powerlink
- Electricity Off-taker
- SunWater
- Springmount Waste Disposal Facility

The outcomes of such consultation have informed the numerous design modifications to date to minimise and manage potential impacts. An additional consultation session will be held post lodgement of the development application to seek further feedback on the overall amended project. Regular updates, in the form of newsletters have been, and will continue to be, disseminated throughout the community and on relevant websites to ensure up to date information is available to all members of the community.

MEWF have proposed a Community Consultative Committee for the Mount Emerald Wind Farm similar to that developed and implemented at other wind farms around the country. The structure of this committee has been developed in conjunction with other companies and the Clean Energy Council's Engagement Officer to ensure the committee charter and proposed operating regime provide the best possible outcomes. A possible Chair has been approached and potential members identified, along with a timeline for commencement initiated.

3.5 Hazards and Risks

Rehbein Airport Consulting was engaged to provide an assessment of potential impact upon aircraft operations likely to be undertaken within the vicinity of the site.

This study considered in detail the likely impact of the location, height and blade rotation of the proposed wind turbines on the nearest aerodromes; air navigation and air traffic management services; transiting air routes; designated airspace such as Danger, Restricted or Prohibited areas; any other aviation activity; and electromagnetic interference (EMI) with airborne radio.

3.5.1 Aviation

The proposed wind farm will not impact upon aircraft operations to and from Cairns Airport or Mareeba and Atherton Aerodromes. Nor will it interfere with airborne radio or navigation aid performance. Flights operating under the Visual Flight Rules (VFR) should not be affected by the proposed wind farm as these flights are required to be conducted at a minimum height of 500 ft above ground level outside populous areas and will be above the level of the turbines. The structures will be sufficiently conspicuous by day, and at night local en route lowest safe altitudes (LSALTs) will provide clearance required for flights under the Instrument Flight Rules (IFR) and night operations under the Visual Flight Rules (Night VFR).

Low level flying operations such as agricultural aerial spreading and spraying operations or power transmission line inspections may be affected on the downwind side of the turbines over land on which the turbines are directly positioned, or over portions of some adjoining properties that are sited downwind from the turbines. This is due to wind shear, turbulence and downdrafts in the wake of the turbine rotors presenting a critical hazard to aircraft such as agricultural aircraft operating at low level and high weights during application of chemicals and seeding. However, agricultural spraying operations are normally conducted at very low levels and often require calm or very light wind conditions of less than 8 knots (15km/h). At these wind speeds it is reasonable to assume the wake can extend for a distance of 6 rotor diameters or 600m downwind of the nearest turbine based on the proposed rotor diameter of approximately 100m. Given the distances from wind turbines to cultivated areas of land on adjacent properties outside the wind farm boundary there should be minimal impact on agricultural aerial operations. A commitment to cease operation of the wind farm for the duration of downwind aerial spraying for lands within 5km of the wind farm would tend to negate any impact on local agriculture. Impacts to local tourism are difficult to quantify as any number of contributing factors may influence tourist economics. There does not seem to be any evidence to support the notion that wind farms have a negative impact on tourism, however, in many jurisdictions local operators and authorities have taken advantage of the opportunity and turned wind farms into a positive.

Apart from aerial agricultural operations over the wind farm, the risk to civil aviation activities if any that this wind farm may pose is negligible. However, as with any reported tall structure that may pose a risk, regardless of its negligible risk, the position of the proposed wind farm should be shown on appropriate air navigation charts to assist pilots operating in the region. Additionally, hazard lighting in accordance with MOS 139, Chapter 9, Section 9.4 should be installed on sufficient turbines in the Mount Emerald Wind Farm to define the extremities of the site.

3.5.2 Telecommunications

Parson Brinckerhoff (PB) was engaged to investigate any potential impacts to radio wave communication services and radar communication services in the locality as consequence of the proposed MEWF project.

Parson Brinckerhoff recommends that, to avoid obstruction interference, no turbines intrude on the calculated 2nd Fresnel zone for point-to-point radio links. PB suggests if the consulted licensees verify the RADCOM data is correct and there is agreement over radio path and tower setback distances, Mt Emerald Wind Farm Pty Ltd investigates mitigation options to avoid any interference. PB has determined that one turbine is located 4 m away from a 2nd Fresnel exclusion zone, presenting the possibility of the turbine encroaching on the exclusion zone depending on the orientation of the rotor. PB is in the process of seeking more precise coordinates from the relevant telecommunications tower operators/licensees.

PB believes point-to-multipoint impacts should be minimal. However, they recommend the position of registered point-to-multipoint license holders is sought with respect to the wind farm development. PB has initiated consultation with those license holders that are located within 3 km of the wind farm.

3.5.3 Fire and Bushfire

Fires have the potential to impact flora, fauna, and infrastructure within the MEWF site. The fire risk varies throughout the study area dependent on topography and fuel load. The bushfire danger season is approximately from August to late October in north Queensland, when the dry season is nearing its end and both temperatures and wind speeds are on the increase. Fire is an important landscape function and should be managed in respect to vegetation communities, cultural significance and human safety.

At a regional perspective, agricultural areas with typically little remaining natural vegetation generally have a low bushfire risk. Comparatively, areas of remnant or regrowth vegetation have bushfire hazard levels mapped between medium and high, depending on a variety of factors such as fuel load, vegetation type, species composition and moisture level. The main uses of fire in the region are associated with cane fires and controlled burns undertaken by state agencies such as the Queensland Parks and Wildlife Service.

Construction and Decommissioning Phase

The MEWF project has limited potential to cause increased impacts upon vegetation or fauna associated with natural fire events as it is unlikely to significantly change existing fire patterns. However, the project may impact on the potential for unnatural fire events particularly during construction and decommissioning.

There are a number of flammable materials and ignition sources in use during construction and decommissioning of a wind farm which may increase the risk of fire. Particular activities may also serve to increase that risk for example improper handling and storage of flammable substances, disposal of cigarette butts, or fuel load under work areas.

All mobile construction equipment should be with spark arresters to prevent accidental spark ignition of combustible material. Where naked flames are required, for example when oxy-acetylene equipment is used or where steel is being cut by grinders, two full fire extinguishers shall be located within 10m of the work area.

Operational Phase

The impact of a bushfire on WTG's at the MEWF site should be limited. Fires will be hot and fast and are unlikely to burn for long enough periods in the vegetation surrounding a turbine to cause any more than superficial damage to the base. Cleared areas under the turbines and the access track also create buffers. It is also unlikely that damage from flames could reach the nacelle or blade tips. The greatest risk will be to the substation, and other associated maintenance infrastructure on site which can if damaged, interfere significantly in the wind production capability on site.

It is also possible for fires suppression systems to be installed in the nacelle of modern wind turbines. Systems are either retrofitted to existing turbines or installed as an option within the factory, and given the relatively low cost of these systems when compared with the overall price of the turbine, there is becoming increasingly more popular with both wind farm owners and their insurers.

Research and operations over the past 20 years suggest that there is little chance of operational wind farms to create a fire risk (Macintosh & Downie, 2006) in Australia.

Wind turbines have the potential to create fire hazard in two ways: mechanically in which turbine bearings wear out, electrical shorts occur or cables are damaged for example; and lightning strikes due to the turbines height (Flynn, 2004). A review of available data reveals three wind turbine fires being reported in Australia with the root cause of each being attributed to mechanical issues. In each case the fires did not spread beyond the turbine due mostly to the passive nature of the turbines (few flammable materials), their lightning protection equipment, and in part due to the wind farms fire management strategy.

A detailed Fire Management Plan is under development by RACL to identify the approach to fire management during the Design, Construction and Operations Phases.

3.5.4 Climate Change

Studies of the sensitivity of ecosystems to climate change conducted by James Cook University, CSIRO Sustainable Ecosystems and others suggest that enhanced greenhouse conditions can have significant impacts on ecosystems of the tropical rainforest region, as well as economy and tourism, and human settlements.

Notwithstanding the considerable variabilities in projections by the Federal Marine and Tropical Sciences Research Facility (MTSRF), the intensity of extreme rainfall events is projected to increase even under slightly reduced average rainfall conditions, which could increase run off intensity, resulting in enhanced soil and in stream erosion with potential decrease in stream water quality and aquatic ecosystem function.

Notwithstanding the uncertainties surrounding the magnitude and temporal and spatial extent of climate changes discussed above, potential cumulative impacts from the MEWF project could include:

- Increased bushfire frequency and impact on vegetation patterns and sensitive plant and animal species survival, including weed invasion;
- Increase in run off turbidity as a result of earthworks and track erosion and reduction in aquatic ecosystem function; and
- Potential incremental loss of montane heath vegetation community from track and turbine construction clearing activities.

Similarly, an increase in the number of hot days (beyond a threshold) and a reduction in the number of cool days could impact agricultural yields and increase human discomfort, bushfire prevalence and energy demand. Rainfall and temperature changes could also increase stress on native plants and animals, resulting in ecosystem degradation, however there is currently no conclusive evidence of changes to rainfall patterns.

Potential impacts identified above are considered to be manageable through careful implementation of planned bushfire, weed management, clearing and erosion and sediment control strategies during the construction and operational phases of the project.

3.5.5 Health and Safety

Windfarm Noise and Health

There has been considerable media attention to the alleged negative health effects from wind energy. This media attention has translated into widespread community concern, including amongst residents living in proximity to the Proposal.

A number of reviews of the perceived impacts of wind turbine operation on human health have been undertaken over the last five years, both in Australia and internationally.

The National Health Medical Research Council (NHRMC) released their draft Information Paper regarding evidence on the potential effects of wind farms on human health in February 2014. The review provides a statement on the evidence of;

> *There is no reliable or consistent evidence that wind farms directly cause adverse health effects in humans.*

The Victorian Department of Health released a document in April 2013 titled *Wind farms, sound and health: Technical Information* along with a less technical summary *Wind farms, sound and health: Community Information*.

The investigation concluded that in relation to the sounds produced by wind farms and their potential impact on health;

> '*The predominant sounds produced by wind farms are in the mid to high frequencies. Wind farm sound, including low levels of low frequency sound, may be audible to nearby residents.*
>
> *Audible noise from any source, including wind farms, can cause annoyance, resulting in prolonged stress and other health effects. The potential for health impacts depends on acoustic factors (including sound pressure levels and other characteristics of the noise) and non-acoustic factors (including individual noise sensitivity and attitude to the source).*
>
> *Infrasound is audible when the sound levels are high enough. The hearing threshold for infrasound is much higher than other frequencies. Infrasound from wind farms is at levels well below the hearing threshold and is therefore inaudible to neighbouring residents.*
>
> *There is no evidence that sound which is at inaudible levels can have a physiological effect on the human body. This is the case for sound at any frequency, including infrasound*.'

The Massachusetts Department of Environmental Protection and Massachusetts Department of Public Health (2012) engaged an independent expert panel to "…*identify any documented or potential health impacts* [or] *risks that may be associated with exposure to wind turbines*…" The Panel - comprising seven individuals with backgrounds in public health, epidemiology, toxicology, neurology and sleep medicine, neuroscience, and mechanical engineering - conducted an extensive review of the scientific literature as well as other reports, popular media, and public comments. A focus of the Panel's review was "…*to examine the plausibility or basis for health effects of turbines (noise, vibration, and flicker)*".

The Panel's findings in relation to operation of wind turbines and noise and vibration generated the following conclusions:

- 'Literature on human response to wind turbines relates to self-reported "annoyance," and this response appears to be a function of some combination of the sound itself, the sight of the turbine, and attitude towards the wind turbine project.
- There is limited evidence from epidemiologic studies suggesting an association between noise from wind turbines and sleep disruption.
- There is insufficient evidence that the noise from wind turbines is causing health problems or disease.
- Impacts on the human body's vestibular system from wind turbine infrasound have not been demonstrated scientifically, with available evidence demonstrating that infrasound levels near wind turbines cannot impact the vestibular system.
- There is no evidence for a set of health effects, from exposure to wind turbines that could be characterised as a "Wind Turbine Syndrome".
- There is no demonstrable association between noise from wind turbines and measures of psychological distress or mental health problems.
- None of the evidence reviewed suggests an association between noise from wind turbines and pain and stiffness, diabetes, high blood pressure, tinnitus, hearing impairment, cardiovascular disease, and headache/migraine.'

3.5.6 Electric and Magnetic Fields

Electricity generates both electric and magnetic fields (EMF). These fields emanate from the wires delivering electricity to our homes and all devices which use electricity in the home. Therefore, Australians are routinely exposed to these fields in their everyday lives.

Studies have consistently demonstrated that prolonged human exposure to weak electric fields does not result in adverse health effects. Whether chronic exposure to weak magnetic fields is equally harmless remains an open question. While there is no evidence that these fields cause immediate, permanent harm, laboratory studies on animals and cell cultures have shown that weak magnetic fields can effect several biological processes (hormone and enzyme levels and the rate of movement of some chemicals through living tissue) (ARPANSA, 2009).

Human studies, known as epidemiological studies, are based on the occurrence and distribution of disease in the population or community. To date no epidemiological studies have produced solid evidence linking EMF exposure to disease. The majority of scientists and Australian radiation health authorities in particular, do not consider it a risk. Moreover, the evidence available is inconclusive and does not allow health authorities to decide whether there is a specific magnetic field level above which chronic exposure is dangerous or compromises human health (ARPANSA, 2009).

The 33kV underground lines connecting the wind turbines to the substation would be located at a depth of approximately 1m below ground level. At this depth, a maximum magnetic field of 10mG could be expected, which is insignificant when compared with the 1,000mG limit recommended for 24-hour exposure.

EMF from the substation would be less than 100mG in the vicinity of the transformers and other electrical components (HPA, 2004). These levels are well below the NHMRC limit of 1,000mG for the public or 5,000mG for occupational exposure. The substation will not be accessible by the public due to the surrounding security fence. The fence will be placed at a distance where the level of electromagnetic radiation is negligible.

To ensure that there would be no unnecessary exposure to EMF from the Proposal, the following mitigation and management measures will be implemented:

- Electrical cables will be placed below ground where possible to shield electrical fields;
- Wires will be bundled to reduce the magnetic field emissions;
- Appropriate security around emitting structures (e.g. Substation) will be placed and maintained to restrict public access and limit potential exposure; and
- Non-staff that need to go near the emitting structures would be accompanied by a trained and qualified staff member.

There is no consistent evidence of human health effects from exposure to extremely low-frequency electromagnetic radiation at much higher levels than is present near wind farms.

3.5.7 Shadow Flicker

Shadow flicker is the fluctuating light levels caused by intermittent (moving or changing) shadows. If a location is in the shadow of a moving object, then there will be a momentary reduction in light intensity as the shadow passes by. This is most noticeable in an enclosed room that is lit by the sun, when the shadow falls across the window that is providing the light. Wind turbines can cause shadow flicker from the moving shadow of the wind turbine blades. Shadow flicker can also be caused by any moving objects that cast a shadow, such as vehicles or aeroplanes.

A shadow flicker assessment was prepared for the proposal by Parsons Brinckerhoff using the methodology described in the Draft National Wind Farm Guidelines (EPHC, 2010).

The results of the shadow flicker assessment including worst case results and realistic results using average sunshine statistics show that none of the receptors are expected to experience shadow flicker for more than 30 hours per year in both the worst and realistic case scenarios, or 30 minutes per day in the worst case scenario.

The worst case assessment for each receptor results in the number of shadow flicker hours that the dwelling could potentially experience in a year. However, the occurrence of all these assumptions at one time is considered highly unlikely as cloud cover will occur over the project site, for example. Therefore, the worst case shadow flicker results serve as a starting point from which a more realistic situation is derived using measured data from reference sites recording sunlight information.

EPHC (2010) note the following in relation to the risk of epileptic seizures from wind turbine shadow flicker:

There is a negligible risk of epileptic seizures being caused by conventional horizontal axis wind turbines, for the following reasons:

- Less than 0.5% of the population is subject to epilepsy at any one time, and of these, approximately 5% are susceptible to strobing light (Epilepsy Action Australia, 2009).

- Most commonly (96% of the time), those that are susceptible to strobe lighting are affected by frequencies in excess of 8 Hz and the remainder are affected by frequencies in excess of 2.5 Hz. Conventional horizontal axis wind turbines cause shadow flicker at frequencies of around 1 Hz or less.
- Alignment of three or more conventional horizontal axis wind turbines could cause shadow flicker frequencies in excess of 2.5 Hz; however, this would require a particularly unlikely turbine configuration.

3.5.8 Blade Throw

Blade throw involves the detachment of a turbine blade, or a fragment thereof, and its ejection from the turbine assembly. This poses a potential risk to nearby people and property.

An analysis of potential safety risks from the Kittitas Valley Wind Power Project (Kammen, 2003) assessed the human health risks of separation and throwing of a whole or partial wind turbine rotor blade. The analysis involved theoretical calculations of individual risk (IR) – the probability that a member of the public will die from an accident if he/she is permanently at a certain place without protection – and assessment of actual probabilities of a blade fragment striking a member of the public.

The theoretical calculations indicated that for a 2MW wind turbine with a rotor diameter of 80 metres, the IR is 1 in a million within 150m of a turbine. As stated above, this probability assumes that an individual is permanently at a certain place without protection.

GL Garrad Hassan (2010) undertook a literature review of wind turbine failure and certification processes and made the following observations:

> *The reduction in failures* [over the last 20 years] *coincides with the widespread introduction of turbine design certification and type approval. This process requires full scale strength testing of every certified design of turbine blades. It also often requires a dynamic test that simulates the complete life loading on the blade. The certification body will also perform a quality audit of the blade manufacturing facilities and perform strength testing of construction materials. This approach has effectively eliminated blade design as a root cause of failures. Unfortunately, this does not mean that blade failures do not occur, but when they do, the root cause is some other factor.*
>
> *The main causes of blade and tower failures are now a control system failure leading to an over speed situation, a lightning strike or a manufacturing defect in the blade. The latter cause does not often lead to detachment of blade fragments.*

Overspeed protection mechanisms for wind turbines are manufacturer-specific. REpower turbines, for example, incorporate an uninterruptible power supply (UPS) (i.e. a battery) in each wind turbine to shut the turbine down safely in the event of a power failure. Furthermore, each individual blade has an independent electronic pitch motor with its own UPS, so that each blade can be pitched out of the wind in an emergency.

Pitching a single blade out of the wind is enough to stop the rotor from spinning. Other manufacturers have similar systems.

3.5.9 Unexploded Ordinance

The MEWF site has been identified as a live firing training ground for allied mortars and grenades by Allied Forces during training and development phases of World War II. To ensure the safety of personnel and civilians working in the vicinity of the site, with regard to any impacts from potential UXO contamination and to identify the potential risk of uncovering either buried, unexploded ordnance or explosive devices an assessment was undertaken by RPS UXO specialists, who deliver the full findings of this investigation.

Nine confirmed UXO contamination sites have been identified in vicinity of Tinaroo-Tolga with the Walkamin Mortar/Grenade range situated in the north-eastern quadrant of the project site as the closest source of 'substantial' contamination.

Activities in which UXO contamination could be considered a potential hazard are:

- Enabling works;
- Intrusive Site Investigations (Trial holes/trenches, boreholes, window samples);
- Excavations and Piling Works.

Blast and fragmentation effects are the more obvious impacts from detonation of UXO's however the potential for fire and chemical contamination from the degradation of unexploded bombs must be considered.

Based on the risk assessment carried out for the site, RPS recommended that the following mitigation strategies be implemented in support of works taking place on site:

- Detailed Geotech investigations.
- Explosives Safety & Awareness Briefings / Explosives Site Safety Guidelines - Personnel conducting intrusive works should attend an Explosives Safety & Awareness Briefing.
- Explosives Engineer Supervision - Explosives Engineer should be present during any excavations/trial pits taking place at the site.
- Intrusive Magnetometer Survey - conduct an intrusive Magnetometer survey ahead of proposed piling and borehole locations across the site to reduce the risk of encountering deep buried UXO. The type of survey methodology required would be dependent upon ground conditions and the works taking place.
- Non-Intrusive Magnetometer Survey - As an alternative to Explosives Safety Engineer Supervision, and considering the specific conditions on site, it may be feasible to carry out a Non-Intrusive Magnetometer survey ahead of shallow excavations/works in certain areas.
- Mitigation measures for UXO's discovered on site are under the jurisdiction of the local Police and subsequently the Department of Defence as conditioned by the Department of Environment and Heritage. Removal or destruction of the device is up to the discretion of these parties and its impact on MNES is dependent on public safety factors.

3.6 Cultural Heritage

Due diligence assessments of likely Indigenous and non-indigenous cultural heritage significance has been undertaken by consultants Converge including assessment of the preliminary corridor layouts and consultation with the traditional owners (identified as members of the Bar-barrum people).

Consultation and meetings have occurred as part of the preparation and negotiation of a Cultural Heritage Management Plan. A component of the Cultural Heritage Management Plan outlines the undertaking of preconstruction Cultural Heritage survey to be conducted by members of the Bar-barrum people. Further proposed consultation will canvas potential project employment opportunities such as site rangers and environmental officers.

It was identified that no sites of non indigenous cultural heritage were located during the assessment of the study area. While there is the possible, but unlikely occurrence for a non indigenous site to be located on the site during construction avoidance and mitigation measures have been provided to protect these significant sites from damage.

3.7 Matter of National Environmental Significance

Extensive surveys of flora and fauna have been undertaken at the proposed MEWF site over three years to develop a sound understanding of the ecology of site and its surrounds and so inform project feasibility and ultimately the ecologically sustainable design and operation of the project. Of the 22 flora species assessed for likelihood of occurrence, 14 species are not considered likely to occur on the site due to the absence of suitable habitat. Six species have a moderate to high chance of being present on the site although surveys did not locate any specimens. No Listed Threatened Ecological Communities were observed within the wind farm site. Two species were confirmed on site: *Grevillea glossadenia* and *Homoranthus porteri.*

Of the 28 fauna species assessed for likelihood of occurrence under the EPBC Act, 12 species are not considered likely to occur on the site due to the lack of suitable habitats: principally closed rainforest, wet sclerophyll forest, permanent wetlands or streams. An additional five species, the Squatter Pigeon, Eastern Bristlebird, Star finch (eastern), Northern Bettong, and Brush-tailed Rabbit Rat are also considered unlikely to occur on the site given knowledge of their known current distributions. Nine species are considered to have a 'Moderate' likelihood of occurrence either due to the presence of suitable habitat or likelihood of overflying, but no positive sightings during field investigations. Of the EPBC-listed fauna, three threatened species, the Northern Quoll (*Dasyurus hallucatus*) Spectacled Flying-fox (*Pteropus conspicillatus)* and the Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus)* were positively confirmed during the field surveys. One migratory species, the Sarus Crane (*Grus antigone*), was also considered at risk due observations of the species made surrounding the site.

3.8 Flora

Field assessments have been performed since May 2010 and over 140 sites have been inspected. The purpose of these surveys was to locate and characterise the species of flora across the site; the vegetation communities which host the flora; and identify species of plants known to be of interest to conservation, and particularly, those listed under the EPBC Act.

Surveys were undertaken in accordance to Mueller-Dombois and Ellenberg (1974), which samples an area of 10-25 m^2 for heath communities; and Neldner, et al. (2012) for surveying woodland communities in an area of 500 m^2. Larger areas of a certain vegetation type were often surveyed by examining the routes chosen for the interconnecting tracks between turbines.

With the exception of the linear clearing associated with the existing 275 kV electrical transmission line that bisects the project area, the wind farm site is predominantly covered by remnant vegetation, much of which is in exceptionally good condition. Landscape disturbance and hence, modification, is minimal and virtually absent from the southern half of the project area in the Wet Tropics bioregion section.

Several REs (regional ecosystems - remnant vegetation communities) are mapped over the project site. The transmission line which bisects the site coincides with the boundary between two bioregions:

- The Wet Tropics to the south of the transmission line; and
- The Einasleigh Uplands to the north.

Regionally, the site forms the northern extent of the Herberton Range. The Wet Tropics bioregion section is contiguous with the Mount Emerald mountain range. The Wet Tropics section and the western ridge of the Einesleigh Uplands section are in near pristine condition. The Wet Tropics Bioregion is not considered to contribute to the WTWHA. The Wet Tropics bioregion and the Wet Tropics World Heritage Area are unrelated biophysical mapping areas. Mapping of the boundaries of these entities indicates the physical separation of the Wet Tropics bioregion section of the wind farm site and the WTWHA boundary. The WTWHA boundary has two sections – to the south, and to the east - both separated from the site by farm land, roads and built infrastructure.

Of the 22 flora species assessed for likelihood of occurrence, 14 species are not considered likely to occur on the site due to the absence of suitable habitat. Six species have a moderate to high chance of being present on the site although surveys did not locate any specimens. Two species were confirmed on site, *Grevillea glossadenia* and *Homoranthus porteri.* The shrub *Grevillea glossadenia* was found to be more resilient to landscape modification and has greater representation (in numbers and populations) than *H. porteri*. This species grows in association with *H. porteri*, but has a wider tolerance of habitat characteristics. It was found to respond to surface disturbance and is considered to be capable of active regeneration.

The most probable significant impact to flora species listed under the EPBC Act is the clearing of ridges in the south-west of the site, and above 900 m ASL. This altitudinal zone is the key habitat for *Homoranthus porteri* - a species which occupies a restricted habitat range characterised by exposed, wind-sheared ridges. Significant populations of *H. porteri* are found in this area and must be considered important on a regional scale when compared with other populations outside the site (i.e. Irvinebank, Watsonville, Toy Creek). The site's populations of the shrub by comparison with the regional populations are large, well-protected and represented by healthy thickets. Clearing of ridges where the shrub is found only on rock pavements is likely to have a significant impact and could disrupt the viability of the local population. Proposed impact mitigation measures focus on avoidance and minimisation of impact through detailed preconstruction surveys, micro siting of tracks and turbines, revegetation research and monitoring and provision of offsets to compensate for any residual impacts.

Key impact mitigation measures will need to avoid impacts in the first place. Wherever possible, careful ground-based route selection and turbine placement will be required. As part of this EIS impact mitigation process RACL designers have removed four (three >900m elevation) turbines from the priority Wet Tropics bioregion.

3.9 Northern Quoll

Extensive field surveys and modelling was conducted over 18 months to assess potential impacts on the Northern Quoll including:

- Camera trapping;
- Elliott and cage trapping, collaring, automated and hand held radio tracking;
- Local and Regional Genetic Diversity Assessment; and
- Population Viability Analysis.

The Northern Quoll population on the proposed Mt Emerald Wind Farm site may be important in maintaining the viability of the Far North Queensland (FNQ) metapopulation of the species, which is one of the most secure of the Australian metapopulations (Pilbara, Kimberleys, Darwin/Kakadu, Cape York, Carnarvon Gorge, Townsville, Mackay/Rockhampton and SE Queensland) due to its persistence despite the presence of Cane Toads. However, population viability analysis models (albeit highly conservative) indicate the Mt Emerald Northern Quoll population is at high risk of extinction over the proposed lifespan of the project (25 years) and even small levels of mortality associated with the project could impact the viability of the local population. Although preliminary research suggests the Mt Emerald population is <1% of the total estimated FNQ metapopulation and only 57 ha of known denning and foraging habitat will be cleared on the site, further studies are required in order to be able to assess the likely significance of these potential impacts on the overall FNQ metapopulation.

Radio-telemetry studies on Mt Emerald suggest that non-breeding season den site habitat is likely to be widespread across the site. However, only limited information is available on the maternal den site habitat availability; with data obtained to date indicating that ridge habitat where turbines are proposed to be located may be critical. Whilst the narrow ridgelines are dominated by rocky habitat, it is also prevalent along creek lines and as outcrops in mid slope areas, therefore it is considered likely that suitable maternal denning habitat may not be restricted to ridgelines only.

3.9.1 Mitigation Measures

Mitigation options are proposed that may reduce the significance of the potential impacts on the local population and the FNQ metapopulation. Further studies are proposed to be conducted on the project site to gather information on seasonal variation in fine-scale habitat utilisation, particularly concentrating on female maternal denning and foraging utilisation patterns using recently available light-weight combined GPS-VHF radio-telemetry collars and live-trapping.

The proposed strategy to minimise impact on the Northern Quoll is based on a hierarchical approach of further risk assessment, avoidance of areas and times of high risk and lastly implementation of specific Northern Quoll management procedures during the construction phase.

The proposed mitigation strategy to reduce the risk of construction associated mortality is as follows:

- Conduct intensive preconstruction live-trapping surveys in the vicinity of the planned infrastructure areas beginning when Northern Quoll are likely to be large enough to be fitted tracking collars. This will allow for the location of denning sites, including maternal sites which can be checked for occupation immediately prior to ground disturbance.
- Two to three days prior to the commencement of primary bulk earthworks (including initial ground breaking and trenching using dozers, rock breakers etc in discrete clearly marked areas; establish live-trapping lines traps immediately outside of the infrastructure area. Before construction starts, traps are checked and all captured animals (with the exception of females with young deposited in maternity den sites – see below) to be relocated to suitable refugial areas (e.g. rocky outcrops) at least 1 km away from the construction area. Trapping and relocation will be continued for the duration of construction.
- When dependent young are deposited by the female Northern Quoll in a maternity den, as opposed to being carried around in the pouch, they will be impossible to capture in live traps. Oakwood (1997) found that young were deposited in maternal dens in mid to late-August and were not trappable until at least November each year. It is not known whether the timing of this will vary significantly each year; therefore, ongoing live-trapping to monitor female reproductive status will need to be undertaken to determine when young are deposited in maternal dens and when they are independent and relocatable.
- In addition to live-trapping, the proposed footprint clearing will be searched methodically for denning radio-collared individuals each morning prior to starting construction activities. If any

actively occupied dens are located within the construction area, then all bulk earthworks will be halted until such time as the individual shifts den sites.

- Primary bulk earthworks will need to be conducted in discrete, clearly marked sections on a sequential basis. The size of each discrete construction area must be limited to that able to be trapped and searched for collared animals in the 1-2 hours around dawn each day.
- If adult females are captured during the pre construction live-trapping and inspection indicates that they have dependent young not in the pouch (i.e. lactating nipples), then the female will be released immediately at the point of capture rather than being relocated, and then tracked to the day-time maternity den and construction will be halted (within a to be determined buffer distance) until live-trapping monitoring indicates that young are trappable or the female vacates the den with the dependant young or fibre optic camera monitoring of maternal behaviour indicates that disturbance is at tolerable levels..
- Preliminary investigation of the use of two specially trained Quoll detection dogs and handlers in October 2012 was successful in identifying areas of the site utilised by Northern Quoll. Further investigation of the potential for using detection dogs to identify inhabited den sites is warranted as it may enable construction activities to be continued into the period when dependent young are deposited in maternity dens and when they are independent (mid-late August to November). The use of Quoll detection dogs would increase the likelihood that the construction area is free of Northern Quoll in dens unlike the use of radio-telemetry and live-trapping alone.

In addition to the above specific live-trapping, radio—tracking and detection dog mitigation strategies, the following general standard mitigation action will be implemented during all construction activities involving potential habitat destruction. A licensed and experienced spotter catcher(s) will be onsite during all clearing activities and will ensure any injured animals are given to an appropriate wildlife carer group or vet, Australian Department of the Environment and Queensland Department of Environment and Heritage Protection will be notified within 24 hours of any native animal injuries or deaths.

Operational phase mitigation will focus on preventing invasion of the site by environmental weed such as grader grass which has a moderate potential to modify foraging and denning habitat through high intensity bushfire generation.

3.10 Sarus Crane

Several species of migratory bird have been confirmed to fly over the proposed MEWF project site, namely the Sarus Crane, White Throated Needle tail, White-bellied Sea Eagle and the Great Egret. Of those species only the Sarus Crane (*Grus antigone*) has been observed in significant numbers flying adjacent to or over the site, or has been observed foraging in the local area surrounding the site. The Sarus Crane was the only species found to potentially have a high risk of impact from the proposed MEWF project and required specialist studies and adaptive mitigation and management strategies.

Survey efforts were made to determine whether Sarus Cranes flights over the site are restricted to particular sections to determine whether these sections of the site pose greater risk of collision than others. The surveys also examined the diurnal and seasonal variation in habitat usage of Sarus Cranes (in particular, are flights more concentrated at particular times of day or months of the year).

Collision risk modelling conducted by Ian Smales of Biosis Research Pty Ltd, using point count bird utilisation data collected on the project site by RPS Group predicts that the mean number of collisions per annum for Sarus Crane ranges from 0.14 to 0.83 individuals per annum depending upon the value of the avoidance rates (90%, 95%, 98% and 99% dynamic avoidance and 99% static avoidance).

There is no empirical information available on the Sarus Crane ability to predict avoidance behaviours, however observations of Crane species monitored at operational wind farms both nationally and internationally have shown a low collision risk which is suspected to be due to behavioural avoidance.

3.10.1 Mitigation Measures

Further utilisation surveys are recommended using a combination of an advanced avian radar system (the radar will provide horizontal coverage over the entire site and the adjacent West Barron Storage and the Rex Rd/Rocky Creek maize fields) to obtain numerical data on *Grus spp*. abundance and flight behaviour (height & flight paths).

The utilisation data obtained from the additional surveys will enable automated turbine curtailment mitigation rules for use with a radar-SCADA (supervisory control and data acquisition) system to be developed.

Numerical collision risk modelling should be repeated using the longer-term and likely to be more accurate data set obtained from 1-2 years of radar utilisation surveys.

Validation of the numerical collision risk model assessments of annual mortality and/or annual number of flights-at-risk should be undertaken in the operation phase of the project. This will be achieved by conducting statistically valid turbine mortality surveys for Sarus Crane (together with scavenger removal and detectability trials). Verification of the effectiveness of the radar-SCADA mitigation rules for Sarus Crane should also be undertaken during the operation phase, and fine-tuning of these rules implemented if detected mortality levels exceed those predicted by the collision risk models.

3.11 Bare-rumped Sheathtail Bat

Three species of EPBC listed threatened microchiropteran bats were assessed as moderately to highly likely to occur on (or in the immediate vicinity of) the proposed MEWF project site:

- Greater Large-eared Horseshoe Bat, *Rhinolophus robertsi* (*R. phillippinensis maros*) listed as endangered under the EPBC;
- Bare-rumped Sheathtail Bat, *Saccolaimus saccolaimus nudicluniatus,* listed as critically endangered under the EPBC; and
- Semon's Leaf-nosed Bat, *Hipposideros semoni*, listed as endangered under the EPBC.

The Bare-rumped Sheathtail Bat was confirmed to occur on the site on the basis of ultrasonic calls analysis conducted by a recognized expert. Although relatively few calls were detected, it is likely that the activity of the species may have been underestimated due to its propensity to fly above the detection range of the bat call detection equipment. The ecology of the species is poorly understood and it is only recently that reliable identification of the species call was possible.

The main potential impacts of the project on the species were considered to be mortality due to turbine collision and/or barotrauma during the operation phases and loss of roosting habitat during the construction phase. There was a high degree of uncertainty regarding the significance of these impacts on the species due to the lack of information on the basic ecology of the species, including local and regional population abundance and flight heights and utilization patterns across the project site.

3.11.1 Mitigation Measures

A potential methodology to gather additional utilisation information for the species is outlined below:

Call Activity Monitoring

- Continuation of continuous dusk to dawn passive ultrasonic call monitoring surveys at the 10 existing towers locations and establishment of additional towers would provide a more complete coverage of the representative habitat where turbines are proposed to be located.

Threatened Bat Utilisation Radar/Thermal Imaging/Call Surveys

- Conduct microchiropteran utilisation surveys in the vicinity of each acoustic monitoring tower using a portable X-band weather radar (including video capture card and storage) operating in vertical mode in conjunction with thermal imaging video and ultrasonic call detectors on balloons or tall towers to collect data suitable for collision risk modelling for each threatened species and for all bats in general (i.e. abundance and flight height data).
- Investigate the potential to positively identify each threatened bat species using radar on the basis of their wing beat frequency and flight behaviour.

To reduce the potential impact to roosting Bare-rumped Sheathtail Bat colonies that may occur on the site during the construction phase, a species management program (SMP) (inclusive of marking habitat trees for spotter catchers, avoid clearing hollow-bearing trees where possible, and using spotter catchers to remove identified bat colonies) will be prepared.

At present, the most proven method of mitigating microchiropteran fatalities due to barotrauma and turbine collisions is offered by curtailing the operation of wind turbines during high-risk periods (i.e. when bats are foraging in the vicinity of turbines) by either changing the wind-speed trigger at which the turbines are allowed to begin turning or by altering blade angles to reduce rotor speed. However, it would be necessary to determine the relationship between environmental factors, such as wind speed, and the abundance/activity of the threatened bat species at the proposed MEWF project site before these cut-in speed thresholds could be validated. A detailed pre operation phase program of investigations has been proposed to optimise cut in speeds and identification of high risk environmental factors which would inform seasonal operational cut in speed strategies.

3.12 Spectacled Flying Fox

Spectacled Flying-foxes have been identified as being a significant component of World Heritage Values in its own right and also contributing to two ecological processes that are important in maintaining other values of the Wet Tropics World Heritage Area (WTWHA) and ensuring the ongoing evolution of the area. Spectacled Flying-foxes are known to be a major pollinator and plant seed disperser, including large-fruited species that are listed as having World Heritage Values. It is also a representative of the mixing of Australian and Asian biota and represents a unit of biodiversity in the WTWHA.

Essential roosting, breeding and mating habitat for Spectacled Flying-foxes include rainforest, gallery forest, Melaleuca swamps, mangroves and eucalypt forest. Most camp sites are located within 6.5 km of rainforest, however at least one colony located at Mareeba is approximately 16 km from the nearest rainforest (**Figure 5**).

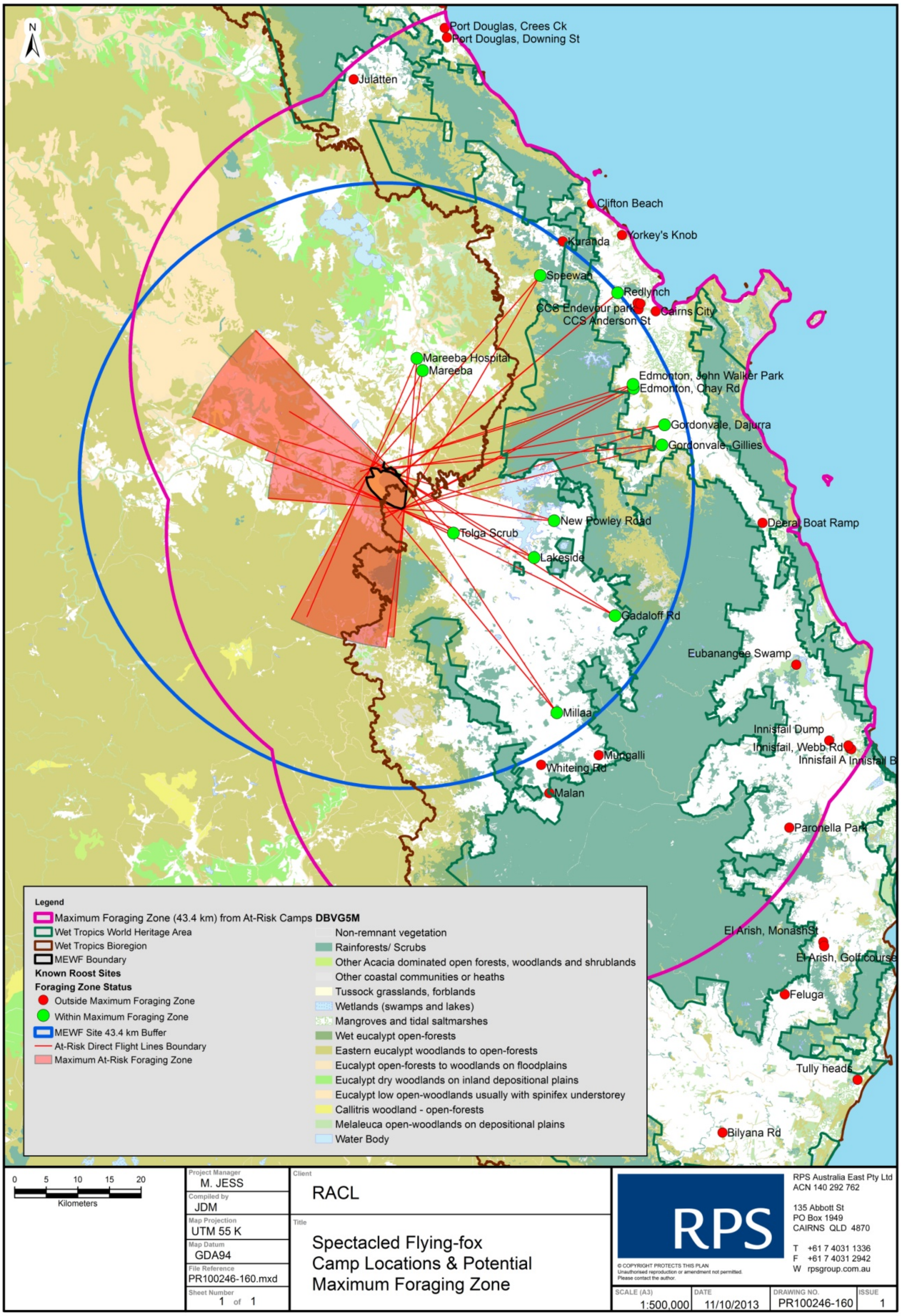

Figure 5 Potential Foraging Areas for Known Spectacled Flying Fox Camps

Ongoing satellite-telemetry tracking of Spectacled Flying-foxes by CSIRO researchers is assisting with the discovery of new roost sites. What constitutes essential foraging habitats for the species is not well understood. Spectacled Flying-foxes forage in wide variety of habitats including rainforest, wet and dry eucalypt forest and woodlands, melaleuca swamps, littoral and coastal mixed forests and mangroves, farmlands and urban and suburban gardens.

There is an estimated total of 2,101,367 ha of potentially suitable foraging habitat within 43.4km of the site. In addition, to these habitats, there is an additional 531,857 ha of non-remnant vegetation and cleared land (**Table 3**), some of which is likely to contain Spectacled Flying-fox food plants, including pastures with isolated trees and *Solanum mauritianum* shrubs.

Table 3 Total Area of Potential Spectacled Flying Fox Foraging Habitats Within 43.4 km of the project site

Broad Vegetation Group (at 1:5,000,000 scale)	Area (ha)
Rainforests, scrubs	690,961
Wet eucalypt open-forests	79,293
Eastern eucalypt woodlands to open-forests	1,018,622
Eucalypt open-forests to woodlands on floodplains	43,415
Eucalypt dry woodlands on inland depositional plains	41,592
Eucalypt low open-woodlands usually with spinifex understorey	54,902
Callitris woodland - open-forests	2,534
Melaleuca open-woodlands on depositional plains	64,254
Acacia dominated open-forests, woodlands and shrub lands	15
Coastal communities or heaths	49,198
Wetlands (swamps and lakes)	7,714

Two methods were trialled between late 2012 and mid 2013, to collect spatially and temporally replicated habitat utilisation data (abundance and flight height) suitable for incorporation in to numerical collision risk models, light-enhancing night vision goggles/infrared spotlight and) thermal imaging video. Significant effort was placed in the development and conduct of the methodologies with the understanding this was a novel approach, untested in Australia, on a species that has been understudied due to the challenges in obtaining sufficient ecological data. The tested methods proved suitable for collection of utilisation data on site; however detailed abundance and flight height data proved difficult to obtain.

There is the potential for these relatively unpredictable, high mortality events to result in the long-term decline in the total population of the species depending upon the frequency and intensity of these possible events.

In addition to rainforest fruits, which are a primary component of their diet, the species also utilises a wide variety of plant resources including myrtaceous pollen and nectar from non-rainforest habitats such as wet and dry sclerophyll. It is possible that high density concentrated ‘streams’ of Spectacled Flying-fox (including some *P. poliocephalus*) could transit over the MEWF site. There is the potential for patchy mass flowering events to attract large numbers of Spectacled Flying-fox for the duration of flowering, which could last for periods of months, however given the large area of similar habitat surrounding Mt Emerald and closer to the known colonies, the probability of a significant number of bats foraging on such events at the site would reasonably be limited.

It is possible but not probable that a significant proportion of the population of Spectacled Flying-fox from all of the camps (**Figure 5**) that are within the maximum foraging zone distance around the proposed MEWF project site, could potentially fly within the proposed rotor strike area (i.e. 26-134 m above the ground) whilst foraging within the site or traversing the site to forage in adjacent areas during the proposed operational life of the project.

3.12.2 Mitigation Measures

Mitigation actions focus mostly around conducting further utilisation surveys with advanced avian radar systems to assist in quantifying turbine collision risk for the species and to assist with development of effective automated selective curtailment of operating turbines. Long-term preconstruction radar studies using systems that are capable of measuring wing-beat frequency and thus, capable of providing accurate species identification, in conjunction with visual observation using thermal imaging video/image enhancing night vision, are currently the best option available to provide a meaningful estimate of the risk of turbine collision by Spectacled Flying-fox.

Bird and bat radar systems currently represent the most effective method of assessing spatial and temporal variation in habitat usage of nocturnally flying animals such as Spectacled Flying-foxes, in addition to allowing the collection of abundance and flight height data suitable for incorporation into a numerical collision risk model. Nocturnal bird and bat utilisation surveys for wind farms in the USA and Europe typically used radar surveys to inform real time adaptive collision risk management (temporary turbine shut down) and assess risk for nocturnally active migrating birds and bats.

It is also recommended to conduct long-term pre-construction radar studies together with visual observation truthing (e.g. high-powered search-lights) to determine spatial and temporal variation in habitat utilisation by Spectacled Flying-foxes over the project site. The use of radar has not been trialled in Australia; however its use is now common as part of US and European wind farm bird and bat risk assessments.

There is a major knowledge gap regarding the ability of Spectacled Flying-foxes, or any other *Pteropus spp*., to avoid turbine collisions, which is essential to more accurately assessing the potential risk to the species from the project. The following studies are recommended to be conducted at the Windy Hill Wind Farm site:

- Trial the effectiveness of automatic micro-avoidance detection systems based on visual detection such as TADS, or bird and bat to assess avoidance rates of Spectacled Flying-fox; and
- Conduct ground-based turbine mortality surveys at WHWF site, standardising for scavenger removal rates and detectability.
- If proactive avoidance action system involving a bird and bat radar with SCADA system (e.g. Detect’s Merlin or Robin Radar 3D FMCW system) or total night time shut-down are not considered as viable options, then the only potentially effective methods that are available to mitigate collision mortality of Spectacled Flying-fox are reactive in nature i.e. collisions are first detected and are then followed by actions to reduce the likelihood of further deaths.

The provision of financial assistance to CSIRO to support their research project collecting satellite telemetry of Spectacled Flying-fox including movement data obtained from individuals from the Tolga Scrub camp and other camps within the potential maximum foraging area may assist with indentifying high collision risk periods when Spectacled Flying-foxes are foraging within the proposed MEWF project site or in surrounding areas.

4.0 Environmental Risk Assessment

A multi-criteria analysis has been used in this assessment in accordance with the Australian Standard AS/NZ 4360 Risk Management where the likely hood of an activity is assessed against the severity (consequence) of the action. Through identification of the environmental risks and assessment of the proposed mitigation measures against these risks we can ascertain the value of the mitigation measures and strategies outlined in the Preliminary Environmental Management Plan (EMP).

4.1 Evaluating Risk

The risk matrix (**Table 4**) provides a risk rating from the combination of likelihood of occurrence and consequence, should the impact occur. Potential impacts with a risk rating of 1 to 3 are considered to present a negligible to moderate environmental risk whereas a risk rating of 4 to 6 is considered to present a moderate to very high environmental risks.

Table 4 Risk Matrix

		CONSEQUENCE					
		Insignificant	Minor	Moderate	Major	Disaster	Catastrophic
LIKELIHOOD	Almost Certain	4	4	5	5	6	6
	Likely	3	4	4	5	5	6
	Probable	2	3	4	4	5	5
	Possible	2	2	3	4	4	5
	Unlikely	1	2	2	3	4	4
	Improbable	1	1	2	2	3	4

A number of potential ecological impacts have been identified and assessed, the majority of which are assessed as low to moderate risk following implementation of proposed mitigation measures. The impacts which remain significant (i.e. Risk Level 4 or greater) after all appropriate measures are applied are as follows:

4.1.2 Flora

Loss of Montane Heath habitat above 900m in the Wet Tropics Bioregion (Risk Level 4).

To reduce the impact from turbines to the montane heath habitat in the wet tropics bioregion, RACL reduced the number of turbines in this area. Removing three turbines above 900m has reduced the impact on this habitat by 2.755 ha. Additionally, the reduction in the turbine layout of a total seven turbines now reduces habitat loss by a total of 4.743 ha. Offsets are proposed for residual impacts on the montane heath above 900m.

4.1.3 Fauna

Northern Quoll high quality denning habitat loss - Risk Level 4

Bare-rumped Sheathtail Bat – turbine collision and barotrauma - Risk Level 4

Potential impacts to fauna from high quality denning habitat loss (Northern Quolls) and turbine collisions and barotraumas (Bare-rumped Sheathtail Bat) remain a Level 4 moderate risk due to the lack of suitable data collection to date.

Other Level 3 residual moderate risk impacts include:

- Flora- Increased bush fire intensity from invasive grass weed spread;
- Northern Quoll- habitat degradation;
- Northern Quoll- construction mortality; and
- Spectacled Flying Fox- turbine collision.

It is anticipated that the preconstruction and construction utilisation surveys will fill information gaps such that the proposed mitigation strategies for these residual moderate impact risks can be fine-tuned, resulting in a significant reduction in residual risk.

4.2 Cumulative Impacts

Cumulative impacts can be defined as the additional changes caused by a proposed development in conjunction with other similar developments, or as the combined effect of a set of developments, taken together. In practice the terms 'effects' and 'impacts' are used interchangeably.

As identified previously, residual impacts are those risks that remain once mitigation measures have been applied to a development. Those residual impacts could result in cumulative impacts when combined with the impacts from other developments. From those residual impacts identified above a cumulative impact assessment was conducted to consider projects by RACL and other proponents, and the potential impacts from these on the significant flora and fauna found on the proposed MEWF site.

In summary, significant cumulative adverse effects are not anticipated on MNES flora and fauna as a result of the proposed MEWF. As identified in **Table 5,** and considered in detail in Chapter 21 none of the individual projects are expected to cause significant impacts to flora or fauna following the implementation of proposed and likely mitigation and management measures and the projects considered together will not cause impacts that interact with or increase the extent of the impacts of other projects.

The cumulative benefit from the construction and operation wind farms in the region will result in significant short and long term net economic benefits to the community, and environmentally, reduce the potential loss of habitat through clearing for coal mine operations.

Table 5 Cumulative Impacts Summary

	Local and Regional
	Land Use Activities/Mining/Wind Farms/Developments
Northern Quoll	Implementation of mitigation measures at each project will remove potential impacts to Northern Quoll denning habitat.
Loss of denning habitat	Temporal differences in project schedules will also minimise any temporary impacts to habitat removing any potential barrier effects that could arise from works. Cumulative impacts from these projects are expected to be minimal.
Habitat degradation	Implementation of mitigation measures at each project will remove potential impacts on Northern Quoll from habitat degradation. Temporal differences in project schedules will also minimise any temporary impacts to habitat removing any potential barrier effects that could arise from works. Cumulative impacts from these projects are expected to be minimal.
Construction mortality	Construction related activities of one project are not expected to increase the effects caused by other projects in this assessment. Temporal variation in project development will also reduce any potential impacts on populations.
Sarus Crane	Bird fatalities are a known impact of wind farm operations worldwide. Collision risk studies have ascertained that with effective mitigation strategies such as radar, fatalities are low.
Turbine collision	Further research being conducted into these strategies will increase the confidence is such results both nationally and internationally..
Bare-rumped Sheathtail Bat	Bat fatalities are a known impact of wind farm operations worldwide.
Turbine collision and Barotrauma	This species is so poorly known that the potential loss of habitat – in particular roosting sites remains critical, therefore any clearing activities for mining, urban development or wind farm development are considered a potential threat. Mitigation strategies for clearing, spotter catcher and habitat avoidance have been employed on new developments. Temporal variation in project development will also reduce any potential impacts on populations.
Spectacled Flying-fox	Bat fatalities are a known impact of wind farm operations worldwide. This region is the first to consider the impacts of wind turbines and other developments on the SFF. Information about bat mortality from wind generation is limited. Mitigation strategies such as radar and protection of foraging habitat throughout the region are key strategies.
Turbine collision	Further research being conducted into these and additional strategies will increase the confidence in mitigation measures nationally and internationally for bat species. Temporal variation in development activities will reduce any potential impacts that result from clearing activities around foraging habitat.
Flora	
Loss of montane heath habitat above 900m ASL	Cumulative impacts at the local and regional project scale are expected to be minimal due to implementation of management strategies.
Loss of specific ridge environment habitat (main *Homoranthus porteri* habitats)	Most projects considered in the region are not within the habitat zone of rare and threatened flora species found at the MEWF site. The Baal Gammon site may have populations of this species however mining activities are unlikely to extend to the ridge top environs, with predicted habitat occurring outside of the development footprint.

	Local and Regional
Altered fire frequency/ inappropriate fire regime.	The implementation of fire management strategies is essential for projects in the region. Inappropriate fire regimes are more likely in the land use zone around the MEWF site due to the mix of agricultural and residential activities however the Mareeba Shire Council is responsible for this area. Larger projects have approved fire management strategies. The cumulative risk is minimal.
Habitat degradation from weed introduction and pathogens.	The implementation of weed management strategies is essential for projects in the region. The cumulative risk is minimal.

5.0 Offsets

As a controlled action subject to the provisions of the EPBC Act, the residual significant impacts of the project on MNES will require offsets. Residual significant impacts are those that remain after avoidance and mitigation measures have been implemented. Offsets for these impacts are to be delivered in accordance with the EPBC Act Environmental Offsets Policy released by the Australian Government in October 2012. The full detail of RACL's approach to offset delivery is outlined in the Mount Emerald Wind Farm Offsets Assessment Guide Preliminary Results and Draft Offset Management Plan Project development requires the removal of approximately 57 ha of remnant vegetation for the construction of the turbine pads, the contractors lay down pad, access tracks and a substation. Based on an assessment of the project's residual impacts, the offset requirements have been identified and are presented in **Table 6.** The offset requirements outlined below are not cumulative as some environmental values occur within the same area.

Table 6 Summary of the project's offset requirements under the EPBC Act Environmental Offsets Policy

ENVIRONMENTAL VALUE	EPBC ACT STATUS[1]	SPECIES DISTRIBUTION WITHIN PROJECT AREA	IMPACT AREA (ha)
Threatened Fauna			
Northern Quoll (*Dasyurus hallucatus*)	E	A number of individuals of both sexes and different ages were detected across the subject site, predominantly in rocky areas in both ridges and valleys. Quolls were detected through cage trapping, camera traps and scat identification. It was concluded that northern quolls are abundant and widespread across the site.	12.2
Spectacled Flying-fox (*Pteropus conspicillatus*)	V	No suitable roosting habitat (rainforest) is present on the subject site; however, the species may forage on site during mass flowering of Myrtaceous trees, and/or fly over site at rotor height between suitable nearby foraging areas.	51.2
Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus nudicluniatus*)	CE	The subject site contains suitable habitat for this species, particularly in the lower reaches of Granite Creek where *E. platyphylla* is present. Calls potentially belong to this species have been recorded.	51.2
Threatened Flora			
Grevillea glossadenia	V	Widespread in rocky habitat of the Wet Tropics bioregion section of site. Relatively common along ridges above 900 m, but rarely found under woodland cover.	10.2
Homoranthus porteri	V	More or less confined to south west ridges of the Wet Tropics bioregion section, with two isolated populations in Einasleigh Uplands bioregion.	5.1

Under the EPBC Act offsets policy there are three primary options available for offset delivery: direct offsets, other compensatory measures and advanced offsets. RACL has undertaken a preliminary

[1] E- endangered; CE- critically endangered; M- migratory; V- vulnerable

assessment to identify suitable direct land based offsets to meet the offset requirements of the project, taking into account:

- The requirements of the EPBC Act offset policy;
- Proximity to the existing project area;
- The characteristics of the offset area (vegetation, topography, ecosystems) and their similarity to the characteristics of the project area; and
- Connectivity to existing reserves (e.g. National parks, state forests).

Based on this assessment a potential direct land based offset area has been identified. The suitability of the offset area has yet to be ground-truthed to determine the actual extent of environmental values on the ground. Should the offset area prove to be unviable following field surveys an alternative direct offset option will be identified. However, a preliminary assessment of the offset area against the EPBC Act Offsets Assessment Guide (the Offsets Assessment Guide) has been undertaken. This assessment indicates that there is sufficient potential to configure a compliant offset on the identified property. Offsets will be implemented in accordance with MNES flora and fauna national recovery plans and/or the threat abatement and recovery recommendations listed in the Department of the Environment (DotE) Species Profile and Threats Database thereby ensuring that the offsets are effective, timely, reasonable and scientifically robust.

In the event that direct offsets do not fulfil the entire project's offset requirements, other compensatory measures will be explored in order to meet any shortfall. Other compensatory measures may include plant translocations, research opportunities, the development of literature and interpretive material and the revegetation of adjacent road verges.

5.2 Environmental Values of the Proposed Offset Area

The proposed offset area is approximately 583.48 ha in size and is situated across six contiguous lots (based on the Digital Cadastral Database, current as of 11 August 2013) that adjoin the project area (**Figure 6;** the offset area). It is located in the Tablelands Regional Council local government area and is zoned as rural (general rural). The offset area fringes the southern boundary of the project area and is connected to the Herberton Range State Forest, Baldy Mountain Forest Reserve and the Herberton Range National Park via the Herberton range. Due to the close proximity of the offset area and the project area, they share similar environmental features such as topography, geology, climate, vegetation communities and fauna diversity.

The offset area is characterised by high elevation ridges and valleys composed of remnant vegetation communities. The Queensland Government's regional ecosystem (RE) mapping has been assessed to identify the vegetation communities present within the offset area and the types of habitat for MNES that may be present. The majority of the remnant vegetation communities are listed as least concern under the *Vegetation Management Act 1999* (Qld; VM Act), however approximately 159 ha of concern montane heath community (RE 7.12.57) is mapped within the offset area. An assessment of the EPBC Act Protected Matters Search Tool database indicates that the Northern Quoll, spectacled flying-fox, *Grevillea glossadenia* and *Homoranthus porteri* and/or their habitat are likely to occur in the offset area. The Atlas of Living Australia has records within the offset area of the *Grevillea glossadenia* and *Homoranthus porteri*. In addition, extensive flora and fauna surveys of the project area were carried out between 2010 and 2013. During these survey efforts a northern quoll was detected by an infrared camera trap near the northern boundary of the offset area.

5.3 Offset potential of the Proposed Offset Area

A preliminary desktop assessment of the environmental values within the offset area demonstrates that management and protection of this area has the potential to acquit the project's offset requirements. The proposed offset area is mapped as containing approximately 583ha of northern quoll habitat (347ha denning and 236ha foraging), 360ha of spectacled flying-fox foraging habitat and 391ha of Bare-rumped Sheathtail Bat roosting habitat.

In addition to containing suitable fauna habitat, the proposed offset area is mapped as containing approximately 167ha of *Grevillea glossadenia* habitat and 117ha of *Homoranthus porteri* habitat. This mapped habitat includes a vegetation community (RE 7.12.57) that was found to support both *Grevillea glossadenia* and *Homoranthus porteri* populations in the project area. The Atlas of Living Australia has known records within the offset area of *Grevillea glossadenia* and *Homoranthus porteri*.

The actual extent and quality of the habitat within the offset area will require field verification; however, as the offset area neighbours the project area, the habitat quality within the offset area is expected to be similar to the baseline conditions identified during flora and fauna survey efforts.

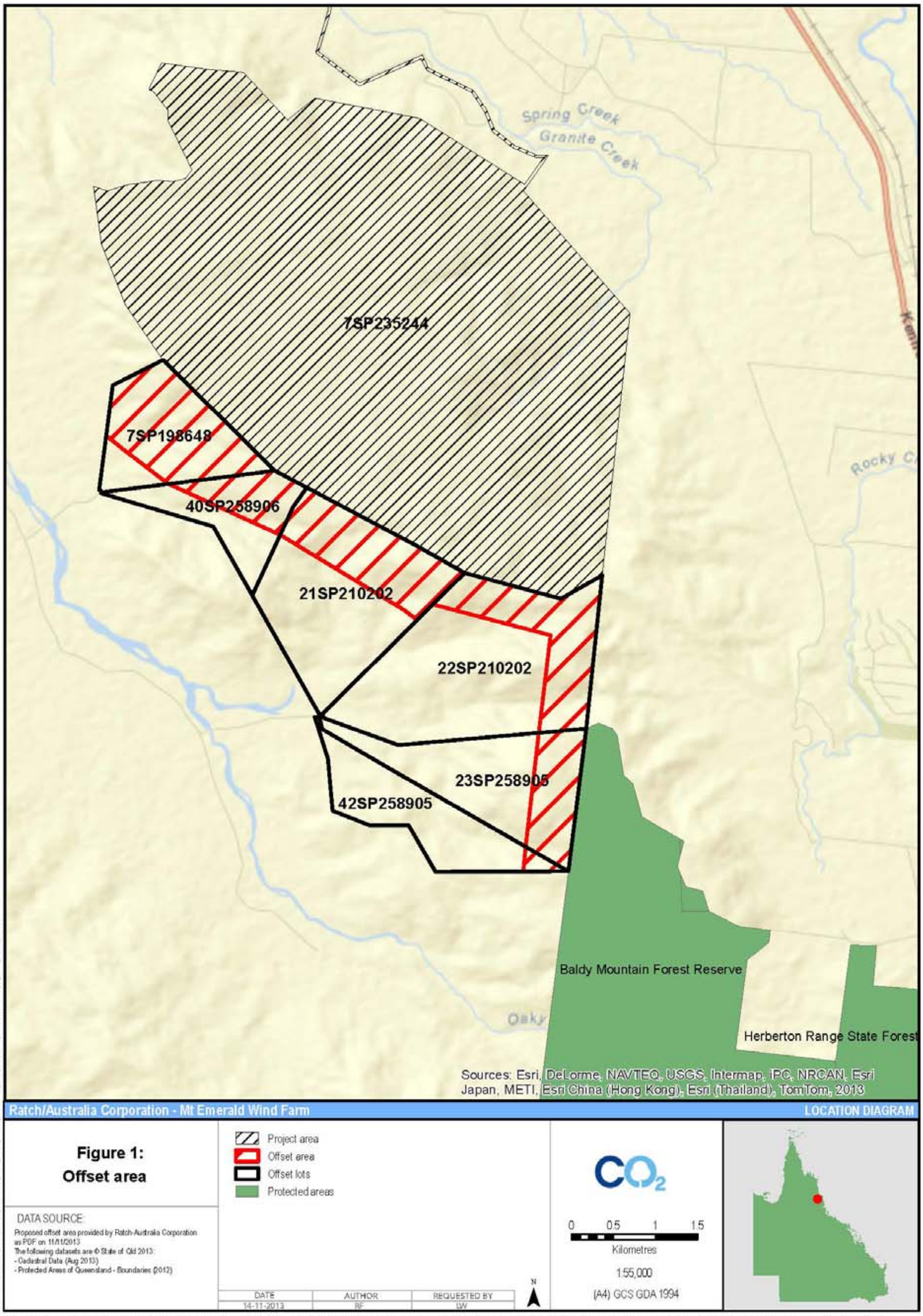

Figure 6 Proposed Offset Area

6.0 Environmental Record

6.1 Responsible Environmental Management

RATCH-Australia Corporation Limited (RACL), as the party taking action, has a satisfactory record of responsible environmental management. This is encapsulated in their Corporate Social Responsibility Policy (CSR) and Carbon Policy (CP) which cover two important environmental considerations for the power generation industry – community and climate change considerations. Furthermore, RATCH-Australia requires responsible environmental management outcomes from its O&M provider, Transfield Worley Power Services, who on behalf of RATCH-Australia provide operational level environmental management.

Mt Emerald Wind Farm is a company with equal shares held between RATCH-Australia and Port Bajool. While it is recognised Ratch-Australia are the party taking action the following information is supplied in reference to the contribution of Port Bajool.

Port Bajool are the owners of the land and have developed property in the Port Douglas and Tablelands areas for over 30 years. They have developed and held interests in various projects during this time including:

- Agriculture – sugar farming and grazing including Wetherby and Crystalbrook Stations;
- Tourism – Vacation Village, Rainforest Habitat, Treetops Resort, Crystalbrook Lodge; and
- Land Development – Gorge Estate, Highland Park, Reef park, Port Gardens, Oaky Creek, Springmount Park

6.2 Proceedings

Tablelands Regional Council commenced enforcement proceedings in the Queensland Planning and Environment Court against RATCH-Australia on 24 August 2012 in relation to periodic noise monitoring requirements for Windy Hill wind farm. On 7 December 2012 the council withdrew the proceedings.

6.3 Environmental Policy and Planning Framework

RACL works closely with their Operations and Maintenance (O&M) provider, Transfield Worley Power Services (TWPS), to ensure that environmental management is given an appropriate focus in the business. A brief overview of the operational environmental management approach (TWPS) is discussed below.

Transfield Worley Power Services is committed to ensuring that when working with RACL to ensure that its activities are safe for the environment and the greater community. TWPS' environmental objectives and how they meet RACL's environmental standards is outlined in TWPS' Health, Safety and Environment Policy (TMC-6032-SA-0001).

Key principles that form the basis of TWPS' approach to environmental management are:

- All incidents are preventable;
- No task is so important that the risk of injury to people or damage to the environment is justified and;
- Effective HSE management is a critical foundation for sustainable management.

Transfield Worley Power Services' Environmental Policy is supported by an Environmental Management System certified to ISO 140001. As a part of that certification, TWPS carry out environmental management planning to ensure the activities carried out meet all RACL's contractual and environmental requirements by:

- Establishing and implementing management strategies that address the environmental risks, safeguards and issues identified during site visits;
- Meeting as a minimum standard of all relevant supplied standards, procedures, guidelines, environmental policy, including environmental management practices;
- Manage the operation and maintenance activities to ensure full compliance with all legislative requirements, statutory approvals/licences and RACL's requirements;
- Implement environmental planning procedures and practices to work activities to ensure that environmental protection principles are considered such as pollution prevention and resource conservation and to ensure the contract is undertaken with due consideration of the community; and
- Identify gaps in environmental documentation or procedures.

Routine practices and processes underpin the implementation of the environmental management system, plan and objectives. Key processes include annual planning, training needs analysis, toolbox talks, Better Ways, Job Analysis, incident investigation, workplace inspections, auditing, management reviews, and monthly management meetings.

6.4 Referrals under the EPBC Act

EPBCA referrals lodged by RACL / Transfield include:

- Collector Wind Farm EPBC 2011 / 5899 – As lodged by Transfield Services;
- High Road Wind Farm EPBC 2010 / 5721 – As lodged by Transfield Services;
- Barn Hill Wind Farm Transmission Line – EPBC 2008 / 4557 – As lodged by Transfield Services; and
- Barn Hill Wind Farm EPBC 2008 / 4321 – As lodged by Transfield Services.

7.0 Conclusion

This project is intended to supply approximately 650 000 megawatt hours, which should supply sufficient renewable energy to power the equivalent annual needs of approximately 75,000 north Queensland homes over a 25 year period. The site has been selected primarily as it displays an excellent wind resource, there are few residences in close proximity to the site, and the site is traversed by the existing 275 kV Powerlink transmission line infrastructure, which further provides for ease of connection.

The construction and operation of the Mt Emerald Wind Farm would have a positive economic contribution to output, value added, employment and household income in the local and regional study areas and the broader Queensland and domestic economy.

Given the infancy of the Australian wind farm industry, particularly in tropical environments and the paucity of available scientific information on the ecology on four species of MNES (Bare-rumped Sheathtail Bat, Northern Quoll, Sarus Crane and Spectacled Flying Fox) there remains however some uncertainty around impact prediction. A rigorous program of additional preconstruction ecological research has been proposed to reduce these uncertainties and further minimise potential environmental risks through informed input into the detailed design process and refinement of operational monitoring and adaptive management based decision making. An additional benefit of such research and ongoing monitoring will be an increased understanding and ongoing regional management of the MNES and other species and importantly facilitate further wind farm development in tropical areas.

While issues of potential negative 'secondary' impacts have been raised in relation to agricultural aviation, adjacent farm operations, noise nuisance and reduced visual amenity and tourism, extensive investigation to date indicate that the likelihood of any significant impacts are low and manageable. Following consultation with surrounding residents amendments were made to the turbine layout to reduce both the noise and the visual impact at the respective homes.

A variety of design options were considered during the conceptual stage of the wind farm development. The overall objective at this time was to identify the layout of the project to maximise electricity generation and deliver significant savings in greenhouse gas emissions whilst being commercially viable and socially and environmentally responsible. Adjustments to the layout and the number of turbines was then performed with consideration given to constructability, environmental constraints and issues relevant to the local community especially noise and visual. The use of larger turbines reduced the preferred layout from 75 to 70 wind turbines and following detailed environmental investigations the wind turbine layout design was further modified to a currently preferred total of 63 turbines.

In addition to the reduction in greenhouse gases, opportunities to offset residual ecological impact and loss of habitat through the protection and enhancement of adjacent existing habitat will help achieve a net environmental benefit from the project. It could therefore be argued that an approval of the project is justifiable on the grounds of long-term and short-term economic, environmental, social and equitable considerations.

It is therefore considered that sufficient consideration of the principles of biodiversity and ecological integrity maintenance and inter-generational equity has been included in all phases of the project, including the proposed design, construction and future management of the project such that approval of the project is supportable.