Mount Emerald Wind Farm

Environmental Management Plan

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Report Number: PR130417-3/R75943
Version / Date: Final - December 2016

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
1	Preliminary Report for EIS	M. Jess	D Finney	19.11.2013
2	Draft Report	M Jess	L Liessmann	11.08.2016
Final	Final Report	M Jess	L Liessmann	07/12/2016

Approval for Issue

Name	Signature	Date
M. Jess		07/12/2016

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1.0 Introduction

This Environmental Management Plan (EMP) has been prepared for RATCH Australia Corporation Ltd (RACL) for construction and operational activities to be carried out on the Mount Emerald Wind Farm (MEWF), in response to the Decision Notice Conditions as issued by the Queensland Minister for Infrastructure, Local Government and Planning, dated 18 December 2015 (**Appendix A**).

This document presents a framework from which the Engineering, Procurement and Construction (EPC) Contractor will prepare a Construction Environmental Management Plan. The CEMP will contain a higher level of detail in relation to management systems and operational details.

This EMP and the CEMP will be subject to approval by RACL, Department of Innovation, Local Government and Planning (DILGP) and the Department of Energy and Environment (DEE).

MEWF is required to comply with 15 key conditions listed within the Minister for Infrastructure, Local Government and Planning's Condition of Approval issued on 18 December 2015.

This EMP aims to identify sources of actual and potential environmental harm identified through the EIS approval process (including the MEWF Statement of Commitments) and what actions, processes and/or strategies will be adopted to avoid, prevent or minimise the likelihood of environmental harm being caused. The EMP aims to provide for the review and 'continual improvement' in the overall environmental performance of the MEWF operations.

The EMP to addresses the following matters:

(a) Identification of environmental issues and potential impacts

(b) Environmental commitments - a commitment by senior management to achieve specified and relevant environmental goals.

(c) Control measures for routine operations to minimise likelihood of environmental harm.

(d) Contingency plans and emergency procedures for non-routine situations.

(e) Organisational structure and responsibility.

(f) Effective communication.

(g) Monitoring of mitigation measures and residual impacts.

(h) Conducting ongoing environmental impact assessments.

(i) Staff training.

(j) Record keeping.

(k) Periodic review of environmental performance and continual improvement.

1.1 Project Description

The MEWF is approved to build a wind farm up to 63 wind turbines and associated infrastructure, on an elevated site approximately 20 km SSW of Mareeba on the Atherton Tablelands in north Queensland (Figure 1). The approximate size of the wind turbines proposed will be; towers 80-90m high, with 50-60m blades, for a capacity of 3-3.5 MW.

The site where the wind turbines, interconnecting tracks and associated infrastructure are to be established is on land formally described as Lot 7 on SP235224, which encompasses an area of 2,422ha. 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 540m up to 1089m 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. Although land to the north of the transmission line (includes the landmark of Walsh Bluff) possesses lower floristic diversity, it is recognised for its habitat value for the endangered Northern Quoll (which is also expected to occur south of the transmission line).

The wind farm project estimates to deliver up to 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.

1.2 Construction Details

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 approximately 10m. The interconnecting tracks will form the routes for the inter-turbine underground cabling - expected to be buried in trenches at approximately 1m deep.

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

Wind turbines will be "micro-sited" - a technique which involves selecting a position in the landscape where the least environmental, constructability and other impacts area considered and weighed up. 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.

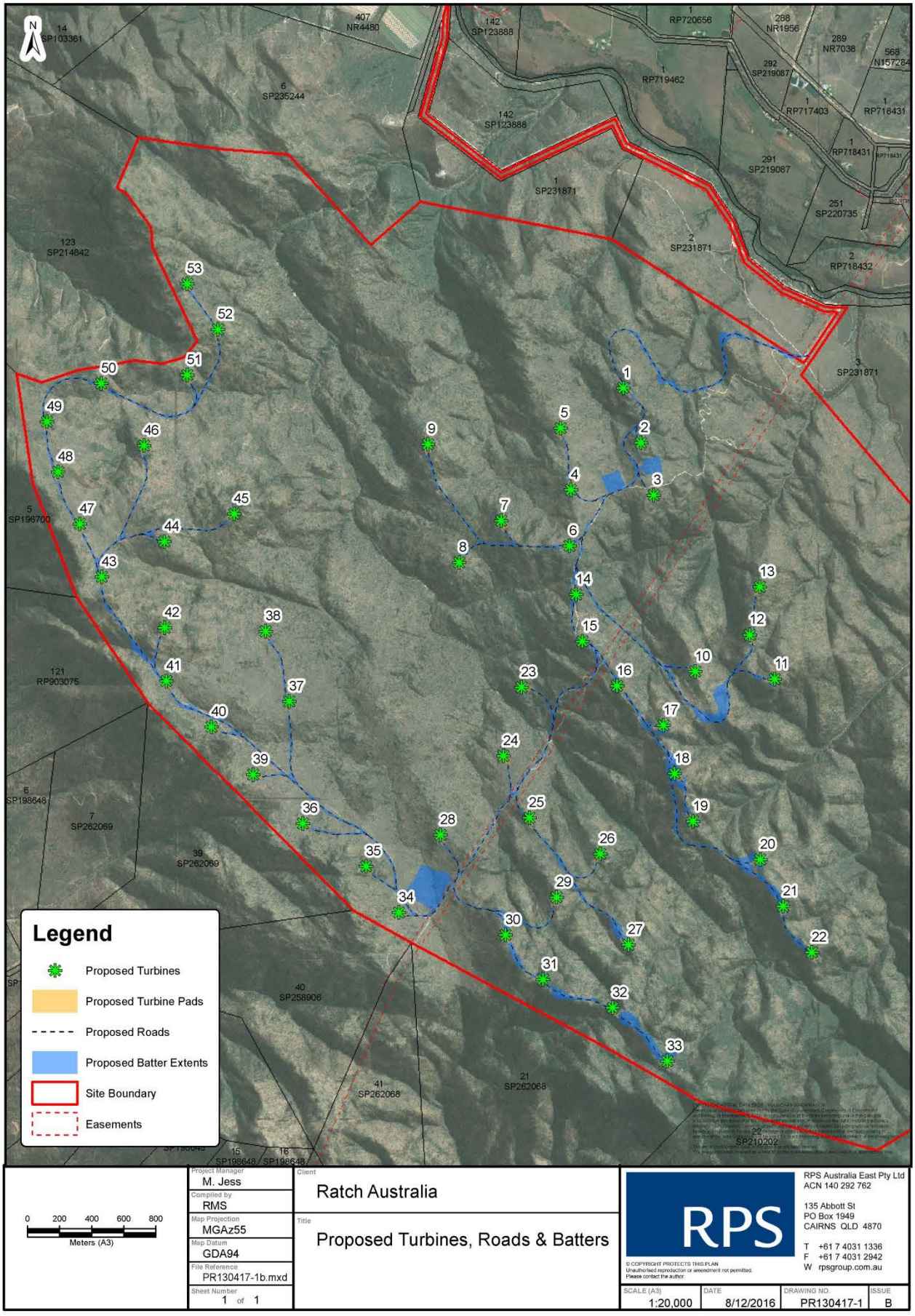


Figure 1 Project Site Location

2.0 Regulatory Requirements

2.1 Project Approvals

2.1.1 Sustainable Planning Act 2009

Conditions relevant to the preparation and implementation of the EMP are detailed in Condition 13 of the Ministerial Decision Notice (**Appendix A**).

2.1.1.1 Ministerial Decision Notice

The Development Notice (dated 18 December 2015) in accordance with the SPA included a number of conditions relating to the preparation of an EMP. *Condition 13 - Environmental Management* which relates to this EMP, states the following:

Table 1 Conditions imposed by Ministerial Delegation on the MEWF Project

Condition		Timing
13	(a) Submit to the chief executive administering SPA an Environmental Management Plan (EMP) prepared by a suitably qualified person(s). The EMP must: i. be generally in accordance with the Preliminary Environmental Management Plan prepared by RPS and dated November 2013 and the draft *Statement of Commitments* contained within Appendix A of the RPS Development Application Material Change of Use Report dated March 2012; ii. be based on the revised Turbine Location and Development Footprint Plan submitted in accordance with Condition 2 of this approval; iii. include the following components as further detailed in Attachment 1: ▪ a construction and work site operational management plan ▪ a sediment, erosion and storm water management plan ▪ a hydrocarbon and hazardous substances plan ▪ a bushfire risk management plan and emergency evacuation plan ▪ a significant species management plan ▪ a weed and pest management plan ▪ a rehabilitation plan ▪ an ecological fire management plan ▪ a cultural heritage management plan ▪ an environmental management plan training program ▪ an environmental management plan reporting program ▪ an implementation plan	(a) Prior to seeking approval for any site, operational building work
	(b) The development must be carried out in accordance with the EMP.	(b) During site / operational / building work and to be maintained

2.2 Legislation Relevant to the Project

The legislation and standards listed in **Table 2** below have been used to guide preparation of this EMP and will form the basis for ongoing decision-making and complaint resolution in respect of the EMP.

Table 2 Environmental legislation, policies and standards relevant to the Project

Element	Legislative and Other Requirements
Construction—General	*Environmental Protection Act 1994 (Qld)* *Environmental Protection Regulation 2008 (Qld)* *Workplace Health and Safety Act 1995 (Qld)* *Workplace Health and Safety Regulation 1997 (Qld)*
Noise and Vibration	*Environmental Protection (Noise) Policy 2008 (Qld)* *Workplace Health and Safety Act 1995 (Qld)* AS 1055.1 & .2: Acoustics—Description and measurement of environmental noise AS 2436: Guide to noise control on construction, maintenance and demolition sites
Air Quality	*Environmental Protection (Air) Policy 2008 (Qld)* National Health and Medical Research Council Guidelines 1985(Cwth) Draft National Environmental Protection Measures and Impact Statement for Ambient Air Quality 1997(Cwth)
Water Quality	*Environmental Protection (Water) Policy 1997 (Qld*) Australian Water Quality Guidelines for Fresh and Marine Waters, ANZECC 2002 *Water Act 2000 (Qld)*
Erosion and Sedimentation Control	Soil Erosion and Sediment Control, Engineering Guidelines for Queensland Construction Sites—IEAust (Qld) 1996
Contaminated Land	*Environmental Protection Act 1994 (Qld)*
Storage and Handling of Dangerous Goods	*Environmental Protection Act 1994 (Qld)* *Environmental Protection Regulation 2008 (Qld)* *Workplace Health and Safety Act 1995 (Qld*) AS1940 – The Storage and Handling of Flammable and Combustible Liquids
Transport of Dangerous Goods	Australian Code for Transport of Dangerous Goods by Road and Rail
Waste Management	*Environmental Protection (Waste Management) Policy 2000 (Qld)* *Environmental Protection (Waste Management) Regulation 2000 (Qld)*
Flora and Fauna	*Environment Protection and Biodiversity Conservation Act 1999 (Cwth)* *Nature Conservation Act 1992 (Qld)* *Nature Conservation Regulation 1994 (Qld)* *Vegetation Management Act 1999 (Qld)* *Environmental Protection Act (Qld)* *Biosecurity Act 2014*
Cultural Heritage	*Native Title Act 1993 (Cwlth)* *Native Title (Queensland) Act 1993* *Queensland Heritage Act 1992* *Queensland Heritage Regulation 2003* *Aboriginal Cultural Heritage Act 2003 (Qld)*
Land Use	*Integrated Planning Act 1997(Qld)* *Biosecurity Act 2014*

2.3 Related Documentation

The operation will be carried out generally in accordance with the following documents:

- MEWF – Environmental Impact Assessment – RPS Australia 2013 (Volumes 1-3) incl. Draft Statement of Commitments;
- This EMP (incl. sub-plans), CEMP;

If there is any inconsistency between the Conditions of Approval and a document listed above, the Conditions of Approval shall prevail to the extent of the inconsistency. If there is any inconsistency between documents listed above (other than the Conditions of Approval) then the most recent document shall prevail to the extent of the inconsistency.

3.0 Management Systems

This section provides an outline of the elements that have been adopted in this Environmental Management Plan.

3.1 Environmental Policy

As a developer of renewable energy in Australia, implementing sustainable measures and ensuring the protection of the environment are fundamental to RACL's long term objectives and philosophy. Investments in renewable energy are both environmentally and commercially sustainable and RACL currently owns three wind farms that are significantly reducing Australia's greenhouse emissions. In addition, RACL continues to improve the environmental ratings of its other power generation assets by continuously revising for economically possible ways of reducing its carbon emissions.

As RACL continues to grow, it strives to promote preservation and restoration of the environment, by managing and minimising the environmental impact of its operations and activities and fully respecting environmental laws and regulations.

RACL encourages employees to take care and demonstrate responsibility towards the environment and to report any incident that may have a hazardous effect. RACL continuously strives to ensure its employees are aware of how they can reduce the consumption of energy and resources and implement strategies focused on waste minimisation and recycling where possible. Ensuring the protection of the environment and implementing sustainable solutions are paramount to the success of RACL, its people and the communities in which it serves.

3.2 Implementation Responsibilities

A draft Site Organisation Chart outlining responsibilities for environmental design and management is presented in **Figure 2** below.

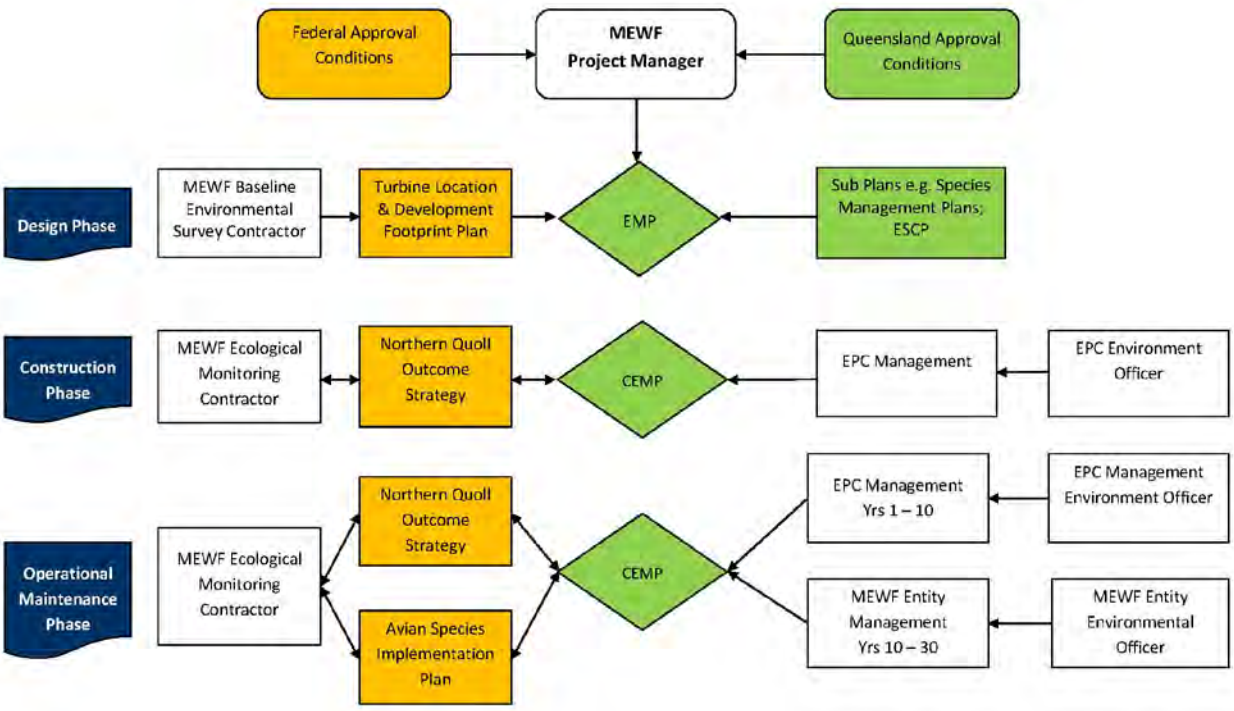


Figure 2 Draft Site Organisation Flowchart

3.2.1 MEWF Australia Project Manager

MEWF Project Manager will amongst other matters, oversee compliance with the EMP/CEMP covering the construction and operation phases of the project. The Project Manager will also be responsible for integration of outcomes of the EIS/Approvals processes into final designs, operational plans and contractual documentation, including facilitating any preconstruction environmental programs, regular review of operational performance reports, and facilitation of external environmental compliance audits.

In addition the Project Manager will continually review environmental performance of the Construction Contractor against all Approval/EMP/CEMP commitments, conditions and audit outcomes and drive any necessary operational changes as required to maintain regulatory compliance.

The Project Manager will also be responsible for commissioning any external environmental expertise, particularly in relation to ecological research and monitoring programs and incorporation of outputs into a range of environmental programs identified in the EMP/CEMP, in consultation with regulatory agencies as required.

3.2.2 Construction Manager

The Construction Manager will direct work in a manner that complies with all relevant environmental procedures, adheres to all legislative requirements and ensures the requirements of this EMP and CEMP are implemented. The Construction Manager will have 'stop task' and 'stop work' authority and will report to the Project Manager. They will also be responsible for initiating and managing external system audits.

3.2.3 Environmental Officers

Environmental Officers will be appointed by the Construction Manager. The Construction Environmental Officers (EO) will be responsible for monitoring and reporting the implementation of the EMP/CEMP for the construction phase and the first 10 years of the operation phase. Jurisdictional responsibilities between MEWF and the Construction Contractor will be incorporated in the contractual documentation.

The Environmental Officers will also be responsible for implementation of environmental programs such as species management plans, the Complaints Register and for setting up compliance audits and monitoring programs. Construction compliance auditing will be conducted against the requirements of this EMP, CEMP, Construction Safe Work Method Statements, License and Permit Conditions.

3.2.4 Ecological Monitoring Contractor

MEWF will appoint an external ecological contractor to assist with all phases of the project commencing with input into the detailed design process which will be informed by a number of preconstruction ecological surveys. A key function will be the preparation and implementation of detailed significant species management plans which will set out key impact management strategies, including further baseline programs, design, construction and operational measures and protocols, monitoring regimes, management targets, corrective actions, timeframes and responsibilities. Elements of these plans are listed below (Section 4), with details to be provided in the specific plans.

3.3 Training

The success of the EMP depends on all those responsible for its implementation and review being thoroughly conversant with its contents, interpretation and performance measurements. MEWF and its contractors will be responsible for ensuring project personnel have sufficient knowledge and awareness to identify potential environmental issues, and that they are trained to take appropriate corrective action.

It is essential all personnel are familiar with the procedures for reporting on issues that may result in environmental degradation. This includes informing key personnel within MEWF its contractors and relevant regulatory authorities.

3.3.1 Induction

All employees and sub-contractors will complete a comprehensive project induction prior to commencing work on the Project. The induction will include safety, access and a comprehensive review of environmental requirements, which will be documented in an EMP Induction Plan (Appendix B) to be issued to all site personnel. All Project personnel from supervisory to managerial level will have an additional detailed training session on the use and implementation of the EMP/CEMPs. It is the responsibility of the Construction Manager to ensure records of training are maintained.

3.3.2 Toolbox Meetings

The Construction (Site) Manager will ensure that supervisors hold at least one weekly toolbox talk with staff and crews to discuss issues associated with the scheduled work.

This will include highlighting and discussing relevant environmental and safety issues as required. The sessions will include discussion of strategies to be implemented as identified in Job Hazard Analysis (JHA) of current work activities.

3.3.3 Job Hazard Meetings

A Job Safety Environment Analysis (JSEA) is a simple tool used in helping personnel identify, analyse and manage the hazards that exist in the work they undertake. It formalises the process of hazard identification and risk management that most people follow when working. The JSEA requires personnel to examine the task they are about to undertake and:

- Break the job down into separate and defined steps;
- For each step identify the potential hazards (including potential environmental or cultural heritage hazards) that could occur; and
- For each potential hazard list the method to be followed to prevent the hazard causing an injury, loss, damage or environmental incident.

Weekly job hazard meetings will be held in conjunction with the Toolbox meetings.

3.4 Reporting and Auditing

3.4.1 Reporting

During construction, operations and decommissioning phases there will be continuous review of the project area and individuals and work crews will be required to demonstrate the pertinent requirements of the EMPs/CEMP's are being adhered to. Daily Inspection Checklists (example **Appendix C**) will be filled out by supervisors to ensure controls are in place and these are reviewed by the Construction Contractor. Monthly Monitoring Environmental Inspections will be undertaken across the work site (**Appendix F**), by the Environmental Officer and signed off by the Construction Manager.

3.4.2 Auditing

The Construction Contractor and Operator are responsible for monitoring and auditing the environmental performance of all persons/organisations involved in their respective stage of the Project. MEWF commissioned external audits will include as a minimum, two annual construction audits (the first within two

months of commencement) and two annual operation phase audits for the first three years, reverting to an annual audit thereafter assuming high levels of compliance. Frequency of auditing will be revised following receipt of approval conditions. Where regulatory authorities determine that compliance levels are unacceptable, auditing and reporting schedules may be reviewed.

3.4.3 Incident Reporting and Non-conformance

Incident reporting will be implemented to record any safety or environmental non-conformances, incidents or complaints. These shall be recorded on an incident report form (**Appendix D**) and forwarded to the Construction Manager for reporting within the MEWF system and for a process of continuous improvement to be implemented.

The notification of emergencies or incidents will include the following information:

- The area where incident occurred;
- The details of incident;
- The location of the emergency or incident;
- Recommended future actions;
- Site supervisor.

3.4.3.1 Compliance and External Reporting Procedure

Section 320 of the Environment Protection Act requires any person who becomes aware of an event that may or has caused environmental harm, reports the event / incident to their employer. Details of the nature and circumstances of the event must be provided.

Any such incidents must be immediately reported to the Construction Manager and recorded on an Incident Report Form (**Appendix D**). The Construction Manager will ensure the appropriate external agencies are notified within the appropriate timeframe.

A written report will be provided to the administering authority within 14 days following the initial notification of an emergency or incident or receipt of monitoring results.

The report will include:

- Results and interpretation of samples taken at the time of the incident and analysed;
- Outcomes of actions taken at the time of the incident to prevent or minimise environmental harm; and
- Proposed actions to prevent a recurrence of the emergency or incident.

Within six weeks of any environmental monitoring performed in relation to the emergency or incident, a written report on the results of any such monitoring will be provided to the administering authority.

All such incidents shall be investigated in a timely manner and any necessary steps implemented to minimise likelihood of recurrence. If required, the EMP shall be reviewed and updated in accordance with **Section 3.4.7**.

3.4.4 Complaints Procedure

3.4.5 Community complaints

The complaints and dispute resolution procedure outlined below will be implemented at the MEWF. This procedure will enable stakeholders to raise grievances or disputes with MEWF PL and will provide a framework for addressing and resolving issues in an appropriate and timely manner.

3.4.5.1 Complaints mechanisms

A range of mechanisms are available to facilitate the lodgment of complaints, including:

- a 24 hour community call line (1800 702 597)
- a Project email address: info@mtemeraldwindfarm.com.au
- a Project mailing address: PO Box 1058, North Sydney NSW 2060
- Website feedback form
- Contacting community relations personnel directly
- Incident/Complaints Form (part of RATCH-Australia Information Management System)

The complaints mechanisms will be advertised on the MEWF website, factsheets and other relevant community publications.

3.4.5.2 Complaints protocol

(1) Complaints received should be recorded using the designated Community Complaints Record Sheet (**Appendix E**) or alternatively, via the Incident/Complaints Form under RATCH-Australia's internal systems. These documents will then be incorporated into the Complaints Management Register.

(2) Any complaint that may not be resolved immediately must be referred to the MEWF Community Liaison via the MEWF project email or telephone number.

(3) The Community Liaison will contact the complainant within 48 hours to acknowledge receipt of the complaint and to explain that either an update or resolution will be provided within seven working days.

(4) The Community Liaison will liaise with the relevant MEWF PL representative and/or external project consultant to investigate the complaint.

(5) The target should be to develop an update or resolution for communication to the complainant within seven working days.

(6) Where complaints are unable to be adequately resolved through this process, and if the MEWF board believe it is necessary, these complaints will be referred to an external mediation body.

(7) At the completion of any follow-up activities and resolution the Community Complaints Record Sheet is to be finalised and the Complaints Management Register updated accordingly.

(8) MEWF PL's community relations team will prepare a monthly communications report during the construction phase and quarterly during the operation phase. Each report will include a summary and analysis of all complaints during the reporting period. The effectiveness of dispute resolution will also be described in the reports. Feedback received via complaints will be incorporated into organisational practice.

3.4.6 Document Control and Records

All relevant personnel involved in the environmental management process will be expected to maintain a document control system for recording environmental management activities on the MEWF site which

includes all monitoring events and activities and all incidents and complaints. It will remain available and accessible by parties on site and also stored securely offsite.

3.4.7 Review and Update

The EMP/CEMP will be regularly reviewed and revised to ensure that they address environmental issues and changes in legislation, policies and guidelines including work practices.

These reviews will occur at minimum on an annual basis however they will occur more frequently as appropriate when:

- There are changes to the MEWF operating procedures;
- There are changes to the conditions of the MEWF Approval Conditions, permits, licences or sub-plans;
- A review is required as a consequence of a corrective action;
- Feedback from regulatory agencies has resulted in appropriate changes to plans;
- Suggested amendments required to the EMP.

3.4.8 Monitoring

The MEWF Project Manager will be responsible for the preparation of project phase reporting as identified in approval conditions; this may include compliance reporting and the status of ongoing research and monitoring programs.

The results of other environmental programs directly commissioned by MEWF including any additional construction/ operation phase ecological impact monitoring, will be provided to DEHP and DOTE as requested and are outlined in the Implementation Program.

4.0 Management Sub Plans

Nine sub-plans (**Table 3**) have been developed to comprise part of this EMP and should be read in conjunction with associated sections of the Construction, Operations and Decommissioning Phases of the MEWF project. Each sub-plan has been developed in response to the Decision Notice Conditions dated 18 December 2015 (**Appendix A**).

Additional documents associated with this plan and referenced throughout the document have been conditioned under the Federal Department of the Environment Ministers Approval Notice (26 November 2015), and are as follows;

- *Northern Quoll Outcomes Strategy* (Burnett, 2016)
- *Implementation Plan* (for Bare-rumped Sheathtailed Bat and Spectacled Flying Fox) (2017,TBA)
- *Offsets Strategy* (RPS, 2016)

Table 3 Summary of Sub-plans Developed for the EMP

Sub-plan	Description
Protected Plant Management Plan	Five significant conservation flora species exist on the Mt Emerald Wind Farm site, these include: ▪ *Homoranthus porteri* ▪ *Grevillea glossadenia* ▪ *Acacia purpureopetala* ▪ *Prostanthera clotteniana* ▪ *Melaleuca uxorum* A *Threatened Plant Management Plan* (**Appendix G**) has been created to ensure impacts to these species are minimized and mitigated. Works will aim to minimise the effect on vegetation and habitat for flora and to promote regeneration of native vegetation on areas affected by construction phase. This management plan details management strategies such as: ▪ Preconstruction surveys to identify locations of rare and threatened species and other significant plants (including habitat trees); ▪ Clearing limits should be well identified and communicated to relevant staff; ▪ No unauthorised clearing; ▪ Stockpiling of topsoil; ▪ Collection and storage of seed and plant propagules to accumulate a seed bank for future rehabilitation; ▪ Placement of physical barriers around significant vegetation areas in order to restrict access and prevent disturbance; and ▪ Transplanting of conservation significant species.
Northern Quoll Species Management Plan	The Northern Quoll is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Nature Conservation Act 1992* (NC Act). This *Northern Quoll Species Management Plan* (SMP) (**Appendix H**) has been developed to minimise the potential impacts on the Northern Quoll (*Dasyurus hallucatus)* from the construction and operation of the Mount Emerald Wind Farm (MEWF) Project. A variety of activities conducted during construction and operation of the MEWF Project have the potential to directly or indirectly affect this species and its habitat include: **Construction** ▪ Direct Mortality during Clearing, Excavating and Blasting Operations; ▪ Noise, Dust & Vibration Disturbance; ▪ Habitat loss; ▪ Habitat degradation. **Operations:** ▪ Disturbance resulting in exclusion and changes in utilisation patterns; ▪ Noise;

Sub-plan	Description
	▪ Vehicular collision. A number of management measures have been developed to mitigate potential impacts on Northern Quoll habitat and Northern Quolls within the project area and adjoining areas throughout construction and operation. This is to be used in conjunction with the MEWF *Habitat Clearing and Management Plan* (Appendix I). These include: ▪ Pre-works surveys that involve intensive pre-construction 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. ▪ During works surveys - 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. ▪ Traffic levels will be maintained and controlled on site, where traffic will be limited during night hours to minimise fragmentation and mortality of Northern Quoll; and ensure no entry into conservation areas by the implementation of signage (except for necessary environmental management and monitoring).
Habitat Clearing and Management Plan	The *Habitat Clearing and Management Plan* (Appendix I) addresses the potential effects of the Project on fauna species and/or their habitat during the clearing process through a range of management measures. The plan considers spotter catcher activities that are undertaken during pre-clearing, management and mitigation measures, vegetation clearing and construction and the necessary safety and reporting processes that are also required. The role of a wildlife spotter catcher at the time of land clearing and development of the site includes the following processes: ▪ Species identification; ▪ Animal trapping, capture and handling; ▪ Identification of suitable wildlife release sites. ▪ Ensure the timely and appropriate removal and management of animals from development sites prior to and/or during operational works or activities. Fauna habitat surveys must be conducted at each site prior to clearance of vegetation. These surveys are required to determine the presence of fauna both current and likely within the clearing alignment. The plan outlines management strategies for salvage and reuse of habitat material, hollow relocation, nest management and the clearing process for targeted species. Clearance methodologies consider staged clearing which should be performed by firstly removing non habitat trees prior to the removal of potential habitat trees. Potential habitat trees should be removed at least 24 hours later to enable resident hollow dependant fauna time to evacuate the tree prior to felling. Each felled tree must be inspected and habitation recorded.
Weed and Pest Management Plans	These plans provide an overview of the procedures that are required to minimise the introduction and spread of particular pests and weeds. For those species already present on the site, the plan will appropriately manage the increased risk they present to flora and fauna with the increased access to areas of the site as a result of the development. Control methods are provided to mitigate against impacts. This plan provides controls to manage potential increase and spread of weed and pests within and directly adjacent to the MEWF project in the Mareeba Walkamin district. These *Weed* and *Pest Management Plans* (Appendix J) establishes the objectives, management requirements and management actions to mitigate and manage the potential impacts that could arise from the introduction and increase in abundance of weed and pest species within the project area. Regular inspection and control methods will be undertaken on the site by a suitably qualified person to prevent the introduction and/or spread of pests throughout the site during development construction and operation activities. Consultation with surrounding landholders and council will be undertaken where required.
Rehabilitation Management Plan	The *Rehabilitation Management Plan* (**Appendix K**) Includes guidelines to incorporate appropriate landscape rehabilitation strategies and methods into the management of disturbed land. A schedule of progressive rehabilitation methods will be incorporated into the work schedules as clearing progresses to ensure that impacts are minimal Natural revegetation will be encouraged through the spreading of native topsoil and active weed management there will be a detailed performance and completion criteria schedule.

Sub-plan	Description
Sediment, Erosion and Stormwater Management Plan	An *Erosion, Sediment and Stormwater Management Plan* (**Appendix L**) has been created to manage water quality and soil erosion, along with the risk of adverse impacts associated with the proposed works on the site and receiving environment. It has been developed to provide a set of Best Practice Site Management Procedures to minimise soil erosion and transport during the earthworks and construction phase; ▪ To provide techniques to control sediment so that it does not cause detrimental impacts to water quality; ▪ To provide a monitoring plan to ensure detrimental impacts to water quality are not occurring; and ▪ Ensure staff are adequately trained and capable of implementing this plan.
Hydrocarbon and Hazardous Substance Plan	This *Hydrocarbon and Hazardous Substance Plan* (**Appendix M**) includes procedures for any on site, permanent post construction storage of fuels lubricants waste oil or other hazardous substances or potential contaminants to be in bunded areas; and contingency measures to ensure that any chemical or oil spills are contained on site and cleaned up in accordance with the Council requirements.
Bushfire Management and Emergency Evacuation plan	The development of the *Bushfire Management and Emergency Evacuation Plan* (**Appendix N**) is to focus on preventing fires on the MEWF site and ensuring preparedness, should a bushfire be ignited or pass through the site. Fire risk can be minimised through strategically managed vegetation and landscaping, and this Plan considers the use of Asset Protection Zones around buildings (where turbine infrastructure are also considered buildings). These measures also include clearing and pruning, mowing and fire breaks. The plan also has procedures for vegetation management, fuel control standards for access roads and tracks to allow access for firefighting vehicles including criteria for access to static water supply tanks for firefighting vehicles. The plan also includes ecological fire management strategies to be implemented in order to maintain an appropriate fire regime for the various faunal and flora habitats represented in site. The ecological fire management guidelines provided by EHP are directed at maintaining the regional ecosystems biodiversity. The objectives of these management strategies are to assist in protecting the flora and fauna habitats represented on the MEWF site and to manage the fuel load to prevent intense dangerous fires that may impact human life and property.
Cultural Heritage Management Plan	The Cultural Heritage Management Plan (**Appendix O**) has been developed due to the potential for Aboriginal Cultural Heritage over the area being moderate. Consultation is with the Barburrum and Muluridji people who are the traditional owners of the land. A summary of studies and assessments were presented that identified an number of Cultural Heritage items of significance in the region and although limited sites or artefacts were identified (6 sites in close proximity to the site within 500m)for the site specifically records indicate the potential presence of cultural heritage values on the site. A lack of records is expected to be a result of a lack of cultural heritage surveys. The category 5 classification of the site was deemed appropriate due to these records in close proximity and given there is little previous disturbance over the majority of the area. The potential for Aboriginal Cultural Heritage over the area is moderate.

5.0 Construction EMP

5.1 Flora

Operational Policy	To minimise the effect on vegetation and habitat for flora, and to promote regeneration of native vegetation on the Wind Turbine Generators (WTG) access tracks and turbine sites.
Performance Objectives	▪ Rehabilitation with native plants of available cleared areas. ▪ Where practicable, avoid disturbance to significant species (endangered, vulnerable and rare flora species). ▪ Minimise habitat fragmentation and maintain absolute minimum width clearing along ridges. ▪ Prevent weeds and plant pest diseases spreading as a result of construction activities. ▪ Offset of any rare, endangered or vulnerable plants disturbed by construction by translocating species where practicable, and providing additional rehabilitation areas where revegetation trials can be established.
Management Strategies	▪ Conduct activities in accordance with *Threatened Plant Management Plan* (**Appendix G**) and *Weed* and *Pest Management Plans* (**Appendix J**). ▪ Preconstruction survey (early works package) undertaken to identify locations of rare and threatened species and other significant plants (including habitat trees) along the preferred WTG access tracks/ turbine sites will be undertaken to allow designers to avoid and minimise clearing of these species and communities during construction. Any seed or plant propagules should be collected, stored and labelled by a botanist or qualified person to accumulate a seed bank for future rehabilitation. ▪ Topsoil is a rare commodity on the site and soil and rock spoil should be stockpiled separately and adjacent to where the material was taken, or the very nearest suitable storage area. Stockpiles of material (particularly soil) should not exceed a height of 1 (one) metre. ▪ Placement of physical barriers around significant vegetation areas in order to restrict access and prevent disturbance. ▪ Transplanting trials of suitable plants to be practiced as a rehabilitation/conservation measure if feasible. Transplanting should occur when ground conditions are best suited to plant growth (i.e. some longer term moisture is available in the soil). ▪ Windrowed vegetation should not be burnt. Respreading of cleared native vegetation over areas available for rehabilitation (i.e. laydown areas, track batters, temporary crane pads) to occur following construction. ▪ Conduct rehabilitation success trials particularly in relation to significant species and trials as per *Threatened Plant Management Plan*. ▪ Control environmental weeds by approved methods and in accordance with *Weed Pest Management Plan* along the WTG access tracks and turbine sites prior to clearing and grading. This should be undertaken at least 2 weeks prior to construction work commencing in the respective areas. ▪ Declared weeds to be controlled by an approved method prior to clearing and grading. ▪ All imported construction material (road base, sand, rock-fill etc) is to be free of weed seed and propagules, and be sourced from clean suppliers in the local region. ▪ All vehicles and machinery to be washed down and certified weed free prior to entering site and in accordance with the *Weed Management Plan*. Vehicles and machinery is to be monitored at the site entry point (washdown bay). ▪ Vehicles and machinery working in internal weed infested areas are not to continue work in weed-free zones unless certified clean and weed free. Mobile washdown facilities will be established.
Performance Indicators	▪ Minimum impact to ecosystems and protected plant species. ▪ Minimal disturbance of flora during construction of the WTG access tracks and turbine sites and associated camp sites. ▪ No damage to protected species without relevant permit and approval. ▪ No presence/increase of environmental and declared weeds (e.g. grader grass, sicklepod, Lantana, thatch grass etc. - refer to *Weed Management Plan*). ▪ Survival and persistence of species planted for the Offset Program

Monitoring, Reporting and Corrective Action	▪ Photographic records are to be maintained throughout the year (monthly basis). Fixed photo monitoring points are to be established. ▪ Daily Check Sheets to include weed presence – completed and reviewed by Environmental Officer / supervisor, and supervising botanist when on site. ▪ Prepare Annual *Threatened Plant Management Plan* and *Rehabilitation Plan* reports. ▪ Additional weed control as required with supplementary weed surveys within 14 days following rainfall events (**Appendix J**). ▪ Offset rehabilitation planting to be monitored for a period of 3 years following rehabilitation to ensure survival, persistence and performance, as well as replacement of mortalities. ▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all areas of the site. This will be filed on site. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**)
Responsible Person	▪ Environmental Officer Annual site rehabilitation assessment by supervising botanist
Associated Documentation	▪ *Threatened Plant Management Plan* (**Appendix G**) ▪ *Rehabilitation Plan* (**Appendix K**) ▪ *Weed and Pest Management Plans* (**Appendix J**) ▪ Offset Area Management Plan (RPS, 2016)

5.2 Fauna

Policy	To protect threatened fauna and habitat from the impacts of construction activities.
Performance Objectives	▪ Where practicable, avoid disturbance to protected fauna species. ▪ Minimize habitat fragmentation and promote habitat regeneration where practicable. ▪ Prevent the spread of pest animals and animal pest diseases as a result of construction activities. ▪ Implement management strategies to limit the spread of fauna pest species (e.g. cane toad) along the WTG rows. ▪ Ensure that the existing population of Northern Quoll in the project area is maintained at pre-construction levels
Management Strategies	Implementation of Key Sub plans as identified in **Section 4.0** above : ▪ *Northern Quoll Species Management Plan* (**Appendix H**); ▪ *Weed and Pest Management Plans* (**Appendix J**) ▪ *Habitat Clearing and Management Plan* (**Appendix I**) *Northern Quoll Species Management Plan* (**Appendix H**) Construction Phase Protocols. Key elements include: ▪ Saturation trapping and collaring of all quolls prior to commencement of section clearing and daily radio tracking/sniffer dog surveys to confirm absence of quolls in proposed clearing area. Trapping to confirm stage of reproduction cycle as this can vary from year to year. ▪ Daily clearing to commence only once all tracked animals are confirmed clear of the area. ▪ Carry out bulk earthworks during February to October period to avoid mortality of dependant juveniles. If earthworks is to occur during November to January period conduct sniffer dog searches in advance of clearing to confirm presence/ absence. If present, delay clearing in that area until maternal dens have been removal. ▪ Primary bulk earthworks will need to be conducted in discrete, clearly marked sections on a sequential basis. ▪ If adult females are captured during the preconstruction live-trapping and inspection indicates that they have dependent young that are 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. Construction will be halted within a buffer distance (to be determined) until live-trapping monitoring indicates that young are trappable. ▪ All site personnel and contractors shall report any evidence of dens, regardless of whether or not the person suspects the den to belong to a Northern Quoll. The Environmental Officer shall establish a 20 metre exclusion zone around the den until proven abandoned. Implementation of *Habitat Clearing and Management Plan* (**Appendix I**) Protocols. Key elements include spotter catcher pre-clearance and fauna management strategies during the clearing process such as animal trapping and capture to remove from clearance areas to a

	suitable wildlife release site. ▪ Staged clearing should be performed whereby firstly removing non habitat trees prior to the removal of potential habitat trees. Potential habitat trees should be removed at least 24 hours later to enable resident hollow dependant fauna time to evacuate the tree prior to felling. Each felled tree must be inspected and habitation recorded. ▪ To manage fauna interactions at trenches, several mitigation measures will be required which include erection of fauna exclusion fences to prevent access to trenches, ramps will be required to be installed at a minimum of 500m apart to ensure small fauna can traverse habitat and hessian bags and polystyrene should be placed intermittently along the trench to allow for shade and height to prevent heat stress or drowning of smaller fauna species. ▪ Avoidance of clearing of any roosting trees identified during preconstruction surveys and micro siting of turbine and track location. Additional strategies include: ▪ Minimizing area of cleared vegetation; ▪ Avoid vehicular use of site at night where possible; ▪ Restrict speed limits at night; ▪ Weed monitoring and control (**Appendix J**); ▪ Develop and implement ecological burning regime (**Appendix N**); ▪ Minimising the introduction and spread of pests (**Appendix J**);
Performance Indicators	▪ Viability of endangered species within approved limits. Refer to *Northern Quoll Outcomes Strategy* (**Burnett, 2016**); and ▪ Compliance with Implementation Plan (2017 TBA) for Bare-rumped Sheathtailed Bat and Spectacled Flying Fox. ▪ Site occupancy of the Northern Quoll population on Mt Emerald windfarm site remains within the normal range of values during each year of construction phase. ▪ No mortalities of fauna during clearing operation. ▪ Successful reintroduction of native fauna to alternative (non-impact) areas of the site during construction.
Monitoring, Reporting and Corrective Action	▪ Clearing scheduling to be determined by Construction Manager in consultation with Spotter Catcher and External Ecological Contractor. ▪ Quarterly reports in accordance with Northern Quoll Outcomes Strategy and Implementation Plan, 2017 TBA) for Bare-rumped Sheathtailed Bat and Spectacled Flying Fox and approval conditions, including mortality surveys to DOTE. ▪ USQ conduct, biannual monitoring of quoll populations at MEWF site and three reference sites (*Outcomes Strategy* **Appendix P**) with reporting to MEWF Project Managers and DOTE regulators annually. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**) ▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all construction areas of the site and signed off by the Construction Manager. This will be filed on site.
Responsible Person	▪ Environmental Officer ▪ External Ecological Contractor / Spotter Catcher ▪ Construction Manager to authorize clearance only
Associated Documentation	▪ *Northern Quoll Species Management Plan* (**Appendix H**), ▪ *Habitat Clearing and Management Plan* (**Appendix I**) ▪ *Weed and Pest Management Plans* (**Appendix J**) ▪ *Bushfire Management and Emergency Evacuation Plan* (**Appendix N**) ▪ Approval permits ▪ Northern Quoll Outcomes Strategy (Burnett, 2016) ▪ Implementation Plan (2017 TBA)

5.4 Erosion, Sediment and Stormwater Control

Policy	To provide effective erosion and sediment practices to mitigate the potential effects of construction on watercourses, land use and the general environment.
Performance Objectives	▪ Minimise environmental impacts caused by soil erosion. ▪ Minimise sedimentation of land. ▪ Minimise modification to drainage patterns. ▪ Prevent as far as practical, sediment transport to adjacent watercourses.
Management Strategies	Conduct all earthworks in accordance with the detailed *Erosion, Sediment and Stormwater Control Plan* (**Appendix L**). Management strategies include: ▪ Install clean water diversions upslope of sloping Wind Turbine Generation (WTG) sites to direct clean stormwater away from work/bare areas. Where possible, runoff from access tracks will also be directed away from WTG sites; ▪ Direct all uncontaminated (clean) stormwater to stable land, ensuring water is dispersed / diffused to prevent erosion. Examples of Flow Control Berms, Catch Drains, Flow Diversion Banks, Level Spreaders and Energy Dissipators which could be utilised to achieve this are detailed in **Appendix L**; ▪ Strip topsoil (~200mm depth) separately and retained for rehabilitation/stabilisation activities. It is important to ensure separate soil horizons are retained in separate stockpiles and not mixed. These stockpiles must be located away from drainage lines and have appropriate controls to ensure sediment is not lost (e.g. sediment fence/geotextile covers); ▪ Respread/cover tower and permanent pad batters with topsoil and rehabilitate as soon as practicable on completion of pads; ▪ Stabilise pad surfaces using methods such as topsoiling and revegetation or gravelling, where there is a risk of erosion of the pad; ▪ Do not carry out clearing activities within 50 metres of a watercourse; where required (e.g. water course crossings), improve or develop appropriately designed watercourse crossings that prevent erosion; ▪ Maintain vegetation cover along hardstands and access tracks where possible. Reduce damage to grass cover and sensitive heath vegetation types by limiting vehicle movements to work areas and approved access tracks; ▪ Sediment fences and temporary drain crossings should be constructed / maintained as per the *Erosion, Sediment and Stormwater Management Plan.* ▪ Minimise disturbance, stage and revegetate disturbed areas to achieve a ground cover of at least 70% on completion of construction in each area. Stormwater Diversion ▪ In areas which are subject to erosion potential (slopes >5%), stormwater diversion banks/drains (whoa-boys) should be placed diagonally across the tracks to divert stormwater to adjacent undisturbed grassed areas following completion of construction. Spacing of such diversion drains can be approximately 50 m to 70 m apart. Where slopes are >5%, then more frequent spacing is required. ▪ Adequate monitoring and follow-up work following construction to ensure any initiated erosion is arrested early.
Performance Indicators	▪ Achievement of downstream water quality targets (turbidity, suspended solids) ▪ No large scale erosion or sedimentation caused to adjacent land uses as a result of construction activities. ▪ No evidence of additional sedimentation in watercourses as a result of erosion from construction activities. ▪ Reinstatement of watercourses to original profile. ▪ Adequate spacing of stormwater diversion drains in areas of erosion potential.
Monitoring, Reporting and Corrective Action	▪ Controls should be inspected weekly by the Construction Manager immediately prior to anticipated runoff producing rain or immediately following runoff-producing rainfall. This will include watercourse crossings, drainage lines and areas of concentrated water flow. Weekly Check Sheets – completed and reviewed by manager / supervisor. Check sheets are provided in the *Erosion, Sediment and Stormwater Management Plan* (**Appendix L**). ▪ A post-construction audit which will evaluate revegetation, erosion control, weed control, water course bank stability will be conducted annually for two years following completion of construction.

	▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all construction areas of the site and signed off by the Construction Manager. Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**)
Responsible Person	▪ External Environmental Scientist (WQ monitoring) ▪ Environmental Officer ▪ Construction Manager
Associated Documentation	▪ *Erosion, Sediment and Stormwater Control Plan* (**Appendix L**) ▪ *Rehabilitation Plan* (**Appendix K**)

5.5 Management of Flammable and Combustible Substances

Policy	To ensure storage and handling of flammable and combustible substances onsite does not cause environmental harm or harm to persons.
Performance Objectives	▪ To minimise potential for land, surface water and groundwater contamination. ▪ To ensure the on-going safety of construction personnel. ▪ To minimise the potential for fire ignition (and wildfire) from site activities.
Management Strategies	▪ A *Hydrocarbon and Hazardous Substance Plan* (**Appendix M**) and Emergency Evacuation Plan shall be in place and employees inducted in its application. ▪ Flammable and combustible substances are stored, handled, separated and signed as required by the Flammable and Combustible Liquids Regulations and AS1940. ▪ Transportation of dangerous goods will be in accordance with the Regulations and with AS 1678, AS 2809 and AS 2931. ▪ A qualified person will be appointed as Site Safety Officer. ▪ An on-site set of the relevant Material Safety Data Sheet (MSDS) for all flammable and combustible substances and dangerous goods used during construction and operation will be maintained and available. ▪ Waste flammable and combustible substances which cannot be recycled will be transported to a designated disposal site as approved by Local Government. ▪ No refuelling of plant and equipment over or within 100m of watercourses. ▪ Spill kits containing absorbent and containment material (e.g. absorbent matting) will be available where hazardous materials are used and stored and personnel trained in their correct use. ▪ Spills of flammable and combustible substances will be rendered harmless and collected for treatment and/or remediation or disposal at a designated site, including cleaning materials, absorbents and contaminated soils and reinstatement made to the affected area. ▪ Personal protective equipment (PPE) appropriate to the materials in use will be provided. ▪ Relevant Local Government permits will be held and conditions of permits met.
Performance Indicators	▪ No hazardous goods will cause contamination of the environment. ▪ Ensure appropriate remedial action has been implemented for any spills. ▪ Major incidents reported to relevant authorities and their directions followed. ▪ Spill kits and PPE available and used as appropriate.
Monitoring, Reporting and Corrective Action	▪ Photographic Records ▪ Regular inspection of storage facilities and work practices in the handling of flammable and combustible substances or other dangerous substances. ▪ Daily Check Sheets – completed and reviewed by manager/supervisor ▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all construction areas of the site and signed off by the Construction Manager. This will be filed on site. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**)
Responsible Person	▪ Construction Manager ▪ Site Safety Officer ▪ Environmental Officer
Associated Documentation	▪ *Hydrocarbon and Hazardous Substance Plan* (**Appendix M**) ▪ *Bushfire Management and Emergency Evacuation Plan* (**Appendix N**)

5.6 Noise and Vibration

Policy	To minimise the impact of construction noise nuisance and vibration to nearby residences.
Performance Objectives	▪ Minimise noise nuisance generated by construction activities. ▪ Minimise any vibration nuisance to nearby residences.
Management Strategy	▪ Provide advance notice of any scheduled atypical noise events to nearby residents. ▪ Equipment maintained in accordance with manufacturer's specifications. ▪ Schedule atypical noise events for appropriate times. ▪ Any blasting is to be carried out in accordance with current practice standards with particular reference to AS 2187. ▪ Maintain liaison with nearby residents. ▪ Noisy construction activities in proximity to residences to be limited to 7.00 am to 6.00 pm Monday to Saturday or in accordance with local permits.
Performance Indicators	▪ Zero damage to non-project associated buildings or structures; ▪ Zero blasting related actions taken by regulators; ▪ Zero blasting nuisance complaints; ▪ Noise does not spread to sensitive areas and isn't more than 115dB (linear) peak for 9 out of 10 consecutive blasts, regardless of the intervals between blasts; ▪ Noise doesn't exceed 120 dB (linear) peak for any blast; and ▪ Vibration does not exceed peak particle velocity of 5mm per second for 9 out of 10 consecutive blasts, regardless of the interval between blasts and 10mm per second for any blast
Monitoring, Reporting and Corrective Action	▪ Complaints Register – recorded and closed out ▪ Noise monitoring will occur at the source of the noise complaint as directed by the regulatory authority to investigate a noise complaint. Refer to **CEMP Appendix C** for further details. ▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all construction areas of the site and signed off by the Construction Manager. This will be filed on site. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**)
Responsible Person	▪ Construction Manager
Associated Documentation	▪ *Complaints Register* (**Appendix E**)

5.7 Air Emissions

Policy	To complete the installation of each WTG line in a manner to maintain ambient air quality of the local area.
Performance Objectives	▪ To maintain acceptable limits of vehicular and machinery operating emissions and to receive no complaints from local landholders regarding air quality. ▪ To minimise the generation of fugitive dust emissions produced during construction.
Management Strategies	▪ Vehicles and machinery shall be maintained in accordance with manufacturer's specifications. ▪ Trucks to have sound tailgates and mud flaps in good condition ▪ Trucks carrying dusty materials on public roads to have their loads covered ▪ Limit vehicle speeds on site to minimise dust generation. ▪ Stockpiles will be maintained at minimum amounts where possible (topsoil max is 2m) ▪ Watering of construction site and access tracks will be carried out on an as required basis, particularly on dry and windy days and especially near residences. ▪ Avoid smoke generation by a strict no burning policy. ▪ Treat stockpiles and/or exposed soil areas with chemical surface stabilisers or physical alternatives (crushed rock). ▪ Implement fire control measures during welding operations. Hot Works Permits must be obtained for all works which may result in ignition of a fire (for example welding, grinding or anything that may cause a flame or spark). This will set out procedures to be followed regarding where the work is undertaken, firefighting equipment, and personnel to be in attendance and timing for the work to be undertaken.

Performance Indicators	▪ No visual observations of dust emissions during windy / dry periods ▪ Nil dust nuisance complaints from nearby residents ▪ No visible dust during construction activities evident.
Monitoring, Reporting and Corrective Action	▪ Dust deposition gauge(s) will be installed on site to monitor dust emissions. All reasonable measures will be undertaken to ensure emissions do not exceed 4 grams per metre squared per month. ▪ Complaints Register – recorded, investigate the source and close out. ▪ Daily Check Sheets – completed and reviewed by manager / supervisor. ▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all construction areas of the site and signed off by the Construction Manager. This will be filed on site. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**)
Responsible Person	▪ Construction Manager ▪ Environmental Officer
Associated Documentation	▪ All other issues to be handled in accordance with the Mt. Emerald Wind Farm Traffic Management Plan ▪ Refer to *Vestas Construction Air Quality and Dust Management Plan* (**Appendix D**) of the **CEMP**.

5.8 Waste Management

Policy	To minimise waste generation and maximise reuse and recycling of construction waste products.
Performance Objectives	▪ Minimise impacts related to waste management. ▪ No evidence of litter or refuse generated from construction related activities. ▪ No contamination of land, air or water as a result of inappropriate waste management.
Management Strategies	▪ Clean up progressively, all working areas will be kept free of rubbish and cleaned up at the end of each work day ▪ Separate skips for paper, waste steel and hydrocarbon containers, if applicable to the local waste transfer station ▪ Vegetation will be chipped for mulch and spread on site ▪ Separate paper and cardboard from office waste/packaging for recycling ▪ Service personnel capture, contain and remove waste liquids. ▪ Contaminated soil is recovered and taken to an appropriate waste facility. ▪ All chemical storage will be bunded, lined with impermeable material and located 100m away at a minimum from any natural watercourse, where possible. ▪ All waste to be kept in skip bins, where possible. Stock piles must be appropriately maintained to reduce the risk of ground or surface water pollution. ▪ Consults SDS to determine appropriate disposal method; provide separate storage if necessary. ▪ After concrete is poured, all chutes, hoppers, wheelbarrows and hand tools need to washed down in a designated area. Concrete washout is to be contained within a plastic lined pit. Wash water must be retained in the wash down area and allowed to evaporate, leaving only the hardened cementitious solids to be recycled. ▪ Excess concrete wastes must be returned to the batching plant for treatment or reuse. ▪ All noxious weeds and exotic plan species will be disposed of at a license facility ▪ Separate waste, in line with local dump and separation agreements ▪ Remove sewage by licensed contractor; Vestas Construction Waste Management Plan **CEMP Appendix E.**
Performance Indicators	▪ Minimise the amount of waste generated. ▪ No improper storage, transport or disposal of waste. ▪ No litter left onsite during construction
Monitoring, Reporting and Corrective Action	▪ Maintain regulated waste tracking records. ▪ Photographic Records

	▪ Complaints Register – recorded and closed out. ▪ Daily Check Sheets – completed and reviewed by manager / supervisor. ▪ Regular housekeeping checks. The camp site area is to be inspected after relocation. ▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all construction areas of the site and signed off by the Construction Manager. This will be filed on site. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**)
Responsible Person	▪ At the planning stage of this project, the Construction (Site) Manager is responsible for identifying and planning methods for waste management and minimisation Environmental Officer. ▪ Environmental Officer
Associated Documentation	▪ Refer to Vestas Construction Waste Management Plan **CEMP Appendix E**. ▪ Material Safety Data Sheets

5.9 Fire Management

Policy	To minimise the potential for bushfires resulting from construction activities.
Performance Objectives	▪ No fires deliberately lit or allowed to remain alight along the WTG line or other project related worksites. ▪ No build-up of flammable material during construction near hot work areas.
Management Strategies	Conduct procedures in accordance with the *Bushfire Management and Emergency Evacuation Plan* (**Appendix N**). ▪ Open fires will be banned on the project. Fires include open barbeques, billy fires, brush burning and rubbish burning. ▪ Hot Works Permits must be obtained for all works which may result in ignition of a fire (for example welding, grinding or anything that may cause a flame or spark). This will set out procedures to be followed regarding where the work is undertaken, firefighting equipment, and personnel to be in attendance and timing for the work to be undertaken. ▪ Adoption of lightning protection measures for both turbines and substations. ▪ Unnecessary build-up of flammable material near working areas will be prevented, with vegetation and other flammable material being stockpiled well clear of hot work activities. ▪ Water trucks (also used for dust suppression) will be available for use as fire trucks in the event of fire. ▪ All vehicles will be equipped with portable fire extinguishers. ▪ Fire extinguishers and a water cart will be available to the welding crew. All appropriate crew members will be trained in the use of firefighting equipment. ▪ Emergency Response Plan shall include details on local contacts for firefighting assistance. ▪ Construction management liaison with local Rural Fire Service personnel during high fire periods.
Performance Indicators	▪ Build-up of flammable material near hot work areas. ▪ Emergency Response Plan in place. ▪ Permits and approvals as required.
Monitoring, Reporting and Corrective Action	▪ Daily Check Sheets – completed and reviewed by manager / supervisor. ▪ Monitor work areas for appropriate fire extinguishers, build-up of dry fuel, or other dry combustible materials (paper etc). ▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all construction areas of the site and signed off by the Construction Manager. This will be filed on site. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**)
Responsible Person	▪ Environmental Officer ▪ Construction Manager
Associated Documentation	▪ *Bushfire Management and Emergency Evacuation Plan* (**Appendix N**)

6.0 Operational EMP

6.1 Flora Management

Policy	To promote vegetation re-establishment, promote a stable landform and protect threatened species.
Performance Objectives	▪ Promote the establishment of ground cover plants and zones of native vegetation (including shrubs and trees) on all areas of disturbance. ▪ Promote natural regeneration of native plant communities on temporarily cleared areas. ▪ In addition to typical regenerating vegetation, planting and transplanting of conservation significant plant species in appropriate areas wherever possible. ▪ Maintenance of revegetation and rehabilitation areas in accordance with the *Rehabilitation Plan* and *Threatened Plant Management Plan*. ▪ Ensure that weeds are not spread along WTG access tracks, particularly environmental weeds, declared plants and invasive grasses.
Management Strategies	▪ Conduct activities in accordance with *Threatened Plant Management Plan* (**Appendix G**). ▪ Promote low regrowth of native plants along access track verges to ensure positive fire break.. Pads required for crane access during maintenance may be grassed with native species or a species certified to be sterile and non-weed forming. This may require spreading native grass seed following rain. ▪ Monthly weed survey by supervising botanist (fortnightly during wet season for first two years after construction); control of weeds along the WTG access tracks, turbine pads and contractors yard implemented *Weed Management Plan* (**Appendix J**) ▪ All vehicles and machinery to be washed down and certified weed free prior to entering site and in accordance with the *Weed Management Plan*. ▪ Vehicles and machinery working in internal weed infested areas are not to continue work in weed-free zones unless certified clean and weed free. Mobile wash down facilities will be established where control required. ▪ All permanent staff provided training and induction in Weed Identification as per *Weed Management Plan* (**Appendix J**)
Performance Indicators	▪ Track verges, turbine pads stabilized and revegetated or rehabilitated according to *Threatened Plant Management Plan* (**Appendix G**). ▪ Nil declared, invasive or environmental weeds present. All outbreaks controlled before setting flowers and seeds. ▪ Achievement of *Threatened Plant Management Plan* targets. ▪ No damage to protected species without a relevant permit and approval. ▪ Survival and persistence of species planted for the Offset Program (RPS, 2016)
Monitoring & Reporting	▪ Inspection checklist ▪ Independent annual audit ▪ Weed records to be maintained according to *Weed Management Plan*. ▪ Offset rehabilitation planting to be monitored for a period of 3 years following rehabilitation to ensure survival, persistence and performance, as well as replacement of mortalities. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**)
Responsible Person	▪ Supervising botanist ▪ MEWF Operations Manager ▪ Annual site rehabilitation assessment by supervising botanist
Associated Documentation	▪ *Threatened Plant Management Plan* (**Appendix G**) ▪ *Rehabilitation Plan* (**Appendix K**) ▪ *Weed* and *Pest Management Plans* (**Appendix J**) ▪ Offset Area Management Plan (RPS, 2016)

6.2 Fauna Management

Policy	To provide strategies to minimise the impacts on of operation activities on abundance and distribution of threatened fauna and habitat
Performance Objectives	▪ Minimise impacts to native fauna. ▪ Where practicable, avoid disturbance to threatened fauna species. ▪ Minimise habitat fragmentation and promote habitat regeneration where practicable. ▪ Prevent the spread of pest animals and animal pest diseases as a result of operational activities. ▪ Implement and monitor management strategies to limit the spread of fauna pest species (e.g. cane toad) along the WTG rows. ▪ Prevent introduction and spread of declared and invasive weeds ▪ Ensure that the existing population of Northern Quoll in the project area is maintained at pre-construction levels
Management Strategies	Adaptive management strategies will be undertaken in accordance with significant species management Plans. **Northern Quoll Species Management Plan (Appendix H)** ▪ Traffic levels will be maintained and controlled on site, where traffic will be limited during night hours to minimise fragmentation and mortality of Northern Quoll; and ensure no entry into conservation areas by the implementation of signage (except for necessary environmental management and monitoring) **Bare-rumped Sheathtailed Bat and Spectacled Flying Fox (Implementation Plan (RPSa, 2016)** ▪ Trial visual and acoustic automated collision detection systems ▪ Conduct carcass searches (calibrated for scavenger removal and detectability); validate collision risk model. ▪ Conduct call activity surveys at turbines within the turbine rotor swept area ▪ Curtail operation of all/some of turbines during high-risk conditions or in response to detected excessive collision mortality ▪ If appropriate, incorporate avian and bat radar with wind farm SCADA system to implement automatic turbine shut-down **Weed and Pest Control** ▪ Ensure adequate controls and check are in place for weeds and pests as per the per the Weed and Pest Management Plan (Appendix) including: ▪ Survey periodically (quarterly) of high risk areas. ▪ Continue management of waste products. ▪ Promote continued education and training of staff to ensure implementation and changes to plan are ongoing. ▪ Liaise with Local and state government to ensure management of declared weeds and pests around property remains current and in line with other property holders and council. ▪ Continue pest and weed control through management of solid and liquid waste.
Performance Indicators	▪ Compliance with Northern Quoll Outcomes Strategy (Burnett, 2016) and Implementation Plan (RPSa, 2016) for Bare-rumped Sheathtailed Bat and Spectacled Flying Fox Management Plans. ▪ Site occupancy of the Northern Quoll population on Mt Emerald windfarm site remains within the normal range of values during each year and each of three years following the construction phase, and at 5 and 10 years following completion of construction. (Burnett, 2016). ▪ Compliance with *Implementation Plan* (2017, TBA). ▪ No pest incursions to the site.
Monitoring & Reporting	▪ Annual (quarterly for first two years) reports in accordance with Northern Quoll Outcomes Strategy and Implementation Plan (2017, TBA) for Bare-rumped Sheathtailed Bat and Spectacled Flying Fox and approval conditions, including mortality surveys to DotE. ▪ USQ conduct, biannual monitoring of quoll populations at MEWF site and three reference sites (*Burnett, 2016)* with reporting to MEWF Project Managers and DotE regulators annually.
Responsible Person	▪ Site Manager ▪ University of Southern Queensland Researchers ▪ MEWF Operations Manager

6.3 Erosion, Sediment and Stormwater Control

Policy	To ensure erosion, sediment and stormwater control measures along access tracks and turbine pads are effectively maintained.
Performance Objectives	▪ Minimise soil erosion. ▪ Minimise sedimentation of land and watercourses. ▪ Minimise modification to drainage patterns. ▪ Prevent as far as practical, sediment transport to adjacent watercourses.
Management Strategies	▪ Retain sediment control measures installed during construction phase until cleared areas are sufficiently revegetated to capture runoff. ▪ Inspect all disturbed areas monthly and maintain erosion and sediment controls as necessary. ▪ Place additional erosion control structures such as diversion banks / drains, rock check dams, rock armouring, whoa-boys) at key locations if additional erosion is detected along tracks. ▪ Inspect drainage lines after first rain event (and after significant rain events) each wet season to assess whether erosion is occurring and to determine if remedial action may be required. ▪ Divert stormwater away from tracks if necessary. ▪ Ensure replacement of any erosion control measures as required.
Performance Indicators	▪ No large scale erosion or sedimentation caused to adjacent land uses as a result of prior construction activities. ▪ No evidence of additional sedimentation in watercourses as a result of erosion from operational activities.
Monitoring & Reporting	▪ A post-construction audit which will evaluate revegetation, erosion control, weed control, water course bank stability will be conducted annually for two years following completion of construction. ▪ Monitor downstream water quality (turbidity) for first 12 months after construction. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**)
Responsible Person	▪ Site Manager ▪ Environmental Officer ▪ MEWF Operations Manager

6.4 Management of Flammable and Combustible Substances

Policy	To ensure that storage and handling of flammable and combustible substances onsite does not cause environmental harm or harm to persons.
Performance Objectives	▪ To minimise potential for land, surface and groundwater contamination. ▪ To ensure the on-going safety of operations personnel.
Management Strategies	▪ A *Hydrocarbon and Hazardous Substance Plan* (**Appendix M)** shall be in place and employees inducted in its application. ▪ Flammable and combustible substances are stored, handled, separated and signed as required by the Flammable and Combustible Liquids Regulations and AS1940. ▪ Transportation of dangerous goods will be in accordance with the Regulations and with AS 1678, AS 2809 and AS 2931. ▪ A qualified person will be appointed as Site Safety Officer. ▪ An on-site set of the relevant MSDS for all flammable and combustible substances and dangerous goods used during construction will be maintained and available. ▪ Waste flammable and combustible substances which cannot be recycled will be transported to a designated disposal site as approved by Local Government. ▪ No refuelling of plant and equipment over or within 100m of watercourses. ▪ Spill kits containing absorbent and containment material (e.g. absorbent matting) will be available where hazardous materials are used and stored and personnel trained in their correct use. ▪ Spills of flammable and combustible substances will be rendered harmless and collected for treatment and / or remediation or disposal at a designated site, including cleaning materials, absorbents and contaminated soils and reinstatement made to the affected area. ▪ Personal protective equipment (PPE) appropriate to the materials in use will be provided.

Performance Indicators	▪ No hazardous goods will cause contamination of the environment. ▪ Ensure appropriate remedial action has been implemented for any spills. ▪ Major incidents reported to relevant authorities and their directions followed. ▪ Spill kits and PPE available and used as appropriate.
Monitoring, Reporting and Corrective Action	▪ Photographic records will be maintained of all works and all corrective actions. ▪ Regular inspection of storage facilities and work practices in the handling of flammable and combustible substances or other dangerous substances. ▪ Daily Check Sheets while works are being undertaken– completed and reviewed by manager / supervisor ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D)**
Responsible Person	▪ MEWF Operations Manager ▪ Environmental Officer ▪ Site Safety Officer
Associated Documentation	▪ Hydrocarbon and Hazardous Substance Plan (**Appendix M**)

6.5 Noise

Policy	To minimise the impact of noise nuisance from wind farm maintenance activities to nearby residences.
Performance Objectives	▪ Minimise noise nuisance generated by operation and maintenance activities. ▪ Compliance with project specific noise criteria at noise sensitive receptors
Management Strategy	▪ Provide advance notice of any scheduled maintenance activities to nearby residents. ▪ Schedule noisy maintenance activities to appropriate times. ▪ Maintain liaison with nearby residents. ▪ Advise nearby residents in advance if any planned noisy activities are to be undertaken. ▪ Conduct noise impact monitoring of operation within three months of commencement and review mitigation measures as necessary
Performance Indicators	▪ Number of noise related complaints received from residents. ▪ Exceedance of noise limits conditions contained in Conditions 4, 5, 6 of the Ministerial (DILG) Decision Notice (18/12/2015)
Monitoring & Reporting	▪ Complaints Register ▪ Noise monitoring will occur at the source of a valid noise complaint as agreed with the regulatory authority to investigate a noise complaint. ▪ Independent audit every year (years 1-3) then every two years.
Responsible Person	▪ Site Manager ▪ MEWF Operations Manager

6.6 Waste Management

Policy	To minimise waste generation and maximise reuse and recycling of waste products.
Performance Objectives	▪ Minimise impacts related to waste management. ▪ No evidence of litter or refuse generated from maintenance activities.
Management Strategies	▪ Collecting and removing waste oil and solvents for recycling, reuse or disposal at approved locations. ▪ Where practical, wastes will be segregated and reused / recycled (e.g. scrap metal). ▪ All maintenance personnel shall be instructed in waste management practices as a component of their induction process. ▪ Ensure wastes are not accessible by stock or wildlife.
Performance Indicators	▪ Percentage of waste recycled ▪ Litter left onsite after maintenance activities
Monitoring & Reporting	▪ Maintain regulated waste tracking records where required. ▪ Regularly review waste management strategies to maximise recycling. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**)

Responsible Person	▪ MEWF Operations Manager ▪ Environmental Officer

6.7 Fire

Policy	To minimise the potential for vegetation to catch fire from operation activities.
Performance Objectives	▪ No fires deliberately lit or allowed to remain alight along the WTG line or other project related infrastructure.
Management Strategies	Conduct procedures in accordance with the *Bushfire Management and Emergency Evacuation Plan* (**Section 5.8** and **Appendix N**). ▪ Open fires will be banned on the project. Fires include open barbeques, billy fires, brush burning and rubbish burning. ▪ Adoption of lightning protection measures for both turbines and substations. ▪ Emergency Response Plan shall include details on local contacts for firefighting assistance. ▪ Ecological Fire Management Strategies undertaken by a bushfire specialist.
Performance Indicators	▪ Fire frequency not above natural fire event. ▪ Emergency Response Plan in place. ▪ Permits and approvals as required.
Monitoring, Reporting and Corrective Action	▪ Monitor work areas for appropriate fire extinguishers; build-up of dry fuel, or other dry combustible materials (paper etc.). ▪ Daily monitoring of local fire hazards/bans during bushfire season. ▪ Annual preseason review of bushfire hazards on MEWF site. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**).
Responsible Person	▪ MEWF Operations Manager
Associated Documentation	▪ *Bushfire Management and Emergency Evacuation Plan* (**Appendix N**)

6.8 Access and Landholder Relationships

Policy	To minimise the impact on surrounding landholders.
Performance Objectives	▪ Minimise impacts to adjoining native flora and fauna. ▪ Eliminate the likelihood of the spread of weeds off site. ▪ Minimise disruption to landholder activities along Kippen Drive. ▪ Maintain regular liaison with landholders along the route.
Management Strategies	▪ Restrict site entry to designated access track. ▪ Maintain regular liaison with landholders. ▪ Landholder concerns are addressed promptly. ▪ Fire control measures will be maintained as required. ▪ Weed and Pest control measures will be maintained as required. ▪ Ensure gates are locked where access can be obtained from a road (to ensure unauthorised users are excluded).
Performance Indicators	▪ 0-3 complaints from land owners annually ▪ Fire, and Weed and Pest control measures are performed as required.
Monitoring & Reporting	▪ Complaint Register ▪ Easement inspection check sheet monitored quarterly. ▪ Independent audit every two years.
Responsible Person	▪ MEWF Operations Manager
Associated Documentation	▪ *Bushfire Management and Emergency Evacuation Plan* (**Appendix N**) ▪ *Weed* and *Pest Management Plans* (**Appendix J**).

7.0 Decommissioning Phase

7.1 Flora and Fauna Management

Policy	To minimise additional impacts and effects on vegetation and habitat for flora and fauna during the decommissioning of the wind farm, including infrastructure such as turbine pads, camps and yards and laydown areas and the access tracks.
Performance Objectives	▪ Prevent impacts to native vegetation and rehabilitation and conservation areas. ▪ Prevent weeds from entering the site. Continue application of *Weed* and *Pest Management Plans* (**Appendix J**) and wash down facilities. ▪ Prevent the spread of weeds, and plant pest diseases within the site as a result of decommissioning activities. The site will be left free of serious weeds (environmental and declared, as well as introduced pasture grasses). ▪ Where practicable, avoid disturbance to threatened and poorly known flora species that have regenerated adjacent to or present in original construction zones. ▪ Avoid all impacts to these types of plants and habitats outside of the original construction zone. ▪ No net loss of habitat connectivity or additional habitat fragmentation to occur. ▪ Offset Program for threatened plants has been successful and the objectives have been met as outlined in respective Management Plans.
Management Strategies	▪ A post-decommissioning survey undertaken to identify threatened species within the decommissioning zone. ▪ Flag individual significant plant species (including habitat trees) which are located in the decommissioning zone so they may be avoided where practicable during decommissioning work. ▪ Placement of physical barriers around significant vegetation areas in order to restrict access and avoid further disturbance. ▪ Harvesting seeds for replacement use in rehabilitation zones as per *Rehabilitation Plan* (**Appendix K**), where natural regeneration was not successful. ▪ Ensure adequate measures are in place to safeguard and assist the movement of fauna from the decommissioning zone. Refer to the *Habitat Clearing and Management Plan* (**Appendix I**) for Spotter Catcher details. ▪ All weeds established within the site are to be recorded in a decommissioning weed survey. ▪ Control environmental and declared weeds within and adjacent to the decommissioning zone. This should be performed in accordance with the methods and control measures detailed in the *Weed* and *Pest Management Plans* (**Appendix J**); ▪ Implement management strategies for the continued health and population growth of threatened flora and fauna are implemented and have a success rate that meets criteria detailed in respective species' management plans.
Performance Indicators	▪ Vegetation, ecosystems, habitats and conservation significant species of flora and fauna are not suffering from adverse impacts, ▪ Threatened Species are maintained in their current condition with negligible declines in population dynamics and the numbers of species present on the site. ▪ Minimal disturbance to flora and fauna has occurred as a result of decommissioning. ▪ Restoration (successful rehabilitation) has resulted from progressive rehabilitation and environmental management of the wind farm site. ▪ Vegetation communities have recovered with a major proportion of the flora comprising native species. ▪ No failure or irreversible decline of rehabilitation measures. ▪ The dominant ground cover adjacent to tracks and turbine pads comprises native species and not introduced pasture grasses or legumes. ▪ No damage to threatened species or designated conservation zones without relevant approval and supervision. ▪ Ensure relevant permits are effective before removing any protected species. ▪ Declared plants and environmental weeds within the WTG line are adequately controlled, and no fauna pests are introduced into the site. ▪ Plant species planted for the Offset Program are self-sustaining and do not require human assistance to survive. Rehabilitated plant communities should be persistent in the landscape able to function without intervention.

Monitoring, Reporting and Corrective Action	▪ Photographic records to be maintained. ▪ Complaints Register – recorded and closed out. ▪ Daily Check Sheets – completed and reviewed by manager / supervisor. ▪ Regular inspections, audits and reviews (non-compliance and incident reporting) undertaken in accordance with EMP and recommendations and corrective actions implemented. ▪ Undertake a Decommissioning Weed Survey to identify all weeds that have established on the site. ▪ Offset planting to be monitored for a period of three years following rehabilitation to ensure survival and replacement of mortalities.
Responsible Person	▪ Environmental Officer ▪ External Ecological Consultant ▪ MEWF Operations Manager
Associated Documentation	▪ *Threatened Plant Management Plan* (**Appendix G**) ▪ *Rehabilitation Plan* (**Appendix K**) ▪ *Weed* and *Pest Management Plans* (**Appendix J**) ▪ Offset Area Management Plan (RPS, 2016) ▪ Implementation Plan (Bare-rumped Sheathtailed Bat/Spectacled flying Fox) (2017, TBA) ▪ Northern Quoll Outcomes Strategy (Burnett, 2016)

7.2 Erosion, Sediment and Stormwater Control

Policy	To provide effective erosion and sediment practices to mitigate the potential effects of construction on watercourses, land use and the general environment.
Performance Objectives	▪ Minimise soil erosion. ▪ Minimise sedimentation of land. ▪ Minimise modification to drainage patterns. ▪ Prevent as far as practical, sediment transport to adjacent watercourses.
Management Strategies	Conduct all earthworks in accordance with an updated and detailed *Erosion, Sediment and Stormwater Management Plan* (**Appendix L**). Management strategies include: ▪ Install clean water diversions upslope of sloping Wind Turbine Generation (WTG) sites to direct clean stormwater away from work/bare areas. Where possible, runoff from access tracks will also be directed away from WTG sites; ▪ Direct all uncontaminated (clean) stormwater to stable land, ensuring water is dispersed/diffused to prevent erosion. ▪ Strip topsoil (~200mm depth) separately and retained for rehabilitation/stabilisation activities. It is important to ensure separate soil horizons are retained in separate stockpiles and not mixed. These stockpiles must be located away from drainage lines and have appropriate controls to ensure sediment is not lost (e.g. sediment fence/geotextile covers); ▪ Respread/cover tower and permanent pad batters with topsoil and rehabilitate as soon as practicable on completion of pads; ▪ Stabilise pad surfaces using methods such as topsoiling and revegetation or gravelling, where there is a risk of erosion of the pad; ▪ Do not carry out clearing activities within 50 metres of a watercourse; where required, improve or develop appropriately designed watercourse crossings that prevent erosion; ▪ Maintain vegetation cover along hardstands and access tracks where possible. Reduce damage to grass cover and sensitive heath vegetation types by limiting vehicle movements to work areas and approved access tracks; ▪ Sediment fences and temporary drain crossings should be constructed/maintained as per the *Erosion, Sediment and Stormwater Management Plan.* ▪ Minimise disturbance, stage and revegetate disturbed areas to achieve a ground cover of at least 70% on completion of construction in each area.

	Stormwater Diversion ▪ In areas which are subject to erosion potential (slopes >5%), stormwater diversion banks / drains (whoa-boys) should be placed diagonally across the tracks to divert stormwater to adjacent undisturbed grassed areas following completion of construction. Spacing of such diversion drains can be approximately 50 m to 70 m apart. Where slopes are >5%, then more frequent spacing is required. ▪ Adequate monitoring and follow-up work following construction to ensure any initiated erosion is arrested early.
Performance Indicators	▪ No large scale erosion or sedimentation caused to adjacent land uses as a result of construction activities. ▪ No evidence of additional sedimentation in watercourses as a result of erosion from decommissioning activities. ▪ Reinstatement of watercourses to original profile – removal of crossings where required. ▪ Adequate spacing of stormwater diversion drains in areas of erosion potential.
Monitoring, Reporting and Corrective Action	▪ Photographic Records ▪ Complaints Register – recorded and closed out. ▪ Daily Check Sheets – completed and reviewed by manager / supervisor. ▪ Regular inspections, audits and reviews (non-compliance and incident reporting) undertaken in accordance with EMP and recommendations and corrective actions implemented. ▪ Decommissioning audits will include all watercourse crossings. ▪ A post-construction audit which will evaluate revegetation, erosion control, weed control, water course bank stability will be conducted annually for two years following completion of decommissioning.
Responsible Person	▪ Environmental Officer ▪ External Environmental Consultant ▪ MEWF Operations Manager
Associated Documentation	▪ *Erosion, Sediment and Stormwater Management Plan* (**Appendix L**)

7.3 Management of Flammable and Combustible Substances

Policy	To ensure that storage and handling of flammable and combustible substances onsite does not cause environmental harm or harm to persons.
Performance Objectives	▪ To minimise potential for land, surface water and groundwater contamination. ▪ To ensure the on-going safety of construction personnel.
Management Strategies	▪ A *Hydrocarbon and Hazardous Substance Plan* (**Appendix M**) and Emergency Evacuation Plan shall be in place and employees inducted in its application. ▪ Flammable and combustible substances are stored, handled, separated and signed as required by the Flammable and Combustible Liquids Regulations and AS1940. ▪ Transportation of dangerous goods will be in accordance with the Regulations and with AS 1678, AS 2809 and AS 2931. ▪ A qualified person will be appointed as Site Safety Officer. ▪ An on-site set of the relevant MSDS for all flammable and combustible substances and dangerous goods used during construction will be maintained and available. ▪ Waste flammable and combustible substances which cannot be recycled will be transported to a designated disposal site as approved by Local Government. ▪ No refuelling of plant and equipment over or within 100m of watercourses. ▪ Spill kits containing absorbent and containment material (e.g. absorbent matting) will be available where hazardous materials are used and stored and personnel trained in their correct use. ▪ Spills of flammable and combustible substances will be rendered harmless and collected for treatment and / or remediation or disposal at a designated site, including cleaning materials, absorbents and contaminated soils and reinstatement made to the affected area. ▪ Personal protective equipment (PPE) appropriate to the materials in use will be provided. ▪ Relevant Local Government permits will be held and conditions of permits met.

Performance Indicators	▪ No environment harm caused on site due to hazardous goods contamination ▪ Cut off flowpath to drains/watercourses e.g. sand bags, earthen bund, in the event of a spill. ▪ Ensure appropriate remedial action has been implemented for any spills. ▪ Major incidents reported to relevant authorities and their directions followed. ▪ Spill kits and PPE available and used as appropriate.
Monitoring, Reporting and Corrective Action	▪ Photographic Records ▪ Regular inspection of storage facilities and work practices in the handling of flammable and combustible substances or other dangerous substances. ▪ Complaints Register – recorded and closed out. ▪ Daily Check Sheets – completed and reviewed by manager / supervisor. ▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all construction areas of the site and signed off by the Construction Manager. This will be filed on site. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**)
Responsible Person	▪ MEWF Operations Manager ▪ Environmental Officer ▪ Site Safety Officer
Associated Documentation	*Hydrocarbon and Hazardous Substance Plan* (**Appendix M**)

7.4 Noise and Vibration

Policy	To minimise the impact of decommissioning noise nuisance and vibration to nearby residences.
Performance Objectives	▪ Minimise noise nuisance generated by construction activities. ▪ Minimise any vibration nuisance to nearby residences.
Management Strategy	▪ Provide advance notice of any scheduled atypical noise events to nearby residents. ▪ Ensure camp sites are located a sufficient distance form residences to limit any noise nuisance. ▪ Equipment maintained in accordance with manufacturer's specifications. ▪ Schedule atypical noise events for appropriate times. ▪ Any blasting is to be carried out in accordance with current practice standards with particular reference to AS 2187. ▪ Maintain liaison with nearby residents. ▪ Noisy construction activities in proximity to homesteads to be limited to 7.00 am to 6.00 pm Monday to Saturday.
Performance Indicators	▪ Less than 3 noise related complaints received from residents during decommissioning. ▪ Repair and replace faulty equipment as soon as possible.
Monitoring, Reporting and Corrective Action	▪ Complaints Register – recorded and closed out. ▪ Noise monitoring will occur at the source of the noise complaint as directed by the regulatory authority to investigate a noise complaint. Monitoring will be undertaken in accordance with the latest edition of DEHP Noise Management Manual Check Sheets – completed and reviewed by manager / supervisor. ▪ Preconstruction audit of any premises located in areas containing hard rock. ▪ Check Sheets – completed and reviewed by manager / supervisor. ▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all construction areas of the site and signed off by the Construction Manager. This will be filed on site. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**)
Responsible Person	▪ MEWF Operations Manager ▪ Environmental Officer
Associated Documentation	▪

7.5 Air Emissions

Policy	To complete the decommissioning of each WTG line in a manner to maintain ambient air quality of the local area.
Performance Objectives	▪ To maintain acceptable limits of vehicular and machinery operating emissions. ▪ To receive zero complaints from local landholders regarding air quality. ▪ To minimise the generation of fugitive dust emissions produced during decommissioning.
Management Strategies	▪ Vehicles and machinery shall be maintained in accordance with manufacturer's specifications. ▪ Watering of construction site and access tracks will be carried out on an as required basis, particularly on dry and windy days and especially near residential homesteads. ▪ Avoid smoke generation by a strict no burning policy. ▪ Implement fire control measures during welding operations. Hot Works Permits must be obtained for all works which may result in ignition of a fire (for example welding, grinding or anything that may cause a flame or spark). This will set out procedures to be followed regarding where the work is undertaken, firefighting equipment, and personnel to be in attendance and timing for the work to be undertaken.
Performance Indicators	▪ Visual observations of dust emissions during windy/dry periods. ▪ No dust nuisance complaints from nearby residents. ▪ No excessive visible dust during construction activities.
Monitoring, Reporting and Corrective Action	▪ Photographic Records ▪ Complaints Register – recorded and closed out. ▪ Daily Check Sheets – completed and reviewed by manager / supervisor. ▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all construction areas of the site and signed off by the Construction Manager. This will be filed on site. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**)
Responsible Person	▪ MEWF Operations Manager. ▪ Environmental Officer
Associated Documentation	▪

7.6 Waste Management

Policy	To minimise waste generation and maximise reuse and recycling of construction (decommissioning) waste products.
Performance Objectives	▪ Minimise impacts related to waste management. ▪ No evidence of litter or refuse generated from construction related activities. ▪ No contamination of land, air or water as a result of inappropriate waste management.
Management Strategies	▪ Waste separated for reuse, recycling and rubbish, with transport and disposal of waste by appropriately licensed contractors. ▪ Stockpiling and salvaging reusable and recyclable wastes, such as timber skids, pallets, drums and scrap metals. ▪ Collecting and removing waste oil and solvents from site for recycling, reuse or disposal at approved locations. ▪ Disposing of sewage and sullage from camp site via a packaged mini sewerage treatment plant (greywater may be discharged to land in accordance with local approvals). ▪ Collection of chemical wastes in 200 L drums (or similar sealed container), appropriately labelled, for safe transport to an approved chemical waste depot or collection by a liquid waste treatment service. ▪ All binding material and dunnage from transport vehicles and unloading areas is to be collected and transported off the easement to designated disposal areas. ▪ Collecting and transporting general refuse to a Local Government approved disposal site. ▪ Ensure wastes are not accessible by stock or wildlife. ▪ Refuse containers will be located at each worksite. ▪ Where practical, wastes will be segregated and reused/recycled (e.g. scrap metal). ▪ All personnel shall be instructed in project waste management practices as a component

	of the environmental induction process. ▪ Spraying of declared plants and disposal to regulated landfill.
Performance Indicators	▪ Clean and waste-efficient construction site. ▪ Percentage of waste recycled. ▪ No litter left onsite during construction.
Monitoring, Reporting and Corrective Action	▪ Maintain regulated waste tracking records. ▪ Photographic Records. ▪ Complaints Register – recorded and closed out. ▪ Daily Check Sheets – completed and reviewed by manager / supervisor. ▪ Regular housekeeping checks and a waste audit to be conducted. The camp site area is to be inspected after relocation. ▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all construction areas of the site and signed off by the Construction Manager. This will be filed on site. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**).
Responsible Person	▪ MEWF Operations Manager ▪ Environmental Officer
Associated Documentation	▪ Material Safety Data Sheets

7.7 Fire Management

Policy	To minimise the potential for bushfires from decommissioning activities.
Performance Objectives	▪ No fires deliberately lit or allowed to remain alight along the WTG line or other project related worksites. ▪ No build-up of flammable material during construction near hot work areas.
Management Strategies	Conduct procedures in accordance with the *Bushfire Management and Emergency Evacuation Plan* (**Appendix N**). ▪ Open fires will be banned on the project. Fires include open barbeques, billy fires, brush burning and rubbish burning. ▪ Hot Works Permits must be obtained for all works which may result in ignition of a fire (for example welding, grinding or anything that may cause a flame or spark). This will set out procedures to be followed regarding where the work is undertaken, firefighting equipment, and personnel to be in attendance and timing for the work to be undertaken. ▪ Adoption of lightning protection measures for both turbines and substations. ▪ Unnecessary build-up of flammable material near working areas will be prevented, with vegetation and other flammable material being stockpiled well clear of hot work activities. ▪ Water trucks (also used for dust suppression) will be available for use as fire trucks in the event of fire. ▪ All vehicles will be equipped with portable fire extinguishers. ▪ Fire extinguishers and a water cart will be available to the welding crew. All appropriate crew members will be trained in the use of firefighting equipment. ▪ Emergency Response Plan shall include details on local contacts for firefighting assistance. ▪ Construction management liaison with local Rural Fire Service personnel during high fire periods.
Performance Indicators	▪ Fire frequency. ▪ Ignition from lightning strikes ▪ Build-up of flammable material near hot work areas. ▪ Emergency Response Plan in place. ▪ Permits and approvals as required.

Monitoring, Reporting and Corrective Action	▪ Daily Check Sheets – completed and reviewed by manager / supervisor. ▪ Monitor work areas for appropriate fire extinguishers, build-up of dry fuel, or other dry combustible materials (paper etc.). ▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all construction areas of the site and signed off by the Construction Manager. This will be filed on site. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**)
Responsible Person	▪ Environmental Officer ▪ MEWF Operations Manager
Associated Documentation	▪ *Bushfire Management and Emergency Evacuation Plan* (**Appendix N**).

7.8 Access

Policy	▪ Existing cleared areas and access tracks shall be used to access the WTG's so as to minimise the impact on vegetation and existing land use and minimise potential for weed invasion. ▪ Safely manage the transportation of wind turbine components in accordance with the Traffic Management Plan.
Performance Objectives	▪ Minimise impacts to native flora and fauna. ▪ Minimise impacts to soil and water. ▪ Avoid adverse impacts on cultural and historic heritage sites. ▪ Reduce the likelihood of the spread of weeds and fauna pests. ▪ As far as reasonably practicable, prevent movement of pest animals across declared barrier fences. ▪ Safely manage the transportation of WTG elements. ▪ Minimise any new access tracks and the number of access tracks. ▪ Minimise disruption to landholder activities and third parties. ▪ Manage road and track usage, and achieve satisfactory road and site rehabilitation. ▪ Minimise damage to existing road networks. ▪ Stakeholder consultation plan implemented.
Management Strategies	▪ Existing roads and tracks will be used where practicable. ▪ New access tracks and any diversions will generally be avoided, but if necessary, will be selected to minimise impacts on sensitive vegetation, erosion-prone soils and watercourse crossings; avoid any significant cultural heritage sites in accordance with the CHMP and HHMP and minimise noise to nearby residents. New access tracks and diversions will only be used by agreement with the landholder. ▪ Consultation shall occur between Site Manager and senior police management at Mareeba and Atherton to ensure any potential cumulative impacts are mitigated. ▪ Disturbance (including access) to No-go areas shall be avoided. These shall be marked with flagging tape, paraweb fencing or equivalent. ▪ Wash down of plant and equipment (including vehicles) following work in any declared plant area. ▪ Erosion and sediment control measures will be used as and where required. ▪ Speed and weight restrictions will be applied to project vehicles as appropriate. ▪ Any damage to existing roads and tracks shall be repaired regularly. ▪ Safely manage the transport of WTG components in accordance with the TMP to be developed in conjunction with local governments, QPS and DTMR. ▪ Undertake a road condition survey of roads used by the Project.
Performance Indicators	▪ Access readily manageable and able to be rehabilitated using standard techniques. ▪ Complaints from land owners, authorities and public are minimised. ▪ Erosion and sediment control in place. ▪ Condition of existing roads and tracks are maintained. ▪ WTG components managed in line with transport management plan. ▪ Road condition not deteriorated as a result of project activities or made good following deterioration caused by project activities.

Monitoring, reporting and corrective actions	▪ Photographic records ▪ Complaint Register – complaints recorded and closed out. ▪ Daily Check Sheets – completed and reviewed by manager / supervisor. ▪ Regular inspections, audits and reviews (non-compliance and incident reporting) undertaken in accordance with EMP and recommendations and corrective actions implemented.
Responsible Person	▪ Environmental Officer / Community Liaison Officer ▪ MEWF Operations Manager
Associated Documentation	▪ Alignment Sheet ▪ Biosecurity (including weeds) Management Strategy ▪ Decommissioning Safety Management Plan ▪ Road condition assessment ▪ Maps of access tracks

7.9 Construction Compounds and Laydown Areas

Policy	To minimise the impact on the environment from the decommissioning contractors compounds providing workspace and provisions for construction teams.
Performance Objectives	▪ Minimal impact on the natural environment. ▪ Compliance with Local Government requirements for provision of infrastructure and waste disposal. ▪ Reinstatement of site to equivalent surrounding conditions following Project use. ▪ Functional waste minimisation, segregation and recycling systems operational at all worksites. ▪ Ensure activities do not encourage feral animals or mosquito breeding or the spread and introduction of weeds. ▪ High standard of site management and general housekeeping. ▪ Stakeholders will be adequately consulted.
Management Strategies	▪ Construction compounds will be located following agreement with landholders and / or local government. ▪ Construction compounds will not be established in floodplains or any other location vulnerable to extreme weather conditions. ▪ Construction compounds will be selected to minimise impacts on sensitive vegetation, erosion-prone soils and watercourse crossings; avoid any significant cultural heritage sites and to minimise noise to any nearby residents. ▪ Effluent to be treated in a packaged sewage treatment plant. ▪ All other wastes will be disposed of in accordance with the requirements of the local government. ▪ Total petroleum hydrocarbon (TPH) soil testing of the area containing temporary fuel storages will be conducted following removal of these storages. ▪ Following use, camp sites and construction compounds will be reinstated and revegetated to as near as practical to their original, natural condition. ▪ Waste will not be burnt.
Performance Indicators	▪ Clean and tidy site. ▪ Waste management, waste disposal and waste recycling measures in place. ▪ Construction compounds successfully rehabilitated following completion of the Project.
Monitoring, Reporting and Corrective Action	▪ Photographic records. ▪ Complaint Register – complaints recorded and closed out. ▪ Daily Check Sheets– completed and reviewed by manager / supervisor. ▪ Regular inspections, audits and reviews (non-compliance and incident reporting) undertaken in accordance with EMP and recommendations and corrective actions implemented. ▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all construction areas of the site and signed off by the MEWF Operations Manager. This will be filed on site. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**)
Responsible Person	▪ MEWF Operations Manager ▪ Environmental Officer
Associated Documentation	▪ Site design plans, SCP

7.10 Watercourse Management

Policy	To avoid degrading water quality and to minimise the impact to watercourses and the riparian environment.
Performance Objectives	▪ Minimise impacts on riparian and aquatic flora and fauna. ▪ Minimise erosion and sedimentation. ▪ Maintain existing water quality and water flow regimes. ▪ Maximise rehabilitation success of achieving long-term site stability. ▪ Prevent the spread of noxious and environmental weeds.
Management Strategies	▪ Existing crossings are to be used and no new crossings are to be constructed as part of the decommissioning stage. ▪ Watercourse crossings will ideally be at right angles to the direction of water flow to minimise scour potential. This will include vehicular and maintenance tracks. ▪ Any vegetation clearing will be kept to a minimum. Advice should be sought from the supervising botanist. ▪ Watercourse banks will be reinstated as near as possible to their former profile, stabilised and revegetated as necessary to prevent scouring. ▪ Any weed establishment is to be controlled in accordance with the methods detailed in the *Weed and Pest Management Plan* (**Appendix J**). ▪ Meteorological forecasts (e.g. BoM website) will be monitored for storm and heavy rain events and no works will occur during heavy rainfall events or when the watercourse is in flood or carrying above normal flow ▪ Stormwater diversion banks / drains (e.g. whoa-boys) are to be placed near to the top of the banks of the watercourse (refer to **Appendix L**). ▪ Additional stormwater diversion banks / drains (e.g. whoa-boys) are to be placed at a distance of 10 m back from each side of the top of the watercourse embankment. ▪ No introduced species of plants are to be used in rehabilitation of watercourse banks. Strict advice should be sought from the supervising botanist and the *Rehabilitation Plan* (**Appendix K**) ▪ Consideration will be given to the use of rock stabilisation to the channel and embankments to prevent scour. ▪ Construction of watercourse crossings will be completed promptly and with due regard to the weather. ▪ The disturbance corridor for the bed, bank and approaches to watercourses will be the narrowest practicable for safe construction. ▪ Where an access track is required through a watercourse, this should be placed on the downstream side of the pipeline to minimise the potential for future erosion over the pipeline. ▪ All large trees will be retained. If clearing of shrubs is to occur, then all rootstock will be retained for soil stabilisation of the banks. ▪ In the event of flooding, remedial action will be taken in accordance with the *Bushfire Management and Emergency Evacuation Plan* where necessary.
Performance Indicators	▪ Watercourse banks and channels effectively reinstated to prevent scouring. ▪ Watercourse flows and channel crossings not altered. ▪ Erosion and sediment control techniques implemented onsite where necessary. ▪ Water quality control maintained. ▪ Success of rehabilitation measures. ▪ Records maintained of all actions and controls.
Monitoring, Reporting and Corrective Action	▪ Photographic records ▪ Complaints Register – recorded and closed out. ▪ Daily Check Sheets – completed and reviewed by manager / supervisor. ▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all construction areas of the site and signed off by the Construction Manager. This will be filed on site. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**) ▪ Post-construction audit to be conducted annually for two years to evaluate revegetation, erosion control, weed control, watercourse integrity and success of bed and bank re-profiling.

Responsible Person	▪ Environmental Officer and Community Liaison Officer
Associated Documentation	▪ *Erosion, Sediment and Stormwater Management Plan* (**Appendix L**) ▪ *Weed* and *Pest Management Plans* (**Appendix J**)

7.11 Clean up and Rehabilitation

Policy	To restore the land to a status that is comparable to the condition of the pre-construction environmental characteristics.
Performance Objectives	▪ Minimise soil erosion ▪ WTG line stable ▪ Minimise modification of drainage patterns ▪ Minimise weed invasion ▪ Minimise visual impact ▪ Minimise adverse impacts on other land uses
Management Strategies	▪ Visual markers used to identify clearing boundaries and sensitive features, will be removed. ▪ Hollow-bearing logs and coarse woody debris are to be repositioned on decommissioned sites to provide habitat for fauna. ▪ Where ground conditions allow, compaction relief will be undertaken where required by scarifying soils along the contours. ▪ Former turbine pads will be re-profiled according to the nearest and most appropriate landform (i.e. additional slopes will not be created). ▪ Erosion and sediment control measures will be installed where necessary. Existing soil erosion measures will be reinstated to a condition at least equal to the pre-existing state. ▪ All waste materials and equipment will be removed from the site following decommissioning. ▪ Soil material is to be returned to the same general area from which it was extracted to minimise the risk of the spread of weeds, pests and diseases. ▪ Where disturbed areas are to be re-planted or re-seeded, only local provenance native species sourced from a local seed bank will be used. If direct-seeding is recommended for particular situations as detailed in the *Rehabilitation Plan* (**Appendix K**), the seed mixtures will be formulated for the conditions of the area. ▪ Where applied, seed will be evenly spread over the entire disturbed area. ▪ Direct-seeding will take place as soon as practicable during clean up and when ground conditions are most conducive to seed germination. ▪ Fertilisers and soil supplements will be used only if prescribed in the Rehabilitation Plan or approved through specific expert advice. ▪ Two monitoring sites for each Regional Ecosystem to be rehabilitated are required to be established as a benchmark from which to measure performance of rehabilitation.
Performance Indicators	▪ No new weed species introduced. ▪ Weed Management implemented. ▪ Groundcover re-established. ▪ No change in drainage pattern leading to soil erosion. ▪ Stable landforms.
Monitoring, Reporting and Corrective Action	▪ Photographic records from monitoring sites. ▪ Complaints Register – recorded and closed out ▪ Check Sheets (recorded at monitoring sites) – completed and reviewed by manager / supervisor. ▪ Environmental monitoring check sheet (**Appendix F**) to be completed by Environmental Officer monthly for all construction areas of the site and signed off by the Construction Manager. This will be filed on site. ▪ Report all incidents and near misses in the *Incident Report Protocol* (**Appendix D**). ▪ Post Construction Audits to evaluate success. ▪ Regular Easement Inspections.
Responsible Person	▪ Environmental Officer ▪ MEWF Operations Manager
Associated Documentation	▪ *Rehabilitation Plan* (**Appendix K**)

8.0 Implementation Schedule

8.1 Environmental Records

The EMP must include a timetable for implementation of all programs of works referred to in the above programs and plans. A number of environmental records are required to be documented and kept for this project (**Table 4**). They are the responsibility of the Construction Manager, Site Manager and Environmental Officers on site, however it is important for all employees to be aware of these documents.

Table 4 provides the timetable for works over the construction and operations of the MEWF project.

Table 4 Environmental Records

Document	What is it used for?	When required
Environmental Management Plan	Details control strategies to mitigate against the potential impacts to the environment as a result of the project. Plan to be amended during project to address changes in design and methodology.	Prior to works commencing
Site Specific Environmental Induction	Addresses environmental management needs and constraints applicable to the project.	Delivered to all new personnel to site
Permits, Licences and Approvals	Details which approvals have been obtained and their conditions.	Duration of project
Environmental Inspection Checklists (incl. Environment and Heritage Inspection Checklist)	Inspection of the site and controls to ensure that management measures are adequate.	Fortnightly
Induction Register	Register of all personnel that have undertaken environment and cultural heritage training and induction prior to commencement.	Ongoing
Waste Transport Certificate	Required under legislation to keep official receipts of disposed regulated and trackable wastes.	Waste collected by Contractor
Weed Hygiene Declaration Forms	Weed seed control: weed hygiene declarations are required for all plant and vehicles (subcontractors) arriving & leaving site.	Plant/Vehicles arriving & leaving site
Water Extraction Log	Record details of water extraction.	When water is being extracted
Monitoring Results Log	This will document the results of water quality monitoring i.e. pH and turbidity	Post monitoring
Audit Reports	Details compliance with contracts, systems and lists and identifies the requirements of corrective actions.	After audit has been completed
Cultural Heritage Monitor Timesheets	Document the working hours of any Cultural Heritage Monitors that work on site (use localised form).	During Monitoring
Fill Agreement	Manages the risks associated with spoiling on private property	Prior to spoiling
Project diary	Daily site inspections to verify compliance with the EMP, licences, permits and approvals and other environmental performance requirements specified within the Contract.	Daily

8.3 Implementation Schedule

Table 5 provides the schedule of works for delivery of all Environmental sub-plans under the Environmental Program.

Table 5 Implementation Schedule – Environmental Sub-plans

Task	2016	2017				2018				2019
Activity	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**
Construction and Worksite Operational Management Plan (CEMP)										
Sediment, Erosion and Stormwater Management Plan										
Hydrocarbon and Hazardous Substance Plan										
Bushfire Risk Management Plan and Emergency Evacuation Plan Ecological Fire Management Plan										
Northern Quoll (Significant Species) Management Plan										
Threatened Plant Management Plan										
Weed Management Plan										
Pest Management Plan										
Rehabilitation Plan										
Habitat Clearing and Management Plan										
Cultural Heritage Management Plan										
Environmental Management Plan Training Program										
Environmental Management Plan Reporting Program										
Northern Quoll Outcomes Strategy										
SFF/BRSF Implementation Plan										

9.0 References

Burnett, S (2016) Outcomes Strategy prepared for prepared for Ratch Australia Pty Ltd, Brisbane.

RPS Australia East (2016) Offset Area Management Plan prepared for Ratch Australia Pty Ltd, Brisbane.

10.0 Glossary

Term	Description / Definition
AADT	Annual Average Daily Traffic
Access Roads	Roads connecting public roads to the Site and the Site Roads
ACH Act	*Aboriginal Cultural Heritage Act 2003*
Aquifer	A water-saturated geologic unit that is capable of transmitting significant or usable quantities of groundwater under ordinary hydraulic gradients.
Arboreal	Living in trees.
ASL	Above Sea Level (referring to altitude).
Assembly Area	Areas on site where rotor blades are attached to the hubs prior to the installation of the complete rotor to the nacelle. The area is only relevant for the rotor assembly installation method.
ATSIHPA	*Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
Bagasse	A by-product of sugar cane
Batching plant	Operational area where concrete and other aggregated materials are prepared.
Biodiversity	Totality of genes, species, and ecosystems of a region. A contraction of biological diversity.
Biological diversity	The totality of genes, species, and ecosystems of a region.
Bioregion	An area of land that comprises broad landscape patterns that reflect major structural geologies and climate, as well as major floristic and faunal assemblages (from Sattler and Williams 1999).
Biota	All the plant and animal life of a particular region.
Buffer	Area of vegetation providing protection from disturbance.
Catchment	The term used to describe the area which is drained by a river. It is sometimes called the river basin or watershed. The catchment is the most significant factor determining the amount or likelihood of flooding.
CHMP	Cultural Heritage Management Plan
Climate Change	Any long-term significant change in the 'average weather' that a given region experiences. Average weather may include average temperature, precipitation and wind patterns. It involves changes in the variability or average state of the atmosphere over durations ranging from decades to millions of years.
Community	A number of definitions depending on the context: a) Used to describe that stakeholder group which is comprised of both individual community members and community groups. Community groups are regarded as members of the public or a group of citizens that have united to form an identifiable group, due to a common interest (as defined in the Social Impact Assessment chapters). b) Group of populations of plants and animals in a given place (as defined in the terrestrial ecology chapters).
Compound for substation and control building	The base area for the site management and technicians. The area consists of restroom facilities, parking, site offices, tools and spare parts containers
Consequence	Outcome or impacts of an event. There can be more than one consequence from one event. Consequences can range from positive to negative. Consequences can be expressed qualitatively or quantitatively. Consequences are considered in relation to the achievement of objectives (*AS/NZS ISO 3100:2009 Risk management - Principles and guidelines*).
Conservation significance	Species or community listed as endangered, vulnerable, rare, near threatened or migratory under either the EPBC Act or the NC Act
Construction Area	The part of the Installation Area located at each WTG foundation position which is required for assembling the cranes and area for operating cranes, containers for lifting equipment, generator unit, working area with tools and containers etc.
Corridor	A continuous link of suitable habitat between vegetation patches allowing movement by fauna.

Term	Description / Definition
Connectivity	The connectedness between patches of suitable habitat for an individual species or group of species
Crane Hard Stand	An improved / stabilized area with a prepared surface where plant and cranes can operate, vehicles can be parked and material can be stored.
Cultural heritage	The legacy of physical artefacts and intangible attributes of a group or society that are inherited from past generations, maintained in the present and bestowed for the benefit of future generations.
Culverts	Reinforced structures (usually concrete) to provide sealed access over watercourses.
DEHP	Department of Environment and Heritage Protection (Queensland)
Development envelope	The area of the project site in which the wind farm infrastructure (turbines, hardstands, access roads, electrical cables and substation) could potentially be sited, comprising an area of approximately 57 ha.
Development footprint	The final locations of the wind farm infrastructure. This includes the infrastructure footprint - the area occupied by turbines, access tracks, substation etc. during the operational phase - and other areas that will be affected by construction (for example, cable trench easements, construction phase access track width, construction compound, crane pads) which can be rehabilitated post-construction.
DNRM	Department of Natural Resources and Mines (Queensland)
DotE	Department of the Environment (Federal)
Ecologically sustainable development	The environmental component of sustainable development. It can be achieved partially through the use of the 'precautionary principle', namely that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
Ecology	The scientific study of the distribution and abundance of life and the interactions between organisms and their environment. The environment of an organism includes physical properties, which can be described as the sum of local abiotic factors such as insolation (sunlight), climate, and geology and biotic factors, which are other organisms that share its habitat.
Economic Impact Assessment	Assessment of the measured effect on the economy of a region of an impacting agent.
Ecosystem	A natural unit consisting of all plants, animals and micro-organisms (biotic factors) in an area functioning together with all of the non-living physical (abiotic) factors of the environment.
Ecosystem function	Processes including soil formation and stabilisation, nutrient cycling, water infiltration, pollination and seed production.
Endemic	A species restricted to a particular place or region.
Environmental values	An aspect of the environment that is to be protected.
EIS	Environmental Impact Assessment -An environmental impact assessment is an assessment of the possible impacts that a proposed project may have on the environment, consisting of the environmental, social and economic aspects.
EMI	Electromagnetic Interference -is disturbance that affects an electrical circuit due to either electromagnetic induction or electromagnetic radiation emitted from an external source
EMF	An electromagnetic field is a physical field produced by electrically charged objects. It affects the behaviour of charged objects in the vicinity of the field.
EMP	Environmental Management Plan
Environmental Impacts	Impacts that could be caused to the environment when a development project is constructed; in operation or when decommissioned.
EP Act	Environmental Protection Act 1994
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
ESCP	Erosion and Sediment Control Plan
ESD	Ecologically Sustainable Development
Fauna	Animal life

Term	Description / Definition
Flora	Plant life
Geotechnical	Technologies and sciences relating to geology.
GQAL	Good Quality Agricultural Land
Gravity Foundations	A standard type of reinforced concrete slab which support the wind turbine tower by gravitational mass. Excavation is required to a depth of approximately 2.5 m.
Greenfield developments	Developments that occur on land that primarily holds natural values (e.g. remnant vegetation, forested, undeveloped with human infrastructure).
LA90	The A-weighted statistical noise level exceeded for 90% over the measurement period (normally 10min), measured in dBA.
LAeq	The A-weighted constant noise level over the time period, equivalent to the actual fluctuating noise level, measure in dBA.
Landscape	Natural and manmade features of the urban, rural or natural environment, such as vegetation, topography and land use elements.
Landscape Character Area	A distinct, recognisable and consistent pattern of elements, be it natural (soil, landform) and/or human (for example settlement and development) in the landscape that makes one landscape different from another, rather than better or worse.
Least Concern	A remnant vegetation conservation status under Queensland's *Vegetation Management Act 1999.*
Likelihood	Used as a general description of probability or frequency. Can be expressed qualitatively or quantitatively (AS/NZS ISO 3100:2009 Risk management – Principles and guidelines).
LVIA	Landscape and Visual Impact Assessment which is to assess the nature and extent of visual impacts and qualities relating to locations and proposals
MEWF	Mount Emerald Wind Farm
MNES	Matters of National Environmental Significance, as defined under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth).
Microhabitat	A small localized habitat within a larger ecosystem.
Micro-siting	Accurately positioning infrastructure in order to take advantage of least environmental impact areas and positions in otherwise constrained areas.
Moisture Conditioning	Adding water to a soil or construction medium to improve its working/forming capability.
Montane heath	A rare plant community hosting numerous important species and restricted to exposed ridges above 900 m ASL.
MSC	Mareeba Shire Council
MW	Megawatts
Nacelle	The housing for the generating components of the wind turbine. This includes the generator, gear box, drive train and brake assembly.
Narrow endemic	A species with very limited and restricted distribution, and often confined to a unique or poorly represented habitat (e.g. *Melaleuca uxorum* and montane heath on the site).
NC Act	*Nature Conservation Act 1992* (Queensland)
NC Plan	Nature Conservation (Protected Plants) Conservation Plan 2006
NTA	*Native Title Act 1993*
Offsetting	Anything that balances, counteracts, or compensates for something else; providing compensation. For example carbon offsetting is the process of reducing greenhouse gas emissions by purchasing credits from others through emissions reductions projects, or carbon trading schemes.
Of Concern	A remnant vegetation conservation status under Queensland's *Vegetation Management Act 1999.*
Potable water	Water deemed safe for human consumption/drinking.
Project site	The land within the cadastral boundaries of all properties involved with the Proposal, comprising an area of 2,422 ha.
Proponent (the)	RATCH Australia Corporation Limited (RACL)
QH Act	Queensland Heritage Act 1992

Term	Description / Definition
RACL	RATCH Australia Corporation Limited
RCA	Radio Communications Act 1992
Regional ecosystem	Vegetation communities that are consistently associated with a particular combination of geology, land form and soil in a bioregion.
Regrowth	A native vegetation community that has regrown after clearing, in which native species that would have naturally occurred within this vegetation community dominate but have not reached the height and canopy cover necessary to be regarded as remnant as defined in the Queensland *Vegetation Management Act 1999.*
Rehabilitation	Relating to mitigating the impacts caused to the environment following disturbance (e.g. removal of vegetation cover, soil profiles, natural land features)
Remnant vegetation	Vegetation which is mapped by the Queensland Department of Environment and Resource Management as being within a remnant endangered regional ecosystem, a remnant of concern regional ecosystem, or a remnant not of concern regional ecosystem map. Vegetation remaining after an area has been cleared or modified.
Revegetation	The practice of direct-seeding or planting tubestock into the ground as part of the landscape rehabilitation process.
Riparian	Any land which adjoins or directly influences or is influenced by a body of water.
Sensitivity	The relative susceptibility to adverse impacts to environments.
Soil profiles	The 'layers' of soil as they are viewed in a vertical projection.
SPA	Sustainable Planning Act 2009 (Queensland)
SPP	State Planning Policy (Queensland)
Sustainable Development	Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Table drains	An erosion and sediment control measure - a flat-bottomed drain constructed adjacent to a road or track to slow down water velocity and reduce the rate of soil erosion, as well as capture transported soil.
Topographical	Relating to the various types of landform and features (e.g. mountains, ridges, watercourses).
TRC	Tablelands Regional Council
Turbine Footing	The stable horizontal platform for the towers sections and elements to be mounted. Foundations will be of either a gravity or rock-anchor type, depending on the geotechnical conditions at each wind turbine site.
Visual impact	Measure of a joint consideration of both visual sensitivity and visual effect that considered together determines the visual impact of a development.
VMA	*Vegetation Management Act 1999* (Queensland)
vpd	Vehicles per day
Weeds	Plant species that invade native ecosystems and can adversely affect the survival of indigenous flora and fauna. . A species not native to Australia. Sometimes referred to as naturalised species.
WTG	Wind Turbine Generator(s) - A wind turbine is a device that converts kinetic energy from the wind into electrical power.
WTWHA	Wet Tropics World Heritage Area - The Wet Tropics of Queensland World Heritage Site consists of approximately 8,940 km² of Australian wet tropical forests growing along the north-east Queensland portion of the Great Dividing Range.

Appendix A

Condition 13 of the Ministerial Decision Notice

Queensland Government

Deputy Premier
Minister for Infrastructure, Local Government and Planning
and Minister for Trade and Investment

Our ref: MC15/4675

Level 12 Executive Building
100 George Street
PO Box 15009 City East
Queensland 4002 Australia
Telephone +61 7 3719 7100
Email deputy.premier@ministerial.qld.gov.au

18 DEC 2015

Mr Anil Nangia
Mount Emerald Wind Farm Pty Ltd
c/- Ratch-Australia Corporation
Level 4, 231 George Street
BRISBANE QLD 4000
Email: anil.nangia@ratchaustralia.com

Dear Mr Nangia

Notice of Decision on Permissible Change Request
Changed approval (responsible entity) under Section 369 of the *Sustainable Planning Act 2009*

Thank you for your letter of 25 August 2015, and for your email correspondence dated 10, 11, 14, 15 and 18 December 2015, on behalf of the applicant Mount Emerald Wind Farm Pty Ltd, requesting a permissible change to a development approval dated 24 April 2015, subject of a previous ministerial call in for the Mount Emerald Wind Farm at Arriga.

I acknowledge that the decision period for the request to change the development approval was extended until 24 December 2015 under section 375(5) of the *Sustainable Planning Act 2009* (the SPA) with your written agreement.

I am pleased to advise that I have approved the requested changes. The approved changes are shown in bold in the attached decision notice for the original application dated 24 April 2015.

Applicant details

Applicant name:	Mount Emerald Wind Farm Pty Ltd
Applicant contact details:	c/- Ratch-Australia Corporation Level 4, 231 George Street BRISBANE QLD 4000

Application details

Original assessment manager:	Mareeba Shire Council
Date application properly made:	29 March 2012
Original approval sought:	Development permit for a material change of use for a wind farm comprising a maximum of 75 turbines
Description of development:	Wind farm
Category of development:	Code assessment

Property details

Real property description:	Lot 7 on SP235244, part of Lot 905 on CP896501 and Easement A in Lot 1, Easement C in Lot 2 and Easement E in Lot 3 on SP231871
Address of property:	Springmount Road and Kippin Drive, Arriga

Ministerial call in details

Date call in notice given:	11 June 2014
Date of decision:	24 April 2015
Details of decision:	Approved, subject to conditions
Type of approval:	Development permit for a material change of use for a wind farm comprising a maximum of 63 turbines

Request to change approval

Date request was properly made:	31 August 2015
Description of requested changes:	1. amend conditions 3, 4, 5, 6 and 11 – to reference existing 'and approved' dwellings and sensitive land uses 'at the date of this approval' 2. amend conditions 4 and 5 - to amend acoustic requirements to clarify the intent of the condition 3. amend condition 6 - to facilitate compliance and monitoring of the acoustic requirements for the wind farm 4. amend condition 7 – to amend the modelling of the shadow flicker to '30 hours per annum and 30 minutes per day' 5. amend the numbering within condition 12 6. amend condition 14 – to amend the timing for the submission of the Community Engagement Strategy from three months prior to 'consultation' to 'five' months prior to 'construction' 7. amend the advice statement in relation to the Significant Species Management Plans to remove specific reference to the Mareeba Rock Wallaby.
Date of Decision:	18 December 2015
Details of decision:	Approved

Nature of the changes

The nature of the approved changes are to:

1. Amend condition 3 (a) (ii) as follows:
   ii. All turbines must be setback a minimum of 1,500 metres from any existing and approved dwelling at the date of this approval;
2. Amend condition 4 as follows:
   The wind farm development must be designed and operated to ensure that:
   (a) The outdoor night-time equivalent noise level ($L_{Aeq,\ 10\ minutes}$) at during the night-time (10pm to 6am) at existing and approved sensitive land uses at the date of this approval, does not exceed the higher of:
   (i) 35dB(A); or
   (ii) the background noise level (L_{A90}) plus 5dB(A);
   and
   (b) The outdoor day-time equivalent noise level ($L_{Aeq\ ,10\ minutes}$) at existing and approved sensitive land uses at the date of this approval, does not exceed the higher of:
   (i) 37dB(A) ; or
   (ii) the background noise level (LA90) plus 5dB(A).
   (c) The equivalent noise levels (L_{Aeq}) are to be assessed at all existing and approved sensitive land uses at the date of this approval for all integer hub height wind speeds from cut-in to rated power of the wind turbine generator.
   (d) Measurements of background noise or operational noise from wind turbine generators for the operation shall be in accordance with Australian Standard AS4959-2010 Acoustics – Measurement, prediction and assessment of noise from wind turbine generators (AS4959-2010) at any existing and approved sensitive land uses at the date of this approval. If an alternative standard or guideline to AS4959-2010 is to be followed for the assessment of Special Audible Characteristics, then reasons for the selection of the alternative are to be provided.
3. Amend condition 5 as follows:
   The wind farm development must be designed and operated to ensure that that the low frequency noise level does not exceed:
   (a) 60dB(C) for the outdoor C-Weighted equivalent noise level ($L_{Ceq,\ 10\ minutes}$) during the outdoor night-time (10pm to 6am); and
   (b) 65dB(C) for the outdoor C-Weighted equivalent noise level ($L_{Ceq,\ 10\ minutes}$) during the day-time (6am to 10pm).
   The C-Weighted noise levels (LCeq) are to be assessed at all existing and approved sensitive land uses at the date of this approval for all integer hub height wind speeds from cut-in to rated power of the wind turbine generator.
   Measurements operational noise from wind turbine generators for the operation shall be in accordance with Australian Standard AS4959-2010 Acoustics – Measurement, prediction and assessment of noise from wind turbine generators at any existing and approved sensitive land uses at the date of this approval.
4. Amend condition 6 as follows:
   (a) Submit to the chief executive administering SPA a revised noise assessment report, certified by a suitably qualified acoustic consultant, demonstrating that the proposed wind farm can meet the noise levels specified in conditions 4 and 5 of this approval. The report is to:
   (i) Model the acoustic impacts of the wind farm based on the revised Turbine Location and Development Footprint Plan submitted in accordance with condition 2 of this approval.
   The noise modelling should take into account the varied topography between the turbine locations and existing and approved sensitive land use receptors at the date of this approval and any impacts that may have on predicted noise levels, and include an assessment of Special Audible Characteristics including tonality, impulsivity and amplitude modulation.

(ii) *Identify any design specifications or operational restrictions that may be necessary to ensure compliance with the noise levels specified in conditions 4 and 5, such as turbine types or limitations on hours of operation of specific turbines.*

(b) *Submit to the chief executive administering SPA a compliance noise assessment report, certified by a suitably qualified acoustic consultant, demonstrating that the proposed wind farm meets the noise levels specified in conditions 4 and 5 of this approval. The report is to:*

(i) *Measure the acoustic impacts of the wind farm based on the final Turbine Location and Development Footprint Plan submitted in accordance with condition 2 of this approval.*
The noise measurements should take into account the turbine locations and any existing and approved sensitive land use receptors at the date of this approval; and include an assessment of Special Audible Characteristics including tonality, impulsivity and amplitude modulation. Assessment of Special Audible Characteristics should be carried out using an appropriate international standard or guideline. Reasons for selection of the standard or guideline are to be provided with the noise assessment report. The assessment should determine whether the Special Audible Characteristics are excessive and require an adverse character adjustment (adj) to specific measurement period.

5. Amend the timing of condition 6 as follows:
   (a) *Prior to the commencement of site / operational / building work*
   (b) *Within twelve (12) months of the completion of construction and then to be maintained.*
6. Amend condition 7 as follows:
   (a) *Submit to the chief executive administering SPA a revised shadow flicker assessment report certified by a suitably qualified and experienced person demonstrating that the shadow flicker from the turbines will not exceed 10 hours per annum at any dwelling existing at the date of this approval.*
   The report is to model the shadow flicker of the wind farm, based on the revised Turbine Location and Development Footprint Plan submitted in accordance with condition 2 of this approval.
   (b) *The wind farm is to be constructed and operated in accordance with the revised shadow flicker assessment report required in part (a) of this condition. In particular any design specifications or operational restrictions required to ensure that shadow flicker from the constructed turbines does not exceed 30 hours per annum and 30 minutes per day at any dwelling existing at the date of this approval.*
7. Amend condition 11 as follows:
   (a) *Undertake an assessment of the television and radio reception strength in the area within 5 km of any proposed turbine and in which any existing and approved dwellings are located as at the date of this approval.*
   The pre-construction assessment must be undertaken by a television and radio monitoring specialist, and include testing at selected locations to enable the average television and radio reception strength in the area within 5 km of the site to be determined. The specific locations of testing must be determined by a television and radio monitoring specialist.
   (b) *If, following commencement of the operation of the wind farm, a complaint is received regarding the wind farm having an adverse effect on television or radio reception at any existing and approved dwelling within 5 km of the site which existed at the date of this approval, a post-construction assessment of the television and radio reception strength must be carried out at or in close proximity to any existing and approved dwelling at the date of this approval by a television and radio monitoring specialist.*
   (c) *If the post-construction assessment establishes an unacceptable increase in interference to reception as a result of the wind farm, measures to restore the affected reception to pre-construction quality must be undertaken.*

(d) *Provide to the chief executive administering SPA, on request, the results of the pre-construction assessment and any post-construction assessment carried out in response to a complaint and evidence that the appropriate restoration measures have been undertaken to address television and radio reception strength where required.*

8. Amend the numbering within condition 12(a) as follows:
   (i) an existing conditions survey of Hansen Road, Springmount Road and Kippen *Drive including details of the suitability, design, condition and construction standard of the relevant public roads;*
   (ii) *the designation of all vehicle access points to the site from surrounding roads. Vehicle access points must be designed and located to ensure safe sight distances, turning movements, and avoid potential through traffic conflicts;*
   (iii) *the designation of appropriate pre-construction, construction/decommissioning and transport vehicle routes to and from the site;*
   (iv) *engineering plans demonstrating whether, and if so how, truck movements to and from the site can be accommodated on sealed roadways and turned without encroaching onto the incorrect side of the road;*
   (v) *recommendations regarding the need for road and intersection upgrades to accommodate any additional traffic or site access requirements (whether temporary or ongoing). Where upgrades are required, the traffic management plan must include:*
      (a) detailed engineering plans showing the required works;
      (b) the timing of when the works are to be undertaken;
      (c) a program of regular inspections to be carried out during the construction of the wind farm to identify maintenance works necessary as a result of construction traffic;
9. Amend the timing on condition 14 as follows:
   (a) Five (5) months prior to construction commencing
10. Amend aspects detailed in the advice statements – Attachment 1 – Components of the Environmental Management Plan, to read as follows:

Significant species management plans

Significant species management plans must:

(a) include plans for all wildlife species listed as Endangered, Vulnerable or Near Threatened under the provisions of the Nature Conservation Act 1992 that:
   (i) are currently known to occur within or periodically utilise the site; or
   (ii) are detected within the site during the conduct of further baseline, construction or operational monitoring pursuant to other conditions; and
   (iii) are not the subject of an equivalent management plan prepared in satisfaction of an approval issued under the provisions of the Environment Protection and Biodiversity Conservation Act 1999 (Cth).

(b) set out key impact management strategies including:
   (i) further baseline programs;
   (ii) management targets;
   (iii) design, construction and operational impact avoidance and mitigation measures and protocols;
   (iv) quantitative performance indicators;
   (v) monitoring and reporting regimes;
   (vi) corrective actions;
   (vii) timeframes for identified actions; and
   (viii) applicant and stakeholder responsibilities.

Referral Agencies

Section 372 of the SPA requires that when a person makes a request to change the development approval, the person must give a copy of the request to the original assessment manager and any concurrence agencies for the original development application as the relevant entities.

Mareeba Shire Council and the Department of Infrastructure, Local Government and Planning, in its capacity as the State Assessment and Referral Agency, have provided responses as relevant entities to the request for the permissible change to the development approval.

Conditions of approval

The conditions of this approval are set out in the decision notice for the original application, with the approved changes shown in bold.

Appeal rights

A person may not appeal against the Minister's decision (section 427(5) of the SPA).

If you require any further information, I encourage you to contact Mr Adam Yem, Acting Executive Director, Planning Group, Department of Infrastructure, Local Government and Planning on 3452 7679 or Ministerial.Callin@dilgp.qld.gov.au.

Yours sincerely

JACKIE TRAD MP
DEPUTY PREMIER
Minister for Infrastructure, Local Government and Planning
and Minister for Trade and Investment

Enc (3)

QUEENSLAND GOVERNMENT

Hon Jackie Trad MP
Deputy Premier
Minister for Transport, Minister for Infrastructure,
Local Government and Planning and Minister for Trade

Our ref: MBN14/753

24 April 2015

Mr Geoff Dutton
Mount Emerald Wind Farm Pty Ltd
c/- RATCH Australia
Level 4, 231 George Street
BRISBANE QLD 4000
Email: Geoff.Dutton@ratchaustralia.com

Dear Mr Dutton

DECISION NOTICE
Ministerial Call In of Development Application
Mount Emerald Wind Farm, Arriga

I refer to the then Deputy Premier, Minister for State Development, Infrastructure and Planning's decision on 11 June 2014 to exercise ministerial call in powers under the *Sustainable Planning Act 2009* (SPA) to call in the development application for the Mount Emerald Wind Farm, Arriga.

Please be advised that on 24 April 2015, I decided to approve the development application subject to conditions.

Applicant details	
Name of applicant:	Mount Emerald Wind Farm Pty Ltd
Address of applicant:	c/- RATCH Australia Level 4, 231 George Street BRISBANE QLD 4000
Application details	
Original assessment manager:	Mareeba Shire Council
Date application properly made:	29 March 2012
Approvals sought:	Development Permit for a Material Change of Use for a Wind Farm comprising a maximum of 63 turbines
Description of development:	Wind Farm comprising a maximum of 63 turbines and ancillary infrastructure
Category of development:	Code Assessment
Property details	
Real property description ("the site"):	Lot 7 on SP235244, part of Lot 905 on CP896501 and Easement A in Lot 1, Easement C in Lot 2 and Easement E in Lot 3 on SP231871
Address of property:	Springmount Road and Kippin Drive, Arriga

Level 12 Executive Building
100 George Street Brisbane
PO Box 15009 City East
Queensland 4002 Australia
Telephone +61 7 3719 7100
Email deputy.premier@ministerial.qld.gov.au

Ministerial call in details	
Date call in notice given:	11 June 2014
I assessed and decided the development application under the normal assessment and decision provisions under SPA.	
Date of decision:	**24 April 2015**
Details of decision:	Approved subject to conditions
Type of approval:	Development Permit for a Material Change of Use for a Wind Farm comprising a maximum of 63 turbines

Referral Agencies
The following agencies were referral agencies for the development application. As a result of the decision to call in the development application under section 425(1) of SPA, a concurrence agency for the development application is taken to be an advice agency until I give the decision notice (section 427(4) of SPA).

Referral agency name at the time of lodgement	Referral agency	Address	Advice or concurrence
Department of Environment and Resource Management	Department of Environment and Heritage Protection	GPO Box 2454 BRISBANE QLD 4001	Advice and Concurrence
	Department of Natural Resources and Mines	PO Box 15216 CITY EAST QLD 4002	Concurrence
Powerlink	Powerlink	PO Box 1193 VIRGINIA QLD 4014	Advice

Further to this, third party advice was also received from the following agencies:

Agency	Address
Queensland Health	GPO Box 48 BRISBANE QLD 4001
Mareeba Shire Council	PO Box 154 MAREEBA QLD 4880
Tablelands Regional Council	PO Box 573 ATHERTON QLD 4883

Approval despite conflict with the planning scheme

I consider that this decision conflicts with the Rural Zone Code in the *Mareeba Shire Planning Scheme 2004* and Overall Outcome (e) in the *Temporary Local Planning Instrument 01/11 (Wind Farms)* (TLPI 01/11).

However, there are sufficient grounds to approve the Mount Emerald Wind Farm development application despite the conflict. These grounds are:

- Parts of the Mareeba Shire Planning Scheme 2004 are out of date in regards to its policy position on wind farms. A shift in planning requirements, through the former TLPI 01/11 (Wind Farms) and TLPI 01/12 (Wind Farms), which is now included within the planning scheme as Amendment 01/11 – Wind Farms, expresses the revised policy position. The Mareeba Shire Planning Scheme 2004 has not yet incorporated all of the appropriate changes to align with these new requirements.

- The Far North Queensland Regional Plan 2009-2031 recognises wind farms as legitimate land use and emphasis is placed on promoting renewable energy. The Far North Queensland Regional Plan is not appropriately reflected in the Mareeba Planning Scheme and is a higher-order planning instrument.

I also consider that the conflict arises because of a conflict between two or more relevant instruments being the Mareeba Shire Planning Scheme and the TLPI 01/11 and later the Amendment 01/11 and the decision best achieves the purpose of the instrument.

Approval subject to conditions

The conditions of this approval are set out in Schedules 1 and 2, attached.

Other development permits and compliance permits

Listed below are other development permits and/or compliance permits that are necessary to allow the development to be carried out:

- building works
- plumbing and drainage works
- operational works.

Codes for self-assessable development

Nil.

Details of any compliance assessment required for documents or work in relation to the development

Nil.

Deemed approval of applications

As a result of the decision to call in and assess and decide the development application, chapter 6, part 5, division 3, subdivision 4 of SPA does not apply to the development application (section 427(7) of SPA).

The application is not taken to have been approved under section 331 of SPA.

When approval lapses if development not started

This development approval will lapse as per section 341 of SPA.

Referenced plans

Copies of the approved plans and documents are set out in Schedule 2.

Appeal rights

A person may not appeal against the Minister's decision (section 427(5) of SPA).

If you require any further assistance, please email: ministerial_call_in@dsdip.qld.gov.au.

Yours sincerely

JACKIE TRAD MP
DEPUTY PREMIER
Minister for Transport, Minister for Infrastructure,
Local Government and Planning and Minister for Trade

Enc (2)

Schedule 1: Conditions of Approval
Development Permit for a Material Change of Use – Code Assessment

<table>
<tr><th>Condition</th><th>Timing</th></tr>
<tr><td colspan="2">General / Planning Requirements</td></tr>
<tr><td>1.</td><td>Undertake the development generally in accordance with the approved plans and documents referred to in Table 1, as modified by the conditions of this approval.
<table>
<tr><th colspan="3">Table 1: Approved Plans and Documents</th></tr>
<tr><th>Plan/Document number</th><th>Plan/Document name</th><th>Date</th></tr>
<tr><td>PR100246-170 Issue A</td><td>Mount Emerald Wind Farm Turbine Location and Development Footprint</td><td>18-11-2013</td></tr>
<tr><td>Appendix A</td><td>Statement of Commitments in RPS Development Application Material Change of Use Report</td><td>March 2012</td></tr>
<tr><td>PR100246/R72893</td><td>Preliminary Environmental Management Plan</td><td>November 2013</td></tr>
<tr><td>CB24504 Rev 1</td><td>Technical Note 2 – Traffic Impact Assessment Engineering Response prepared by Jacobs</td><td>29/08/2014</td></tr>
</table></td><td>While site / operational / building work is occurring and then to be maintained</td></tr>
</table>

Location and Design		
2.	Submit to the chief executive administering SPA, a revised Turbine Location and Development Footprint Plan identifying the final position of: • all proposed turbines; and • the operations and maintenance depots *Note: Micro-siting of turbines, prior to the submission of the above mentioned reports, is permitted.* *Micro-siting means an alteration to the siting of a turbine by not more than 100 metres beyond the siting of turbines identified in approved plan Mount Emerald Wind Farm Turbine Location and Development Footprint PR100246-170 Issue A, dated 18-11-2013.*	Prior to seeking approval for any site, operational or building work
3.	(a) The wind farm must be designed and constructed in accordance with the following: i. The maximum number of turbines must not exceed 63; ii. **All turbines must be setback a minimum of 1,500 metres from any existing and approved dwelling at the date of this approval;** iii. All turbines and the operations and maintenance depot are to be located in accordance with the revised Turbine Location and Development Footprint Plan required by condition 2 of this approval; iv. The overall maximum height of any turbine (measured to the tip of the rotor blade at their highest point above ground level) must not exceed 1179.5 metres AHD; v. The hub height of any turbine must not exceed 90 metres above ground level; vi. All cabling must be provided underground, except where the approved Environmental Management Plan recommends an alternative method in environmentally sensitive locations.	**(a)** Prior to the commencement of use and then to be maintained
	(b) Submit certification to the chief executive administering SPA from an Registered Professional	**(b)** Prior to the commencement of use

	Engineer Queensland (RPEQ) that the wind farm as constructed complies with the design specifications indicated in part (a) of this condition.	
Acoustic Amenity		
4.	The wind farm development must be designed and operated to ensure that: **(a) The outdoor night-time (10pm to 6am) equivalent noise level ($L_{Aeq,10\ minutes}$) at existing and approved sensitive land uses at the date of this approval, does not exceed the higher of:** (i) 35dB(A); or **(ii) the background noise level (L_{A90}) plus 5dB(A);** **and** **(b) The outdoor day-time equivalent noise level ($L_{Aeq,10\ minutes}$) at existing and approved sensitive land uses at the date of this approval, does not exceed the higher of:** (i) 37dB(A) ; or **(ii) the background noise level (L_{A90}) plus 5dB(A).** **(c) The equivalent noise levels (L_{Aeq}) are to be assessed at all existing and approved sensitive land uses at the date of this approval for all integer hub height wind speeds from cut-in to rated power of the wind turbine generator.** **(d) Measurements of background noise or operational noise from wind turbine generators for the operation shall be in accordance with Australian Standard *AS4959-2010 Acoustics – Measurement, prediction and assessment of noise from wind turbine generators* (AS4959-2010) at any existing and approved sensitive land uses at the date of this approval. If an alternative standard or guideline to AS4959-2010 is to be followed for the assessment of Special Audible Characteristics, then reasons for the selection of the alternative are to be provided.**	Prior to the commencement of use and then to be maintained

5.	The wind farm development must be designed and operated to ensure that that the low frequency noise level does not exceed: **(a) 60dB(C) for the outdoor C-Weighted equivalent noise level ($L_{Ceq, 10\ minutes}$) during the outdoor night-time (10pm to 6am); and** **(b) 65dB(C) for the outdoor C-Weighted equivalent noise level ($L_{Ceq, 10\ minutes}$) during the day-time (6am to 10pm).** **The C-Weighted noise levels (L_{Ceq}) are to be assessed at all existing and approved sensitive land uses at the date of this approval for all integer hub height wind speeds from cut-in to rated power of the wind turbine generator.** **Measurements of operational noise from wind turbine generators for the operation shall be in accordance with Australian Standard AS4959-2010 *Acoustics – Measurement, prediction and assessment of noise from wind turbine generators* at any existing and approved sensitive land uses at the date of this approval.**	Prior to the commencement of use and then to be maintained
6.	(a) Submit to the chief executive administering the SPA a revised noise assessment report, certified by a suitably qualified acoustic **consultant,** demonstrating that the proposed wind farm can meet the noise levels specified in conditions 4 and 5 of this approval. The report is to: i. Model the acoustic impacts of the wind farm based on the revised Turbine Location and Development Footprint Plan submitted in accordance with condition 2 of this approval. **The noise modelling should take into account the varied topography between the turbine locations and existing and approved sensitive land use receptors at the date of this approval and any impacts that may have on predicted noise levels, and include an assessment of Special Audible Characteristics including tonality, impulsivity and amplitude modulation.** ii. Identify any design specifications or operational restrictions that may be necessary to ensure compliance with the noise levels specified in conditions 4 and 5, such as turbine types or limitations on hours of operation of specific turbines.	(a) Prior to the commencement of site / operational / building work

	(b) Submit to the chief executive administering the SPA a compliance noise assessment report, certified by a suitably qualified acoustic consultant, demonstrating that the proposed wind farm meets the noise levels specified in conditions 4 and 5 of this approval. The report is to: **i. Measure the acoustic impacts of the wind farm based on the final Turbine Location and Development Footprint Plan submitted in accordance with condition 2 of this approval.** **The noise measurements should take into account the turbine locations and any existing and approved sensitive land use receptors at the date of this approval; and include an assessment of Special Audible Characteristics including tonality, impulsivity and amplitude modulation. Assessment of Special Audible Characteristics should be carried out using an appropriate international standard or guideline. Reasons for selection of the standard or guideline are to be provided with the noise assessment report. The assessment should determine whether the Special Audible Characteristics are excessive and require an adverse character adjustment (adj) to specific measurement period.**	**(b) Within twelve (12) months of the completion of construction and then to be maintained**
Visual Amenity		
7.	(a) Submit to the chief executive administering SPA a revised shadow flicker assessment report certified by a suitably qualified and experienced person demonstrating that the shadow flicker from the turbines will not exceed 10 hours per annum at any dwelling existing at the date of this approval. The report is to model the shadow flicker of the wind farm, based on the revised Turbine Location and Development Footprint Plan submitted in accordance with condition 2 of this approval. (b) The wind farm is to be constructed and operated in accordance with the revised shadow flicker assessment report required in part (a) of this condition. **In particular, any design specifications or operational restrictions required to ensure that shadow flicker from the constructed turbines does not exceed 30 hours per annum and 30 minutes per day at any dwelling existing at the date of this approval.**	(a) Prior to seeking approval for any site, operational or building work (b) Prior to the commencement of use and then to be maintained

8.	The turbines and blades must have a low reflectivity finish.	Prior to the commencement of use and to be maintained
9.	External lighting of infrastructure associated with the wind farm is not permitted other than: (a) low-level, low-intensity security lighting; (b) aviation obstacle lighting where required by the Civil Aviation and Safety Authority; (c) lighting necessary in the case of an emergency or for operational call-outs at reasonable times. Any external lighting, excluding aviation obstacle lights, is to comply with Australian Standard *AS 4282-1993 Control of the obtrusive effects of outdoor lighting*.	Prior to the commencement of use and to be maintained
10.	(a) Submit to the chief executive administering the SPA an on-site landscaping plan prepared by a suitably qualified landscape architect. The plans must be fully dimensioned and drawn to a recognised scale. (b) The on-site landscaping plan must include but not limited to: (i) landscaping to screen the substation, switchyard and maintenance depots and other associated buildings (excluding the turbines); (ii) details of plant species proposed to be used in the landscaping, including height and spread at maturity; (iii) a timetable for implementation of all on-site landscaping works; (iv) a maintenance and monitoring program to ensure the ongoing health of the landscaping. (c) Carry out and maintain the development in accordance with the submitted on-site landscaping plan prepared in accordance with part (a) of this condition. (d) Submit certification to the chief executive from a suitably qualified landscape architect that the works have been carried out in accordance with part (a) of this condition.	(a) Prior to the commencement of site / operational / building work (b) Prior to the commencement of use and to be maintained at all times (c) Prior to the commencement of use (d) Prior to the commencement of use

Television and Radio Reception		
11.	(a) **Undertake an assessment of the television and radio reception strength in the area within 5 km of any proposed turbine and in which any existing and approved dwellings are located as at the date of this approval.** The pre-construction assessment must be undertaken by a television and radio monitoring specialist, and include testing at selected locations to enable the average television and radio reception strength in the area within 5 km of the site to be determined. The specific locations of testing must be determined by a television and radio monitoring specialist.	(a) Prior to the commencement of site / operational / building work
	(b) **If, following commencement of the operation of the wind farm, a complaint is received regarding the wind farm having an adverse effect on television or radio reception at any existing and approved dwelling within 5 km of the site which existed at the date of this approval, a post-construction assessment of the television and radio reception strength must be carried out at, or in close proximity to, any existing and approved dwelling at the date of this approval by a television and radio monitoring specialist.**	(b) Within one (1) month of receiving a complaint
	(c) If the post-construction assessment establishes an unacceptable increase in interference to reception as a result of the wind farm, measures to restore the affected reception to pre-construction quality must be undertaken.	(c) Within two (2) months of the post-construction assessment
	(d) Provide to the chief executive administering the SPA, on request, the results of the pre-construction assessment and any post-construction assessment carried out in response to a complaint and evidence that the appropriate restoration measures have been undertaken to address television and radio reception strength where required.	(d) Within (2) months of the post-construction assessment
Traffic Management		
12.	(a) Submit to the chief executive administering the SPA a Construction Traffic Management Plan (CTMP) prepared by an RPEQ and in consultation with the Department of Transport and Main Roads, Cairns Regional Council, Tablelands Regional Council and	(a) Prior to the commencement of site / operational / building work

	Mareeba Shire Council. The CTMP must relate to the roads proposed to be used in transporting material, personnel and equipment related to the construction and decommissioning of the wind farm. The CTMP must include but not limited to: **(i) an existing conditions survey of Hansen Road, Springmount Road and Kippen Drive including details of the suitability, design, condition and construction standard of the relevant public roads;** **(ii) the designation of all vehicle access points to the site from surrounding roads. Vehicle access points must be designed and located to ensure safe sight distances, turning movements, and avoid potential through traffic conflicts;** **(iii) the designation of appropriate pre-construction, construction/decommissioning and transport vehicle routes to and from the site;** **(iv) engineering plans demonstrating whether, and if so how, truck movements to and from the site can be accommodated on sealed roadways and turned without encroaching onto the incorrect side of the road;** **(v) recommendations regarding the need for road and intersection upgrades to accommodate any additional traffic or site access requirements (whether temporary or ongoing). Where upgrades are required, the traffic management plan must include:** (a) detailed engineering plans showing the required works; (b) the timing of when the works are to be undertaken; (c) a program of regular inspections to be carried out during the construction of the wind farm to identify maintenance works necessary as a result of construction traffic; (vi) measures to be taken to manage traffic impacts	

	associated with the ongoing operation of the wind farm on the traffic volumes and flows on surrounding roads. This may include, as recommended in the "Technical Note 2 – Traffic Impact Assessment Engineering Response" prepared by Jacobs dated 29/08/14: a) providing a 30 seat shuttle bus service for construction workers arriving and departing the site, servicing the key townships where the construction workers live; b) providing minimal or restricted on-site parking to discourage workers arriving to and departing the site via private vehicles (vii) a program to rehabilitate Hansen Road, Springmount Road and Kippen Drive to the pre-construction condition identified by the surveys required under sub-section (a) of this condition, at the conclusion of the construction of the wind farm. (b) Carry out the development in accordance with the CTMP. (c) Submit to the chief executive administering SPA certification from an RPEQ that all works identified in the CTMP have been carried out in accordance with the CTMP.	(b) In accordance with the timeframes specified in the CTMP (c) Within three (3) months of the completion of construction
Environmental Management		
13.	(a) Submit to the chief executive administering the SPA an Environmental Management Plan (EMP) prepared by a suitably qualified person(s). The EMP must: i. be generally in accordance with the Preliminary Environmental Management Plan prepared by RPS and dated November 2013 and the draft Statement of Commitments contained within Appendix A of the RPS Development Application Material Change of Use Report dated March 2012;	(a) Prior to seeking approval for any site, operational or building work

	ii. be based on the revised Turbine Location and Development Footprint Plan submitted in accordance with condition 2 of this approval; iii. include the following components, as further detailed in Attachment 1: • a construction and work site operational management plan • a sediment, erosion and storm water management plan • a hydrocarbon and hazardous substances plan • a bushfire risk management plan and emergency evacuation plan • a significant species management plan • a weed and pest management plan • a rehabilitation plan • a habitat clearing and management plan • an ecological fire management plan • a cultural heritage management plan • an environmental management plan training program • an environmental management plan reporting program • an implementation plan (b) The development must be carried out in accordance with the EMP.	(b) During site / operational /building work and to be maintained
Community Engagement		
14.	(a) Submit to the chief executive administering SPA a Community Engagement Strategy (CES) that includes at a minimum: (i) A Community Consultation Plan that demonstrates and includes:	(a) **Five (5) months prior to construction commencing**

	a. consultation methods b. consultation calendar that identifies activities that must be carried out at least on a quarterly basis and during: • three (3) months prior to construction commencing • during construction • once operational for at least one year from the commencement of stage 1 (ii) A Complaints Management Plan / Register (CMPR) that demonstrates and includes: a. how contact details will be communicated to the public b. a toll free telephone number and email contact for complaints and queries c. a register outlining complaint information for each complaint received d. the processes for investigation and actions undertaken to resolve the complaint (b) All community consultation and complaints must be managed in accordance with the CES. (c) Provide to the chief executive administering SPA and Council, on request, a copy of the CMPR, in particular the processes of investigation and actions undertaken to resolve the complaint.	(b) - (c) Prior to construction / during construction and once operational
Decommissioning and Rehabilitation		
15.	Submit to the chief executive administering SPA a decommissioning and rehabilitation plan prepared by a suitably qualified person(s). The decommissioning and rehabilitation plan must address the actions to be undertaken where any or all turbines have permanently ceased to generate electricity. The plan must include a program for: (a) removal of above ground non-operational equipment; (b) removal and clean up any residual contamination; (c) rehabilitation/revegetation of storage areas, construction areas, access tracks and other areas affected by the decommissioning of the turbines, if those areas are not otherwise useful to the on-going	Prior to decommissioning

	use or decommissioning of the wind farm; (d) notification to the relevant authorities of the turbines ceasing operation. Such notification should be given no later than two months after the turbine(s) cease operation.	

General advice	
a.	This development permit does not constitute an approval to commence operational works within Powerlink easements. Prior written approval is required from Powerlink before any additional operational work is undertaken within the easement areas. All additional operational works within the easements will require separate assessment and approval by Powerlink.
b.	Development must comply with the *Electrical Safety Act 2002* including any Code of Practice under that Act and the Electrical Safety Regulation 2002 including any safety exclusion zones defined in the Regulation.
c.	In respect to this application the exclusion zone for untrained persons and for operating plant operated by untrained persons is 6 metres from the 275,000 volt wires and exposed electrical parts. Should any doubt exist in maintaining the prescribed clearance to the conductors and electrical infrastructure, then the applicant is obliged under the *Electrical Safety Act 2002* to seek advice from Powerlink.
d.	Any works must comply with the easement terms and conditions as per easement Dealing 701758510 and 713030213
e.	Engagement must occur with Powerlink with regards to a connection to Powerlink's transmission line network. Further technical assessments regarding safe clearance between turbines and Powerlink infrastructure will have to be performed and must be submitted to Powerlink for approval.
f.	Works in the vicinity of Powerlink infrastructure must comply with the Management of Easement Co-Use Requests Guideline.
g.	The site has slight residual risk of unexploded ordnance (UXO). In the event of identification of UXO, the Department of Defence recommends the following procedure: • do not touch or disturb the object; • take action, where appropriate, to prevent it being disturbed by another person; • note its approximate dimensions and general appearance; • note the route to its location; and • advise the Police as soon as possible.

h.	Copies of the final development plans must be provided to the following entities, to enable details of the development to be shown on aeronautical charts of the area: • the Civil Aviation Safety Authority; • the Department of Defence (RAAF Aeronautical Information Service); • Airservices Australia; • any aerodrome operator within 15 km of the outside property boundaries of the site; • the Aerial Agriculture Association of Australia; • any organisation responsible for providing air ambulance services in the area.

Attachment 1 – Components of the Environmental Management Plan

Construction and work site operational management plan

The environmental management plan must include a construction and work site operational management plan.

The construction and work site operational management plan must include:

a) the identification of fuels, other hazardous materials and all other potential contaminants stored or used on site during the construction phase of the wind farm, and appropriate storage, construction and operational methods to control any identified contamination risks;

b) procedures for managing potential spills and leaks and pollution incidents, including incorporation of appropriate pollution control;

c) procedures to suppress dust emissions from construction-related activities. Appropriate measures may include water spraying of roads and stockpiles, stabilising surfaces, temporary screening and wind fences, modifying construction activities during periods of heightened winds and revegetating exposed areas as soon as practicable;

d) procedures for managing noise emissions from construction-related activities;

e) appropriate sanitary facilities to be provided for construction and maintenance staff;

f) a timetable, where practicable, for the construction of turbine bases, access tracks and power cabling during warmer months, to minimise impacts on ephemeral

wetlands, local fauna and sediment mobilization;

g) measures to minimise waste generation on site and maximising opportunities for recycling and reuse;

h) measures for dust mitigation, control and monitoring dust gauges;

i) procedures to ensure that construction vehicles and equipment use designated tracks and works areas to avoid impacts on native vegetation;

j) procedures for covering trenches and holes at night, and filling trenches as soon as practical after excavation, to protect native fauna;

k) the removal of works, buildings and staging areas on completion of the construction phase of the project.

Sediment, erosion and storm water management plan

The environmental management plan must include a sediment, erosion and storm water management plan.

The sediment, erosion and storm water management plan must include:

a) identification of all construction and operational processes that could potentially lead to water contamination;

b) procedures to ensure that silt from batters, cut-off drains, table drains and road works is retained on the site during and after construction and replaced as soon as possible. To this end:

(i) all land disturbances must be confined to a minimum practical working area;

(ii) soil to be removed must be stockpiled and separate soil horizons must be retained in separate stockpiles and not mixed, and soil must be replaced as soon as possible in sequence;

(iii) stockpiles must be located away from drainage lines;

c) the installation of geo-textile silt fences (with sedimentation basins where appropriate) on all drainage lines from the site which are likely to receive run-off from disturbed areas;

d) procedures for waste water discharge management;

e) a process for overland flow management to prevent the concentration and diversion of waters onto steep or erosion prone slopes;

f) pollution management measures for stored and stockpiled materials including

waste materials, litter, contaminated run-off and any other potential source of pollution to ground or surface waters;

g) agreed program and appropriate capacity for annual inspection and regular maintenance of any on-site wastewater management system;

h) a program of inspection and remediation of localised erosion within a specified response time.

Hydrocarbon and hazardous substances plan

The hydrocarbon and hazardous substances plan must include:

(a) procedures for any on-site, permanent post-construction storage of fuels, lubricants, waste oil or other hazardous substances or potential contaminants to be in bunded areas;

(b) contingency measures to ensure that any chemical or oil spills are contained on-site and cleaned up in accordance with the Council requirements.

Bushfire risk management plan and emergency evacuation plan

The bushfire risk management plan and emergency evacuation plan must include:

(a) criteria for the provision of static water supply tanks solely for firefighting purposes, including minimum capacities, appropriate connections and signage;

(b) procedures for vegetation management, fuel control and the provision of firefighting equipment during declared fire danger periods;

(c) minimum standards for access roads and tracks to allow access for fire fighting vehicles, including criteria for access to static water supply tanks for fire fighting vehicles;

(d) training of personnel of the organisations referred to above in relation to suppression of wind farm fires;

(e) details of a lightning and earthing system to mitigate against the risk of bush-fires caused by direct lightning strikes on the turbines.

Significant species management plans

Significant species management plans must:

(a) include plans for all wildlife species listed as Endangered, Vulnerable or Near Threatened under the provisions of the *Nature Conservation Act 1992* that:

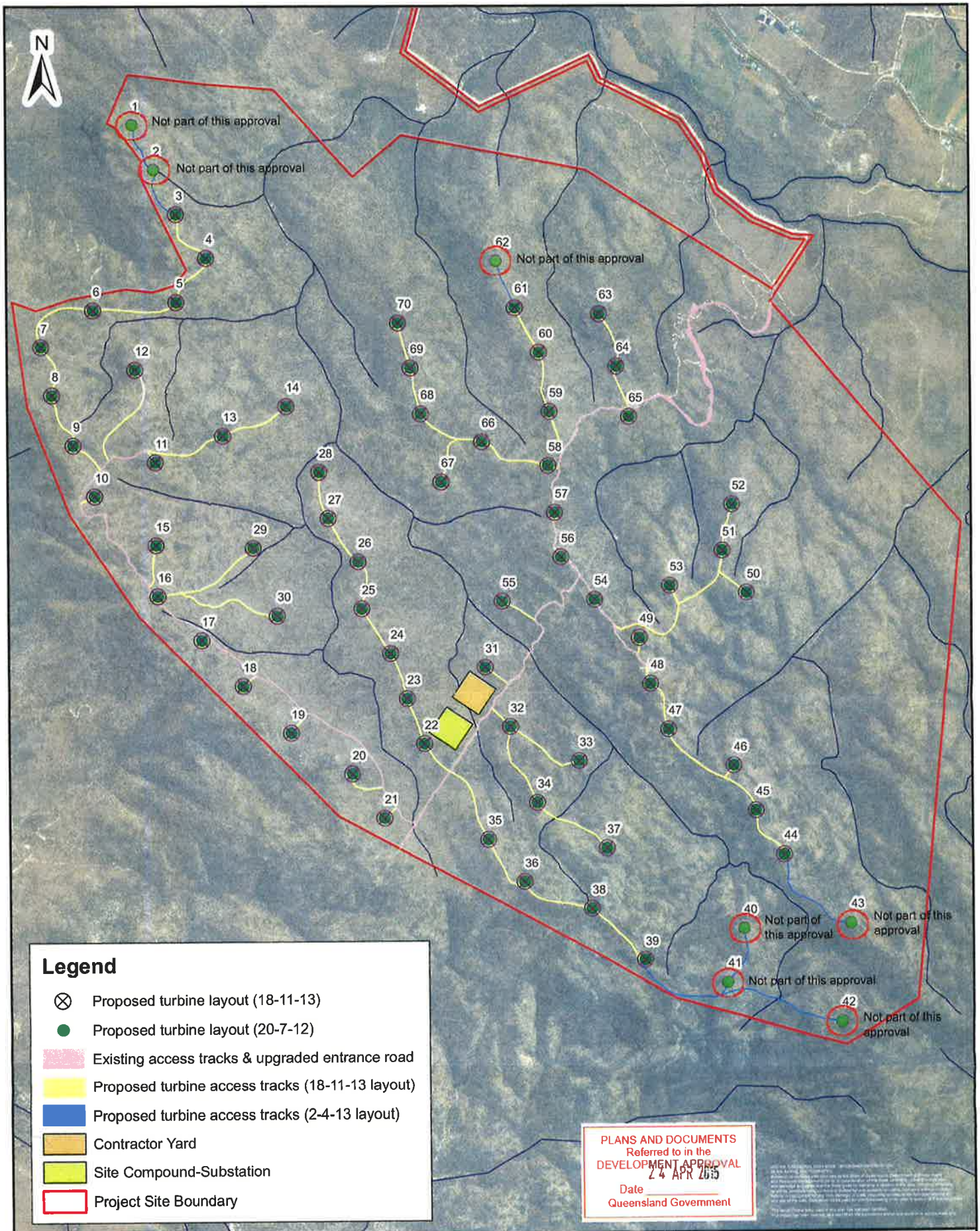
i. are currently known to occur within or periodically utilise the site; or

ii. **are detected within the site during the conduct of further baseline, construction or operational monitoring pursuant to other conditions; and** iii. **are not the subject of an equivalent management plan prepared in satisfaction of an approval issued under the provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).** **(b) set out key impact management strategies including:** i. **further baseline programs;** ii. **management targets;** iii. **design, construction and operational impact avoidance and mitigation measures and protocols;** iv. **quantitative performance indicators;** v. **monitoring and reporting regimes;** vi. **corrective actions;** vii. **timeframes for identified actions; and** viii. **applicant and stakeholder responsibilities.**
Weed and pest management plan The weed and pest management plan must include: (a) protocols for the management of noxious environmental weed species on the site, with the objective of minimising the potential risk of introducing such weeds and pests.
Rehabilitation plan The rehabilitation plan must include guidelines to incorporate appropriate landscape rehabilitation strategies and methods into the management of disturbed land.
Habitat clearing and management plan The habitat clearing and management plan must include management strategies involved in mitigating impacts of habitat clearing on susceptible fauna, including the induction of workers and for wildlife spotters and catchers involved in habitat clearing.
Ecological fire management plan The ecological fire management plan must include management strategies to be implemented in order to maintain an appropriate fire regime for the various faunal

and flora habitats represented on site.
Cultural heritage management plan The cultural heritage management plan must include the procedures to be followed for impact avoidance and mitigation of impacts upon Aboriginal heritage.
Environmental management plan training program The environmental management plan must include a training program for construction workers and permanent employees or contractors at the site, including a site induction program relating to the range of issues addressed by the environmental management plan.
Environmental management plan reporting program The environmental management plan must include a program for reporting environmental incidents, including: (a) a register of environmental incidents, non-conformances and complaints, together with corrective actions taken in response to such incidents, non-conformances or complaints; (b) identification of the person to whom reports of environmental incidents, non-conformances and complaints should be made.
Implementation plan The environmental management plan must include a timetable for implementation of all programs and works referred to in sections above.

Schedule 2:

Approved plans and documents



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Meters (A3)

Project Manager	M. Jess
Compiled by	J. Middleton
Map Projection	MGAz55
Map Datum	GDA94
File Reference	PR100246-170a.mxd
Sheet Number	1 of 1

Client: RACL

Title: Mount Emerald Wind Farm
Turbine locations and development footprint

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SCALE (A3)	DATE	DRAWING NO.	ISSUE
1:22,000	18-11-2013	PR100246-170	A

Appendix B

EMP Induction Plan

Mount Emerald Wind Farm

Environmental Management Plan Training Program Induction Plan

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
1	Report	MJ/BC	L. Liessmann	12.08.2016
2	Review	BC/MJ	TJ	18/08/2016
3	Final	TJ	BC	18/11/2016

Approval for Issue

Name	Signature	Date
Mellissa Jess		18/11/2016

Contents

Tables

Figures

1.0 Introduction

RPS Australia East Pty Ltd (RPS) has prepared the following Environmental Management Plan Training Program Induction Plan (herein known as the 'Induction Plan') for works on the Mount Emerald Wind Farm (MEWF) project developed by RATCH Australia Pty Ltd (RATCH). The Induction Plan is designed to be provided as an induction tool to be used in conjunction with the *Mount Emerald Wind Farm Induction Slide Show* (RPS 2016) to deliver an induction program to new personnel.

The success of an Environmental Management Plan (EMP) depends on all those responsible for its implementation and review being thoroughly conversant with its contents, interpretation and performance measurements. The construction contractor and its sub-contractors will be responsible for ensuring project personnel have sufficient knowledge and awareness to identify potential environmental issues and that they are trained to take appropriate corrective action if incidences arise.

Conditions relevant to the preparation and implementation of this Induction Plan are detailed in Condition 13 of the Ministerial Decision Notice (dated 18 December 2015) particularly Attachment 1, which states;

> *Environmental management plan training program:*
>
> *The environmental management plan must include a training program for construction workers and permanent employees or contractors at the site, including a site induction program relating to the range of issues addressed by the environmental management plan.*

It is essential all personnel are familiar with the procedures for reporting on issues that may impact on environmental values. This includes informing key construction personnel and relevant regulatory authorities.

This induction provides environmental management information relevant to everyone working on site. Therefore it is expected all staff, including construction and field staff, will complete a comprehensive project induction prior to commencing work on the Project. Where required, specific operations inductions will be dealt with in detail in subsequent management plans (e.g. Quoll Management Plan and Habitat Clearing and Management Plan) at the discretion of the Environmental Manager/Officers and the Construction Manager.

The aim of this induction plan is to ensure all relevant contractors understand their role in achieving the required environmental requirements.

Topics covered include:

(1) Environmental Role

(2) Environmental Legislation and Approvals

(3) Project Plans and Environmental Management Systems

(4) Environmental Elements, Impacts and Management

- (a) Soil (ESC)
- (b) Water
- (c) Air, Noise, Vibration
- (d) Cultural Heritage
- (e) Flora
- (f) Fauna

(g) Weeds and Pests

(h) Waste Management

(i) Fuel and Chemical Management

(j) Unexploded Ordinance (UXO)

2.0 Mount Emerald Wind Farm

2.1 The Site

General site details are stated below:

- Approved to build 63 wind turbines generating up to 189 megawatt (MW) of power.
- Approximately 20 km SSW of Mareeba on the Atherton Tablelands in north Queensland (**Figure 1**).
- Towers will be approx 80-90m high with approximately 50m blades, utilising 3 MW machines.
- The land encompasses an area of 2,422ha.
- 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.
- Elevation range of the site is between 540m up to 1089m above sea level (ASL).
- 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 site has eight recognised rare and threatened flora and fauna species located across its ranges.

2.2 Construction

Access to the site will be via Kennedy Highway, onto Hansen Drive and then onto 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 10m. The interconnecting tracks will form the routes for the inter-turbine underground cabling - expected to be buried in trenches at approximately 1m deep.

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

Wind turbines will be "micro-sited" - a technique which involves selecting a position in the landscape where the environmental, constructability and other impacts are considered and weighed up. 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 Environmental Impact Statement (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.

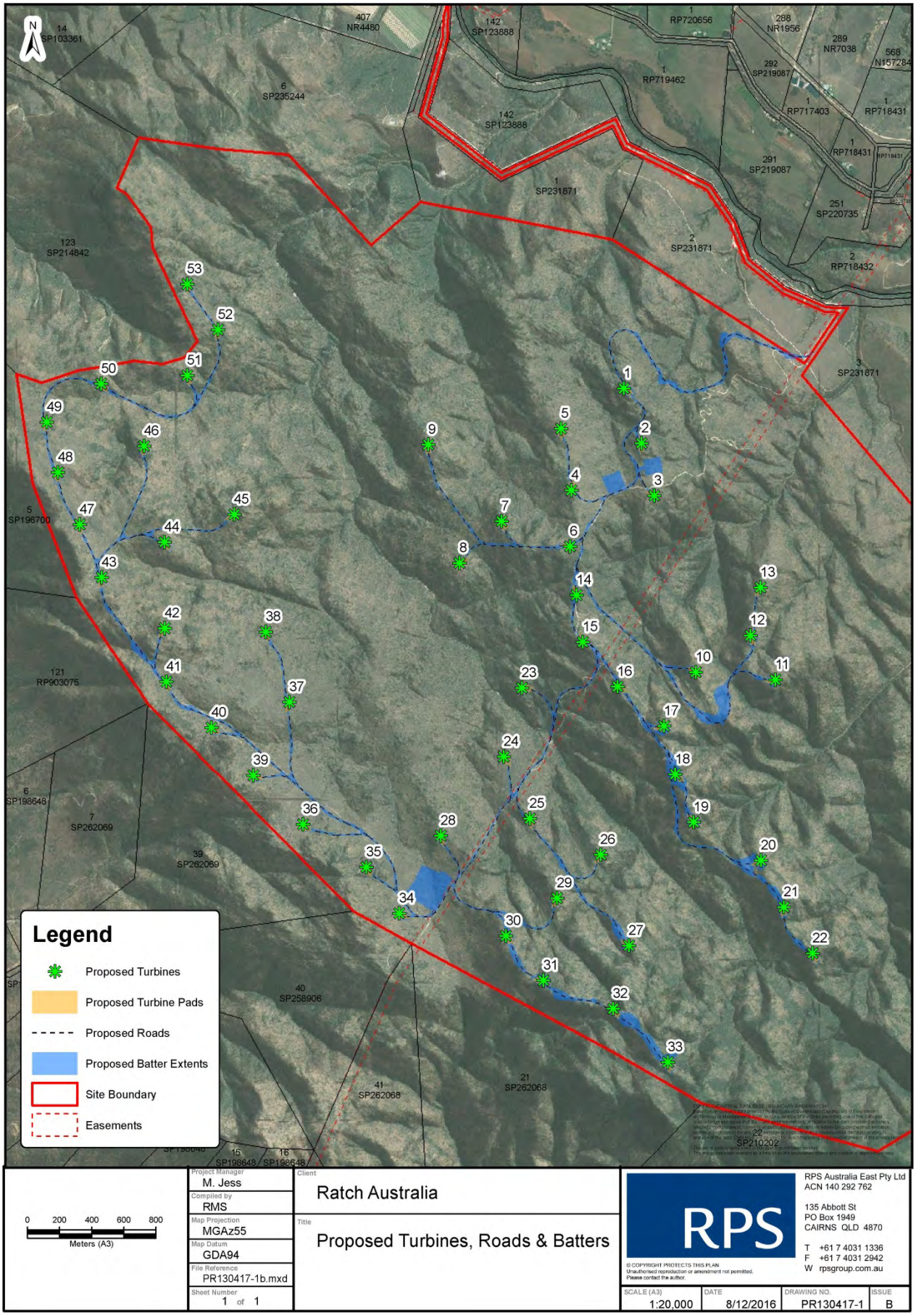

Figure 1 Project Site Location

3.0 Legislation and Other Considerations

Environmental legislation consists of a large number of acts, policies, codes, standards and regulations and there are instances where permits and other forms of approval are required. General personnel are not expected to have this knowledge however it is necessary to appreciate the importance of this legislation to works being undertaken.

Each person should become familiar with aspects of the **project plans** that outline applicable environmental legislation, permits and licenses required. This will assist in achieving good compliance outcomes.

Under the *Environmental Protection Act 1994* all employees must understand the following duties:

- The General Environmental Duty – requires all persons to minimise or prevent "Environmental Harm"
- The Duty to Notify - requires persons to notify supervisors (and subsequently the Department of Environment and Heritage Protection) of "Material" or "Serious" environmental harm

Environmental Harm is considered:

- Nuisance – Noise, odour, dust
- Material - >$5K to clean up and/or restore environment
- Serious – >$50K to clean up and/or restore environment

The Heritage Act applies a similar "duty of care" in relation to the protection and preservation of heritage values.

Environmental legislation is administered by various government departments. Authorised Officers have power to issue:

(i) On-the-spot fines – fines issued by Authorised Officers.

(ii) Remedy notices – written order to make good.

In extreme cases, an individual or company may be prosecuted.

Any concerns regarding legislative compliance should be raised with the Project Manager and / or Environmental Officer.

3.1 Legislative and Other Considerations

Table 1 below identifies the many legislations, policies and standards that are relevant to the project. Potential areas for concern are identified.

Table 1 Environmental legislation, policies and standards relevant to the Project

Element	Legislative and Other Requirements	Area of Concern
Construction—General	*Environmental Protection Act 1994 (Qld)* *Environmental Protection Regulation 2008 (Qld)* *Workplace Health and Safety Act 1995 (Qld)* *Workplace Health and Safety Regulation 1997 (Qld)*	Safety of person and property
Noise and Vibration	*Environmental Protection (Noise) Policy 2008 (Qld)* *Workplace Health and Safety Act 1995 (Qld)* AS 1055.1 & .2: Acoustics—Description and measurement of environmental noise AS 2436: Guide to noise control on construction, maintenance and demolition sites	Noise Compliance
Air Quality	*Environmental Protection (Air) Policy 2008 (Qld)* National Health and Medical Research Council Guidelines 1985 (Cwth) Draft National Environmental Protection Measures and Impact Statement for Ambient Air Quality 1997 (Cwth)	Dust creation Impact on local amenity
Water Quality	*Environmental Protection (Water) Policy 1997 (Qld*) Australian Water Quality Guidelines for Fresh and Marine Waters, ANZECC 2002 *Water Act 2000 (Qld)*	Taking water from a natural source. Concern is the uncontrolled removal of water may impact viability of natural system. Vegetation on banks provides stability and its damage or removal may impact water quality via sedimentation Uncontrolled activity may damage waterway. Uncontrolled releases of contaminants may impact water quality.
Erosion and Sedimentation Control	Soil Erosion and Sediment Control, Engineering Guidelines for Queensland Construction Sites—IEAust (Qld) 1996	Erosion of sensitive ecosystems and sedimentation of watercourses.
Storage and Handling of Dangerous Goods	*Environmental Protection Act 1994 (Qld)* *Environmental Protection Regulation 2008 (Qld)* *Workplace Health and Safety Act 1995 (Qld*) AS1940 – The Storage and Handling of Flammable and Combustible Liquids	Many chemicals are hazardous and require specific handling and use practices. Contamination of soils, groundwater and surface water.
Transport of Dangerous Goods	Australian Code for Transport of Dangerous Goods by Road and Rail	Many chemicals are hazardous and require specific handling and use practices.
Waste Management	*Environmental Protection (Waste Management) Policy 2000 (Qld)* *Environmental Protection (Waste Management) Regulation 2000 (Qld)*	Impact of local amenity Wildlife accessing waste Waste contaminating watercourses
Flora and Fauna	*Environment Protection and Biodiversity Conservation Act 1999 (Cwth)* *Nature Conservation Act 1992 (Qld)* *Nature Conservation Regulation 1994 (Qld)* *Vegetation Management Act 1999 (Qld)* *Environmental Protection Act (Qld)* *Land Protection (Pest and Stock Route Management) Act 2002 (Qld)*	Plants and animals are protected, some being specifically targeted for their significance and scarcity. Broad environmental areas (regional ecosystems) are protected because of their significance to the viability of plant and animal populations. Specifically identified environmental features are targeted for preservation.
Cultural Heritage	*Native Title Act 1993 (Cwlth)* *Native Title (Queensland) Act 1993* *Queensland Heritage Act 1992* *Queensland Heritage Regulation 2003* *Aboriginal Cultural Heritage Act 2003 (Qld)*	Heritage values are protected for preservation and a duty of care applies
Land Use	*Integrated Planning Act 1997(Qld)* *Biosecurity Act 2014*	Impact of weeds and pests

3.2 Approval Requirements

3.2.1 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* Approval

Approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was required due to the presence of federally protected flora and fauna. This approval stipulates conditions such as:

- The area of clearing allowed;
- Requirements to monitor and ensure the Northern Quoll population is not adversely impacted;
- Requirements to monitor and ensure the Bare-rumped Sheathtail Bat and Spectacled Flying-fox populations are not adversely impacted by turbine collision;
- Offsets to compensate for the loss of habitat for EPBC listed threatened species from the wind farm site; and
- Other administrative conditions such as records management requirements.

3.2.2 State *Sustainable Planning Act 2009* Approval

Approval under the *Sustainable Planning Act 2009* (SPA) was required due to the impacts on local and state government economic, environmental and social interests. This approval stipulates conditions relating to the following:

- Social Requirements;
- Setback distance from existing dwellings;
- Visual amenity – i.e. turbine heights, paint finish, lighting, landscaping;
- Acoustic amenity – maximum noise levels;
- Television and Radio Reception;
- Traffic Management;
- Community engagement;
- Environmental Requirements;
- Environmental Management Plans detailing how to mitigate impacts on the environment.

4.0 Project Plan and Environmental Management System

The MEWF project plan has been developed by the Contractor from the contract documentation and details the roles and responsibilities, permits, licenses etc. of all aspects of the development. The Environmental Management Plan (EMP) is to be used in conjunction with that plan and is considered a mitigation strategy to control for risks against the project.

The Environmental Management System (EMS) is the support system that is operated by the Contractor on the MEWF project. The role of the EMS is to assist the contractor with environmental management and includes all management plans processes, practices and responsibilities that make up the environmental component of the project.

An EMS has provisions for monitoring and corrective actions to ensure that organisations/companies will improve procedures where required (i.e. following an uncontrolled event or incident which may impact the environment).

4.1 Environmental Records

A number of environmental records are required to be documented and kept for this project (Table 2). They are the responsibility of the Construction Manager and Environmental Officers on site however, it is important for all employees to be aware of these documents.

Table 2 Environmental Records

Document	What is it used for?	When required
Environmental Management Plan	Details control strategies to mitigate against the potential impacts to the environment as a result of the project. Plan to be amended during project to address changes in design and methodology.	Prior to works commencing
Site Specific Environmental Induction	Addresses environmental management needs and constraints applicable to the project.	Delivered to all new personnel to site
Permits, Licences and Approvals	Details which approvals have been obtained and their conditions.	Duration of project
Induction Register	Register of all personnel that have undertaken environment and cultural heritage training and induction prior to commencement.	Ongoing
Waste Transport Certificate	Required under legislation to keep official receipts of disposed regulated and trackable wastes.	Waste collected by Contractor
Weed Hygiene Declaration Forms	Weed seed control: weed hygiene declarations are required for all plant and vehicles (subcontractors) arriving & leaving site.	Plant/Vehicles arriving & leaving site
Water Extraction Log	Record details of water extraction.	When water is being extracted
Monitoring Results Log	This will document the results of water quality monitoring	Post monitoring
Audit Reports	Details compliance with contracts, systems and lists and identifies the requirements of corrective actions.	After audit has been completed
Cultural Heritage Monitor Timesheets	Document the working hours of any Cultural Heritage Monitors that work on our job sites (use localised form).	During Monitoring
Fill Agreement	Manages the risks associated with spoiling on private property	Prior to spoiling
Project diary	Daily site inspections to verify compliance with the EMP, licences, permits and approvals and other environmental performance requirements specified within the Contract.	Daily

5.0 Environmental Elements

5.1 Sediment, Erosion and Stormwater

A *Sediment, Erosion and Stormwater Management Plan* has been created to manage water quality and soil erosion, along with the risk of adverse impacts associated with the proposed works on the site and to the receiving environment.

In general, best practice erosion and sedimentation control involves the principles of (in order of preference):

- Avoidance;
- Minimisation; and
- Treatment.

A primary objective for erosion control is avoidance by limiting the amount of exposed soil subject to erosion. This should be achieved through measures such as minimising clearing extents, staging clearing and progressively revegetating areas as soon as practicable. Planning to ensure works requiring the most exposed soil are completed during the dry season months with lower rainfall. However, where avoidance is not possible the following erosion and sediment control mitigation measures should be implemented:

- Conduct all earthworks in accordance with the detailed Erosion and Sediment Control Plan;
- Protect topsoil, root and seed stock;
- Install and maintain temporary erosion and sediment control measures during construction;
- Inspect disturbed areas and maintain erosion and sediment controls as necessary during and after construction until stabilisation is achieved;
- Achievement of downstream water quality targets (e.g. turbidity, TSS);
- Adequate spacing of stormwater diversion drains in areas of erosion potential;
- Maintain vegetation cover along hardstands and access tracks where possible. Reduce damage to grass cover and sensitive heath vegetation types by limiting vehicle movements to work areas and approved access tracks; and
- Limiting off road vehicle movements after rainfall events to those essential for efficient and safe construction activities.

5.1.1 Sediment and Erosion Control Techniques

A range of available techniques should be considered for sediment and erosion control. Potential techniques are outlined, but not limited to those shown below:

- Rock check dams;
- Rock-lined channels;
- Rock filter dam;
- Grass filter strips with returns;
- Sediment fences (ensure they are trenched in);
- Divert drainage around areas of disturbance; and
- Protect exposed surfaces and revegetate.

5.2 Air Emissions

Dust can cause an environmental nuisance to local residents and businesses. Works must be completed in a manner which maintains ambient air quality of the local area.

5.2.1 Control Devices - Air

- Vehicles and machinery shall be maintained in accordance with manufacturer's specifications.
- Watering of construction site and access tracks will be carried out when visible dust is observed, with increasing frequency particularly on dry and windy days and especially near residences.
- Avoid smoke generation by a strict no burning policy.
- Implement fire control measures during welding operations.

5.3 Noise and Vibration

Noise and vibration can cause an environmental nuisance to local residents and businesses. Construction works can result in vibration causing property damage or cause environmental nuisance or harm.

The following control measures are to be implemented to ensure negative impacts do not occur:

- Provide advance notice of any scheduled atypical noise events to nearby residents.
- Equipment selected based on its low inherent potential to generate noise and vibration and be maintained in accordance with manufacturer's specifications.
- Enclose noisy equipment and use mufflers where appropriate
- Schedule atypical noise events for appropriate times.
- Any blasting is to be carried out in accordance with current practice standards with particular reference to AS 2187.
- Maintain liaison with nearby residents.
- Noisy construction activities in proximity to residences to be limited to 7.00 am to 6.00 pm Monday to Saturday or in accordance with local permits.

5.4 Cultural Heritage

An indigenous cultural heritage site contains artefacts and other physical evidence of indigenous Australian life in the past, or is a place of mythological, spiritual or religious importance. These sites are not only of scientific or historical interest, many continue to be a vital part of indigenous culture today. Indigenous cultural heritage sites are protected in all States and Territories, with severe penalties for unauthorised damage or destruction.

As contractors working in the field, it is important to recognise there is an obligation in ensuring protection of indigenous cultural heritage sites.

In Queensland, indigenous cultural heritage sites are protected under the *Aboriginal Cultural Heritage Act, 2003*. Requirements include:

- The *Heritage Act* applies a Duty of Care, no indigenous site, object or remains may be damaged, disturbed or interfered with;
- Areas must be assessed before they are disturbed;
- Once discovered, any indigenous site, object or remains must be reported to the Minister for Natural Resources and Mines (who is responsible for administering this Act) and Traditional Owners;

- Areas known to have heritage value are to be isolated and works must be stopped.
- Penalties for breaches are severe with fines of up to $1,275,000 for individuals or imprisonment for two years, and $1,275,000 for a company.

The appropriate Aboriginal Parties for the area are the Barbarrum People. A specific Cultural Heritage Management Plan (CHMP) has been established with the Barbarrum People, which contains detail on actions and responsibilities expected of all parties. All works are to be conducted in accordance with the provisions of the CHMP.

5.5 Flora

Works will aim to minimise the effect on vegetation and habitat for flora and to promote regeneration of native vegetation on areas affected by construction phase. Several significant conservation flora species exist on the Mt Emerald Wind Farm site, these include:

- *Homoranthus porteri* – Vulnerable under NCA and EPBC
- *Grevillea glossadenia* – Vulnerable under NCA and EPBC
- *Acacia purpureopetala* – Critically Endangered EPBC Vulnerable NCA
- *Prostanthera clotteniana* – Critically Endangered EPBC and Endangered NCA
- *Melaleuca uxorum* – Endangered under NCA

A Protected Plant Management Plan has been created to ensure impacts to these species are minimized and mitigated. This management plan details management strategies such as:

- Preconstruction surveys to identify locations of rare and threatened species and other significant plants (including habitat trees);
- Avoiding as to the greatest extent feasible during the detailed design phase;
- Clearing limits should be well identified and communicated to relevant staff;
- No unauthorised clearing;
- Stockpiling of topsoil;
- Collection and storage of seed and plant propagules to accumulate a seed bank for future rehabilitation;
- Placement of physical barriers around significant vegetation areas in order to restrict access and prevent disturbance; and
- Transplanting of conservation significant species.

5.6 Fauna

Three significant conservation fauna species exist on the Mt Emerald Wind Farm site, including:

- *Northern Quoll* – Endangered under NCA
- Bare-rumped Sheathtail Bat – Critically Endangered under NCA
- *Spectacled Flying-fox* – Vulnerable under EPBC and NCA

The following management plans (**Table 3**) have been created to minimise and mitigate impacts to the above conservation significant fauna.

Table 3 Fauna Management Plan Detail

Plan	Details
Northern Quoll Management Plan	The *Quoll Management Plan* (QMP) has been developed to minimise the potential impacts on the Northern Quoll (*Dasyurus hallucatus)* from the construction and operation of the Mount Emerald Wind Farm (MEWF) Project. Specific management actions include for example: ▪ Conduct intensive pre-construction 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. ▪ An exclusion zone shall remain in place until an identified den has been inspected by a suitably qualified and experienced person and confirmed the den is not being utilised by Northern Quoll or other threatened species of fauna.. ▪ Anyone working on these specific sites will also have regular toolbox meeting updates on the Northern Quoll.
Habitat Clearing and Management Plan	This plan encompasses spotter catcher pre-clearance and fauna management strategies during the clearing process and includes ▪ Fauna and flora assessment; ▪ Species identification; ▪ Animal trapping, capture and handling; ▪ Assessment of animal health and injuries; ▪ Husbandry of captured wild animals; ▪ Identification of suitable wildlife release sites; ▪ Emergency management and/or euthanasia of injured or sick animals; and ▪ Ensuring all State and Commonwealth policies, permits and conditions are met.
Northern Quoll Outcomes Strategy	For the protection of the Northern Quoll, MEWF must maintain a viable population (that is a population that is in good condition for a species that is endangered) on the Wind Farm site. The Outcomes Strategy is a monitoring program. In this program quarterly baseline data is collected on quoll population size, site occupancy (how many are there and how are they using the site), population vital statistics and habitat condition on the site and in at least three regional reference sites within a 50km radius of the site.
Implementation Plan	The MEWF Implementation Plan is currently being developed and will be completed before the wind farm is operational. The purpose of the Implementation Plan is to protect the Spectacled Flying Fox and the Bare-rumped Sheathtail Bat, and it will include measures to avoid and mitigate the impacts of turbine collisions with these species.

5.7 Weeds and Pests

5.7.1 Weeds

Environmental weeds are required to be controlled in accordance with the provision of the *Weed and Pest Management Plan*.

The greatest risk in relation to weeds on the project site is the potential of them spreading by the movement of material, plant (including vehicles) and equipment that is contaminated with seed or other productive components of the weed, as such;

- All vehicles and machinery are to be washed down and certified weed free prior to entering site.

Any vehicles and machinery working in internal weed infested areas are not to continue work in weed-free zones unless certified clean and weed free. *The Biosecurity Act 2014* regulates weed management in

Queensland. Under this legislation MEWF is required to develop management strategies for weeds on land under their control.

Classification of potential weeds are:

- Class 1 declared weed plant: one that has potential to become a very serious weed in Queensland in the future – introduction, possession and sale of these species is prevented. All landholders are required by law to keep their land free of Class 1 weed without a permit.
- Class 2 declared weed plant: one that has already spread over substantial areas of Queensland and needs to be controlled. Landowners must try to keep their land free of Class 2 weeds and it is an offence to possess, sell or release these weeds without a permit.
- Class 3 declared weed plant: one that is commonly established in Queensland but control by landholders is not required unless the plant is impacting upon a nearby 'environmentally significant area' (eg national park). It is an offence to sell, introduce, release or supply a Class 3 weed.

5.7.2 Pests

For successful management of pest species there are four principles:

- Identify the pests and the area of infestation;
- Avoid utilising and placing infrastructure in areas of know infestation;
- Prevent/minimise the translocation spread of pests by implementing sound work practices and promotion of risk awareness; and
- Control – identified pests to contain or eradicate populations as required.

The pest species likely to be found on the MEWF project that require control and monitoring are detailed in **Table 4**.

Table 4 Declared Pest species on MEWF

Species Name	Declared Species	Potential Species Impact
Rhinella marinus Cane Toad	Class 2	The Cane Toad is poisonous at every stage of its life cycle and it's known to impact nearly all native frog larvae and many aquatic invertebrates. Cane toads are known to have caused a severe decline in small predatory mammal species across northern Australia since their introduction.
Canus lupus dingo Dingo	Class 2	Dingoes prey on local native fauna and often carry parasites and pathogens.
Canus lupus familiaris Wild Dog	Class 2	Wild dogs prey on local native fauna and often carry parasites and pathogens.
Sus Scrofa Feral Pig	Class 2	Feral pigs damage crops, stock, property and the natural environment. They transmit disease and could spread exotic diseases such as foot and mouth if this was introduced to the country.
Felis catus Feral Cat	Class 2	Feral cats prey on local native fauna and often carry parasites and pathogens.
Orictolagus cuniculus Rabbit	Class 2	This species causes destruction of native vegetation and subsequent erosion. They compete heavily with native species for food and shelter therefore reducing the native species ability to survive predation.

A number of control methods have been identified to control pests on the project site (**Table 5**). This is the responsibility of the Environmental Manager and the Construction Manager unless otherwise advised.

Table 5 Control Methods Required at Each Stage of MEWF Project Development

Project Phase	Objective	Action
Preconstruction	Identify abundance of pest species on MEWF project site	▪ Record the incidental occurrence of pests at key locations on project site. ▪ Liaise with local government Pest Management Officer regarding pest species management on site and methods of control undertaken.
Construction	Ensure effective pest control is undertaken for the project area	▪ Manage solid and liquid waste generated from the site compounds. ▪ Avoid creating artificial water points. ▪ Dump all the non-hazardous waste in a designated location which (fenced if required) can then be removed from site. ▪ Ensure appropriate training and induction of staff on pest issues and strategies.
Ongoing	Ensure pest control is undertaken	▪ Survey periodically (quarterly) of high risk areas. ▪ Continue the management of waste products. ▪ Promote continued education and training of staff to ensure implementation and changes to plan are ongoing. ▪ Liaise with local and state government to ensure management of declared pests around property remains current and in line with other property holders and council. ▪ Continue management of solid and liquid waste. ▪ Report infestations to Environmental Manager.

5.8 Waste Management

Waste is anything left over from, or an unwanted by-product of a process or activity (**Figure 2**).

General Waste: Not regulated (generally benign), Suitable for general landfill disposal.

Regulated Waste: Non-domestic, hazardous/targeted wastes, special transport and disposal.

Trackable Waste: Specific regulated wastes, special transport and disposal, special record management.

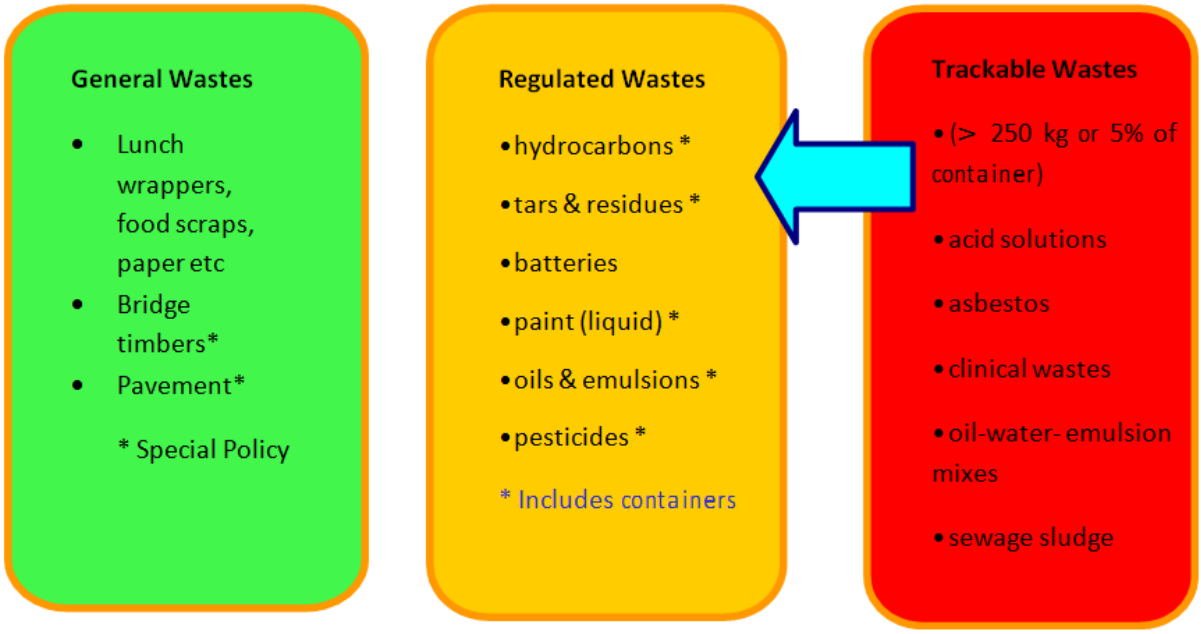

Figure 2 Waste Tracking Process

5.8.2 Management Strategies:

All personnel shall be instructed in project waste management practices as a component of the environmental induction process. The management of wastes on site should include, but not be limited to:

- Stockpiling and salvaging reusable and recyclable wastes, such as timber skids, pallets, drums and scrap metals.
- Collecting and removing waste oil and solvents from site for recycling, reuse or disposal at approved locations.
- Disposing of sewage and sullage from camp site via a packaged mini sewerage treatment plant (greywater may be discharged to land in accordance with local approvals).
- Collection of chemical wastes in 200 L drums (or similar sealed container), appropriately labelled, for safe transport to an approved chemical waste depot or collection by a liquid waste treatment service.
- All binding material and dunnage from transport vehicles and unloading areas is to be collected and transported off the easement to designated disposal areas.
- Collecting and transporting general refuse to a Local Government approved disposal site.
- Ensure wastes are not accessible by stock or wildlife.
- Refuse containers will be located at each worksite.

- Where practical, wastes will be segregated and reused / recycled (e.g. scrap metal).
- Spraying of declared plants and disposal to regulated landfill.
- Complete waste tracking certificates where required.
- Littering even on a construction site is illegal and makes the site look untidy – use the bins or take your general wastes with you.

Wastes should be managed in accordance with the following principles (in order of preference):

Avoid – Prevent waste generation by substituting materials that produce a smaller volume of waste, or that produce wastes that are less hazardous.

Reuse - Minimise waste generation by reusing materials or incorporating into projects.

Recycle - Separate materials that can be recycled from those that cannot.

Energy Recovery – for example burning waste, using the heat to heat water and using the hot water in an industrial process

Dispose - Dispose of wastes to landfill as a last resort.

Figure 3 indicates the management value of these principles.

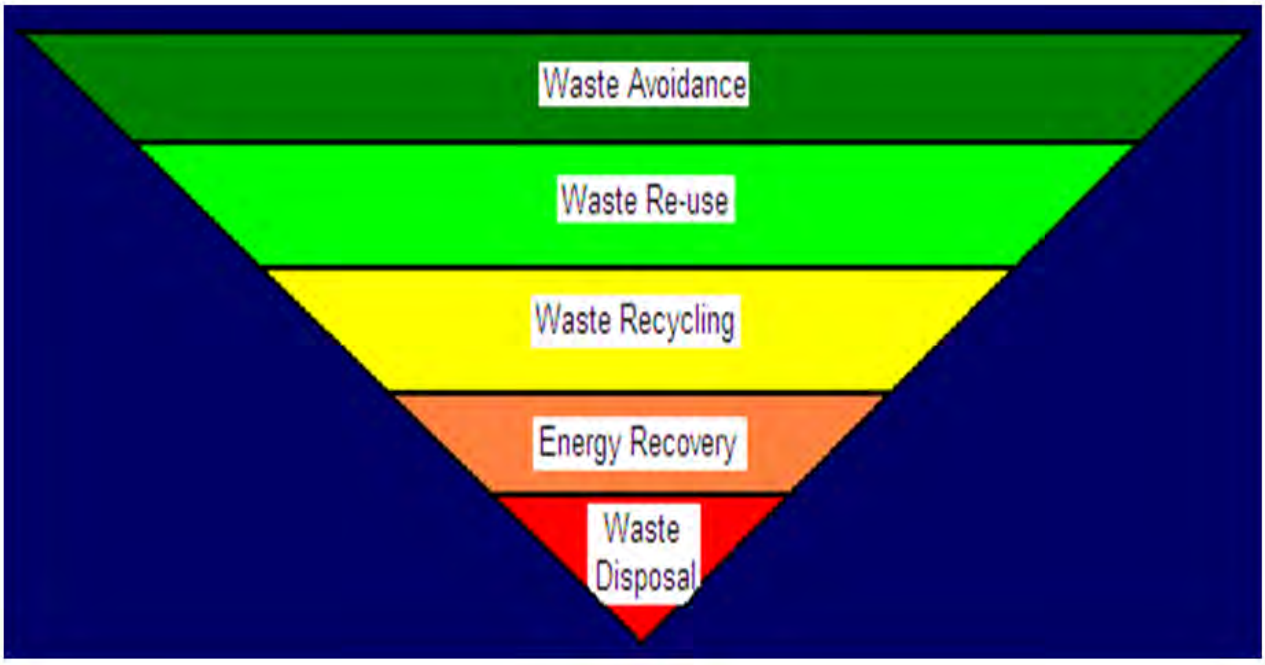

Figure 3 Waste Management Principles

5.9 Fuel and Chemical Management

5.9.1 Hydrocarbons and Hazardous Substances

When working with fuels and chemicals it is important to remember that safety must come first. Ensure you have the MSDS available for each chemical, and also be aware that some fuels and chemicals must not be stored together. For further advice, speak to your Environmental Officer.

The main environmental concern for fuel and chemical management is avoiding any spills on land or entering a watercourse.

A *Hydrocarbon and Hazardous Substance Plan* has been prepared to detail measures to ensure environmental incidents are avoided. This includes measures such as:

- Ensure spill response equipment is available on site for use in emergency.
- Spill response equipment must be the appropriate type and quantity for chemicals and fuels being stored on site.
- Maintain machinery to minimise the leakage of oil, fuel, and hydraulic and other fluids.
- During the servicing of machinery, use measures to capture and contain oils, fuels, hydraulic and other fluids so as to minimise contamination of the servicing area.
- Refuelling of machinery must conform to the following requirements:
- No refuelling of plant and equipment over or within 100m of watercourses.
- Waste flammable and combustible substances which cannot be recycled will be transported to a licenced waste disposal facility such as Springmount landfill.
- All hydrocarbon and hazardous chemicals will be stored in bunded areas which can contain 110% of the largest container.
- The storage area shall be adequately ventilated.
- Appropriate signage warning flammable liquids/dangerous goods are present.
- Spill kits containing absorbent and containment material (e.g. absorbent matting) will be available where hazardous materials are used and stored and personnel trained in their correct use.
- Spills of flammable and combustible substances will be rendered harmless and collected for treatment and / or remediation or disposal at an approved landfill, including cleaning materials, absorbents and contaminated soils and reinstatement made to the affected area.
- Personal protective equipment (PPE) appropriate to the materials in use will be provided.

5.9.2 Incident Response

Relevant site contacts for an incident response are detailed in **Table 6**.

Table 6 Site Contacts Details

Issue	Organisation	Person	Position	Contact Details
Implementation and management of the various plans	Contractor	TBA	Project Manager / HSEQ Coordinator	
Receiving the following reports; monitoring, remedial action, environmental complaints and emergencies	Contractor	TBA	Project Manager / HSEQ Coordinator	
Ensuring measures/action plans are implemented	Contractor	TBA	Project Manager / HSEQ Coordinator	
Reporting	Contractor	TBA	Project Manager / HSEQ Coordinator	

Where a chemical spill occurs, consult the Material Safety Data Sheet (MSDS) for spill procedures. If the MSDS indicates a requirement for containment and clean up then the following steps should also be considered:

(1) Stop the source and spread of the spill if safe to do so:

- Check for danger;
- Prevent the spill from getting larger (turn off valves, block damaged tanks or pipes), and

- Use any suitable material or equipment to confine the spill by "damming it off" (e.g. use available spill response equipment such as booms or absorbent or if unavailable then use soil or other suitable material).

(2) Clean up the spill

- Once the spill has been contained, retrieve as much of the spilled liquid as possible and place in an appropriate container (e.g. 20 L drum or 1000 L pod). The liquid should then be disposed of;
- Absorb remaining spill with absorbent material and place used absorbent in the appropriate waste bin; and
- Where applicable, replenish equipment used from Spill Response Kit.

(3) Report the spill

- Report and investigate all spills in accordance with Incident Reporting and Analysis (see below).

5.10 Land Management

5.10.1 Bushfire Management and Emergency Evacuation

It is crucial fire management of vegetation communities be undertaken on the MEWF project site to ensure that both the project and the environmental values of the property are also protected. A *Bushfire Management and Emergency Evacuation Plan* has been developed to ensure this objective is achieved and utilises the following mitigation measures to minimise the potential for a bushfire:

- Open fires will be banned on the project. Fires include open barbeques, billy fires, brush burning and rubbish burning.
- Adoption of lightning protection measures for both turbines and substations.
- Unnecessary build-up of flammable material near working areas will be prevented, with vegetation and other flammable material being stockpiled well clear of hot work activities.
- Water trucks (also used for dust suppression) will be available for use as fire trucks in the event of fire.
- All vehicles will be equipped with portable fire extinguishers.
- Fire extinguishers and a water cart will be available to the welding crew. All appropriate crew members will be trained in the use of fire fighting equipment.
- Emergency Response Plan shall include details on local contacts for fire fighting assistance.
- Construction management liaison with local Rural Fire Service personnel during high fire periods.
- The establishment of the Asset Protection Zone.
- Clearing and pruning.
- Fire breaks.

5.10.2 Fire Fighting Equipment

All project vehicles will contain a fire extinguisher and CB radios. A specific project vehicle will be fitted with a water tank, diesel pump, 30m fire hose and a knapsack spray. Each Wind Turbine Generator contains a fire extinguisher in the base of the tower and up in the nacelle.

5.10.3 Water Supply Tanks

One storage container will be located at the Substation, Operation and Maintenance Building with the other at the Contractors Site Compound. Each will contain a water tank (approx. 50,000 litres capacity) collecting

water from the buildings in the compound. The tank will be fitted with outlets allowing fire trucks to connect to the tank. Should the water level drop below a minimum set point, a water truck will deliver water to the tank. Guidance from Rural Fire Service Queensland (RFSQ) will be sought on what the minimum level within these tanks should be.

5.10.4 Evacuation Routes

TBC

5.10.5 Emergency Contacts

For all fires and emergencies call 000

In the instance that it is not an urgent emergency the following contact details may be of assistance.

5.10.6 Emergency Services Contacts

Service	Location and Phone Number
Ambulance	Cairns and Hinterland Local Area Service Network: (07) 4032 8615
Fire Warden (Urban Fire Brigade)	Atherton Fire Station: (07) 4091 9290 Mareeba Fire Station: (07) 4092 1044
State Emergency Services (SES)	Cairns: (07) 4032 8682

5.10.7 Rehabilitation Management Plan

Landscape rehabilitation aims at restoring native vegetation cover over sections of land that have been disturbed during the construction, operational and decommissioning stages of the wind farm. The main objectives of rehabilitation are to stabilise the disturbed ground surface by establishing plant cover; and to restore a vegetation community that is ecologically functional and self-sustaining.

Ultimately, and over a period of time which may take over five years to establish, the restored vegetation is to be of a similar floristic composition and structure as the adjacent remnant community on a similar landform. The restored vegetation is to be free of weeds and alien plants, and able to persist in the landscape without intervention or assistance.

This Rehabilitation Plan describes the strategies and actions that apply to mitigating the impacts of vegetation clearing and disturbance in the Mt Emerald Wind Farm project site, including:

- Identify areas for rehabilitation and assign priorities for treatment.
- Rehabilitate areas progressively
- Collect, acquire, manage and store adequate quantities and appropriate species of native plant seed throughout the construction, operation and decommissioning stages of the wind farm.

- Apply the most appropriate techniques and practices for rehabilitation on a site-specific basis.
- Translocate and manage threatened plants, grass trees and cycads where feasible.
- Establish trial rehabilitation plots in areas which are accessible and able to be monitored.
- Continuously maintain rehabilitation areas to a standard which excludes significant weed incursions and promotes healthy growth and development of native vegetation.
- Monitor rehabilitation areas and maintain records and data which will be used to inform improved rehabilitation practices.

5.11 Unexploded Ordinance (UXO)

Parts of the site have been designated by the Department of Defence (DoD) as at risk of containing unexploded ordinances due to past land use at the site by the DoD. A detailed investigation for UXO's has been undertaken by a DoD approved UXO expert within ~50m of planned infrastructure. This was a thorough search of the site using state of the art detection technology and included clearing any UXO's that were identified.

There is, however, still the potential for unexpected UXO finds. A procedure for dealing with this is included in the *Construction and Work Site Operational Management Plan* and includes the following:

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.

In areas where UXO's will be a risk there will be:

- 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 to be present during any excavations/trial pits taking place at the site.
- Intrusive Magnetometer Survey
- Non-Intrusive Magnetometer Survey

ADD once agreed with Contractor. Need to confirm the agreed process for dealing with unexpected finds (may also need to deal with any contaminated land)

Appendix C

Daily Inspection Checklist

Daily Inspection Checklist

Site Location: …… Person in charge of Site: ……

Indicate in the following manner in the 'Result' column:

✔ **Acceptable** ✘ **Not Acceptable** ***NA*** **Not Applicable** ***NC*** **Not Checked**

Item	Result	Comment
Stockpile Management		
Are all stockpiles adequately protected to prevent erosion and run-off?		
Fauna		
Visual assessment of habitat preservation measures to ensure integrity		
Vegetation Management		
Visual assessment of vegetation		
Pest Management Strategies		
Visual assessment to determine the effectiveness of pest management		
Erosion and Sedimentation Control		
Erosion/Sediment Controls in place if required		
Is there any presence of sediment or chemical plumes in the water		
Are the controls in good condition, maintained and effective		
Noise and Vibration		
Are all reasonable practicable steps to reduce construction noise and vibration taken?		
Air Quality		
Is dust minimised by limiting the extent of disturbed areas and regular watering?		
Are loads with the potential of generating dust covered or dampened?		
Chemical Management		
Are spill kits stocked and easily accessible?		
Have any environmental incidents occurred since the last report? If yes, have incidents been reported and investigated?		
If chemical and fuel management effective		
Waste Management		
Is all waste stored in a designated waste storage area?		
Is the waste storage area bunded to preventing spills or leakages?		
Is there a need to dispose of any waste from the storage areas?		
Heritage / Archaeology		
Were the appropriate authorities notified, and work stopped, if any heritage or archaeological item or artifact was found? Does the area need to have an exclusion zone		
Staging of Works		
Is being maintained Existing environmental controls inspected Existing environmental controls maintained Environmentally sensitive areas undisturbed Roads fronting site are clean		
Daily Plant Checks		
Have checks been completed for oil, fuel leaks etc…..		

Daily checks on clearing of vegetation	Yes / No	Comment
Number of trees removed per section		
Have any plants of least concern been removed and or relocated		
If yes what plant/s location and location of where plants were relocated to:		
Have any animals of least concern have been injured /removed		
If yes what animal, section /location and locations of where animal (s) were relocated to:		

Further Comments and Actions

.....

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.....

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.....

Signed: _____ **Date:** _____

Name: _____ **Position:** _____

Appendix D

Incident Report Form

DATE:		**TIME:**	
INCIDENT REPORTED BY:			
AREA WHERE INCIDENT OCCURRED:			
DETAILS OF INCIDENT:			
ACTIONS FOLLOWING INCIDENT: (date, method, personnel)			
RECOMMENDED FUTURE ACTIONS: (date, method, personnel)			
RELEVANT PERSONNEL INFORMED: (names and signatures)			
SITE SUPERVISOR:			
COPY SENT TO DEHP: (date and initial)			

Appendix E

Complaints Register

Complaints Register

Record the complaint in this register, and action the Non Conformance Corrective Action Record for each complaint.

Date	Issue / Complaint	Affected Neighbours	Activity Date	Follow-up/Complaints	
				Action	Date

Appendix F

Environmental Monitoring Checklists

Project: Mount Emerald Wind Farm

Inspection by: **Date:**

Environmental Representatives are required to complete a fortnightly/monthly inspection of a project (or more often depending on project requirements).

At the completion of the inspection the completed and signed form including the additional comments and corrective actions sheet is to be signed off by the Project Manager and filed.

	TOPIC/ISSUE	STATUS			COMMENTS AND RECOMMENDATIONS
		Yes	No	N/A	
1	**General**				
1a	Have all previous issues been actioned	☐	☐	☐	
1b	All complaints correctly recorded and resolved	☐	☐	☐	
1c	All employee inductions completed	☐	☐	☐	
1d	Environmental records in order	☐	☐	☐	
1e	All licences and permits obtained, current and complied with	☐	☐	☐	
1f	Energy efficiency strategies implemented	☐	☐	☐	
2	**Water Quality Management**				
2a	Contaminated water/runoff contained/treated	☐	☐	☐	
2b	Recycled Water controls applied	☐	☐	☐	
3	**Erosion & Sediment Control**				
3a	Unacceptable erosion/sediment risks avoided	☐	☐	☐	
3b	All controls in good order	☐	☐	☐	
3c	Sufficient E&S control materials on standby	☐	☐	☐	
3d	Revegetation commenced in available areas	☐	☐	☐	
4	**Cultural Heritage (CH)**				
4a	CH values protected and undisturbed	☐	☐	☐	
5	**Nuisance and Amenity**				
5a	No new noise/vibration/amenity risks	☐	☐	☐	
5b	Noise/vibration controls being implemented	☐	☐	☐	
5c	Dust controls are working effectively	☐	☐	☐	
5d	Plant appears in good operating order	☐	☐	☐	
5e	Site and compounds are being kept tidy	☐	☐	☐	
6	**Land Management**				
6a	Clearing has remained within allowable limits	☐	☐	☐	
6b	Revegetation strategies incorporated	☐	☐	☐	
6c	Actual/potential contaminated land issues - nil	☐	☐	☐	
6d	Declared plants identified and under treatment	☐	☐	☐	
6e	Weed hygiene controls implemented	☐	☐	☐	
6f	Unauthorised spoiling/stockpiling avoided	☐	☐	☐	
7	**Waste Management**				
7a	Waste stored and disposed correctly	☐	☐	☐	
7b	Are waste minimisation strategies applied	☐	☐	☐	
8	**Chemicals and Fuels**				
8a	Bulk fuels/hazardous chemicals stored in bunded areas	☐	☐	☐	
8b	MSDS register readily accessible	☐	☐	☐	
8c	Spills contained and removed	☐	☐	☐	
8d	Spill kits readily available and in good order	☐	☐	☐	
9	**Flora and Fauna**				
9a	Strategies to protect R&T flora sp. implemented	☐	☐	☐	
9b	Strategies to protect R&T fauna sp. implemented	☐	☐	☐	
8c		☐	☐	☐	
8d		☐	☐	☐	

Appendix G

Threatened Plant Management Plan

Threatened Plants Management Plan

Mt Emerald Wind Farm

Report prepared for RPS Australia Asia Pacific (Cairns) for MEWFPL

September 2016

Threatened Plants Management Plan

Mt Emerald Wind Farm

Final Report

Simon Gleed

7th September 2016

Report Prepared for RPS Australia Asia Pacific (Cairns) for MEWFPL

Disclaimer

Simon Gleed: sgleed@internode.on.net

Photo credits in this report are as follows: SG - Simon Gleed, TDR - Tom De Ridder.

This document is confidential and its contents or parts thereof cannot be disclosed to any third party without the written approval of the author.

Simon Gleed undertook the fieldwork and preparation of this document in accordance with specific instructions from RPS Australia Asia Pacific (Cairns), to whom this document is addressed. This report has been prepared using information and data supplied by RPS Australia Asia Pacific (Cairns) and other information sourced by the author.

The conclusions and recommendations contained in this document reflect the professional opinion of the author based on the data and information supplied and available at the time of the work. The author has used reasonable care and professional judgment in the interpretation and analysis of the data. The conclusions and recommendations must be considered within the agreed scope of work, and the methodology used to perform the work, both of which are outlined in this report.

Document Status

Document Status	Author	Reviewer	Date of Issue
Draft Report	S. Gleed	M. Jess (RPS)	26th August 2016
Final Report	S. Gleed	T. Johannesen	7th September 2016

Distribution

Company	Copies	Contact Name
RPS	1 (electronic: PDF)	Via email to M. Jess
Simon Gleed	1 (electronic)	S. Gleed

CONTENTS

TABLES

FIGURES

1.0 SUMMARY

The Mt Emerald Wind Farm site provides important habitat and refuge areas for threatened plants. These plants are endemic to the region and in many instances, are only found or have significant populations in the vicinity of Mt Emerald Wind Farm project site on the Herberton Range.

Six threatened plant species are confirmed to be present within the project footprint and could be impacted during construction, maintenance and decommissioning of the wind farm. These plants are listed under either the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or the Queensland *Nature Conservation Act 1992* (NC Act). Some species are listed under both legislation.

Major threats to the survival of the conservation significant species include altered fire regimes, weed invasion, and physical clearing and modification of critical habitats.

This Threatened Plants Management Plan details the distribution, habitat, ecology, conservation status, threats and management actions relating to the following threatened plant species:

Acacia purpureopetala (Purple-flowering Wattle) - Critically Endangered/Endangered (EPBC Act / NC Act);

Grevillea glossadenia (no common name) - Vulnerable / Vulnerable (EPBC Act / NC Act);

Homoranthus porteri (no common name) - Vulnerable / Vulnerable (EPBC Act / NC Act);

Melaleuca uxorum (no common name) - Endangered (NC Act);

Plectranthus amoenus (Plectranthus) - Vulnerable (NC Act); and

Prostanthera clotteniana (Mint Bush) - Critically Endangered/Endangered (EPBC Act / NC Act).

To provide an indication of "rarity" of each of the threatened plant species in terms of the numbers of individuals or area of representation of populations on the Mt Emerald Wind Farm site, the threatened species are ordered as follows (rarest first):

1) *Acacia purpureopetala* - exceptionally rare, with only 18 plants seen in a very small area.

2) *Melaleuca uxorum* - exceptionally rare and found in the proposed road network as one thicket of a small population measuring 7 x 5 metres.

3) *Prostanthera clotteniana* - exceptionally rare and found at only one location with approximately 30 plants seen on a proposed access road.

4) *Plectranthus amoenus* - scattered individuals over rock pavement habitat and mostly restricted to north of the 275 kV powerline.

5) *Homoranthus porteri* - several individuals which form dense thickets. The main population area is south of the 275 kV powerline.

6) *Grevillea glossadenia* - the most widespread threatened plant on the wind farm site, but primarily restricted to south of the 275 kV powerline.

The listing above **DOES NOT** infer importance, and all threatened plants should be managed in accordance with this plan.

2.0 INTRODUCTION

2.1 Project Description

Mount Emerald Wind Farm Pty Ltd (MEWFPL) proposes to construct and operate a wind farm located approximately 20 km SSW of Mareeba on the Atherton Tablelands in north Queensland.

Given the nature of the project to efficiently and effectively harness wind energy, the wind turbine generators (WTG's) are located on high points through the project site. The northern half of the site has broad, rolling hills, with dissected areas found in ravines and gorges; whereas the land to the south of the existing 275 kV powerline is markedly rugged and steeply dissected, rendering the highest points a series of narrow ridges and rocky knolls with steep drop-offs on adjacent slope faces.

2.2 Project Components

The wind farm will consist of a maximum of 63 hollow tower WTG's, which will be approximately 80 m high with 55 m diameter rotor blades.

The wind farm will provide energy to feed into the main electricity grid infrastructure currently provided by the 275 kV Chalumbin to Woree powerline. The WTG's will be connected and linked by a series of access tracks and underground cabling.

Other infrastructure and facilities to be constructed within the wind farm project site include a contractors site compound, a laydown area, a substation and an associated substation operation and management building. The location of the works and layout of the wind farm infrastructure are shown in **Figure 1**.

2.3 Duration and Intent of the Threatened Plants Management Plan

This Threatened Plant Management Plan is effective for the construction, operation and decommissioning stages of the Mt Emerald Wind Farm. The management strategies in this Plan are intended to be adapted where specific circumstances require modified or different approaches. Situations where adaptive management approaches may be required include for example:

- weather events that might otherwise prevent normal management strategies to be performed;
- limited knowledge or absence of data and information specific to a certain issue. For example, limited knowledge of the ecology of a plant species;
- significant changes to the project layout, operation or decommissioning.

The Plan is intended to be "flexible" and will require an on-going review process, with specific amendments or recommendations made to the Plan (if required) annually. In the event that a significant management issue arises and requires attention before the annual review, then adaptive management will need to be implemented in a timely manner to ensure an efficient response.

The Plan's overarching intent is to provide guidance to avoid or minimise adverse impacts to threatened plant species and their respective habitats listed under the Queensland NC Act and the Commonwealth EPBC Act.

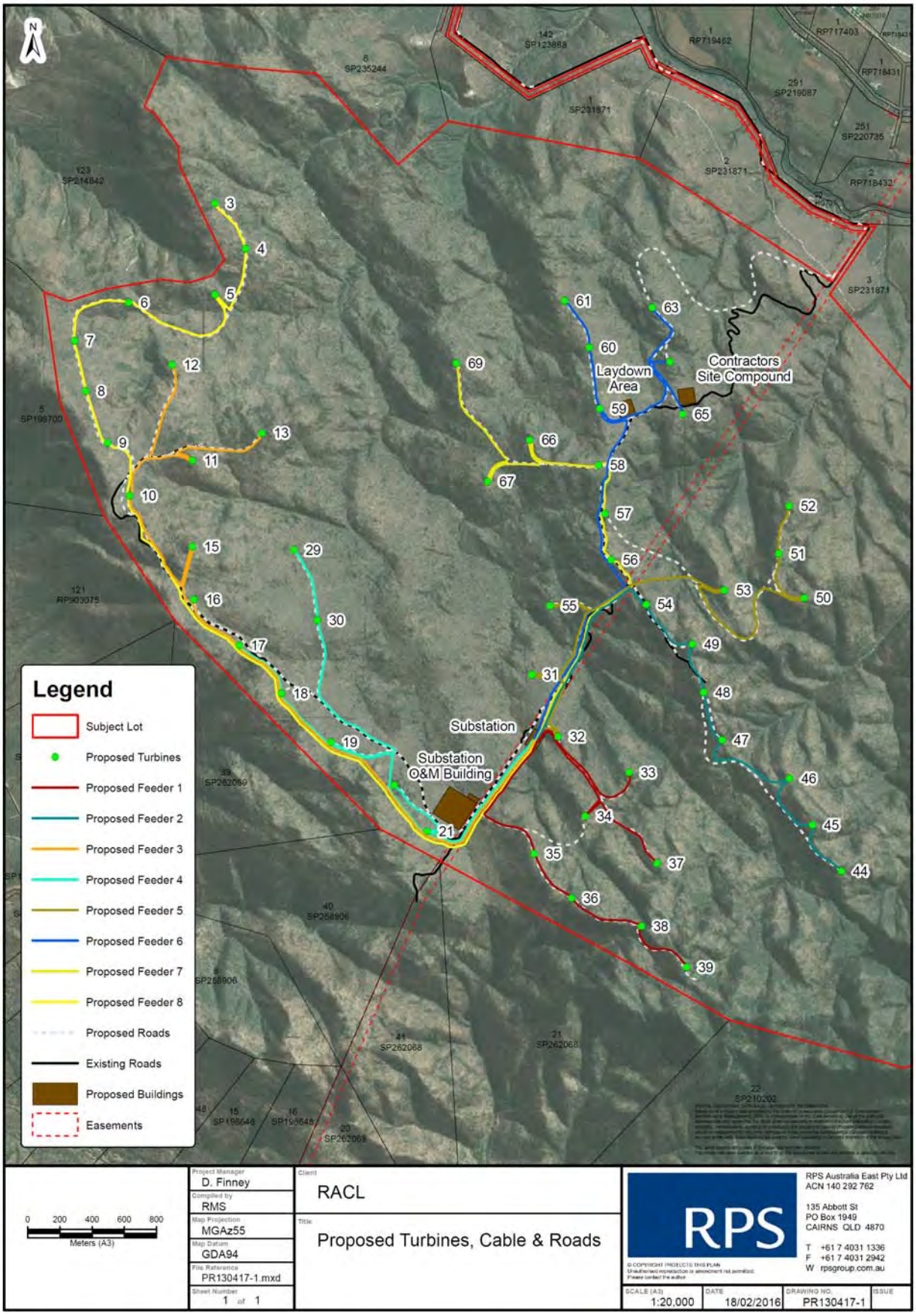


Figure 1. Layout of the Mt Emerald Wind Farm

2.4 Project Stages

The main stages of the wind farm project are:

Planning & Approvals: Environmental field surveys and investigations; Environmental Impact Statement; conditional approval under the EPBC Act.

Construction: Includes pre-clearance surveys and micro-siting of WTG's; clearing and construction of tracks, WTG's; road infrastructure and other facilities. Rehabilitation commences. Weed and threatened plants management commences. Baseline environmental monitoring commences.

Operation: Construction of WTG's and associated infrastructure completed. Environmental safeguards in place and functional. Continued and progressive rehabilitation and environmental monitoring. Weed and threatened plants management continues. Periodic review of management plans and management strategies and actions.

Decommissioning: Re-widening of track and road network to allow for heavy machinery access and removal or replacement of WTG's. Weed and threatened plants management continues. Rehabilitation of disturbed areas commences.

2.5 Project Timing

Preliminary investigations of the site including environmental and planning have been undertaken since 2010. The project is presently approved under the EPBC Act with conditions. Construction works are expected to commence in the latter half of 2016. Completion and operation of the wind farm is expected in 2018.

2.6 Legislative Context

The plants described in this Threatened Plants Management Plan are listed under Commonwealth or Queensland legislation. Some species are listed under both. The two pieces of legislation that are relevant are:

- *Environment Protection and Biodiversity Act 1999* (Commonwealth) - referred to in this document as the EPBC Act.
- *Nature Conservation Act 1992* (Queensland) - referred to in this document as the NC Act.

The plant species listed under the legislation with their respective status which are confirmed to occur in the wind farm project footprint are summarised in **Table 1**.

Table 1. Conservation significant plant species found in the Mt Emerald Wind Farm project footprint.

Species	Common Name	Form	EPBC Act[1]	NC Act[1]
Acacia purpureopetala	Purple-flowering Wattle	Shrub	CE	V
Grevillea glossadenia	No common name	Shrub	V	V
Homoranthus porteri	No common name	Shrub	V	V
Melaleuca uxorum	No common name	Shrub	-	E
Plectranthus amoenus	No common name	Semi-succulent shrub	-	V
Prostanthera clotteniana	Mint Bush	Shrub	CE	E

[1] Conservation status: CE - Critically Endangered; E - Endangered; V - Vulnerable. Hyphen indicates the species is not listed.

2.6.1 Conditions of EIS approval

The EIS (Environmental Impact Statement) compiled in compliance with the EPBC Act was approved with conditions in November 2015. Several aspects of this plan address key components of the conditions in respect of avoiding and minimising impacts to EPBC Act listed threatened species.

In relation to this Threatened Plants Management Plan, the following conditions of the approval are relevant.

General Conditions (listed in the EPBC Act approval)

1. The action is limited to the construction of a maximum of 63 wind turbines and associated infrastructure on the wind farm site.

2. To minimise impacts to EPBC Act listed threatened species, the approval holder must not disturb more than 58 ha of habitat for EPBC Act listed threatened species on the wind farm site.

3. Prior to commencement of the action, the approval holder must submit a Turbine Location and Development Footprint Plan identifying the final position of all turbines, access roads and associated operational and maintenance infrastructure, for the written approval by the Minister.

   Note: The approval holder may undertake micro-siting of turbines.

4 The Turbine Location and Development Footprint Plan must demonstrate how the approval holder has avoided and minimised disturbance to denning habitat for the Northern Quoll (*Dasyurus hallucatus*) and to *Grevillea glossadenia* and *Homoranthus porteri.*

3.0 DESCRIPTION OF EXISITING ENVIRONMENT

The Mt Emerald Wind Farm site is located at the northern limit of the Herberton Range and immediately north of Mt Emerald. The landscape is characterised by steeply dissected hills, rocky terrain and areas of precipitous ravines and narrow ridges. The broad geology of the site is mapped as the Walsh Bluff Volcanics, which comprises fine-grained rhyolite.

3.1 Vegetation

The predominant vegetation cover over the project site is a mosaic of sclerophyll woodlands, shrublands and heathlands.

Common trees of the woodlands include Lemon-scented Gum (*Corymbia citriodora*), Yellow Stringybark (*Eucalyptus mediocris* - this species was referred to its former name in the EIS as *E. portuensis*), Range Bloodwood (*C. abergiana*), Ironbark (*E. crebra*), Dead Finish (*E. cloeziana*), Cypress Pine (*Callitris intratropica*), Silver-leaf Ironbark (*E. shirleyi*), Orange Jacket (*C. leichhardtii*), White Stringybark (*E. reducta*), and *E. lockyeri.* The dominant grasses are usually Kangaroo Grass (*Themeda triandra*) and *Arundinella setosa*. Woodlands are most frequent over broad slopes, flats and rolling hills with less dissected surfaces.

Shrublands is characterised by many species, but typically include Sheoak (*Allocasuarina littoralis*), (*Xanthorrhoea johnsonii*), *Eucalyptus lockyeri*, Wattle (*Acacia aulacocarpa*), *Homoranthus porteri*, *Grevillea glossadenia*, and stunted forms of Range Bloodwood (*Corymbia abergiana*). Shrublands are generally found in relation to the ridge environment where thin rocky soils prevail. The endangered shrub *Melaleuca uxorum* is found on the boundary of this vegetation type with taller woodlands. It is found elsewhere in association with the montane heathland and rock pavements described below.

Heathlands have a special and diverse group of plants which include species such as Broom (*Jacksonia thesioides*), Grass Tree (*Xanthorrhoea johnsonii*), *Gompholobium nitidum*, the wattles *Acacia calyculata* and *A. whitei*, the grass *Cleistochloa subjuncea*, emergent stunted forms of *Eucalyptus lockyeri*, shrubs such as *Grevillea glossadenia* and *Homoranthus porteri*; and compact shrublets such as *Cryptandra debilis*, *Mirbelia speciosa* subsp. *ringrosei*, *Pseudanthus ligulatus*, *Zieria whitei*, *Boronia occidentalis* and others. The critically endangered *Acacia purpureopetala* and *Prostanthera clotteniana* grow in this vegetation type. It is referred to in the EIS as montane heathland, because of its reliance on high elevation aspects and very thin soils.

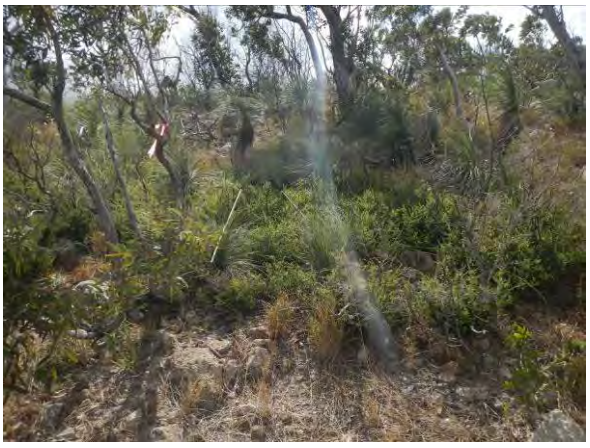
A feature of the montane heathland and shrublands at high elevation is the presence of rock pavements and areas of poorly vegetated rock outcrops. This particular habitat supports few large plant species because of the near-absence of soil or growth medium on their surfaces. The soil that does develop is trapped in rock hollows, scoops and crevices between rock plates and boulders, and is developed from small plants such as lichens, mosses and the remains of rock ferns (*Cheilanthes* spp.). This plant matter integrates with weathered rock material to form a soil that has the texture of peat, where in wetter times the absorbent nature of the medium is able to store water for longer periods. Plants on rock pavements include the Resurrection Plant (*Borya septentrionalis*), *Pseudanthus ligulatus*, scattered shrubs of *Grevillea glossadenia*, *Plectranthus* species (including the threatened *P. amoenus*) and occasionally, sentinel specimens of Cypress Pine (*Callitris intratropica*). Grasses are sparsely represented and can include Five Minute Grass (*Tripogon loliiformis*) and *Eriachne humilis*. *Eriachne mucronata* is often found around the edges of rock pavements. Some rock pavements are entirely covered by Firegrass (*Schizachyrium pachyarthron*).

3.2 Significance of the Ridge Environment and Key Plant Habitats

The high altitude ridges in the wet tropics bioregion section of the site (south of the 275 kV powerline) are sensitive environments that serve as important habitats for plants and the poorly represented montane heathland and shrubland mosaic found around 900 m ASL. Here the cloud base is a determinant of the moisture regime in relation to plants and their exposure to extreme conditions.

The land south of the 275 kV powerline holds the highest levels of species diversity and endemism, where many species are restricted to and have adapted to the harsh environment of exposed high elevation points on ridges, rock pavements and areas of skeletal soil. This montane habitat supports six species of plants which are listed as critically endangered, endangered and vulnerable under Queensland and Commonwealth legislation. Many other species, not listed under legislation, are restricted to the montane heathland along and on the edges of narrow ridges and rock pavement areas.

The rugged nature of the land with steep rocky slopes, bare rock pavements, outcrops and cliffs provides a unique environment for plants, and it is these characteristics which act as a refuge and reduces the effects of the severity and intensity of bush fires due to the low levels of flammable material such as grasses. Consequently, the conservation significant plants are found almost exclusively in fireproof habitats and niches. The protection from fire is a critical attribute, which renders most of the ridge tops and rock pavements as significant habitats where many threatened plants are able to persist.



Habitat of *Melaleuca uxorum* on edge of low woodland and shrubland. Outside of the tree and taller plant layer, montane heathland is present.

Matrix of low shrubland and montane heathland with *Homoranthus porteri* and *Acacia aulacocarpa*. This the specific habitat of *Acacia purpureopetala* on the wind farm site.

The rocky area in centre of photo is fire-protected habitat for *Prostanthera clotteniana*.

Montane heathland over large area of rock, here dominated by *Borya septentrionalis* and *Pseudanthus ligulatus*.

4.0 DESCRIPTIONS OF THREATENED PLANT SPECIES

The following descriptions are of threatened plants found on the Mt Emerald Wind Farm project site. To facilitate identification, the descriptions use characteristics of the plants as they are seen in the field within the project area. Detailed species distribution mapping is provided at the end of this document.

4.1 *Acacia purpureopetala*

Purple-flowering Wattle Family: Mimosaceae

Conservation Status: EPBC Act 1999: Critically Endangered; NC Act 1992: Vulnerable

Description

Habit: The Purple-flowering Wattle *Acacia purpureopetala* is a prostrate shrub with a spreading habitat growing to approximately 50 cm high. Most plants are lower and usually attain a height of 20-35 cm. Older plants have a distinctive "rosette" pattern to the branches, where they tend to radiate outwards in a circular fashion and arch downwards. Mature plants may spread to a diameter of one metre or more.

Branches are distinctly dull red, angular in cross-section, slightly hairy and often with blunt prickles formed by the bases of old phyllodes (leaves). **Leaves** (phyllodes) are grey green, small (25 mm long and 10 mm wide) and can be covered with fine pale hairs. The leaf apex is terminated by a short bristly point.

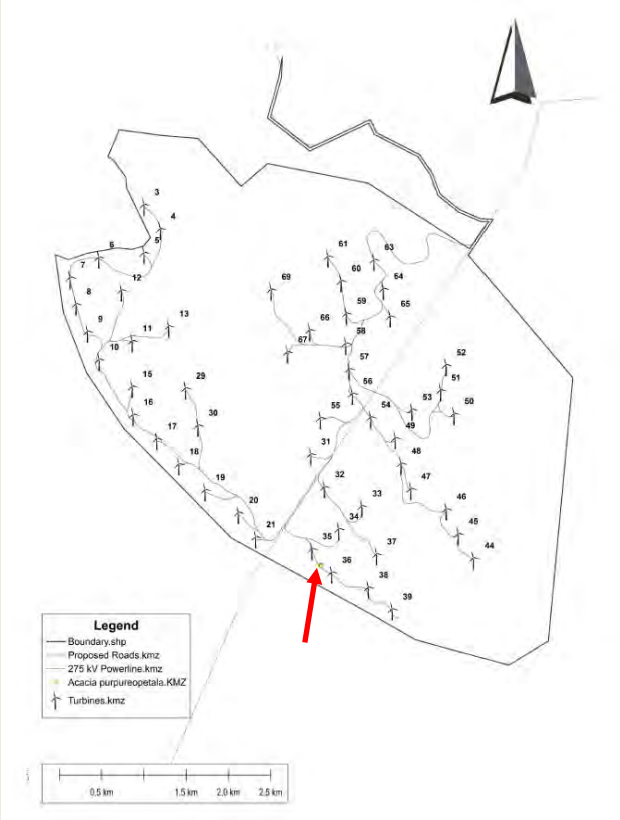
Flowers are a characteristic feature which can draw attention to the plant's presence. They are ball-shaped about 10 mm diameter or less and are pink to pale purple. Flowering occurs between December through to about July, but sporadic flowering can occur during other months. **Fruit** is a flattened pod with swellings where the seeds are held inside, up to 30 mm long and 8 mm wide. The pod when fresh is often a similar colour to the leaves and can be quite obscure. When dry it turns brown, splits open lengthways and contains about 1 to 5 hard, black seeds.

Seedlings in the early stages of development have a characteristic "bipinnate" leaf appearance, but later this feature falls off the seedling and the leaves are similar to those found on adult plants. Seedlings are mostly single-stemmed, green and erect and are often covered in fine pale hairs.

Distinguishing characteristics are the low-growing habit, reddish stems that radiate in a circular fashion from the main stem, small grey-green phyllodes, and pink-purple ball flowers. *Acacia purpureopetala* is the only wattle in Australia with pink or purple flowers. All other species of wattle in the region have white, cream or yellow flowers (in rods or balls).

Distribution: *Acacia purpureopetala* is endemic to northern Queensland and has a restricted distribution with populations between Herberton and Irvinebank, Stannary Hills, and Silver Valley. The Mt Emerald Wind Farm site populations represent the most north-eastern distribution of the species, where it is found at only a single location between WTG's 35 and 36.

The location of known populations of *A. purpureopetala* on or near the Mt Emerald Wind Farm site is shown in **Figure 2**.



Location of *Acacia purpureopetala* - Mt Emerald Wind Farm.

Acacia purpureopetala foliage and flowers. Photo SG

Acacia purpureopetala growth habit. Photo TDR

Acacia purpureopetala fruit pod. Photo SG

Acacia purpureopetala seedling. Photo SG

Figure 2: *Acacia purpureopetala* (Purple-flowering Wattle)

4.2 *Grevillea glossadenia*

(No common name - a Grevillea) Family: Proteaceae

Conservation Status: EPBC Act 1999: Vulnerable; NC Act 1992: Vulnerable

Description

Habit: *Grevillea glossadenia* (no common name) is a well-branched and often rounded shrub which grows to approximately 2 metres tall. On the Mt Emerald Wind Farm site, this species rarely gets much taller than 1.6 m. The **leaves** of *G. glossadenia* are elliptic with entire margins and about 12 cm long. They are not divided or lobed like many other Grevillea species in Australia. The upper surface of the leaf is typically light green, and the lower surface is characteristically silvery, with a slight metallic sheen, where the veins can be easily seen.

Flowers are mixture of yellow, orange and red and quite attractive and large enough to be easily see from a short distance.

Fruits are a follicle, which superficially resembles a pea pod. They are green when fresh and ripen to almost black, at which time they split open lengthways and contain one or two flattened and slightly papery seeds.

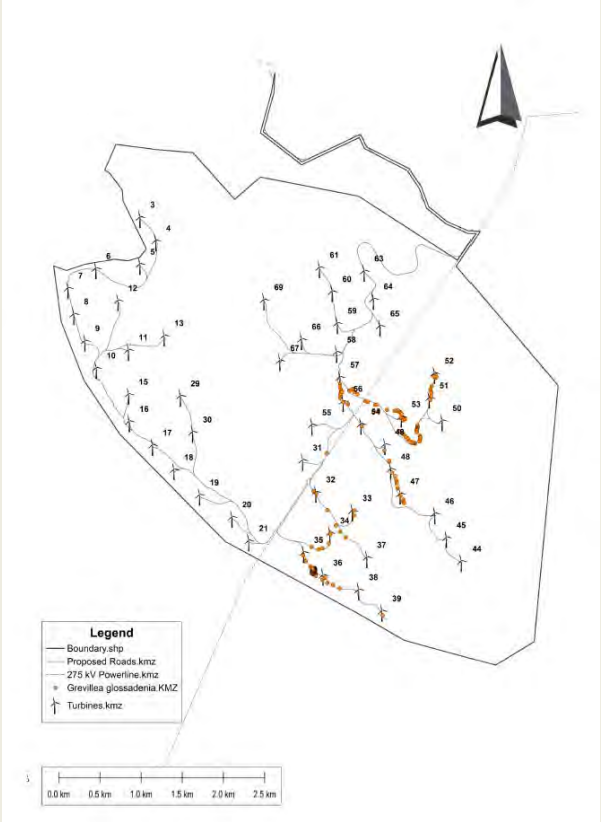
Seedlings have leaves similar in shape to the adult plants but are smaller.

Distinguishing characteristics of *G. glossadenia* are the silvery sheen on the lower leaf surface and the conspicuous red-yellow-orange flowers. In some areas and especially a few months after a bushfire, the seedlings can be seen growing densely around burnt and dead adult plants.

Habitat: *Grevillea glossadenia* grows in rocky soils or on ridges in exposed conditions or on the edges of woodlands. It rarely grows under woodland cover. Associated plants can include: *Eucalyptus lockyeri*, *E. mediocris*, *Corymbia abergiana*, *C. citriodora*, *Xanthorrhoea johnsonii* and the grasses *Themeda triandra* and *Cleistochloa subjuncea*.

Distribution: *Grevillea glossadenia* is endemic to northern Queensland and has a restricted distribution, with the main populations around Mt Emerald, Irvinebank and Silver Valley. The population on the Mt Emerald Wind Farm site is large when compared to other more dispersed populations in the region.

The location of known populations of *G. glossadenia* on or near the Mt Emerald Wind Farm site is shown in **Figure 3**. On the wind farm site it is found mainly close to and south of the 275 kV powerline and is widely distributed in this area. It is often encountered on the edges of existing tracks.



Location of *Grevillea glossadenia* - Mt Emerald Wind Farm.

Grevillea glossadenia foliage and flowers. Photo SG

Grevillea glossadenia growth habit. Photo SG

Grevillea glossadenia fruit pod. Photo SG

Grevillea glossadenia seedlings. Photo SG

Figure 3: *Grevillea glossadenia* (no common name - a Grevillea)

4.3 *Homoranthus porteri*

(No common name) Family: Myrtaceae

Conservation Status: EPBC Act 1999: Vulnerable; NC Act 1992: Vulnerable

Description

Habit: *Homoranthus porteri* (no common name) is an upright and spreading shrub which grows to approximately 2 metres tall and forms dense, woody thickets. On the Mt Emerald Wind Farm site this species rarely gets much taller than 1.7 m.

Leaves of *H. porteri* are narrow and linear, approximately 10 mm long and 1.5 mm wide, with entire margins and a pointed apex. Leaves are arranged oppositely and tend to be crowded towards the ends of the branches. The leaf veins are very difficult to see.

Flowers are pink to red and occasionally with white. They grow in "pairs" on the branches and are quite attractive. When in full flower, the flowers can be seen from some distance.

Fruits are difficult to come across and see and are a light brown dry, semi-woody capsule.

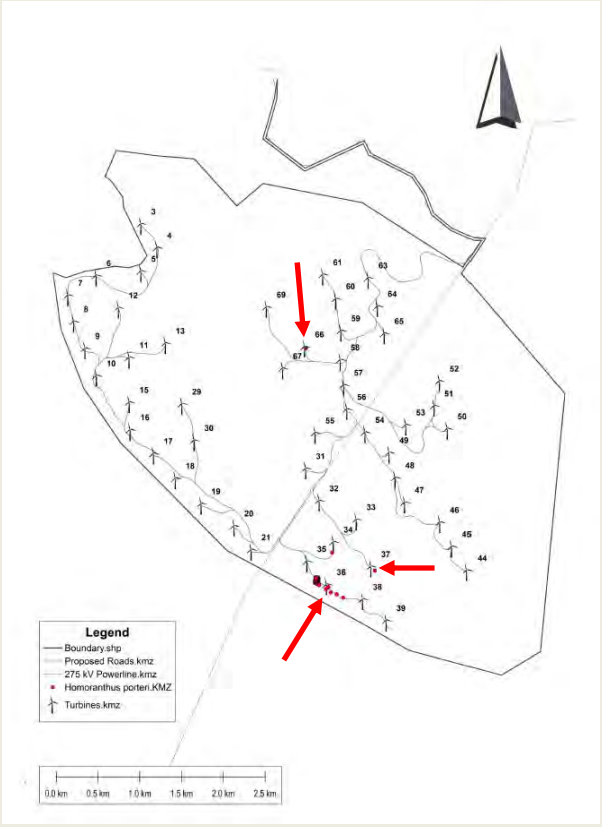
Seedlings have leaves similar in shape to the adult plants but are slightly smaller.

Distinguishing characteristics of *H. porteri* are its bright green foliage, narrow leaves and bright pink to red flowers that grow in pairs. Another feature is its preference for growing on or around the edges of rock pavements or large areas of bare rock.

Habitat: *Homoranthus porteri* grows on and around rock pavements and amongst wide areas of bare or poorly vegetated rocks and mostly on ridges or above very steep rocky slopes. It is seldom found under trees of woodlands. Associated species include *Acacia aulacocarpa*, *Leptospermum amboinense*, *Pseudanthus ligulatus*, *Grevillea glossadenia* and *Eucalyptus lockyeri*. Grasses include *Cleistochloa subjuncea*, *Cymbopogon obtectus*, *C. bombycinus* and *Aristida* spp. Stunted trees of *Corymbia abergiana* are sometimes found around the edges of rock pavements.

Distribution: *Homoranthus porteri* is endemic to northern Queensland and has a restricted distribution, with the main populations around Mt Mulligan, Mt Emerald, Watsonville, and south to near Ravenshoe. A disjunct occurrence of the species is found north-west of Townsville. The populations on the Mt Emerald Wind Farm site are large and significant in a regional context.

The location of known populations of *H. porteri* on or near the Mt Emerald Wind Farm site is shown in **Figure 4**. On the wind farm site the largest populations are found south of the 275 kV powerline along the ridge between WTG's 38 and 35. Another reasonably large population is found around the edge of the rock pavement at WTG 66.



Location of *Homoranthus porteri* - Mt Emerald Wind Farm.

Homoranthus porteri foliage and flowers. Photo SG

Homoranthus porteri growth habit. Photo SG

Homoranthus porteri habit on rock pavement. Photo SG

Homoranthus porteri typical habitat. Photo SG

Figure 4: *Homoranthus porteri* (no common name)

4.4 *Melaleuca uxorum*

(No common name) Family: Myrtaceae

Conservation Status: NC Act 1992: Endangered

Description

Habit: *Melaleuca uxorum* (no common name) is a low-growing, dense and stiff shrub, which grows to approximately 1 metre tall and forms very closely spaced, woody thickets.

Leaves of *M. uxorum* are light to mid-green and are arranged oppositely on the branches in a distinct pattern, where the pairs of leaves are at right-angles to each other (decussate). Leaves are small, scale-like and rounded with the tips curving backwards. They have a distinctive pointed apex giving the shrub a prickly texture.

Flowers are white and similar to a small bottlebrush flower with many stamens.

Fruits are a compact, rounded woody capsule and are grouped together and held tightly to the branches.

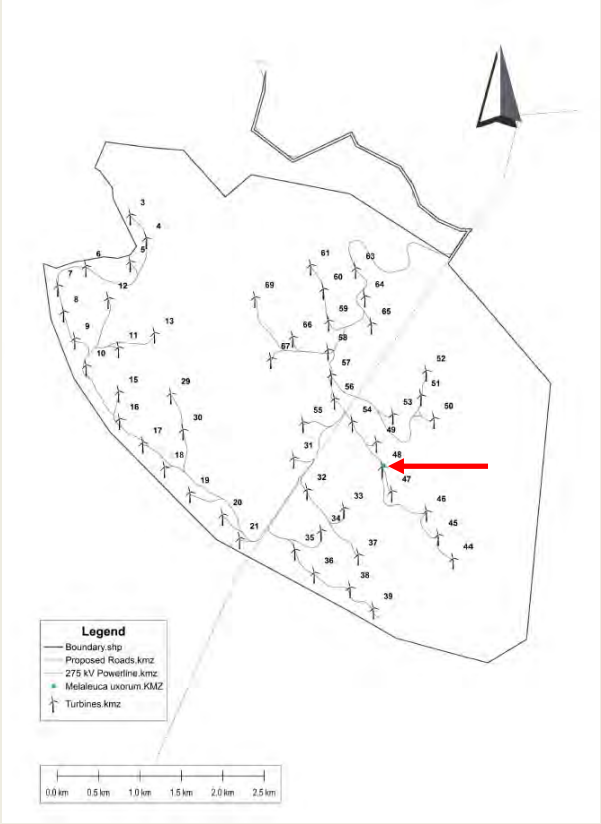
Seedlings have not be observed, but the juvenile foliage of *M. uxorum*, which is typically seen when plants regenerate after fire, is similar to the adult leaves and lighter green.

Distinguishing characteristics of *M. uxorum* are its low, dense thicket habitat and the small decussate, prickly scale-like leaves. Shrubs are prickly to touch, which is caused by the sharp, pointed apex of the leaf.

Habitat: *Melaleuca uxorum* grows on very rocky slopes and rock pavements and generally in exposed, wind-swept areas of ridges. Associated species include *Acacia aulacocarpa*, *A. calyculata*, *Pseudanthus ligulatus*, *Grevillea glossadenia*, *Eucalyptus lockyeri*, *E. mediocris*, and *Corymbia abergiana*. Grasses include *Cleistochloa subjuncea* and *Themeda triandra*. Grass trees (*Xanthorrhoea johnsonii*) are often present.

Distribution: *Melaleuca uxorum* is endemic to northern Queensland and has a very restricted distribution, where the species is represented by only 6 or 7 small populations on Mt Emerald and the wind farm site. The populations on the Mt Emerald Wind Farm site are therefore of very high significance in a regional context.

The location of the population of *M. uxorum* on the Mt Emerald Wind Farm site is shown in **Figure 5**. It is found on the eastern edge of the broad ridge between WTG's 48 and 49 just below the wind monitoring tower.



Location of *Melaleuca uxorum* - Mt Emerald Wind Farm.

Melaleuca uxorum foliage. Photo SG

Melaleuca uxorum regeneration after fire. Photo SG

Melaleuca uxorum fruit capsules. Photo SG

Melaleuca uxorum habitat below monitoring tower. Photo SG

Figure 5: *Melaleuca uxorum* (no common name)

4.5 *Plectranthus amoenus*

(Plectranthus) Family: Lamiaceae

Conservation Status: NC Act 1992: Vulnerable

Description

Habit: *Plectranthus amoenus* (Plectranthus) is a sparse open growing semi-succulent shrub with grey stout, ascending stems. The species grows to approximately 60-70 cm tall. The stems radiate outwards at the base from a central growth point.

Leaves of *P. amoenus* are thick and fleshy and covered with dense, pale hairs. Leaves have a felt-like texture. They are broad and have prominent raised veins. Leaves are aromatic when crushed. The veins are readily visible on both sides of the leaf and strongly raised on the lower surface.

Flowers are quite small (about 10 mm long), blue to purple and arise from a terminal stalk held above the main stems. The flowers are unscented.

Fruits are a small, dry papery capsule.

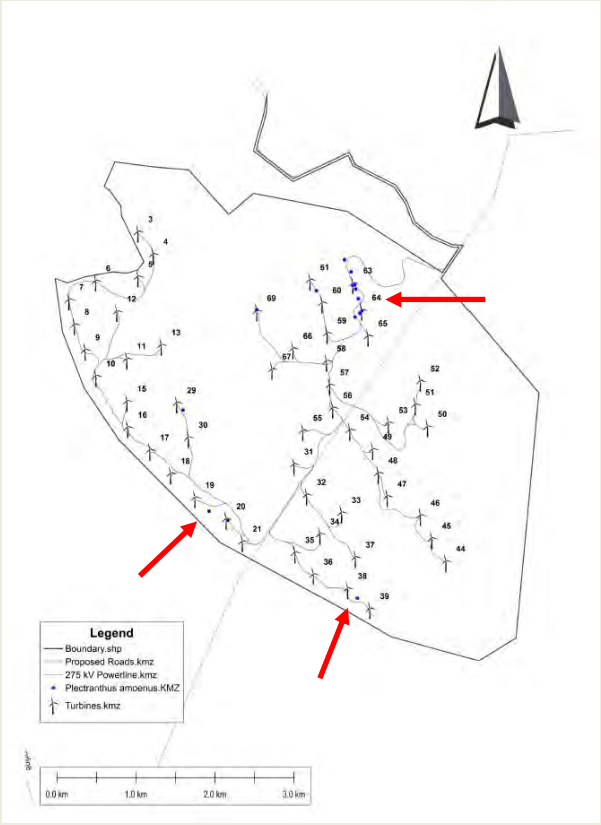
Seedlings have not be observed, but the juvenile foliage of *P. amoenus* is similar, but smaller than the adult leaves and the leaves are soft and felt-like to touch.

Distinguishing characteristics of *P. amoenus* are its sparse open growth habitat with only a few ascending grey and fleshy stems. The thick, soft and felt-like leaves are a feature of the species. Its preference for bare rock pavements is also the characteristic habitat.

Habitat: *Plectranthus amoenus* grows almost exclusively on rock pavements and large areas of bare rock in accumulated soil pockets and in crevices. The species has a strong association with the tree *Callitris intratropica* on the wind farm site. Associated species include the grass *Eragrostis schultzii* and the Cypress Pine *Callitris intratropica*.

Distribution: *Plectranthus amoenus* is endemic to northern Queensland and is primarily confined to the Herberton Range.

The location of the population of *Plectranthus amoenus* on the Mt Emerald Wind Farm site is shown in **Figure 6**. The largest populations are found north of the 275 kV powerline around WTG's 61, 63, 64 and 65. Isolated occurrences occur further south in the project area.



Location of *Plectranthus amoenus* - Mt Emerald Wind Farm.

Plectranthus amoenus foliage and flowers. Photo SG

Plectranthus amoenus underside of leaf. Photo SG

Plectranthus amoenus habit. Photo SG

Plectranthus amoenus typical habitat. Photo SG

Figure 6: *Plectranthus amoenus* (Plectranthus)

4.6 *Prostanthera clotteniana*

(Mint Bush) Family: Lamiaceae

Conservation Status: EPBC Act: Critically Endangered; NC Act 1992: Endangered

Description

Habit: *Prostanthera clotteniana* (Mint Bush) is a small erect, openly branched shrub which grows to about 1 metre tall. The Mt Emerald Wind Farm specimens grow to approximately 60 cm tall. Plants grow separately from each other and do not form thickets or dense shrubby areas.

Leaves of *P. clotteniana* are light green, opposite or in whorls of three. They are broader towards the apex and up to 35 mm long and 9 mm wide. On close inspection, both surfaces of the leaf are covered with fine, pale silky hairs which lay flat. The same hairs are found on the younger branches. The leaf veins are difficult to see. The apex of the leaf is drawn into a short point.

Flowers are pink to white (the wind farm population flowers are predominantly white) and about 10 mm, with attractive, lobed petals. The throat of the flower is streaked with pink to purple fine lines.

Fruits of *P. clotteniana* have not been observed, but is expected to be an inconspicuous dry capsule.

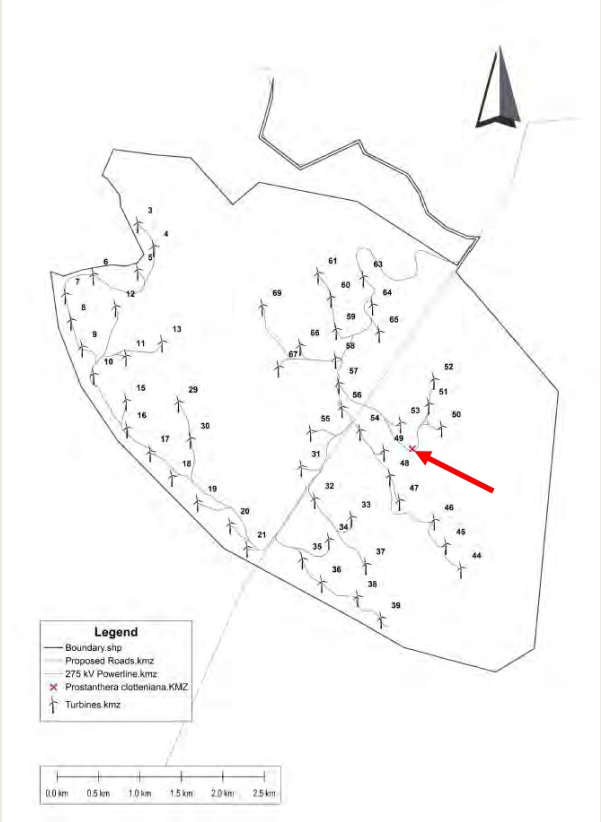
Seedlings have a similar erect growth habit of the adult plants but the features are much smaller (i.e. smaller leaves and less degree of branching).

Distinguishing characteristics of *Prostanthera clotteniana* are its low, open-branched erect growth habitat and attractive flowers. The grey branches with fine pale silky hairs is characteristic. When not in flower, this species is difficult to identify quickly and looks superficially similar to the widespread shrub *Platysace valida*.

Habitat: *Prostanthera clotteniana* grows in exposed rocky areas that are protected from hot fires. The species prefers the tops of steep rocky drop-offs and with a southeast aspect. Associated species include *Pseudanthus ligulatus*, *Grevillea glossadenia*, *Eucalyptus lockyeri* and *Xanthorrhoea johnsonii*. There can be woodland of *Eucalyptus reducta* in gullies and on slopes in adjacent areas. Grasses include *Cleistochloa subjuncea*, *Cymbopogon obtectus* and *Themeda triandra*.

Distribution: *Prostanthera clotteniana* is endemic to northern Queensland and is highly restricted. Populations are found near Ravenshoe, the Dinden State Forest to the north-east, and the single population of the Mt Emerald Wind Farm site. It has also been recorded from the Baal Gammon mine area near Watsonville, and at lower elevation around Oaky Creek. All populations are small.

The location of the population of *P. clotteniana* on the Mt Emerald Wind Farm site is shown in **Figure 7**. It is found on the eastern edge of the broad ridge south of WTG 53.



Location of *Prostanthera clotteniana* - Mt Emerald Wind Farm.

Prostanthera clotteniana foliage and flowers. Photo SG

Prostanthera clotteniana growth habit. Photo SG

Prostanthera clotteniana flower and branches. Photo SG

Prostanthera clotteniana habitat. Photo SG

Figure 7: *Prostanthera clotteniana* (Mint Bush)

5.0 IMPACTS TO THREATENED PLANTS AND HABITATS

Impacts are expected to occur during the construction and operational phases of the project. A range of new impacts will occur at the decommissioning stage; for example, tracks will require re-widening to allow for heavy machinery access.

The primary impacts are those associated with vegetation clearing at WTG construction pads and the linear clearing between WTG's. It is expected that the most severe effect of impacts will occur in the dissected land south of the 275 kV powerline, which coincides with the greatest representation of poorly represented and specialised habitats for threatened plants. Much of this habitat is found from 850 m ASL and above.

The removal of habitat in this altitudinal zone will have implications in regard to the total area of similar habitat for these plants found in the region. For example, clearing ridges around and above the 900 m contour will remove the key habitat for *Homoranthus porteri* and *Acacia purpureopetala*. These species are restricted to this type of particular habitat on the site.

5.1 Types of Impact

5.1.1 Vegetation and habitat clearing

Linear clearing causes edge effects, pathways for weeds, and potential for pathogens and diseases. Clearing also creates barrier effects with the potential to limit seed movement and genetic material across landscapes.

On a smaller scale, surface hydrology can be altered and redirected, which affects micro-habitat function in sensitive environments reliant on limited resources such as mosses, lichens and ferns which contribute to pockets of soil and the scarce growing medium required by threatened plants restricted to ridges and rock pavements. This is more applicable to narrow ridges where the actual habitat representation for threatened plants may only be in the order of 5-10 m wide in places.

Slow vegetation succession is also expected on ridges where soil development is minimal and of very low fertility. Plant species which occur along ridges are specialists and rely on special habitat and soil characteristics that may not be able to be replaced or rehabilitated to their original status.

Some plants of ridges are termed obligate seeders, where their regeneration capacity is only through production and germination of seed. This regenerative strategy differs from other plants of ridges and woodlands that may recover from resprouting from root or stem stock. Scalping of ridge top soils will remove the soil seed bank, and if excavated to a depth below the root zone, could seriously affect the species composition of regenerating vegetation.

5.1.2 Invasive weeds

Invasive weeds are introduced grasses and broadleaf plants (i.e. non-native species). Weeds displace native plants and habitats. They contribute to changed fire regimes, which negatively affect the structure, flora composition and habitat values of native vegetation. On the Mt Emerald Wind Farm site, invasive grasses and other weeds pose a significant threat to the natural values of the project area. Invasive weeds place adverse and unnatural pressure on the integrity and function of the vegetation of all aspects of the wind farm site, and notably the function of threatened plant habitats. Hence, it is crucial that weed management and control is actively and diligently practiced throughout all stages of the project.

Weed invasion results in loss of vegetation and landscape integrity. The impacts of weeds affects vegetation function, alters floristic composition, retards or stops natural plant regeneration and has a profound effect on the local fire ecology and dynamics. Species of weeds that have a high potential to enter the site through construction will be those found primarily along the access road edges; those which are already present at higher elevation; and a range of other deleterious species generally found in drier landscapes. Invasive weeds move into a site through human activity, on machinery and vehicles and by expansion of nearby weed populations (for example, along Kippen Drive).

5.1.3 Altered fire dynamics

Altered fire dynamics may occur as a result of increased fuel loads developing adjacent to newly cleared tracks. Changed fire ecology could result in the elimination of certain plant species or the promotion of different plant functional groups, and consequently, change the habitat micro-environment.

Obligate seeder species are killed by fire and regenerate through germination of seed stored in the soil seed bank; whereas, resprouters recuperate after fire by reshooting from stems or rootstock. Fire ecology (intensity, timing, duration etc) is critical for the successful regeneration of plant communities. As many rock areas are considered refuges, inappropriate fire regimes that breach the natural level of protection afforded by rock pavements and outcrops are likely to have a negative effect at least in the short-term, but possibly in the longer-term if the fire event is unnaturally severe.

The introduction of dense swards of grass (weeds or even native species) that are not typical of a particular vegetation type or habitat has the capacity to tilt fuel loads and could introduce unnatural fire events in formerly protected rock environments.

5.1.4 Erosion and sedimentation

Following track and WTG pad construction, an increased potential for soil erosion will be present. Different sections of the site have different soil textures and structures, and therefore, the potential for erosion will vary according to site-specific situations. Slope and rainfall intensity will also affect the rate and severity of soil erosion.

Sediment movement from construction and excavation areas in niche habitats for threatened plants has the potential to adversely alter the soil fertility and drainage status - both of which are crucial factors that if changed could displace threatened species from a particular habitat, and allow opportunistic weeds to quickly colonise more fertile soil environments.

5.2 Information Gaps Regarding Impacts

It is not fully understood what practices are best suited to rehabilitating the disturbed land and plant habitats of ridges dominated by rock cover. Natural plant regeneration is expected to be slow. The loss of fruticose and crustose lichens, mosses and ferns from cleared rock areas will affect the rate and status of soil generation on otherwise soilless landforms. This will have implications for the eventual plant species composition and success rates of rehabilitation.

On more dissected ridges, where a majority of threatened plants grow, it is expected that the original floristic composition and structure will not be able to be accurately reproduced through conventional rehabilitation treatment. This has implications for the rehabilitation and maintenance of specific habitat types for threatened plants.

6.0 THREATENED PLANTS MANAGEMENT STRATEGIES

This section outlines the environmental management strategies required for mitigating the impacts (section 5.0) on threatened plants and their habitats described in section 3.0. The strategies provide guidance on the overall management plan intent and its purpose to avoid or limit the impact to threatened plants and key habitats. The strategies also identify the desired management outcomes and standards.

The following management strategies are intended to target the impacts from pre-construction to post-construction of the wind farm, which includes the stage of decommissioning. Prior to the decommissioning stage and periodically throughout the operational stage, the management strategies are to be reviewed and amended to allow for unpredicted circumstances or events that require an adaptive management approach.

Management Strategy 1: Avoid direct impacts on threatened plant species and their habitats during construction, operation and decommissioning of the wind farm.

Management Strategy 2: Where direct impacts to threatened plants are unavoidable, reduce the level of impacts on threatened plant species and their habitats during construction, operation and decommissioning.

Management Strategy 3: Avoid indirect impacts on threatened plant species during construction, operation and decommissioning.

Management Strategy 4: Maintain and enhance the populations of threatened plant species and their habitats following completion of the wind farm construction.

6.1 Threatened Plants Management Actions

The broader management strategies described above form the basis for individual management actions. Specifically, management actions include the key components of management measures, monitoring, success indicators and corrective actions. These are detailed in **Table 2** to **Table 5** on the following pages.

Table 2. Threatened Plants Management Strategy 1.

MANAGEMENT STRATEGY 1	Avoid direct impacts on threatened plant species and their habitats	
Threatened Plants Management Actions	**Responsibility**	**Timing**
- Complete pre-clearance surveys in conjunction with surveyors, engineers and civil contractors prior to final decision on road alignment and position of WTG's.	Botanist/Environmental Officer/Senior Contractors	Pre-construction
- Align roads and cabling network, and micro-site WTG base pads in order to avoid physical disturbance to these species and the supporting habitat (see buffer below).	Environmental Officer	Pre-construction
- Identify and clearly mark all populations in vicinity of potential impact. Establish a minimum **30 metre** quarantine zone buffer around each population of ***Acacia purpureopetala***, ***Homoranthus porteri***, ***Melaleuca uxorum*** and ***Prostanthera clotteniana***. No machinery or contractor work (except environmental) to be allowed in quarantine zone.	Botanist	Pre-construction
- Provide permanent signage: "Sensitive Environmental Area" in clear view of buffer edge of each population of ***Acacia purpureopetala***, ***Homoranthus porteri***, ***Melaleuca uxorum*** and ***Prostanthera clotteniana***.	Environmental Officer	Pre-construction
- All contractors to be provided with identification guides/species profile sheets for each threatened plant species. - Contractors to be given site-specific threatened plant induction and familiarisation training. New contractors to be inducted prior to construction - when required.	Environmental Officer/Botanist/Contractors	Pre-construction and/or at stage when new contractor enters site.
- Constrain clearing and modification of narrow ridges to the absolute minimum to achieve useable road width.	Environmental Officer/Contractors	Construction
- DO NOT construct or direct turn-out drains in the vicinity of populations of ***Acacia purpureopetala***, ***Homoranthus porteri***, ***Melaleuca uxorum*** and ***Prostanthera clotteniana***. - Maintain a minimum distance of 30 metres from sensitive population areas during construction of WTG pads.	Environmental Officer/Contractors	Construction
- Rehabilitate road edges in accordance with **Rehabilitation Plan** and increase areas of specific threatened plant habitat where possible. - ONLY native plant seed sourced from a local provenance is to be used. NO exotic grasses and pasture legumes will be used.	Environmental Officer/Botanist	Post-construction
- Take opportunities to selectively harvest seed from the wind farm site populations of all threatened plant species. Store, label and record data appropriately.	Botanist	All stages
- Report any new or suspected populations of ***Acacia purpureopetala***, ***Homoranthus porteri***, ***Melaleuca uxorum*** and ***Prostanthera clotteniana*** immediately and mark location in field. - Alert machinery operators and contractors in vicinity to avoid work at new or suspected new population until clearance has been given.	Environmental Officer/Contractors/Botanist	All stages

Threatened Plants Management Strategy 1 (continued).

MANAGEMENT STRATEGY 1	Avoid direct impacts on threatened plant species and their habitats	
Monitoring	**Responsibility**	**Timing**
- Develop a **Monitoring Program** for management actions in relation to measuring effectiveness of impact mitigation for all threatened plants.	Environmental Officer/Botanist	Pre-construction
- Map all locations of threatened plants: record coordinates, location in relation to WTG's.	Botanist	Pre-construction
- Define population boundaries of ***Acacia purpureopetala***, ***Homoranthus porteri***, ***Melaleuca uxorum*** and ***Prostanthera clotteniana*** and undertake population counts. Including any new population discoveries.	Botanist	All stages
- Establish photographic monitoring protocol and intervals.	Environmental Officer	All stages
- Record baseline data and on-going population health observations: flowering, fruiting, dieback, seedling emergence and survival, mortality.	Environmental Officer/Botanist	All stages
- Record "natural" damage, modification or significant decline in population size and health.	Environmental Officer/Botanist	All stages
- Record all fire events: date, source (if known), severity and impact on populations. - Record extreme weather events: frost, heavy rain (and erosion if present), drought, cyclone.	Environmental Officer	All stages
- Record and report all incidences of human damage or modification to populations and the significant habitat area.	Environmental Officer	All stages
- Review monitoring program.	Environmental Officer	Twice yearly
Success Indicators	**Responsibility**	**Timing**
- No impact to significant habitat or decline in population sizes of ***Acacia purpureopetala***, ***Melaleuca uxorum*** and ***Prostanthera clotteniana***. There is likely to be a reduction in the number and size of *Homoranthus porteri* and *Grevillea glossadenia* populations near WTG36, but avoidance is recommended where feasible.	Environmental Officer	All stages
- Increase in population size and number of individuals of ***Acacia purpureopetala***, ***Melaleuca uxorum*** and ***Prostanthera clotteniana***.	Environmental Officer	All stages
Corrective Actions	**Responsibility**	**Timing**
- Increase quarantine zone buffers if found to be inadequate.	Environmental Officer	When required
- Improve quality of significant habitat by eliminating weeds if present.	Environmental Officer	When required
- Increase area of rehabilitation for habitat enhancement.	Environmental Officer	When required
- Review rehabilitation species selection if incorrect or poor establishment success.	Environmental Officer	When required

Table 3. Threatened Plants Management Strategy 2.

MANAGEMENT STRATEGY 2	Where direct impacts to threatened plants are unavoidable, reduce the level of impacts on threatened plant species and their habitats	
Threatened Plants Management Actions	**Responsibility**	**Timing**
- Complete pre-clearance surveys in conjunction with surveyors, engineers and civil contractors prior to final decision on road alignment and position of WTG's.	Botanist/Environmental Officer/Senior Contractors	Pre-construction
- Align roads and cabling network, and micro-site WTG base pads in order to avoid physical disturbance to these species and the supporting habitat.	Environmental Officer	Pre-construction
- Reduce the width and area of clearing to an absolute minimum necessary to achieve useable road width and construction pad.	Environmental Officer/Contractors	Construction
- Avoid inadvertent and unnecessary clearing by observing quarantine areas and significant habitat zones. - Clearly mark all locations of threatened plants. - Only clear what is necessary. - Provide threatened plant profile sheets to contractors and retain in machinery (see below).	Environmental Officer/Contractors	Construction
- All contractors to be provided with identification guides/species profile sheets for each threatened plant species. - Contractors to be given site-specific threatened plant induction and familiarisation training. New contractors to be inducted prior to construction - when required.	Environmental Officer/Botanist/Contractors	Pre-construction and/or at stage when new contractor enters site.
- Select road routes that follow straighter contours and avoid tight bends and zig-zagging.	Environmental Officer/Contractors	Pre-construction and construction
- Reduce size of disturbance footprint for turn-out drains and construction pads. - Avoid over-widening bends to accommodate truck and heavy machinery turning limits.	Environmental Officer/Contractors	Construction
- Avoid clearing and damaging large trees (>30 cm diameter at breast height). - Retain tree buffers around montane heathland vegetation where possible.	Environmental Officer/Contractors	Construction
- Identify and approve location of major soil and rock stockpiles prior to earthmoving. - Do not stockpile soil and rock spoil indiscriminately or on areas of montane heathland vegetation.	Environmental Officer/Contractors	Construction
- Rehabilitate road edges and turbine pads in accordance with **Rehabilitation Plan** and increase areas of threatened plant habitat where possible. - ONLY native plant seed sourced from a local provenance is to be used. NO exotic grasses and pasture legumes will be used.	Environmental Officer/Botanist	Post-construction

Threatened Plants Management Strategy 2 (continued).

MANAGEMENT STRATEGY 2	Where direct impacts to threatened plants are unavoidable, reduce the level of impacts on threatened plant species and their habitats	
Threatened Plants Management Actions	**Responsibility**	**Timing**
- DO NOT burn windrowed cleared vegetation. - Pre-harvest seed from selected plants species if available prior to clearing. - Store heath vegetation separately from large tree branches and stems, and use shrub branches in rehabilitation sites.	Environmental Officer/Botanist	All stages
- Take opportunities to selectively harvest seed from the wind farm site populations of all threatened plant species. Store, label and record data appropriately.		
- Identify threatened plants (tag and mark) that are candidates for translocation. - Translocate to recipient site as soon as possible after removal from site and manage in accordance with **Threatened Plant Translocation Plan**.	Botanist/Environmental Officer	Pre-construction and construction
- Report any new or suspected populations of ***Acacia purpureopetala***, ***Homoranthus porteri***, ***Melaleuca uxorum*** and ***Prostanthera clotteniana*** immediately and mark location in field. - Alert machinery operators and contractors in vicinity to avoid work at new or suspected new population until clearance has been given.	Environmental Officer/Contractors/Botanist	All stages
Monitoring	**Responsibility**	**Timing**
- Develop a **Monitoring Program** for management actions in relation to measuring effectiveness of impact mitigation for all threatened plants.	Environmental Officer/Botanist	Pre-construction
- Map all locations of threatened plants: record coordinates, location in relation to WTG's.	Botanist	Pre-construction
- Establish photographic monitoring protocol and intervals.	Environmental Officer	All stages
- Define population boundaries of all threatened plants, particularly ***Acacia purpureopetala***, ***Homoranthus porteri***, ***Melaleuca uxorum*** and ***Prostanthera clotteniana*** and undertake population counts. Including any new population discoveries.	Botanist	All stages
- Record area and number of cleared plants. - Record species names, number and location of translocated plants. - Map all records and enter into monitoring database.	Environmental Officer	Construction and post-construction
- Record baseline data and on-going population health observations: flowering, fruiting, dieback, seedling emergence and survival, mortality.	Environmental Officer/Botanist	All stages
Success Indicators	**Responsibility**	**Timing**
- No loss or decline in population sizes of ***Acacia purpureopetala***, ***Melaleuca uxorum*** and ***Prostanthera clotteniana***. There is likely to be a reduction in the number and size of *Homoranthus porteri* populations near WTG36, but avoidance is recommended. *Grevillea glossadenia* and *Plectranthus amoenus* will also be affected.	Environmental Officer	All stages

Threatened Plants Management Strategy 2 (continued).

MANAGEMENT STRATEGY 2	Where direct impacts to threatened plants are unavoidable, reduce the level of impacts on threatened plant species and their habitats	
Success Indicators	**Responsibility**	**Timing**
- Increase in population size and number of individuals of ***Acacia purpureopetala***, ***Melaleuca uxorum*** and ***Prostanthera clotteniana***.	Environmental Officer	All stages
- Active regeneration of *Grevillea glossadenia* around disturbance sites where it formerly existed. - Successful establishment of *Plectranthus amoenus* on adjacent/recipient rock pavements and in suitable habitat. - Successful translocation for all threatened plants managed in this way.	Environmental Officer	All stages
Corrective Actions	**Responsibility**	**Timing**
- Increase quarantine zone buffers if found to be inadequate.	Environmental Officer	When required
- Improve quality of significant habitat by eliminating weeds if present.	Environmental Officer	When required
- Increase area of rehabilitation for habitat enhancement.	Environmental Officer	When required
- Review rehabilitation species selection if incorrect or poor establishment success.	Environmental Officer	When required
- Review translocation program if low success rates.	Environmental Officer	When required

Table 4. Threatened Plant Management Strategy 3.

MANAGEMENT STRATEGY 3	Avoid indirect impacts on threatened plant species during construction, operation and decommissioning.	
Threatened Plants Management Actions	**Responsibility**	**Timing**
- Develop a **Weed Management Plan** prior to construction.	Botanist	Pre-construction
- Map all occurrences and categories of weeds prior to construction.	Botanist	Pre-construction
- Reduce potential for erosion to affect significant habitats by reducing road widths and the disturbance footprint.	Environmental Officer/Contractors	Construction
- Avoid constructing turn-out drains near significant habitats.	Environmental Officer/Contractors	Construction
- DO NOT burn windrowed cleared vegetation. - DO NOT start *ad hoc* bush fires.	Environmental Officer/Contractors	Construction
- Control all weeds in Significant plant habitat areas according to the **Weed Management Plan**.	Environmental Officer/Contractors	Construction
- Maintain and proceed with an effective program of progressive rehabilitation in accordance with the **Rehabilitation Plan**. - Rehabilitate all disturbed sites after disturbance and impact.	Environmental Officer/Contractors	All stages
Monitoring	**Responsibility**	**Timing**
- Develop a **Monitoring Program** for management actions in relation to measuring effectiveness of impact mitigation for all threatened plants.	Environmental Officer/Botanist	Pre-construction
- Establish photographic monitoring protocol and intervals.	Environmental Officer	All stages
- Undertake floristic composition surveys of natural areas and compare with baseline data.	Botanist	All stages
- Monitor all weed outbreaks: species, density, importance.	Environmental Officer/Botanist	All stages
- Record dieback or health decline events in **any** vegetation or plant species - regardless of conservation status.	Environmental Officer	All stages
Success Indicators	**Responsibility**	**Timing**
- No loss or decline in population sizes of the balance of threatened plant species remaining after construction or decommissioning.	Environmental Officer	All stages
- Significant plant habitats remain (structurally and floristically) in near-pristine condition and hold high levels of natural integrity.	Environmental Officer	All stages
- No change in floristic composition of natural habitats when compared to baseline data.	Environmental Officer	All stages
- Increase in population size and number of individuals of ***Acacia purpureopetala***, ***Melaleuca uxorum*** and ***Prostanthera clotteniana***.	Environmental Officer	All stages
- Active regeneration of *Grevillea glossadenia* around disturbance sites where it formerly existed. - Successful establishment of *Plectranthus amoenus* on adjacent/recipient rock pavements and in suitable habitat. - Translocation success for all threatened plants managed in this way.	Environmental Officer	All stages

Threatened Plant Management Strategy 3 (continued).

MANAGEMENT STRATEGY 3	Avoid indirect impacts on threatened plant species during construction, operation and decommissioning.	
Corrective Actions	**Responsibility**	**Timing**
- Review weed management if appropriate.	Environmental Officer	When required
- Increase vigilance for weed outbreaks and control.	Environmental Officer	When required
- Increase area of rehabilitation for habitat enhancement.	Environmental Officer	When required
- Review rehabilitation species selection if incorrect or poor establishment success.	Environmental Officer	When required
- Seek expert advice in regard to pathogen that could cause dieback (e.g. Phytophora).	Environmental Officer	When required

Table 5. Threatened Plant Management Strategy 4.

MANAGEMENT STRATEGY 4	Maintain and enhance the populations of threatened plant species and their habitats following completion of the wind farm construction	
Threatened Plants Management Actions	**Responsibility**	**Timing**
- Control, manage and eliminate where practicable all weeds within the project footprint above the main access road into the site.	Environmental Officer/Contractors	Post-construction
- Continue with progressive rehabilitation and habitat enhancement. Implement corrective actions where rehabilitation areas require intervention.	Environmental Officer/Contractors	Post-construction
- Establish research rehabilitation plots for montane heathland at appropriate locations. Develop appropriate level of data collection and monitoring protocols.	Botanist/Environmental Officer	Construction/post-construction
- Maintain healthy populations of all plants regardless of conservation status within the montane heathland environment surrounding and between WTG's.	Environmental Officer/Contractors	Post-construction
- Continue with propagation and use of threatened species in targeted rehabilitation areas.	Botanist/Environmental Officer/Nursery	Post-construction
- Engage in active research and applying new approaches to rehabilitation and plant translocation.	Botanist/ Environmental Officer/third party researchers and institutions	Post-construction
Monitoring	**Responsibility**	**Timing**
- Monitor contraction or expansion of montane heathland areas including rehabilitation sites.	Environmental Officer/Botanist	Pre-construction
- Record recruits for flora species, structural changes to montane heathland, reproduction and productivity.	Botanist/Environmental Officer	Post-construction
Success Indicators	**Responsibility**	**Timing**
- No loss or decline in population sizes of the balance of threatened plant species remaining after construction or decommissioning.	Environmental Officer	Post-construction
- Significant plant habitats remain (structurally and floristically) in near-pristine condition and hold high levels of natural integrity.	Environmental Officer	Post-construction
- Zero net increase in weed population areas and numbers; and no new weed species detected in project footprint (WTG's and road and cabling network).	Environmental Officer	Post-construction
- No change in floristic composition of natural habitats when compared to baseline data.	Environmental Officer	Post-construction
- Increase in area of montane heath.	Environmental Officer	Post-construction
- No significant increase in area of dominant wattle regrowth around and between WTG's.	Environmental Officer	Post-construction
- Populations of threatened plants are stable and reproducing (flowering and fruiting).	Environmental Officer	Post-construction

Threatened Plants Management Strategy 4 (continued).

MANAGEMENT STRATEGY 4	Maintain and enhance the populations of threatened plant species and their habitats following completion of the wind farm construction	
Corrective Actions	**Responsibility**	**Timing**
- Review weed management if appropriate.	Environmental Officer	When required
- Increase vigilance for weed outbreaks and control.	Environmental Officer	When required
- Increase area of rehabilitation for habitat enhancement.	Environmental Officer	When required
- Review rehabilitation species selection if incorrect or poor establishment success, or increasing dominance of wattles.	Botanist/Environmental Officer	When required

7.0 TRAINING

The uniqueness of the site, mainly south of the 275 kV powerline, necessitates a good understanding and appreciation of the local environment and how it supports special plants. Staff and contractors of the Mt Emerald Wind Farm must be aware of the importance and significance of the project area in terms of the special habitat qualities that host threatened plants particularly those listed at the highest levels under Queensland and Commonwealth legislation (e.g. *Acacia purpureopetala*, *Melaleuca uxorum* and *Prostanthera clotteniana*).

Site-specific training and environmental awareness must be undertaken and delivered to all contractors prior to construction. New contractors who enter the project at later stages of the construction and operation of the wind farm will need to receive the same level of environmental awareness training. Training should be delivered by an appropriately qualified person who is familiar with the threatened plants and ecology of the wind farm site.

Generic approaches to environmental awareness training are not recommended unless the training has merit and is valid to the site's landscape context. Training must be delivered as part of site induction and toolbox meetings, which should include the following key aspects:

- An outline of why the Mt Emerald Wind Farm project site is important in a regional context; and what specific environmental values the site holds. For example, the site south of the 275 kV powerline is unique in respect to its high elevation, montane environment and the group of specialist plants that are dependent on and restricted to this environment.
- A series of Threatened Plant Profile sheets should be available to all contractors working in sensitive threatened plant habitats (e.g. the montane heathland). These profile sheets should be readily available in the field (i.e. kept in vehicles or machinery).
- The identification and understanding of special habitats and threatened plant species should be reinforced by actual field visits to appropriate sites at the time of induction for those areas that are readily accessed using the existing road network. For example, the tall wind monitoring tower is a suitable location to highlight and explain the habitat qualities for *Grevillea glossadenia*. The population of the endangered *Melaleuca uxorum* is also within easy viewing distance of the monitoring tower.
- Why weeds pose a significant threat to habitat quality and the maintenance of high quality habitats into the future and throughout the operation of the wind farm. A series of Weed Profile sheets or a field guide should be available to all contractors.
- Reporting procedures for informing the Environmental Officer of threatened plant sightings, uncertain identifications, weed sightings and events that could be causing impacts to sensitive threatened plant habitats. A database of these records should be kept and regularly updated by the Environmental Officer.

8.0 TRANSLOCATION AND PROPAGATION

A management action for threatened plants includes taking opportunities to remove a living plant from its natural habitat and planting it into a suitable recipient site, where there is a reasonable probability of it surviving and forming a healthy and functional population in the future. This process is called translocation and is an accepted impact mitigation technique used for threatened plants listed under the EPBC Act and the NC Act.

The translocation of living threatened plants requires a detailed and site-specific *Translocation Plan* to be developed in order that a number of matters including the selection of suitable recipient sites; the technique of translocation; and a monitoring component are clearly defined. This Threatened Plants Management Plan is not a dedicated translocation plan; however, a brief summary of the predicted likelihood of successfully translocating the threatened plant species recorded from the Mt Emerald Wind Farm site is shown in **Table 6**.

Table 6. Predicted success rates for translocating threatened plant species.

Species	Transplant/translocation	Stem/leaf cuttings	Seed propagation
Acacia purpureopetala (Purple-flowered Wattle)	Low. Adult plants could have underground perennating stems or other plant parts. Possible higher success rate transplanting seedlings. Plants (on Mt Emerald) have peculiar and very specific habitat requirements.	Low.	Low-moderate. Seeds germinate okay, but new seedlings are prone to fungal disease and difficult to grow on to more mature stages.
Grevillea glossadenia (no common name)	Adult plants - low. Seedlings - would need to select relatively fresh seedling material (post-fire germination event). Plants are likely to require mycorrhyzal inoculation from parent soil to improve success rates.	Low.	Moderate to high.
Homoranthus porteri (no common name)	Low. Insufficient knowledge of propagation. Plants have very specific habitat requirements.	Low - insufficient knowledge of propagation through cuttings, although other species of *Homoranthus* have been propagated using this method.	Insufficient knowledge to determine validity of this method.
Melaleuca uxorum (no common name)	Low. Natural regeneration appears to be from resprouting stems from adult plants. Seedlings not observed in wild - insufficient knowledge.	Low to moderate, although insufficient knowledge of propagation through cuttings.	Moderate to high. Fresh seed material would need to be collected.
Plectranthus amoenus (Plectranthus)	Moderate to high. Would need to have recipient site and dedicated process to increase success rates.	High. Plectranthus plants are likely to be successfully propagated through leaf or stem cuttings.	Insufficient knowledge, although other methods of propagation or transplanting are likely to prove successful and are a more valid means of horticultural reproduction.
Prostanthera clotteniana (Mint Bush)	Low for adult plants. Juvenile material may have higher rates of transplanting success. Insufficient knowledge to determine validity of this method.	Moderate, but would require specialised nursery set-up.	Insufficient knowledge to determine validity of this method.

APPENDIX A

EVNT PLANT SPECIES DISTRIBUTION

Mt Emerald Wind Farm Site

N

Substation

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Contiguous Grevillea glossadenia specimens located within polygon.

Homoranthus porteri and Grevillea glossadenia mixed thicket contained within waypoints.

Legend

- Acacia purpureopetala *(Critically Endangered)*
- Grevillea glossadenia *(Vulnerable)*
- Homoranthus porteri *(Vulnerable)*
- Plectranthus amoenus *(Vulnerable)*
- Proposed Turbines
- Proposed Feeders
- Proposed Roads
- Proposed Buildings
- Existing Roads
- Subject Lot
- Easement

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Meters (A3)

Project Manager	M. Jess
Compiled by	RMS
Map Projection	MGAz55
Map Datum	GDA94
File Reference	PR130417-3.mxd
Sheet Number	1 of 1

Client: RACL

Title: Rare and Threatened Plant Species Turbines 32-39

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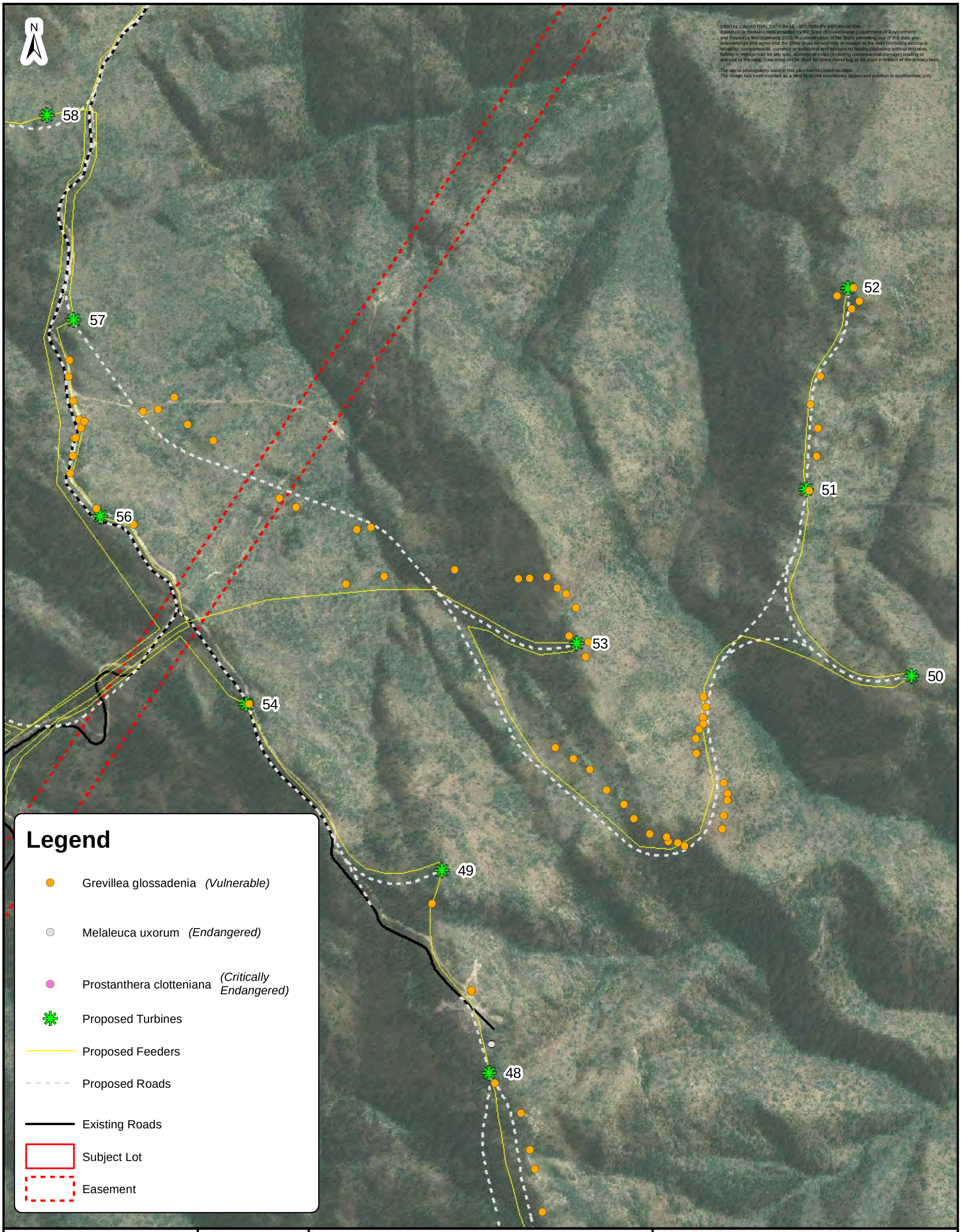
SCALE (A3)	DATE	DRAWING NO.	ISSUE
1:5,000	29/07/2016	PR130417-3	



Project Manager	M. Jess
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Map Projection	MGAz55
Map Datum	GDA94
File Reference	PR130417-4.mxd
Sheet Number	1 of 1

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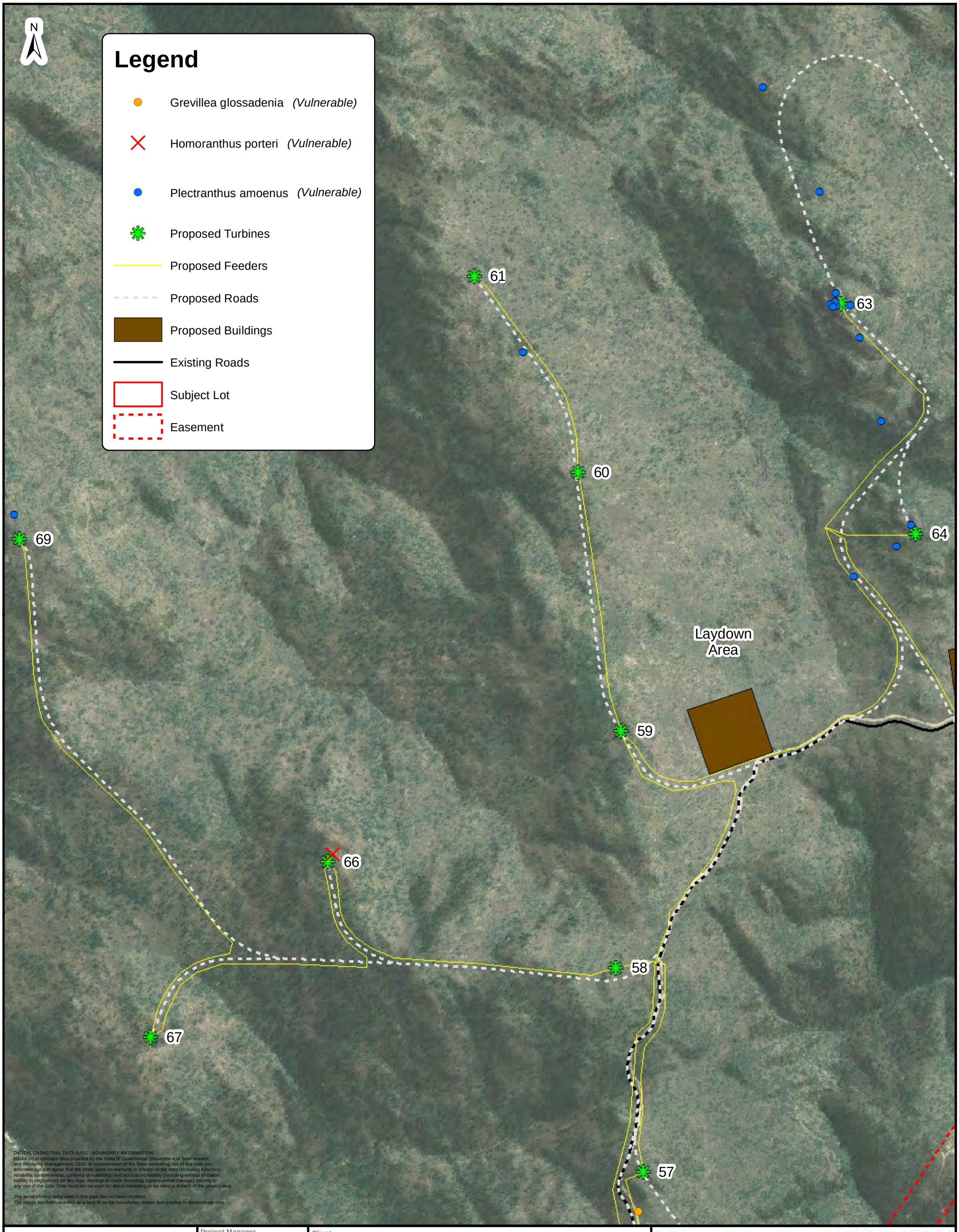
SCALE (A3)	DATE	DRAWING NO.	ISSUE
1:5,000	29/07/2016	PR130417-4	



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Meters (A3)

Project Manager	M. Jess
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Map Projection	MGAz55
Map Datum	GDA94
File Reference	PR130417-5.mxd
Sheet Number	1 of 1

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SCALE (A3)	DATE	DRAWING NO.	ISSUE
1:5,000	29/07/2016	PR130417-5	

Appendix H

Northern Quoll (Species) Management Plan

Mount Emerald Wind Farm

Northern Quoll Species Management Plan

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Report Number: PR128938-2
Version / Date: Final - November 2016 / R75725

IMPORTANT NOTE

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
1	Report	MJ	DF	07/03/2016
2	Report	MJ	LL	10/06/2016
3	Report	MJ	TJ	14/06/2016
4	Final Repot	MJ	TJ	15/11/2016

Approval for Issue

Name	Signature	Date
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Figures

1.0 Introduction

This Species Management Plan (SMP) has been prepared by RPS Australia East (RPS) on behalf of RATCH Australia Corporation Ltd (RATCH) to minimise the potential impacts on the Northern Quoll *Dasyurus hallucatus* from the construction and operation of the Mount Emerald Wind Farm (MEWF) Project.

The Northern Quoll is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Nature Conservation Act 1992* (NC Act).

The Species Management Plan outlines the procedure for land clearing and development of turbines in areas that may contain the Northern Quoll and for *tampering* with *animal breeding places* being used by the above species to incubate or rear the animal's offspring in accordance with section 88 of the NC Act and section 332 of the *Nature Conservation (Wildlife Management) Regulation 2006* (WMR).

This SMP should also be used in conjunction with the MEWF Outcomes Strategy (Burnett, 2016) for the Northern Quoll, which details monitoring strategies for the species on the MEWF project site. This will be updated over the course of the development.

In preparing the Environmental Impacts Statement (EIS) (RPS, 2013) for the MEWF Project, 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 have now been compiled to facilitate the delivery of mitigation measures. These are incorporated into the Environmental Management Plan (EMP). The EMP is to be supported by a number of sub-plans including: a Rehabilitation Plan, Weed and Pest Management Plans, Fire Management Plan and this SMP. These plans will have an effective life span to include the decommissioning phase and will be revised periodically to reflect ongoing changes and improvements.

1.1 The Project

The Mount Emerald Wind Farm is approved for the construction of up to 63 wind turbines on an elevated site approximately 20km SSW of Mareeba on the Atherton Tablelands in north Queensland (**Figure 1**). The towers will be approximately 80-90m high with approximately 50m blades, utilising 3 MW machines.

The site where the wind turbines, interconnecting tracks and associated infrastructure are to be established is on land formally described as Lot 7 on SP235224, which encompasses an area of 2,422ha. 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 existing land modification is associated with a 275 kV transmission line 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 540m up to 1089m 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. Although land to the north of the transmission line (including

the landmark of Walsh Bluff) possesses lower floristic diversity, it is recognised for its habitat value 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. Therefore, this pre-existing disturbed area will be utilised by the proposed MEWF 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.

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 10m. The interconnecting tracks will form the routes for the inter-turbine underground cabling - expected to be buried in trenches at approximately 1m deep.

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

Wind turbines will 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.

1.2 Construction Process

The process for construction of the wind farm will generally follow;

- Site Establishment – construction of road to the site and establishment of an area for site offices and equipment storage;
- Access Roads – the construction of access roads to each of the wind turbine sites;
- Hardstands – an area will be cleared at each site to allow for the assembly of the various components;

- Footings – excavation, followed by the placement formwork and reinforcement and then concrete to form the turbine footing;
- Turbine Assembly – the various components are delivered to site and assembled to form the complete wind turbine;
- Cabling – turbines will be linked into common circuits via underground electrical cables buried in accordance with Australian Safety standards. The cables will generally follow the site access roads. Trenches will typically be 0.5m wide and 1m deep with cables buried at 0.7m.
- Collection Substation – all cabling circuits will terminate at a common point, namely the project substation. The substation will also include additional infrastructure to facilitate the connection of the wind farm to the existing electricity grid; and
- Earthworks on site will typically follow a similar process, consisting of initial clearance, followed by the specific task (road, hardstand footing) and then remediation.

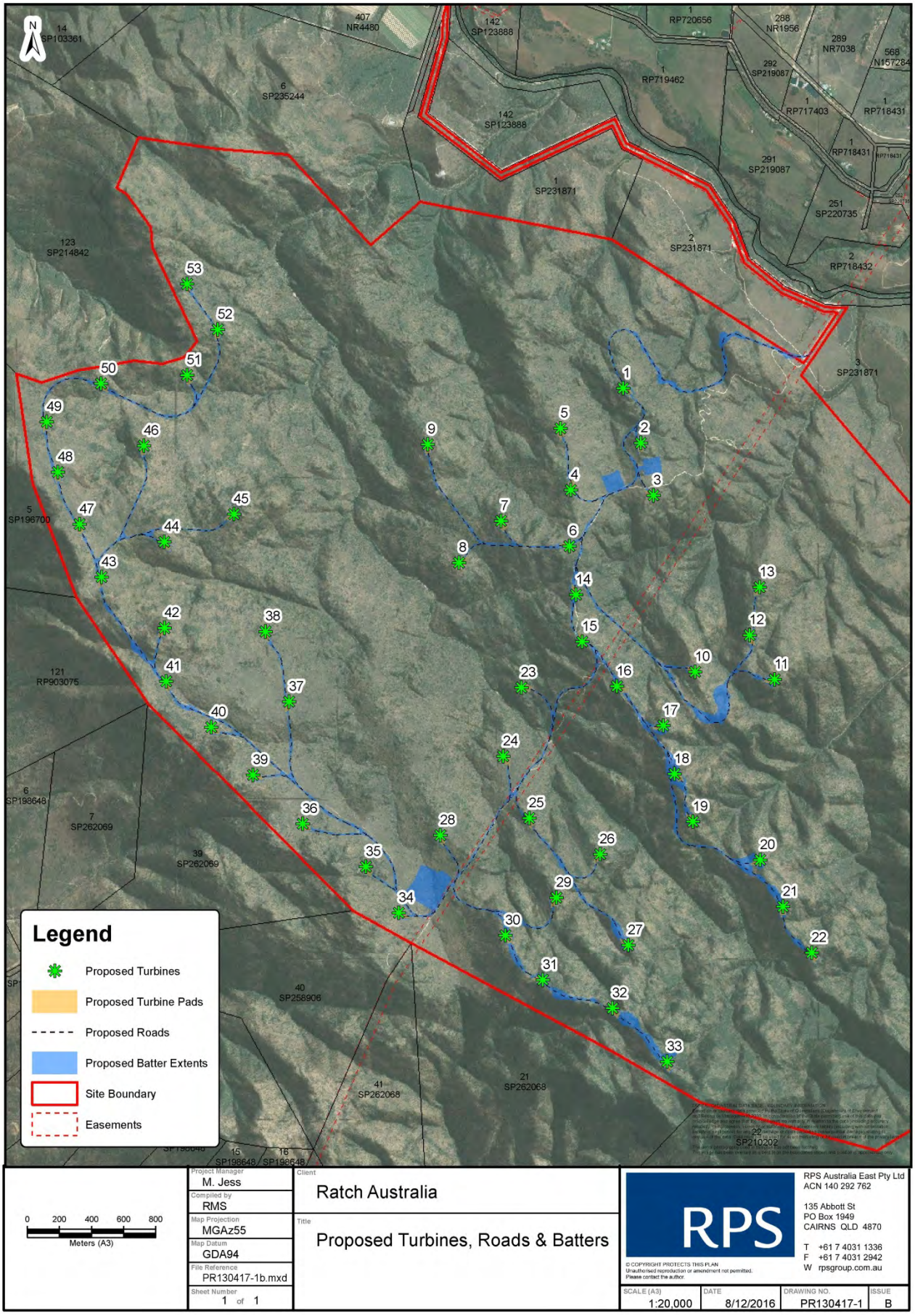

Figure 1 Site Location

1.3 Approved Entity

The following entity is approved to operate under this SMP:

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231 George Street
BRISBANE QLD 4000

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The Approved Entity is responsible for ensuring all employees and contractors (Approved Parties) engaged in development activities undertaken at the Mount Emerald Wind Farm covered by this SMP comply with the requirements of this SMP. Approved Parties may include machinery operators, site supervisors and drivers.

1.4 Organisational Summary

This SMP only applies to construction and operation activities at the MEWF Project site.

1.5 Term of Approval

Should this SMP be approved by the delegate, MEWF requests it be approved for the maximum period of three years as per the *Nature Conservation (Administration) Regulation 2006.*

2.0 Legislative Framework

2.1 Approval Conditions

This plan has been set out in accordance with the *MEWF Outcomes Strategy* (Burnett, 2016) developed under the EPBC Approval conditions and requirements with specific targets as identified under section 13 of the DSDIP approval, which are detailed below.

2.1.1 *Sustainable Planning Act 2009*

Conditions relevant to the preparation and implementation of the Significant Species Management Plans are detailed in Condition 13 of the Ministerial Decision Notice.

2.1.1.1 Ministerial Decision Notice

The Development Notice (dated 18 December 2015) in accordance with the SPA included a number of conditions relating to the preparation of a Significant Species Management Plan. *Condition 13 - Environmental Management* which relates to the SMP, states the following:

Submit to the chief executive administering the SPA an Environmental Management Plan (EMP) prepared by a suitably qualified person(s). The EMP must:

i. be generally in accordance with the Preliminary Environmental Management Plan prepared by RPS and dated November 2013 and the draft Statement of Commitments contained within Appendix A of the RPS Development Application Material Change of Use Report dated March 2012;

ii. be based on the revised Turbine Location and Development Footprint Plan submitted in accordance with condition 2 of this approval;

iii. include the following components:

- *a significant species management plan.*

Significant species management plans must:

a) include plans for all wildlife species listed as Endangered, Vulnerable, or Near Threatened under the provisions of the Nature Conservation Act 1992 that:

i. are currently known to occur within or periodically utilise the site; or

ii. are detected within the site during the conduct of further baseline, construction or operational monitoring pursuant to other conditions; and

iii. are not the subject of an equivalent management plan prepared in satisfaction of an approval issued under the provisions of the Environment Protection and Biodiversity Conservation Act 1999 (Cth)".

b) *set out key impact management strategies including:*

i. further baseline programs;

ii. management targets;

iii. design, construction and operations impact avoidance and mitigation measures and protocols;

iv. quantitative performance indicators;

v. monitoring and reporting regimes;

vi. corrective actions;

vii. timeframes for identified actions; and

viii. applicant and stakeholder responsibilities.

2.1.2 *Environment Protection and Biodiversity Conservation Act 1999* (EPBC)

The EPBC Referral Approval 2011/6228 conditions are very specific in the management of the Northern Quoll. The purpose of the Outcomes Strategy is to protect the population of this species, its habitat and the ecological integrity of the MEWF project site throughout the duration of works on the site. The relevant conditions of the EPBC Referral Approval which refer to the Northern Quoll SMP are contained in **Table 1**.

Table 1 Conditions of EPBC Referral Approval

Species	Condition
Northern Quoll	For the protection of the Northern Quoll, the approval holder must maintain a viable population of Northern Quoll on the wind farm site.
Northern Quoll	The approval holder must prepare and submit an Outcomes Strategy for the Minister's written approval which describes a monitoring program to inform adaptive management and determine whether the outcome required under condition 7 is being or has been met. The Outcomes Strategy must: (a) be prepared by a suitably qualified expert; (b) identify and justify performance measures, which are capable of accurate and reliable measurement, and will be used to measure the outcome required under condition 7; (c) include a monitoring program, to detect changes in the performance measures. The monitoring must include baseline surveys, control sites and experimental design (to test the effectiveness of different management measures); and (d) describe how the baseline and monitoring data will be adequate to: inform adaptive management; enable an objective decision to be made on whether the outcome described in condition 7 has been met.
Northern Quoll	The approval holder must not commence construction until the Minister has approved the Outcomes Strategy in writing.
Northern Quoll	The approved Outcomes Strategy must be implemented.
Northern Quoll	If the Minister is not satisfied that either the outcomes required under condition 7 are likely to be achieved, or there is insufficient evidence that the outcomes required under condition 7 are being achieved, the Minister may (in writing) require the approval holder to submit a plan for the Minister's approval to reduce, mitigate, remediate, or offset impacts to matters protected under the controlling provisions of this approval within a designated timeframe. The Minister may require the plan be prepared or reviewed by a suitably qualified person or another person specified or agreed to by the Minister. If the Minister approves the plan then the approved plan must be implemented.

This SMP satisfies requirements of the Outcomes Strategy (EPBC Approval) and Significant Species Management Plan (SPA Approval) by providing '***design, construction and operations impact avoidance and mitigation measures and protocols'*** for the Northern Quoll.

3.0 Assessment

3.1 Applicable Species

This SMP applies only to the Northern Quoll (*Dasyurus hallucatus*), that has been confirmed to be present within the project footprint and surrounding areas. The Northern Quoll was determined to present on site from baseline and targeted field surveys undertaken for the MEWF project (RPS, 2013). For the management of general native species during the lifetime of the MEWF project, a *Habitat Clearing and Management Plan* (RPS, 2016) has been prepared.

3.2 Ecology of the Northern Quoll in Far North Queensland

Size: 200-310mm (hb). The males weigh up to 1kg and females up to 500g typically.

Plate 1 Northern Quoll

Identification: The species is grey brown to brown above with large white spots on its body and sometimes on the base of the tail. The underbelly is cream. The nose is pointy with large prominent ears and eyes. Individuals will hiss when disturbed.

Abundance: The population of Northern Quolls on site is estimated to be in the order of 53 individuals or 0.5% of the total metapopulation estimate for the region (Burnett *et al* 2013). This population estimate was determined through a "population density" approach and was supported by a "closed population capture/recapture" approach which also provided the same population estimate across the site. The population density research included an estimate of 1.09 Quolls/100ha in flat or near flat suitable habitat and of 2.25 Quolls/100ha in moderately to extremely rugged, suitable habitat (Burnett, 2013).

Distribution: The Mount Emerald Northern Quoll population forms a part of the greater Far North Queensland Northern Quoll metapopulation, which ranges from around Ravenshoe in the south to Cooktown in the north. This is one of ten known Northern Quoll metapopulations that occur across Australia, and one of six metapopulations within Queensland (RPS, 2013)

Habitat: Found in rocky Eucalypt woodland, however, has been located in variety of habitats including rainforest, shrubland, grassland and desert. On the MEWF site individuals have been known to utilise ridgeline and creek habitats for denning.

Diet and Foraging: The species is an opportunistic omnivore and is known to prey on small mammals, reptiles, arthropods and fruit.

Behaviour: The species is nocturnal and they are known to den in tree hollows and rock crevices. Animals appear to have extensive home ranges and may travel several kilometres in one night.

Reproduction: The species breeds once a year with birthing occurring in the mid dry season, with all males dying after mating. Females typically live two mating seasons. Juveniles have a high chance of survival while in the pouch, however, once they leave the pouch and are left in the den while the mother forages (at the age of around 8 weeks) this drops significantly. Juveniles are weaned at 6 months old (DotE, 2016).

3.3 Site Assessment

Extensive field surveys and modelling has occurred since 2012 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 MEWF 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 (i.e. Pilbara, Kimberleys, Darwin/Kakadu, Cape York, Carnarvon Gorge, Townsville, Mackay/Rockhampton and SE Queensland) due to its persistence despite the presence of Cane Toads. Population viability analysis models (albeit highly conservative) indicate the Mt Emerald Northern Quoll population is at 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.

Research suggests the Mt Emerald population is <1% of the total estimated FNQ metapopulation and with only 58ha of the total 2,422ha of habitat on the property to be disturbed risks are considered to be very low. However, further studies are required in order to be able to assess the likely significance of these potential impacts on the overall FNQ metapopulation (Burnett, 2013).

Ongoing research into the size, occupancy and demographic characteristics of the Northern Quoll population on the MEWF project site will continue over the next three years.

Radio-telemetry studies on Mt Emerald suggest 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 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.

The most recent studies (RPS, 2015) have confirmed that VHF radio collars are adequate to determine the locations of day-time dens and therefore are clearly a useful and effective mitigation tool to ensure animals would not be in the clearance/disturbance zone during development. The study re-confirmed that Northern Quolls can be reliably trapped in order to identify den sites and deploy and recover collars.

3.4 Potential Impacts

A variety of activities conducted during construction and operation of the MEWF Project have the potential to directly or indirectly affect this species and its habitat.

3.4.1 Construction

3.4.1.1 Direct Mortality during Clearing, Excavating and Blasting Operations

There is the potential for some individual Northern Quoll present within their day time den sites to be killed by crushing during the construction phase, when habitat is being cleared or during civil works. This impact may be particularly significant if females are preferentially utilising ridge habitats for maternity denning.

3.4.1.2 Noise, Dust & Vibration Disturbance

Noise is an environmental stressor and can potentially affect wild animals in a number of ways including: alienation from noisy habitats, hearing loss, increased rates of predation or reduction in foraging success due to masking (i.e. interference with the perception of sounds of interest), physiological stress and associated adverse health effects, increases in energetic expenditure due to startling etc (see references in Kerlinger *et al*., 1995). It is not well understood how the Northern Quoll is likely to respond to disturbance associated with construction activities. Although the Northern Quoll display some tolerance to human activities, being known to inhabit human dwellings in the vicinity of the site (Luke Jackson, *pers. com*.), they are not typically exposed to the levels of disturbance likely to be experienced during construction of the wind farm. The majority of the site will not be impacted by the development and the development will occur in stages that will be of minimal impact to breeding stages of the species.

3.4.1.3 Habitat Loss

There is the potential for the loss of approximately 58 ha of foraging and denning habitat due to the proposed infrastructure footprint. Given the abundance of potentially suitable fallen and standing (live or dead) hollow eucalypts and rocky outcrops as denning microhabitats across the site, it is not likely the loss of 58ha of potential habitat will significantly impact the local population.

3.4.1.4 Habitat Degradation

Invasion of Introduced Pasture Grasses – The introduction of exotic pasture grasses in the Northern Territory disadvantages Northern Quoll by inhibiting movement and hunting ability through high density stands of exotic pastures and also fosters more intense fire regimes (Hill & Ward 2010).

The use of stringent machinery weed hygiene protocols on site and frequent and comprehensive weed monitoring and control actions, will reduce the likelihood of potentially highly invasive introduced grasses from spreading. Introduced grasses already established within small areas along access tracks and creek crossings within the site, includes Grader grass (*Themeda quadrivalvus*), Thatch grass (*Hyparrhenia rufa*) and Pigeon grasses (*Setaria spp.*).

Inappropriate fire regime - The frequency, season and intensity of fires are all likely to be important factors affecting Northern Quoll populations (Hill & Ward, 2009). Hill & Ward (2009) suggest the decline of the Northern Quoll may be related to increased vulnerability of individuals to predation following the removal of ground cover vegetation by fire, particularly in areas without extensive rocky outcrops.

The use of strict weed hygiene, monitoring and control management actions will prevent the likelihood of invasive pasture grasses becoming more widely established on the project site. If these grasses become well

established across the site, they are likely to contribute to a more intense fire regime which could pose a serious threat to the viability of the local Northern Quoll population.

3.4.2 Operation Phase

3.4.2.1 Disturbance resulting in exclusion and changes in utilisation patterns

Noise – Noise studies conducted by RATCH show existing background noise on the site can vary with wind speed, ranging from 30dBA to 60dBA across the operating range of the wind turbines. Therefore it is unlikely operational turbines noise will influence the behaviour of the Northern Quoll outside the range in which it currently survives in its predatory niche. The majority of the site will not be impacted by the development and construction will occur in stages that will be of minimal impact to breeding stages of the species. The species also displays some tolerance to human activities, being known to inhabit human dwellings in the vicinity of the site.

Vehicular Collision - A study by Oakwood (2000) of Northern Quolls in Kakadu National Park suggests road mortality is a frequent occurrence with this species and appears to be biased towards males, with six times as many males as females hit by cars. Oakwood (2000) also concluded increased frequency of road mortality in Northern Quolls corresponds highly with the breeding season (May-October).

There is the potential for some Northern Quoll individuals to be directly killed due to vehicular collisions during the night and day; although a vehicle speed limit (40km/h) will be enforced throughout construction and operation.

Mitigation measures as described in **Section 5** of this SMP; have been designed to minimise direct impacts such that they are unlikely to be significant.

4.0 Responsibilities

4.1 Roles and Responsibilities

The roles and responsibilities of important personnel are detailed in **Table 2** below.

Table 2 Roles and Responsibilities of Important Personnel

Position	Roles	Contact Details
MEWF	Owner, responsible for ensuring approval conditions are met.	Terry Johannesen Level 4, 231 George Street BRISBANE QLD 4000 T: +61 7 3214 3401
Environmental Officer	The site Environment Officer(s) is responsible for ensuring all monitoring and auditing, and corrective actions are undertaken as outlined in **Section 4.5.**	
Fauna Ecologist	An experienced Fauna Ecologists will be responsible for implementation of the survey and relocation activities on behalf of MEWF and the Contractor. This person will have ultimate responsibility for suspending or ceasing works in the event criteria are not met (e.g. decision on cessation of works if deleterious impacts on welfare of Northern Quoll identified). They will be responsible for reporting to administering authorities such as the Department of the Environment (DotE) and Department of Environment and Heritage Protection (DEHP) as required. It will be their responsibility to ensure that all requirements of this plan and applicable permits/legislation are met.	RPS Mellissa Jess 135 Abbott Street Cairns 07 4031 1336 0447 171 417
Spotter Catcher	The spotter catchers undertaking the spotter catcher works during clearing activities will be DEHP registered and will be responsible for carrying out the spotter catcher activities during tree removal activities as per the requirements of this plan and the *MEWF Habitat Clearing and Management Plan* (RPS 2016).	Jeff Middleton M: 0419 345 559 Dave Walton M: 0408 331 700
Wildlife Carer/Vet	Wildlife Carers will be engaged to assist in the care of any Northern Quoll that may become injured either directly or indirectly throughout any relocation. A vet will be briefed and made available for treatment of injured Northern Quoll if they are encountered.	QPWS Level 3, Building 2 William McCormack Place 5B Sheridan Street Cairns Qld 4870 (07) 4222 5303 Mareeba Veterinarian 149 Walsh Street T: 07 4092 4260 Tablelands Wildlife Rescue 24 Hour Emergency Hotline T: 07 4091 7767
Other Parties	All parties will have responsibilities to ensure the welfare of Northern Quoll population is maintained throughout the works. All parties will be inducted on identification of the Northern Quoll and who to contact in the event one is identified in the works site.	

4.1.2 Survey Personnel

To ensure the monitoring and the data collected is undertaken in an accurate and robust manner, representatives must have demonstrated ability in all aspects in which they are to be engaged and possess all relevant licences before the commencement of works. This includes spotter catcher licence and ethics approvals.

4.1.3 Training and Awareness

All site personnel and contractors must undertake a site specific environmental induction prior to commencing works on the MEWF project. The environmental induction shall provide information to enable staff to recognise and respond to signs of current Northern Quoll activity.

5.0 Management Actions

A number of management measures have been developed to mitigate potential impacts on Northern Quoll habitat, Northern Quolls within the project area and adjoining areas throughout construction and operation. This SMP is to be used in conjunction with the *MEWF Habitat Clearing and Management Plan* (RPS, 2016).

5.1 Pre Construction Management

5.1.1 Pre Works Surveys

- Conduct intensive pre-construction 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.
  - » 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 line traps immediately outside of the infrastructure area. Wire cage traps will be set up 150m apart and 5-10m in from the track edge, and baited with chicken necks in sections. Each trap will be flagged with pink marking tape and a GPS point. These coordinates will be provided to the Environmental Officer. Traps are to be checked between sunrise and 9 am, then closed for the day and set in the late afternoon. Each trap will be covered with protective cloth to shield it from the elements. Traps will be open for three consecutive nights.
  - » Before construction starts, traps are to be checked at dawn 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 1000m away from the construction area. Trapping and relocation will be continued for the duration of construction. All trapped Northern Quoll individuals will be fitted with light-weight tracking collars.

5.1.2 During Works

- In addition to live-trapping, the proposed clearance footprint will be searched methodically for denning individuals each morning prior to starting construction activities. Search techniques may include manual or visual inspection, radio-tracking or use of sniffer dogs. 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.
- 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 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.
- Primary bulk earthworks will need to be conducted in discrete, clearly marked sections on a sequential basis. The size of each discrete construction area would be limited to that able to be trapped and searched for collared animals in the 1-2 hours around dawn each day. Best practice mitigation options as described in the *Referral Guidelines for the Northern Quoll* (DotE, 2011) strongly recommend all construction activities that involve the use of heavy machinery or blasting should be avoided during the breeding season (i.e. typically May-November, but the exact timing of breeding varies across the range of the species). If this recommendation is followed, it would only leave five months of the year available for primary earthworks. Limiting the use of heavy machinery to the non-breeding season months is not considered to be an economically feasible option and therefore trapping and relocation of individuals, and exclusion from breeding dens is the preferred strategy.

- If adult females are captured during the preconstruction live-trapping and inspection indicates they have dependent young that are 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. Construction will be halted within a buffer distance (to be determined) until live-trapping monitoring indicates that young are trappable, 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 2013 was successful in identifying areas of the site utilised by Northern Quoll At the time of the detection dog trial, no Northern Quolls were fitted with radio-collars. This survey was only the second actual field trial of the dogs and at the time, it was not possible to differentiate between Northern Quoll scent and actual inhabited den sites. However, ongoing field testing of the sniffer dogs throughout the Australia distribution of the species indicates that the trained Quoll sniffer dogs are capable of discriminating between scats/scent and live animals within daytime dens (Amanda and Lloyd Hancock, Sadler Springs Education Centre, pers. com.). 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 together with radio-telemetry would increases the likelihood that all animals denning in each construction area is free of Northern Quoll in den sites.
- All site personnel and contractors shall report any evidence of dens, regardless of whether or not the person suspects the den to belong to a Northern Quoll, to the Environmental Officer who will inform the Project Manager. The Environmental Officer shall establish a 20 metre exclusion zone around the den. The Environmental Officer shall notify all site personnel and contractors of the exclusion zone and the restriction on works surrounding this area;
- The exclusion zone shall remain in place until the den has been inspected by a *suitably qualified and experienced person* and confirmed the den is not being utilised by Northern Quoll or other threatened species of fauna. This may include the use of track monitoring pads and/or camera traps to detect current activity;
- If the den is being utilised by a least concern species, the animal may be removed and relocated by a licensed wildlife carer or spotter-catcher in accordance with the *MEWF Habitat Clearing and Management Plan* (RPS, 2016) relating to tampering with animal breeding places of least concern species;
- If the den is confirmed to be used by Northern Quoll or other threatened species, the Environmental Officer shall liaise with the Ecologist to relocate animals.
- No domestic pets are allowed on the site **at any time** during construction or operation.
- Records should be kept of the date surveyed, whether any evidence of the activity was observed and actions taken to prevent harm to any animals and their habitat and per **Section 6.1.1** of this SMP.

5.1.3 Clearing Strategies

- 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, DotE and DEHP will be notified within 24 hours of any native animal injuries or deaths.
- All clearing activities must be completed under the *MEWF Habitat Clearing and Management Plan* (RPS 2016) for the MEWF project site.
- The following practices will be followed for open trenches:

  (a) Surveillance of the open trench in all areas and the removal of wildlife from the trench by appropriately trained personnel will be undertaken (the whole trench length will be checked at least twice a day (early morning/late afternoon);

  (b) Minimise the period of time the trench is open, particularly in any identified important habitat areas,

(c) Backfilling of trenching will be preceded by visual inspection to identify and remove trapped wildlife.

(d) Formed slopes or plugs, branches, hessian sacks, ramped gangplanks or similar will be used to create 'ladders' to enable fauna to exit the trench. Where trenches are to be left open for prolonged periods (overnight or longer), these structures will be placed every 50 to 100m, depending on the surrounding landscapes.

5.2 Operations

- Traffic levels will be maintained and controlled on site, where traffic will be limited during night hours to minimise fragmentation and mortality of Northern Quoll;
- Ensure no entry into conservation areas by the implementation of signage (except for necessary environmental management and monitoring);
- Avoid and enforce unauthorised off track driving through the implementation of signage and penalties;
- Reduce and enforce speed limits in the vicinity of Quoll habitat through the implementation of signage and penalties.
- Report and record road kills.
- Implement quarantine protocols, as detailed in the Northern Quoll Recovery Plan (2007) to prevent the spread of weed species into the MEWF project area, including:
  - » Installation of a wash down facility. The wash down facility should comprise high pressure water and steam devices;
  - » Development and facilitation of educational programs for staff and contractors about quarantine protocols and associated risks involved with invasive weed species;
  - » Implementation a no fill policy for the life of the project e.g. no introduction of material from off-site such as soil or vegetation.
  - » Control and eradication (where possible) of weeds with a high priority for habitat-modifying weeds;
  - » Remove and spray high priority weeds; and
  - » Manage fuel loads of weeds to reduce risk of high fire intensity.

5.3 Contingency Planning

In the event of unexpected impacts on other protected wildlife, the following process is to be followed:

- Sick, injured or orphaned native animals located during clearing activities are to be reported to the Queensland Parks and Wildlife service by phoning (07) 4222 5303 and appropriate arrangements made.
- Evidence of injury or death of fauna resulting from construction activities will be reported to the Contractor's Environmental Officer immediately for investigation and action if necessary.
- Should additional species listed under the provisions of the NC Act or EPBC Act be identified during the construction of the Project, then the relevant approvals should be sought before works recommence in the relevant area and management actions adapted accordingly to address the species concerned.
- DEHP are to be notified if any Northern Quoll are injured. The Contractor's Environmental Officer or other relevant site personnel are to contact the Wildlife Ranger at the Cairns Office, or alternatively the DEHP hotline on 137 468 if outside of normal business hours.

6.0 Monitoring and Reporting

The Contractor's Environmental Officer is to:

- Check on a daily basis during construction that vegetation to be cleared is clearly delineated (i.e. 'no go' zones are clearly demarcated and/or barricaded).
- Ensure vegetation clearing is being undertaken in accordance with 'Construction Strategies' listed above (e.g. pre-clearing surveys, requirement for licensed fauna spotter-catcher).
- Ensure on a daily basis that contractors are clearing vegetation in accordance with the Project environmental management plans and monitor for unauthorised works beyond the extent of clearing barriers. During construction, record any discernible evidence of listed threatened or iconic species activity, which would require the presence of a spotter-catcher to relocate.

6.1.1 Records

The following records shall be kept for the duration of construction and for at least five years after activities have ceased at the MEWF project site:

Records shall be kept of all inspections undertaken in accordance with this SMP, including the following information.

- Date of inspection;
- Name and qualifications of person conducting the inspection;
- Results of inspection (description of area surveyed, type of works activity proposed in area, number and location (GPS coordinates) of dens found, individual identification (sex, status, dependent young recurring presence);
- Control measures / exclusion fencing put in place;
- Persons notified (e.g. Environmental Officer, Project Manager, QPWS, and DEHP);
- Any unauthorised damage to dens shall be reported as an Environmental Incident; and
- Any harm to threatened species, in particular Northern Quoll that occurs during works shall be reported to DEHP and DotE within 24 hours of the incident and no works shall commence on site until approval to proceed has been obtained from DEHP.

6.1.2 Review

- Third party audits of the Northern Quoll SMP is to take place at least four times a year for the duration of the construction of the MEWF project, then yearly once the MEWF project is in operation. These audits are to be arranged by the Contractor's Environmental Officer.
- Should findings from research identified in the MEWF Outcomes Strategy (Burnett, 2016) become available and useful to this SMP, this SMP will be updated accordingly to reflect the new information.

7.0 Definitions

Animal Breeding Place:	A bower, burrow, cave, hollow, nest or other thing that is commonly used by the animal to incubate or rear the animal's offspring.
Licensed Wildlife Carer	A person qualified to take and keep protected wildlife under a current rehabilitation permit in accordance with the Nature *Conservation (Administration) Regulation 2006*.
Suitably Qualified and Experienced Person	▪ A person with formal qualifications and/or experience in fauna identification and life ecology and environmental management. A person is considered to be suitably qualified and experienced if they meet one or more of the following criteria: ▪ An ecological consultant with experience in conducting fauna surveys; ▪ A person who possesses a degree in natural science or similar with experience in conducting fauna surveys; ▪ A person who is a *spotter-catcher* under a rehabilitation permit issued under the NCA; or A person who can demonstrate significant experience in the removal of trees and spotting for wildlife to ensure they are not harmed during vegetation clearing.
Spotter-Catcher	A person qualified to take and keep protected wildlife under a current rehabilitation permit extended to authorise the take, keep or use of an animal who's habitat is about to be destroyed by human activity in accordance with the *Nature Conservation (Administration) Regulation 2006*.
Tamper	Tamper with an animal breeding place, means damage, destroy, mark, move or dig up the breeding place.
Take	Includes: In relation to an animal: (i) Hunt, shoot, wound, kill, skin, poison, net, snare, spear, trap, catch, dredge for, bring ashore or abroad a boat, pursue, lure, injure or harm the animal; or (ii) Attempt to do an act mentioned in subparagraph (i).

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Appendix I

Habitat Clearing and Management Plan

Habitat Clearing and Management Plan

Mount Emerald Wind Farm, Herberton Range, North Queensland

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In preparing this report we have made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
V1	Report	MJ	DF	10/02/2016
V2	Report	MJ	LL	6/06/2016
V3	Report	MJ	TJ	16/11/2016

Approval for Issue

Name	Signature	Date
Mellissa Jess		16/11/2016

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1.0 Introduction

RPS Australia East Pty Ltd (RPS) has been commissioned by RATCH Australia Corporation Ltd (RATCH) to develop a Habitat Clearing and Management Plan (HCMP) which encompasses spotter catcher pre-clearance and fauna management strategies for works proposed at the Mount Emerald Wind Farm, Arriga. Refer to **Figure 1** for the Locality Plan. The aim of this HCMP is to address potential effects of the Project on fauna species and/or their habitat during the clearing process through a range of management objectives.

1.1 Purpose

The purpose of this plan is to summarise the measures that will be implemented as part of the spotter catcher process and general fauna management activities associated with the construction phase. The plan considers spotter catcher activities undertaken during pre-clearing, vegetation clearing and construction and the necessary safety and reporting processes that are also required.

In particular this plan outlines how fauna management will be undertaken in accordance with the requirements of the conditions issued under the Approvals listed in the **EPBC Referral 2011/6228** pursuant to the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) and the Development Notice pursuant to the *Sustainable Planning Act 2009* (SPA) (**Section 1.2)**

This plan follows the *Draft Queensland Code of Practice for the Welfare of Wild Animals Affected by Land Clearing and Other Habitat Impacts and Wildlife Spotter Catchers* (Hanger and Nottidge, 2009).

All subcontractors will supply permit approvals upon contract negotiation.

In preparing the Environmental Impact Statement, 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 have been 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.

1.2 Permit Approvals

All activities are conducted under permit approvals issued to RPS as identified in **Table 1** below. These permits enable RPS to conduct, observe and relocate protected animals exposed to disturbance as a result of the clearing and destruction of their natural and artificial habitat.

Table 1 Permit/Authorisation Information

Permit/Authorisation	Permit Number	Expiry Date
Scientific Purposes Permit	WISP14220714	07/03/2019
Animal Ethics	CA 2016/02/943	25/03/2019
Registration as Scientific User	063	25/03/2019

1.3 Role of Wildlife Spotter Catcher

The proper conduct of wildlife management procedures at the time of land-clearing and development of the site involves the following processes:

- Fauna and flora assessment;
- Species identification;
- Animal trapping, capture and handling;
- Assessment of animal health and injuries;
- Assessment of development risks and impacts on wildlife and ecosystems;
- Preparation of *Wildlife Protection and Management Plans*;
- Husbandry of captured wild animals;
- Identification of suitable wildlife release sites;
- Emergency management and/or euthanasia of injured or sick animals; and
- Ensure that all State and Commonwealth policies, permits and conditions are met.

1.4 Responsibilities

A spotter catcher has ethical responsibilities to ensure the welfare of wild animals in respect to a development or activity for which they are acting in that role. A spotter catcher also has an obligation to comply with the provisions of this suggested protocol.

In terms of the performance of duties and operating procedures required for each project, the spotter catcher's responsibilities include, but are not limited to:

(a) Thorough site assessment and fauna survey (or validation of a previously conducted fauna survey).

(b) Clearly identifying to all relevant persons the specific wildlife welfare risks associated with the project, and recommended risk mitigation measures.

(c) Ensuring the timely and appropriate removal and management of animals from development sites prior to and/or during operational works or activities.

(d) Ensuring the appropriate housing, veterinary assessment and care, translocation, euthanasia or other appropriate disposal of animals removed from development sites.

(e) Preparation of reporting on wildlife activities;

(f) Notification of the appropriate local, state and/or federal regulatory authorities of breaches of the applicable laws.

In addition, the spotter catcher should be aware of their own "duty of care" obligations under the applicable local State and/or Federal law(s) as these apply to animals captured, trapped or held in the course of their duties.

1.5 Project Site

The Mount Emerald Wind Farm (MEWF) is approved for the construction of up to 63 wind turbines on an elevated site approximately 20km SSW of Mareeba on the Atherton Tablelands in north Queensland (**Figure 1**). The towers will be approximately 80-90m high with approximately 50m blades, utilising 3 MW machines.

The site where the wind turbines, interconnecting tracks and associated infrastructure are to be established is on land formally described as Lot 7 on SP235224, which encompasses an area of 2,422ha. 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 540m up to 1089m 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. Although land to the north of the transmission line (including the landmark of Walsh Bluff) possesses lower floristic diversity, it is recognised for its habitat value 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. 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.

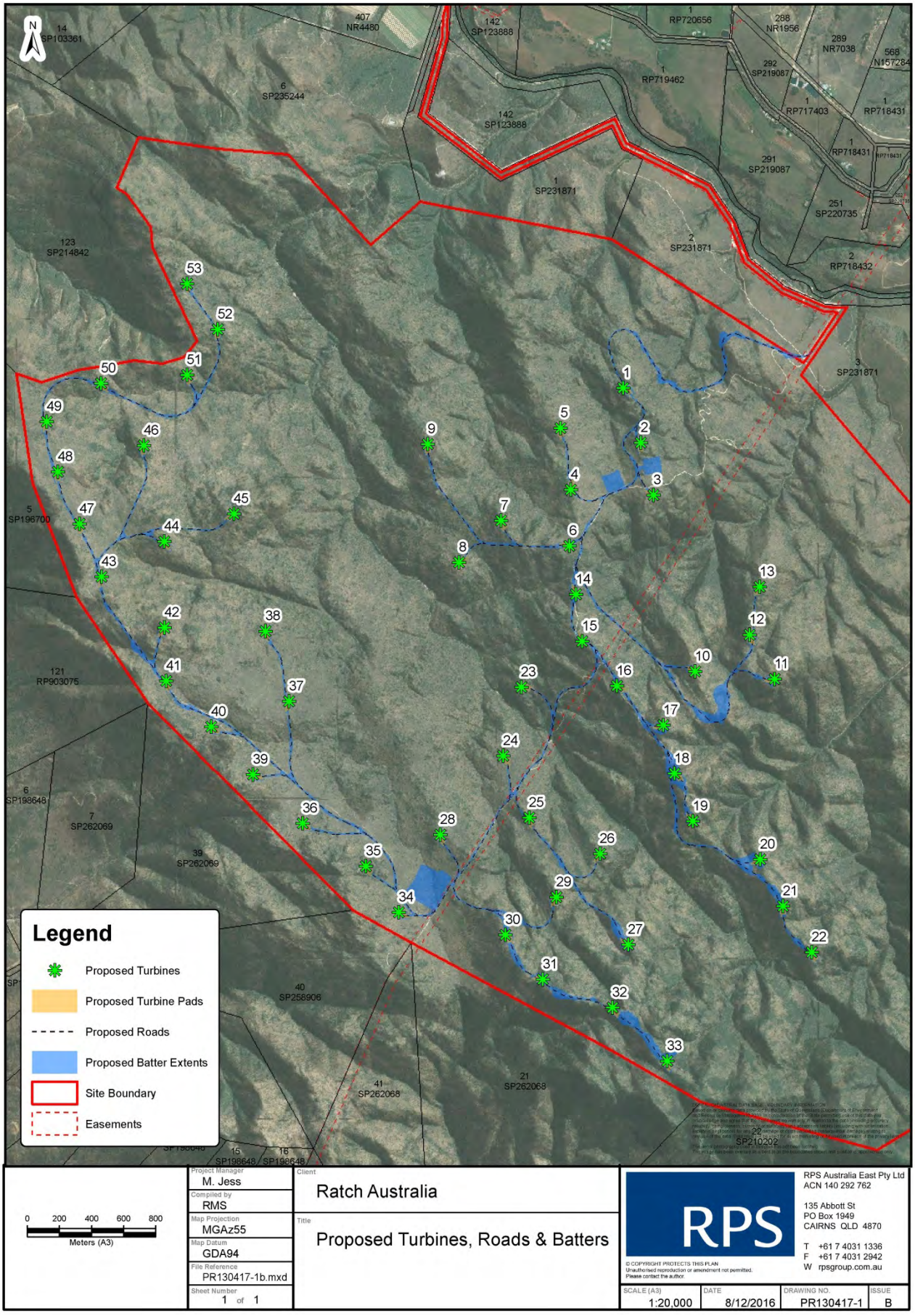

Figure 1 Project Site Location

1.6 Construction Details

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 10m. The interconnecting tracks will form the routes for the inter-turbine underground cabling - expected to be buried in trenches at approximately 1m deep.

Each turbine construction pad is expected to occupy an area in the order of 40m (long) x 60m (wide). The substation and associated compound will be in the order of 200m x 200m 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 (MEWF) 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.

2.0 Regulatory Requirements

2.1 Project Approvals

2.1.1 Sustainable Planning Act 2009

Conditions relevant to the preparation and implementation of the HCMP are detailed in Condition 13 of the Ministerial Decision Notice.

2.1.1.1 Ministerial Decision Notice

The Development Notice (dated 24 April 2015) in accordance with the SPA included a number of conditions relating to the preparation of a HCMP. *Condition 13 - Environmental Management* which relates to the HCMP, states the following:

Submit to the chief executive administering SPA an Environmental Management Plan (EMP) prepared by a suitably qualified person(s). The EMP must:

i. be generally in accordance with the Preliminary Environmental Management Plan prepared by RPS and dated November 2013 and the draft Statement of Commitments contained within Appendix A of the RPS Development Application Material Change of Use Report dated March 2012;

ii. be based on the revised Turbine Location and Development Footprint Plan submitted in accordance with condition 2 of this approval;

iii. include the following components,:

- *Habitat Clearing and Management Plan (timing as required with the EMP).*

In accordance with the *Attachment 1 – Components of the Environmental Management Plan* this plan must *'include management strategies involved in mitigating impacts of habitat clearing on susceptible fauna, including the induction of workers and for wildlife spotters and catchers involved in habitat clearing*"

2.1.2 Nature Conservation Act 1992

The primary purpose of the *Nature Conservation Act 1992* (NC Act) is to conserve biodiversity by creating and managing protected areas, managing and protecting native wildlife and managing the spread of non-native wildlife. Unless authorised, it is an offence under the NC Act to take, keep, use, or move protected flora and fauna for commercial, recreational or other purposes. Where a proposed development will result in such impacts to flora and/or fauna protected under the NC Act, authorisation from Department of Environment and Heritage Protection will be required.

Under section 332 of the *Nature Conservation (Wildlife Management) Regulation 2006 (NCR)*, MEWF requires a Species Management Plan (SMP) to undertake any works that will, or potentially will, disturb or interfere with a protected animal breeding place. This HCMP will ensure the correct procedures are undertaken to protect native wildlife.

Section 332 of the NCR states the following:

s332 - Tampering with animal breeding place

(1) A person must not, without a reasonable excuse, tamper with an animal breeding place that is being used by a protected animal to incubate or rear the animal's offspring.

(2) For subsection (1), an animal breeding place is being used by a protected animal to incubate or rear the animal's offspring if -

(a) the animal is preparing, or has prepared, the place for incubating or rearing the animal's offspring; or

(b) the animal is breeding, or is about to breed, and is physically occupying the place; or

(c) the animal and the animal's offspring are physically occupying the place, even if the occupation is only periodical; or

(d) the animal has used the place to incubate or rear the animal's offspring and is of a species generally known to return to the same place to incubate or rear offspring in each breeding season for the animal.

(3) Also, subsection (1) does not apply to a person removing or otherwise tampering with the breeding place if -

(e) the removal or tampering is part of an approved species management program for animals of the same species; or

(f) the person holds a damage mitigation permit for the animal and the permit authorises the removal or tampering.

2.1.3 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Referral Approval 2011/6228 conditions are very specific to several threatened species, namely the Northern Quoll, Spectacled Flying Fox and Bare-rumped Sheathtail Bat. The purpose of the HCMP is to protect all threatened species and communities, minimise impact on native flora and fauna and manage clearing on the site. Therefore activities undertaken as part of this plan will only serve to work in conjunction with the *Northern Quoll Management Plan* and *MEWF Outcomes Strategy* (RPS,2016), and *MEWF Implementation Strategy* (RPS, 2016) on the site, as also required by the EPBC Referral approval.

The relevant conditions of the EPBC Referral Approval which refer to the HCMP are contained in **Table 2**.

Table 2 Conditions of EPBC Referral Approval

Species	Condition
Northern Quoll	For the protection of the Northern Quoll, the approval holder must maintain a viable population of Northern Quoll on the wind farm site.
Northern Quoll	The approval holder must prepare and submit an Outcomes Strategy for the Minister's written approval which describes a monitoring program to inform adaptive management and determine whether the outcome required under condition 7 is being or has been met. The Outcomes Strategy must: be prepared by a suitably qualified expert; identify and justify performance measures, which are capable of accurate and reliable measurement, and will be used to measure the outcome required under condition 7; include a monitoring program, to detect changes in the performance measures. The monitoring must include baseline surveys, control sites and experimental design (to test the effectiveness of different management measures); and describe how the baseline and monitoring data will be adequate to: inform adaptive management; enable an objective decision to be made on whether the outcome described in condition 7 has been met.
Northern Quoll	The approval holder must not commence construction until the Minister has approved the Outcomes Strategy in writing.
Northern Quoll	The approved Outcomes Strategy must be implemented.

Species	Condition
Northern Quoll	If the Minister is not satisfied that either the outcomes required under condition 7 are likely to be achieved, or there is insufficient evidence that the outcomes required under condition 7 are being achieved, the Minister may (in writing) require the approval holder to submit a plan for the Minister's approval to reduce, mitigate, remediate, or offset impacts to matters protected under the controlling provisions of this approval within a designated timeframe. The Minister may require the plan be prepared or reviewed by a suitably qualified person or another person specified or agreed to by the Minister. If the Minister approves the plan then the approved plan must be implemented.
Bare-rumped Sheathtail Bat Spectacled Flying Fox	Prior to commissioning, the approval holder must evaluate the effectiveness of suitable measures, including changed cut-in speed, avian radar system and SCADA system, to avoid and mitigate the impacts of turbine collision to Spectacled Flying-fox (*Pteropus conspicillatus*) and Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus nudicluniatus*) on the wind farm site.
Bare-rumped Sheathtail Bat	Prior to commissioning, the approval holder must submit to the Minister for written approval, a Wind Farm Implementation Plan that is informed by the results of the evaluation required by condition 12. The Wind Farm Implementation Plan must include: details of intended outcomes and measurable performance criteria which are based on the outcomes of population viability analysis and numerical collision risk modelling for the Spectacled Flying-fox and Bare-rumped Sheathtail Bat; a program to monitor the effectiveness of progress against performance criteria; and contingency measures and corrective actions that will be implemented if performance criteria are not being or are not likely to be met.
Spectacled Flying Fox	The Wind Farm Implementation Plan must be reviewed by a suitably qualified expert prior to submission to the Minister for approval. The Wind Farm Implementation Plan must include the findings of the review undertaken by the suitably qualified expert and details of how any recommendations made by the suitably qualified expert have been addressed.
Bare-rumped Sheathtail Bat	The approval holder must not commission the wind farm until the Wind Farm Implementation Plan has been approved by the Minister in writing.
Spectacled Flying Fox	The approved Wind Farm Implementation Plan must be implemented.
Bare-rumped Sheathtail Bat	Upon the direction of the Minister, the approval holder must cease to operate any specified wind turbine generator/s if the Minister considers that, based on compliance reporting required by condition 26, they are having an impact on Bare-rumped Sheathtail Bat and Spectacled Flying-fox greater than the performance criteria required by condition 13(a) that cannot be mitigated or compensated.

3.0 Existing Environment

3.1 Flora

The vegetation that occurs throughout the study area has been described in detail within the EIS (RPS, 2013) and the Ecological Assessment Report (RPS, 2010).

Eight vegetation communities were identified across the site. 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, which is located in the Wet Tropics bioregion section as shown in **Table 3**. Where disturbance is present adjacent to cleared tracks, wattle regrowth (*Acacia* spp.) is the main successional community. The most severe land modification and lowest ecological function is associated with Kippen Drive at the base of the project site, where weeds are the dominant vegetation.

Table 3 Vegetation Communities located on the Mount Emerald Wind Farm site

Community Description	
Rustyjacket Woodland Woodland to open woodland of *Corymbia leichhardtii*, *Callitris intratropica* with *Eucalyptus shirleyi* and *Eucalyptus granitica* to 8 - 12 m. Occurs mainly the centre of the site in the EU bioregion section.	
Silver-leaf Ironbark Woodland Woodland to low open woodland of *Eucalyptus shirleyi* to 4 m with emergent *Callitris intratropica* (12 m). Best representation is near the centre of the site close in the EU and WT bioregion sections.	

Community Description	
Yellow Stringybark Woodland Grassy woodland of *Eucalyptus portuensis* with *Corymbia citriodora* to 7-12 m. Occurs on slopes of WT and EU bioregion sections.	
White Stringybark Woodland Tall, grassy woodland of *Eucalyptus reducta* with *Eucalyptus portuensis* and occasional *Corymbia citriodora* and *Eucalyptus drepanophylla* (sens. lat.) to 12-18 m. Occurs mainly in the WT bioregion section on slopes.	
Range Bloodwood Woodland and Shrubland Low, windswept woodland to open woodland and shrubland of *Corymbia abergiana* to 4 m on exposed ridges. Mainly occurs in the WT bioregion section close to ridge tops and edges.	

Community Description	
Montane Heathland Low heathland with scattered shrubs or isolated, wind-sheared and stunted trees of *Corymbia abergiana* and *Eucalyptus lockyeri* subsp. *exuta*. Includes patches of rock pavements and outcropping rock. Occurs above 900 m in the WT bioregion section.	
Narrow-leaf Ironbark and Lemon-scented Gum Woodland Woodland of *Eucalyptus drepanophylla* (sens. lat.) and *Corymbia citriodora* to 15 m. Occurs in northern aspects of the site mainly in the EU bioregion section.	
Dead Finish Woodland Grassy woodland to 8-10 m of *Eucalyptus cloeziana*, *Corymbia citriodora* and *E. portuensis*. Occurs mainly around the boundary junction of the WT and EU bioregion sections.	
WT - Wet Tropics, EU - Einasleigh Uplands	

3.1.2 Threatened Flora

Ridge tops are the proposed location for a majority of the interconnecting tracks and turbine construction pads. This type of habitat in the Wet Tropics section and the western ridge of the Einasleigh Uplands section supports the following conservation significant plant species; all were confirmed to potentially occur on the site and within the construction footprint:

- *Grevillea glossadenia*: a shrub found on ridges and adjacent to tracks. Relatively common on site. Listed under EPBC Act and NC Act as vulnerable.

- *Homoranthus porteri*: a shrub found mainly on higher elevation ridges, where it forms thickets on rock pavements or their edges. Common in places where important populations exist. Uncommon elsewhere. Listed under EPBC Act and NC Act as vulnerable.
- *Melaleuca uxorum*: a shrub found (during the surveys) only in two locations on exposed ridges in the SW of the site. Exceptionally uncommon and rare. Listed under NC Act as endangered.
- *Plectranthus amoenus*: a succulent, low shrub found on rock pavements in the SW of the site and an isolated occurrence near proposed turbine 66. Relatively uncommon and restricted to rock pavement geology. Listed *NC Act* as vulnerable. Conservation plants are rarely if ever encountered in the Einasleigh Uplands section on rolling hills, flat zones, and wide ridges.

3.1.3 Conservation Significant Plant Communities

Regional ecosystems 7.12.57 and 7.12.58 are listed under the *Vegetation Management Act 1999* as "Of Concern". These communities are also linked to the key habitats for the conservation significant plants listed above and only occur in the Wet Tropics section.

The montane heath community which occurs above 900 m ASL is a variant of regional ecosystem 7.12.57; and is narrowly represented along ridges to the south of the transmission line in an area of very high biodiversity value with a concentration of conservation significant and poorly distributed plants.

3.2 Fauna

3.2.1 Threatened Species

During preparation of the Environmental Impact Statement (RPS 2013) it was found that a relatively diverse range of fauna species are represented across the site due to the moderately high quality of the habitat.

Of the 29 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 and 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 were considered to have a 'Moderate' likelihood of occurrence either due to the presence of suitable habitat or likelihood of overflying, but none of these species were observed during field investigations.

The remaining three threatened terrestrial fauna species were identified through field surveys occurring on the proposed MEWF project site:

- Northern Quoll (EPBC Act – endangered);
- Bare-rumped Sheathtail Bat (EPBC Act - critically endangered; NC Act - endangered); and
- Spectacled Flying-fox (EPBC act - vulnerable).

While modelling indicates the local Mount Emerald population of Northern Quoll represents <1% of the estimated total Far North Queensland metapopulation (~10,000 individuals) and does not represent a distinct genetic sub-population, (Burnett, 2013) the population located on site is important to the genetic diversity of the regional population. The most probable significant impact to this species is directly through mortality/disturbance and loss of habitat during construction. While there is uncertainty whether ridge tops are the most favoured denning locations, it is known the species utilise ridgetop habitats of the MEWF site.

Although, the overall impact on the site from footprint clearing is only 2.4% or ~57 ha, much of this clearing is specific to the ridgelines therefore mitigation measures specifically targeting this impact have been devised. These measures are detailed in:

- *Northern Quoll Outcomes Strategy (Burnett, 2016)*
- *Northern Quoll Species Management Plan* (RPS, 2016).

The most significant potential impact to the Spectacled flying fox is predicted to be turbine mortalities through the operation phase of the project. This is also the case for the Bare-rumped Sheathtail Bat, however, preferred habitat for roosting and foraging is so poorly known that land clearing activities may also be a threat to the local population. Mitigation measures to reduce and potentially remove these impacts have been addressed in the *MEWF Implementation Plan (RPS, 2016)*.

Of the six migratory bird species confirmed to occur on site, two are known to utilise the habitat on site. Neither of these species preferentially utilise the site as key habitat. There are also large tracts of continuous habitat available to these species throughout the region and the project is unlikely to impact on their population.

Four migratory species were recorded to fly over the site:

- Sarus Crane;
- Whitethroated Needletail;
- Great Egret; and
- White-bellied Sea Eagle.

Mitigation measures including detailed radar observations and implementation of turbine curtailment are currently being investigated for use on this site but will not be discussed further here. Refer to the MEWF *Implementation Plan (2016)* for further information.

3.2.2 General Fauna

A complete list of the fauna recorded within the site is provided in **Appendix A**.

Those species observed within the site that may be identified during spotter catcher activities include the following provided in **Table 4**.

Table 4 Common Fauna found on the MEWF Project Site

Mammals	Birds	Reptiles	Amphibians
Terrestrial ▪ Dingo ▪ Agile Wallaby ▪ Echidna **Arboreal** ▪ Common Brushtail Possum ▪ Giant White-tailed Rat **Bats** ▪ Little Bent-wing Bat ▪ Eastern Freetail Bat ▪ Northern Freetail Bat	▪ Red-tailed Black Cockatoo ▪ Rainbow Bee-eater ▪ Noisy Friarbird ▪ Laughing Kookaburra ▪ Striped Pardalote ▪ Pied Butcherbird ▪ Grey Faintail ▪ Brown Honeyeater	▪ Northern Spotted Velvet Gecko ▪ Rainbow Skink ▪ Tommy Roundhead Dragon ▪ Brown Snake	▪ Cane Toad ▪ Green Tree Frog ▪ Bumpy Rocket Frog

4.0 Management Actions

4.1 Responsibilities

The site Environment Officer(s) is responsible for ensuring all monitoring and auditing, and corrective actions are undertaken as outlined in **Sections 5.0 and 6.0**.

4.1.1 Qualified Ecologist

An experienced Fauna Ecologist will be responsible for implementation of any pre works surveys, survey and relocation activities and Endangered, Vulnerable, and Near Threatened (EVNT) species surveys on behalf of MEWF. This person will have ultimate responsibility for suspending or ceasing works in the event criteria are not met (e.g. decision on cessation of works if deleterious impacts on welfare of fauna identified). They will be responsible for reporting to administering authorities such as the Department of the Environment (DotE) and Department of Environment and Heritage Protection (DEHP) as required. It will be their responsibility to ensure all requirements of this plan and applicable permits/legislation are met.

4.1.2 Spotter Catchers

The spotter catchers undertaking the spotter catcher works during clearing activities will be EHP registered and will be responsible for carrying out the spotter catcher activities during tree removal activities as per the requirements of this plan.

4.1.3 Wildlife Carers/Vet

Wildlife Carers will be engaged to assist in the care of any fauna that may become injured either directly or indirectly throughout any relocation.

A vet will be briefed and made available for treatment of injured fauna if they are encountered.

4.1.4 Others involved

All parties will have responsibilities to ensure the welfare of fauna is maintained throughout the works. All parties will be inducted on identification EVNT fauna and who to contact in the event one is identified in the works site.

4.1.5 Training and Awareness

All site personnel and contractors must undertake a site specific environmental induction prior to commencing works on the MEWF project. The environmental induction shall provide information to enable staff to recognise and respond to signs of current fauna activity.

4.2 Pre-works Meeting

The Spotter Catcher should ensure the Environmental Manager, Site Foreman and Operators understand the sequence of events should wildlife capture be necessary, and to identify habitat features.

4.3 Contact Information

Table 5 Contact Information

Name	Details
RATCH	Terry Johannesen Level 4, 231 George Street BRISBANE QLD 4000 T: 07 3214 3401 F: 07 3214 3499 E: terry.johannesen@ratchaustralia.com W: www.ratchaustralia.com
Contractor	TBA
Ecologist	Mellissa Jess 135 Abbott Street Cairns T: 07 4031 1336 M: 0447 171 417 E: mellissa.jess@rpsgroup.com.au
Spotter Catcher	Jeff Middleton M: 0419 345 559 Dave Walton M: 0408 331 700
Mareeba Veterinary Surgery	149 Walsh Street T: 07 4092 4260
Tablelands Wildlife Rescue	24 Hour Emergency Hotline T: 07 4091 7767
QPWS	Level 3, Building 2 William McCormack Place 5B Sheridan Street Cairns Qld 4870 T: 07 4222 5303

5.0 Preclearance Methodologies

5.1 Fauna Habitat Surveys

Fauna habitat surveys must be conducted at each site prior to clearance of vegetation.

These surveys are required to determine the presence of fauna both current and likely within the clearing alignment. The timing of the survey must be conducted within one week to 2 days of construction and features required to identify include:

- Terrestrial microhabitats. For example logs, burrows, termitaria, leaf litter, bark fissures, cave habitats.
- Arboreal microhabitats. For example hollows, nests, exfoliating bark.
- Aquatic habitats. For example creeks, culvert and seepage areas that may be impacted by falling timber or dammed during clearing.
- Direct observation of fauna within each of the habitat which may identify the habitat location of individuals. Animals actively nesting or roosting that may require active management prior to the clearing campaign to minimise the impact to individuals of the species.
- Scats, tracks, carrion, scratches can indicate presence or historical presence of certain species. It can also identify any areas of high fauna utilisation.
- Artificial habitats from previous cleared events or development processes on the site.

Habitat areas of high fauna value should be flagged to identify as exclusion zones. These areas will then be assessed individually to ensure exclusion/ vacation of fauna from the habitat.

Wherever appropriate and required, the spotter catcher will install fauna exclusion devices if fauna are absent from habitat. For example, empty tree hollows with no evidence of nesting fauna will be closed until clearing has commenced.

5.2 Salvage and Reuse of Habitat Material

Vegetation clearance can result in loss of habitat in the project area due to the removal of hollows, log, rocks, ground habitat such as leaf litter and vegetation. Some of this habitat is of high quality to fauna and relocation of microhabitat where possible will assist in maintaining fauna populations and diversity across the site. This habitat could also provide a safe place for relocated individuals should spotter catchers be forced to remove them from hazards during a clearing campaign.

5.3 Hollow Relocation

Trees with hollows which could provide important habitat to fauna will be flagged before the commencement of clearing. Where possible active hollows will be removed and relocated to a nominated area external to the clearing zone to prevent the fauna from being reintroduced to the hazard. It is anticipated most ground dwelling fauna will move once vibrations from clearing equipment commences.

5.4 Nest Management

Nests should be flagged and an exclusion zone should be clearly marked at a 10m radius around the vegetation. If no chicks or eggs are present in the nest, it is able to be destroyed. As vegetation clearance is on a relatively small scale on the MEWF site, only a limited amount of arboreal habitat is expected to be removed. If there are a large number of hollows that require removal as identified by the Ecologist during

preclearance surveys, artificial nest boxes will be erected at suitable habitats within the project area (at one box per two hectares to prevent over saturation).

5.5 Release Points

RPS have identified suitable release points for fauna (**Figure 2**), across the project site. Specific locations will be selected within the identified release points based on the captured species niche requirements.

5.6 Timing Considerations

The timing for conducting the vegetation clearing will be determined by the Environmental Manager in consultation with the Contractor and with input from the appointed Ecologist. The timing of the vegetation clearing must consider the following:

- Clearing needs to be undertaken progressively to minimise disturbance at any one time and allow for placement of topsoil onto rehabilitation areas where possible;
- Avoidance of breeding periods of key species where possible (Northern Quoll) or hibernating of species; and
- Experience from the past clearing campaign which have identified threatened species or species that require particular relocation strategies.

5.7 Targeted Species

Northern Quoll Species Management Plan, Bat Implementation Plan have been developed for threatened species on the MEWF site. These plans will be used in conjunction with this HCMP to provide best management practice for fauna and flora species on the site. This includes targeted searches for threatened flora species along identified sections of the clearing transect.

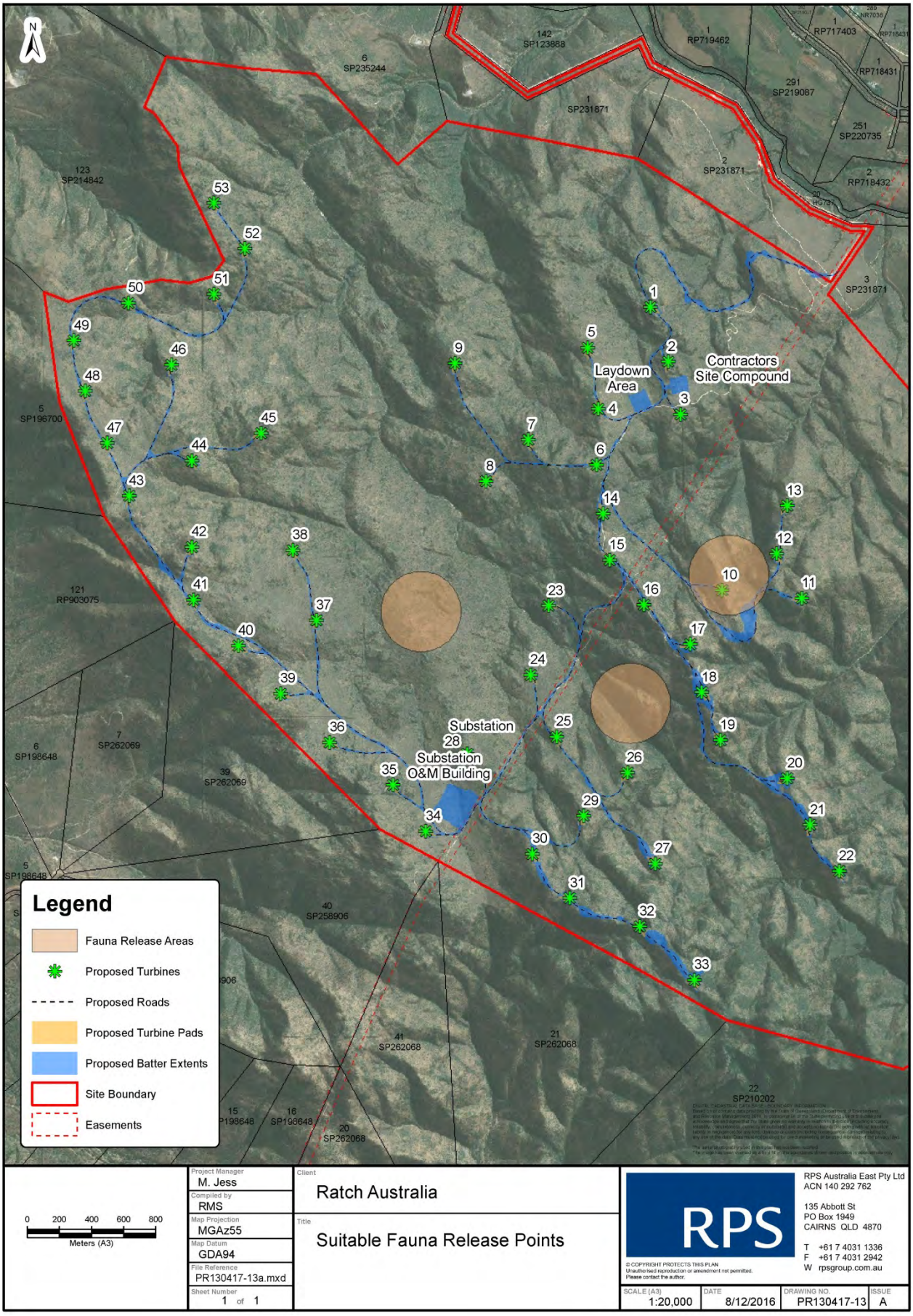

Figure 2 Fauna Release Sites

5.8 Animal Handling

Some animals may need to be handled. Captured animals should be handled in a way that minimizes the risk of injury or stress-induced disease. This can be best achieved by:

- Firm and quiet handling;
- Keeping handling and restraint time to the minimum needed to achieve the scientific or educational objectives; and
- Using techniques and timing appropriate to the species.

In unusual circumstances, animals may need to be temporarily housed for identification. Housed animals will be kept in a way appropriate to their biology and in circumstances that ensure they are safe from harm, environmental stresses and other adverse conditions. Mammals and reptiles can be held in cloth bags and frogs in plastic bags with some water. When transported in vehicles, cloth or plastic bags should be kept within hard plastic containers to prevent animals from being inadvertently squashed. Containers should be cleaned frequently to minimize chances of spread of parasites and disease.

Bats should not be released in daylight but will be held until dusk. They should be held separately in suspended calico bags in dark, quiet, warm places.

Animals will only be transported in an emergency and if they are in need of veterinary care or to be euthanased by a veterinarian. Animals will be transported in a suitable secure container protected by a blanket or other material to provide darkened conditions. Transportation will be by air-conditioned vehicle and will aim to ensure the trip is as brief and comfortable as possible.

Animals considered to be in good health will be released provided conditions are appropriate. In the event of extreme weather conditions or significant risk of wildfire, immediate predation or other disturbance, animals may be suitable housed until release conditions are acceptable. Animals will be released at suitable release points identified in **Figure 2** (These sites will be modified based on final detail of alignment).

5.8.1 Frogs

Handling of frogs should be consistent with the NSW NPWS Threatened Species Management Information Circular No. 6 regarding the *Hygiene protocol for the control of disease in frogs*. This protocol is aimed primarily at reducing the spread and impact of amphibian chytrid fungus. Frogs should only be handled where necessary.

Where handling of frogs is necessary:

- Hands should be cleaned and disinfected between samples or a new pair of disposable gloves used; and
- A one bag-one frog and one bag-one tadpole approach should be used.

Frogs and tadpoles should only be removed from a site when absolutely necessary. Where it is necessary to collect frogs and tadpoles the following procedures should be followed:

- Frogs from different sites should be kept separately from each other and from other captive animals; and
- Tanks or containers used to hold frogs must be disinfected prior to housing and after frogs are removed.

When travelling between sites (which may be considered as separate water-bodies that are not clearly connected) the following must be undertaken:

- Footwear must be thoroughly cleaned of mud and disinfected (gum boots are the easiest to clean) or several changes of footwear used and bagged between sites; and

- Equipment such as nets, bags, torches and waders should be cleaned and disinfected.

5.9 Injured Animals and Euthanasia

Animals showing signs of stress, injury or ill health following continued monitoring will be taken to a veterinarian. In certain circumstances (e.g. for a larger animal such as a Koala), a veterinarian may be requested to treat the animal on site.

Seriously injured animals encountered in the field will be euthanased using appropriate methods. Euthanasia procedures conform to the recommendations contained within the 2001 ANZCACART publication “Euthanasia of Animals Used for Scientific Purposes”, which are adopted by the Animal Ethics Committee (AEC). Emergency euthanasia of animals less than 150gms will be carried out by cervical dislocation in the field by the person identified under the ethics committee permit as the responsible party) or if not available, the animal will be taken to a local Veterinarian.

The above mentioned staff are competent in performing cervical dislocation of small mammals and birds, and stunning and decapitation/destruction of the brain or pithing for small reptiles and amphibians. Larger animals will be taken to a Veterinary Surgeon or biology department where animals can be euthanased appropriately.

Voucher specimens will only be collected in rare circumstances and in accordance with the "Guidelines for Voucher Specimens"(2016).

6.0 Clearance Methodologies

6.1 Tree Felling Procedure

Staged clearing should be performed whereby firstly removing non habitat trees prior to the removal of potential habitat trees. Potential habitat trees should be removed at least 24 hours later to enable resident hollow dependant fauna time to evacuate the tree prior to felling. Each felled tree must be inspected and habitation recorded.

The clearing procedure for hollow bearing trees (HBT) will include:

- Clearing all vegetation around hollow bearing trees prior to their removal.
- Tapping hollow bearing trees following clearing of surrounding vegetation and leaving them to stand for 24 hours. Tapping should occur as a single tap, then wait for 5 minutes then 2 further taps. This should be sufficient to convince to animal to move from the habitat tree when it considers it safe to do so. This may take several minutes.
- Smoothly felling hollow bearing trees to minimise damage to hollows is to slowly lower the tree to the ground.
- Inspecting hollows of felled hollow bearing trees (by fauna spotter/catcher) and removing and relocating any fauna found.
- Leaving the tree on the ground for a minimum of two hours to provide any trapped fauna with an opportunity to escape.
- Where possible leave fallen trees overnight.
- Identification of locations outside the project area for relocation that contain suitable habitat/breeding places.
- Where necessary prepare for the distribution of artificial and natural habitat features and resources for relocated/displaced fauna such as hollows and rock piles.
- Post felling - All fauna found are to be translocated to an adjacent locality or nominated relocation point comprising suitable refugia and feeding resources consistent with individual species requirements. Where possible relocate fauna as soon as possible.
- Injured fauna are to be taken to a Veterinarian.

7.0 Trenching Operations

In addition to clearing operations, lengths of trench will be excavated to install electrical cabling. There will typically be a time delay between excavating the trenches, installation of the cabling work and the back filling of the trench. The trenches may potentially be open for several days which may become a hazard to fauna.

7.1 Management Measures

As per **Section 4.0**, preclearance surveys will be conducted prior to all vegetation clearing activities which will also be a requirement before trench digging commences.

To manage fauna interactions at trenches, several mitigation measures will be required:

- Erect where possible fauna exclusion fences to prevent access to trenches. If exclusion fences are greater than 500m in length, ramps will be required to be installed at a minimum of 500m apart to ensure small fauna can traverse habitat.
- Hessian bags and polystyrene should be placed intermittently along the trench to allow for shade and height to prevent heat stress or drowning of smaller fauna species.
- Structures for shade will be implemented near egress points to encourage fauna to seek out these cooler areas.
- The Environmental Officer must check the trenches twice daily (am/pm) for signs of trapped fauna.

8.0 Safety Processes

8.1 Job Safety Environmental Analysis (JSEA)

Before a spotter catcher commences work they must complete a Job Safety Environmental Analysis (JSEA) to identify the potential and real time hazards of the area. In addition they must ensure they have read and understood the relevant work Method Statements and job specific JSEA.

8.2 Equipment

A spotter catcher must have the equipment detailed in **Table 6** available to them at all times for their own safety and that of wildlife.

Table 6 Equipment Required for Safe Spotter Catcher Activities on the MEWF site

Fauna	Personal Protective Equipment
4-wheel drive vehicle	Hard hat with sun brim.
2-way radios	Hi-vis clothing above the waist (vest or shirt, sleeves buttoned down).
Cages of various sizes and construction	Long pants.
Various traps for animal capture	Safety glasses (tinted and clear).
Calico bags of various sizes	Steel cap boots (lace-up).
Various nets with extendable handles (site dependent)	Riggers gloves.
Leather and latex gloves	Sunscreen/zinc.
Towels	Backpack with hydration bladder (minimum 2.5L).
Blankets	First Aid Kit/Snake bite kit
Spray marking paint	
Flagging tape	
2.5L water bladder or alternative	
Extension ladder (site dependent)	
GPS unit	
Digital camera	
Complete set of field guide publications to enable identification of wildlife to species level	
Snake handling equipment	
Binoculars	
Torch	
Waders	
Range of containers to hold and transport aquatic fauna (dependent on site)	
Scales	
10 x lens and vernier calipers	
Complete set of fauna first aid kit containing scissors, tweezers, bandages, antiseptic, tape)	
Hot water bottle	

9.0 Safety Activities

A summary of the activities that are high risk to spotter catchers and which have very specific control measures in place have been identified and are provided in **Table 7** below.

Table 7 High risk activities with recommended control measure to reduce risk

Activity	Risk	Control
Falling / Felled Timber	Injury or death from falling timber or felled trees during clearing process	▪ Remain two tree lengths from falling timber; ▪ For large dead trees increase the distance from the tree. Dead trees can shatter once felled and the risk of debris scattering away from the tree is high; ▪ Maintain visual and radio contact with your machinery operators at all times; ▪ Look for remaining hanging debris still present in standing vegetation; ▪ Make sure the tree has settled before going in to inspect; ▪ Look out for potential sprung branches; ▪ Look and listen whilst inspecting the tree for signs of movement (i.e. cracking, branches slipping); ▪ Be aware of broken or protruding branches; ▪ Never walk or crawl under limbs.
Interaction with Machinery	Serious Injury or Death caused by interaction with heavy machinery such as an excavator, dozer, grader etc.	Positive communications between the Fauna Spotter/Catcher and machinery operators is paramount. Before moving in and around any machinery for any reason make sure of the following: ▪ Positive communication between the wildlife spotter and machinery operator has been made within the area; ▪ The machinery operator/s has lowered their boom, blade or ripper to acknowledge the communication between the wildlife spotter and machinery operator; ▪ A clear line of sight should be maintained at all times where possible. If working out of sight communication should be maintained by means of a UHF radio; ▪ Stay clear of machinery with a minimum distance of 30m or two times the length of felled trees.
Long periods working in hot conditions without shade	Serious injury or death from Heat Stroke / Sun Stroke / Thermic fever	▪ Drink sufficient water; always carry adequate drinking water (amount will depend upon conditions and distance/time away from vehicle); ▪ Take regular breaks in cool/shade; ▪ Reduce physical activity and avoiding vigorous exertion in hot weather; ▪ Minimise sun exposure by wearing lightweight clothing (SP50+ rated), a broad brimmed hat or legionnaire style cap and sunglasses; ▪ Apply sunscreen (at least SPF30+) on exposed skin at recommended intervals throughout the day; ▪ Carry first aid kit and communication appropriate devices (mobile/sat phone, VHF radio) with spare batteries.
Live trapping/animal handling, Quolls etc	Bites, scratches, Injury resulting from handling/capturing animals (infection)	▪ Only appropriate qualified staff to handle animals; handlers to have appropriate up-to-date vaccinations (tetanus; rabies for microbats and flying-foxes); ▪ Ensure appropriate handling equipment is used (e.g. calico handling bags, snake tongs etc.); ▪ Carry first aid kit and communication appropriate devices (mobile/sat phone, VHF radio); ▪ Wear appropriate PPE (e.g. Latex gloves); ▪ Wash hands with soap and water or alcohol wash following handling animals and especially before eating or drinking.

Activity	Risk	Control
Snake Bite	Serious Injury or death from snake bite	▪ Mandatory PPE must be worn at all times; ▪ Only physically handle fauna when necessary; ▪ Only competent and authorised personnel to handle venomous snakes; ▪ First Aid / Snake Bite kit to be carried at all times; ▪ Use appropriate techniques for the situation; ▪ No handling of venomous insects (i.e. spiders, scorpions, centipedes); ▪ Move away from disturbed ants nests; ▪ Only personnel vaccinated for Australian Bat Lyssavirus (ABL) to handle bats; ▪ Report all bites and scratches immediately; ▪ Apply antiseptic to all bites and scratches. Medical advice should be sought for bites which break the skin.

10.0 Monitoring and Reporting

It is a requirement of the Habitat Clearing and Management Plan developed by MEWF and the Conditions specified by Department of the Environment (DotE) and DEHP that the following information be recorded as a Wildlife Capture and Disposal Record. The form is provided in **Appendix B**.

The *Wildlife Capture and Disposal Record* must contain the following details for each captured animal classified as *endangered, vulnerable* or *near threatened* under State legislation, classified by the local regulatory authority as *locally significant* or under the federal *EPBC* Act as *critically endangered, endangered, vulnerable or near threatened*:

(a) Species;

(b) Identification name or number;

(c) Sex (M, F, or unknown);

(d) Approximate age or age class (neonate, juvenile, sub-adult, adult);

(e) Time and date of capture;

(f) Method of capture;

(g) Exact point of capture (GPS point);

(h) State of health;

(i) Incidents associated with capture likely to affect the animal;

(j) Onsite treatment if required and injury specified;

(k) Veterinary intervention or treatments;

(l) Time held in captivity;

(m) Disposal (euthanasia, re-release, translocation etc);

(n) Date and time of disposal;

(o) Details of disposal (if released, exact point of release GPS);

(p) For released animals: distance from point of capture to point of release (GPS).

10.1.1 Training and Awareness

All site personnel and contractors must undertake a site specific environmental induction prior to commencing works on the MEWF project. The environmental induction shall provide information to enable staff to recognise and respond to signs of current fauna activity.

10.1.2 Monitoring and Reporting

The Contractor's Environmental Officer is to:

- Check on a daily basis during construction that vegetation to be cleared is clearly delineated (i.e. 'no go' zones are clearly demarcated and/or barricaded)
- Ensure vegetation clearing is being undertaken in accordance with 'Construction Strategies' listed above (e.g. pre-clearing surveys, requirement for licensed fauna spotter-catcher)
- Ensure on a daily basis that contractors are clearing vegetation in accordance with the Project environmental management plans and monitor for unauthorised works beyond the extent of clearing

barriers. During construction, record any discernible evidence of listed Threatened or Iconic species activity, which would require the presence of a spotter-catcher to relocate.

10.1.3 Records

The following records shall be kept for the duration of construction and for at least five years after activities have ceased at the MEWF project site:

- Records shall be kept of all inspections undertaken in accordance with this HCMP, including the following information:
  - Date of inspection;
  - Name and qualifications of person conducting the inspection;
  - Results of inspection (description of area surveyed, type of works activity proposed in area, number and location (GPS coordinates) of dens found, individual identification (sex, status, dependent young recurring presence);
  - Control measures / exclusion fencing put in place; and
  - Persons notified (e.g. Environmental Officer, Project Manager, QPWS, and DEHP).
- Any unauthorised damage to dens shall be reported as an Environmental Incident; and
- Any harm to threatened species, in particular Northern Quoll that occurs during works shall be reported to DEHP within 24 hours of the incident and no works shall commence on site until approval to proceed has been obtained from DEHP.

10.1.4 Review

Third party audits of the HCMP are to take place at least four times a year for the duration of the construction of the MEWF project, then yearly once the MEWF project is in operation. These audits are to be arranged by the Contractor's Environmental Officer.

11.0 Field Guides and Further References

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Australian Frog Calls (Sub-tropical and tropical) – CD

Bird Calls of SE QLD – CD

Nocturnal Bird and Mammal Calls of North-east NSW – CD

Appendix A

Species List

Family	Common Name	Scientific Name	EPBC	NCA
AMPHIBIANS				
Bufonidae	Cane Toad	*Bufo marinus*		
Hylidae	Green Tree Frog	*Litoria caerulea*		
Hylidae	Floodplain Frog	*Litoria inermis*		
Hylidae	Broad-palmed Frog	*Litoria latopalmata*		
Hylidae	Rocket Frog	*Litoria nasuta*		
Hylidae	Desert Tree Frog	*Litoria rubella*		
Myobatrachidae	Montane Toadlet	*Uperoleia altissima*		
BIRDS				
Acanthizidae	Yellow Thornbill	*Acanthiza nana*		
Acanthizidae	Weebill	*Smicrornis brevirostris*		
Accipitridae	Collared Sparrowhawk	*Accipiter cirrocephalus*	M	
Accipitridae	Brown Goshawk	*Accipiter fasciatus*	M	
Accipitridae	Wedge-tailed Eagle	*Aquila audax*	M	
Accipitridae	Black-shouldered Kite	*Elanus axillaris*	M	
Accipitridae	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	M	
Accipitridae	Brahminy Kite	*Haliastur indus*	M	
Accipitridae	Whistling Kite	*Haliastur sphenurus*	M	
Accipitridae	Little Eagle	*Hieraaetus morphnoides*	M	
Alcedinidae	Azure Kingfisher	*Ceyx azureus*		
Apodidae	Australian Swiftlet	*Aerodramus terrareginae*		NT
Apodidae	House Swift	*Apus affinis*		
Apodidae	Fork-tailed Swift	*Apus pacificus*	M	
Apodidae	White-throated Needletail	*Hirundapus caudacutus*	M	
Ardeidae	Cattle Egret	*Ardea ibis*	M	
Artamidae	Dusky Woodswallow	*Artamus cyanopterus*		
Artamidae	White-breasted Woodswallow	*Artamus leucorynchus*		
Artamidae	Little Woodswallow	*Artamus minor*		
Artamidae	Masked Woodswallow	*Artamus personatus*		
Artamidae	White-browed Woodswallow	*Artamus superciliosus*		
Artamidae	Pied Butcherbird	*Cracticus nigrogularis*		
Artamidae	Grey Butcherbird	*Cracticus torquatus*		
Artamidae	Australian Magpie	*Gymnorhina tibicen*		
Artamidae	Pied Currawong	*Strepera graculina*		

Family	Common Name	Scientific Name	EPBC	NCA
Cacatuidae	Sulphur-crested Cockatoo	*Cacatua galerita*		
Campephagidae	White-bellied Cuckoo-shrike	*Coracina papuensis*		
Campephagidae	Cicadabird	*Coracina tenuirostris*		
Caprimulgidae	White-throated Nightjar	*Eurostopodus mystacalis*		
Centropodidae	Pheasant Coucal	*Centropus phasianinus*		
Climacteridae	Brown Treecreeper	*Climacteris picumnus*		
Columbidae	Bar-shouldered Dove	*Geopelia humeralis*		
Columbidae	Peaceful Dove	*Geopelia striata*		
Columbidae	Common Bronzewing	*Phaps chalcoptera*		
Coraciidae	Dollarbird	*Eurystomus orientalis*		
Corvidae	Torresian Crow	*Corvus orru*		
Cuculidae	Pallid Cuckoo	*Cacomantis pallidus*		
Cuculidae	Oriental Cuckoo	*Cuculus optatus*		
Dicaeidae	Mistletoe bird	*Dicaeum hirundinaceum*		
Dicruridae	Spangled Drongo	*Dicrurus bracteatus*		
Dicruridae	Leaden Flycatcher	*Myiagra rubecula*		
Dicruridae	Grey Fantail	*Rhipidura albiscapa*		
Dicruridae	Rufous Fantail	*Rhipidura rufifrons*	M	
Falconidae	Brown Falcon	*Falco berigora*	M	
Falconidae	Nankeen Kestrel	*Falco cenchroides*	M	
Falconidae	Peregrine Falcon	*Falco peregrinus*	M	
Falconidae	Black Falcon	*Falco subniger*	M	
Fringillidae	Chestnut-breasted Mannikin	*Lonchura castaneothorax*		
Fringillidae	Nutmeg Mannikin	*Lonchura punctulata*		
Fringillidae	Black-throated Finch (northern black-rumped subspecies)	*Poephila cincta atropydialis*		
Gruidae	Sarus Crane	*Grus antigone*	M	
Halcyonidae	Blue-winged Kookaburra	*Dacelo leachii*		
Halcyonidae	Laughing Kookaburra	*Dacelo novaeguineae*		
Hirundinidae	Barn Swallow	*Hirundo rustica*	M	
Maluridae	Red-backed Fairy-wren	*Malurus melanocephalus*		
Meliphagidae	Bridled Honeyeater	*Lichenostomus frenatus*		
Meliphagidae	Brown Honeyeater	*Lichmera indistincta*		
Meliphagidae	Noisy Miner	*Manorina melanocephala*		
Meliphagidae	White-throated Honeyeater	*Melithreptus albogularis*		
Meliphagidae	White-naped Honeyeater	*Melithreptus lunatus*		
Meliphagidae	Scarlet Honeyeater	*Myzomela sanguinolenta*		
Meliphagidae	Little Friarbird	*Philemon citreogularis*		
Meliphagidae	Noisy Friarbird	*Philemon corniculatus*		
Meliphagidae	White-cheeked Honeyeater	*Phylidonyris niger*		
Meropidae	Rainbow Bee-eater	*Merops ornatus*	M	
Neosittidae	Varied Sittella	*Daphoenositta chrysoptera*		

Family	Common Name	Scientific Name	EPBC	NCA
Oriolidae	Yellow Oriole	*Oriolus flavocinctus*		
Oriolidae	Olive-backed Oriole	*Oriolus sagittatus*		
Pachycephalidae	Grey Shrike-thrush	*Colluricincla harmonica*		
Pachycephalidae	Rufous Whistler	*Pachycephala rufiventris*		
Pardalotidae	Spotted Pardalote	*Pardalotus punctatus*		
Pelecanidae	Australian Pelican	*Pelecanus conspicillatus*		
Phasianidae	Brown Quail	*Coturnix ypsilophora*		
Podargidae	Tawny Frogmouth	*Podargus strigoides*		
Pomatostomidae	Grey-crowned Babbler	*Pomatostomus temporalis*		
Psittacidae	Red-winged Parrot	*Aprosmictus erythropterus*		
Psittacidae	Little Lorikeet	*Glossopsitta pusilla*		
Psittacidae	Pale-headed Rosella	*Platycercus adscitus*		
Psittacidae	Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*		
Psittacidae	Rainbow Lorikeet	*Trichoglossus haematodus*		
Ptilonorhynchidae	Great Bowerbird	*Chlamydera nuchalis*		
Strigidae	Southern Boobook	*Ninox novaeseelandiae*		
Sylviidae	Rufous Songlark	*Cincloramphus mathewsi*		
MAMMALS				
Canidae	Dingo/Wild Dog	*Canis lupus dingo/C. Familiaris*		
Dasyuridae	Northern Quoll	*Dasyurus hallucatus*	E	E
Emballonuridae	Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*		
Emballonuridae	Bare-rumped Sheathtail Bat	*Saccolaimus saccolaimus nudicluniatus*	CE	E
Emballonuridae	Common Sheathtail Bat	*Taphozous georgianus*		
Emballonuridae	Troughton's Sheathtail Bat	*Taphozous troughtoni*		E
Equidae	Domestic Horse	*Equus caballus*		
Felidae	House Cat	*Felis silvestris catus*		
Hipposideridae	Dusky Leafnosed Bat	*Hipposideros ater*		
Hipposideridae	Diadem Leafnosed Bat	*Hipposideros diadema reginae*		NT
Hipposideridae	Semon's Leafnosed Bat	*Hipposideros semoni*	E	
Leporidae	European Rabbit	*Oryctolagus cuniculus*		
Macropodidae	Agile Wallaby	*Macropus agilis*		
Macropodidae	Whiptail Wallaby	*Macropus parryi*		
Macropodidae	Wallaroo or Euro	*Macropus robustus*		
Molossidae	White-striped Freetail Bat	*Austronomus australis*		
Molossidae	Northern Freetail Bat	*Chaerephon jobensis*		
Molossidae	Beccari's Freetail Bat	*Mormopterus beccarii*		
Molossidae	Little Northern Freetail Bat	*Mormopterus loriae*		
Molossidae	Eastern Freetail Bat	*Mormopterus ridei*		
Muridae	Water Rat	*Hydromys chrysogaster*		
Muridae	Grassland Melomys	*Melomys burtoni*		
Muridae	Black-footed Tree-rat	*Mesembriomys gouldi*		

Family	Common Name	Scientific Name	EPBC	NCA
Muridae	House Mouse	*Mus musculus*		
Muridae	Black Rat	*Rattus rattus*		
Muridae	Giant White-tailed Rat	*Uromys caudimaculatus*		
Muridae	Common Rock-rat	*Zyzomys argurus*		
Peramelidae	Northern Brown Bandicoot	*Isoodon macrourus*		
Phalangeridae	Common Brushtail Possum	*Trichosurus vulpecula*		
Pteropidae	Spectacled Flying-fox	*Pteropus conspicillatus*	V	V
Rhinolophidae	Eastern Horseshoe Bat	*Rhinolophus megaphyllus*		
Rhinolophidae	Large-eared Horseshoe Bat	*Rhinolophus philippinensis maros*	E	E
Suidae	Pig	*Sus scrofa*		
Tachyglossidae	Short-beaked Echidna	*Tachyglossus aculeatus*		
Vespertilionidae	Gould's Wattled Bat	*Chalinolobus gouldii*		
Vespertilionidae	Hoary Wattled Bat	*Chalinolobus nigrogriseus*		
Vespertilionidae	Little Bentwing Bat	*Miniopterus australis*		
Vespertilionidae	Large Bentwing Bat	*Miniopterus orianae oceanensis*		
Vespertilionidae	Northern Large-footed Myotis	*Myotis moluccarium*		
Vespertilionidae	Northern Longeared Bat	*Nyctophilus bifax*		
Vespertilionidae	Lesser Longeared Bat	*Nyctophilus geoffroyi*		
Vespertilionidae	Gould's Long-eared Bat	*Nyctophilus gouldii*		
Vespertilionidae	Greater Broadnosed Bat	*Scoteanax rueppellii*		
Vespertilionidae	Eastern Broadnosed Bat	*Scotorepens orion*		
Vespertilionidae	Northern Broadnosed Bat	*Scotorepens sanborni*		
Vespertilionidae	Eastern Forest Bat	*Vespadelus pumilus*		
Vespertilionidae	Eastern Cave Bat	*Vespadelus troughtoni*		
REPTILES				
Agamidae	Frill-necked dragon	*Chlamydosaurus kingii*		
Agamidae	Tommy roundhead	*Diporiphora australis*		
Agamidae	Two-lined dragon	*Diporiphora bilineata*		
Cheluidae	Saw-shelled turtle	*Wollumbinia latisternum*		
Colubridae	Common tree snake	*Dendrelaphis punctulatus*		
Colubridae	Keelback	*Tropidonophis mairii*		
Elapidae	Eastern brown snake	*Pseudonaja textilis*		
Gekkonidae	Dubious dtella	*Gehyra dubia*		
Gekkonidae	Northern spotted rock dtella	*Gehyra nana*		
Gekkonidae	Bynoe's gecko	*Heteronotia binoei*		
Gekkonidae	Northern velvet gecko	*Oedura castelnaui*		
Gekkonidae	Northern spotted velvet gecko	*Oedura coggeri*		
Gekkonidae	Zigzag velvet gecko	*Oedura rhombifer*		
Gekkonidae	Eastern spiny-tailed gecko	*Strophurus williamsi*		
Pygopodidae	Excitable delma	*Delma tincta*		
Pygopodidae	Burton's legless lizard	*Lialis burtonis*		

Family	Common Name	Scientific Name	EPBC	NCA
Pythonidae	Black-headed python	*Aspidites melanocephalus*		
Pythonidae	Scrub python	*Morelia kinghorni*		
Pythonidae	Carpet python	*Morelia spilota*		
Scincidae	Lined rainbow-skink	*Carlia jarnoldae*		
Scincidae		*Carlia longipes*		
Scincidae	Shaded-litter rainbow-skink	*Carlia munda*		
Scincidae		*Carlia mundivensis*		
Scincidae	Black-throated rainbow-skink	*Carlia rostralis*		
Scincidae	Robust rainbow-skink	*Carlia schmeltzii*		
Scincidae		*Carlia stori*		
Scincidae	Lively rainbow skink	*Carlia vivax*		
Scincidae		*Cryptoblepharus plagiocephalus*		
Scincidae	Wall skink	*Cryptoblepharus virgatus*		
Scincidae	Straight-browed ctenotus	*Ctenotus spaldingi*		
Scincidae	Copper-tailed skink	*Ctenotus taeniolatus*		
Scincidae	Pink-tongued skink	*Cyclodomorphus gerrardii*		
Scincidae	Major skink	*Egernia frerei*		
Scincidae	Northern barsided skink	*Eulamprus brachysoma*		
Scincidae	Common blue-tongued skink	*Tiliqua scincoides*		
Varanidae	Spotted tree monitor	*Varanus scalaris*		
Varanidae	Storr's monitor	*Varanus storri*		
Varanidae	Black-headed monitor	*Varanus tristis*		

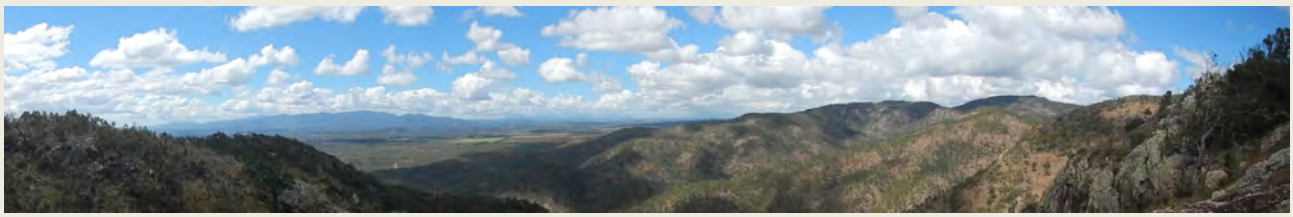
Appendix B

Wildlife Capture and Disposal Record

Wildlife Capture and Disposal Record	
Name	
Date	
Qualification	
Project	
Species	
Identification name or number	
Sex	M / F / Unknown
Approximate age or age class	Neonate / Juvenile / Sub-Adult / Adult
Time and date of capture	
Method of capture	
Exact point of capture (GPS point)	
State of health	
Incidents associated with capture likely to affect the animal	
Onsite treatment if required and injury specified	
Veterinary intervention or treatments	
Time held in captivity	
Disposal	Euthanasia / Re-Release / Translocation .....
Date and time of disposal	...../...../..... ..... : .....
Details of disposal (if released, exact point of release GPS)	
For released animals: distance from point of capture to point of release (GPS)	

Appendix J

Weed and Pest Management Plans



Weed Management Plan

Mt Emerald Wind Farm

2016 - 2020

Report prepared for RPS Australia Asia Pacific (Cairns) for MEWFPL

September 2016

Weed Management Plan

2016 to 2020

Mt Emerald Wind Farm

Simon Gleed

9th September 2016

Report prepared for RPS Australia Asia Pacific (Cairns) for MEWFPL

Disclaimer

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Simon Gleed undertook the fieldwork and preparation of this document in accordance with specific instructions from RPS Australia Asia Pacific (Cairns), to whom this document is addressed. This report has been prepared using information and data supplied by RPS Australia Asia Pacific (Cairns) and other information sourced by the author.

The conclusions and recommendations contained in this document reflect the professional opinion of the author based on the data and information supplied and available at the time of the work. The author has used reasonable care and professional judgment in the interpretation and analysis of the data. The conclusions and recommendations must be considered within the agreed scope of work, and the methodology used to perform the work, both of which are outlined in this report.

Document Status

Document Status	Author	Reviewer	Date of Issue
Draft Report	S. Gleed	M. Jess (RPS)	6th September 2016
Final Report	S. Gleed	T. Johannesen	9th September 2016

Distribution

Company	Copies	Contact Name
RPS	1 (electronic: PDF)	Via email to M. Jess
Simon Gleed	1 (electronic)	S. Gleed

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1.0 SUMMARY

The Mt Emerald Wind Farm site provides important habitat and refuge areas for threatened plants, animals and a majority of the project site is in an undisturbed ecological condition. The project area is covered by remnant vegetation, in which few if any weeds are present prior to the wind farm being constructed.

The areas of weed presence and large populations were in 2016 at the lowest elevation along the pre-disturbed Kippen Drive: the main entry and exit point into the Mt Emerald Wind Farm site. At higher elevation where the wind turbine generators (WTG's) and associated road and compound infrastructure are located, weeds are confined to the edges of the existing track network that provides access to the 275 kV powerline infrastructure which passes through the project area. Weeds are also found under a number of transmission towers.

Some weeds have entered the site elsewhere at higher elevation, such as around the 80 m wind monitoring tower, where increased vehicle access has resulted in some weed establishment . The wind monitoring tower area is amongst critical habitat for threatened plants and weeds have the potential to significantly degrade habitat integrity and values.

Major threats to the survival of threatened plants and animals and their habitats include altered fire regimes, weed invasion, and physical clearing and modification of habitat zones. The three impacts are interrelated.

The example of new weeds entering the project area at the wind monitoring tower highlights the crucial requirement to practice robust weed management in an environment that holds significant environmental values.

Changed fire ecology, for example modification to the landscape and habitats caused by unnaturally intense and hot fires, is identified as one of the major potential impacts to the long-term viability of the environment at the Mt Emerald Wind Farm site. One of the main determinants of fire impacts is an increase in fuel loads, which is typically caused by tall, bulky invasive grasses. Hence, the following list includes many species of this group of weeds.

Key weeds that are present along Kippen Drive or near the 275 kV powerline infrastructure that pose a high risk to the long-term quality and values of the wind farm site include:

- Grader Grass (*Themeda quadrivalvis*),
- Mission Grass (*Cenchrus polystachyum*),
- Thatch Grass (*Hyparrhenia rufa*),
- Signal Grass (*Urochloa decumbens*),
- Molasses Grass (*Melinis minutiflora*),
- Giant Rat's Tall Grass (*Sporobolus natalensis*) and other *Sporobolus* species,
- Rhodes Grass (*Chloris gayana*),
- Guinea Grass (*Megathyrsus maximus*),
- Lantana (*Lantana camara*),
- Hyptis (*Hyptis suaveolens*),
- Stinking Passionflower (*Passiflora foetida*) and
- Gambia Pea (*Crotalaria goreensis*).

This list is not exhaustive and many other weeds known from the surrounding region could be introduced into the site (e.g. Japanese Sunflower - *Tithonia diversifolia*).

This Weed Management Plan forms the framework and provides guidelines on how weeds will be managed on the Mt Emerald Wind Farm. The plan sets out the strategies and outcomes, and also considerations that are intended to form the basis on which day-to-day weed management decisions are made.

The Weed Management Plan was prepared in August 2016 and it is intended that the plan will have a life of 4 years between 2016 and 2020. The plan is to be reviewed and amended as necessary on an annual basis or earlier if particular events require an adaptive approach to weed management.

2.0 INTRODUCTION

2.1 Project Description

Mount Emerald Wind Farm Pty Ltd (MEWFPL) proposes to construct and operate a wind farm located approximately 20 km SSW of Mareeba on the Atherton Tablelands in north Queensland at the northern extent of the Herberton Range mountainous area.

The nature of the project requires wind energy to be harnessed efficiently and effectively therefore the WTG's are located on high points through the project site. The northern half of the site has broad, rolling hills, with dissected areas found in ravines and gorges; whereas the land to the south of the existing 275 kV powerline is markedly rugged and steeply dissected, rendering the highest points a series of narrow ridges and rocky knolls with steep drop-offs on adjacent slope faces. WTG's will be connected to each other by a network of tracks, some of which will accommodate underground cabling. A substation and contractors compound will be constructed within the wind farm site.

The primary access from Springmount Road to the wind farm will be along Kippen Drive at the base of the site. From the end of the flat section of Kippen Drive, the access will then ascend the hills into the wind farm site at elevation.

2.2 Project Components

The wind farm will consist of a maximum of 63 hollow tower wind turbine generators (WTG's), which will be approximately 80 m high and with 55 m diameter rotor blades. The wind farm will provide energy to feed into the main electricity grid infrastructure currently provided by the 275 kV Chalumbin to Woree powerline. The WTG's will be connected and linked by a series of access tracks and underground cabling.

Other infrastructure and facilities to be constructed within the wind farm project site include a contractors site compound, a lay-down area, a substation, and an associated substation operation and management building. The location of the works and layout of the wind farm infrastructure are shown in **Figure 1**.

2.3 Purpose and Objectives of Weed Management Plan

This Weed Management Plan describes the management measures and actions that apply to eliminating or reducing the impact of weeds in the Mt Emerald Wind Farm project site. The purpose of this Weed Management Plan is to reduce the impacts of weeds by achieving the following objectives:

- Significantly reduce and manage the dominant weed infestations along the proposed access route on Kippen Drive.
- Eliminate or control to negligible populations sizes the priority weeds within the WTG footprint area of the Mt Emerald Wind Farm site.
- Enhance and improve the quality of natural habitats within the wind farm site where identified.

The Plan's framework comprises: weed management objectives; management actions; performance indicators; monitoring; roles and responsibilities; and reporting requirements.

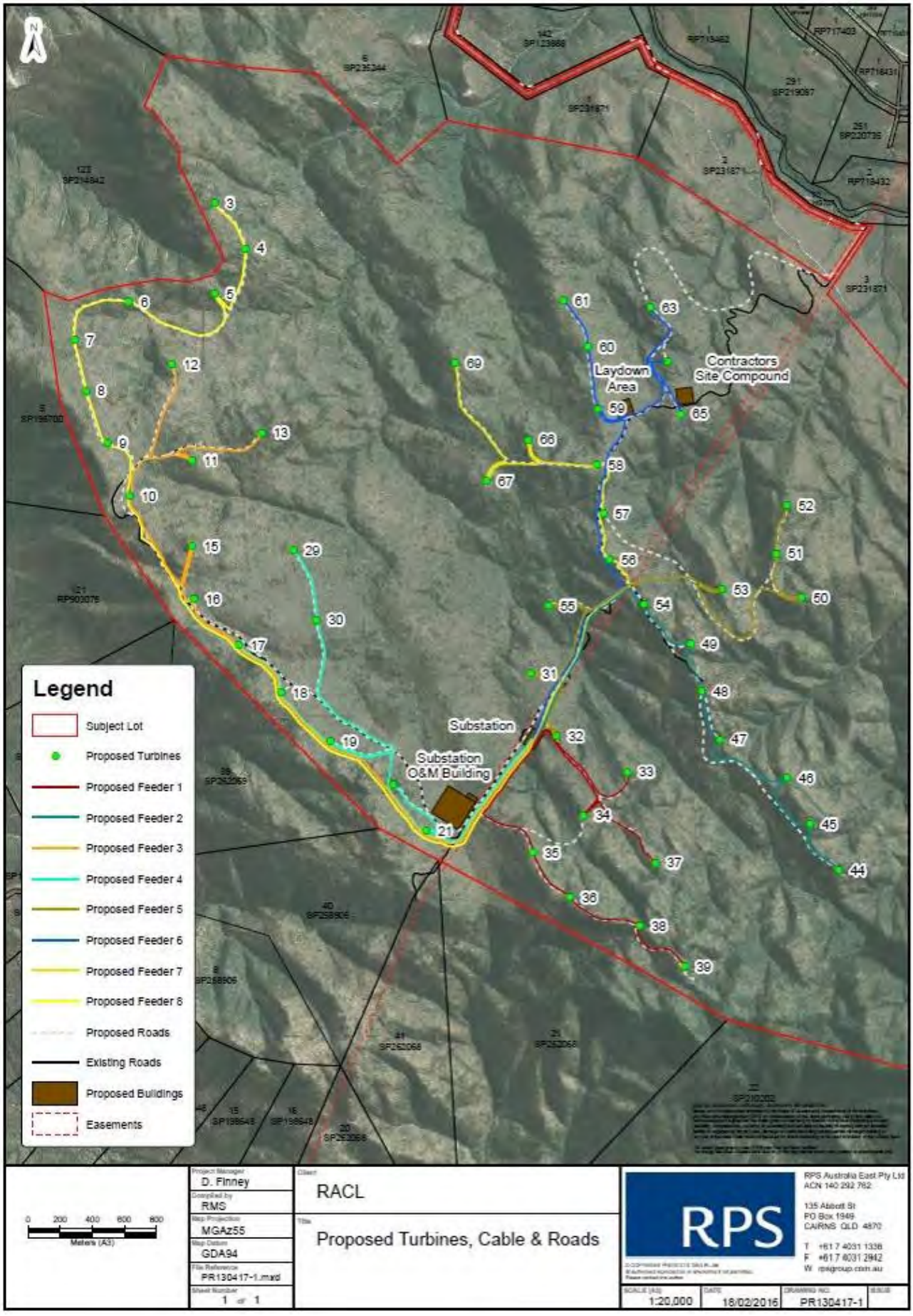

Figure 1. Layout of the Mt Emerald Wind Farm

2.4 Legislative Context

Invasive weeds are known to pose a significant threat to biodiversity and natural landscape function. As a result of the impacts weeds cause, including economic reasons, weeds are regulated at three government levels. For major infrastructure projects such as the Mt Emerald Wind Farm, weed priorities are established, which consider whether a species is listed (declared) under legislation, local law or under Australia-wide national plans; and importantly, at the project site-scale, whether a weed species poses a risk of causing environmental degradation to important habitats or sensitive areas.

2.4.1 *Land Protection (Pest and Stock Route Management) Act 2002* (Queensland)

Declaration of weeds under Queensland's *Land Protection (Pest and Stock Route Management) Act* 2002 (LP Act) imposes a legal responsibility for control by all landowners on land under their management. Declared weeds are given a status of class 1, class 2 or class 3. The descriptions and legal obligations for the declared weed classes are as follows:

A Class 1 weed is one that has the potential to become a very serious weed in Queensland in the future. All landholders are required by law to keep their land free of Class 1 weeds. It is a serious offence to introduce, keep, release or sell Class 1 weeds without a permit.

A Class 2 weed is one that has already spread over substantial areas of Queensland. By law, all landholders must attempt to keep their land free of Class 2 weeds and it is an offence to possess, sell or release these weeds without a permit.

A Class 3 weed is one that is commonly established in parts of Queensland. Landholders are not required to control a Class 3 declared pest plant on their land unless a pest control notice is issued by a local government because the weed is causing or has potential to cause an negative impact on an adjacent environmentally significant area. It is an offence to supply a Class 3 weed.

Weeds not declared under the LP Act may still be declared at a local government level under local laws (see Mareeba Shire Pest Management Plan).

Declared weeds found on or in the vicinity of the Mt Emerald Wind Farm site are listed in **Table 1** under the following section.

2.4.2 Mareeba Shire Pest Management Plan 2015 to 2020

The Mareeba Shire Council lists priority pest plants in its Mareeba Shire Pest Management Plan 2015 to 2020 (MSPMP). Priority weeds are given a ranking, where weeds with higher scores are a higher priority for control. The highest score that a priority weed can be scored is 45. The priority weeds occurring in or near the Mt Emerald Wind Farm site are listed and categorised in **Table 1**.

Table1. Priority weeds listed under local law, nationally and Queensland legislation.

Weed species	MSPMP Score	WONS	LP Act	On wind farm site?
Parthenium (*Parthenium hysterophorus*)	35.9	Yes	Class 2	No
Bellyache Bush (*Jatropha gossypifolia*)	35.0	Yes	Class 2	No
Rubber Vine (*Cryptostegia grandiflora*)	33.2	Yes	Class 2	No
Lantana (*Lantana camara*)	29.5	Yes	Class 3	**Yes**

Weed species	MSPMP Score	WONS	LP Act	On wind farm site?
Sicklepod (*Senna obtusifolia*)	27.0	No	Class 2	**Yes**
Giant Rat's Tail Grass (*Sporobolus natalensis*)	26.8	No	Class 2	**Yes**
American Rat's Tail Grass (*Sporobolus jacquemontii*)	-	No	Class 2	**Yes**
Cat's Claw Creeper (*Dolichandra unguis-cati*)	-	Yes	Class 3	No
Gamba Grass (*Andropogon gayanus*)	-	Yes	Class 2	No
Mother of Millions (*Bryophyllum* spp.)	-	No	Class 2	**Yes**
Asparagus Fern/Ground Asparagus (*Asparagus aethiopicus*)	-	Yes	Class 3	No
Captain Cook Tree / Yellow Oleander (*Cascabela thevetia*)	-	No	Class 3	No
Madeira Vine (*Anredera cordifolia*)	-	Yes	Class 3	No

The following extract from the Mareeba Shire Pest Management Plan relates to the legal requirement for landholders to control class 1 and 2 declared pest plants as regulated by the LP Act. The extract also refers to priority weeds species listed in the shire's pest management plan.

> "Where an infestation of a class 1 or 2 plant or animal or one identified in the "Priority Pest Plan" is identified by Council's Pest Management Officer, a notice under the Land Protection (Pest and Stock Route Management) Act or Local Law will be served to destroy all declared weeds on the property within seven (7) and twenty-one (21) days (or other length as required by the circumstance i.e. notices will give the landholder a reasonable and sufficient period of time for each particular circumstance to take the required action). Council hereby delegates the authority to serve notice to the Chief Executive Officer and Pest Management Officer generally under the Land Protection (Pest and Stock Route Management) Act and its Local Laws."

2.4.3 Weeds of National Significance

The Australian, state and territory governments have compiled a list of thirty-two *Weeds of National Significance* (WONS). Nomination of a weed for inclusion on the WONS list is based the species' invasiveness, impacts, the potential to spread, environmental and socio-economic values.

Two species from the WONS list occur in the Mt Emerald Wind Farm project site: the shrubs Lantana (*Lantana camara*) and Bellyache Bush (*Jatropha gossypifolia*). A small population of Lantana is found under a powerline tower, and one juvenile plant of Bellyache Bush was observed around the 80 m wind monitoring tower.

Seven other WONS terrestrial weed species that occur regionally or in the vicinity, but are not found in the wind farm site include: Gamba Grass (*Andropogon gayanus*), Rubber Vine (*Cryptostegia grandiflora*), Parthenium (*Parthenium hysterophorus*), Cat's Claw Vine (*Dolichandra unguis-cati*), Climbing Asparagus Fern (*Asparagus plumosus*), Ground Asparagus (*Asparagus aethiopicus*) and Madeira Vine (*Anredera cordifolia*).

3.0 WEED MANAGEMENT PLAN

3.1 Existing Environment and Current Weed Status

The following summary information regarding the existing environment, which has been described in detail in the EIS (Environmental Impact Statement), and the current status and distribution of weeds in the wind farm project area forms the baseline information needed to form the framework of the monitoring component of this Weed Management Plan. Reference should also be made to detailed documents that have been published about the environmental characteristics of the Mt Emerald Wind Farm site, such as the EIS and any relevant supporting reports.

3.1.1 Description of existing environment

The Mt Emerald Wind Farm site is characterised by steeply dissected hills, rocky terrain and areas of precipitous ridges and ravines. The broad geology of the site is mapped as the Walsh Bluff Volcanics, which comprises fine-grained rhyolite.

The predominant vegetation cover over the project site is a mosaic of sclerophyll woodland, shrubland and heathland. Weeds are virtually absent from remnant vegetation.

Common trees of the woodlands include Lemon-scented Gum (*Corymbia citriodora*), Yellow Stringybark (*Eucalyptus mediocris* - this species was referred to its former name in the EIS as *E. portuensis*), Range Bloodwood (*C. abergiana*), Ironbark (*E. crebra*) and Dead Finish (*E. cloeziana*) and Cypress Pine (*Callitris intratropica*), Silver-leaf Ironbark (*E. shirleyi*), Orange jacket (*C. leichhardtii*), White Stringybark (*E. reducta*), and *E. lockyeri.* The dominant grass is usually Kangaroo Grass (*Themeda triandra*). Woodlands are most frequent over broad slopes, flats and rolling hills

Shrublands are characterised by many species, but typically include Sheoak (*Allocasuarina littoralis*), (*Xanthorrhoea johnsonii*), *Eucalyptus lockyeri*, Wattle (*Acacia aulacocarpa*), *Homoranthus porteri*, *Grevillea glossadenia*, and stunted forms of Range Bloodwood (*Corymbia abergiana*). Shrubland is generally found in relation to the ridge environment where rocky soils prevail. The endangered shrub *Melaleuca uxorum* is found on the boundary of this vegetation type with taller woodlands. It is found elsewhere in association with the montane heathland and rock pavements described below.

Heathlands have a special and diverse group of plants which include species such as Broom (*Jacksonia thesioides*), Grass Tree (*Xanthorrhoea johnsonii*), *Gompholobium nitidum*, the wattles *Acacia calyculata* and *A. whitei*, the grass *Cleistochloa subjuncea*, emergent stunted forms of *Eucalyptus lockyeri*, *Grevillea glossadenia*, *Homoranthus porteri*, *Cryptandra debilis*, *Mirbelia speciosa* subsp. *ringrosei*, *Pseudanthus ligulatus*, *Zieria whitei*, *Boronia occidentalis* and others. The critically endangered *Acacia purpureopetala* and *Prostanthera clotteniana* grow in this vegetation type. It is referred to in the EIS as montane heathland, because of its reliance on high elevation aspects and very thin soils.

A feature of the montane heathland and shrublands at high elevation is the presence of rock pavements and areas of poorly vegetated rock outcrops. This particular habitat supports few large species because of the near-absence of soil or growth medium on their surfaces. The soil that does develop is trapped in rock hollows and scoops and crevices between rock plates and boulders. The soil is developed from small plants such as lichens, mosses and the remains of rock ferns (Cheilanthes spp.). These plant matter integrates with weathered rock material to form a soil that has the texture of peat, where in wetter times the absorbent nature of the medium is able to store water for longer periods.

Plants on rock pavements include the Resurrection Plant (*Borya septentrionalis*), *Pseudanthus ligulatus*, scattered shrubs of *Grevillea glossadenia*, *Plectranthus* species (including the threatened *P. amoenus*) and occasionally sentinel specimens of Cypress Pine (*Callitris intratropica*). Grasses are sparsely represented and can include Five Minute Grass (*Tripogon loliiformis*) and *Eriachne humilis*. *Eriachne mucronata* is often found around the edges of rock pavements. Some rock pavements are entirely covered by Firegrass (*Schizachyrium pachyarthron*).

Land surrounding Kippen Drive from Springmount Road to the low sections of the Herberton Range before the road ascends into the wind farm site is highly modified through long-term disturbance and farming. Consequently, this section of the project site carries the highest proportion of weeds and the most serious weeds. Grader Grass (*Themeda quadrivalvis*) is considerably problematic along this section of the access into the wind farm site. Grader Grass is also gradually entering higher sections of the site and has been introduced by recent machinery operations.

3.1.2 Significance ridge environment and key plant habitats

The high altitude ridges in the wet tropics bioregion section of the site (south of the 275 kV powerline) are sensitive environments that serve as important habitats for plants and the poorly represented montane heath and shrubland mosaic found around 900 m ASL. Here the cloud base is a determinant of the moisture regime in relation to plants and their exposure to extreme conditions.

The land south of the 275 kV powerline holds the highest levels of species diversity and endemism, where many species are restricted to and have adapted to the harsh environment of exposed high elevation points on ridges, rock pavements and areas of skeletal soil. This montane habitat supports six species of plants which are listed as critically endangered, endangered and vulnerable under Queensland and Commonwealth legislation. Many other species, not listed under legislation, are restricted to the montane heath along and on the edges of narrow ridge lines and rock pavement areas.

The rugged nature of the land with steep rocky slopes, bare rock pavements, outcrops and cliffs provides a unique environment for plants, and it is these characteristics which act as a refuge and reduces the effects of the severity and intensity of bush fires due to the low levels of flammable material such as grasses. Consequently, the conservation significant plants are found almost exclusively in fireproof habitats and niches. The protection from fire is a critical attribute, which renders most of the ridge tops and rock pavements as significant habitats where many threatened plants are able to persist.

3.2 Current Weed Status

Some weeds are established within the project footprint, and most probably as a result of construction of the 275 kV powerline and its associated track network. Some zones of the site have suffered longer term weed incursions as a result of grazing and regular vehicle movements at lower elevation, particularly along Kippen Drive.

The most significant manifestation of weed invasion is along and adjacent to both sides of the main access road into the site along Kippen Drive. In this section, loss of native woodlands through prior land clearing, plus road verge maintenance have resulted in large areas being infested and dominated by weedy grasses and shrubs including Grader Grass (*Themeda quadrivalvis*), Stylo (*Stylosanthes scabra* and other species), Hyptis (*Hyptis suaveolens*) and Stinking Passion Flower (*Passiflora foetida*). These are invasive weeds which pose a significant threat to the high quality environments higher up in the wind farm site if allow to establish.

Higher on the site, where traffic, machinery and human movement is less frequent, weed presence is found wherever land has been cleared and modified. Weeds observed on the site at higher elevation include Praxelis (*Praxelis clematidea*), Molasses Grass (*Melinis minutiflora*), Guinea Grass (*Megathyrsus maximus*), Thatch Grass (*Hyparrhenia rufa*) and Mission Grass (*Cenchrus polystachyum*). Occurrences of Giant Rat's Tail Grass (*Sporobolus natalensis*), American Rat's Tail Grass (*S. jacquemontii*) and Lantana (*Lantana camara*) are found in containable populations around the existing 275 kV powerline and towers.

An important baseline observation is that the invasive weeds listed above (with the exception of isolated occurrences of Praxelis) are absent from remnant vegetation areas. In this regard, ridges, rocky slopes and undisturbed land is in pristine condition and holds significantly high levels of natural integrity and condition.

3.3 Priority Weed Species on the Mt Emerald Wind Farm

For the purposes of this Weed Management Plan, priority weeds are the species that have been identified as posing the highest risk of causing environmental harm in a site-based context. Any declared weeds as listed under Queensland or National legislation, or local government laws will be managed accordingly.

3.3.1 Invasive weeds

Invasive weeds, including grasses and broadleaf plants, quickly adapt to disturbed environments and can rapidly outcompete native species and dominate a disturbed site. They spread quickly and are responsible for significant levels of environmental damage displacing native plants and habitats.

Weeds contribute to changed fire regimes, which negatively affect the structure, flora and habitat values of native vegetation. On the Mt Emerald Wind Farm site, invasive grasses and other weeds are a significant threat to the natural values of the project area. Invasive weeds place adverse and unnatural pressure on the integrity and function of the vegetation of all aspects of the wind farm site, and notably the function of threatened plant habitats. Tall weedy grasses and other lower growing introduced grasses are given priority status in this weed management plan for control and ongoing management.

Typical invasive weeds present on the Mt Emerald Wind Farm site include; Grader Grass, Thatch Grass, Guinea Grass, Molasses Grass, Signal Grass, Mission Grass, two species of Rat's Tail Grass and Lantana. The priority weeds on the site are listed in **Table 2** and reference should be made to the weed schedule in **Appendix A** for other weed management priorities.

Table 2. Priority weeds on the Mt Emerald Wind Farm site (listed in order of importance).

			MEWF Management Priority		
Weed	**LP Act**	**Threats**	**Kippen Drive**	**WTG site**	**Notes**
Grader Grass (*Themeda quadrivalvis*)	-	Invasive. Increases unnatural fire risk. Displaces ground flora.	Very High	Very High	Encroaching into WTG site on lower slopes.
Mission Grass (*Cenchrus polystachyum*)	-	Invasive. Increases unnatural fire risk. Displaces ground flora.	Very High	Very High	Main patches under 275 kV powerline in WTG site. Spot occurrences along Kippen Drive.
Giant Rat's Tail Grass (*Sporobolus natalensis*)	Class 2	Invasive and fire risk.	-	Very High	Under 275 kV powerline towers in WTG site.
Thatch Grass	-	Invasive and increase fire risk.	Very High	Very High	Only one incidence seen on

			MEWF Management Priority		
Weed	**LP Act**	**Threats**	**Kippen Drive**	**WTG site**	**Notes**
(*Hyparrhenia rufa)*					northern approach track into WTG site. Isolated along Kippen Drive. Control early.
American Rat's Tail Grass (*Sporobolus jacquemontii*)	Class 2	Invasive and fire risk.	Very High	Very High	Under 275 kV powerline towers in WTG site and along Kippen Drive.
Molasses Grass (*Melinis minutiflora*)	-	Invasive. Increases unnatural fire risk. Displaces ground flora.	Medium	Very High	Main area around watercourse crossing under powerline in WTG site.
Signal Grass (*Urochloa decumbens*)	-	Invasive. Increases unnatural fire risk. Displaces ground flora.	Medium	High	Only small areas in WTG site - control early.
Rhodes Grass (*Chloris gayana*)	-	Invasive, increases unnatural fire risk. Displaces native species.	High	-	Small patches along Kippen Drive.
Guinea Grass (*Megathyrsus maximus*)	-	Invasive. Increases unnatural fire risk. Displaces ground flora.	Medium	High	Isolated on WTG site. Along Kippen Drive. Control early.
Hyptis (*Hyptis suaveolens*)	-	Increases risk of hot fires. Invasive and lowers integrity.	High	High	Along Kippen Drive and encroaching up lower northern slopes.
Lantana (*Lantana camara*)	Class 3	Invasive. Increases unnatural fire risk. Displaces ground flora.	High	Very High	Isolated along Kipen Drive and under 275 kV powerline tower in WTG site.
Sicklepod (*Senna obtusifolia*)	Class 2	Invasive. Displaces native vegetation. Difficult to eradicate.	-	Very High	Isolated record at 80 m wind monitoring tower when first constructed. Not seen in 2016. Vigilance required.

NOTES

A hyphen (-) in the table indicates that the species has not been recorded at a location; or the species is not listed under the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act), Mareeba Shire Pest Management Plan (MSPMP) or WONS (Weeds of National Significance). If a species is indicated as not being observed at a location this does not infer that the species is absent - weed surveillance should update presence if a weed is a new detection.

LP Act: Declared weed status under the *Land Protection (Pest and Stock Route Management) Act 2002*.

MSPMP: Priority score under the Mareeba Shire Pest Management Plan.

WONS: Indicates if the species is listed as a Weed of National Significance.

Threats: Describes the main threats and potential impacts that the species could cause once established.

MEWF Management Priority: This is the site-specific Mt Emerald Wind Farm priority ranking for management of weeds. It is based on invasiveness, current population sizes, potential to affect fire ecology and whether a species is considered to impose a significant threat to sensitive environmental areas. Very High - requires to be managed as a priority; High - requires early intervention and management; Medium - requires to be managed on a regular basis; Low - requires to watched and managed if deemed problematic.

Kippen Drive: Refers to the flat, modified land that will be used as the primary access from Springmount Road to the base of the wind farm site.

WTG site: Refers to all the land in which the wind farm operational infrastructure will be located and begins at the base of the hill at the terminus of Kippen Drive and extends into all ridges and land at higher elevation where WTG's, access roads, cabling network, lay-down pads, substation and compound infrastructure will be located.

3.4 Potential Impacts of Weeds

The following impacts are relevant to the pre-construction, construction, operation and decommissioning stages of the Mt Emerald Wind Farm. The main triggers for weed invasion and outbreaks are:

- Disturbance of the natural ground surface. This provides good opportunities for weeds to occupy soil where no natural competition would otherwise exclude weeds. Disturbance or modification can be in the form of new excavation work; introduction of foreign soil material and roadbase; and trampled or flattened vegetation.

- Weeds being introduced into a site on machinery and vehicles; which often includes weed-contaminated soil and roadbase or construction materials.

- Repeated use of herbicide can modify a natural surface. Often one species of weed is killed by the herbicide, but another species of weeds replaces the former species. For example, Bluetop and Praxelis will often colonise areas that were once infested with noxious grasses.

Invasive weeds displace native plants and habitats by out-competing native plants for resources. Weeds prevent native seedling recruitment and retard germination of seed. They contribute to changed fire regimes, which affect the structure, flora composition and habitat values of native vegetation. On the Mt Emerald Wind Farm site, invasive grasses and other weeds pose a significant threat to the natural values of the project area.

The key impacts that weeds cause to natural environments are:

- **Changed fire regimes** through increased fuel loads (tall, dense grasses) and the generation of flammable fuel loads that burn hotter and more fiercely than native grasses.

- **Displacement of native plant species** by outcompeting smaller plants. For example, the critically endangered wattle *Acacia purpureopetala* (Purple-flowering Wattle) is found in the wind farm project footprint, and has a low growing habit which would quickly be smothered by invasive grasses.

- **Modification and degradation** of the quality of remnant habitats for flora and fauna. For example, on the wind farm site, many native species of flora and fauna rely on specialist habitats to survive: some species are only found on this site and in the local region.

- **Habitat destruction**: intense fire events destruct and incinerate hollow logs (important for wildlife); kill trees (nectar source for bats and birds); and destroy soil seed banks and the thin veneer of soil matter found around rock pavements.

- **Increased soil erosion**: widespread, unnaturally hot fires caused by weedy grasses can promote higher levels of soil erosion by burning out native grasses and patches of woody shrubs that protect the soil surface.

- **Pathogens and diseases** such as Phytophora root rot, scale insects, and fungal diseases can be introduced by weeds.

- **Expanding impacts**: large areas of weeds promote more weed growth and the scale of the problem increases and causes more widespread environmental impacts.

3.5 Weeds and Fire

Altered fire dynamics may occur as a result of increased fuel loads developing adjacent to newly cleared areas where weeds establish. A changed fire ecology can result in the elimination of certain native plant species or the promotion of different plant functional groups, and consequently, change the micro-habitats for species of flora and fauna.

Invasive grasses such as tall species like Grader Grass, Mission Grass, Thatch Grass, increase fuel loads and introduce unnatural fierce and intense fire events in sensitive habitats. Even a blanket covering of lower growing grasses such as Molasses Grass and Signal Grass carry very hot, unnatural fires.

The priority weeds identified within the wind farm project area and along the access road of Kippen Drive, which are considered to pose the highest threats to natural values are listed in the weed schedule for the Mt Emerald Wind Farm, are included at the end of this document.

3.6 Weed Dispersal and Sources of Contamination

Weeds are plants either not native to Australia, or species that grow outside of their natural range and become problematic. They are opportunistic and can quickly establish at disturbed sites, where for example, construction works break the natural ground surface. Once native ground covers such as grasses have been removed, a modified environment is available for weeds to quickly establish.

Weeds are dispersed and brought into previously weed-free areas by various means. Weeds can be "transported" by,

- wind dispersed seeds (daisies for example);
- animals in their fur;
- seed consumed by the animal;
- human activity.

Dispersal of weeds by humans is one of the main factors in how weeds become established at construction sites and around infrastructure such as roads, farms and powerline corridors. Examples of typical reasons why construction can lead to weeds being introduced are:

- Heavy machinery and vehicles carrying weed seed trapped in soil and mud on tyres and tracks and implements. For example, weeds can be transported by excavators, contractor light vehicles, graders, dozers, tractors, water trucks and even delivery trucks if they pass through weed contaminated roads and access points.
- Contractor vehicles such as slashing tractors pose a notable risk after working in weed infested areas. For example, a tractor slashing Grader Grass along Kippen Drive will invariably carry Grader Grass seed in the slasher and other tractor components. If allowed past an uncontrolled point to higher elevation into the site, the potential to spread the weed is high.
- Dozers, graders and any earthmoving machinery used for constructing and widening roads has a high risk of introducing new weeds into a site. For example, small turnout drains dozed within the hilly part of the wind farm site already have developing populations of Graders Grass.
- Road-base material, gravel and quarry aggregates are often a carrier of weed seed and consequently, new weed introductions.

- Vehicles and machinery that have travelled from high risk weed infected areas heighten the risk of weeds being introduced into a weed-free or low weed level sites.

3.7 Roles and Responsibilities

The Principal Contractor, contractors, sub-consultants and personnel have a responsibility to avoid and minimise the impact of weeds, which pose a threat to the condition and function of the natural landscape within the Mt Emerald Wind Farm site.

Weeds require considerable costs to eradicate and manage, particularly when infestations become large and widespread, at which stage they cannot be effectively controlled. Understanding the roles and responsibilities for good weed management helps reduce annual costs and increases management efficiency.

3.7.1 Principal contractor

The Principal Contractor of the Mt Emerald Wind Farm project is responsible for:

- Implementing and updating this Weed Management Plan.
- Designing, constructing and management of a weed washdown bay and machinery cleaning area.
- Prioritising weed management actions according to this Weed Management Plan.
- Identifying relevant weed species listed under the Queensland *Land Protection (Pest and Stock Route Management) Act 2002* and complying with the requirements for management of declared plant species.
- Identifying and directing weed management practices to the priority weed species according to this Weed Management Plan.
- Identifying appropriate site-specific training and induction materials and procedures required for weed management.
- Maintaining records of inductions and training given to contractors, sub-consultants and workers.
- Ensuring that contractors, sub-consultants and workers that use vehicles, machinery and equipment known to spread weeds undertake appropriate training.
- Investigating and taking corrective actions in relation to new records of weeds or weed population expansions being detected in the wind farm project area.
- Scheduled reporting, monitoring and maintenance of records relating to weed management in the wind farm project site.

3.7.2 Contractors, sub-consultants and personnel

Contractors, sub-consultants and personnel engaged in work practices that have the potential to transport or spread weeds into the wind farm site are responsible for:

- Fulfilling duties as directed by the Principal Contractor in relation to weed management.
- Identifying significant habitats for flora and fauna, and ensuring weed management work methods are of a standard that avoids or minimises harm to the natural environment.
- Undertaking site-specific weed management inductions and training before commencing work. All inductions must be signed off by the Principal Contractor after completion.
- Complying with the weed management requirements as directed by the Principal Contractor.

- Reporting to the Principal Contractor new weed species, and unusual or expanding weed populations.
- Requesting further advice and clarification from the Principal Contractor in relation to weed species identification, uncertainties and knowledge gaps before proceeding with the related weed management issue.
- Ensuring that the equipment and products used for weed management is legal, in safe working condition and meets current specifications and regulatory requirements.

3.8 Weed Management Actions

The following weed management actions (**Table 3**) are recommended for the early prevention of weed movement from the Kippen Drive area higher up into the wind farm site and to achieve the overall management objectives of the Weed Management Plan. Additional steps or actions may be required if considered necessary to address unexpected circumstances.

Table 3. Weed management actions and responsibilities.

	Weed Management Action	Responsibility
1	**Adopt** Weed Management Plan.	MEWFPL
2	**Implement** Weed Management Plan and follow weed management protocols and procedures.	Principal Contractor, Environment Officer, contractors and personnel.
3	**Machinery Washdown Bays**. Before heavy machinery commences work in the WTG site, construct a permanent machinery and vehicle washdown bay at the base of the wind farm site at the terminus of Kippen Drive. Implement operational procedures such as washdown log, signage and directional entry control points.	Principal Contractor
4	**Control Priority Weeds**: Before construction commences, control the following weeds inside the wind farm site (i.e. at elevation and around the 275 kV powerline and towers): Giant Rat's Tail Grass, American Rat's Tail Grass, Mission Grass, Molasses Grass, Signal Grass, Grader Grass, and Lantana. Check and control priority weeds found around the 80 m wind monitoring tower. Kippen Drive: slash, contain and control the entire length from the base of the wind farm site to Springmount Road.	Principal Contractor, contractors and personnel.
5	**Contain Weed Infestations**: Keep the access road free of weeds, with particular attention to Grader Grass and any other tall grasses. Maintain a 2 m wide weed-free clear zone each side of Kippen Drive. The weed-free clear zone should allow for 2 m clearance each side of the largest expected vehicle or machinery that will enter the site.	Principal Contractor, contractors and personnel.
6	**Before Construction of WTG Site**: At construction, establish machinery and vehicle washdown facility within the WTG site within the contractors compound or suitable area. This is to control and limit soil movement into the ridge country south of the 275 kV powerline (highly sensitive environment).	Principal Contractor
7	**Practice Good Weed Management**: Always work from the cleanest, weed-free areas towards contaminated areas.	Principal Contractor, contractors and personnel.
8	**Monitor**: monitor weeds throughout ALL stages of the wind farm.	Environmental Officer
9	**Review Weed Management Plan**: amend and adapt weed management practices as required throughout the duration of the construction and operational stages of the wind farm.	Environmental Officer, principal Contractor.

3.9 Principles of Weed Control and Management

It is recommended for the following weed management principles to apply to the Mt Emerald Wind Farm.

3.9.1 Weed prevention and early detection

Prevention of weed contamination and spread should be the first objective in weed management. Vigilance and early detection of weeds prevent small and new populations becoming problematic and uncontrollable. Any new or unusual weeds sightings should be reported immediately to allow for rapid control to occur to prevent outbreaks of new populations. Locations should then be added to a register of all known weeds locations.

Contractors and workers should be alerted to the presence and location of high priority weeds across the wind farm project area. This can be achieved through inductions and toolbox meetings.

Be vigilant of areas of weeds that have been controlled with herbicide as weeds quickly respond to changes in the soil condition and plant cover, and often a new species of weed will colonise a site treated with herbicide.

Roadbase, fill materials and sources of soil contamination should also be strictly monitored. Incidences of weed incursion or germination at newly prepared construction sites should be investigated immediately and corrective actions taken as a matter of priority.

3.9.2 Machinery washdown facility

For effective cleaning of potentially weed-contaminated vehicles and machinery it is important that the underside of the vehicle can be accessed with a high pressure water cleaner. A washdown bay with clear side access with a minimum height of 1.5 m between the lower side of vehicle and washdown base is preferred. Elevated washdown bays where the vehicle or machine stops on a grid allows users to direct high pressure cleaners to the areas of a vehicle where weed seed is most likely to adhere to the underside. High pressure cleaning and manual inspection should be completed for all accessible parts of the vehicle or machine.

The washdown bay base should be impervious and constructed with an adequate fall to allow for unimpeded drainage of washdown water and contaminated soil.

Washdown areas should be bunded to prevent overflow of washdown water and escape of contaminated soil and weed seed.

Washdown water should be drained, diverted and filtered into a suitably designed sediment trap that facilitates cleaning and disposal of seed-contaminated soil. Disposal of contaminated soil should be to a designated location, and not indiscriminately dumped at any location.

3.9.3 Prioritising weed management

Weed management is ongoing and must be performed throughout all stages of the Mt Emerald Wind Farm project: pre-construction, construction, operation and decommissioning.

All species of weeds on the wind farm site should be treated as undesirable and unwanted plants. Target control of priority weeds should be undertaken according to their ranking given in this Weed Management Plan. Reference should be made to the weed schedule in **Appendix A**. The distribution of weeds along Kippen Drive and in the WTG site is shown on the mapping in **Appendix B**.

Best results would be achieved by eradication of major weed infestations early in the project cycle, and application of progressive control measures throughout the life of the project.

The areas of the wind farm project that require urgent weed containment and control are along Kippen Drive and the lower slopes leading into the WTG site; and under or adjacent to the 275 kV powerline.

3.9.4 Managing the spread and introduction of weeds

Machinery work areas are to be minimised as much as possible and should be constrained to clearly defined and marked areas within the wind farm site. The creation of unplanned tracks, short-cuts, dump areas or random machinery movement should be treated as non-compliance.

Machinery is to be kept free of weed seed to prevent spreading weeds beyond infested areas. Use of the vehicle and machinery washdown facilities should be mandatory and records of each washdown should be kept and signed off.

Vehicles associated with the planning, surveying and construction phases of the project must be cleaned and inspected before entering the site. The number of vehicles accessing a particular section of construction during a single event should be limited to a practical minimum.

Do not use any introduced grasses, legumes or shrubs in revegetation or as soil stabilisation for erosion and sediment control in the WTG site and particularly not in environmentally sensitive areas south of the 275 kV powerline.

3.9.5 Weed control recommendations

Manually remove isolated specimens of weeds when first detected as part of the daily work routine (i.e. remove a clump of Mission Grass before it spreads).

It is important when managing priority invasive weeds such as Grader Grass to undertake mechanical (slashing) control measures before they seed. Where appropriate (i.e. along Kippen Drive. NOT in sensitive areas), the use of herbicide control over active weed growth is preferred; for example, new leaf growth of Grader Grass.

Consider all options to reduce herbicide use over time, and implement rehabilitation with native species. For example, invasive grasses along Kippen Drive could be slashed, controlled with herbicide over new growth and then the area revegetated to form thickets of native wattles as a replacement species.

Where clearing of vegetation is required, always work machinery from clean, weed-free areas and work towards weed infested areas. It is important weed seed is not carried back through reverse operation of machinery. For example, if an upgrade to Kippen Drive is required, it would be good practice to begin earthworks from the base of the wind farm site and work towards the Springmount Road intersection.

If excavated soil is required to be stockpiled from weed infected areas of the site, the soil should not be moved or stored in or near weed-free parts of the site.

A major source of new weed introductions into otherwise weed free areas is through the import and use of contaminated roadbase and fill materials. Roadbase and fill materials must be certified free of weeds as far as is practicable. It is strongly recommended suppliers' sources of these materials (from local quarries) are audited by the Environmental Officer. Serious weeds are imported into sites through contaminated quarry materials and include difficult to eradicate species such as Sicklepod and Siratro.

Weedy invasive grasses that generate higher than normal fuel loads or promote hot fires should not be allowed to establish. Considerably reduce the size or eliminate all populations of the following grasses within the WTG operational area of the project site: Mission Grass, Giant and American Rat's Tail Grass, Thatch Grass, Grader Grass, Guinea Grass, Molasses Grass and Signal Grass.

Contractors involved in weed control must be aware of the importance of the vegetation at higher elevations within the site, and should not apply herbicide in areas identified as environmentally sensitive. Appropriate training and inductions should be provided as part of the overall weed management strategy.

Weed control contractors and workers undertaking practical weed management should be suitably qualified in the areas of weed identification of target species and the appropriate level of control for each weed species. Workers must be able to apply the most appropriate control technique to any given weed situation.

The blanket application of herbicide in sensitive environmental areas is not advised or recommended. Off-target herbicide application is an unacceptable practice. The application of herbicides should be targeted, be specific to the weed, and should be kept to the minimum necessary to adequately control the weed.

The continuous use of herbicide around WTG footings or other concrete-soil interfaces should be avoided as permanent loss of plant cover often results in localised erosion of the exposed soil surface. It is recommended the establishment of low-growing forms of native grasses; for example, *Cleistochloa subjuncea* and Kangaroo Grass (*Themeda triandra*) and shrubs such as *Acacia calyculata*, *A. whitei* and *Jacksonia thesioides* and other native shrubs should always be promoted to expand into disturbed sites.

4.0 MONITORING, REVIEW AND TRAINING

4.1 Monitoring

Monitoring of weed populations, control methods, decreasing or increasing populations, problematic species and new detections should be continuous throughout all stages of the wind farm. It is the responsibility of the Principal Contractor and/or the Environmental Officer to ensure progressive records and observations of weed management are kept. The EIS describes in detail the baseline information relating to the condition of all parts of the wind farm site and recognises the weed-degraded Kippen Drive as a critical potential source of weed invasion into the relatively pristine high ridge country south of the 275 kV powerline.

The performance indicators outlined below are derived from the current condition of the wind farm site and are intended to be an important aspect of determining a successful approach to weed management on the Mt Emerald Wind Farm.

4.2 Performance Indicators

The following performance indicators will help identify that the most efficient and effective methods of weed management are being implemented throughout the construction and operational phases.

- Construction and operation of weed washdown bays. Vehicle and machinery washdown log records maintained, complete and signed off.
- Development of weed management training and induction material for contractors, sub-consultants and personnel.
- Weed management training and inductions delivered to contractors, sub-consultants and personnel.
- Ongoing weed surveillance, monitoring and reporting completed for entire wind farm site monthly or more frequently if deemed necessary throughout the construction phase, and every three months during the operational phase.
- New infestations of invasive, environmental and / or declared weeds do not occur across the wind farm site (including WTG sites, access roads and tracks, substation, maintenance facilities and construction compounds) either during or after the construction phase.
- Native flora expands into disturbed areas after construction.
- A net reduction in weed species and population sizes across the wind farm site.
- Eradication of Giant Rat's Tail Grass, Mission Grass, Molasses Grass, Grader Grass, Signal Grass and Lantana along the existing 275 kV powerline access tracks and within the WTG operational area.
- The Weed Management Plan is reviewed and amended annually or before if deemed necessary.
- Corrective actions are implemented methodically and diligently.

4.3 Review and Evaluation of the Weed Management Plan

The Mt Emerald Wind Farm Weed Management Plan has a currency life of four (4) years and is effective from 2016 to 2020. After this period a review of the plan will be undertaken. Updates, amendments and corrections to the plan will be made annually to reflect changes to weed statuses (new threats or decreases in threats) on the wind farm, changes to legislation, and other relevant amendments as deemed necessary.

It is the responsibility of the Principal Contractor and the Environmental Officer to undertake the review.

Changes, modifications and amendments to the plan may be required on an annual basis, or earlier if necessary. These changes should reflect improved management actions and reassess management priorities in terms of problematic weeds or new infestations.

4.4 Reporting and Recordkeeping

An annual Weed Management Plan Review report is to be compiled, which will report on the following:

- Records of vehicle and machinery washdowns will be required to be compiled for any facility established in relation to the site.
- Techniques and control methods and dates of weed management actions.
- Records of any new, expanding or problematic weeds.
- Records of weed-contaminated roadbase and construction materials brought into the site from external sources.
- Records of contractor non-compliance with weed management protocols.
- Recommendations for corrective actions, and if implemented prior to the annual report, the dates, types and effectiveness of the corrective actions.
- Development of a complaints recording system: dates, source of complaint and type of complaint.
- An annual weed audit and report by an independent monitoring botanist or suitably qualified person. Weeds are to be re-mapped.

4.5 Training

Staff and contractors of the Mt Emerald Wind Farm must be aware of the importance of high quality and efficient weed management.

Site-specific training and environmental awareness must be undertaken and delivered to all contractors prior to construction. New contractors who enter the project at later stages of the construction and operation of the wind farm will need to receive the same level of weed management training.

Training must be delivered as part of site induction and toolbox meetings, which should include the following components:

- An outline of why the Mt Emerald Wind Farm project site is important in a regional context; and what specific environmental values the site holds. For example, the site south of the 275 kV powerline is unique in respect to its high elevation, sensitive environment.
- Weed identification sheets or guides should be made available, and should be able to be accessed at any stage of the project.
- Training should identify the priority weeds species described in this Weed Management Plan for the Mt Emerald Wind Farm.
- Reporting procedures for informing the Environmental Officer of weed sightings, new populations or evidence of weed spread. A database of these records should be kept and regularly updated by the Environmental Officer.

5.0 PRIORITY WEED PROFILES

The following weed profiles are of the priority species identified as posing a significant threat because of their invasiveness, modification of natural fire ecology and potential to cause serious environmental impacts in the long-term.

Information regarding relevant control methods is available as a number of factsheets published by either the Queensland or Federal Government. It is recommended that these factsheets are kept on file and updated when necessary. All factsheets should be reviewed annually by the Environmental Officer.

	**Grader Grass** (*Themeda quadrivalvis*) A highly invasive grass, which often lines the sides of tracks and is introduced by machinery such as slashers and graders. The grass grows to over 1 m tall and is characteristically golden brown when the seed heads start to mature. This grass dominates both sides of Kippen Drive and is also steadily entering the site at higher elevation through increased frequency of vehicles and periodic grading of the track.
	**Mission Grass** (*Cenchrus polystachyum*) A highly invasive grass that can grow to 3 m tall. It significantly increases the risk of hot fires and displaces native vegetation.

	**Giant Rat's Tail Grass** (*Sporobolus natalensis*) - Class 2 A highly invasive grass and difficult to eradicate. grows to over 2 m tall and has a fine. narrow seed head. Increases fire risk and displaces native vegetation. Also similar to **American Rat's Tail Grass** (*Sporobolus jacquemontii*) - Class 2, which is a shorter grass to 75 cm tall and has the same degrading characteristics.
	**Thatch Grass** (*Hyparrhenia rufa*) Thatch grass can grow to 3 m tall. Because of its height, it creates an unnatural fire risk, which once established can facilitate hot wild fires. It is currently present as scattered plants along Kippen Drive and one or two incidences higher into the wind farm site.
	**Molasses Grass** (*Melinis minutiflora*) Molasses Grass forms very dense swards, which outcompete most native vegetation. The grass grows to about 1 m tall and poses a significant fire risk. It is established in linear patches along Kippen Drive and also just above the watercourse under the 275 kV powerline. It is identified by its "sticky" foliage, which also has a distinctive smell.

	**Signal Grass** (*Urochloa decumbens*) Signal grass is widespread in pastures, but is becoming increasingly problematic in woodlands where it displaces native vegetation and prevents native species from establishing. The grass forms dense patches to 60 cm tall or more. It creates an increased fire risk and once established under native woodland is difficult to eradicate.
	**Rhodes Grass** (*Chloris gayana*) This grass can grow to 2.5-3 m. It is a successful coloniser of disturbed land and when established becomes persistent in the landscape. It displaces native flora and heightens the risk of unnatural fires.
	**Guinea Grass** (*Megathyrsus maximus*) A tall invasive grasses that will favour marginally wetter conditions. It poses a high fire risk because of the size of the grass, and will easily outcompete native vegetation. Guinea Grass is presently only in small areas along Kippen Drive and one or two isolated occurrences at higher elevation.

	**Hyptis** (*Hyptis suaveolens*) An open branched, erect shrub that completely dries out during the dry season, at which time it increases the risk of unnaturally hot fires developing. It typically grows along the edges of tracks and some incursions are found on the lower slopes leading into the wind farm site. Its main occurrence is along Kippen Drive.
	**Stinking Passionflower** (*Passiflora foetida*) Stinking Passionflower is a sprawling vine which smothers native vegetation. It has tendrils which assist it to attach to other plants. It is often seen adjacent to roads and areas of frequent vehicle use. Some incursions are found on the lower northern slopes of the wind farm site and along Kippen Drive. It displaces native plants and lowers natural integrity.
	**Lantana** (*Lantana camara*) - Class 3 Lantana is a highly invasive dense, tangled shrub which can grow to 3 m tall. Its colourful flowers are a characteristic which makes it easy to identify. When established, Lantana forms thickets which can heighten fuel loads and cause unnaturally hot fires. The shrub also displaces native flora.

	**Red Natal Grass** (*Melinis repens*) This grass is not yet problematic in the wind farm site at elevation. It is often encountered as scattered individuals in woodland. But once established (as along Kippen Drive), it forms dense patches similar to that of Molasses Grass. It contributes to unnatural fires and displaces native vegetation when growing densely.
	**Sicklepod** (*Senna obtusifolia*) - Class 2 Sicklepod is an erect shrub that can grow to 2-3 m tall. When mature it forms dense stands which outcompete native vegetation. The species produces very hard-coated seeds which remain viable in the soil for several years, making this weed difficult to eradicate if allowed to establish.
	**Gambia Pea** (*Crotalaria goreensis*) Gambia Pea is an erect shrub growing to approximately 1 m tall. When established it forms dense thickets, which displace native vegetation. It produces hard-coated seeds (similar to Sicklepod), which remain viable in the soil for many years. Isolated patches are found on the northern slopes and along Kippen Drive.

APPENDIX A

WEED SCHEDULE - Mt Emerald Wind Farm (including Kippen Drive)

							MEWF Management Priority		
Species	**Common Name**	**Habit**	**LP Act**	**MSPMP**	**WONS**	**Threats**	**Kippen Drive**	**WTG site**	**Location**
Ageratum conyzoides	Bluetop	Forb	-	-	-	Flora displacement	Low	Low	Kippen Drive and remote ridge at south of site.
Bidens pilosa	Cobbler's Pegs	Forb	-	-	-	Flora displacement	Low	Medium	Kippen Drive and 80 m wind monitoring tower.
Bryophyllum sp.	Mother of Millions	Forb	Class 2	-	-	Invasive	-	High	Isolated population on remote access track at minor watercourse crossing.
Cenchrus polystachyum	Mission Grass	Grass	-	-	-	Fire; invasive	Very High	Very High	Scattered swards along Kippen Drive and under 275 kV power near watercourse crossing.
Chamaecrista rotundifolia	Wynn Cassia	Forb	-	-	-	Flora displacement	Low	Medium	Kippen Drive and isolated at 80 m wind monitoring tower.
Conyza sumatrensis	Tall Fleabane	Shrub	-	-	-	Flora displacement	Low	Medium	Kippen Drive and 80 m wind monitoring tower.
Chloris gayana	Rhodes Grass	Grass	-	-	-	Fire; invasive	High	-	Kippen Drive at watercourse.
Chloris virgata	Feathertop Rhodes Grass	Grass	-	-	-	Invasive	Medium	-	Along Kippen Drive.
Crassocephalum crepidioides	Thickhead	Forb	-	-	-	Flora displacement	Low	Low	Kippen Drive and very isolated occurrence along ridge.
Crotalaria goreensis	Gambia Pea	Shrub	-	-	-	Invasive	Medium	Medium	Along Kippen Drive and isolated incidences in remnant grassland at northern end of site.
Cynodon dactylon	Couch Grass	Grass	-	-	-	Lowers integrity	Low	-	Kippen Drive.
Dactyloctenium aegyptium	Egyptian Crowfoot Grass	Grass	-	-	-	Flora displacement	Low	High	Scattered along Kippen Drive and one occurrence at 80 m wind monitoring tower.
Eleusine indica	Crowfoot Grass	Grass	-	-	-	Flora displacement	Low	Low	Along Kippen Drive.
Hyparrhenia rufa	Thatch Grass	Grass	-	-	-	Fire; invasive	Very High	Very High	Scattered clumps along Kippen Drive and isolated on site. Presently not common.
Hyptis suaveolens	Hyptis	Shrub	-	-	-	Fire; invasive	High	High	Kippen Drive and expanding into site along lower slopes.
Lantana camara	Lantana	Shrub	Class 3	29.5	Yes	Fire; invasive	High	Very High	Isolated along Kippen Drive and only seen under 275 kV powerline tower.
Macroptilium atropurpureum	Siratro	Vine	-	-	-	Invasive	Medium	-	Along Kippen Drive.
Megathyrsus maximus	Guinea Grass	Grass	-	-	-	Fire; invasive	Medium	High	One clump on site and scattered along Kippen Drive on marginally wetter soil.
Melinis minutiflora	Molasses Grass	Grass	-	-	-	Fire; invasive	Medium	Very High	Along Kippen Drive, at watercourse crossing under 275 kV powerline and sporadic occurrences in remnant vegetation on northern and eastern slopes.
Melinis repens	Red Natal Grass	Grass	-	-	-	Low fire threat	Low	Medium	Scattered and diffuse over site; denser along Kippen Drive.
Mimosa pudica	Sensitive Weed	Subshrub	-	-	-	Habitat degrading	Low	-	Along Kippen Drive.
Mitracarpus hirtus	White Eye	Forb	-	-	-	Flora displacement	Low	Medium	Kippen Drive and 80 m wind monitoring tower.
Passiflora foetida	Stinking Passionflower	Vine	-	-	-	Invasive	Medium	High	Kippen Drive and scattered on northern slopes.
Praxelis clematidea	Praxelis	Forb	-	-	-	Flora displacement	Medium	High	Widespread as individual plants in remnant areas, but notably denser around disturbed ground.

							MEWF Management Priority		
Species	**Common Name**	**Habit**	**LP Act**	**MSPMP**	**WONS**	**Threats**	**Kippen Drive**	**WTG site**	**Location**
Richardia scabra	Richardia	Forb	-	-	-	Flora displacement	Low	Medium	Kippen Drive and 80 m wind monitoring tower.
Senna obtusifolia	Sicklepod	Shrub	Class 2	27.0	-	Invasive	-	Very High	80 m wind monitoring tower. Not present in August 2016.
Setaria pumila	Pigeon Grass	Grass	-	-	-	Fire; invasive	Medium	-	Scattered along Kippen Drive.
Sida cordifolia	Flannel Weed	Shrub	-	-	-	Habitat degrading	Low	Low	Kippen Drive and isolated occurrences on northern slopes.
Sporobolus jacquemontii	American Rat's Tail Grass	Grass	Class 2	-	-	Invasive	High	Very High	Kippen Drive. Isolated specimens under 275 kV powerline.
Sporobolus natalensis	Giant Rat's Tail Grass	Grass	Class 2	26.8	-	Invasive	-	Very High	Under 275 kV powerline towers.
Stachytarpheta cayennensis	Dark Blue Snakeweed	Shrub	-	-	-	Habitat degrading	Low	-	Along Kippen Drive.
Stachytarpheta jamaicensis	Pale Blue Snakeweed	Shrub	-	-	-	Habitat degrading	Low	-	Along Kippen Drive.
Stylosanthes humilis	Townsville Stylo	Shrub	-	-	-	Flora displacement	Low	Low	Kippen Drive and 80 m wind monitoring tower.
Stylosanthes scabra	Shrubby Stylo	Shrub	-	-	-	Flora displacement	Medium	Medium	Kippen Drive and advancing into site along lower slopes.
Themeda quadrivalvis	Grader Grass	Grass	-	-	-	Fire, invasive	Very High	Very High	Entire length of Kippen Drive and expanding into site along lower slopes. Also under 275 kV powerline.
Tridax procumbens	Tridax Daisy	Forb	-	-	-	Habitat degrading	Low	Low	Kippen Drive and 80 m wind monitoring tower.
Triumfetta rhomboidea	Chinese Burr	Shrub	-	-	-	Habitat degrading	Low	Medium	Kippen Drive and isolated occurrences on northern slopes.
Urochloa decumbens	Signal Grass	Grass	-	-	-	Fire, invasive	Medium	High	Along Kippen Drive and developing patches under 275 kV powerline near watercourse crossing.

NOTES

A hyphen (-) in the table indicates that the species has not been recorded at a location; or the species is not listed under the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act), Mareeba Shire Pest Management Plan (MSPMP) or WONS (Weeds of National Significance). If a species is indicated as not being observed at a location this does not infer that the species is absent - weed surveillance should update presence if a weed is a new detection.

LP Act: Declared weed status under the *Land Protection (Pest and Stock Route Management) Act 2002*.

MSPMP: Priority score under the Mareeba Shire Pest Management Plan.

WONS: Indicates if the species is listed as a Weed of National Significance.

Threats: Describes the main threats and potential impacts that the species could cause once established.

MEWF Management Priority: This is the site-specific Mt Emerald Wind Farm priority ranking for management of weeds. It is based on invasiveness, current population sizes, potential to affect fire ecology and whether a species is considered to impose a significant threat to sensitive environmental areas. **Very High** - requires to be managed as a priority; **High** - requires early intervention and management; **Medium** - requires to be managed on a regular basis; **Low** - requires to watched and managed if deemed problematic.

Kippen Drive: Refers to the flat, modified land that will be used as the primary access from Springmount Road to the base of the wind farm site.

WTG site: Refers to all the land in which the wind farm operational infrastructure will be located and begins at the base of the hill at the terminus of Kippen Drive and extends into all ridges and land at higher elevation where WTG's, access roads, cabling network, lay-down pads, substation and compound infrastructure will be located.

APPENDIX B

WEED DISTRIBUTION - Mt Emerald Wind Farm (including Kippen Drive)

Site	Weed 1	Weed 2	Weed 3	Weed 4	Weed 5
1	Grader Grass	Feathertop Rhodes Grass			
2	Grader Grass				
3	Grader Grass	Stylo	Praxelis	Sicklepod	
4	Grader Grass	Mission Grass	Passiflora foetida	Stylo	
5	Grader Grass	Mission Grass	Passiflora foetida	Stylo	
6	Grader Grass	Hyptis	Red Natal Grass	Stylo	
7	Grader Grass	Melinis repens	Stylo		
8	Grader Grass	Hyptis	Stylo		
9	Grader Grass	Hyptis	Stylo		
10	Grader Grass				
11	Grader Grass				
12	Grader Grass				
13	Grader Grass	Mission Grass	Stinking Passionflower	Stylo	Praxelis
14	Grader Grass				
15	Grader Grass				
16	Grader Grass				
17	Grader Grass	Thatch Grass			
18	Grader Grass	Thatch Grass			
19	Grader Grass				
20	Grader Grass				
21	Mission Grass				
22	Grader Grass	Mission Grass	Thatch Grass	Signal Grass	
23	Mission Grass				
24	Giant Rat's Tail Grass	Grader Grass			
25	Grader Grass	Signal Grass	Stylo		
26	Grader Grass				
27	Giant Rat's Tail Grass	Grader Grass	Stylo		
28	Molasses Grass	Giant Rat's Tail Grass			
29	Mother of Millions				
30	Grader Grass	Stinking Passionflower	Hyptis		
31	Gambia Pea	Stinking Passionflower			
32	Gambia Pea				
33	Grader Grass				
34	Grader Grass				
35	Chinese Burr				
36	Molasses Grass				
37	Mission Grass				
38	Mission Grass				
39	Thatch Grass				
40	Rhodes Grass				
41	Lantana				
42	American Rat's Tail Grass	Rhodes Grass	Pigeon Grass		
43	Thatch Grass				

Legend

- Weed Sites
- Subject Lot
- Proposed Turbines
- Proposed Cable Reticulation
- Proposed Roads
- Existing Roads
- Proposed Buildings
- Easements

Substation

Substation O&M Building

N

0 200 400 600

Meters (A3)

Project Manager	M. Jess
Compiled by	RMS
Map Projection	MGAz55
Map Datum	GDA94
File Reference	PR130417-10.mxd
Sheet Number	1 of 1

Client: RACL

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SCALE (A3)	DATE	DRAWING NO.	ISSUE
1:16,000	25/08/2016	PR130417-10	

Pest Management Plan

Mount Emerald Wind Farm, Herberton Range, North Queensland

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In preparing this report we have made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
V1	Report	MJ	DF	23/02/2016
V2	Report	MJ	LL	06/06/2016
Final	Report		MJ	16/11/2016

Approval for Issue

Name	Signature	Date
Mellissa Jess		16 November 2016

Contents

Tables

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Appendices

1.0 Introduction

RPS Australia East Pty Ltd (RPS) has prepared the following Pest Management Plan (PMP) to minimise the potential for the spread of pest species as a result of the Mount Emerald Wind Farm (MEWF) project developed by RATCH Australia Corporation Ltd (RATCH). In particular this plan outlines how pest management will be undertaken in accordance with the requirements of the conditions issued under the Approvals listed Development Notice pursuant to the *Sustainable Planning Act 2009* (SPA) (**Section 2**).

This PMP provides an overview of the procedures required to minimise the introduction and spread of particular pests. For those species already present on the site, the plan will appropriately manage the increased risk they present to flora and fauna with the increased access to areas of the site as a result of the development. A separate Weed Management Plan has been developed for the site which will be used in conjunction with this plan where required.

This plan provides the framework to ensure controls to manage potential pest disturbance within and directly adjacent to the MEWF project in the Mareeba Walkamin district. This PMP establishes the objectives, management requirements and management actions to mitigate and manage the potential impacts that could arise from the introduction and increase in abundance of pest species within the project area.

1.1 The Project

The Mount Emerald Wind Farm (MEWF) is approved for the construction of up to 63 wind turbines on an elevated site approximately 20 km SSW of Mareeba on the Atherton Tablelands in north Queensland (**Figure 1**). The towers will be approx 80-90m high with approximately 50m blades, utilising 3 MW machines.

The site where the wind turbines, interconnecting tracks and associated infrastructure are to be established is on land formally described as Lot 7 on SP235224, which encompasses an area of 2,422ha. 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 540m up to 1089m 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. Although land to the north of the transmission line (including the landmark of Walsh Bluff) possesses lower floristic diversity, it is recognised for its habitat value 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. 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.

1.2 Construction Details

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 10m. The interconnecting tracks will form the routes for the inter-turbine underground cabling - expected to be buried in trenches at approximately 1m deep.

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

Wind turbines will 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 (MEWF) 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 Environmental Impact Statement (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 were compiled to facilitate the delivery of mitigation measures. These 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 Bushfire Management Plan and this 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.

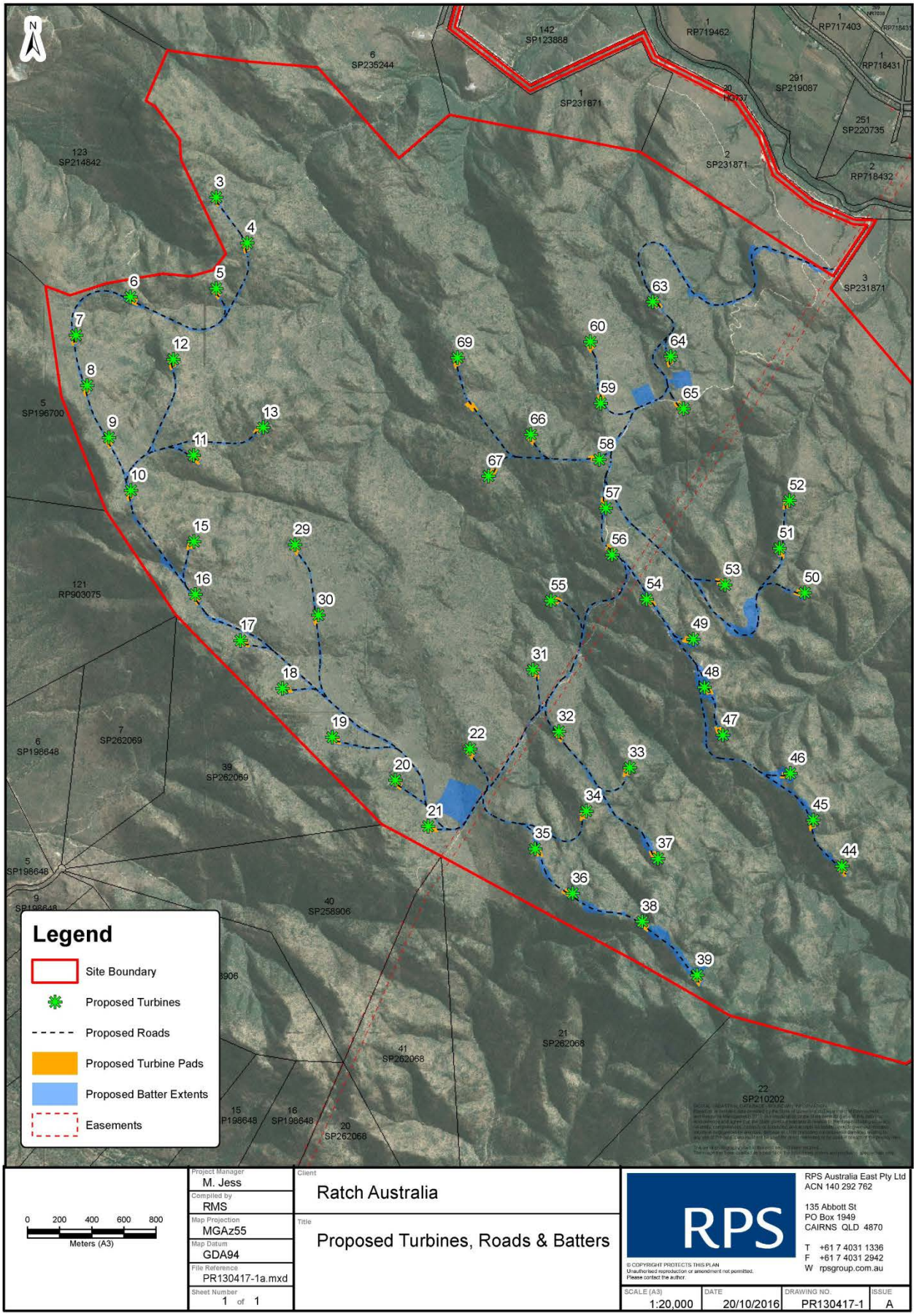

Figure 1 Project Site Location

1.3 Purpose

The objectives of the PMP are to:

- Facilitate compliance with the relevant commonwealth, state and local government legislation regulations and approvals;
- Provide a framework for MEWF to:
  - Identify, monitor and prioritise the appropriate management of pest species present at or pose a threat to the existing environment
  - Prevent and minimise the introduction and dispersal of pests onto the site and neighbouring properties;
  - Engage stakeholders including landholders and local communities in assisting in the identification and management of pests at the MEWF; and
  - Develop specific procedures as required during the project lifetime.

1.4 Scope

This report addresses all pest management planning requirements described in the MEWF Project Approval Conditions. Specifically, this report provides details-

- The incidence reporting of pest species on or near the project area;
- Impacts associated with the invasive/exotic species introduction and increase in abundance;
- Mitigation measures; and
- Evaluation of management efficacy.

2.0 Regulatory Requirements

2.1 Project Approvals

2.1.1 Sustainable Planning Act 2009

Conditions relevant to the preparation and implementation of the PMP are detailed in Condition 13 of the Ministerial Decision Notice.

2.1.1.1 Ministerial Decision Notice

The Development Notice (dated 24 April 2015) in accordance with the SPA included a number of conditions relating to the preparation of a Pest Management Plan (PMP). *Condition 13 - Environmental Management* which relates to the PMP, states the following:

> *Submit to the chief executive administering SPA an Environmental Management Plan (EMP) prepared by a suitably qualified person(s). The EMP must:*
>
> *i. be generally in accordance with the Preliminary Environmental Management Plan prepared by RPS and dated November 2013 and the draft Statement of Commitments contained within Appendix A of the RPS Development Application Material Change of Use Report dated March 2012;*
>
> *ii. be based on the revised Turbine Location and Development Footprint Plan submitted in accordance with condition 2 of this approval;*
>
> *iii. include the following components,:*
>
> - *Weed and Pest management Plans (timing as required with the EMP).*

3.0 Roles and Responsibilities

The roles and responsibilities of the various stakeholders related to the management and actions of this PMP are outlined in **Table 1** below.

Table 1 Stakeholder Roles and Responsibilities

Role	Responsibility
Environmental Representative	Manage independent consultant and pest and weed contractors and maintain records, carry out quarterly environmental inspection of site, monitor and review the effectiveness of the PMP.
MEWF Project Manager	Manage pest contractors and maintain records of pest management for site.
All Employees	Report outbreaks and sightings of declared pests.
Pest Contractors	Implement pest control activities and ensure required specifications are met.
Independent Consultants	Implement pest control activities and ensure required specifications are met.

4.0 Relevant Legislation, Policy and Strategy

This section describes the relevant Commonwealth and Queensland legislation that applies to the management and control of pests and weeds.

Legislation	Description
Nature Conservation Act 1992 and Nature Conservation (Wildlife) Regulation 2006	The *Nature Conservation Act 1992 (NC Act)* provides for the conservation and management of Queensland's native flora and fauna. The Act prohibits the taking or destruction, without authorisation, of certain listed flora and fauna species. The *Nature Conservation (Wildlife) Regulation 2006 (NC Regulation)* lists the flora and fauna species presumed extinct in the wild, endangered, vulnerable, near threatened, least concern, international and prohibited. It states the declared management intent and the principles to be observed in any taking of or destruction for each group.
Land Protection (Pest and Stock Route Management) Act 2002	The *Land Protection (Pest and Stock Route Management) Act 2002* (The Act) is the overarching legislation with the main purpose to provide for: (a) pest management for land; and (b) stock route network management. The purpose of the Act is to be achieved mainly through the following— (a) establishing principles of pest management for land and stock route network management; (b) providing for pest management planning and stock route network management planning; (c) declaring animals and plants to be declared pests; (d) restricting the introduction, keeping or sale of declared pests; (e) preventing the spread of declared pests in the State, including, for example, preventing their spread by human activity; (f) establishing responsibilities for pest and stock route network management; (g) building and maintaining fences to prevent declared pest animals moving from a part of the State to another part; (h) establishing the Land Protection (Pest and Stock Route Management) Council to give advice and make recommendations to the Minister about managing pests and the stock route network; (i) providing for the establishment of pest operational boards; (j) constructing and maintaining travelling stock facilities on the stock route network; (k) monitoring, surveying and controlling pests and the movement of travelling stock. The Act requires that local government prepare a pest management plan for its area. The plan may include provision for the following— (a) achievable objectives under the plan; (b) strategies, activities and responsibilities for achieving the objectives; (c) strategies to inform the local community about the content of the plan and achievement of its objectives; (d) monitoring implementation of the plan and evaluating its effectiveness; (e) other matters the local government considers appropriate for management of declared pests in its area. The plan must however be consistent with the principles of pest management; the State pest management strategies; and the guidelines for pest management.

Legislation	Description
Biosecurity Act 2014	The *Biosecurity Act 2014* (the Act) was passed by Parliament and will come into effect on 1 July 2016 superseding the *Land Protection (Pest and Stock Route Management) Act 2002.* The Act deals with: ▪ pests (such as wild dogs and weeds) ▪ diseases (such as foot-and-mouth disease) ▪ contaminants (such as lead on grazing land) Decisions made under the Act will depend on the likelihood and consequences of the risk. This means risks can be managed more appropriately. The main biosecurity function of each local government will continue to be the management of invasive plants and animals in its area. A more comprehensive range of response tools and associated powers will be able to be tailored to address the unique nature and tactical challenges presented by individual biosecurity threats. Under the new Act, local governments, like other persons, will be obliged to take all reasonable and practical steps to minimise biosecurity risks posed by their activities. This is known as a general biosecurity obligation (GBO). To meet their own obligations, local governments may wish to consider formal planning processes for biosecurity risk management to demonstrate due diligence. Local government will only be able to enforce the GBO if the risk is related to invasive biosecurity matter. This Act replaces the Quarantine Act of 1908.
Queensland Pest Animal Strategy	The Queensland Pest Animal Strategy establishes a state wide planning framework, providing clear direction to government, community, industry and individuals for the management of pest and problem animals across the state. It gives a common basis for addressing current and potential pest problems that impact on primary industries, ecosystems, human health and the community's enjoyment of our natural resources. It also assists in the development of regional natural resource management planning. The following species or groups of species are covered in the strategy: ▪ introduced mammals and reptiles that have pest impact, including animals declared under the Act ▪ introduced pest birds ▪ introduced amphibians ▪ some native species in certain situations, including kangaroos, bats, native rats, native birds and locusts ▪ exotic pest fishes. The strategy is based on a number of accepted principles of pest management that have been considered for both pest and problem animals and incorporated into the desired outcomes, objectives and strategic action.
National Strategies	National strategies help government, industry and the broader community manage weeds in a coordinated manner at a national level. National strategies include: ▪ Australian Pest Animal Strategy (Department of the Environment, Water, Heritage and Arts) ▪ Threat Abatement Plans
Local Area Pest Management Plans	▪ Mareeba Shire Council -Weed and Pest Management Strategy 2015-2020 Requires that all Local Governments develop and implement a Local Government Area Pest Management Plan. The Pest Management Plan has therefore been developed in line with legislation and reflects Council's views towards natural asset management and the benefits of planning with stakeholder communication and on-ground actions.

5.0 Pest Species in the Project Area

The data used to inform this PMP has come from the following databases and reports:

- **MEWF Environmental Impact Statement**: Fauna assessments have been conducted on site since May 2010. The emphasis of the initial ecological surveys was to assess the general ecology of the site and to assess the presence/absence of Matters of National Environmental Significance (MNES) species for the referral process. Further surveys (from 2012) involved targeted surveys specific threatened species considered at risk of being impacted (i.e. Northern Quoll, Bare-rumped Sheathtail Bat and Spectacled Flying-fox). The majority of these surveys focussed on fauna; where flora surveys were undertaken at lower frequency and with less spatial coverage. Surveys occurred over a three year period; however the methodologies chosen to satisfy the requirements of the EIS Guidelines were to survey from August 2012 to September 2013 (i.e. to provide a seasonal survey effort).(RPS 2011, 2013)
- **EPBC Protected Matters Database of MNES**. This database applies a range of bio-models to predict the presence of species of flora and fauna and other MNES within a given radius of the site (a search parameter was prescribed limiting the search area to a 10 km radius around an approximate central point of the study area), as cited under the Commonwealth's *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- **Wildlife Online database**. This database is managed by the Queensland Department of Heritage and Environmental Protection (DEHP) and holds records animals that have either been sighted or collected within a given radius of the site (a search parameter was prescribed limiting the search area to a 10 km radius around an approximate central point of the study area).
- **Queensland Museum Biodiversity Database**. This database provides confirmed records of fauna species recorded within a specified area. Data from this source provides additional information on the known location of rare and threatened fauna species;

The above information determined the likelihood of a particular pest species occurring at or in the vicinity of the project site.

5.1 Pests

Following the review of available databases and reports, a number of declared (QLD) pest species were recorded from the project area (**Table 2**).

With the exception of the cane toad which was prevalent across the project site, only incidental observations were recorded of the dingo, wild dog, feral pig and feral cat. These observations were made during the wet season primarily around available watercourses.

There were **no** significant populations of any declared species on or within the vicinity of the project site.

The rabbit has only been recorded in desktop results and there were no confirmed sightings of the species on the project site.

Table 2 Pest Species Located on the Mount Emerald Wind Farm Project

Species Name	Survey/Desktop	Declared Species	# Potential Species Impact
Amphibian			
Rhinella marinus Cane Toad	Survey/ Desktop		The Cane Toad is poisonous at every stage of its life cycle and it's known to impact nearly all native frog larvae and many aquatic invertebrates. Cane toads are known to have caused a severe decline in small predatory mammal species across northern Australia since their introduction. The Northern Quoll is known to persist in FNQ despite the presence of the Cane Toad (research is yet to determine why) however there remain a large number of native vertebrate and invertebrate species that are impacted by this species (RPS, 2013).
Mammal			
Canus lupus dingo Dingo	Survey/ Desktop	Class 2	Dingoes prey on local native fauna and often carry parasites and pathogens.
Canus lupus familiaris Wild Dog	Survey/ Desktop	Class 2	Wild dogs prey on local native fauna and often carry parasites and pathogens.
Sus Scrofa Feral Pig	Survey/ Desktop	Class 2	Feral pigs damage crops, stock, property and the natural environment. They transmit disease and could spread exotic diseases such as foot and mouth if this was introduced to the country. (DAF, 2016)
Felis catus Feral Cat	Survey/ Desktop	Class 2	Feral cats prey on local native fauna and often carry parasites and pathogens.
Orictolagus cuniculus Rabbit	Desktop	Class 2	This species causes destruction of native vegetation and subsequent erosion. They compete heavily with native species for food and shelter therefore reducing the native species ability to survive predation.

#Refer to Species Fact Sheets for further information (**Appendix A**).

5.1.2 Risk of Pest Invasion

The confirmed presence of several threatened species within the MEWF project area increases the potential impact that pest species could have on the sites ecological values. In particular, the Northern Quoll and Bare-rumped Sheathtail Bat which have been confirmed on site may be impacted by the increase in pest numbers on the site. Therefore it is of particular importance to ensure the proposed project does not increase the opportunity for pest species to utilise the site.

Pest species can have been documented to have the following impact on native animals:

- Feral predators such as cats and wild dogs are known contributors to the decline of Northern Quoll across its range due to direct predation and competition for food which decreases the abundance of native prey (Oakwood, 2004). Fortunately, Northern Quolls are known to coexist with cane toads on the MEWF project site, however due to the species toxicity to a large number of native fauna, any reduction in opportunity for this species to breed is advised.
- Feral pigs are known to cause destruction of plants which results in invasion of weed species and changes to the vegetation composition and reduced water quality and availability.

Pests are known to congregate where resources are available, therefore they are likely to move into the temporary camp areas (construction phase) and permanent areas (operational phase) of the project for food and water. Therefore management strategies will be focused on these areas.

6.0 Management Strategies

All activities identified as being responsible from introducing pests will be subject to controls on site and managed under this plan

For successful management of pest species there are four principles:

(1) Identify the pests and the area of infestation;

(2) Avoid utilising and placing infrastructure in areas of know infestation;

(3) Prevent/minimise the translocation spread of pests by implementing sound work practices and promotion of risk awareness; and

(4) Control – identified pests to contain or eradicate populations as required.

A response to each of these four principles in relation to the MEWF project have been provided in **Table 3**.

Table 3 Response to of Pest Management Principles

Principle	Response
Identify	All pest species have been identified and regular monitoring of the site will continue on a quarterly basis to ensure any new species or infestations of known species are located.
Avoid	There are no areas of known infestations on the site, however no turbines or site compounds will be located near watering points or aggregation points.
Prevent/Minimise	To prevent/minimise the translocation spread of pests by implementing sound work practices and promotion of risk awareness, a number of procedures are incorporated into the *MEWF Environmental Management Plan* (2016) These are specifically: ▪ Water management procedures will require a focus on avoiding the clearing of artificial water points that provide a source of drinking water for vertebrate pests and additional breeding habitat for cane toads. ▪ Waste management will be required to ensure waste is managed at a central location on site and disposed of offsite to ensure any introduced species do no significantly increase numbers around these typical aggregate areas. This specifically relates to rat and mice species common to development and waste management areas.
Control/Eradicate	Controls are detailed in Section 4.2 below. An integrated approach in co-operation with State and Council representatives is required. The MEWF project site is relatively pest free which has been one of the factors in the persistence of several threatened species on the Mount Emerald massif.

6.2 Integrated Pest Management

Integrated pest management involves the use of a variety of control methods where a single control measure may be constrained by a number of environmental safety, spatial or logistical issues that prevent that control from working effectively on its own. There are four effective pest methods identified below, which if used in conjunction will ensure vertebrate pests are controlled. **Table 4** summarises those controls that will be typically required during construction and operation of the wind farm. Additionally, the Mareeba Shire Council provides further details on these controls in the Local Areas Pest Management Plan (2014) and the collaborations required with other stakeholders within the local government area.

6.2.1 Exclusion Fencing

Exclusion fencing is the installation of barriers including electric fencing or mesh fencing as a control option for vertebrate pests on smaller properties to exclude wild dogs and pigs, and sometimes macropod fauna (depending on the fence). It can only be used when the site is not too large or difficult to manage and there are not significant numbers of other large mammalian species that should be accessing the site. Typically

this works for species such as pigs and wild dogs as eradication is not a viable option of naturalised pests in these environments.

Due to the size of the site barrier fencing will be used in the case of protecting sensitive areas only).The most effective fences are fabricated sheep mesh held close to the ground with plain wire and supported on steel posts.

6.2.2 Baiting

Baiting for pest species is a cost effective and proven management control. However, the MEWF project site is a sensitive site for the Northern Quoll, a small endangered predatory mammal which may easily take any baits set for mice or declared pests. Therefore baiting on the MEWF project site is not recommended under any circumstances.

Pest baiting requires knowledge of what species are being targeted so that appropriate deployment and baits are utilised. Baiting requires trained and qualified personnel to utilise baits for pest control.

6.2.3 Trapping

Trapping is commonly used as an alternative to baiting due to the risks baiting poses to humans and wildlife, as it is a non-specific control. Some trapping methods are typically used domestically and can be used around the site compound for species such as rats and mice.

To date, large vertebrate species (pigs and wild dogs) have not been seen in significant numbers on site to warrant trapping on site. This control method requires trained and skilled personnel, and requires outsourcing to an expert contractor. Traps must be checked daily for success and pests must be removed in a humane and ethical manner.

6.2.4 Shooting

Shooting of pests may occasionally be required. If this is required it will be carried out by qualified persons. This control method is only effective for low numbers of pest animals and should be opportunistic. Pests must be disposed of in a humane and ethical manner.

Table 4 Control Methods Required at Each Stage of MEWF Project Development

Project Phase	Objective	Action
Preconstruction	Identify abundance of pest species on MEWF project site	▪ Record the incidental occurrence of pests at key locations on project site. ▪ Liaise with local government Pest Management Officer regarding pest species management on site and methods of control undertaken.
Construction	Ensure effective pest control is undertaken for the project area	▪ Erect the appropriate exclusion fence around sensitive areas. ▪ Manage solid and liquid waste generated from the site compounds. ▪ Avoid creating artificial water points. ▪ Dump all the non-hazardous waste in a designated location which (fenced if required) and then taken offsite. ▪ Ensure appropriate training and induction of staff on pest issues and strategies.

Project Phase	Objective	Action
Ongoing	Ensure pest control is undertaken	▪ Survey periodically (quarterly) of high risk areas. ▪ Continue management of waste products. ▪ Promote continued education and training of staff to ensure implementation and changes to plan are ongoing. ▪ Check the exclusion fence periodically for any breakdown on the barrier and wear and tear. ▪ Liaise with Local and state government to ensure management of declared pest around property remains current and in line with other property holders and council. ▪ Continue pest and weed control through management of solid and liquid waste. ▪ Report infestations to Environmental Manager. ▪ Review this plan within 2 years.

7.0 Records, Monitoring and Review

7.1 Records

Both hard and electronic copies of records from all pest control activities are kept in a central location at RATCH for a minimum of five years to allow for a comprehensive review of the PMP. The minimum is recorded for the control events:

- Date;
- Location of activity;
- Target species;
- Method utilised;
- Area treated; and
- Numbers successfully controlled.

7.2 Monitoring and Evaluation

An annual monitoring program will be undertaken to determine the current presence of pest species and their abundance within the study area. Any significant findings of the pest species or new species out break or actions resulting from incidents which will incorporated into the annual review.

The implementation and effectiveness of this management plan and its associated procedures will be regularly assessed to ensure:

- The management strategy remains relevant and up to date;
- The plan and procedures adequately manage the environmental issue.

The methods use to assess the effectiveness are outlines in **Table 5** below:

Table 5 Methods to Assess Management Plan Effectiveness

Assessment Tool	Description
Audit	Audit outcomes are used to develop corrective actions which may include changes to this plan and or procedures.
Review of Data	Analyse all relevant data collected for negative and or undesirable trends that may be prevented by procedural change or by implementation and/or process.

7.2.2 Performance Indicators

Performance against pest control measures will be assessed against the following:

- There is no net increase in the abundance or distribution of pest animal species in the project area.

This performance indicator will be met by implementing control actions outlined in **Table 4** Management Control Actions.

7.3 Review

The PMP is a living document and shall be reviewed annually or sooner if any of the following occur:

- The plan is not adequately managing the issue;
- Legislative requirements change;

- The area of activity changes;
- A previously unidentified declared pest is found within an area of activity ; and/or
- New procedures relating to pest management are developed.

Reviews and changes to the PMP are to be communicated to relevant RATCH project personnel.

8.0 Definitions

Term	Meaning
Management Plan	Management plans are specific to and environmental issue or topics.
Non declared Animal	While sometimes pests, they are sometimes considered a significant state-wide threat and do not require and enforceable response. If warranted, local governments can declare these animals using local laws.
Notifiable Pest	A plant or animal species whose presence must be notified to the Queensland Government within 24 hours of becoming aware of it. Notifiable pests are declared under Section 12 of the Plant Protection Act 1989 and associated regulation.
Procedure	Procedures are designed to assist in the implementation of the Management Plan by prescribing a series of processes and actions for a specific topic.
Vector	An agent (person, animal or microorganism), that carries/transmits pests or weeds.

9.0 References

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Appendix A

Species Fact Sheets

Department of Agriculture, Fisheries and Forestry
Biosecurity Queensland

Fact sheet
PEST ANIMAL
PA21 December 2013

Cane toad

Bufo marinus

The cane toad is not a declared pest in Queensland, so there is no legal requirement to control them.

Their original introduction in 1935 was to control agricultural pests, but they proved ineffective.

For the past 60 years, cane toads have been expanding their territory in Australia, and are capable of colonising at least four of the mainland Australian states.

As the toad's geographical range continues to expand, concern has increased about their detrimental environmental effects, particularly on the wetlands of the Northern Territory.

Studies into the feasibility of biological control have commenced.

History of introduction and spread

The cane toad or giant toad is an amphibian, native to Central and South America. Cane toads have been introduced throughout the world as a biological control for insect pests of agriculture, most notably sugarcane.

A consignment of cane toads from Hawaii was released into Queensland cane fields in 1935. The introduction was surrounded by controversy as to the potential costs and benefits to Australia.

It was hoped that the toad would control Frenchi and greyback beetles—pests of economic importance to the sugarcane industry.

By 1941, however, it had become evident that the cane toad was exerting only limited control over its intended prey. There were two main reasons for this:

- Greyback beetles are only rarely in contact with the ground and Frenchi beetles invade cane fields at a time when the toads are absent due to a lack of protective cover.
- The cane toad has a wide-ranging and indiscriminate diet, and it was not solely dependant upon its intended prey.

The unlimited food source, suitable environment and low rates of predation allowed dynamic reproduction and spread. Toads were recorded in Brisbane only 10 years after release. The toad continues to thrive and has now invaded the Northern Territory and New South Wales (see Map 1).

Map 1. Distribution of the cane toad in Australia

The cane toad's advance is only limited by environmental factors, such as the availability of water for breeding, tolerable temperatures, suitable shelter and availability of food.

Toads at the frontier of their range of expansion may be larger than those in established populations. This is most probably due to greater food supply, combined with a lower incidence of disease.

Description and general information

In comparison with native frog and toad species, adult cane toads have a distinctive head and face, and are large and heavily built creatures (adults may grow to 20 cm).

Following their aquatic larval stages (eggs and tadpoles), cane toads are generally encountered at night near any source of light. Cane toads are ground-dwelling—they are poor climbers and unable to jump very high.

A definite visor or awning extends over each eye and a high angular bony ridge extends from the eyes to the nose.

The parotid glands (see Figure 1) are perhaps the most characteristic feature of the adult cane toad. These glands are large, protuberant, and are situated on the head behind each ear. These glands carry a toxin.

Map 2. Distribution of the cane toad in Queensland

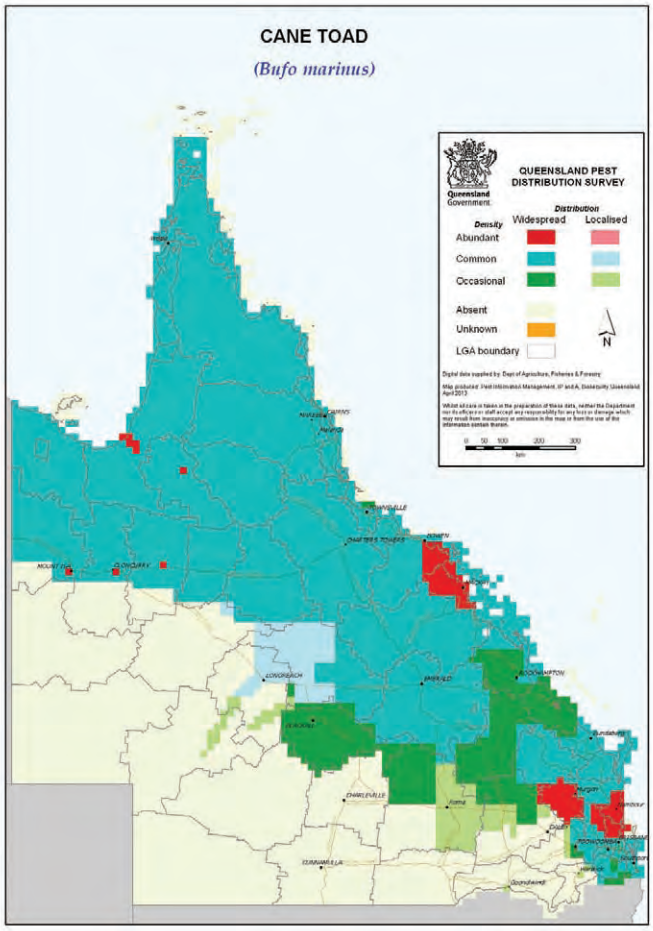
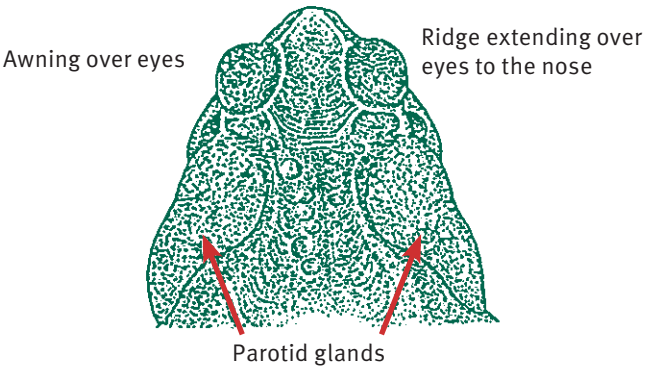


Figure 1. Distinguishing features of the cane toad



The cane toad's hands and feet are relatively small and lack discs at the tips of the digits. Webbing is absent between the fingers but is distinct and leathery between the toes.

Colouring on the dorsal (upper) surface may be brown, olive-brown or reddish-brown. The ventral (under) surface varies from white to yellow and is usually mottled with brown.

Warts are present on all cane toads; however, males possess more than females. Warts are dark brown at the caps.

Mating

Mating can occur at any time of the year and depends only on available food and permanent water. The mating call is a continuous purring trill that sounds like a running motor.

In situations where females are scarce or absent, male cane toads may have the ability to undergo a sex change to become fertile females; however, this has not been proved.

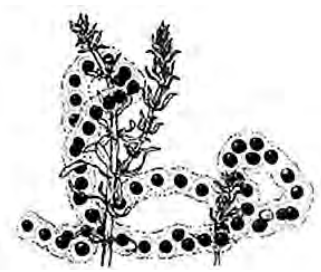
Eggs

Both cane toads and native frogs spawn in slow-moving or still water, but their eggs can be easily distinguished.

Cane toad eggs are laid in long, gelatinous 'strings' with the developing tadpoles appearing as a row of small black dots along the length. The strings are unique to cane toads, generally appearing as blobs of jelly attached to water plants or debris. Native frogs generally produce egg clusters as mounds of foam floating on the water surface.

Compared with native species, cane toad egg production is dynamic and a single clutch can contain up to 35 000 eggs. Remove any cane toad eggs found in the water and allow to dry out.

Figure 2. Drawing of toad spawn from *Wildlife of greater Brisbane*



Tadpoles

The cane toad is the only species in Australia that has a pure black tadpole. Native frogs have lighter-coloured undersides with a great range of colours and markings—cane toad tadpoles may turn paler colours to almost transparent at night.

Cane toad tadpoles are small and usually congregate in vast, slow-moving shoals. This 'shoaling' behaviour is uncharacteristic of most native species.

Unlike cane toad tadpoles, native species develop lungs at an early stage and periodically rise to the surface in order to exchange their lung gasses. Large groupings of tadpoles that do not break the water surface for air indicate cane toads.

Young toads

Following emergence from the water, the young toadlets usually congregate around the moist perimeter of the water body for about a week before they eventually disperse.

Young toads are very difficult to distinguish from the native *Uperoleiea* species, which also have parotid glands, but all *Uperolelea* species have bright red patches in the groin area.

Under ideal conditions toadlets may reach adult size within a year.

Toxicity

Bufo marinus produce venom in glands occurring in most of the skin on their upper surface. The venom is concentrated in the parotid glands as a creamy-white solution, which is released when the animal experiences extreme provocation or direct localised pressure (e.g. grasped by the mouth of a predator).

The parotid solution is highly toxic and when ingested it produces drastic acceleration of the heartbeat, shortness of breath, salivation and prostration. It is extremely painful if accidentally rubbed into the eye.

Ingestion of toads by domestic and most native animals can result in death. In some recorded cases, death has occurred within 15 minutes.

Field observations suggest that some predatory Australian species have learned how to feed safely on cane toads.

Birds have been observed flipping toads over to avoid the parotid glands. Predatory reptiles may have more trouble adapting, being unable to remove a toad from the mouth once they start feeding.

Effects on wildlife

The cane toad is poisonous at all stages of its life cycle and most native frog larvae and many aquatic invertebrates are dramatically affected by their presence.

Cane toads are voracious feeders that consume a wide variety of insects, frogs, small reptiles, mammals and even birds. Perhaps the only limiting factor to the prey taken is the width of the cane toad's mouth.

It has been suggested that cane toad competition for food and breeding grounds has been responsible for reducing the populations of some native frogs. However, many native frogs are arboreal (tree-dwelling) and occupy different niches. Cane toads don't have the native frogs' ability to 'shut down' during dry seasons when resources are limited.

Pressure from cane toads may displace native animals (frogs and other species) where they are already suffering due to manipulation of their habitat by humans and grazing animals. Animals that use waterholes as retreat sites during the dry season are especially vulnerable—toads will congregate here in large numbers.

Public health

Cane toads readily eat animal and human faecal material and, in areas of poor hygiene, they have been known to transmit disease such as salmonella.

Control

Control of cane toads is not enforced as there is currently no available effective broad scale control. Individuals and community groups have carried out removal campaigns to decrease numbers and slow the invasion front.

Fencing is recommended to keep toads out of ponds intended for native fish and frogs; a height of 50 cm is sufficient. Bird wire with 1 cm holes may keep toads out of an area.

Research indicates that spread can be delayed in semi-arid areas by blocking access to water holes.

Individual toads may be killed relatively humanely using a commercial spray available from hardware stores or may be stunned and decapitated (only by experienced operators). The removal of eggs from small water bodies such as frog ponds can be effective

Researchers have successfully mitigated impacts in recently colonised areas by 'training' predators however, large scale application of this technique is difficult.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

This fact sheet is developed with funding support from the Land Protection Fund.

Fact sheet

DECLARED CLASS 2 PEST ANIMAL

Dingoes

Canis familiaris dingo

The dingo *(Canis familiaris dingo)* is a primitive canid related to wolves and coyote. The dingo was not a part of the ancestral fauna of Australia. Though its origins are not clear, it is thought to have arrived in Australia 3500–4000 years ago.

It is the largest mammalian carnivore remaining in mainland Australia, and as such fills an important ecological niche. Females weigh about 12 kg and males 15 kg.

The dingo has been regarded as a serious predator of domestic stock since early European settlement in Australia. Early research emphasis was on control, indeed eradication of the dingo. No attempt was made to study the animal, measure predation, or to understand why the problem existed.

Declaration details

Under the *Land Protection (Pest and Stock Route Management) Act 2002* the dingo/wild dog is a declared Class 2 pest animal. It is the responsibility of landholders to reduce the number of dingoes/wild dogs on their property.

PA9 July 2010

Queensland Government

Description and general information

Red, ginger and sandy-yellow are the dominant coat colours, though dingoes can also be pure white, black and tan or solid black.

It is not difficult to distinguish between most dingoes and hybrids. The presence of domestic genes is suggested by broken colours—brindling and patchiness in the normally pure white feet and chest patch and sable colouration (black hairs along the back and sides).

Dingoes have a more heavily boned skull and larger teeth (especially the canine) than domestic dogs of similar size.

Distribution

Dingo numbers are believed to be higher today than in pre-European times. This is thought to be due to increased food availability via the introduced rabbit and cattle carcasses, and the development of permanent waters in arid areas of the state.

Dingoes/wild dogs are now present in all parts of the state.

The distribution of the wild dog in relation to purebred dingoes varies throughout the state. In far western areas, most dingoes sighted appear to be 'pure', with characteristic white points and broad heads. Closer to settled areas a greater number of feral domestic dogs produce a generally hybrid population. It has been estimated that dingoes are 50% pure in south-eastern Queensland and 90–95% pure in south-western and central Queensland.

Reproduction

Dingoes have only one breeding season per year (usually April to June), whereas domestic bitches have two or more oestrus cycles per year. However, unless seasons are particularly favourable, or human sources of food are intentionally or inadvertently provided, feral domestic dogs are unlikely to successfully rear two litters per year.

After a nine-week gestation, dingo pups (usually four to six) are born in a hollow log or cave den. Bitches tend to use the same den each year. Pups are suckled at four to six weeks and generally weaned at four months. When large enough to travel, pups are taken from the den to kills, and other dens many be used. The range of pups is increased as they are moved from den to den. In this way the pups are gradually moved around the bitch's home range.

Independence may occur as early as six months of age when parents abandon them, but this results in high juvenile mortality. Pups that become independent around 12 months appear to disperse voluntarily. Being larger and more experienced, mortality is then usually low.

Where dingoes live alone or in small groups (most pastoral and semi-settled areas), mature females will breed successfully each year.

By contrast, dominant female infanticide results in only one litter being successfully raised each year within groups containing several adult females (e.g. undisturbed areas such as the Simpson Desert). The dominant (alpha) female will kill all pups of the other females, and then use subordinate females to suckle and rear her litter.

Home range

Radio tracking studies show dingoes occupy a discrete area known as a 'home range'. The dingo visits the edge of this area frequently.

The home range can vary in size according to the productivity of the country—from 9 km² in rainforest areas to 300 km² on the Nullarbor Plain.

The edge of the home range is commonly associated with a major topographic feature (e.g. an escarpment, a major ridge or stream).

The home range is not used uniformly. Activity is centred on areas with highest food density.

Hunting movement is slow and exploratory, in contrast to frequent rapid movement around the home range boundary.

Pads follow well defined paths and are most likely associated with sociality and home range boundary maintenance. Activity is highest at dusk and dawn.

Social organisation

Dingoes in an undisturbed area generally belong to discrete packs (3–12 members), which occupy long-term, non-overlapping territories. The group rarely moves as a pack—rather, members meet and separate again throughout the day. Dingoes are most gregarious during the breeding season.

There is overlap of home ranges within a group. In contrast, boundaries between groups are more rigid, actively defended and infrequently crossed.

Olfactory communication (smell) is important in dingo social organisation. Dingo droppings are deposited along pads in specific areas where other dingoes will encounter them (creek crossings, intersections of roads and fences).

These 'scent posts' appear to delineate the home range boundary and act as a warning to neighbouring groups and individuals.

This strong site attachment of dingoes is contrary to the notion commonly held by property owners that dingoes will travel large distances to kill stock.

Diet

Dietary research of stomach content and faecal scats has shown dingoes are opportunistic predators.

Medium-size animals such as kangaroos, wallabies, rabbits and possums consistently form the major part of the dingo diet.

Studies by the Western Australia Agriculture Protection Board show dingoes in undisturbed refuge areas killed and ate kangaroos strictly according to need.

On grazing country, however, 'dingoes harassed, bit or killed sheep in large numbers, often without eating any'. The consumption of these sheep carcasses was the exception rather than the rule. Even kangaroos in these areas were sometimes killed in 'play' type behaviour rather than for food.

Such dietary studies could suggest dingo predation of domestic stock is low. There is, however, a need for caution in using such studies to assess dingo impact on stock.

Grouping increases foraging efficiency and appears necessary to exploit larger prey. Dingoes cooperating in groups are more successful in hunting kangaroos than lone dingoes are. While lone dingoes can easily kill sheep, it is less likely a solitary dingo would successfully attack a calf in the presence of a defending cow.

Disease threat

Dingoes are vectors of canid diseases (e.g. distemper, parvovirus) and parasites. The hydatid parasite *Echinococcus granulosus* is a major problem of dogs and domestic stock. It can cause illness and occasionally death in humans.

The dingo could pose a serious risk if the exotic disease rabies was introduced to Australia.

Beneficial considerations

The establishment of watering points during post-European settlement has resulted in a huge increase in the kangaroo population, with consequent strong pasture competition with domestic livestock.

Though it is widely accepted that sheep production is near impossible in the presence of dingoes, many cattle producers will tolerate dingoes because of their believed suppression of kangaroo numbers.

Research has shown that not only does the dingo have the potential to mitigate population growth of native species during abundant seasons, it could also be an important limiting factor for many feral animal populations (e.g. feral pigs and goats).

Destruction of the dingo could cause increases in other pests to the grazing industry and result in widespread degradation of environmentally sensitive areas. However, this has not been proven.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

PR10–5203

Department of Agriculture, Fisheries and Forestry
Biosecurity Queensland

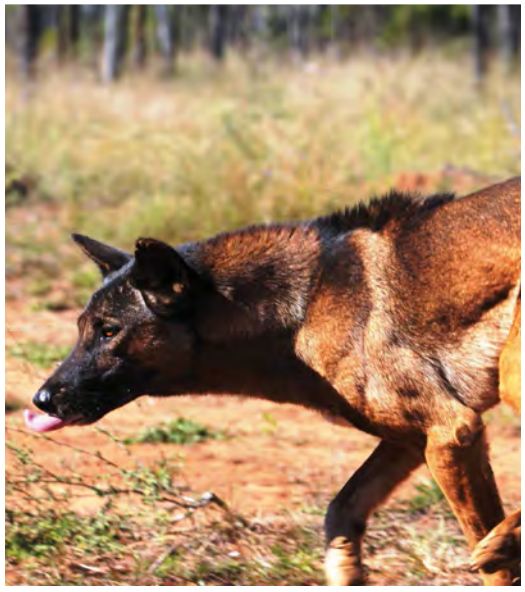
Fact sheet

DECLARED CLASS 2 PEST ANIMAL

December 2014

Wild dog control

Canis familiaris



The term wild dog refers collectively to purebred dingoes, dingo hybrids and domestic dogs that have escaped or been deliberately released.

Wild dog control methods include baiting, trapping, shooting, fencing, and the use of guardian animals to protect stock. A planned strategy using a combination of these methods that also considers wild dog behavior will enable effective management.

Declaration details

Wild dogs are a declared Class 2 pest animal under Queensland legislation. As such, all landholders in Queensland are required to reduce the number of wild dogs on their properties.

Management strategies

To increase wild dog control effectiveness, it is essential that control programs are coordinated among adjoining properties.

Queensland research has shown that in some situations wild dogs can quickly re-colonise baited areas due to a number of factors including inconsistent bait programs which do not provide comprehensive wild dog control across the landscape. Such programs may alter the dynamics of wild dog populations in the area. To prevent livestock attacks and enhance wild dog management, it is important for producers to work together using a variety of control methods.

Wild dog ecology and seasonal variations can also influence the likelihood of wild dogs coming into contact with a control tool. The timing of control should consider seasonal variations and the availability of water (where water is restricted) and then target watering points. Many land owners bait using 1080 twice a year to target wild dogs during peaks in activity associated with breeding (March/May) and then again in September/November to target pups and juveniles. However, baiting and trapping is recommended at all times when wild dogs are active.

Control

Baiting

Poison baits are the most economic, efficient and effective method of controlling wild dogs, especially in inaccessible or extensive areas. Baits can be laid quickly by hand, from vehicles and from aircraft.

Currently there are two poisons legally available for wild dog control. These are 1080 (sodium fluoroacetate) and strychnine.

Subject to restrictions, 1080 baits, either manufactured or prepared from fresh meat can only be obtained from authorised persons. A permit from the Queensland Department of Health is required for land owners to purchase strychnine. Strychnine can be used both in baits and on traps. The use of both 1080 and strychnine require adherence to the associated conditions of supply.

The use of poison baits will control some but not all wild dogs. Baits should be used in conjunction with all other control tools and not be relied on as a total control method.

Meat baits are attractive both to wild dogs and a range of non-target species. When using meat baits, they can be strategically positioned as wild dogs' keen sense of smell enables them to find baits intentionally buried in sand or otherwise hidden under bushes or in hollow logs. Meat baits may also be tied to prevent their loss to non-target species.

These meat bait placement techniques help to:

- reduce the risk of poisoning non-target species
- increase wild dog contact, hence receiving a lethal dose
- minimise bait removal by non-target scavengers
- deter ants (ant-covered baits are believed to be less attractive to wild dogs).

Heavy rain within two weeks of baiting can leach 1080 from baits, but baits may still remain toxic for a considerable time.

Trapping

A key success to trapping wild dogs (using foot-hold traps) depends on the skill of the operator. Visit www.feral.org.au to watch a PestSmart video on best practice techniques for wild dog trapping.

For humane reasons and to prevent escape, poisoning traps with strychnine is recommended to quickly kill captured wild dogs. A properly poisoned trap becomes a lethal device rather than a holding device.

A mixture of dog faeces and urine is a popular lure used by trappers. Attractiveness of lures varies with seasons and locations. No single lure has yet been found that is consistently attractive to all wild dogs and repeated use of one lure can lead to aversion amongst remaining dogs.

Traps are best placed in areas of high wild dog activity (known as leads). Here the wild dog is most likely to find and investigate the decoy/odour.

A wild dog scent post (an area where urine or faeces have been deposited) can be found by walking with a domestic dog on a lead along a known pad. Trap placement in relation to the scent post can be optimised by observing the domestic dog's behaviour as it approaches. Factors to consider are:

- where on the bush it smells
- placement of feet while urinating/defecating/sniffing
- how it approaches and where it scratches in relation to the pad and scent post.

Padded, laminated or offset foot-hold traps, in a well tuned and functioning state are recommended.

Shooting

Shooting is an opportunistic method, mostly used for control of small populations or individual problem animals.

Fencing

Property fencing suitable to exclude wild dogs is expensive to build and requires continual maintenance to repair damage caused by fallen timber, fire, floods, feral and domestic animals, as well as vegetation regrowth. However, a properly maintained fence can restrict movement into an area where wild dogs have been controlled.

Electric fences suitable for wild dogs have been developed. Electrifying a fence creates a fear of the fence itself and deters wild dogs from approaching.

For property fencing to be successful, the fence must be maintained in good order and ongoing wild dog control conducted within the protected area to limit livestock impacts.

Fencing is the most effective method of protecting livestock and pets from wild dog attack on small acreage blocks.

A fence can also be a good area to place baits and traps when wild dogs are active.

Livestock guardian animals

Livestock guardian animals have been used to protect livestock from predators in Europe, Asia and America. Some producers in Queensland have decreased predation on sheep and goats using this method. The use of trapping and poisoning in conjunction with guardian animals must be well planned and managed to ensure guardian animal safety.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

This fact sheet is developed with funding support from the Land Protection Fund.

Department of Agriculture and Fisheries
Biosecurity Queensland

Fact sheet
DECLARED CLASS 2 PEST ANIMAL
March 2016

Feral pig

Sus scrofa

Pigs were introduced to Australia by early settlers. Subsequent accidental and deliberate releases resulted in the wild (feral) population establishing throughout Australia.

Feral pigs cause environmental and agricultural damage, spread weeds and can transmit exotic diseases such as leptospirosis and could spread foot-and-mouth disease.

Declaration details

Feral pigs are declared Class 2 pest animals under Queensland legislation. Declaration requires landholders to control declared pests on land under their control.

Description

Feral pigs are typically smaller, leaner and more muscular than domestic pigs with well developed shoulders and necks, and smaller, shorter hindquarters.

The body is usually covered in sparse, coarse hair and they have a longer, larger snout, longer tusks, a straighter tail and narrower back than domestic pigs. Feral pigs are mostly black, buff-coloured or spotted black and white.

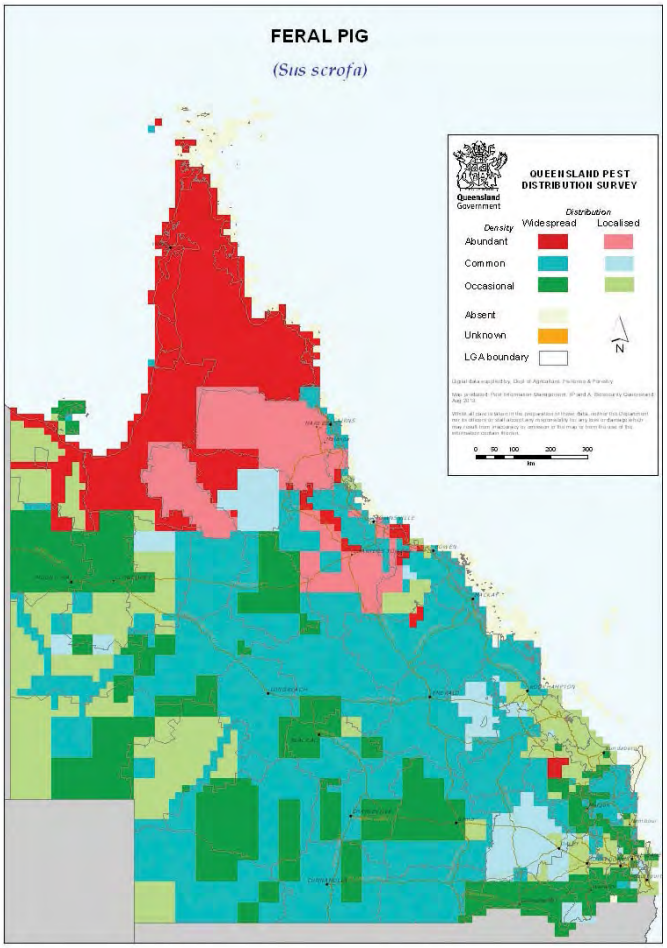
Growth potential is similar to domestic pigs, although harsh environmental conditions tend to stunt development. Adult female feral pigs usually weigh 60–75 kg, while males usually weigh 90–110 kg. Older boars (razorbacks) can have massive heads and shoulders and a raised and prominent back bone that slopes steeply down to small hams and short hind legs. Some boars develop a crest or mane of stiff bristles extending from their neck down the middle of their back.

Queensland Government

Feral pig wallow

Feral pig rooting

Map 1. Distribution of feral pigs in Queensland



Habitat and distribution

Feral pigs are found in all habitat types in Queensland. The greatest concentrations of feral pigs are on the larger drainage basins and swamp areas of the coast and inland. In hot weather, pigs need to remain near water.

Population estimates can be achieved by spotlighting, aerial survey or the use of motion cameras.

Evidence of feral pigs includes fresh digging or rooting of the ground, tracks and faeces on and off pads, mud or hair at holes in fences where pigs have pushed through, wallows, tusk marking and mud rubs on trees and fence posts and nests in vegetation made by sows before farrowing.

Biology and behaviour

Female and juvenile pigs usually live in small family groups with a home range of 2–20 km^2. Adult males are typically solitary, with a home range of 8–50 km^2. Range size varies with season, habitat, food availability and disturbance. Herds of 400 pigs have been recorded in Cape York.

Feral pigs are generally nocturnal, spending daylight hours sheltering in dense cover. Pigs are omnivorous, eating plants and animals and are extremely opportunistic feeders, exploiting any temporarily abundant food.

They prefer green feed and will eat grains, sugarcane and other crops, fruit and vegetables. They root extensively for tubers, worms and soil invertebrates.

Feral pigs have relatively high energy and protein requirements, particularly during pregnancy and lactation and often move to other parts of their home range during pregnancy.

Life cycle

Under good seasonal conditions, breeding occurs all year and sows can produce two litters per year. Adult females have a 21–day oestrus cycle, with a gestation period of about 113 days, producing a litter of 4–10 piglets. Sows can make nests of available vegetation just before farrowing. Nests sometimes have a domed roof and are usually less than 2 km from available water. Piglets normally spend the first 1–5 days of life inside the nest, with the sow nearby. Weaning occurs after 2–3 months. Sexual maturity is reached when sows weigh about 25 kg, usually around six months of age.

Mortality of juveniles is high if the mother's dietary protein intake is low (up to 100% mortality in dry seasons). Adult mortality does not vary as much with seasonal conditions, but few animals live more than five years.

Impacts

Pigs can damage almost all crops from sowing to harvest, starting with uprooting seed and seedlings to feeding on or trampling mature crop.

They feed on seed, sugar cane and grain crops (except safflower), fruit (especially banana, mango, papaw, macadamia and lychee) and vegetable crops. Research has shown feral pigs can take up to 40% of lambs.

Pastures are damaged by grazing and rooting and pigs can also transport weeds. Wallowing pigs damage and foul the water in tanks and bore drains and silt up troughs. They can also damage fences and dam walls.

Pig activity degrades water quality and the habitat for small terrestrial and aquatic animals. It also creates erosion and allows exotic weeds to establish. Predation of native fauna does occur and examination of faeces has shown remains of marsupials, reptiles, insects, and ground-nesting birds and their eggs.

Feral pig damage to river banks

Feral pig damage to sugar cane

Diseases and parasites

Feral pigs can carry many infectious diseases and internal and external parasites. Some are endemic (already present), while others are exotic to Australia.

Many of the diseases can spread to domestic pigs, other livestock and humans. Feral pigs can transmit sparganosis, melioidosis, leptospirosis, Q fever and brucellosis to humans.

To prevent contracting these diseases it is advisable to either avoid handling feral pigs or use suitable protective clothing (mask, goggles, strong rubber gloves and plastic apron and boots) to minimise contamination with blood, urine and faeces. Rare or undercooked meat should not be eaten; thoroughly cook meat to avoid contracting pathogens.

Control

Feral pigs are difficult to control because they are primarily nocturnal, breed rapidly, are generalist omnivores and have large home ranges and thus control programs need to be conducted over a wide area (often including several properties) to be effective.

Effective control requires an integrated, collaborative approach where all stakeholders participate in planning, implementation and evaluation of the actions taken.

Trapping

Trapping is an important technique that is most useful in populated areas, on smaller properties (‹5000 ha), and where there are low pig numbers. Trapping can be particularly useful in ‘mopping up’ survivors from baiting programs. It is most successful when food resources are limited.

Trigger mechanisms for pig traps can be made pig-specific and therefore pose little danger to wildlife or domestic animals.

Advantages

- This is the safest form of control and can be safely undertaken on closely populated areas.
- It’s flexible and can be incorporated into routine property activities, making economical use of labour and materials.
- Carcasses can be safely disposed.
- Traps can be moved and re-used; good trapping makes use of opportunities as they arise.
- Normal pig behaviour is not altered, which allows a greater number of the total population in an area to be targeted.
- More humane to pigs and non-target species.
- The number of animals removed can be easily monitored.

Disadvantages

- Can be time consuming and expensive to construct and maintain.
- Must be checked regularly.
- Not practical for large-scale control.
- Some pigs are trap shy.

Tips

- Stop all activities that will disturb normal feeding (i.e. do not undertake any shooting or dogging).
- Pre-feeding (i.e. ensure that pigs are visiting trap and consuming bait) prior to activating traps is an essential part of successful trapping.
- Feeding sites should be placed where feral pigs are active (i.e. water points, holes in fences, areas containing old carcasses on which pigs have been feeding).
- Bait for traps must be food that pigs usually eat in that area. Pigs feeding on one crop (e.g. sugarcane) will often not take to alternative foods. However, new, novel baits are sometimes attractive (e.g. fermented grains).
- The trap can be built around the feeding site, with feeding within the trap undertaken for several nights before it is set.
- Set the trap every night and check each day. If the trap cannot be checked daily then shade and water must be provided.
- Continue to trap until no more pigs are caught. A change of bait can be tried. Again, feed for one or two nights before re-setting the trap.
- Traps may be left permanently in locations used by pigs and can be utilised when fresh signs of pigs appear.
- If the trap is to be moved, start feeding at the new site before re-locating the trap.

Design

There are several trap designs but all are principally an enclosed area with one-way gates (see Figure 1).

The main area of the trap can be any shape and be made from materials on the property. The best material is steel mesh with a grid 100 × 100 mm, with a minimum height of at least 1.5 m. Star pickets need to be placed no more than 1.5 m apart and imbedded far enough to ensure that adult pigs cannot push them over or lift them up out of the ground.

Alternative trap entrances

Funnel entrance

Formed by the two ends of the mesh forming a funnel, the ends are tied together at the top with wire or rope. The pig moves through the funnel forcing the bottom of the mesh ends apart and once it is in the trap the ends spring back together (see Figures 1 and 2).

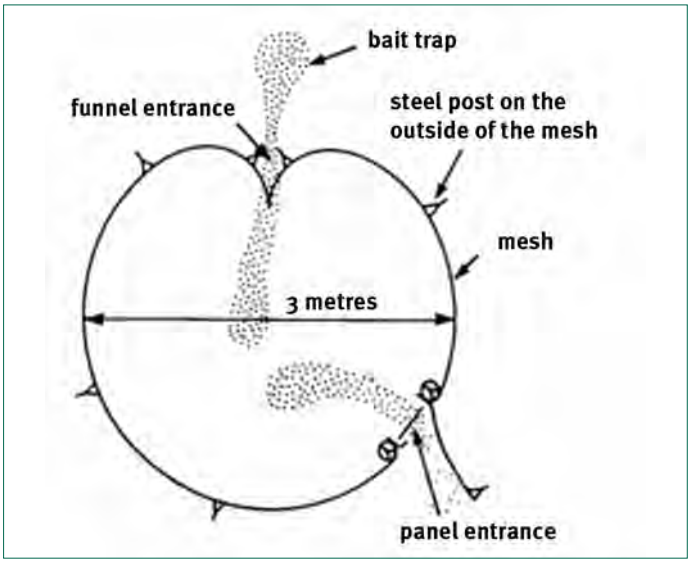


Figure 1. Alternative trap entrances – funnel entrance

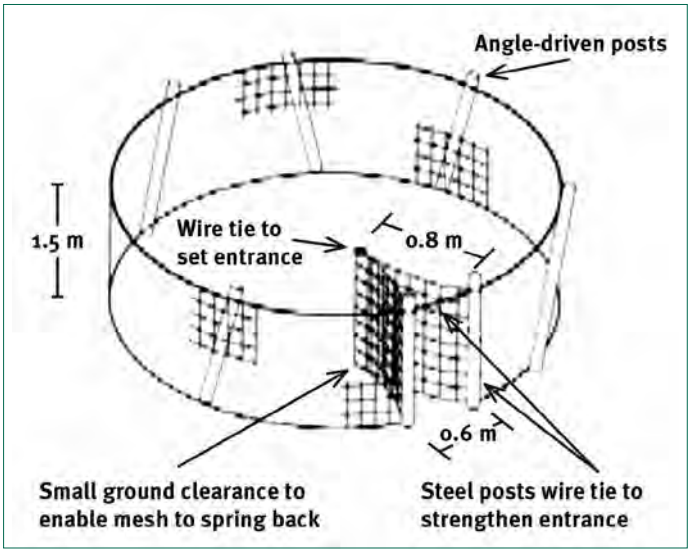


Figure 2. Silo trap with funnel entrance (14 m of silo mesh diameter about 4.5 m

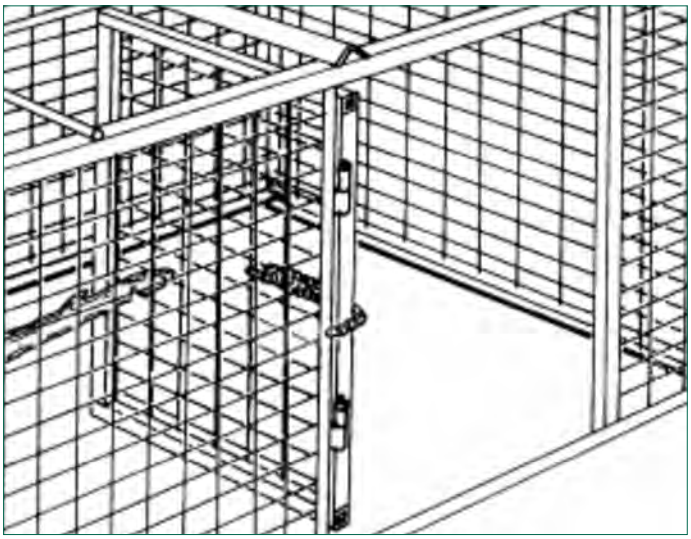


Figure 3. Pig-specific trigger

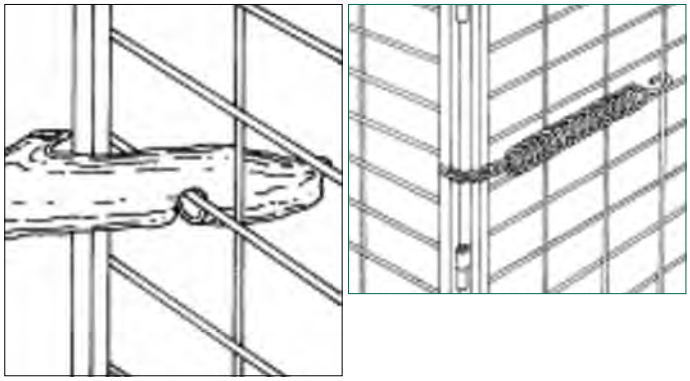


Figure 4. Close up of pig-specific trigger

Feral pig trap

Trapped feral pigs

Hog hopper – pig specific bait station

Tripped gate entrance

A side-hinged gate is pulled shut by springs and is held open by many systems that can be triggered to allow the gate to swing shut. Often trip wires or other systems are used; most of these systems are not selective for feral pigs and can be triggered by any animal attracted to the bait. Once triggered the trap is no longer effective in trapping pigs.

Pig-specific trigger

By far the simplest and most effective trigger system has the gate held open by a bar (often a branch or piece of wood) which is hooked over the wire on the gate and on the side panel (see Figure 3). For a close up of the pig specific trigger (see Figure 4).

Pigs rooting for feed in the trap lift the bar allowing the gate to swing shut. The specific feeding habit of pigs insures they are the only animals that lift the trigger bar.

The gate may be latched to prevent pigs from opening the door once triggered. However, this will prevent more pigs pushing their way in to join those inside.

Poisoning

Poisoning is the most effective control method available that can quickly reduce a pig population.

Only authorised persons can supply 1080 baits to landholders.

Pre-feeding is the most important step in ground-based poisoning operations. Free feeding with non-poisoned bait should be performed for several days prior to laying poisoned baits.

By selecting bait wisely, landholders can be species-selective in their poisoning program and avoid many of the unintentional effects of secondary poisoning.

Bait material such as fermented grains are very attractive to pigs. It is a good idea to establish a free feeding routine so that pigs are the only animals feeding, which helps to keep other non-targets away from the feeding site.

Other options (like pig-specific feeders) are now commercially available, and can assist in reducing non-target species access to bait. Other options include burying baits; feral pigs are one of the few animals that will dig up bait.

Aerial poisoning is also available and typically used for broadscale control in western and northern regional areas. Bait is distributed from an aircraft. This is particularly useful for covering large, remote, areas or restricted ground access. Aerial poisoning is a proven and cost-effective method for reducing pig populations.

A phosphorous-based poison is also available for use in Queensland.

Shooting

Shooting pigs by helicopter is effective in areas where pigs exist in reasonable numbers and are observable from the air.

Ground shooting is not effective in reducing the pig population unless intense shooting is undertaken on a small, isolated and accessible population of pigs.

Fencing

Though an expensive option, fencing can offer successful pig control especially for high value crops grown on small areas. Research has indicated that the most successful pig-proof fences are also the most expensive.

The most effective pig-proof fences use fabricated sheep mesh held close to the ground by plain or barbed wire and supported on steel posts.

Electrifying a conventional fence greatly improves its effectiveness if used before pigs have established a path through the fence.

Pigs will often charge an electric fence and unless the fence incorporates fabricated netting they often successfully breach the fence.

For crop protection or to avoid lamb predation, pig-proof fences need to be constructed before the pigs become a problem. Once pigs have adjusted to feeding on grain or lambs in a particular paddock fencing may be ineffective.

Fertility control

There are currently no available means to deliver fertility control to feral pigs. Such a technique is likely to remain unavailable for practical use given the lack of suitable contraceptives, suitable delivery mechanisms, and concerns with non-target species.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au). Visit www.biosecurity.qld.gov.au to download a copy of the feral pig control manual.

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Feral pig exclusion fencing

This fact sheet is developed with funding support from the Land Protection Fund.

Department of Agriculture and Fisheries
Biosecurity Queensland

Fact sheet

DECLARED CLASS 2 PEST ANIMAL

March 2015

Feral cat

Felis catus

A descendant of the African wild cat (*Felis silvestris lybica*), the common 'house' cat (*Felis catus*) has now been domesticated for about 4000 years. Although the domestic cat has a long history of association with humans, it retains a strong hunting instinct and can easily revert to a wild (feral) state when abandoned or having strayed from a domestic situation.

Semi-feral cats live around dump sites, alleys or abandoned buildings, relying on humans by scavenging rubbish scraps and sheltering in abandoned structures. The true feral cat does not rely on humans at all, obtaining its food and shelter from the natural environment.

Declaration details

The feral cat is a pest animal under Queensland legislation and landholders are required to control its numbers on their land. Declared pest animals represent a threat to agricultural industries and natural resources, and have a social impact on other human activities.

Legislation describes a feral cat as one that is not fed and kept by someone. The word 'kept' specifically means that the cat is housed in a domestic situation.

Queensland Government

Description and general information

The feral cat differs little in appearance from its domestic counterpart; however, when in good condition, the feral cat displays increased overall muscle development, especially noticeable around the head, neck and shoulders, which gives the animal a more robust appearance. The average body weight of male feral cats is 3–6 kg, while females weigh 2–4 kg. Body weights vary with condition, with some extremely large specimens documented.

Australian feral cats are predominantly short-haired, with coat colours that range between ginger, tabby, tortoiseshell, grey and black. White markings may be present on the feet, belly, chest and throat; completely white feral cats are extremely rare. In established populations, coat colours are the result of a natural, genetically selective process. Terrain, predators and the ability to capture prey limit coat colours to those that provide the most suitable camouflage and cause a predominance of these colours in subsequent offspring. Ginger cats are more likely to be found in the semi-arid and desert areas, while grey and black specimens generally predominate in scrub and more heavily timbered habitats.

The feral cat is most active at night, with peak hunting activity occurring soon after sunset and in the early hours before sunrise. At night the cat displays a distinctive green eyeshine under spotlight, making it easily distinguishable from other animals. During the day it will rest in any number of den sites, which may include hollow logs, dense clumps of grass, piles of debris, rabbit burrows, and even the hollow limbs of standing trees.

The most obvious and characteristic field signs of feral cats are their scats (droppings). Unlike the domestic cat, the feral cat does not bury its scats, but leaves them exposed at prominent sites to warn other cats of its territorial boundary.

History of introduction and dispersal

There is some evidence to suggest that the cat was present in Australia long before European settlement. This may have occurred as a result of Dutch shipwrecks and regular visits to northern Australia by early South-East Asian vessels as long as 500 years ago.

Post-settlement dispersal resulted from cats straying from areas of early colonisation. In the late 19th and early 20th centuries, large numbers of cats were purposely released in many rural areas to combat plague numbers of rabbits. Unwanted cats continue to be released into urban and rural areas by irresponsible pet owners.

The feral cat is now present Australia-wide, thriving under all climatic extremes and in vastly different types of terrain.

Population dynamics

Male cats attain sexual maturity at about 12 months, whereas females are capable of reproduction at approximately seven months. Annually, and under ideal conditions, an adult female can produce up to three litters—each of usually four kittens, but varying from two to seven.

As the breeding instinct is triggered by the increasing length of daylight, litters are less frequent in winter. Most reproduction occurs during the spring and summer months, and is generally limited to two litters per year. Birth follows a gestation period of 65 days, and kittens may be reared in a single den site or may be frequently shifted to other sites within the female's home range. Family and litter bonding begin to break down when the kittens are approximately seven months old. The female's ability to bear litters does not decrease with age, so reproduction continues for the course of her life.

Social organisation and behaviour

Feral cats maintain stable home ranges, the sizes of which depend upon the relative abundance of food and the availability of suitable den sites. Dominant male cats may have territories of up to 8 km^2, while the territories of females are smaller and may even be halved while kittens are being reared.

Scent glands are present on the chin, at the corners of the mouth, and in the anal region. Territorial boundaries are maintained by scent marking with the cheek glands, pole-clawing, urinating and leaving exposed faecal deposits.Although feral cats are often thought of as being solitary animals, studies show this behaviour is generally limited to hunting activities. At other times feral cats display a degree of social interaction that peaks during the breeding season. Group behaviour has been observed in semi-feral populations, and it has been suggested that such behaviour is exhibited also in feral populations.

Groups usually comprise several related adult females, their young of both sexes, and an adult male—whose range may include other groups of females. Young females usually remain in a group, while young males either leave or are driven from the group as they reach sexual maturity.

Effects on wildlife

The energy expended by an adult male cat requires it to consume 5–8% of its body weight in prey per day, while females raising kittens require 20%. Based on these figures, one study concluded that 375 feral cats on Macquarie Island would consume 56 000 rabbits and 58 000 sea birds per year. Where present on the mainland, rabbits may comprise up to 40% of a feral cat's diet. Cats are successful as a control mechanism only when rabbit densities are low. At other times cat predation does little to halt the build-up or spread of

rabbit populations; rabbits merely help to support a larger number of cats. When seasonal shortages of rabbits occur there is a corresponding rise in the number of native animals taken by cats.

The feral cat is an opportunistic predator, and dietary studies have shown that small mammals, birds, reptiles, amphibians, insects and even fish can be taken as prey. Cat predation is particularly harmful in island situations, and a number of species have become extinct due to the introduction of cats by early sealers and lighthouse keepers. On the mainland, native animals—which already suffer due to the destruction of their habitats by man and other introduced animals—may be endangered further by cat predation. Actual competition for prey can cause a decline in the numbers of native predatory species such as quolls, eagles, hawks and reptiles. Not only do native animals bear the brunt of predation, but they also suffer the effects of a parasite that reproduces only in the intestine of the cat. This disease (toxoplasmosis) is particularly harmful to marsupials, which may develop blindness, respiratory disorders, paralysis, and suffer the loss of offspring through abortion and stillbirths.

Exotic disease—rabies

Due to their widespread distribution, feral cats may prove to be a major vector for this fatal viral disease if it ever enters Australia. Overseas studies have revealed that wounds inflicted by rabid cats are more dangerous than those caused by rabid dogs. While the bites of rabid dog are generally inflicted on the arms and legs, the cat attacks the head of its victim, biting and clawing viciously. These head and facial bites reduce the time taken for the virus to enter the central nervous system, lessening the chance of success from subsequent remedial treatment.

Control

Exclusion

Fencing is the only feasible method of control when special areas need protection from cats. Feral cats have been successfully prevented from climbing over netted fences that use an electrified wire mounted 15 cm from the top and 10 cm outward from the fence. Non-electrified fencing should incorporate a netted ceiling, or a curved overhang, which prevents the cat from climbing straight up and over the fence.

Shooting

Night shooting is assisted by the cat's distinctive, green eyeshine. Cats have been successfully attracted by the use of a fox whistle.

Poisoning

Fresh meat baits containing 1080 may be used for controlling feral cats under an APVMA Permit (PER14015 effective until 30 June 2016).

Only authorised persons can supply 1080 baits to landholders.

Lures

Audible recorded lures for feral cats and other predators are available through a number of sources. These recordings mimic the distress call of a small animal and can be used to draw a predator to a bait or trap site.

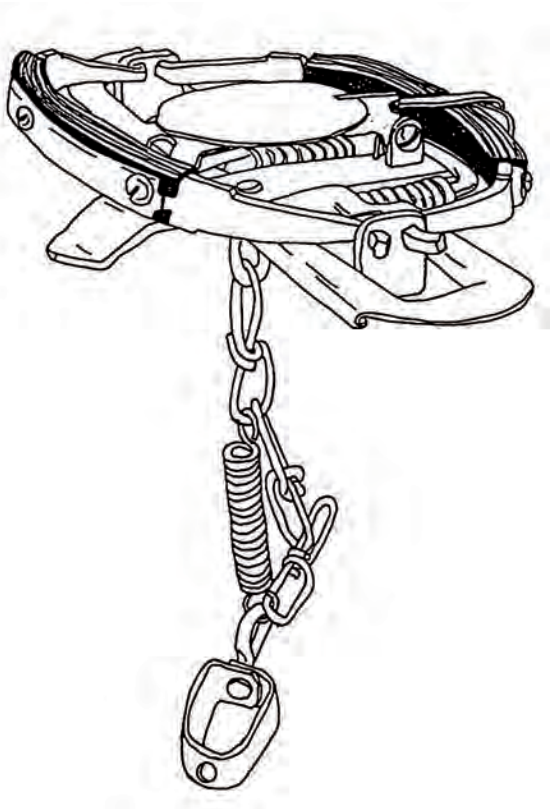
Trapping

Rubber-jawed, leg-hold traps (see below) can be laid in the same manner as they are laid for dingoes and foxes. Leg-hold traps can work well with true feral cats, which would normally avoid the live-capture box traps.

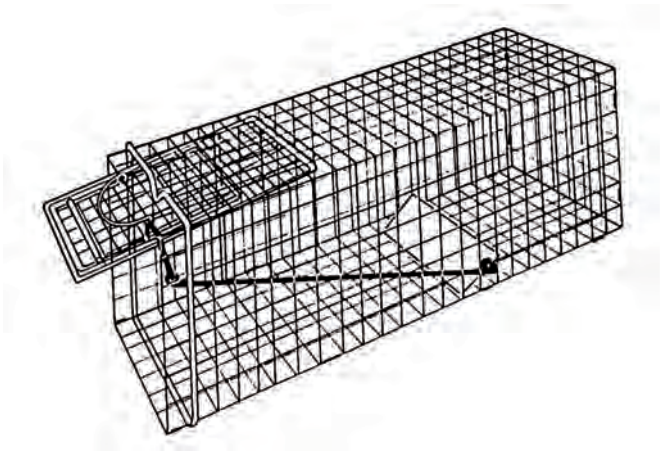
Ideal sites are those where territorial markers, such as faecal deposits and pole-clawing, are noticed. Tuna fish oil has shown some success as an attractant; however, feral cats seem more readily attracted to a site by some visual stimulus such as a bunch of bird feathers hung from a bush or stick.

Semi-feral urban cats are easily trapped in wire 'treadle-type' box traps (see diagram at right). Attractants/lures may be of meat or fish and should be placed so that they cannot be reached through the wire and be retrieved by clawing.

A number of local governments hire cat traps for the purpose of removing stray and feral cats in urban situations.



Rubber-jawed leg-hold trap



Treadle box trap

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

This fact sheet is developed with funding support from the Land Protection Fund.

Department of Agriculture, Fisheries and Forestry
Biosecurity Queensland

Fact sheet

DECLARED CLASS 2 PEST ANIMAL

December 2014

Rabbit

Oryctolagus cuniculus

Declaration details

The rabbit is a declared Class 2 pest animal under Queensland legislation. Declaration requires landholders to control declared pests on land under their control.

Description and general information

Rabbits are one of Australia's major agricultural and environmental animal pests, costing the country between $600 million and $1 billion annually. They compete with native animals, destroy the landscape and are a primary cause of soil erosion by preventing regeneration of native vegetation.

Pet rabbits

Introducing and selling rabbits in Queensland is not permitted (penalties apply). Limited numbers of permits for domestic rabbits are only available from Biosecurity Queensland for research purposes, public display, magic acts or circuses. Before a permit is granted, a number of guidelines need to be fulfilled.

Habitat

Rabbits are adaptable and sometimes live in close association with people. They live in built environments such as:

- in and under buildings
- old machinery and storage containers
- in old dumps.

In rural environments rabbits frequently live in:

- felled timber and associated windrows
- tussock grasses and rocky areas
- warrens (if soils are easy to dig).

Rabbit warrens

Rabbits prefer to live in warrens as protection against predators and extremes in temperature. However, they will survive in above-ground harbours such as logs, windrows and dense thickets of scrub (e.g. blackberry and lantana) or under built harbour, old sheds and machinery etc. In newly colonised areas without warrens, rabbits tend to live in 'scrapes' (or 'squats').

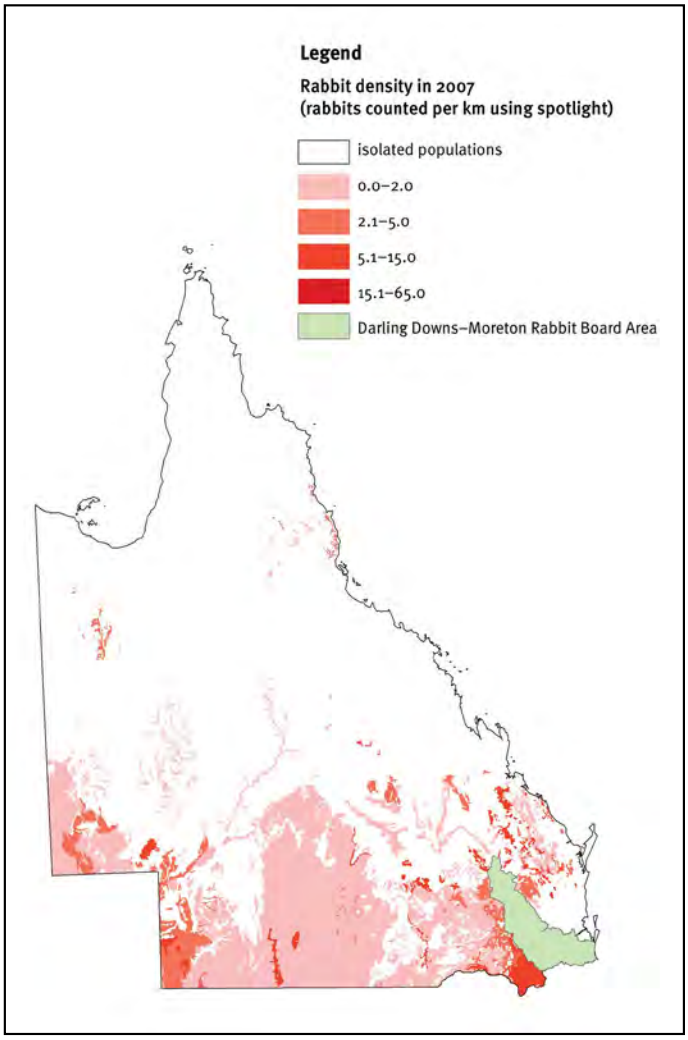
Breeding

Does (females) are pregnant for 28–30 days, but are able to mate within hours of giving birth. The average litter is 3–4 kittens but varies from two in a young doe, up to eight or more in a mature doe, and depends on the amount and quality of food available.

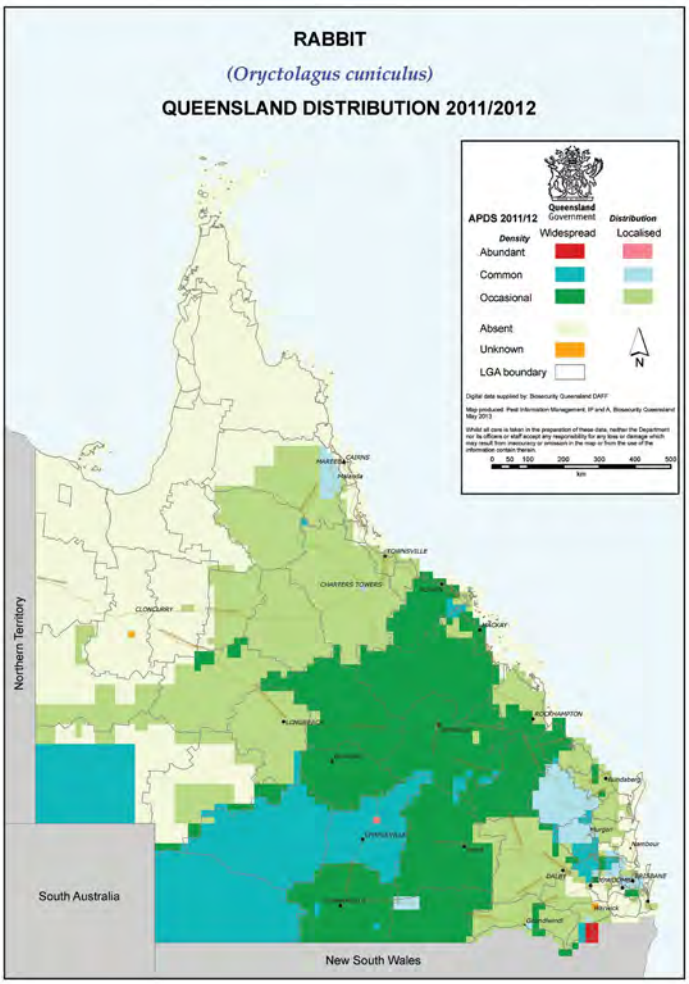
Five to six litters are possible in a good season.

Young does can breed at four months of age if conditions are suitable.

Map 1. Number of rabbits likely to be seen with a spotlight at night. Darker areas indicate more suitable rabbit habitat



Map 2. Distribution of rabbits in Queensland



Where to start control

For effective long-term rabbit control, concentrate on destroying source areas. Source areas will all have well-established warrens or ready-made structures that are cool and provide protection from predators. A source area must also have a good supply of green feed during the cooler seasons.

Coordinating control

Rabbit control is best done as a joint exercise involving all land mangers in the district. Cost-effective, long-term results can be achieved in rabbit control by following the methods outlined below.

Control

Integrated control

Landholders should adopt an integrated control approach, incorporating appropriate strategies from those listed below. Landholders must understand that

Effective rabbit control cycle

biological control agents such as myxomatosis and rabbit hemorrhagic disease virus (RHDV) are not a complete solution to rabbit problems. It is essential to incorporate them into a management strategy with other control techniques.

RHDV offers landholders a major opportunity to reduce rabbit numbers; however, failure to combine RHDV with other control strategies could cause rabbit immunity to develop (as occurred with myxomatosis).

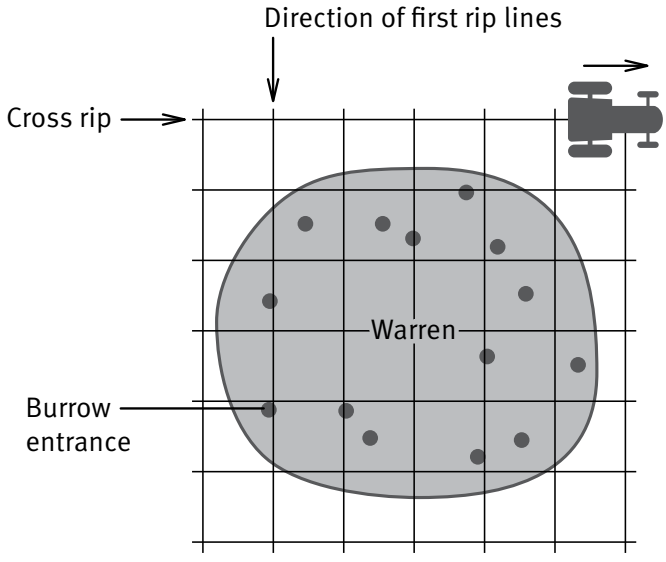
Destroying a rabbit's home (e.g. warren) is the most effective method for long-term control.

Conventional control methods, such as fumigating, ripping warrens and harbour destruction, are essential for the continued long-term reduction of rabbit numbers.

Warren ripping

In areas where rabbits live in warrens, ripping is the most effective method of long-term control. Ripping is so successful because warrens can rarely be reopened and rabbits are unable to recolonise these areas.

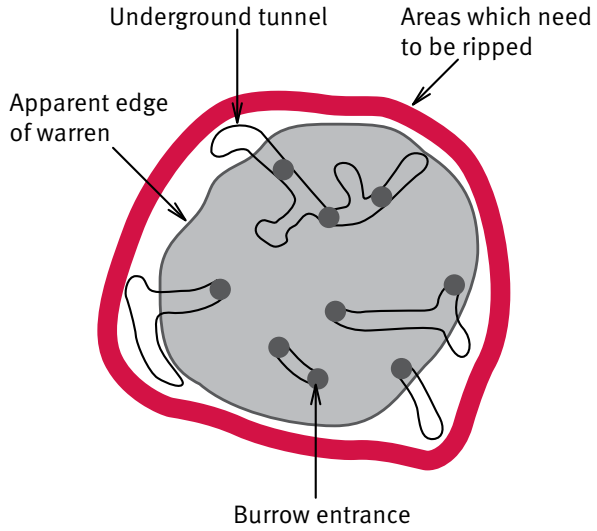
Tyne for ripping warrens (photo courtesy Mark Ridge)



Direction to rip warrens (illustration courtesy Will Dobbie)

To get the best results it is important to chase as many of the rabbits inside the warren as possible. Dogs can be used to drive rabbits into the warren before ripping starts.

The aim of ripping is to completely destroy the warren. It involves using a tractor with a tyned (sharp-pronged) implement—one tyne or many—that rips through the warren and collapses it. Larger tractors and dozers are more appropriate for properties with many warrens as they are able to move faster and rip wider.



Extent to rip warrens (illustration courtesy Will Dobbie)

Obviously, ripping is not suitable for warrens located underneath buildings or on steep rocky country. In such cases, other methods (poison baiting, releasing virus or fumigating burrows) should instead be used to reduce rabbit numbers. Warrens should then be either filled in or covered to stop rabbits from re-establishing. Burrows can be blocked with small boulders or rocks (see photo below).

Rock blocking rabbit hole

Harbour destruction

Where there is abundant surface harbour, a high proportion of rabbits may live above ground rather than in underground warrens. Rabbits can make their homes in windrows, dense thickets of shrubs (such as blackberries and lantana) and even in old machinery.

To eliminate these above-ground breeding areas, it may be necessary to:

- burn windrows and log piles
- remove noxious weeds through chemical and physical control
- remove movable objects (such as old machinery) from paddocks.

Sometimes removing harbour can expose warrens underneath. If this happens, the warrens need to be ripped.

Poison baiting

Baiting is not effective as a sole control method and will not eradicate an entire rabbit population. Numbers will quickly increase again, and you will have to continue baiting year after year with no permanent overall change in the rabbit population.

Rabbits can also become 'bait shy' and this method becomes less and less effective over time. Ideally, baiting is best used either before ripping/fumigation to reduce a population, or after ripping/fumigation as a 'mop-up'.

Baiting works best when rabbits are not breeding. During breeding season the majority of the population feeds over a larger-than-normal area, and it is the young rabbits that are most likely to take baits. While numbers will be reduced, animals of breeding age are not likely to be affected.

1080—sodium fluouroacetate

Pre-feeding is required when using 1080 because rabbits will not readily take new feed. The poison-free bait should be laid at least three times over a one-week period before the poisoned bait is laid. (1080-impregnated carrot baits are the most common form of bait used.) The practice helps to ensure that, when the poisoned bait is laid, it will be eaten by most of the rabbit population.

Only authorised persons can supply 1080 baits to landholders. Your local Biosecurity officer or your local government office should be able to assist you.

Pindone

Pindone is an anticoagulant registered for rabbit control. This poison works by preventing blood from clotting. In Queensland, it is not recommended for broadacre use and is mainly used in urban areas and near farm buildings.

Pindone works best when given as a series of small doses/feeds over a period of three days. Although pre-feeding is not essential, it does enhance the bait uptake by shy rabbits as they get used to the feed prior to any poison bait being laid. To be effective, pindone requires multiple feeds so that the poison can build up to fatal levels in the rabbit's body. Feeding over a number of nights provides plenty of opportunity for most of the rabbit population to consume the required lethal dose. Rabbits poisoned with pindone will usually die within 10–20 days.

Pindone baiting does not work well when there is a lot of green pick around for rabbits.

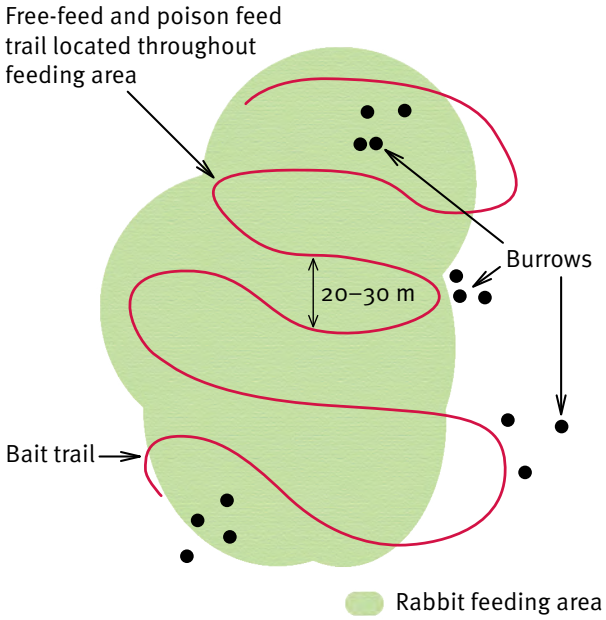
Poison bait trails

It is important that bait trails are laid properly to ensure the best results. 'Baitlayers' make it easier to put out bait trails at the correct rate, and they can be towed behind most 4WD vehicles, quad bikes and tractors.

When scratching and laying a trail, consider the following:

- Rabbits like freshly scratched/disturbed soil—this may be because rabbits are territorial and inspect newly disturbed soil, and/or the disturbed vegetation smell attracts them.
- Lay trails around warrens and in the areas where rabbits most often feed.
- Laying trails on slopes and hills requires care—it can cause erosion in some soils types (e.g. granite and traprock). Trails are best laid in a zigzag pattern in steep terrain to minimise erosion.
- A trail that has been scratched for the first feed is easy to follow for the rest of the baiting program.
- The soil should be turned only enough to scratch the surface—don't plough the ground.
- A trail that has been scratched too deep will spook the rabbits because they will not have full sight of their predators.
- Where vegetation is thick, or it is difficult to find the main feeding areas, lay bait trails in a grid pattern across the site.

As a general rule, avoid crossing the bait trail—it can cause confusion when you try to follow the same trail on subsequent occasions.



Method for laying a bait trail (illustration courtesy Animal Control Technologies)

Bait trials will be most effective if you follow these guidelines:

- Use good quality, non-contaminated bait material. (Simple rule: if you wouldn't eat it, the rabbit won't either.)
- Use enough feed to bait all the rabbits in the area. (The pre-feed will give an indication of the potential bait take.)
- Expect a greater uptake of pre-feed and bait material when vegetation is scarce, dried off or soured.
- Ensure that all the preparation equipment is clean and free of any chemical residues or smells—rabbits can be very shy of unusual odours.
- When there are kittens in a warren, lay the bait trail close to the warrens.

Fumigation

Fumigation is labour intensive and time consuming, and is not usually an effective method if used alone. However, as a 'mop-up' technique or control method for use in areas where ripping is not practical (e.g. steep and rocky terrain), it may be a good alternative.

Because this technique relies on directly affecting the rabbits, and does not affect the structure of the warren, it is crucial that as many rabbits as possible are underground when fumigation is carried out. Rabbits usually take refuge in their burrows from mid-morning to mid-afternoon and during hot weather so these are the best times to fumigate. Dogs can also be used to drive rabbits into their warrens.

For best results, fumigation should be carried out in two stages—initially, before the breeding season starts (as this reduces the breeding stock), and then again during the breeding season.

There are two types of warren fumigation—static and pressure. In Queensland, static fumigants are a more popular and safer option for controlling rabbits and will be explained below.

Static fumigation

This method is easy to use, and time- and cost-effective. Static fumigation comes in the form of aluminium phosphide (phosphine) tablets, which can be purchased from most agricultural suppliers. These tablets are small and round (about the size of a marble), and weigh 3 g. Trade names for phosphine include Pestex®, Quickphos® and Gastion®. General directions for the use of phosphine tablets appear below, but always refer to the manufacturer's specific recommendations for use.

To fumigate warrens using phosphine tablets:

1. Find all warren entrances—both active and inactive.
2. Cut back the warren entrance at right angles using a shovel.
3. Separately wrap two tablets in moistened absorbent paper (toilet paper/paper towels).
4. Insert the tablets as far down into the entrance as possible. (Polypipe and a push rod can be used to help push the tablets down.)
5. Push some scrunched-up newspaper down the hole to block the entrance and then cover it up with soil and, if possible, a rock.
6. Treat all entrances to the warren (active and inactive) the same way.
7. Check warrens about a week after fumigation and re-fumigate any reopened entrances.

Once in the warren, the moistened tablets react with air to release a toxic gas, which spreads quickly throughout the warren. The phosphine gas itself is invisible and odourless but leakages from the warren can be detected by the smell of ammonia. (This is a safety mechanism that is built into the tablet.) Any leakages need to be blocked immediately.

Biological controls

Rabbit hemorrhagic disease virus (also known as rabbit calicivirus disease)

RHDV is a virus specific to rabbits which works by infecting the lining of the throat, lungs, gut and liver.

RHDV relies primarily on direct rabbit-to-rabbit contact in order to spread. High rabbit numbers are therefore needed before this control method will be effective.

After RHDV has infected an area, it is important to use another method for follow-up control to increase the likelihood that the population is eradicated before it is able to develop resistance and increase its numbers again.

Resistance to RHDV depends primarily on the age of the rabbit. Therefore, it is better for RHDV to go through a rabbit population after rabbits have bred and the young are old enough to be affected by the virus. Rabbits that survive RHDV develop antibodies against the virus. Breeding females can also pass these antibodies on to the young (through antibodies in their milk), conferring temporary protection on rabbits up to 12 weeks old.

Myxomatosis

Myxomatosis is no longer produced as a laboratory strain but field strains are still known to recur and affect rabbit populations.

Trapping

Trapping is an extremely labour-intensive control method and requires a skilled operator to set the traps to successfully capture rabbits.

If you do plan to trap rabbits on your property, common sense and respect for animal welfare are essential. While there are currently no strict guidelines for the use of traps in Queensland, it is an area of growing concern for animal welfare advocates.

Cage trap

A cage trap has a lever that closes the cage when a rabbit steps on it. The rabbits are lured into the cage with bait—usually diced carrot. Traps need to be disabled and left open for two or three nights with bait leading into the cage. This entices rabbits to enter. A trap can be set once a rabbit has consumed a trail of bait all the way into that trap. Traps should be checked and emptied regularly—usually a couple of times a night.

This effective and humane technique is most useful for removing any remaining rabbits from places like hay sheds and after the shed has been fenced to prevent additional rabbits from entering and leaving. Free-feed then trap, and keep the shed rabbit-proof to prevent rabbits recolonising.

Barrel trap

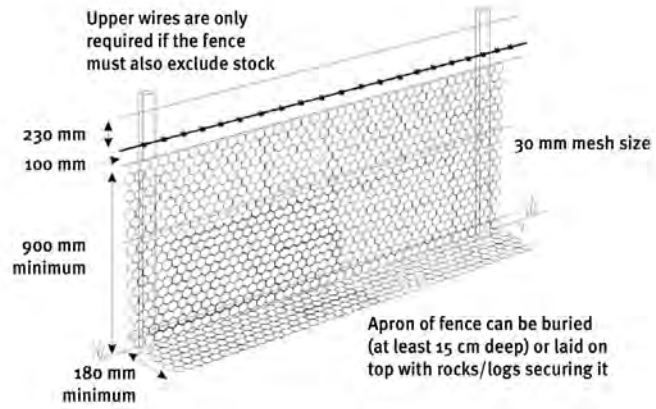
A barrel trap is designed specifically for rabbits. It is cylindrical, made of light mesh, and is about 1 m long and 15 cm in diameter. The trap has one open end with two hinged trap doors along its side. The open end is placed in the burrow, and the hinged gates close and trap the rabbit after it enters from the burrow.

The trap can be left in the burrow entrance for a number of days. However, it must be checked at least daily so that if a rabbit has been caught it does not suffer and animal welfare responsibilities are met.

Barrel rabbit trap in hole

Exclusion fencing

Rabbit exclusion fences are built with the aim of keeping rabbits out of a particular area. It is appropriate for small, high-value areas that require protection. A fully fenced area will only remain rabbit-free in the long term if all rabbits are removed from the enclosed area after fencing and the fence is regularly maintained and checked for holes.



Exclusion fence for rabbits (illustration courtesy DEWHA)

A rabbit-proof fence should be made of wire mesh netting (40 mm or smaller) and needs to be at least 900 mm high. The netting should also be buried to depth of at least 150 mm. Gates into the fenced area need to be rabbit-proof as well.

Electric fencing is a cheaper alternative, but it is not a complete physical barrier and is also prone to damage from other pest animals and stock.

Shooting

Shooting is most useful when used to 'mop up' after other control methods (such as ripping). To get the best results, shoot at the time of day when rabbits are active. This is usually in the early morning, late afternoon or at night. The best and most economical firearm to use is a .22 calibre rifle.

If your property is within an urban area, you will need to comply with local government regulations and the *Police Powers and Responsibilities Act 2000*, which restrict the use of firearms.

Further information

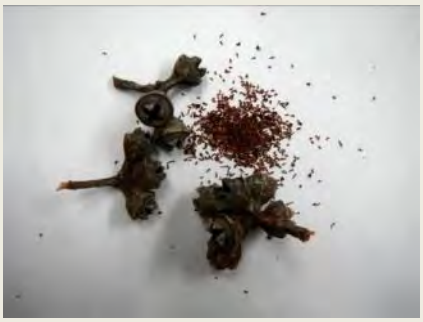
For further detailed reading information on specific rabbit control techniques or costing your rabbit control please refer to Rabbit control in Queensland; a guide for land managers. Download from the Biosecurity Queensland website at www.biosecurity.qld.gov.au

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

This fact sheet is developed with funding support from the Land Protection Fund.

Appendix K

Rehabilitation Plan



Rehabilitation Plan & Guidelines

Mount Emerald Wind Farm

Report prepared for RPS Australia Asia Pacific (Cairns) for MEWFPL
Reference: SG1612

December 2016

Rehabilitation Plan & Guidelines

Mount Emerald Wind Farm

Simon Gleed

12th December 2016

Report prepared for RPS Australia Asia Pacific (Cairns) on behalf of MEWFPL

Disclaimer

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Simon Gleed undertook the fieldwork and preparation of this document in accordance with specific instructions from RPS Australia Asia Pacific (Cairns), to whom this document is addressed. This report has been prepared using information and data supplied by RPS Australia Asia Pacific (Cairns) and other information sourced by the author.

The conclusions and recommendations contained in this document reflect the professional opinion of the author based on the data and information supplied and available at the time of the work. The author has used reasonable care and professional judgment in the interpretation and analysis of the data. The conclusions and recommendations must be considered within the agreed scope of work, and the methodology used to perform the work, both of which are outlined in this report.

Document Status

Document Status	Author	Reviewer	Date of Issue
Draft Report	S. Gleed	M. Jess (RPS)	4thOctober 2016
Final Report	S. Gleed	M. Jess, T. Johannesen	12th December 2016

Distribution

Company	Copies	Contact Name
RPS	1 (electronic: PDF)	Via email to M. Jess
Simon Gleed	1 (electronic)	S. Gleed

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1.0 INTRODUCTION

1.1 Overview

The Mount Emerald Wind Farm site provides important habitat and refuge areas for threatened plants and animals. A majority of the project site is in an undisturbed condition and holds high levels of ecological integrity. The project area is covered by remnant vegetation, with the most conspicuous disturbances to land being a result of the 275 kV powerline infrastructure and its associated access tracks, and the unsealed Kippen Road at the northern end and base of the wind farm site.

Construction of the Mount Emerald Wind Farm will result in a range of new impacts being introduced to the site. A prominent impact will be the creation of the road and cabling network, plus the wind turbine generator (WTG) construction pads. Roads and access tracks are proposed to be cleared to a width of 10 m at the construction stage. Wider clearing will be required in some situations to allow for adequate manoeuvring space for large machinery and trucks.

Following initial clearing and use of the roads and access tracks for construction, it is envisaged that the linear clearing features will be allowed to naturally regenerate to a narrower width of approximately 4-5 m, or the narrowest width to practicably allow for access and maintenance of the wind farm infrastructure.

The Mount Emerald Wind Farm site is unique in many respects because of its high altitude position in the landscape and the special flora and vegetation values the dissected ridge country holds south of the 275 kV powerline. Given this special setting and the potential for slow plant establishment in rehabilitated areas, a series of rehabilitation trials are proposed to be established within the wind farm site.

Natural regeneration of native plants (plant succession) is one aspect of rehabilitating disturbed land. Because of the special characteristics and landscape context of the wind farm site, natural regeneration could be slow to establish or may not be successful in some instances. Intervention by way of introducing appropriately selected native plants through the application of seed is another method that could improve rehabilitation results and speed up the time in which plants establish on formerly cleared land.

This rehabilitation plan provides strategies and guidelines for mitigating clearing impacts to vegetation. The plan details areas of the wind farm site which require specific treatments and plant selection. Information is provided on the collection and management of native plant seeds, which will be required progressively throughout construction, operation and at the decommissioning stages.

1.2 Project Description

Mount Emerald Wind Farm Pty Ltd (MEWFPL) proposes to construct and operate a wind farm located approximately 20 km SSW of Mareeba on the Atherton Tablelands in north Queensland at the northern extent of the Herberton Range mountainous area.

The nature of the project requires wind energy to be harnessed efficiently and effectively therefore the Wind Turbine Generators (WTG's) are located on high points through the project site. The northern half of the site has broad, rolling hills, with dissected areas found in ravines and gorges; whereas the land to the south of the existing 275 kV powerline is markedly rugged and steeply dissected, rendering the highest points a series of narrow ridges and rocky knolls with steep drop-offs on adjacent slope faces.

The primary access from Springmount Road to the wind farm will be along Kippen Drive at the base of the site. From the end of the flat section of Kippen Drive, the access will ascend the hills into the wind farm site at higher elevation.

The wind farm will consist of up to a maximum of 53 WTG's, which will be approximately 80 m high and with 55 m diameter rotor blades. The wind farm will provide energy to feed into the main electricity grid infrastructure currently provided by the 275 kV Chalumbin to Woree powerline.

WTG's will be connected to each other by a network of tracks, some of which will accommodate underground cabling. Other infrastructure and facilities to be constructed within the wind farm project site include a contractors site compound, a lay-down area, a substation, and an associated substation operation and management building. The location of the works and layout of the wind farm infrastructure are shown in **Figure 1**.

The primary components, infrastructure and areas of the wind farm which will require varying levels of rehabilitation at the construction, operation and decommissioning stages include:

- WTG foundations and surrounding machinery manoeuvring space;
- Wind monitoring towers;
- Access roads (including Kippen Drive management area), interconnecting tracks and underground cabling network;
- Hard stands and lay down areas;
- Substation;
- Site compounds and O & M building;
- Storage areas, machinery yards and car parking areas;
- Watercourse crossings and remedial rehabilitation sites around existing 275 kV infrastructure.

1.3 Purpose and Objectives of the Rehabilitation Plan

This Rehabilitation Plan describes the strategies and actions that apply to mitigating the impacts of vegetation clearing and disturbance in the Mount Emerald Wind Farm project site. The purpose of this Rehabilitation Plan is to provide guidance on appropriate measures to reinstate vegetation and native plant cover on cleared and disturbed land by achieving the following objectives:

- Adopt a philosophy of continuous improvement for rehabilitation and habitat enhancement.
- Identify areas for rehabilitation and assign priorities for treatment.
- Rehabilitate areas progressively
- Collect, acquire, manage and store adequate quantities and appropriate species of native plant seed throughout the construction, operation and decommissioning stages of the wind farm.
- Apply the most appropriate techniques and practices for rehabilitation on a site-specific basis.
- Translocate and manage threatened plants, grass trees and cycads where feasible.
- Establish trial rehabilitation plots in areas which are accessible and able to be monitored.

- Continuously maintain rehabilitation areas to a standardwhich excludes significant weed incursions and promotes healthy growth and development of native vegetation.
- Monitor rehabilitation areas and maintain records and data which will be used to inform improved rehabilitation practices.
- Compile timely reporting which identifies successful and unsuccessful rehabilitation.
- Respond quickly and take actions to remediate unsuccessful rehabilitation areas, serious weed incursions and incidences of plant mortality or patchy vegetation establishment.
- Review the Rehabilitation Plan on an annual basis and make document and treatment amendments as required and approved.

1.4 Duration of Rehabilitation Plan

This Rehabilitation Plan is effective for the construction, operation and decommissioning stages of the Mount Emerald Wind Farm.

A major review of the plan is to be undertaken every five (5) years. Intermediate reviews of the plan are to be made annually or at any time when an amendment is deemed necessary to take into account unforeseen or unplanned circumstances or significant changes.

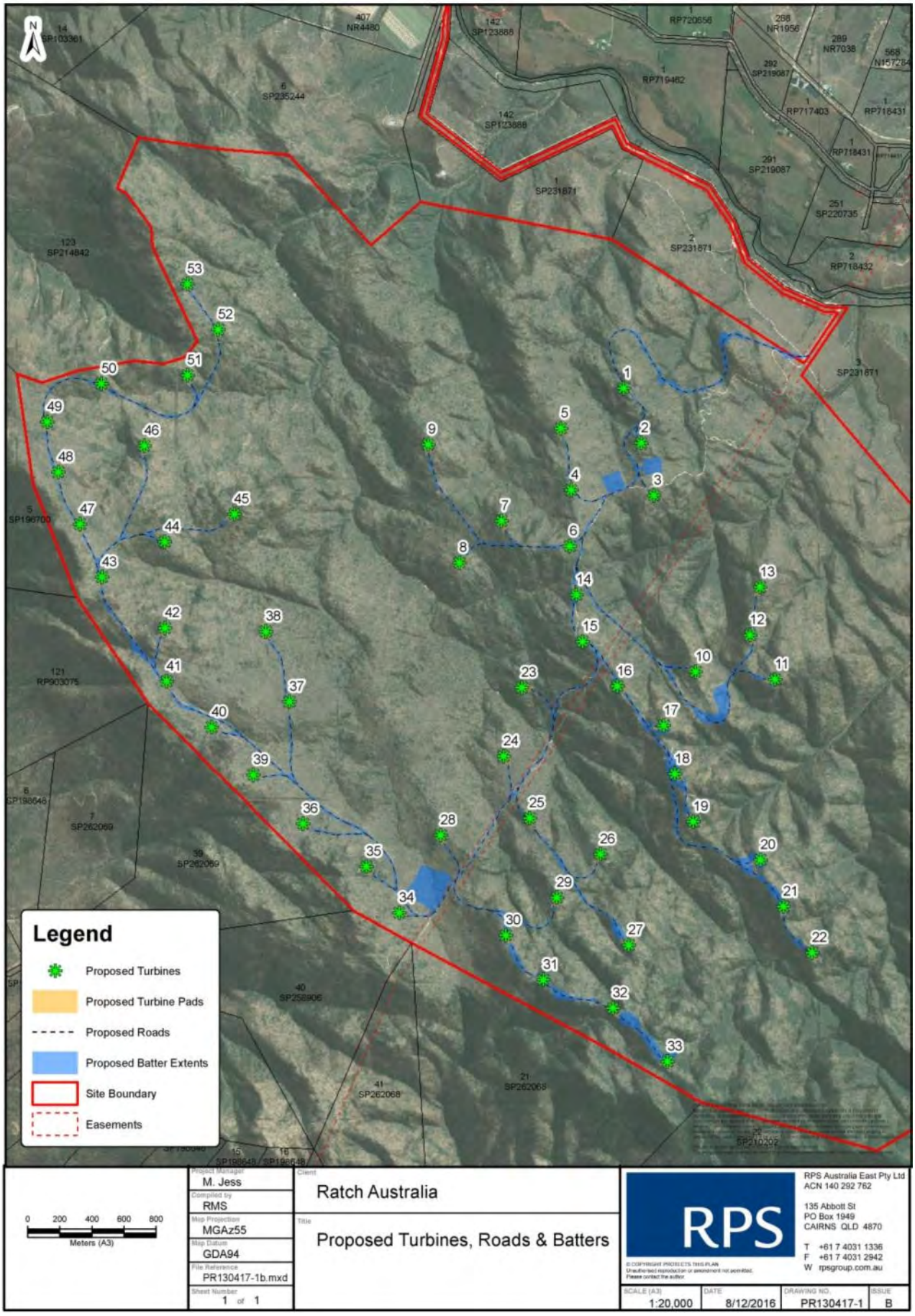


Figure 1. Layout of the Mount Emerald Wind Farm

2.0 EXISTING ENVIRONMENT

The Mount Emerald Wind Farm site is located at the northern limit of the Herberton Range and immediately north of Mount Emerald. The landscape is characterised by steeply dissected hills, rocky terrain and areas of precipitous ravines and narrow ridges. The broad geology of the site is mapped as the Walsh Bluff Volcanics, which comprises fine-grained rhyolite.

2.1 Vegetation

The predominant vegetation cover over the project site is a mosaic of sclerophyll woodlands, shrublands and heathlands.

Common trees of the woodlands include Lemon-scented Gum (*Corymbia citriodora*), Yellow Stringybark (*Eucalyptus mediocris*), Range Bloodwood (*C. abergiana*), Ironbark (*E. drepanophylla*), Dead Finish (*E. cloeziana*), Cypress Pine (*Callitris intratropica*), Silver-leaf Ironbark (*E. shirleyi*), Orange Jacket (*C. leichhardtii*), White Stringybark (*E. reducta*), and *E. lockyeri*. The dominant grasses are usually Kangaroo Grass (*Themeda triandra*) and *Arundinellasetosa*, with *Cleistochloa subjuncea* on very rocky soils at higher elevation on ridges and amongst rocky outcrops. Woodlands are most frequent over broad slopes, flats and rolling hills with less dissected surfaces. Low, sparse woodlands and shrublands develop on ridges and in exposed conditions.

Low woodlands and shrublands are characterised by many species, but typically include Sheoak (*Allocasuarina littoralis*), Grass Trees (*Xanthorrhoea johnsonii*), *Eucalyptus lockyeri*, Wattle (*Acacia aulacocarpa*), *Homoranthus porteri*, *Grevillea glossadenia*, and stunted forms of Range Bloodwood (*Corymbia abergiana*). Shrublands are generally found in relation to the ridge environment where thin rocky soils prevail. The endangered shrub *Melaleuca uxorum,* is found on the boundary of this vegetation type with slightly taller woodlands, but is also found in association with the montane heathland and rock pavements described below.

Heathlands have a special and diverse group of plants which include species such as Broom Bush (*Jacksonia thesioides*), Grass Tree (*Xanthorrhoea johnsonii*), *Gompholobium nitidum*, wattles *Acacia calyculata* and *A. whitei*, grasses *Cleistochloa subjuncea*, Kangaroo Grass (*Themeda triandra*) and *Cymbopogon bombycinus*. Taller woody plants in this community include emergent stunted forms of *Eucalyptus lockyeri* and *E. mediocris*, shrubs such as *Grevillea glossadenia* and *Homoranthus porteri*; and compact shrublets such as *Cryptandra debilis*, *Mirbelia speciosa* subsp. *ringrosei*, *Pseudanthus ligulatus*, *Zieria whitei*, *Boronia occidentalis* and others. The critically endangered *Acacia purpureopetala* and *Prostanthera clotteniana* grow in this vegetation type. It is referred to as montane heathland, because of its structure and reliance on high elevation aspects and very thin soils.

A feature of the montane heathland and shrublands at high elevation is the presence of rock pavements and areas of poorly vegetated rock outcrops. This particular habitat supports few large plant species because of the near-absence of soil or growth medium on their surfaces. The soil that does develop is trapped in rock hollows, scoops and crevices between rock plates and boulders, and is developed from small plants such as lichens, mosses and the remains of rock ferns. This plant matter integrates with weathered rock material to form a soil that has the texture of peat, where in wetter times the absorbent nature of the medium is able to store water for longer periods. Plants on rock pavements include the Resurrection Plant (*Borya septentrionalis*), *Pseudanthus ligulatus*, scattered shrubs of *Grevillea glossadenia*, *Plectranthus* species (including the threatened *P. amoenus*) and occasionally, sentinel specimens of Cypress Pine (*Callitris intratropica*). Grasses are sparsely represented and can include Five Minute Grass (*Tripogon*

loliiformis), *Cymbopogon bombycinus* and *Eriachne humilis*. *Eriachne mucronata* is often found around the edges of rock pavements,with some pavements entirely covered by Firegrass (*Schizachyrium pachyarthron*).

Woodlands in the centre of the site grow on relatively flat land where soil has a high clay content and in places, is slowly drained. These flat areas are often interspersed with sections of rock plates or pavements, and occasionally rocky outcrops with low relief. Typical trees of these woodlands include *Corymbia leichhardtii*, *Eucalyptus lockyeri* and *Callitris intratropica*. As the land ascends into gently rolling hills, trees such as *C. citriodora* (Lemon-scented Gum) and *E. cloeziana* (Dead Finish) become more frequent. The ground layer of these woodlands is dominated by Kangaroo Grass (*Themeda triandra*) and in some areas near watercourses, by *Pseudopogoantherum contortum*. The Grass Tree *Xanthorrhoea johnsonii* is usually well-represented and occasionally forms a secondary shrub layer. As the ground becomes drier in northern aspects of the site, Ironbark trees (*Eucalyptus drepanophylla*) become more common.

Degraded non-remnantvegetation is associated with the lowest hill sections of the wind farm site and adjacent to both sides of Kippen Drive. Scattered trees of Molloy Box (*Eucalyptus leptophleba*) and Poplar Gum (*E. platyphylla*) overtop a weedy and degraded shrub and ground layer. Native grasses such as *Heteropogon contortus* (Black Speargrass) are common, but most grasses are weeds - the most characteristic being the priority weed Grader Grass (*Themeda quadrivalvis*).

2.2 Significance of the Ridge Environment and Key Plant Habitats

The high altitude ridges in the wet tropics bioregion section of the site south of the 275 kV powerline are sensitive environments and serve as important habitats for plants and the poorly represented montane heathlandand shrubland mosaic found mostly around 900 m ASL. Here the cloud base is a determinant of the moisture regime in relation to plants and their exposure to extreme conditions.

The land south of the 275 kV powerline holds the highest levels of species diversity and endemism, where many species are restricted to and have adapted to the harsh environment of exposed high elevation points on ridges, rock pavements and areas of skeletal soil. This montane habitat supports six species of plants which are listed as critically endangered, endangered and vulnerable under Queensland and Commonwealth legislation. Many other species, not listed under legislation, are restricted to the montane heathland along and on the edges of narrow ridges and rock pavement areas.

The rugged nature of the land with steep rocky slopes, bare rock pavements, outcrops and cliffs provides a unique environment for plants, and it is these characteristics which act as a refuge and reduces the effects of the severity and intensity of bush fires due to the low levels of flammable material such as grasses. Consequently, the conservation significant plants are found almost exclusively in fireproof habitats and niches. The protection from fire is a critical attribute, which renders most of the ridge tops and rock pavements as significant habitats where many threatened plants are able to persist.

3.0 REHABILITATION PRINCIPLES AND PURPOSE

3.1 Continuous Improvement and Habitat Enhancement

The unique landscape setting and environmental values of the Mount Emerald Wind Farm site warrant a specific and targeted approach to landscape rehabilitation. Some sections of the wind farm site will pose challenges in terms of the approaches to rehabilitation and the success rates and timeframes in which vegetation cover becomes established or colonises a site through natural regeneration.

Because of these challenges, generic approaches to rehabilitation and revegetation; for example, widespread use of improved pasture grasses and legumes is not recommended.

The very high levels of natural integrity within the project site will necessitate a strategic approach to species selection and site treatments.

Extremes of climate will be a determinant of the success of rehabilitation. Long periods of dry weather and wind-shearing could slow growth of direct-seeded plots, or even prevent seeds from germinating. Rehabilitation success rates are likely to fluctuate.

3.2 Minimise Disturbance

Minimising the area of disturbance during the construction stage, throughout operation and at the decommissioning stage will require less area of land to be rehabilitated. This will result in more manageable rehabilitation areas, higher success rates and decreased time until the vegetation has established over the disturbed land.

Deep excavation will entirely remove the soil seed bank and render the re-application of topsoil less effective. Weeds will have a far greater chance of invading a significantly excavated site than one which has been selectively and carefully worked by machinery. Wherever feasible, limit the depth and extent of soil excavation to the absolute minimum.

3.3 Purpose of Rehabilitation

Landscape rehabilitation aims at restoring native vegetation cover over sections of land that have been disturbed during the construction, operational and decommissioning stages of the wind farm. The main objectives of rehabilitation are to stabilise the disturbed ground surface by establishing plant cover; and to restore a vegetation community that is ecologically functional and self-sustaining.

Ultimately, and over a period of time which may take over five years to establish, the restored vegetation is to be of a similar floristic composition and structure as the adjacent remnant community on a similar landform. The restored vegetation is to be free of weeds and alien plants, and able to persist in the landscape without intervention or assistance.

4.0 REHABILITATION GUIDELINES

The following notes are not intended to be prescriptive, and are to be used as guidelines to the main practices involved in site rehabilitation. All rehabilitation practices are to be specific to individual rehabilitation areas in the Mount Emerald Wind Farm site.

4.1 Seed Collection and Management

Prior to construction and progressively throughout the operational and decommissioning stages of the wind farm project, a native seed collection and management program is to be implemented. The following will need to be considered:

1. Seed will need to be collected from close-by (local provenance) and from vegetation types represented on the wind farm site. Seed should be continuously collected from within the wind farm and adjacent areas over time. Sources from the adjacent mountain ranges can also be considered if the source vegetation types match those found in the wind farm site. For example, the proposed offset site would be a suitable and supplementary location to collect native plant seed subject to appropriate botanical advice.
2. The need for forward planning of seed requirements is crucial. Some species only set seed once a year or less frequently.
3. Seed collection should be progressive and ongoing. Large quantities are likely to be required.
4. Under typical seed collecting circumstances, the whole fruit is taken from the plant and the seed is separated from the capsule of fruit. Seed should be cleaned (separated from capsules and chaff).
5. All seed collections must be labelled with the species name (scientific), date of collection, location (including GPS coordinates), name of collector and additional notes if considered useful. It can be helpful to retain two or three seed pods or capsules with the seed to aid identification if the identity of the species is uncertain.
6. Seed should only be collected from healthy plants growing in healthy vegetation. Avoid collecting seed from weak looking shrubs and trees, diseased plants and plants growing amongst serious weed infestations. Collect from a range of the same species to maximise genetic diversity.
7. Collect seeds from many species and do not rely on a few abundant seeding plants. For example, *Acacia simsii* (Sim's Wattle) supplies good, easy to collect seed crops, which should be collected when opportunities arise. But other species are equally as important to collect to maintain diversity within the seed stock, so different species can be used for different rehabilitation situations.
8. Take photos of fruits and seeds of different species - this can be helpful for identification and training. Keep field notes about flowering and fruiting times, big seed crops or poor crops.
9. Do not collect seed from vines unless absolutely sure the species is native. There are very few vines which grow on the Mount Emerald Wind Farm site, with identified species *Pandorea linearis* and *Clematocissus opaca* (mostly south of the 275 kV powerline) and *Psydrax attenuata*, *Cassytha filiformis* and a *Parsonsia* sp. (found in woodlands over the site). Some exotic vines and creeping pasture legumes are serious environmental weeds, and occur along Kippen Drive. DO NOT collect from this area unless absolutely certain the species is native, in which case, the seed should be restricted in use to Kippen Drive.
10. Do not collect seed from pasture, agricultural lands or gardens.

11. Seek expert botanical advice if uncertain of a species' status as native or weed.
12. Collect seed from unusual species such as those found along the ridges south of the 275 kV powerline. A number of these plants are particular to the montane heathland and will be required for rehabilitation around WTG in the high elevation zone.
13. Process collected seed as soon as possible. Prior to storage, the seed should be naturally air dried (i.e. do not store wet seed after rain). The seed should remain untreated.
14. Seed should be stored in zip-lock bags or air-tight plastic containers in a freezer. Label all seed collections and containers.
15. Develop a Seed Collection and Management database and maintain up-to-date records (Refer to later notes). An example of the data fields are: unique consecutive batch number (for future reference), species name, common name, growth form, location (descriptive), location (coordinates), date of collection, name of collector, quantity collected (weight), threatened status (if any), appropriate rehabilitation sites within wind farm to use, notes regarding pre-treatment (if any), notes on viability (ease of germination in nursery environment, response to direct-seeding, and issues with problematic germination - low viability, recalcitrant), and other notes as deemed useful and informative to furthering the knowledge of the species.

4.2 Species Selection

All plants species to be used in rehabilitation of the Mount Emerald Wind Farm are to be native to Australia and selected from the range of naturally occurring species from similar vegetation types found in the vicinity of the Mount Emerald Wind Farm site. Seed and plant supplies are to be sourced from a local provenance.

Introduced pasture grasses, legumes and shrubs are not permitted to be used for rehabilitation within the wind farm site. Most of these species become problematic, weedy, displace native vegetation, and are difficult to eradicate. A schedule of appropriate plant species is given later in this rehabilitation plan.

It is the responsibility of the proponent of the Mount Emerald Wind Farm to ensure adequate supplies of seed of the appropriate species and provenance are available for rehabilitation. This will require a strategic and long-term commitment to seed collection and management.

4.3 Seed Provenance (Origin)

Exotic or introduced plant species (not native to Australia) are NOT to be used in rehabilitation work above Kippen Drive. Non-native pasture legumes, grasses or improved pasture species are prohibited. Introduction of these species in seed mixes will be recorded as a non-compliance with the Environmental Code of Practice of the Mount Emerald Wind Farm.

Landscaping - internal compounds: the use of cultivated varieties of common horticultural plants of domestic commerce are not to be used in "landscaping" works around building and compound infrastructure. Landscape architects must refer to the consulting botanist for species recommendations in these situations.

Within the wind farm operational area above Kippen Drive, all seeds or plant products for rehabilitation are to be native and sourced from the region bounded by the high elevation country to the west of Oaky Valley extending into Toys Creek and the northern hills around Baal Gammon, the northern slopes of Mount

Emerald, and from within the wind farm itself. Additional locations can be considered and must be approved by the consulting botanist or Environmental Officer.

4.4 Seed Field Collection

It is recommended to collect seed for a species from at least 20 different parent plants to maintain genetic quality and ensure higher rates of seed in good physical condition (i.e. are insect and disease free, and have high levels of viability). For rare species, where less than 20 plants may be found, seed collection should be minimal. Aim at harvesting about 30 percent of the seed from each plant. If the plant is extremely rare, do not take the seed.

Seed collecting in the wild involves taking (removing) the fruit (capsules or pods, etc.) from a living plant, as the fruits contain the seeds. Harvesting should only be undertaken when the seed viability of a bulk of the collection is likely to be at its highest. One way of determining when the right time to harvest is by looking at a range of capsules (e.g. *Eucalyptus*), pods (e.g. *Acacia* and legumes) or follicles (e.g. *Grevillea*, *Hakea*) on the plant and seeing whether some of these fruits have started to split open. These types of fruit split open at maturity along fine lines called sutures, at which time the seed is released from the opening. If seed is being released, then it is a preferable time to collect.

The colour of the fruit is another indicator of maturity. Generally, immature fruits are green and may be fleshy and soft. Mature or maturing fruit turns brown and slightly woody in many sclerophyll plants.

For small collections of special or rare plants, appropriately mature fruits can be hand-picked from the plant and stored in the field in paper bags. Avoid storing harvested fruits of sclerophyll plants in plastic bags or containers (except for final storage in a freezer) as these promote condensation moisture to develop, which can cause moulds or other diseases to contaminate the seed.

For large, bulk collections of fruits (*Eucalyptus* and *Corymbia* and some *Acacia*), fruiting branches are pruned from the tree or shrub and stored in the field in either large, breathable finely woven cloth bags, or placed on a tarpaulin and the edges pulled up around the fruit collection.

It is important when using pruning equipment (secateurs, parrot beak pruners, pruning saws) to ensure that the equipment is disinfected to prevent the introduction or spread of plant pathogens. Equipment should be dipped and thoroughly cleaned in methylated spirits prior to use, and between working in different areas.

4.5 Seed Drying

After collection in the field, the fruits should be allowed to dry naturally in a freely ventilated, covered but well-lit area. As much of the bulk vegetative material such as leaves and branches should be pruned from the fruits and discarded. Fruits can be transferred to shallow flat-bottomed plastic drying trays/boxes lined with dry newspaper. The newspaper helps wick moisture away and facilitates the seed cleaning process. ALL seed collections must be labelled and dated.

Collections of fruits in tarpaulins should be transferred to the same drying area and similarly have the extraneous leaf and branch matter removed and discarded. The fruits can remain on the tarpaulin, with the edges raised to prevent seed loss.

Fruits stored at the drying stage as described above are left to gradually dry, split open (dehisce) and release the seed. Periodic gentle shaking and agitation of the container helps release seeds from the fruit.

When the majority of the fruits have dehisced, they can be sieved using a fine gauze, and the empty fruit capsules or pods progressively discarded.

The time required for the fruits to release the seeds depends on a number of factors, such as the size of the fruit, the species, and the prevailing drying conditions of air-flow, temperature and humidity. Fruits collected at an immature stage may not dehisce, or if they do, may release sterile seeds.

Beware of vermin during this stage and protect seed collections from mice as well as insects (borers) as deemed fit.

4.6 Seed Storage

Store dried seeds in zip-lock bags, each labelled with the minimum of species name, date collected and location of collection. Enter label details into database or spreadsheet (see later notes).

Seeds can be stored in a chest freezer. Temperatures around -18° C will kill insect larval stages if seed is stored for a minimum of 48 hours. Seed can remain stored in a freezer and will probably retain viability longer (several years for *Acacia* and *Eucalyptus* species).

4.7 Seed Viability

Healthy seed should only be collected and stored, as they have higher viability and the capacity to germinate (germinability).

Seed that is dried up and shrivelled and contains insects (borer holes) is unlikely to germinate. Seeds which are not fully developed in the capsule or pod are also unlikely to germinate. For example, if the seed of wattles (*Acacia* species) are green, it is a good indication the fruit is not fully mature - wattle seeds are mostly black or brown and have hard seed coats.

The seed of some groups of plants such as *Grevillea* have papery or thin seed coats, which can usually be easily broken or cut in half. The inside of a seed (endosperm) with good viability is generally white and firm. Spongy, soft or hollow seeds with brown or black endosperm may be of poor quality or insect damaged and are unlikely to germinate.

Floating seeds in a small container of water is an easy and effective way of determining viability. Healthy seeds will sink, and poor quality seeds will float. This test is best for heavier seeds such as wattles and a few Eucalypts such as Lemon-scented Gum (*Corymbia citriodora*). However, very fine seed of species such as Yellow Stringybark (*Eucalyptus mediocris*), or papery seed (e.g. *Grevillea glauca*), may float and give a false result.

Some species of grass need to be stored for a number of months to break their dormancy; however some species also lose their viability if stored for more than 12 months. Therefore, it may be beneficial to sow grass seed after approximately 8 months of storage. Kangaroo Grass (*Themeda triandra*) is thought to require 12 months of storage to overcome seed dormancy.

4.8 Records for Seed Collection and Storage

A records management system (spreadsheet or database) for seed collection should be designed and regularly maintained and updated with descriptive and quantitative data.

Table 1 outlines the important records and information required to be kept for seed collections and storage.

Table 1. Records data for seed collection and storage.

Category (field name)	Description	Example data entry
Collection identification number	Unique and consecutive running number that identifies each batch of seeds.	0001, 0002, 0003, etc.
Plant species	The scientific name of the plant species.	*Acacia purpureopetala*
Collection date	The date the seed was collected.	21 July 2016
Date of storage	The date the seeds were cleaned and then stored.	22 July 2016
Treatment before storage	Describe treatment (if any) before storage.	Removed from pods.
Storage method	How the seed was stored.	Freezer, in zip -lock bag.
Collector	Name of the person who collected the seed.	Patti Smith
Species description	Short description of species.	Prostrate shrub 25 cm tall.
Species unknown	If species is not known, record as "No" and keep seed pod or capsule and branch specimen for future reference. Forward specimen to botanist for confirmation. Photograph specimen in wild.	Yes
Plants sampled	Approximate number of plants from which the seed was collected.	4
Number collected	Approximate number of seeds collected by weight for bulk collection or number if infrequent species.	40 seeds
Population origin	Are seeds collected from naturally occurring populations or from plantation/nursery crops within wind farm site.	Natural
Site name	A name that allows others to find site.	Between WTG 30 and 31
Coordinate datum	Coordinate datum (preferred GDA94 or WGS84)	GDA94
Coordinate location	GPS coordinates (preferred UTM easting and northing format).	E 328301 N 8098861
Elevation	GPS elevation.	991 m
Natural species frequency	Whether the species is abundant, common or rare.	Very rare
Topography - landform	Description of topography and landform.	Narrow ridge in dissected hills.
Geology	Description of predominant geology.	Rhyolite
Soil	Description of soil texture and structure	Rocky lithosol
Vegetation type	Description of vegetation type and dominant species.	Montane heath on edge of low woodland with *Corymbia abergiana*, *Eucalyptus lockyeri*, *Grevillea glossadenia* and *Homoranthus porteri*.
Restriction on use	Is the species restricted for use at a particular site/area within the wind farm?	Restricted to use between WTG 30 and 31.
Notes	Presence of flowers and buds, heavy crop, unusual timing, etc.	Flowers observed, only few ripe pods.

4.9 Topsoil Management

All soils on the wind farm site are thin, low in fertility and a scarce resource.

Topsoil contains seeds (soil seed bank) of the surrounding native woodlands and vegetation communities. One of the important objectives of rehabilitation of the Mount Emerald Wind Farm site is to allow for natural regeneration to take place along track edges and around WTG footings. Re-spreading topsoil can assist and promote natural regeneration.

During construction when topsoil is being excavated and moved, it should be handled with the intention of re-spreading it as close to the original site where it was taken. This may necessitate stockpiling at relatively short intervals along tracks to avoid mixing soil types and creating stockpiles that are too large. Clearing of additional vegetation to make room for soil stockpiles is not permitted, unless specific authorisation is granted by the Environmental Officer.

Soil stockpiles should be no higher than 1.0 m and should be re-spread within the shortest possible timeframe following construction. Stockpiles older than one year are likely to have considerably lower levels of seed viability.

Excavated soil from weed contaminated sites is NOT to be re-spread. Weed contaminated soil stockpiles are to be quarantined and signage placed in clear view to alert machinery operators that the soil is not be moved or re-spread without authorisation from the Environmental Officer.

4.10 Site Preparation

By default, a majority of the rehabilitation areas will be in the form of the constructed tracks or shaped edges of WTG footings. Turn-out drains, perimeters of site compounds and lay-down areas will also be present.

The ground to be rehabilitated should not be smoothed and compacted. A roughened surface is required to accept seed and capture seed rain from neighbouring remnant vegetation. Any surface treatment with machinery should work parallel with the natural ground contours and not direct or concentrate water flow into one location so that rill and surface erosion is minimised and avoided.

Soil loss from the prepared rehabilitation site will usually result in the loss of seed, which effectively lowers the success rates and quantities of germination and plant establishment. Supplementary erosion and sediment control measures may need to be implemented in some rehabilitation areas.

Additional site preparation in the form of deep ripping is not recommended given the rocky substrate. However, where soil compaction may have occurred, surface scarification may be required. Some sites may require light surface dressing with machinery such as graders to prepare a surface more conducive to access and site treatment. In these circumstances, the lightest machinery capable to efficiently undertake the work is to be used. In most situations the rehabilitation areas will be left in the form following construction and no further disturbance is recommended.

As outlined above, re-spreading topsoil should occur as soon as possible following construction. This will increase the chances of seed germination from the soil seed bank, and helps retain any soil microbial activity that is important in developing healthy soil ecosystems. Seed with relatively short viability (e.g. annual grasses and forbs) also has an improved opportunity to germinate from soil that has been stockpiled for relatively short periods.

4.11 Rehabilitation Timing

It is difficult to prescribe an exact time when rehabilitation of a site should take place; however, a number of important factors usually dictates timing. The following should be considered:

- Do not rehabilitate in very dry times and after a very long period of no rain when the ground is completely devoid of moisture.
- Avoid rehabilitating prior to the prevailing fire season (often October to December, but use local fire information as a guide).
- Avoid re-spreading topsoil and direct-seeding prior to imminent heavy rainfall and storms.
- Direct-seed after heavy rainfall events have tapered off.
- Direct-seeding synchronised with maturing of fruit/seed of woodland trees (*Eucalyptus* and *Corymbia*) may have better results.
- Brush-matting (see later notes) when shrubs or trees are in fruit (not flowering or budding) may improve results.
- Only use tubestock planting in moist soil and where follow-up rain is expected.
- Transplant and translocate plants (cycads, grass trees) quickly when good soil moisture is available. Do not transplant during very hot and dry weather.
- Re-spread topsoil as soon as possible after initial stockpiling.

4.12 Natural Regeneration

This is the process where vegetation is allowed to colonise the edges of disturbed areas without assistance or with very limited human intervention. It can be an effective method, but the results are dependent on a number of factors such as availability of seed in the soil seed bank, plus the quantity of seed remaining/stored in the soil.

Areas which have been deeply excavated or scalped are likely to hold considerably less seed in the soil. It is important therefore to re-spread topsoil over the disturbed area within the shortest possible timeframe following initial disturbance or clearing.

Natural regeneration can be "assisted" by direct-seeding the site with a range of appropriately selected species.

Weed control should be undertaken only as a last resort, as herbicide application is likely to kill most seedlings with could be obscured by grasses. Good weed management in the first place should ensure weed control is kept to the absolute minimum. Early intervention and manual removal of serious grass weeds as they emerge can be effective.

4.13 Direct-seeding

This is the process of spreading plant seeds by broadcasting across the rehabilitation site. In a typical scenario, a number of different species are included in the seed mix. The wind farm site can be adequately direct-seeded by hand application.

When broadcasting seed in the direct-seeding, the seed should be mixed with a bulking carrier, which helps with more even and wider distribution of the seed.

A range of carriers can be considered - all should be guaranteed free from weeds and pathogens. Some carriers includegypsum which has the added benefit of being heavier and will bind to the seed and can improve soil structure by improving the texture of clay soils. The gypsum should be very lightly moistened at the time of mixing with the seed and spreading.

Some seed may need to be treated prior to application. The seed of wattles (*Acacia* spp.) requires softening or scarifying to accelerate germination. A simple method is to pour boiling water over the seed in a container and allow to cool down for four hours or overnight. Seed should then be sown as soon after treatment as possible. *Eucalyptus* seed does not require treatment.

Avoid direct-seeding prior to imminent heavy rainfall and storms, as the seed is likely to be washed from the surface.

4.14 Brush-matting

This technique involves retaining cleared vegetation (especially shrubs) and re-spreading it over the cleared site following construction. The branches or shrubs may be holding fruits, which can disperse seeds back into the site.

The method may have limited success and is reliant on seed being present of the cleared vegetation; nevertheless, the additional function this method introduces into a site is that the branches act as capture points for leaves and seed from adjacent intact vegetation. It can help build soil, reduce erosion and adds a level of naturalness back into an otherwise cleared site.

4.15 Tubestock Planting

This technique requires a comparatively higher level of preparation and maintenance than other, more passive methods of rehabilitation. It involves planting nursery grown seedlings directly into a prepared site. Generally, fertiliser is added to the plant and it is watered - at least at the planting stage.

Given the remoteness of many sections of the wind farm, tubestock plating is probably better reserved for specialist, trial plots close to infrastructure, where water is available and plants can be tended on a more frequent basis.

This method could be considered for trial plots around site compounds. It is also applicable to transplanting specimens of threatened species, grass trees and cycads - all of which will require a relatively high level of maintenance and tensing until the plants are established and able to persist in the landscape unassisted.

All tubestock should be fully sun-hardened and ideally grown from seed as opposed to cuttings or other asexual methods of propagation. However, exceptionally threatened plants such as *Prostanthera* could be trialled through cuttings, given the rarity of the species on the site.

4.16 Plant Translocation

This is a specialised technique involving removing the living plant with its roots intact from the wild and replanting it at a specifically selected recipient site. The method adopts aspects of nursery grown plants in tubestock and pots and therefore requires similar levels of maintenance and tending. The success rates of this method are unproven for many sclerophyll plants and it is generally reserved for threatened species and other plants of conservation interest (e.g. cycads, grass trees and orchids).

A dedicated Translocation Plan has been prepared for the Mount Emerald Wind Farm.

4.17 Hydro-mulching

Hydro-mulching has obvious direct benefits in terms of surface stabilisation; however, the method is prone to a number of inefficiencies and can prove to be problematic in sensitive environments. It is not recommended for use south of the 275 kV powerline because this area is the most sensitive in terms of its high-end ecological integrity and the prevalence of key habitats for threatened plants.

One of the main problems with hydro-mulching is the difficulty in guaranteeing the seed mix does not contain weed seed. Despite its widespread use on road batters in the wet tropics bioregion, virtually all applications have introduced the weedy vine Siratro (*Macroptilium atropurpureum*), which once established is impossible to eradicate.

If hydro-mulching is to be used, it is to be confined to the batter faces created on the northern slopes close to Kippen Drive, and only as a last resort. Any hydro-mulched sites will need to be closely monitored for weed emergence and excessive weed outbreaks recorded as a non-compliance.

4.18 Weed Control and Maintenance

Weeds, especially grasses, prevent or retard the growth of seedlings by out-competing native species for soil nutrients. It is critical therefore to control and manage weeds in all rehabilitation sites.

The Weed Management Plan for the Mount Emerald Wind Farm forms the base document for managing weeds at previously degraded areas as well as at rehabilitation sites. The key objective is to prevent weeds from entering and establishing in rehabilitation sites. Early intervention and control is critical.

4.19 Fire Management

Fire is to be excluded from all rehabilitation sites for a period no less than five (5) years from the time of the original rehabilitation treatment. This time period will allow regenerating vegetation to establish, and grow to a stage of being self-regenerating (flowering and fruiting) and able to contribute seed to the soil seed bank.

5.0 REHABILITATION AREAS

The Mount Emerald Wind farm site has been partitioned into 6 rehabilitation areas. The areas are based on similarities of broad landscape and vegetation characteristics such as topography, degree of surface relief and dissection, elevation, vegetation type and flora composition. These areas are shown inn **Figure 2**. The general descriptions and rehabilitation objectives for each area are given in the following section.

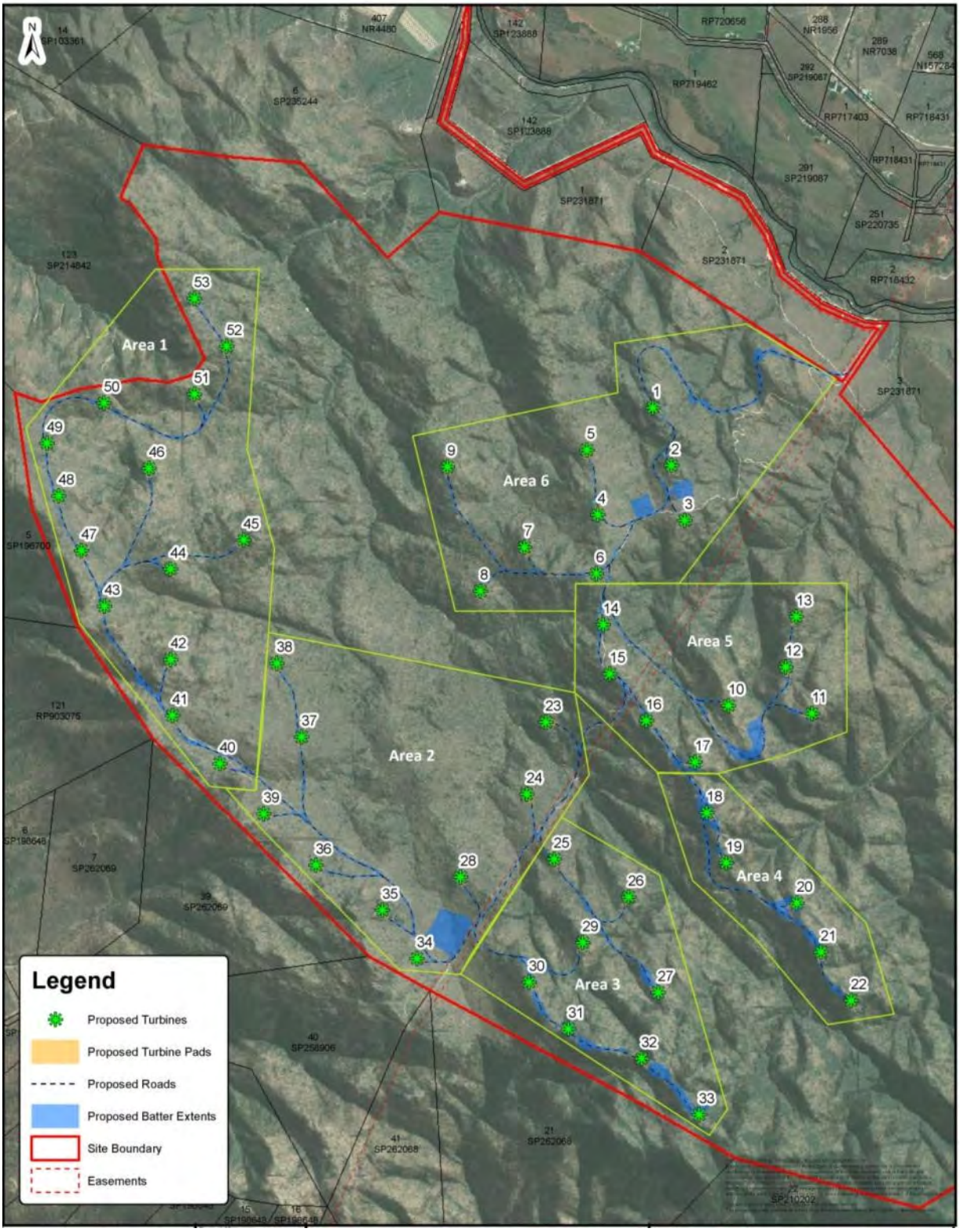
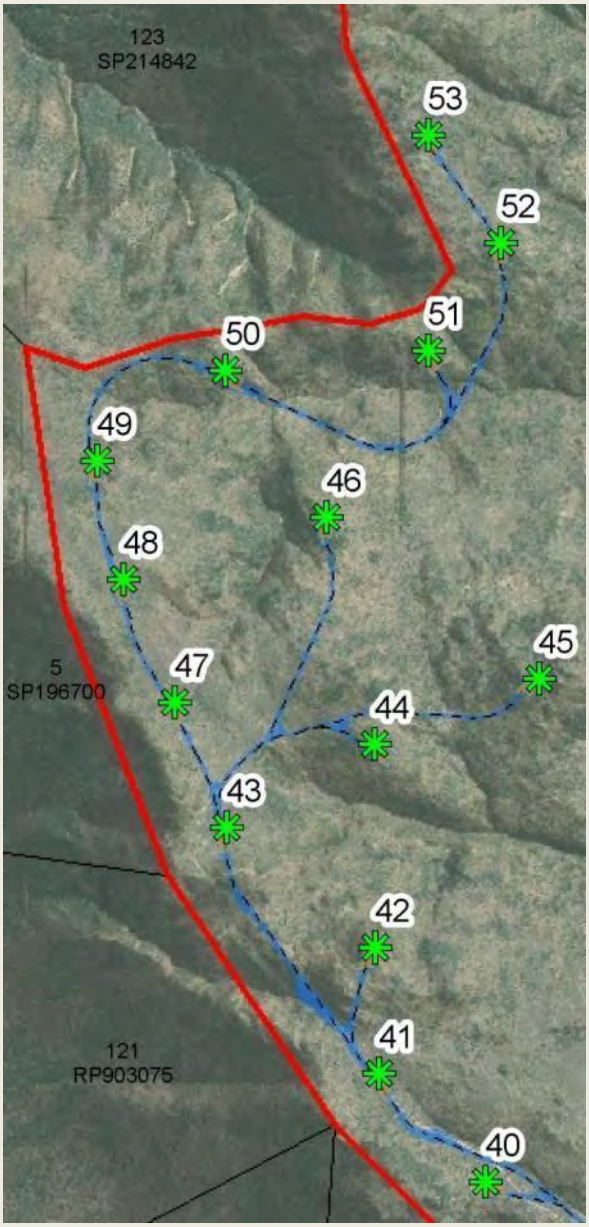


Figure 2. Rehabilitation areas for the Mount Emerald Wind Farm.

5.1 Rehabilitation Area Descriptions

The plant species in **Table 2** are recommended for specific site situations in relation to the Mount Emerald Wind Farm layout. In situations where tracks or WTG positions have changed due to topographical constraints or repositioning, a review of the group of species for a particular location may have to be made. The species selection is derived from field-based surveys. Species selections are for "arrays" of WTGs, for example, if a string of WTG's occurs on aridge with a continuous tract of vegetation of the same species composition, then the same species are applied.

Table 2.Descriptions of rehabilitation areas.

REHABILITATION AREA 1	
	**AREA DESCRIPTION** Includes WTG's 40 to 53. All tracks and cabling between WTG's. **ENVIRONMENTAL FEATURES** Rolling hills with minor areas of rock outcrop. Clay soils start to develop around southern section of rehabilitation area. Shallow to moderately incised drainage line crossings near WTG 50 and WTG 51. Elevated rocky area around WTG 53 with different species composition. Common trees include *Corymbia citriodora* and *Eucalyptus mediocris*. Large trees of Cypress Pine (*Callitris intratropica*) near WTG 51 close to watercourse crossing. Dominant grass is *Themeda triandra* (Kangaroo Grass). *Arundinella setosa* and *Heteropogon triticeus* (Giant Spear Grass) are also common in places. **REHABILITATION RECOMMENDATIONS** Use field-based observations to determine species composition. Apply specific plant species to unique vegetation types and habitats: watercourse banks, rocky outcrops, flat, clay areas (close to WTG 40 and 41). Do not clear large Cypress Pine trees (*Callitris intratropica*) near watercourse crossing south of WTG 51 or other areas where large specimens of this species are encountered. Avoid clearing any large-class trees (Eucalypts >30 cm dbh, non-Eucalypts >20 cm dbh). Allow and promote natural regeneration of track edges. Limit use of herbicides to absolute minimum and only when necessary. Weed control should be site and species specific and undertaken in accordance with the MEWF Weed Management Plan. Transplant grass trees (*Xanthorrhoea johnsonii*).

REHABILITATION AREA 2

AREA DESCRIPTION

Includes WTG's 23, 24, 28, 34 to 40, Substation and Substation O&M Building.

All tracks and cabling between WTG's.

Spot remedial works under 275 kV powerline.

ENVIRONMENTAL FEATURES

Surrounding rolling hills with isolated and low sections of rock outcrop.

Rock plates and pavements interspersed in flat area.

Large area of relatively flat land with pale, clay soils and slow drainage in some parts.

Well-formed watercourse lined with *Lophostemon grandiflorus* trees.

Open woodland dominated by *Corymbia leichhardtii*, *Callitrisintratropica* and *Eucalyptus lockyeri*. Patches of *E. shirleyi* low woodland. Grass trees (*Xanthorrhoea johnsonii*) are common and form a secondary shrub layer.

Dominant grass is *Themeda triandra* (Kangaroo Grass). In wetter areas adjacent to watercourse, *Pseudopogoantherum contortum* is common. *Schizachyrium pachyarthron* (Fire Grass) over rock plates and pavements.

REHABILITATION RECOMMENDATIONS

Use field-based observations to determine species composition.

Apply specific plant species to unique vegetation types and habitats: watercourse banks, rocky outcrops, flat, clay areas.

Do not clear large *Lophostemon grandiflorus* trees (>20 cm dbh) along watercourse near Substation O&M Building.

Avoid clearing any large-class trees (Eucalypts >30 cm dbh, non-Eucalypts >20 cm dbh).

Allow and promote natural regeneration of track edges.

Limit use of herbicides to absolute minimum and only when necessary. Weed control should be site and species specific and undertaken in accordance with the MEWF Weed Management Plan.

Transplant grass trees (*Xanthorrhoea johnsonii*).

REHABILITATION AREA 3

AREA DESCRIPTION

Includes WTG's 25 to 27 and 29 to 33 on elevated ridges south of the 275 kV powerline.

All tracks and cabling between WTG's.

ENVIRONMENTAL FEATURES

High elevation ridges (narrow) and dissected hills.

Exposed, wind-swept montane heathland vegetation (stunted trees and shrubs) between WTG 30 and 33.

Concentration of threatened plants and important habitats for ***Acacia purpureopetala*** **(red star on map)**, ***Grevillea glossadenia*** and ***Homoranthus porteri*** between WTG 30 and 31.

Large area of rock pavements between WTG 30 and 32.

Well-developed woodlands south-east of WTG 32 with large class trees.

Shrubland, low woodland and montane heathland dominated by *Acacia aulacocarpa*, *Eucalyptus lockyeri*, *Corymbia abergiana* and *Homoranthus porteri*. Grass trees (*Xanthorrhoea johnsonii*) are common on ridges.

Dominant grasses are *Themeda triandra* (Kangaroo Grass) and *Cleistochloa subjuncea*. Key ground layer species include *Gompholobium nitidum*, *Jacksonia thesioides*, *Zieria whitei*, *Sannantha angusta* and *Grevillea dryandri*.

REHABILITATION RECOMMENDATIONS

Detailed botanical investigation required prior to clearing and rehabilitation.

Use field-based observations to determine species composition.

Apply specific plant species to unique vegetation types and habitats: montane heathland and rocky outcrops.

Do not clear narrow sections of ridge between WTG 30 and 32.

Avoid clearing any large-class trees (Eucalypts >30 cm dbh, non-Eucalypts >20 cm dbh).

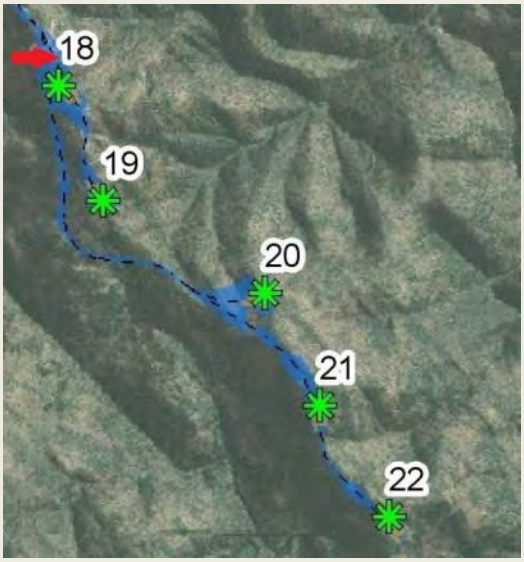
Brush-matting material and direct-seeding species to be taken from same ridges and immediately adjacent areas only.

Allow and promote natural regeneration of track edges.

Do not use herbicide between WTG's 30 and 33 - this is a critical environmentally sensitive area.

Transplant grass trees (*Xanthorrhoea johnsonii*).

REHABILITATION AREA 4



AREA DESCRIPTION

Includes WTG's 18 to 22 on elevated ridges south of the 275 kV powerline.

All tracks and cabling between WTG's.

ENVIRONMENTAL FEATURES

Key habitat for threatened plants just north of WTG 18 (***Melaleuca uxorum***) (red arrow).

Habitat for ***Grevillea glossadenia*** along most of ridge.

Large-class trees on south-western slopes and edges of ridge (*Callitris intratropica* and *Eucalyptus reducta*).

Potential habitat for ***Prostanthera clotteniana*** (critically endangered).

Mixture of low woodlands, shrublands and heathland. Taller woodlands on south-west slopes. Ridge vegetation dominated by *Corymbia abergiana*, *Eucalyptus lockyeri*, *E. mediocris*. Sections of taller *E. reducta*.

Heathy shrub layer of *Jacksonia thesioides*, *Acacia calyculata* and *Xanthorrhoea johnsonii* (Grass Tree)

Main grasses include *Themeda triandra* (Kangaroo Grass) and *Cleistochloa subjuncea*, with *Lepidosperma laterale* (Flat Sedge) under *E. reducta*.

REHABILITATION RECOMMENDATIONS

Detailed botanical investigation required prior to clearing and rehabilitation.

Avoid clearing any large-class trees (Eucalypts >30 cm dbh, non-Eucalypts >20 cm dbh), especially old Cypress Pines (*Callitris intratropica*) and Range Bloodwood (*Corymbia abergiana*).

Brush-matting material and direct-seeding species to be taken from same ridges and immediately adjacent areas only.

Direct-seed open rocky areas with *Acacia calyculata*, *Jacksonia thesioides*, *Themeda triandra*, *Cymbopogon bombycinus* and *Xanthorrhoea johnsonii*.

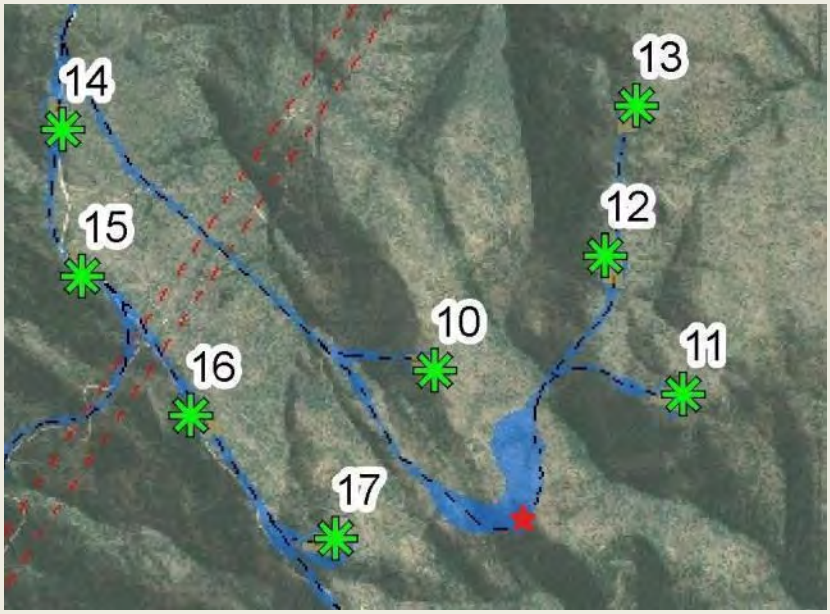
Supplement seed mix with locally occurring legumes (*Hovea nana*, *Galactiatenuiflora*, *Cajanus marmoratus*, *C. confertiflora*, *Crotalaria montana*).

Allow and promote natural regeneration of track edges.

Do not use herbicide between WTG's 18 and 22 - this is an environmentally sensitive area.

TranslocateGrass Trees (*Xanthorrhoea johnsonii*).

REHABILITATION AREA 5



AREA DESCRIPTION

Includes WTG's 10 to 17 on exposed eastern hills.

All tracks and cabling between WTG's.

Watercourse crossing under powerline and west of WTG 16.

ENVIRONMENTAL FEATURES

Sections of heathland with *Pseudanthus ligulatus* and *Borya septentrionalis* on rock pavements.

Threatened plants (*Prostanthera clotteniana* and *Grevillea glossadenia*) on ridges and around rock pavements. Location of ***Prostanthera clotteniana*** (critically endangered) on track u-bend SSE of WTG 10 - **red star on map**.

Grevillea glossadenia along existing track under powerline, at WTG 10 and between WTG 11 and 13.

Large groves of mature and very well-developed cycads (*Cycas media*) in valley east of WTG 10.

Woodlands of *Corymbia abergiana* (on ridges), *Eucalyptus cloeziana*, *E. lockyeri*, *E. mediocris* and *Callitris intratropica*. *E. reducta* near WTG 17 and in some eastern gullies and dissected slopes.

Disjunct occurrence of woodland with *Eucalyptus pachycalyx* south-east of WTG 15.

At higher elevation, often a heathy shrub and ground layer with *Acacia calyculata*, *Xanthorrhoea johnsonii*, *Melaleuca borealis* and *Borya septentrionalis* on rock pavements.

Common grasses include *Themeda triandra* (Kangaroo Grass), *Cymbopogon bombycinus*, *Cleistochloa subjuncea* (rock outcrops), and *Arundinella setosa* and *Mnesithearottboellioides* (both under woodland).

REHABILITATION RECOMMENDATIONS

Pre-clearing survey for threatened plants prior to clearing and rehabilitation.

Avoid clearing any large-class trees (Eucalypts >30 cm dbh, non-Eucalypts >20 cm dbh), especially old Cypress Pines (*Callitris intratropica*), Range Bloodwood (*Corymbia abergiana*) and *Eucalyptus pachycalyx* (Pumpkin Gum).

Brush-matting material and direct-seeding species to be taken from same ridges and immediately adjacent areas only.

Avoid clearing groves of Cycads (*Cycas media*) in the valley east of WTG 53.

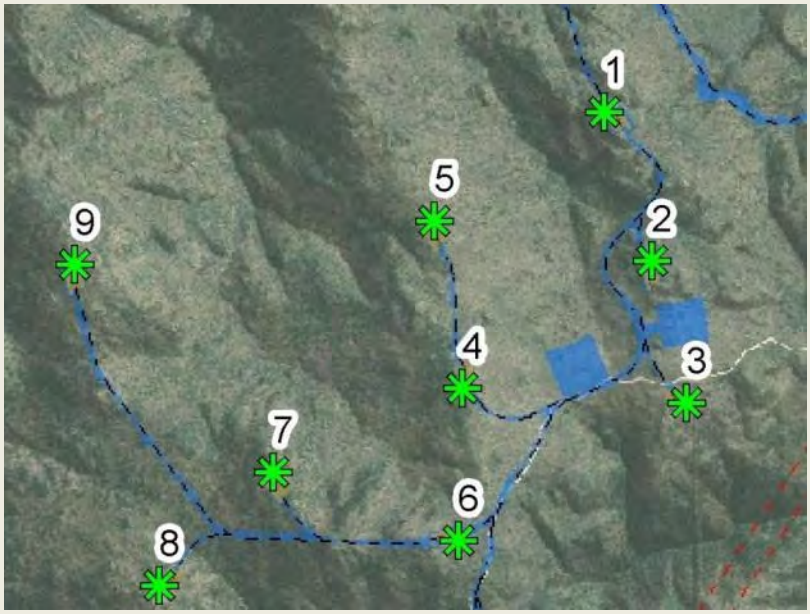
Allow and promote natural regeneration of track edges.

Only use herbicide as a last resort in this rehabilitation area - this is an environmentally sensitive zone.

Transplant grass trees (*Xanthorrhoea johnsonii*) and cycads (*Cycas media*).

Control priority weeds at watercourse crossing (*Melinis minutiflora*, *Cenchrus polystachyum*, *Urochloa decumbens*).

REHABILITATION AREA 6



AREA DESCRIPTION

Includes WTG's 1 to 9.

All tracks and cabling between WTG's.

Approach tracks from Kippen Drive and the northern slopes.

Contractors Site Compound and Laydown Area.

ENVIRONMENTAL FEATURES

Rolling hills with woodlands.

Sections of flat land interspersed with rock plates and pavements.

Incidences of priority weeds (Grader Grass - *Themeda quadrivalvis*) on northern approach track from Kippen Drive.

Woodlands of *Corymbia leichhardtii*, *Eucalyptus cloeziana*, *E. lockyeri*, *Callitris intratropica* with a heathy shrub layer of *Acacia calyculata*, *Jacksonia thesioides*, *Exocarpos cupressiformis* and *Xanthorrhoea johnsonii* (Grass Tree). Some areas of ironbark (*E. drepanophylla*) and Variable-barked Bloodwood (*Corymbia erythrophloia*).

Flat areas dominated by Kangaroo Grass (*Themeda triandra*). Woodlands on slopes and hills with a grassy ground layer of *T. triandra*, *Mnesithea rottboellioides*, *Arundinella setosa* and *Heteropogon triticeus*. Weedier native grasses such as *H. contortus* at lower elevation in hills and around Kippen Drive.

Main population area for ***Plectranthus amoenus*** around WTG's 1 to 3.

Outlier population of ***Homoranthus porteri*** on rock pavement at WTG 7.

REHABILITATION RECOMMENDATIONS

Translocate specimens of *Plectranthus amoenus*.

Control priority weeds in rehabilitation area: *Melinis minutiflora* (Molasses Grass), *Themeda quadrivalvis* (Grader Grass). Prevent spread of Grader Grass further into site.

Limit site disturbance at rock pavement sites (habitat for *Plectranthus amoenus*).

Progressively control weeds on Kippen Drive management area and replace with direct-seeded wattle thickets.

Decrease use of herbicide at rehabilitation sites until thickets of wattles have established.

Allow and promote natural regeneration of track edges.

Translocate Grass Trees (*Xanthorrhoea johnsonii*).

5.2 Rehabilitation Plant Species Schedule

A rehabilitation plant species schedule is given in **Appendix A**. The plant species in the schedule may be suitable for rehabilitation in various parts of the wind farm site. The list is not inclusive and is intended as a guide. In all rehabilitation scenarios, particularly in important habitats such as south of the 275 kV powerline, site based observations of the flora composition of the adjacent remnant vegetation should provide the most accurate indication of the most appropriate species to be used at the rehabilitation site.

6.0 REHABILITATION MONITORING

The effectiveness of rehabilitation will be measured and assessed by designing and implementing a monitoring program. The purpose of monitoring is to measure successful rehabilitation and also record unsuccessful rehabilitation. The information gained from monitoring observations and records will inform the development of improved techniques and site treatments.

Rehabilitation areas are to be monitored from fixed plots twice yearly to assess the levels of success of the treatment and the development of vegetation on previously cleared land. Data will be compared to the adjacent remnant, undisturbed vegetation community from which baseline vegetation condition and composition information will be recorded.

6.1 Monitoring Components

The following monitoring components will be recorded and assessed for a period of five (5) years commencing at the start of the operational stage of the wind farm:

- Photographic record (fixed photo points: north, south, east west, ground cover, others).
- Percentage ground cover (living plants, leaf litter, rock, bare ground, coarse woody debris).
- Ratio of woody plants to grasses (functional groups).
- Species composition.
- Species dominance (if recordable).
- Recruitment of native species (species, prevalence, common species, thicket formation).
- Presence of threatened species (from resprouting or seeding).
- Successful versus unsuccessful species germination in direct-seeded plots.
- Plant mortality.
- Weeds (cover, species, type: grasses, broadleaf, vines, shrubs).
- Pathogens and insects (dieback, sooty mould, thrips, lerps-physillids, mealy bugs, borers).
- Fire influence and damage (regrowth after fire).
- Animal damage (wallabies, pigs, bettongs).
- Human damage (trampling, new tracks, off-target herbicide application, vandalism) .
- Natural damage (desiccation/drought, wilting, dieback, frost, wind burn).

6.2 Monitoring Sites

Fixed monitoring sites are to be established across the wind farm where rehabilitation takes place. Monitoring sites are to account for discrete vegetation communities. The monitoring site locations given in **Table 3** are given as a guide and are provisional. Refining the location of the sites can occur at the field-based level.

Baseline floristic and vegetation data for the adjacent remnant community at each monitoring site will need to be compiled.

Table 3.Provisional location of rehabilitation monitoring sites.

Site ID	Location	Rehabilitation situation and baseline vegetation
R001	Terminus of Kippen Drive where it meets the base of the hills of the wind farm site.	Weed degraded road verges with priority weeds (Grader Grass). Non-remnant vegetation. Regrowth with *Melaleuca viridiflora*.
R002	Near WTG 3 and Contractors Site Compound	Remnant woodland of *Corymbia leichhardtii*, *Eucalyptuslockyeri*, *E. shirleyi*, *Callitris intratropica*. With a heath ground and lower shrub layer of *Themeda triandra*, *Jacksonia thesioides*, *Acaciacalyculata* and *Xanthorrhoea johnsonii*. Weed-free at pre-construction.
R003	Near WTG 7	Remnant woodland with rock pavements. Woodland of *Eucalyptus cloeziana*, *Callitris intratropica*, *Corymbia citriodora* and *C. leichhardtii*. Ground and shrub layers include *Themeda triandra*, *Arundinella setosa*, *Jacksonia thesioides*, *Acacia calyculata* and *Xanthorrhoea johnsonii*. A healthy, disjunct population of *Homoranthus porteri* grows on a rock pavement close to WTG 7. Weed-free at pre-construction.
R004	Near WTG 18	Ridge with sections of rock pavement and remnant low woodland to shrubland of *Eucalyptus lockyeri*, *E. mediocris*, *E. reducta* on west-facing slopes, *Corymbia abergiana*, *C. citriodora* and *Callitris intratropica*. Shrub and ground layers include *Themeda triandra*, *Grevillea glossadenia*, *Jacksonia thesioides*, *Acacia calyculata* and *Xanthorrhoea johnsonii*. *Melaleuca uxorum* is north of WTG 18 site just below wind monitoring tower. Site is prone to hot fires. Weed-free at pre-construction.
R005	Near substation O & M building	Remnant woodland over relatively flat land interspersed with rock plates. Woodland of *Corymbia leichhardtii*, *Callitris intratropica*, *Eucalyptus shirleyi* with *E. lockyeri*. Ground layer of *Themeda triandra*, *Arundinella setosa*, *Jacksonia thesioides*, *Acacia humifusa* and *Xanthorrhoea johnsonii*. Weed-free at pre-construction.
R006	Between WTG 30 and 33	Remnant montane heathland on narrow ridge at high elevation. Adjacent to low woodland and shrubland complex. Location of important populations of *Homoranthus porteri* and close to *Acacia purpureopetala*. Remnant species include *Acacia calyculata*,*A. aulacocarpa*, *Jacksonia thesioides*, *Grevillea dryandri*, *Zieria whitei*, *Sannantha angusta*, *Boronia occidentalis*, *Leptospermum neglectum*, *Mirbelia pungens*, *M. speciosa* subsp. *ringrosei*, *Grevillea glossadenia*, *Homoranthus porteri*, *Pseudanthus ligulatus*, *Gompholobium nitidum*, *Themeda triandra*, *Cleistochloa subjuncea*, *Cymbopogon bombycinus* and *Xanthorrhoea johnsonii*.
R007	Near WTG 47	Remnant woodland of *Corymbia citriodora*, *C. leichhardtii*, *Jacksonia thesioides*, *Xanthorrhoea johnsonii*, *Themeda triandra* with *E. mediocris*.

6.3 Monitoring Surveys

Detailed botanical surveys are to be completed every six (6) months following construction and during the monitoring period. The purpose of the surveys is to record the species composition and recruitment into rehabilitation areas at the fixed rehabilitation monitoring sites.

6.4 Rehabilitation Performance Indicators

The following descriptions of indicators of rehabilitation success and establishment of vegetation on cleared land will be used to inform improved techniques, methods and treatments for rehabilitation areas.

Natural regeneration: after construction is completed, the cleared width of tracks is colonised incrementally by native vegetation until a track width of 5 m is achieved. Areas of weeds do not constitute rehabilitation vegetation cover.

Erosion and surface stability: twelve (12) months after rehabilitation treatment, erosion should be minimal and adequately managed by rehabilitation and erosion and sediment control, or a combination of both if deemed necessary. Rill erosion should be minimal with a maximum tolerance of 100 mm depth. There should be zero tunnel erosion. Surface runoff is managed to a level where rehabilitation surfaces retain topsoil, collect leaf litter and other plant matter, and have active plant growth.

Ground cover: twelve (12) months after rehabilitation treatment, the ground has 70% vegetative cover (grasses, shrubs and forbs) or greater when compared with the adjacent remnant vegetation of the same type as the pre-disturbed area. For example, if the adjacent remnant condition ground cover is measured as 60%, then the rehabilitation site should have 70% of that cover (i.e. 42% ground cover comprising grasses, shrubs and forbs).

Species composition: the plant species composition is a reflection of diversity, which contributes to ecological function. Twelve (12) months after the rehabilitation treatment, the species composition at the rehabilitation site should consist of two species or greater of grasses, shrubs and forbs found in the adjacent remnant vegetation of the same type as the pre-disturbed area.

Species recruitment: the recruitment into rehabilitation sites of key species of different vegetation and habitat types as outlined in this document is an indication of potentially successful establishment and development of rehabilitated vegetation. Similarly, the presence and recruitment of threatened species into a rehabilitation site is a positive outcome and can demonstrate the development of niche habitats. Threatened species such as *Grevillea glossadenia* may colonise rehabilitation sites with rocky soils near and south of the 275 kV powerline.

Species resilience and mortality: twelve (12) months after rehabilitation treatment, plants in the rehabilitation area should be actively growing and demonstrating good signs of establishment. There should be no signs of wilting, dieback, atypical deciduousity, foliage discoloration or disease. Mortality rates should be no higher than 5% for a single species.

Weeds: twelve (12) months after rehabilitation treatment, there should be no evidence of priority weeds as identified in the Weed Management Plan for the Mount Emerald Wind Farm. Other deleterious weeds with a wider distribution in woodlands on the site such as Praxelis (*Praxelis clematidea*) and Red Natal Grass (*Melinis repens*) are not to occupy an area greater than 5% of the rehabilitation site's total area. Successive monitoring events should record a decline in the presence of any weed species when compared to the previous monitoring event.

Kippen Drive access point: the section of Kippen Drive which constitutes part of the management area of the Mount Emerald Wind Farm is to be progressively rehabilitated along both road verges. Twelve (12) months following completion of construction, all linear sections of Grader Grass (*Themeda quadrivalvis*) and other priority weeds as identified in the Weed Management Plan for the Mount Emerald Wind Farm do not reach a stage of flowering and setting seed.

Grader Grass is regularly controlled by scheduled slashing and herbicide application (if necessary) and replacement of this weed by thickets of wattles (*Acacia simsii*, *A. holosericea* and *A. leptostachya*, plus other native species) is evident for a minimum of 50% of the length of the management area. After three (3) years following construction, Grader Grass along the management section of Kippen Drive and incidences within the wind farm is to be excluded or adequately managed to a stage where the grass is no longer problematic. At this stage, thickets of wattles and other native species are the dominant vegetation cover in the Kippen Drive management area.

Habitat reinstatement: habitat for flora and fauna is maintained or reintroduced at the rehabilitation site. This includes the presence of intact rocky outcrops, tree hollows, large-class woody debris (fallen logs). Plant species diversity is included in this performance indicator, and the greater the plant diversity, the greater the value of the site as habitat for flora and fauna. Low diversity sites where for example, one or two plant species take dominance (e.g. *Acacia* species) should be assessed as to whether remedial planting or seeding is required to bolster species diversity. Vegetation thinning may also be considered for dense and tall stands of wattles, where the thickets preclude further species recruitment, but should only be undertaken after consultation with an appropriately skilled botanist or ecologist.

Increase in critical habitat: Any area increases in functional critical habitat for threatened plants will be recorded as a positive rehabilitation outcome. Decreases in areas of this type of habitat, plus decreases in areas of undisturbed vegetation types will be recorded as a non-compliance.

Translocation: plants identified as potential candidates for translocation within the site become established and able to survive without intervention at the recipient site.

6.5 Monitoring Indicator Plants

The species outlined in **Table 4** are found at various locations around the wind farm site in remnant types of undisturbed vegetation, and can act as indicators of vegetation development and habitat function. The column labelled *importance* provides an indication of the species' occurrence within the vegetation type, and can be used as guide for rehabilitation monitoring. The list is not inclusive. For example, the presence of *Cryptandra debilis* in heathland vegetation as a recruited species is a strong indication of functional habitat development at the rehabilitation site. See also more inclusive species information in **Appendix A**.

Table 4.Selected plant species found in the wind farm site and their habitats.

Species	Form	Landscape habitat	Importance
Acacia aulacocarpa	Shrub	Around and on rock pavements and tops of rocky drop-offs.	Key species
Acacia calyculata	Shrub	Ridges, woodlands, track edges.	Key species
Acacia flavescens	Tree	Taller woodlands adjacent to ridges (see *Eucalyptus reducta*).	Key species
Acacia multisiliqua	Shrub	Woodlands and track edges.	Desirable
Acacia nesophila	Shrub	Woodlands with grassy ground layer.	Desirable
Acacia purpureopetala	Shrub	Ridge top under thickets of *Homoranthus porteri* and *A. aulacocarpa* between WTG 35 and 36.	Desirable
Acacia whitei	Shrub	High elevation ridges and edges of rock pavements.	Key species
Allocasuarina inophloia	Tree	Patchily distributed, but associated with montane heathlands and rocky, exposed areas.	Desirable
Allocasuarina littoralis	Tree	Patchily distributed on ridges and flatter areas.	Key species
Alloteropsis semialata	Grass	Woodlands and track edges.	Desirable

Species	Form	Landscape habitat	Importance
Arundinella setosa	Grass	Woodlands and track edges.	Key species
Bursaria incana	Shrub	Woodlands and track edges.	Desirable
Bursaria tenuifolia	Tree	Restricted to rocky bank environment of watercourses.	Key species
Cajanus confertiflorus	Shrub	Woodlands and track edges.	Desirable
Callitris intratropica	Tree	Around rock pavements and rocky areas. Open woodlands.	Key species
Cleistochloa subjuncea	Grass	Frequent grass of very rocky soil areas and ridges.	Key species
Coronidium newcastlianum	Forb	All areas.	Optional
Corymbia abergiana	Tree	Ridges and edges of woodlands at high elevation.	Key species
Corymbia citriodora	Tree	Woodlands and track edges.	Key species
Corymbia erythrophloia	Tree	Mainly in woodlands on the northern slopes of the wind farm site.	Desirable
Corymbia leichhardtii	Tree	North of the 275 kV powerline, less so south of powerline.	Key species
Chrysopogon fallax	Grass	Woodlands	Key species
Cryptandra debilis	Shrub	Rock pavements and rocky outcrops.	Desirable
Cymbopogon bombycinus	Grass	Woodlands, ridges and rocky soil areas.	Desirable
Dianella nervosa	Grass-like	Woodlands and track edges.	Desirable
Eucalyptus cloeziana	Tree	Woodlands and track edges.	Key species
Eucalyptus drepanophylla	Tree	Woodlands in north of site and scattered south of powerline.	Desirable
Eucalyptus lockyeri	Tree	Ridges and track edges.	Key species
Eucalyptus mediocris	Tree	Woodlands, track and ridge edges.	Key species
Eucalyptus reducta	Tree	Denser/taller woodlands and protected slopes, track edges.	Desirable
Eucalyptus shirleyi	Tree	Around the substation and O & M building and north of the 275 kV powerline. Less common on ridges south of powerline.	Key species
Gompholobium nitidum	Shrub	Ridges and woodlands - with heath component.	Desirable
Grevillea dryandri	Shrub	Woodlands and ridges, also in montane heath.	Desirable
Grevillea glauca	Tree	Woodlands and track edges.	Desirable
Grevillea glossadenia	Shrub	Ridges and track edges.	Key species
Heteropogon triticeus	Grass	Woodlands	Key species
Homoranthus porteri	Shrub	Ridge between WTG 35 and 39, also at WTG 66.	Desirable
Jacksonia thesioides	Shrub	Woodlands, ridges and around rock pavements.	Key species
Lophostemon grandiflorus	Tree	Dominant tree of rocky watercourses.	Key species
Melaleuca borealis	Grass	Track edges, rock pavements.	Key species
Melaleuca viridiflora	Tree	Clay soil areas in centre of site. Sporadic in woodlands.	Desirable
Pseudopogoantherum contortum	Grass	Clay soils adjacent to watercourses.	Key species
Schizachyrium pachyarthron	Grass	Rock pavements, flat rocky areas in woodlands.	Key species
Setaria surgens	Grass	Track edges, woodlands.	Desirable
Themeda triandra	Grass	Woodlands, edges of rocky outcrops.	Key species
Xanthorrhoea johnsonii	Grass Tree	Widespread as secondary shrub layer species.	Key species

6.6 Review and Evaluation of the Rehabilitation Plan

The Mount Emerald Wind Farm Rehabilitation Plan has a currency for the life of the project and includes the stages of construction, operation and decommissioning. A major review of the plan will be undertaken after a period of five (5) years from construction.

Updates, amendments and corrections to the plan will be made annually to reflect changes to rehabilitation areas, techniques and treatments applied and other related matters as relevant at the time of review.

It is the responsibility of the Principal Contractor and the Environmental Officer to instigate the review process and contribute to the review.

Changes, modifications and amendments to the plan may be required on an annual basis, or earlier if necessary. These changes should reflect improved management actions and rehabilitation techniques.

6.7 Reporting and Recordkeeping

An annual Rehabilitation Quality Assurance report is to be compiled, which will report on the following:

- Descriptions of the rehabilitation treatments used in mitigating impacts to cleared land.
- A complete record of all plant species used for rehabilitation, and broken down to the rehabilitation site level.
- Rehabilitation site mapping showing the location and identifying name of each rehabilitation and monitoring site.
- The specific treatment in which the species were applied. This information is to include the data associated with seed collection, which should be extracted from the seed collection management database.
- An annotated photographic catalogue of all rehabilitation sites. Photos are to be taken from fixed positions within the monitoring plots.
- The baseline remnant vegetation information including detailed stratified descriptions of the adjacent vegetation community to each rehabilitation site.
- The indicators used to measure and assess rehabilitation performance and vegetation development at formerly cleared sites.
- Records of plant mortality as well as records of species dominance or good performance at a site.
- Records of non-compliance (off-target weed control, vehicle damage etc).
- Records of weeds being introduced by contractor revegetation methods (e.g. Siratro in hydro-mulch mixes).
- Recommendations for corrective actions, and if implemented prior to the annual report, the dates, types and effectiveness of the corrective actions.
- An annual rehabilitation audit report by an independent monitoring botanist or suitably qualified person.

7.0 ROLES AND RESPONSIBILITIES

The Principal Contractor, contractors, sub-consultants and personnel have a responsibility to minimise the area of disturbance during construction, operation and decommissioning of the Mount Emerald Wind Farm to maintain the area of land requiring rehabilitation at the minimum which is able to be adequately and efficiently managed.

7.1 Principal Contractor

The Principal Contractor of the Mount Emerald Wind Farm project is responsible for:

- Implementing and updating this Rehabilitation Plan.
- Managing and directing the progressive and on-going collection and supply of appropriate plant species for use in rehabilitation.
- Prioritising rehabilitation of areas according to this Rehabilitation Plan.
- Ensuring the best techniques of rehabilitation are applied to respective areas.
- Ensuring skilled and qualified contractors and workers are engaged in rehabilitation.
- Providing specific training relating to the unique environmental characteristics of the wind farm site and how they relate to the specialised rehabilitation approaches.
- Ensuring the highest possible quality of rehabilitation is achieved through continuous improvement and adoption of best practice.
- Maintaining records of inductions and training given to contractors, sub-consultants and workers.
- Implementing a rehabilitation monitoring program and compiling scheduled monitoring reports in accordance with this rehabilitation plan.
- Investigating and taking corrective actions in relation to poor rehabilitation performance and unsuccessful approaches to rehabilitation.

7.2 Contractors, Sub-consultants and Personnel

Contractors, sub-consultants and personnel engaged in work practices related to rehabilitation of the wind farm site are responsible for:

- Fulfilling duties as directed by the Principal Contractor in relation to site rehabilitation.
- Identifying significant habitats for flora and fauna, and ensuring rehabilitation work methods are of a standard that avoids or minimises harm to the natural environment.
- Undertaking site-specific land rehabilitation inductions and training before commencing work. All inductions must be signed off by the Principal Contractor after completion.
- Complying with the Rehabilitation Plan requirements as directed by the Principal Contractor.
- Reporting to the Principal Contractor weed outbreaks or modification of rehabilitation areas.
- Requesting further advice and clarification from the Principal Contractor in relation to seed collection and species selection, uncertainties and knowledge gaps before proceeding with the related task.
- Ensuring the equipment and products used for land rehabilitation is legal, in safe working condition, hygienically clean and is free of weed seed and pathogens.

APPENDIX A

Rehabilitation Plant Schedule

TREES		
Species	**Common Name**	**Notes**
Acacia flavescens	Primrose Ball Wattle	In sheltered woodlands often with *Eucalyptusreducta*.
Allocasuarina inophloia	Hairy Oak	Tree of high elevation areas and rocky soils mostly south of powerline and in western parts of site.
Allocasuarina littoralis	Black She-oak	A tree of disturbance areas as well as wind-battered ridges and slopes. Widespread but diffuse distribution in more rugged woodlands. Key species.
Alphitonia excelsa	Red Ash	Woodlands in the centre of the site on flatter ground.
Callitris intratropica	Cypress Pine	In all woodlands, particularly where rocky outcrops and rock pavements occur. Rare directly on ridges, but found along edges. Key species.
Corymbia citriodora	Lemon-scented Gum	In all woodlands but less frequent directly on ridges, where it is replaced by *Corymbia abergiana*, *Eucalyptuslockyeri* and *E. mediocris*. Key species.
Corymbia erythrophloia	Variable-barked Bloodwood	Confined more towards the drier northern slopes and aspects of the wind farm site. Also found as scattered trees in the interior.
Corymbia intermedia	Pink Bloodwood	Found in more sheltered woodlands south of the powerline with longer-term moisture availability. Often associated with *Eucalyptusreducta*.
Corymbia leichhardtii	Rustyjacket	Widespread tree of woodlands and a key species in many areas. Less frequent or absent from ridges south of the 275 kV powerline. Common north of the powerline.
Eucalyptus cloeziana	Dead Finish/Gympie Messmate	Widespread in most woodlands, and particularly closer to the powerline. Key species.
Eucalyptus crebra	Ironbark	Confined more towards northern hills of wind farm site. rare south of the powerline.
Eucalyptus lockyeri	No common name	Widespread in a range of woodlands from the north adjacent to the access track and south of the powerline, where it is a key species of the ridges.
Eucalyptus mediocris	Inland White Mahogany (often called Yellow Stringybark in NQ)	Widespread and similar in distribution to *E. lockyeri*. Key species.
Eucalyptus pachycalyx	Pumpkin Gum	Restricted distribution to woodlands on rocky soils near the powerline.
Eucalyptus reducta	White Stringybark	Woodlands in gullies and wetter slopes. Mostly found south of the powerline.
Eucalyptus shirleyi	Silver-leaf Ironbark	Occurs in patches, but is most common in centre of site north of powerline. Scattered trees along ridges.
Ficus obliqua	Fig	Usually a lithophyte (growing on rocks) in woodland drainage lines.
Larsenaikia ochreata	Native Gardenia	Woodlands, rocky ridges and occasionally on or near rock pavements. Widespread but occasional species.
Lophostemon grandiflorus	Northern Swamp Box	Use at watercourse crossings and along rocky drainage lines. Key species on watercourses.

TREES (continued)		
Species	**Common Name**	**Notes**
Lophostemon suaveolens	Swamp Mahogany	Scattered distribution in woodlands and near watercourses on clay soils.
Melaleuca monantha	Minute-leaved Paperbark	Unusual and patchy distribution from northern slopes to an occurrence south of the powerline near WTG 48. In open woodlands. Also common along Kippen Drive.
SHRUBS		
Species	**Common Name**	**Notes**
Acacia aulacocarpa	Hickory Wattle	Key species of exposed rock pavements, outcrops and ridges south of powerline. Scattered in northern areas.
Acacia calyculata	A wattle	Very common in all woodlands and settings. Key species.
Acacia holosericea	Silky Wattle	Found along Kippen. Not in wind farm site. Restrict use to Kippen Drive and lower northern slopes.
Acacia humifusa	A wattle	Rocky soils often near or on rock pavements.
Acacia leptostachya	Townsville Wattle	Isolated along Kippen Drive. Not found in wind farm footprint. Good for use along Kippen Drive.
Acacia multisiliqua	A wattle	Scattered woodland species.
Acacia nesophila	A wattle	Scattered woodland species.
Acacia simsii	Sim's wattle	Thicket forming wattle of disturbed woodlands and track edges. Would be well-suited for use along Kippen Drive and northern tracks. Limit use south of powerline.
Acacia umbellata	Umbellata Wattle	Patchy distribution, sometimes on shallow clay soils near rock pavements, but locally common.
Acacia whitei	A shrub	Restricted to high elevation ridges south of the powerline. key species in relation to threatened plants.
Alyxia spicata	Chain Fruit	A scrambling shrub of rocky outcrops and fire-protected niches. Sometimes found growing in association with *Homalium brachybotrys*, old *Callitris intratropica* trees, *Maytenus disperma* and other semi-vine thicket species.
Breynia oblongifolia	Dwarf Apple	Woodlands across the site.
Bursaria incana	Prickly Pine	Widespread but scattered in all woodlands.
Bursaria tenuifolia	Sweet Boxthorn	Use on banks of watercourses and drainage lines. Key species in this situation.
Cajanus confertiflorus	A shrub	Scattered but locally common in grassy woodlands more to the north of the powerline.
Dodonaea lanceolata var. *subsessilifolia*	Hop Bush	Widespread species of all woodlands and situations. tends to respond to disturbance.
Cryptandra debilis	No common name	Rock pavements and exposed ridges at higher elevation. key indicator species of healthy vegetation development.
Gastrolobium grandiflorum	Heart-leaf Poison Bush	Scattered but common in patches across site. More frequent south of powerline.

SHRUBS (continued)		
Species	**Common Name**	**Notes**
Gompholobium nitidum	Gompholobium	Common species of heath vegetation on ridges and higher woodlands. Grows in association with *Jacksoniathesioides* and *Grevillea dryandri*. Key species.
Grevillea glauca	Bushman's Clothes Pegs	Woodland species - responds well to direct seeding individual seeds planted in ground just after wet season.
Grevillea glossadenia	A shrub	Restricted to south of the powerline of just north of it. Key species of rocky soils.
Grevillea parallela	Beefwood	Woodland species across the site.
Hibbertia stirlingii	No common name	Rock pavements and exposed ridges in the western section of the site.
Homoranthus porteri	No common name	Thicket forming shrub mainly south of powerline on ridge between WTG35 to 39. Outlier population near WTG 66. Grows on rock pavements and very rocky, almost bare surfaces.
Indigofera bancroftii	No common name	Restricted to high elevation ridges and very rocky sites mainly south of the powerline, but scattered in the north of the site.
Indigofera pratensis	Forest Indigo	Scattered in woodlands across the site.
Jacksonia thesioides	Broom Bush	Widespread in woodlands across site and important species of ground layer of heath vegetation. Key species.
Leptospermum amboinense	Teatree	Thicket forming shrub on exposed rocky ridges south of powerline and at high elevation.
Leptospermum neglectum	Teatree	Shrub of exposed ridges south of powerline and in heath vegetation at high elevation.
Melaleuca borealis	No common name	An important shrub of rock pavement areas and their perimeters. Found mostly near and south of the powerline. Key species.
Melaleuca uxorum	No common name	Very restricted species found just north of WTG 18 on an exposed rocky ridge.
Melaleuca viridiflora	Broad Leaf Paperbark	Woodlands and clay soil areas in centre of site, where it is a key species.
Mirbelia speciosa subsp. *ringrosei*	Mirbelia	Restricted to Rehabilitation Area 3 at high elevation. Shrub of heath vegetation and exposed ridges. Indicator species of habitat function.
Persoonia falcata	Geebung	Woodlands across most aspects of the site.
Petalostigma banksii	Quinine Bush	Mostly in open woodlands at base of northern slopes and along Kippen Drive. Rare in interior of wind farm site.
Petalostigma pubescens	Quinine Bush	Often a stunted shrub of woodlands - widespread.
Pimelea sericostachya	Pimelea	Woodlands and slopes across the site.
Platysace valida	Platysace	Woodlands - widespread, but more common to south of site on rocky soils.

SHRUBS (continued)		
Species	**Common Name**	**Notes**
Pogonolobus reticulatus	Medicine Bush	Woodlands mainly north of the powerline on rolling hills.
Pseudanthus ligulatus	No common name	Rock pavements, heath and high elevation ridges. Key indicator species of vegetation health and development.
Pultenaea millarii	A shrub	Woodlands across the site, although more common in marginally protected woodlands with *E. reducta*. Also found in heath vegetation.
Sannantha angusta	No common name	Grows on exposed ridges south of powerline mostly between WTG 30 and 33 at high elevation. Indicator species of heathland health.
Zieria whitei	No common name	Exposed ridges and rocky areas south of the powerline at high elevation. Indicator species of good vegetation development.
GRASSES		
Species	**Common Name**	**Notes**
Arundinella setosa	Reed Grass	Widespread in woodlands but not on ridges or rock pavements. Key species.
Cleistochloa subjuncea	No common name	Ridges and rocky slopes. Key species.
Cymbopogon bombycinus	Silky Oilgrass	Woodlands, prefers rocky soils. Key species. Sometimes common on ridges.
Eragrostis schultzii	Blacksmith Grass	Frequent grass found in open areas of woodlands as well as around and on rock pavements and also semi-disturbed areas.
Eriachne mucronata	Mountain Wanderrie Grass	Rocky sites in woodlands across the site. Often around rock outcrops.
Eriachne pallescens	Wanderrie Grass	Woodlands with very rocky soils.
Grewia retusifolia	Dog's Balls	Woodlands across the site.
Heteropogon triticeus	Giant Spear Grass	Widespread in woodlands but not on ridges or rock pavements. Key species.
Mnesithea rottboellioides	Northern Cane Grass	In well-developed woodlands usually under *Eucalyptusreducta*.
Schizachyrium pachyarthron	Fire Grass	Rock pavements and fringes, flat and hard ground. Usually in sparse woodland. Key species in some areas.
Themeda triandra	Kangaroo Grass	Widespread throughout woodlands and on ridges. Seed may require storage for one year to break dormancy. Transplant new plants after/during wet season flushes. Key species.
Triodia microstachya	Spinifex	Flat surfaces in open woodland with sand-clay soils near the centre of the site (around WTG's 39 to 34).

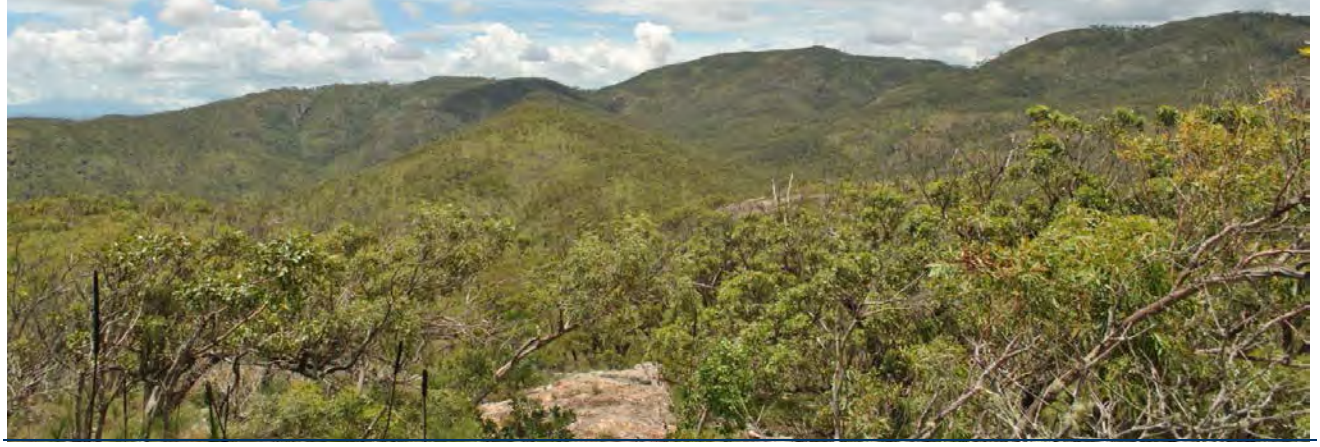
OTHER PLANTS		
Species	**Common Name**	**Notes**
Borya septentrionalis	Resurrection Plant	On rock pavements in scoops and crevices. key indicator species of vegetation development. Should be trialled for translocation.
Cajanus marmoratus	No common name	Leguminous creeper of developed woodlands across the site.
Clematocissus opaca	Vine	Found in rocky outcrops and along rocky ridges - mostly south of the 275 kV powerline. Fleshy fruit, would add diversity to rehabilitation treatment.
Coronidium newcastlianum	White Everlasting Daisy	Widespread through all woodlands and ridges.
Cycas media	Cycad	Restricted but common in some locations. Important groves of mature specimens in valley east of WTG 16. Transplant all specimens where possible in adjacent areas.
Davallia denticulata	Rabbit's Foot Fern	Found tucked away in sheltered rock crevices usually along ridges. Candidate for translocation.
Dendrobium speciosum	Rock Orchid	Occasionally found nestled in rock crevices at high elevation. Candidates for translocation.
Dianella nervosa	Flax Lilly	More developed woodlands across the site.
Durabaculum undulatum var. *undulatum* (Syn. *Dendrobium undulatum*)	Golden Orchid	Usually found on rocks or in low branches of trees on watercourses and seasonal drainage lines. Candidates for translocation.
Drynaria rigidula	Basket Fern	A lithophytic fern of rock outcrops, but sometimes found in trees. Candidate for translocation.
Galactia tenuiflora	No common name	Leguminous creeper of woodlands across the site.
Hovea nana	Hovea	Exposed ridges and rocky outcrops mainly south of the powerline at high elevation. Key indicator species of healthy vegetation development.
Lepidosperma laterale	Flat Sedge	Grass-like plant found in well developed and more sheltered woodlands often under *E. reducta*.
Lomandra multiflora	Mat Rush	Woodlands across the site, more common in northern areas.
Moss, lichen and fern patches	Soil builders	Translocate patches of thick moss, fruticose and foliose lichens and rock ferns (*Cheilanthes* spp.) to nearby rock pavements and crevices during wet weather.
Plectranthus spp.	Plectranthus	Almost exclusively found on rock pavements. Potentially good candidates for translocating.
Polycarpaea spirostylis	Copper Plant	Restricted to rock pavements and more frequent south of the powerline. Candidate for translocation.
Sedopsis sp. (Bulimba Station)	Bulimba Pinks	Tiny plant restricted to rock pavements usually at high elevation. Translocate onto nearby rock pavements.
Xanthorrhoea johnsonii	Grass Tree	Widespread throughout woodlands and on ridges. Transplant all specimens where possible in adjacent areas.
Xerochrysum bracteatum	Yellow Everlasting daisy	Woodlands of rolling hills. Widespread but diffuse.

Appendix L

Erosion, Sediment and Stormwater Management Plan

Sediment, Erosion and Stormwater Management Plan

Mt Emerald Wind Farm, Herberton Range, North Queensland



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Document Status

Version	Purpose of Document	Orig	Review	Review Date
1	Draft	BC	MJ	06/06/2016
2	Final	BC	LL	10/06/2016
3	Final	TJ	BC	16/11/2016
4	Final	BC	MJ	12/12/2016

Approval for Issue

Name	Signature	Date
Mellissa Jess		12/12/2016

Contents

Tables

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Appendices

1.0 Introduction

This Sediment, Erosion and Stormwater Management Plan (SWMP) has been prepared for RATCH Australia Corporation Limited (RACL) for construction and operational activities proposed to be carried out on the Mount Emerald Wind Farm (MEWF) site. This SWMP is required in accordance with Condition 13(a)iii of Ministerial Decision Notice on 24 April 2015.

The objectives of this SWMP are to:

- Gain an understanding of the site and the degree of potential for erosion to occur;
- Provide a set of Best Practice Site Management Procedures to minimise soil erosion and transport during the earthworks and construction phase;
- Provide techniques to control sediment so that it does not cause detrimental impacts to water quality;
- Provide a monitoring plan to ensure detrimental impacts to water quality are not occurring; and
- Ensure staff are adequately trained and capable of implementing this plan.

2.0 Site Description

The project area comprises Lot 7 on SP235224, Easements A, C & E in Lots 1, 2 & 3 on SP231871 and part of Lot 905 on CP896501. The project involves the construction and operation of a wind farm located approximately 20 km SSW of Mareeba on the Atherton Tablelands in north Queensland. The project approval allows for the construction of up to 63 wind turbines, associated access tracks and an electricity substation that will feed into the main electricity grid (Powerlink's Chalumbin – Woree 275 kV transmission line).

Lot 7 is a large rural allotment, situated (at its closest point) approximately 3.5 km south-west of Walkamin, off Springmount Road at Arriga on the Atherton Tablelands. The site is characterised by rugged terrain with elevations of between 540m up to 1089m above sea level (ASL). Virtually the entire site is covered by remnant vegetation, as defined under Queensland's *Vegetation Management Act 1999* (VMA).

The main construction and operational processes that could potentially lead to water contamination are:

- Sediment transport off-site due to exposed soils as part of earthworks in construction
- Hydrocarbons from fuels and oil/grease used in machinery.

2.1 Waterways and Catchments

A number of defined watercourses are present across the site; these waterways are seasonal and generally only flow during the wet season. During the dry season minor pools may remain in the Granite Creek tributary at the lower northern part of the site, depending on the duration and intensity of the season. A search of the Department of Environment and Heritage Protection (DEHP) referable wetlands database did not identify any referable wetlands within the project area. The nearest referable wetland is the freshwater Nardello's Lagoon, which is located 2km away.

Figure 1 depicts the sites location in respect to this wetland, along with all major watercourses in and around the site. As shown in **Figure 1**, all runoff from the construction footprint will eventually drain into Granite Creek. Therefore water quality within this creek will be closely monitored pre-construction through to post construction.

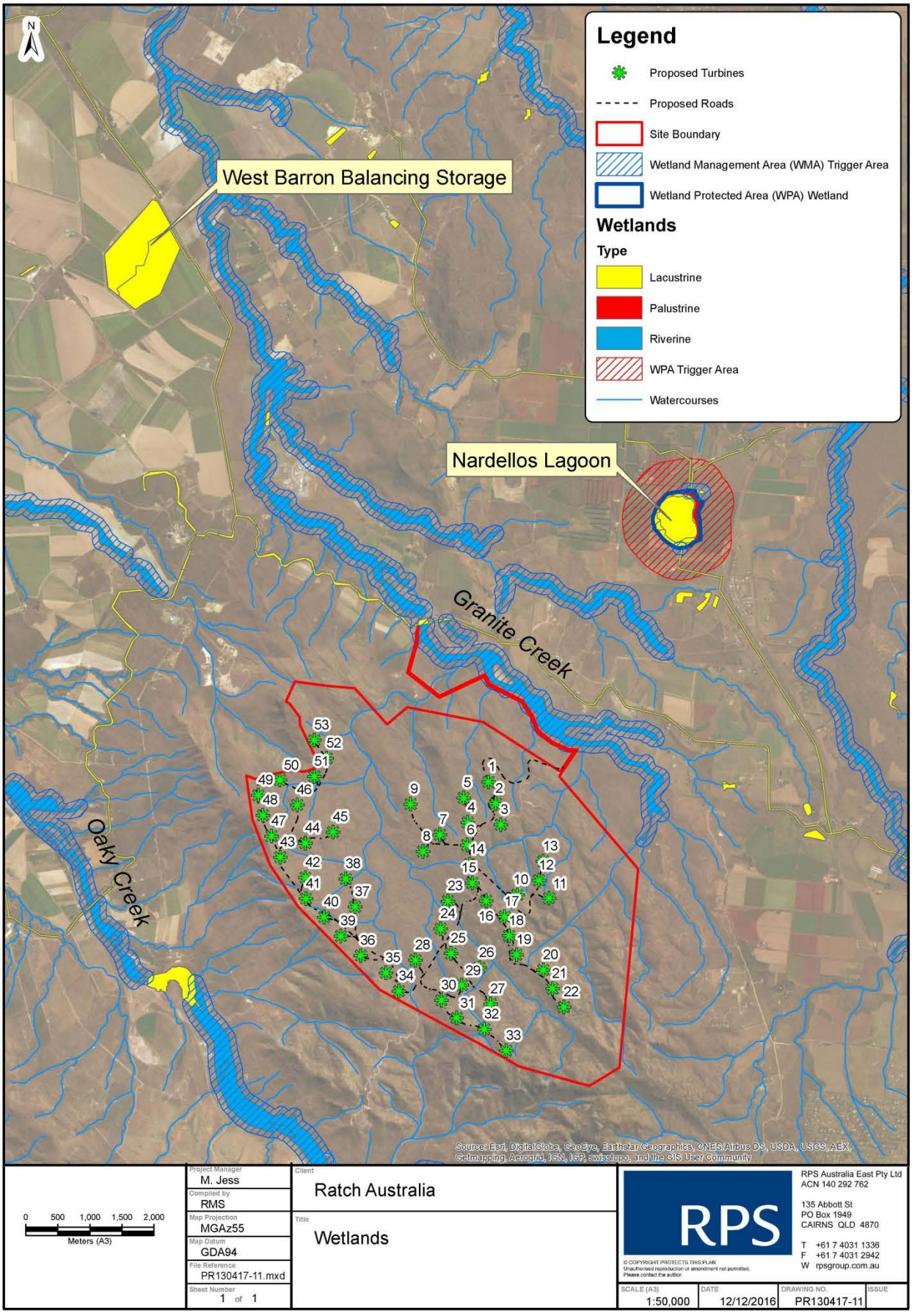


Figure 1 Wetlands and Major Watercourses Located within and nearby to the site.

2.2 Rainfall

The dominant rainfall pattern of the local area is monsoonal, with alternating wet and dry seasons that typically last for four and eight months respectively. The Walkamin Research Station (station number 031108, elevation 594m) has been selected as a suitable reference site, due to its close proximity (situated 6km from the wind farm) and availability of long term climate records. A summary of the weather data from this station is presented in **Table 1**.

Table 1 Summary of Weather Data for Walkamin Research Station (BoM, 1965 - 2016)

Weather Conditions	Measurements
Mean Annual Rainfall	1022.3mm
Highest Annual Rainfall	1750.5mm (1974)
Lowest Annual Rainfall	470.2mm (2002)
Highest Monthly Rainfall	894.1mm (Feb 2000)
Highest Daily Rainfall	284.8mm (28 Feb 2000)
Lowest Monthly Rainfall	0.0mm (May 2001)
Mean Annual Minimum/Maximum Temperature	17.0°C/27.4°C

Bureau of Meteorology (2013).

Average annual rainfall in the area is 1032.4mm with the wettest month being February (248.9mm), and the driest month being September (8.4mm). The majority of rain (80%) falls within the months of December to March. This rainfall distribution over the year is displayed in **Figure 2** (BoM, 1965 – 2016):

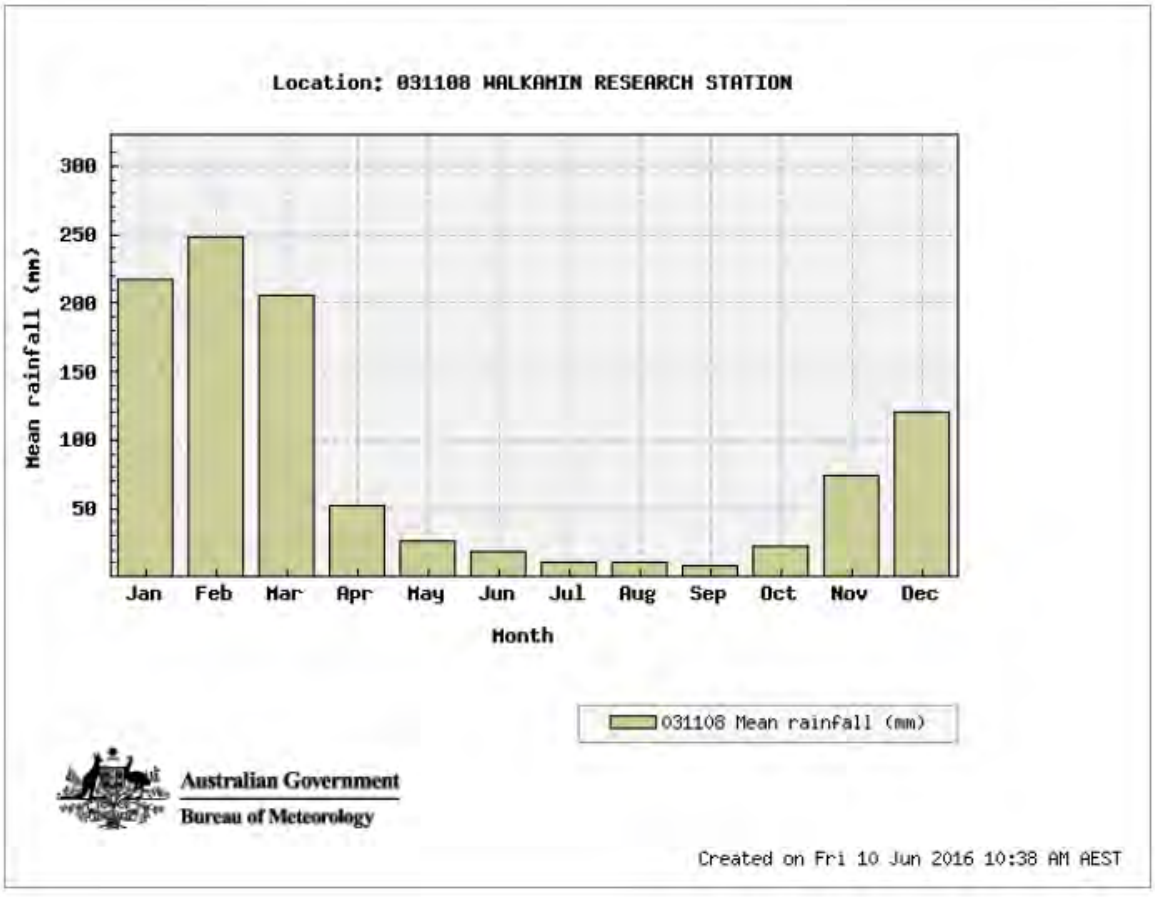


Figure 2 Mean monthly rainfall for Walkamin Research Station (BoM, 1965 – 2016)

The highest aspects of the site are 1089m ASL, which are 550m higher in altitude than the Walkamin Monitoring Station. The change in temperature as a function of elevation is typically between 0.6^{o}C and 1^{o}C (BOM, 2013), but this can vary significantly by factors such as wind speed, moisture and daily temperatures. Some of the highest elevated parts of the site also experience higher precipitation and ground moisture due to cloud stripping, as clouds intersect the landform.

2.3 Geology and Soils

The MEWF project site is situated over mountainous terrain coinciding with the northern extent of the Herberton Range. The site is characterised by acid igneous rhyolite geology forming windswept ridges and rocky outcrops interspersed with rock pavements, which support skeletal soils. Between these prominent features are undulating valleys with sheltered aspects and with deeper, more structured soils.

Thin veneers of soil with low fertility, wind-shearing and exposure to extremes of temperature and solar radiation prevent the growth of tall vegetation on ridges and rock pavements. Soils developed from rhyolite parent rock are naturally low in important plant nutrients such as nitrogen and phosphorus. The primary geological unit described for the entire site is the Walsh Bluff Volcanics. The Walsh Bluff Volcanics (Pb) are included in the Early Permian, Koolmoon Volcanic Group and described as "Buff, greenish-grey or dark grey, welded rhyolitic ignimbrite; minor rhyolite lava, quartzose sandstone, volcanic breccia, tuff." (Donchack & Bultitude, 1998).

Regionally, the Walsh Bluff Volcanics (Pb) unit is not represented elsewhere on the ATHERTON 1:250 000 geological series map sheet (Donchak, *et al*., 1997). The unit's northern limit is the landmark of Walsh Bluff. It extends southwards to incorporate Hoot Hill and Mount Emerald, east to Bones Knob, and includes parts of the ranges west of Atherton, and Rocky Bluff north of the Walsh River.

A shallow soil profile (generally <1m thick) has been recorded at borehole locations. Soils consisted of Sandy Silt (ML) with low plasticity with fine to coarse sand of stiff consistency. Soils were underlain by slightly weathered to fresh rhyolitic ignimbrite with minor moderately and highly weathered zones. Initial assessment of rock strength, later confirmed by laboratory analysis, was of high to very high strength.

Although there is only considered to be a low to moderate erosion risk across the study area, during construction and maintenance there is an increased potential for erosion in steep terrain where soil, particularly finer subsoil is exposed and/or excavated for new access tracks and tower locations. Gully erosion is most likely to occur on hilly and steep terrain, while areas of lower relief are potentially more susceptible to sheet erosion and rill erosion.

Fine sediments displaced as a result of erosion may be carried downstream and potentially adversely affect the water quality of Granite Creek and dependent aquatic ecosystems.

3.0 Stormwater Quality Management Strategy

3.1 Erosion and Sediment Control Techniques

In general, best practice erosion and sedimentation control involves the principles of (in order of preference):

- Avoidance;
- Minimisation; and
- Treatment.

A primary objective for erosion control is avoidance by limiting the amount of exposed soil subject to erosion. This should be achieved through measures such as minimising clearing extents, staging clearing and progressively revegetating areas as soon as practicable. Planning to ensure works requiring the most exposed soil are completed during the dry season months with lower rainfall. However, where avoidance is not possible the following erosion and sediment control mitigation measures should be implemented:

- Install clean water diversions upslope of sloping Wind Turbine Generation (WTG) sites to direct clean stormwater away from work/bare areas. Where possible, runoff from access tracks will also be directed away from WTG sites;
- Direct all uncontaminated (clean) stormwater to stable land, ensuring water is dispersed / diffused to prevent erosion. Examples of Flow Control Berms, Catch Drains, Flow Diversion Banks, Level Spreaders and Energy Dissipators which could be utilised to achieve this are detailed in **Appendix 4**;
- Strip topsoil (~200mm depth) separately and retained for rehabilitation/stabilisation activities. It is important to ensure separate soil horizons are retained in separate stockpiles and not mixed. These stockpiles must be located away from drainage lines and have appropriate controls to ensure sediment is not lost (e.g. sediment fence/geotextile covers);
- Respread/cover tower and permanent pad batters with topsoil and rehabilitate as soon as practicable on completion of pads;
- Stabilise pad surfaces using methods such as topsoiling and revegetation or gravelling, where there is a risk of erosion of the pad;
- Do not carry out clearing activities within 50 metres of a watercourse; where required, improve or develop appropriately designed watercourse crossings that prevent erosion;
- Maintain vegetation cover along hardstands and access tracks where possible. Reduce damage to grass cover and sensitive heath vegetation types by limiting vehicle movements to work areas and approved access tracks;
- Prepare and implement a dewatering plan or work procedure (if required);
- Keep off site sealed public roadways clean and free of sediment. Tracking of soil onto local roads will be prevented by:
  - Limiting off road vehicle movements after rainfall events to those essential for efficient and safe construction activities;
  - Installing in areas with problematic soil types, a rock rumble pad or similar device in accordance with the International Erosion Control Association *Best Practice Guidelines* (2008) near the intersection of the access track and the sealed road. This entry/exit point must have a vibration grid and rock pad as detailed in **Appendix 3**. Having a split entry/exit, whereby the vibration grid and rock pad are on the "exit only" lane, is not advisable, as this creates potential for users to circumnavigate the sediment trap control.

  - » Providing brush/wash down equipment to remove loose soil from wheels, wheel arches, tracks, augers and under bodies; and
  - » Limiting access during and immediately after wet weather, when access tracks may be severely damaged by vehicle movements and there is a high possibility of the transport of soil materials onto sealed public roads.
- Sediment fences should be constructed/maintained as per the diagrams and instructional text in **Appendix 1**.
- Retain sediment fences and other temporary erosion and sediment controls in place and maintained until the site has been successfully stabilised. On successful stabilisation, the temporary controls will be removed; and
- If wind erosion occurs, water trucks or geotextile silt fences should be installed to minimise soil loss and soil movement away from the construction site.
- All long term stockpiles must have appropriate controls installed (i.e. geotextile silt fence and covers) to ensure they do not erode and cause sediment releases. They also need to be located away from drainage lines.
- All domestic waste skips onsite are required to be covered to avoid the egress of stormwater.
- Bunded areas associated with fuel and generator storage must be bunded in such a way that limits standing water (ponding) of stormwater contacting potentially oily generators/tanks and not allowed to overflow (i.e. covered areas or raised rock/gravel pads with PVC standpipe/valves or similar). Bunded areas are to be keep free of contaminates at all times. Dry cleaning techniques shall be prioritised over wet cleaning techniques at all times.
- All vehicle maintenance should be completed offsite. If onsite maintenance is required it must be completed within a bunded area with an impermeable base (e.g. geotextile lined). Spill kits must be available to ensure spills are not allowed to escape.
- Vehicle refuelling must occur within a bunded area with an impermeable base (e.g. geotextile lined). Spill kits must be available to ensure spills are not allowed to escape.
- Temporary drain crossing(s) should be constructed as per design and details in **Appendix 5**.

Minimise Disturbance, Stage and Revegetate

The area of soil disturbance should be minimized as much as possible. The smaller the area disturbed the less erosion and sediment controls required, including revegetation. Ideally, earthworks should be staged for winter dry season works.

In any area where soils are disturbed and construction activities are completed, revegetation should be undertaken as soon as possible to achieve a ground cover of at least 70%. This is particularly important prior to the start of the wet season (October). This may be completed progressively as works are completed.

Before seeding, soil testing should be completed to ensure the soil does not have nutrient deficiencies or unfavourable conditions (e.g. soil pH too low). This testing should guide the application of soil conditioners and fertilizer in conjunction with drill seeding. Revegetation with plant species of local provenance should be used wherever possible. A revegetation specialist may need to be consulted prior to completing revegetation.

Watering following drill seeding should start immediately after planting and continue at the following rate:

- 25mm every second day for the first three weeks;
- 25mm twice a week for the next 3 weeks; and
- 25mm once weekly for a further two weeks.

If the required amount of water above is received naturally (i.e. rainfall events) then watering can be reduced accordingly.

3.1.1 Monitoring of Sediment Controls

Erosion and sediment controls should be inspected weekly by the Site Manager (or nominated representative), immediately prior to anticipated runoff producing rain or immediately following runoff-producing rainfall. Any issues affecting erosion and sediment control effectiveness will be repaired and amended as appropriate to maintain the water quality objectives.

Weekly site inspections (or following runoff-producing rainfall) must include:

- All drainage, erosion and sediment control measures;
- Occurrences of excessive sediment deposition (whether on-site or off-site);
- All site discharge points;
- Occurrences of excessive erosion, sedimentation, or mud;
- Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements;
- Litter and waste receptors;
- Bunded oil, fuel and chemical storage facilities;
- Health of recently established vegetation; and
- Proposed staging of future site clearing, earthworks and site/soil stabilisation.

Site inspections immediately prior to anticipated runoff-producing rainfall must include:

- All drainage, erosion and sediment control measures; and
- All temporary flow diversion and drainage works.

Note that additional water quality monitoring maybe required if the Water Quality Objectives (WQO) in **Table 3** are not being met

3.2 Non-compliance

Non-compliance with agreed performance criteria by visual inspections identifying:

- Build-up of sediment off the site (i.e. roads and watercourses);
- Excessive sediment build-up on the site (i.e. check dams, sediment fences etc.);
- Excessive erosion on the site;
- Release of construction material from the site;
- Poor vegetation establishment;
- Poorly maintained, damaged or failed Erosion and Sediment Control (ESC) devices; or
- Deteriorated water quality identified by the Environmental Consultant as being attributable to the construction activities.

3.3 Corrective Actions

After any identification of incident or failure, the source/cause is to be immediately identified and the following measures implemented:

- Build-up of sediment off the site – the material must be collected and disposed of in a manner that will not cause ongoing environmental nuisance or harm; then on-site ESC measures amended, where appropriate, to reduce the risk of further sedimentation.
- Excessive sediment build-up in the site controls – collect and dispose of material, then amend up-slope drainage and/or erosion control measures as appropriate to reduce further occurrence.
- Severe or excessive rill erosion – investigate cause, control up-slope water movement, re-profile surface, cover dispersive soils with a minimum 100mm layer of non-dispersive soil, and stabilise with erosion control blankets and vegetation as necessary.
- Release of construction material from the site – collected and disposed of in a manner that will not cause ongoing environmental nuisance or harm; then inspect litter and waste receptors.
- Poor vegetation growth or soil coverage – plant new vegetation and/or mulch as required. Newly planted and previously planted areas may require supplementary watering and replanting.
- Sediment control failure – replace and monitor more frequently. Regular failures may mean that the sediment control, location, alignment or installation may need to be amended.

If the release of excessive sediment and/or other materials off the site is identified during site inspections, or water quality monitoring indicates levels not within the WQOs, then review and revise the Erosion and Sediment Control Plan (ESCP), or otherwise reduce the extent and/or duration of soil exposure.

3.4 Reporting

All weekly monitoring, non-compliance and corrective actions reporting should be stored with this SWMP and be available for auditing.

4.0 Water Quality Monitoring and Control

4.1 Monitoring Protocol

4.1.1 Timing and Forecasting

Monitoring will be undertaken immediately following rainfall event which causes runoff. Monitoring will be undertaken by an Environmental Scientist who will be responsible for monitoring the Bureau of Meteorology's rainfall predictions/outlook for seven days in advance. The Environmental Scientist will also be responsible for ensuring they personally, or another suitably qualified person (SQP), will be available at all times to complete sampling, particularly during forecasted periods of increased rainfall.

4.1.2 Water Quality Sample Collection

Sufficient laboratory sample containers for two sampling events shall be kept at the local office at all times. Spare equipment (such as star pickets, container holders and specially designed sample containers) will also be kept in case sample structures are damaged during flooding events.

Once a rainfall event which causes sufficient runoff to fill sample containers has occurred, an Environmental Scientist will mobilise to site with laboratory sample containers, spare structural material for sampling apparatus, field sheets (Field Sheets provided in **Appendix 4**), a sealable container (such as an esky) with ice and a water quality meter to analyse key physio-chemical parameters such as pH, EC and turbidity. Samples will then be taken from each surface water monitoring location as shown in **Figure 3**, with field physio-chemical results noted on field sheets. The samples collected from each surface water location will be immediately stored in a sealable container with crushed ice and replacement sample bottles will be installed at the sites. Samples will then transported to the laboratory, where a Chain of Custody requesting analysis for total suspended solids will be completed.

Two types of in-stream samplers are being utilised.

(1) Rising Stage Samplers (RSS1 and RSS2) are being utilized upstream and downstream of the site on Granite Creek as shown in Figure 2. These samplers consist of three 1L bottles at heights of approximately 50cm, 1m and 1.5m above regular stream flow.

(2) Surface water sites (SW1, SW2, SW3) which are located in-stream on major drainage lines will utilise 1L Thermofisher Nalgene HDPE sampler bottle's to automatically collect sample once the stream rises high enough to fill the bottle (approximately 30cm above base stream height). Physio-chemical parameters and sample for laboratory analysis will be taken from the 1L containers retrieved at both the Rising Stage Samplers and the Nalgene automatic sampler sites.

Co-ordinates for sample sites are:

Table 2 Co-ordinates for Sample Sites

Name	Elevation (m)	Longitude (Decimal Degrees, GCS WGS 1984)	Latitude (Decimal Degrees, GCS WGS 1984)
RSS1	541.12	145.380664	-17.13217
RSS2	564.95	145.404239	-17.149893
SW1	561.44	145.382138	-17.142495
SW2	559.15	145.390973	-17.142175
SW3	578.85	145.401904	-17.15599

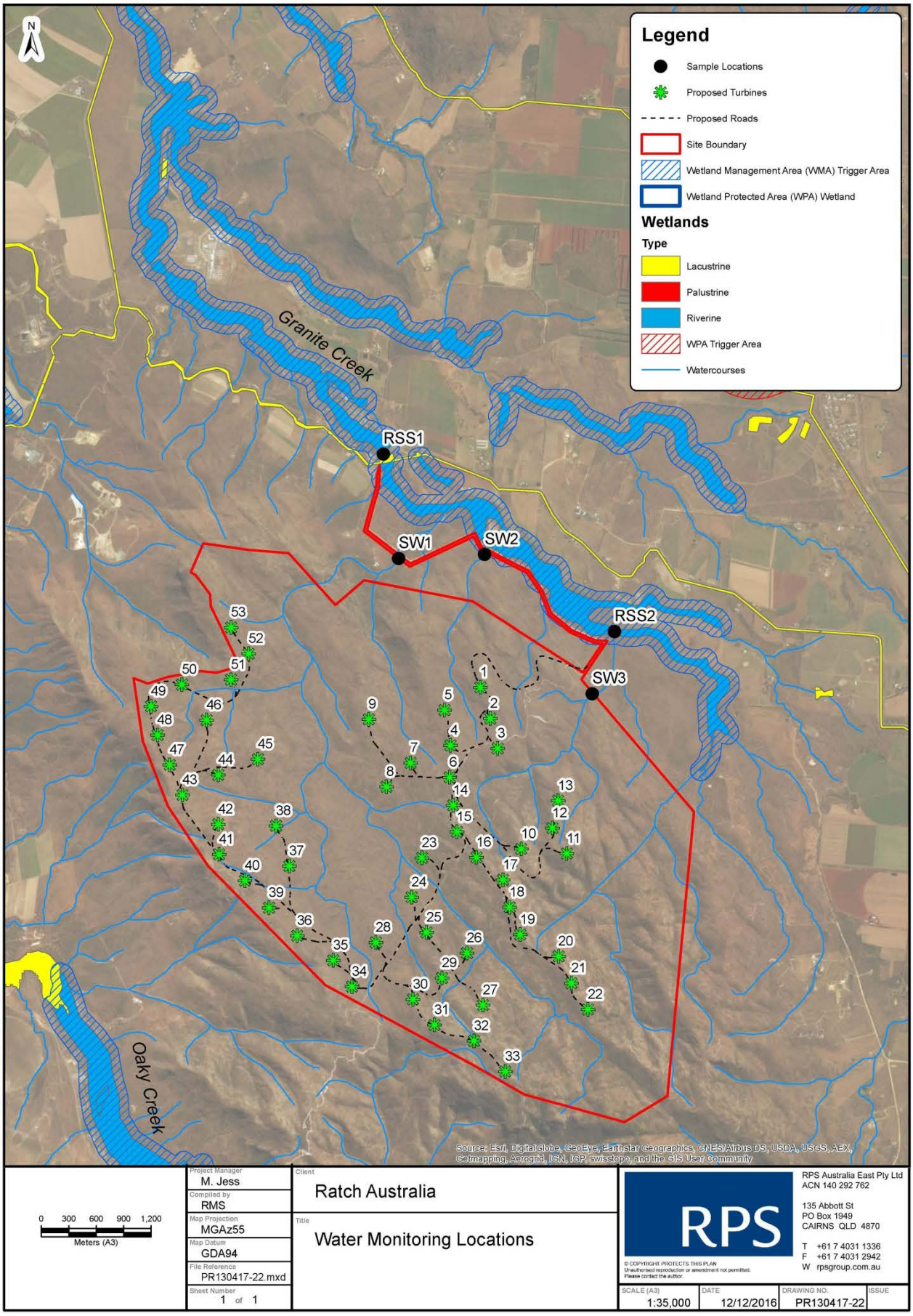


Figure 3 Water Quality Monitoring Locations

4.1.3 Trigger Levels

The Australia and New Zealand Environment Conservation Council (ANZECC) water quality guidelines for Fresh and Marine Water Quality (2000), which are widely adopted by regulatory authorities as the default guidelines, stipulate a minimum of two years of contiguous monthly data at the reference site is required before a valid trigger value can be established. Once 2 years of data has been collected the 80th percentile of the background data will be compared against the median of the test sites. If the median of the test sites is greater than 80th percentile of the background site than the trigger level will have been exceeded.

In the absence of this locally specific data, the Queensland Department of Environment and Heritage Protection (DEHP) Queensland Water Quality Guidelines 2009 (QWQG) have addressed the need identified in the ANZECC Guidelines by:

- Providing guideline values (numbers) that are tailored to Queensland regions and water types; and
- Providing a process/framework for deriving and applying local guidelines for waters in Queensland (i.e. more specific guidelines than those in the ANZECC).

Water quality guideline values presented in The Queensland Water Quality Guidelines (QWQG) will therefore be adopted as interim values until sufficient data has been collected to calculate locally relevant guideline values. Water Quality Objectives (WQO) are identified in **Table 3**.

Table 3 Water Quality Objectives

Parameter	Triggers	Guideline
Temp (^{0}C)	**22-32**	Based on Table 3.3.1a QWQG Regional guideline values for physico-chemical indicators – Wet Tropics region fresh and estuarine waters.
Electrical Conductivity (uS/cm)	**100**	Based on Table G.1: EC percentiles for Queensland salinity zones – 80th percentile
pH units	**6-8.0**	Based on Table 3.3.1a QWQG Regional guideline values for physico-chemical indicators – Wet Tropics region fresh and estuarine waters.
Turbidity (NTU)	**>10%**	Released waters from the discharge point(s) have turbidity (NTU) less than 10% above receiving waters turbidity. Based on Table 8.2.1 QWQG – Summary of design objectives for management of stormwater quality and flow.
Total Suspended Solids	**<50mg/L**	Based on Table 8.2.1 QWQG – Summary of design objectives for management of stormwater quality and flow.
Oils and Grease	**None**	No Visible films or odour
Litter	**None**	No visible litter washed or blown from the site

Source: Queensland Water Quality Guidelines 2009

4.2 Responsibilities

4.2.1 Water Quality Monitoring

A Environmental Scientist will be responsible for the implementation of the Water Quality Monitoring Program described in section 4 during the course of all construction activities. The Environmental Scientist will report to the Construction Contractor Manager and the MEWF Project Manager. These managers will ensure any necessary corrective actions are undertaken.

4.2.2 Erosion and Sediment Controls

Environmental Officers will be appointed by the Construction Contractor Manager. The Construction Contractor Environmental Officers (EO) will be responsible for monitoring and reporting the implementation of the Sediment, Erosion and Stormwater Management Plan. The Construction Contractor Environmental Officers will report to the Construction Contractor Project Manager.

5.0 Training

MEWF and its contractors will be responsible for ensuring project personnel have sufficient knowledge and awareness to identify potential environmental issues relating to soil erosion and stormwater management, and they are trained to take appropriate corrective action.

It is essential all personnel are familiar with the procedures and strategies within this document, and are able to report on issues that may result in environmental degradation.

5.1 Induction

All staff, including field staff, will complete a comprehensive Project Induction prior to commencing work on the Project. The induction will include safety, access and a comprehensive review of environmental requirements, which will be documented in an Induction Manual to be issued to all site personnel. All Project personnel from supervisory to managerial level will have an additional detailed training session on the use and implementation of this SWMP along with the EMP. It is the responsibility of the EPC managers to ensure records of training are maintained.

5.2 Toolbox Meetings

The EPC Manager will ensure supervisors hold at least weekly toolbox talks with staff and crews to discuss issues associated with the scheduled work.

This will include highlighting and discussing relevant erosion and stormwater management issues as required. The sessions will include discussion of strategies to be implemented and maintenance / construction of appropriate controls as necessary.

6.0 Conclusion

It is considered this SWMP will adequately manage water quality and soil erosion, along with the risk of adverse impacts associated with the proposed works on the site and receiving environment. In the instance management practices and procedures have been determined to be ineffective, corrective actions are to be identified and implemented. Following the identification of corrective actions, the SWMP will be updated to reflect these improvements.

Appendix I

Flow Diversion and Dissipation Examples

Outlet Structures

DRAINAGE CONTROL TECHNIQUE

Low Gradient		Velocity Control	✓	Short Term	✓
Steep Gradient		Channel Lining		Medium-Long Term	
Outlet Control	✓	Soil Treatment		Permanent	

Symbol

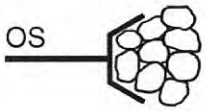


Photo 1 – Temporary *Slope Drain* with rock stabilisation at inlet and outlet

Photo 2 – Temporary rock mattress outlet structure at end of a *Chute*

Key Principles

1. The primary performance objectives generally relate to minimising the risk of soil erosion at the outlet, and preventing excessive undermining of the pipe and/or headwall.
2. Critical design parameters are the mean rock size (d_{50}) and length of rock protection (L).
3. The recommended rock sizing design charts/tables are based on the acceptance of some degree of rock movement (rearrangement) following initial storm events.
4. Critical construction issues relate to the provision of suitable rock (size and density), suitable pad dimensions (width, length and depth), and suitably recessing/integrating the rocks into the outlet channel to allow outflows to pass evenly over the rocks.

Design Information – General:

The design procedures presented in this fact sheet are <u>not</u> appropriate for the design of energy dissipaters for Sediment Basin spillways. Designers are advised to always seek expert hydraulic advice regarding the appropriate use of the material supplied within this fact sheet.

The following information is appropriate for the design of loose rock outlet structures for small Slope Drains (300/375mm diameter) and minor batter Chutes (<300mm flow depth).

Recommended mean (d_{50}) rock sizes and length (L) of rock protection for ***Slope Drain*** outlets are presented in Tables 2 and 3 for smooth and rough internal sidewall pipes respectively.

Recommended mean (d_{50}) rock sizes and length (L) of rock protection for minor batter ***Chute*** outlets are presented in Tables 4 and 5. These rock sizes are based on information presented within ASCE (1992) rounded up to the next 100mm increment, with a minimum rock size set as 100mm.

The thickness of the rock pad should be based on at least two layers of rock. This typically results in a minimum thickness as presented in Table 1.

Table 1 – Minimum thickness (T) of rock pad

Min. Thickness (T)	Size distribution (d_{50}/d_{90})	Description
1.4 d_{50}	1.0	Highly uniform rock size
1.6 d_{50}	0.8	Typical upper limit of quarry rock
1.8 d_{50}	0.67	Recommended lower limit of distribution
2.1 d_{50}	0.5	Typical lower limit of quarry rock

[1] d_{50} = nominal rock size (diameter) of which 50% of the rocks are smaller (i.e. the mean rock size).

Design Information – Outlet structures for Slope Drains:

Table 2 – Mean rock size (mm) and length (m) of rock pad outlet structure for smooth internal sidewall slope drain

Pipe diameter: 300 and 375mm							Smooth internal sidewall: n = 0.01						
Pipe slope (X:1)	Pipe discharge (L/s)												
	30	40	50	60	70	80	100	120	140	160	180	200	220
10	150	150	150	150	150	150	200	200	200	200	200	300	300
8	150	150	150	150	150	150	200	200	200	200	300	300	300
7	150	150	150	150	150	150	200	200	200	300	300	300	300
6	150	150	150	150	150	200	200	200	300	300	300	300	300
5	150	150	150	150	200	200	200	200	300	300	300	300	300
4	150	150	150	200	200	200	200	300	300	300	300	300	300
3	150	150	200	200	200	200	300	300	300	300	300	300	300
2	150	200	200	200	200	300	300	300	300	300	400	400	400
1	200	200	300	300	300	300	300	400	400	400	400	400	400
L [1]	1.1	1.2	1.5	1.5	1.5	1.5	1.7	2.0	2.0	2.0	2.1	2.1	2.5

[1] Recommended minimum length (m) of rock pad outlet structure.

Table 3 – Mean rock size (mm) and length (m) of rock pad outlet structure for rough internal sidewall slope drain

Pipe diameter: 300 and 375mm							Rough internal sidewall: n = 0.03						
Pipe slope (X:1)	Pipe discharge (L/s)												
	30	40	50	60	70	80	100	120	140	160	180	200	220
10	150	150	150	150	150	150	150	150	150	150	150	150	150
8	150	150	150	150	150	150	150	150	150	150	150	150	150
7	150	150	150	150	150	150	150	150	150	150	150	150	150
6	150	150	150	150	150	150	150	150	150	150	150	150	150
5	150	150	150	150	150	150	150	150	150	150	150	150	150
4	150	150	150	150	150	150	150	150	150	150	150	150	200
3	150	150	150	150	150	150	150	150	150	150	200	200	200
2	150	150	150	150	150	150	150	150	200	200	200	200	200
1	150	150	150	150	150	150	200	200	200	200	300	300	300
L [1]	1.6	1.8	1.9	2.1	2.2	2.3	2.5	2.6	2.8	2.9	3.1	3.2	3.3

[1] Recommended minimum length (m) of rock pad outlet structure.

Technical Note – Development of Tables 2 and 3

Many of the rock sizing charts traditionally presented for the design outlet structures can attribute their origins to the published work of Bohan (1970). This research work was based on low gradient flow conditions where the pipe is flowing full just upstream of the outlet, and during low tailwater conditions, the flow passed through critical depth at or near the outlet of the pipe. Such flow conditions are not consistent with the high-velocity, partial-full flow expected at the base of a slope drain.

The rock sizes and pad lengths presented in Tables 2 and 3 have been determined by firstly determining the partial-full, supercritical flow velocity expected at the base of a slope drain for a given discharge, internal pipe roughness, and slope gradient. Secondly an equivalent pipe diameter was determined that would have a full-pipe discharge and velocity equivalent to that determined above. Using this equivalent pipe diameter and actual discharge velocity, the design charts presented by Bohan for low tailwater conditions were used to determine the required mean rock size and length of rock protection. The rock sizes where then rounded up to the nearest 100mm rock size, with a minimum rock size set as 150mm.

The typical layouts of a rock pad for a *Slope Drain* is shown in Figure 1. The rock pad should straight and align with the direction of the pipe outlet.

If the width of the rock pad is governed by the width of the receiving channel, then the rock protection should ideally extend up the banks of the channel to a height no less than the central elevation of the pipe outlet, but no more than the expected depth of flow.

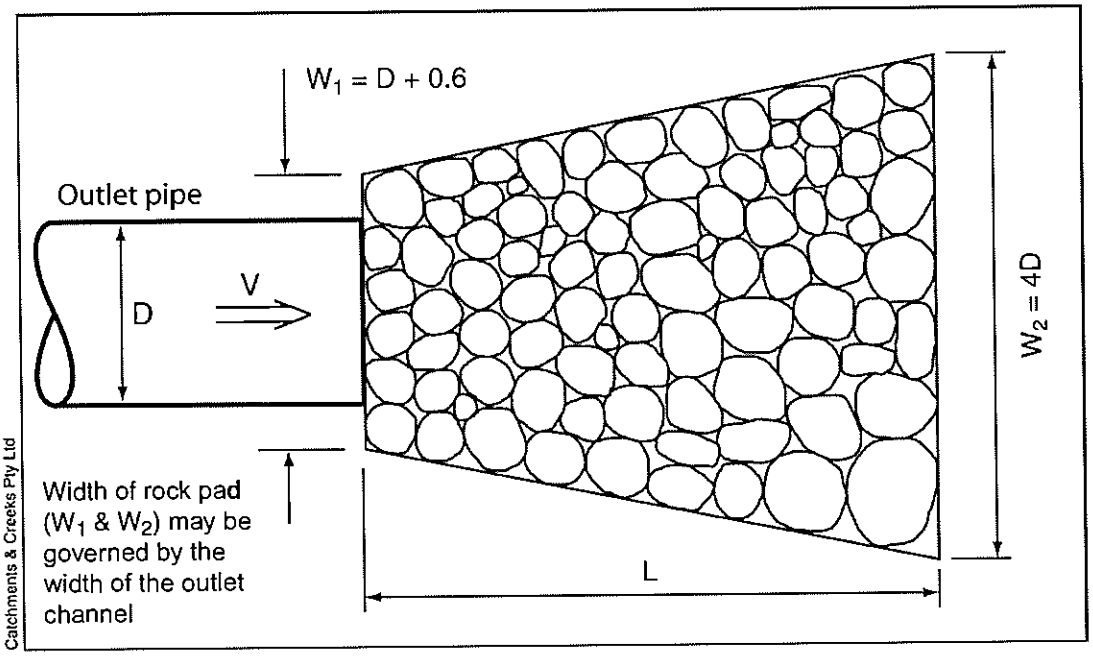


Figure 1 – Typical layout of a rock pad for a single pipe outlet (plan view)

The outlet structure for *Slope Drains* should be constructed at a level grade, or a gradient equal to that of the receiving channel.

The surface level of the downstream end of the rock pad should be level with the invert of the receiving channel, i.e. the rocks should be recessed into the outlet channel to minimise the risk of erosion around the outer edges of the rock pad.

The placement of filter cloth under the rock pad is generally considered optional for temporary outlet structures placed at the end of *Slope Drains*.

Design Information – Outlet structures for temporary drainage Chutes:

Table 4 – Mean rock size, d_{50} (mm) for batter *Chute* outlet protection [1]

Depth of approach flow (mm) [2]	Flow velocity at base of *Chute* (m/s)						
	2.0	3.0	4.0	5.0	6.0	7.0	8.0
50	100	100	100	200	200	200	300
100	100	100	200	200	300	300	400
200	100	200	300	300	400	[3]	[3]
300	200	200	300	400	[3]	[3]	[3]

[1] For exit flow velocities not exceeding 1.5m/s, and where growing conditions allow, loose 100mm rock may be replaced with 75mm rock stabilised with a good cover of grass.

[2] Flow depth is based on the maximum depth, not the average flow depth.

[3] Consider using 400mm grouted rock pad, or a rock-filled mattress outlet.

The outlet pad lengths provided in Table 5 are suitable for temporary, rock-lined outlet structures only. These rock pad length will not necessarily fully contain all energy dissipation and flow turbulence; therefore, some degree of scour may still occur downstream of the outlet structure.

For permanent structures, or concrete-lined energy dissipaters, the length of the dissipater should be based on the estimated length of the resulting hydraulic jump. Also, in circumstances where the outlet structure is located downstream of a smooth surface chute, e.g. concrete-lined chutes, then the rocks should be grouted in place to avoid displacement.

Table 5 – Recommended length, L (m) of rock pad for batter *Chute* outlet protection [1]

Depth of approach flow (mm)	Flow velocity at base of *Chute* (m/s)						
	2.0	3.0	4.0	5.0	6.0	7.0	8.0
50	1.0	1.5	2.1	2.6	3.1	3.6	4.2
100	1.3	2.0	2.7	3.4	4.1	4.8	5.5
200	2.1	2.7	3.4	4.3	5.2	6.1	7.0
300	2.7	3.6	4.3	4.8	5.8	6.8	7.9

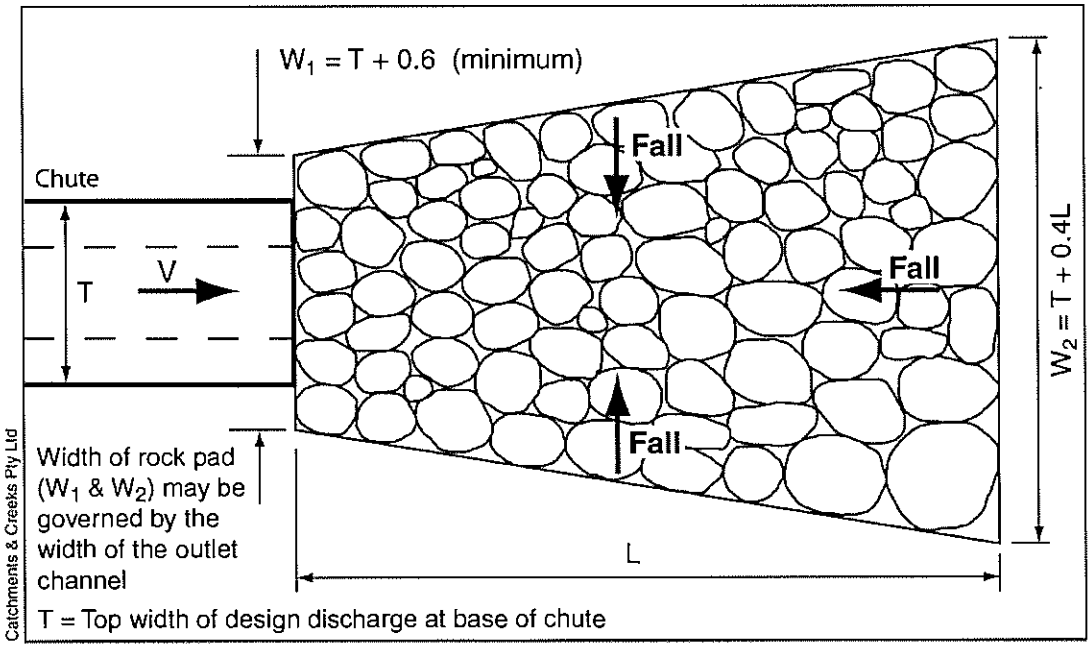


Figure 2 – Typical layout of a recessed rock pad for a *Chute* (plan view)

As indicated in Figures 2, 3 and 4, outlet structures for minor batter *Chutes* should be recessed below the surrounding ground level to promote effective energy dissipation. The recommended recess depth (Z) can be determined from Table 6.

Table 6 – Recommended recess depth, Z (m) for batter *Chute* outlet protection

Depth of approach flow (mm)	Flow velocity at base of *Chute* (m/s)						
	2.0	3.0	4.0	5.0	6.0	7.0	8.0
50	0.13	0.20	0.28	0.36	0.43	0.50	0.60
100	0.14	0.23	0.32	0.42	0.50	0.60	0.70
200	0.12	0.21	0.31	0.42	0.50	0.60	0.70
300	0.07	0.16	0.25	0.35	0.44	0.55	0.65

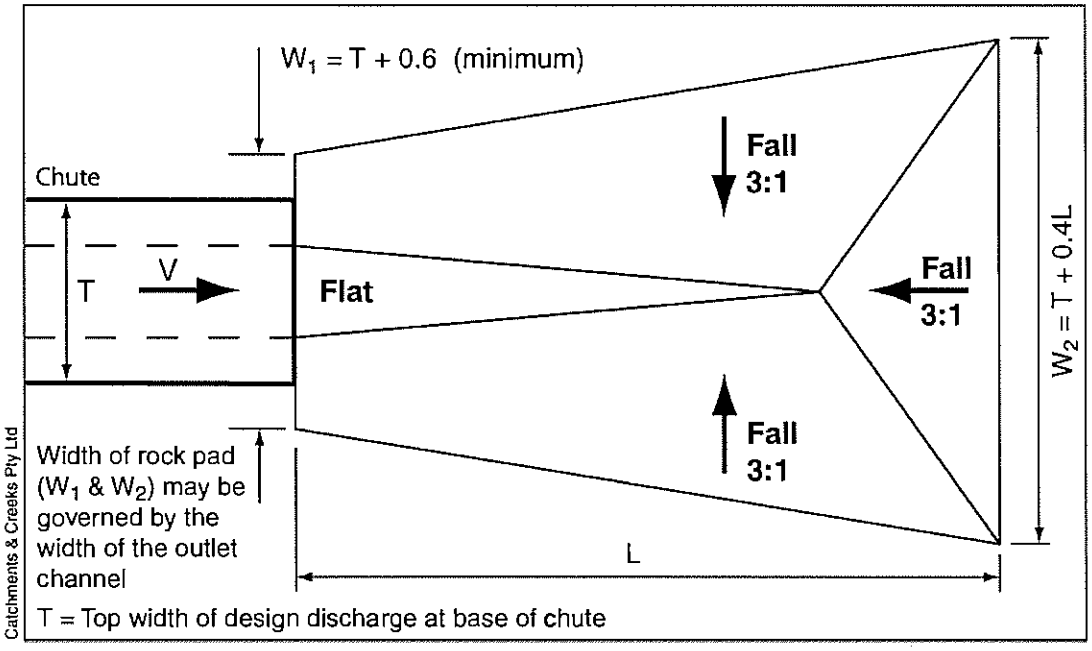


Figure 3 – Typical arrangement of recessed outlet structure for minor *Chutes*

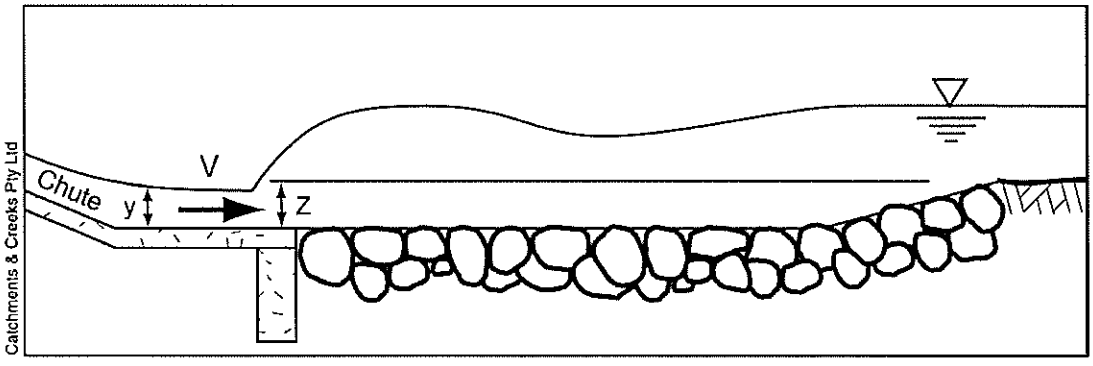


Figure 4 – Typical profile of recessed outlet structure for minor *Chutes*

References:

ASCE 1992, *Design and construction of urban stormwater management systems.* ASCE Manuals and Reports of Engineering Practice No. 77, and Water Environment Federation Manual of Practice FD-20, American Society of Civil Engineers, New York.

Bohan, J.P. 1970, *Erosion and riprap requirements at culvert and storm-drain outlets.* Research Report H-70-2, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Design example 1 – Slope drain outlet structure:

Design the outlet protection for a temporary slope drain with a diameter (D) of 300mm, smooth internal sidewall, and design discharge of 100L/s.

Solution

Given D = 300mm and Q = 100L/s, the recommended mean rock size as obtained from Table 2 is d_{50} = 300mm and L = 1.7m.

Upstream width of the rock pad, W1 = D + 0.6 = 0.9m (see Figure 1).

Downstream width of the rock pad, W2 = 4D = 1.2m

If it is assumed that the largest rock is likely to be around 1.5 times the size of the average rock size, i.e. d_{50}/d_{90} approximately equals 0.67, then from Table 1 we can obtain the required depth of rock protection as, T = 1.8(d_{50}) = 0.54m. In any case, a minimum of two layers of rock should be specified on the construction plans.

Design example 2 – Chute outlet structure:

Design the outlet protection for a temporary, trapezoidal chute lined with filter cloth on a 3:1 batter slope with a base width of 1.0m, side slopes of 2:1, and design discharge of 600L/s.

Solution

Adopting a Manning's roughness of, n = 0.022 for the filter cloth, the flow conditions at the base of the chute can be determined from Manning's equation as:

Discharge, Q = 0.6m^3/s

Manning's roughness, n = 0.022 (based on an expected flow depth > 0.1m)

Channel slope, S = 0.333 (m/m)

Bed width, b = 1.0m

Channel side slope, m = 2:1

Flow depth, y = 0.1m

Flow top width, T = b + 2my = 1.4m

Hydraulic radius, R = 0.083m

Velocity, $$V = \frac{1}{n}R^{2/3}S^{1/2} = \frac{1}{0.022}(0.083)^{2/3}(0.333)^{1/2} = 5.0\text{m/s}$$

From Table 4 the mean rock size, d_{50} = 200mm

From Table 5 the length of the rock pad, L = 3.4m

From Table 6 the recommended recess depth, Z = 0.42m

From Figure 3 the upstream width of the rock pad, W1 = T + 0.6 = 2.0m

From Figure 3 the downstream width of the rock pad, W2 = T + 0.4L = 2.8m

If it is assumed that the largest rock is likely to be around 1.5 times the size of the average rock size, i.e. d_{50}/d_{90} approximately equals 0.67, then from Table 1 we can obtain the required depth of rock protection as, T = 1.8(d_{50}) = 0.36m. In any case, a minimum of two layers of rock should be specified on the construction plans.

Note, the symbol 'T' has traditionally been used for both the depth of rock protection (as in Example 1), and the top width of flow (as in Example 2).

Description

The term *Outlet Structure* refers to a wide range of outlet control devices including rock pads, rock mattress aprons, and various impact-type energy dissipaters.

The standard outlet structure consists of a pad of medium sized rock placed at the outlet of *Slope Drain*, *Chute*, stormwater pipe or culvert.

Purpose

Used to control soil erosion adjacent to the outlet and to dissipate flow energy.

Limitations

These rock pads are generally ineffective in controlling erosion caused by high-velocity outlet 'jetting' occurring during high tailwater conditions.

Advantages

Quick to install.

The rock can often be retained as a permanent erosion control measure.

Disadvantages

If the rock is not appropriately recessed into the surrounding soil, erosion can occur around the edge of the rock pad.

Common Problems

Inadequate rock size.

Inadequate length, width or depth of rock protection.

Rock not recessed into the channel bed.

Erosion along the outer edge of the rock pad caused by lateral inflows (i.e. water flowing towards the outlet from a location other than the pipe).

Special Requirements

Important to recess the rock so that the top of the rock pad is level with the surrounding earth surface.

The rock should extend downstream until non-erosive flow conditions are achieved. In some cases this may require the rock protection to be extended beyond standards outlet dimensions determined from the attached design tables.

Location

Rock pad outlet structures are constructed downstream of temporary *Chutes* and *Slope Drains*, as well as permanent stormwater outlets and culverts.

Site Inspection

Check for erosion around the edge of the rock pad.

Ensure the rocks are adequately recessed into the earth.

Check for excessive displacement of rocks. Some degree of rock movement should be expected, especially immediately down-stream of the pipe or concrete apron.

Check for excessive sediment deposition.

Materials (Rock pads)

- Rock: hard, angular, durable, weather resistant and evenly graded with 50% by weight larger than the specified nominal rock size and sufficient small rock to fill the voids between the larger rock. The diameter of the largest rock size should be no larger than 1.5 times the nominal rock size. Specific gravity to be at least 2.5.
- Geotextile fabric: heavy-duty, needle-punched, non-woven filter cloth, minimum 'bidim' A24 or equivalent.

Installation (Rock pads)

1. Refer to approved plans for location and construction details. If there are questions or problems with the location, dimensions or method of installation contact the engineer or responsible on-site officer for assistance.
2. The dimensions of the outlet structure must align with the dominant flow direction.
3. Excavate the outlet pad footprint to the specified dimension such the when the rock is placed in the excavated pit the top of the rocks will be level with the surrounding ground, unless otherwise directed.
4. If the excavated soils are dispersive, over-excavated the rock pad by at least 300mm and backfill with stable, non-dispersive material.
5. Line the excavated pit with geotextile filter cloth, preferably using a single sheet. If joints are required, overlap the fabric at least 300mm.
6. Ensure the filter cloth is protected from punching or tearing during installation of the fabric and the rock. Repair any damage by removing the rock and placing with another piece of filter cloth over the damaged area overlapping the existing fabric a minimum of 300mm.
7. Ensure there are at least two layers of rocks. Where necessary, reposition the larger rocks to ensure two layers of rocks are achieved without elevating the upper surface above the pipe invert.
8. Ensure the rock is placed in a manner that will allow water to discharge freely from the pipe.
9. Ensure the upper surface of the rock pad does not cause water to be deflected around the edge of the rock pad.
10. Immediately after construction, appropriately stabilise all disturbed areas.

Maintenance

1. While construction works continue on the site, inspect the outlet structure prior to forecast rainfall, daily during extended periods of rainfall, after significant runoff producing rainfall, and on at least a weekly basis.
2. Replace any displaced rock with rock of a significantly (minimum 110%) larger size than the displaced rock.

Removal

1. Temporary outlet structures should be completely removed, or where appropriate, rehabilitated so as not to cause ongoing environmental nuisance or harm.
2. Following removal of the device, the disturbed area must be appropriately rehabilitated so as not to cause ongoing environmental nuisance or harm.
3. Remove materials and collected sediment and dispose of in a suitable manner that will not cause an erosion or pollution hazard.

Level Spreaders

DRAINAGE CONTROL TECHNIQUE

Low Gradient	✓	Velocity Control		Short Term	✓
Steep Gradient	[1]	Channel Lining		Medium-Long Term	✓
Outlet Control	✓	Soil Treatment		Permanent	✓

[1] Level spreaders can release sheet flow down steep slopes, but the level spreader itself must be constructed across a level gradient.

Symbol

Photo 1 – Diversion drains (centre) collect stormwater from roadside table drains, then releases the water as sheet flow via a level spreader

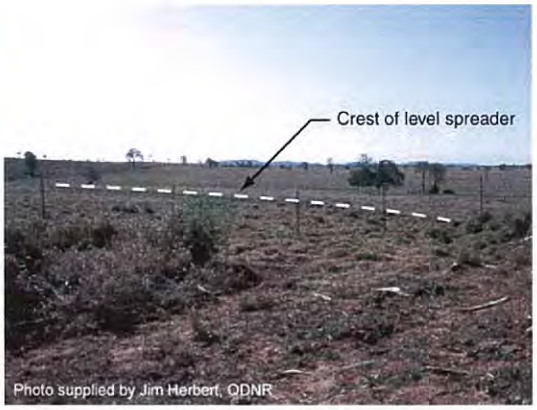


Photo 2 – Level spreader established to discharge stormwater from a diversion drain into the roadside property

Key Principles

1. Flow must be released from the level spreader as *sheet flow*.
2. Flow must be released over a stable, well-grassed surface that will maintain suitable flow conditions down the slope.
3. Critical design parameter is the length of the outlet sill.
4. Critical operational parameter is the level construction of the outlet sill.

Design Information

The length of the outlet sill (weir) of the level spreader is governed by the design discharge, and the allowable flow velocity of the down-slope area.

Allowable flow velocity for grassed surfaces can be determined from Table 1.

Minimum dimension can be determined from Tables 2 and 3.

Minimum sill length is 4m.

Maximum sill length is 25m. If a longer sill length is required, then the inflow must be spilt and released through more than one level spreader.

Up-slope channel grade should not exceed 1% for the last 6m before entering the level spreader.

Discharge must release evenly along a level surface (sill) of 0% cross gradient.

Caution the use of a design discharge exceeding 0.85m^3/s.

Caution the release of water onto grass slopes steeper than 10%.

Table 1 – Allowable flow velocity (m/s) for grassed surfaces [1]

Percentage grass cover	Gradient of grass surface (%)									
	1	2	3	4	5	6	8	10	15	20
70% [2]	2.0	1.8	1.7	1.6	1.6	1.5	1.5	1.4	1.3	1.3
100% [3]	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.8	1.7
Poor soils [3]	1.5	1.4	1.3	1.2	1.2	1.1	1.1	1.1	1.0	0.9

[1] Maximum allowable flow velocity limited to 2.0m/s due to shallow water flow and resulting high shear stress. High flow velocities are allowable on reinforced grass.

[2] 70% cover would be typical for most grasses recently established by seed, but only when there is sufficient plant establishment time.

[3] 'Poor soils' refers to the soil's high erosion potential, such as dispersive clays (Emerson Class 1 and 2) such as sodic, yellow and red soils. Unstable, dispersible clayey sands and sandy clays, such as yellow and grey massive earths formed on sandstones and some granites. Highly erodible soils may include: lithosols, alluvials, podzols, siliceous sands, soloths, solodized solonetz, grey podzolics, some black earths, fine surface texture-contrast soils, and Soil Groups ML and CL.

Table 2 – Level spreader sill length – metres per unit discharge (m per m³/s) [1]

Land slope (%)	Allowable down-slope velocity over well grassed surface (m/s)						
	1.0	1.2	1.5	1.8	2.0	2.2	2.5
1.0	3.5*	2.5*	1.6*	1.1*	0.9*	0.8*	0.6*
2.0	5.2	3.8*	2.5*	1.8*	1.4*	1.2*	0.9*
3.0	6.6	4.8	3.2*	2.3*	1.8*	1.5*	1.2*
4.0	7.7	5.6	3.8*	2.7*	2.2*	1.8*	1.4*
5.0	8.7	6.3	4.3*	3.1*	2.5*	2.1*	1.6*
6.0	9.5	7.0	4.7	3.4*	2.8*	2.3*	1.8*
7.0	10.3	7.6	5.2	3.7*	3.1*	2.6*	2.0*
8.0	11.0	8.2	5.6	4.0*	3.3*	2.8*	2.2*
9.0	11.8	8.7	6.0	4.3*	3.5*	3.0*	2.4*
10.0	12.4	9.2	6.3	4.6*	3.8*	3.2*	2.5*
Caution the release of water onto grass slopes steeper than 10%.							
15.0	15.2	11.3	7.8	5.7	4.8	4.0*	3.2*
20.0	17.4	13.1	9.1	6.7	5.6	4.7	3.7*
25.0	19.4	14.6	10.3	7.6	6.3	5.3	4.3*
33.3	22.1	16.8	11.9	8.8	7.4	6.2	5.0
50.0	26.6	20.3	14.5	10.8	9.1	7.8	6.3

* Sill length limited to minimum 4m for discharges less than 0.85m^3/s.

Design example:

Design a level spreader to release a flow rate of 0.5m^3/s down a 10% slope containing a good (70%) grass cover on moderately erodible soil.

Solution:

From Table 1, choose a maximum flow velocity of 1.4m/s as best representative of a good grass cover on a moderately erodible soil.

From Table 2, select a sill width per unit flow rate of 7.3m/m^3/s.

Therefore, the sill length would need to be 0.5 x 7.3 = 3.65m < 4m (minimum).

Conclusion, specify a sill length of 4m.

The minimum sill lengths presented in Table 2 have been determined assuming a Manning's roughness for 50-150mm (Class D) grassed surfaces based on Equation 1. The sill length is sensitive to the selection of Manning's roughness. Variations between Table 2 and other published design tables for is due to variations in the assumed Manning's roughness, which is highly variable depending on the type and length of grass, and local growing conditions.

Class D roughness:
$$n = \frac{R^{1/6}}{51.24 + 20.77 \log_{10}(R^{1.4}.S^{0.4})} \quad \text{(Eqn 1)}$$

Table 3 – Minimum dimension of level spreader

Discharge (m^3/s)	Entrance width (m)	Depth (m)	End width (m)
0 to 0.28	3.0	0.15	0.9
0.29 to 0.57	4.9	0.18	0.9
0.58 to 0.85	7.3	0.21	0.9

Construction of a level spreader may require formation of flow control banks as shown in Figures 1 to 3.

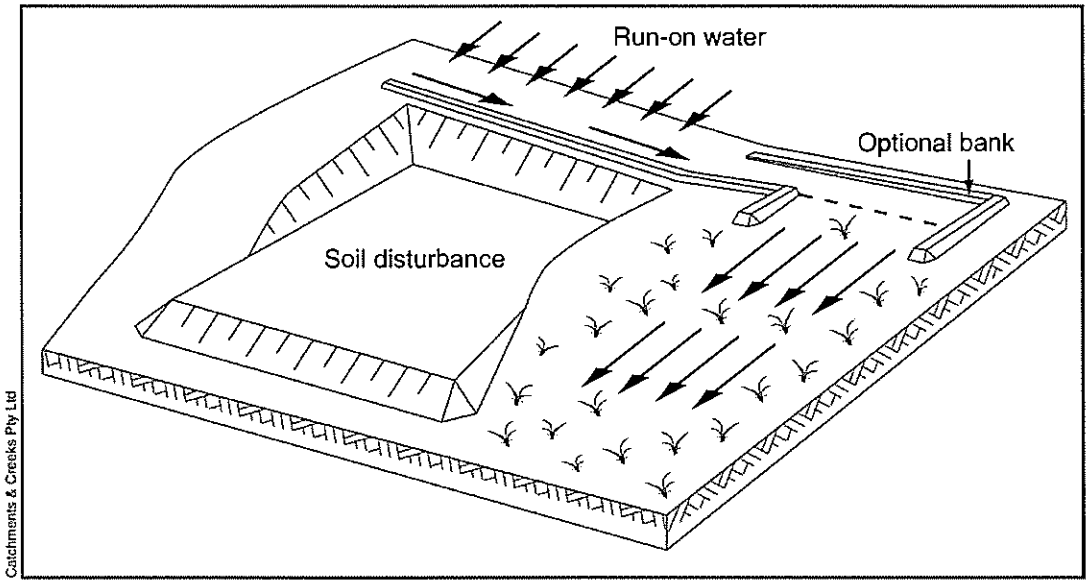


Figure 1 – Example of a level spreader used for flow diversion around a soil disturbance

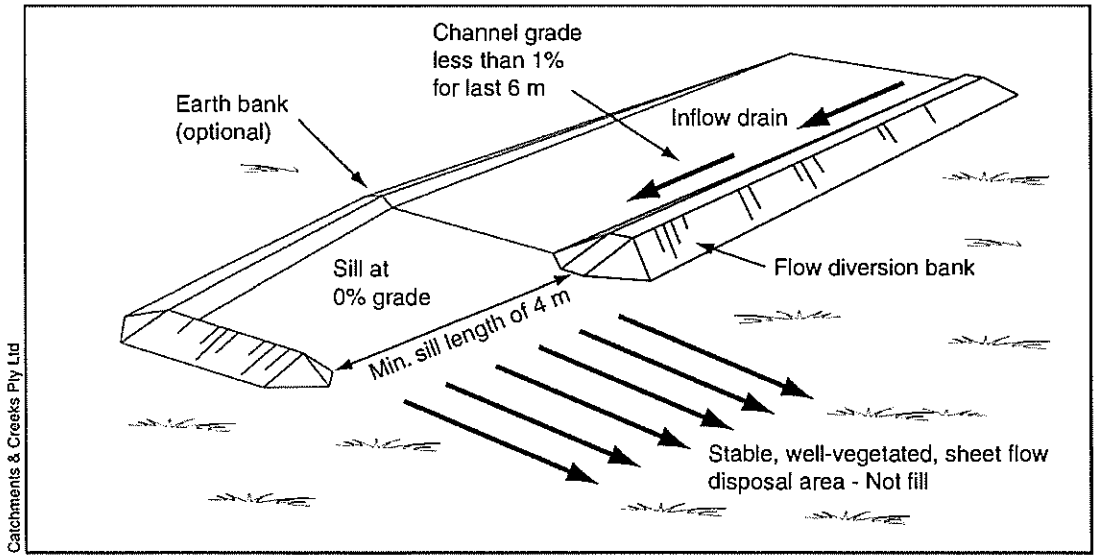


Figure 2 – Typical layout of level spreader

Description

Level spreaders consist of a level, grassed, side-flow weir (i.e. water discharges at 90 degrees to the inflow direction) constructed along the contour.

Purpose

Used to allow concentrated inflow to be released as *sheet flow* down a stable, vegetated slope.

Can be used as an outlet for *Catch Drains* and *Flow Diversion Banks*.

Level spreaders are commonly used in rural areas to discharge stormwater from roadside table drains into an adjacent property (Photos 1 & 2).

Limitations

Minimum sill length of 4m.

Maximum sill length of 25m.

Maximum discharge of around 0.85m^3/s.

Must only be used where the outflow can be discharged to an undisturbed; stable, grassed surface.

Construction traffic should be prohibited from the area of the level spreader.

Not suitable for highly erosive soils, dispersive soils, or soils with poor vegetation cover.

Advantages

Inexpensive to construct and maintain.

Disadvantages

Can be difficult to construct the outlet sill to the required precision.

May require a considerable width of undisturbed land.

May require the land to be free of trees, shrubs and other surface irregularities to avoid local erosion problems.

Common Problems

The most common problems result from damage to the outlet sill either from erosion, sedimentation, or stock.

Other problems can result from water flow concentrating below the level spreader due to the existence of a concave surface, vehicular tracks, or uneven vegetation cover.

Special Requirements

Outlet area must be free of depressions that may concentrate the outflow.

Extra erosion protection using jute mesh, *Erosion Control Mats*, turf, rock etc. may be required at the sill (Figure 4).

Generally constructed by dozers no larger than D5 or equivalent.

Extreme caution must be exercised when attempting to discharge *sheet flow* down a steep gradient (>10%) to ensure that the sedimentation or damage to the outlet sill does not concentrate the outflow.

Site Inspection

Check for sediment build-up on the sill, or the concentration of outflow.

Check for erosion down-slope of the sill.

Installation

1. Refer to approved plans for location, dimensions and construction details. If there are questions or problems with the location, dimensions, or method of installation contact the engineer or responsible on-site officer for assistance.
2. Wherever practical, locate the level spreader on undisturbed, stable soil.
3. Ensure flow discharging from the level spreader will disperse across a properly stabilised slope not exceeding 10:1 (H:V) and sufficiently even in grade across the slope to avoid concentrating the outflow.
4. The outlet sill of the spreader should be protected with erosion control matting to prevent erosion during the establishment of vegetation. The matting should be a minimum of 1200mm wide extending at least 300mm upstream of the edge of the outlet crest and buried at least 150mm in a vertical trench. The downstream edge should be securely held in place with closely spaced heavy-duty wire staples at least 150mm long.
5. Ensure that the outlet sill (crest) is level for the specified length.
6. Immediately after construction, turf, or seed and mulch where appropriate, the level spreader.

Maintenance

1. Inspect the level spreader after every rainfall event until vegetation is established.
2. After establishment of vegetation over the level spreader, inspections should be made on a regular basis and after runoff-producing rainfall.
3. Ensure that there is no soil erosion and that sediment deposition is not causing the concentration of flow.
4. Ensure that there is no soil erosion or channel damage upstream of the level spreader, or soil erosion or vegetation damage downstream of the level spreader.
5. Investigate the source of any excessive sedimentation.
6. Maintain grass in a health condition with no less than 90% cover unless current weather conditions require otherwise.
7. Grass height should be maintained at a minimum 50mm blade length within the level spreader and downstream discharge area, and a maximum blade length no greater than adjacent grasses.

Removal

1. Temporary level spreaders should be decommissioned only after an alternative stable outlet is operational, or when the inflow channel is decommissioned.
2. Remove collected sediment and dispose of in a suitable manner that will not cause an erosion or pollution hazard.
3. Remove and appropriately dispose of any exposed geotextile.
4. Grade the area and smooth it out in preparation for stabilisation.
5. Stabilise the area as specified on the approved plan.

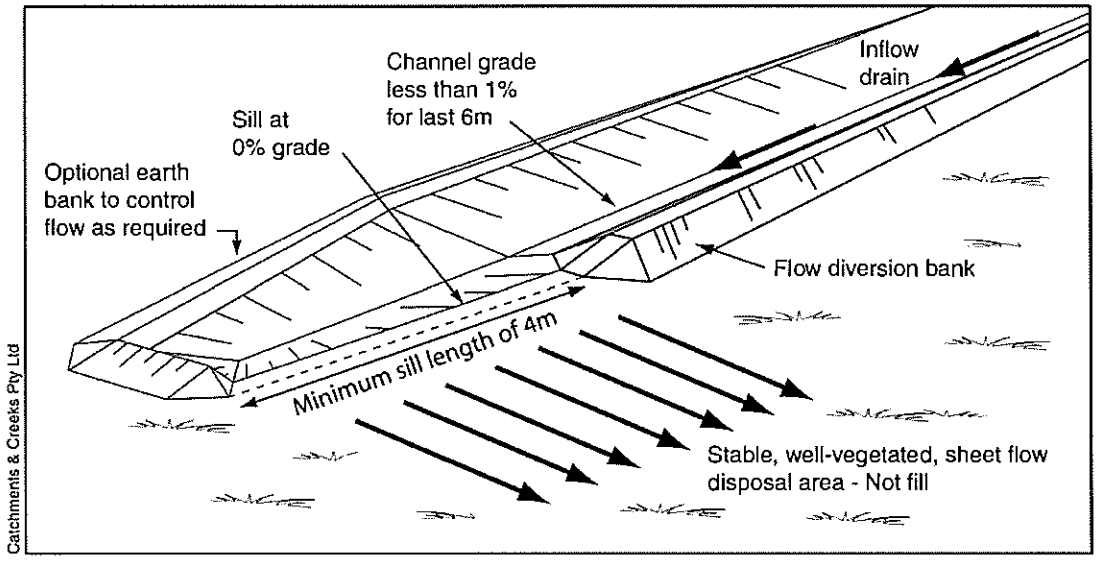


Figure 3 – Alternative level spreader layout

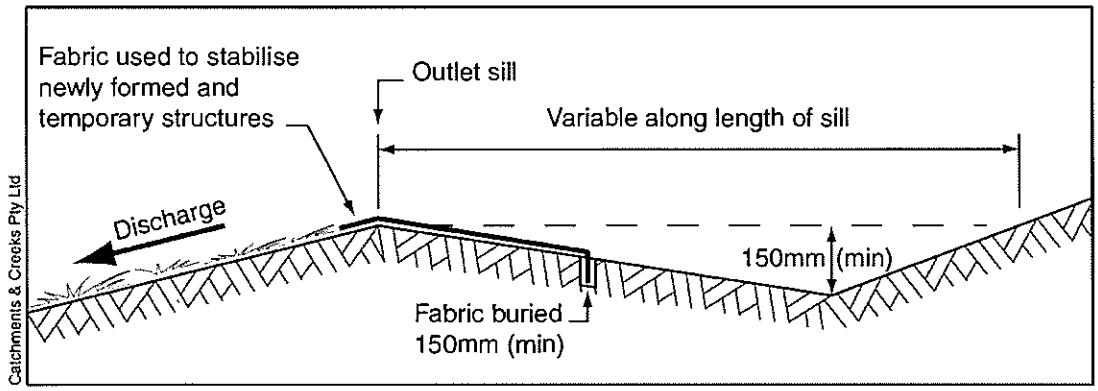


Figure 4 – Cross-sectional profile of end sill

Flow Diversion Banks Part 1: General

DRAINAGE CONTROL TECHNIQUE

Low Gradient	✓	Velocity Control		Short Term	✓
Steep Gradient		Channel Lining		Medium-Long Term	✓
Outlet Control		Soil Treatment		Permanent	[1]

[1] Flow diversion banks are not commonly used as permanent drainage structures.

Symbol → DB →

Photo 1 – Flow diversion bank down-slope of a future pipeline installation

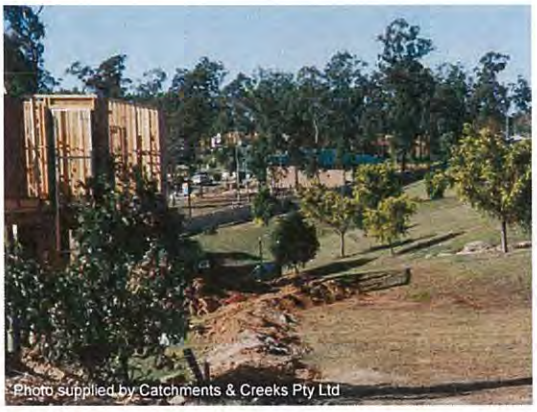


Photo 2 – Flow diversion bank up-slope of a building site

Key Principles

1. Key design parameters are the effective flow capacity of the structure, and the scour resistance of the embankment material.
2. The critical operational issue is usually preventing structural damage to the embankment as a result of high velocity flows or construction traffic.
3. Flow diversion banks are often favoured over *Catch Drains* in areas containing dispersive subsoil because their construction does not require exposure of the subsoils.

Design Information

Dimensional requirements of flow diversion banks and berms vary with the type of embankment. The recommended values are outlined in Table 1.

Table 1 – Recommended dimensional requirements of flow diversion banks/berms

Parameter	Earth banks	Compost berms [1]	Sandbag berms
Height (min)	500mm	300mm (450mm)	N/A
Top width (min)	500mm [2]	100mm (100mm)	N/A
Base width (min)	2500mm [2]	600mm (900mm)	N/A
Side slope (max)	2:1 (H:V)	1:1 (H:V)	N/A
Hydraulic freeboard	150mm (300mm) [3]	100mm	50mm

[1] Values in brackets apply to berms placed across land slopes steeper than 4:1 (H:V).

[2] Top width may be reduced in those non-critical situations in which overtopping will not cause excessive erosion and the banks are unlikely to experience damage from construction equipment.

[3] A minimum freeboard of 300mm applies to non-vegetated earth embankments.

Free standing earth embankments may be stabilised with rock, vegetation, or *Erosion Control Blankets*; however, unprotected topsoil embankments are also acceptable for short-term applications.

Maximum recommended spacing of flow diversion banks down long continuous slopes is provided in Table 2. The actual spacing specified for a given site may need to be less than that presented in Table 2 if the soils are highly susceptible to erosion, or if intense storm events are expected (i.e. northern parts of Australia during the wet season).

Table 2 – Maximum recommended spacing of flow diversion banks down slopes

Open Earth Slopes						Vegetated Slopes		
Slope	**Horiz.**	**Vert.**	**Slope**	**Horiz.**	**Vert.**	**Slope**	**Horiz.**	**Vert.**
1%	80m	0.9m	15%	19m	2.9m	< 10%	No maximum	
2%	60m	1.2m	20%	16m	3.2m	12%	100m	12m
4%	40m	1.6m	25%	14m	3.5m	15%	80m	12m
6%	32m	1.9m	30%	12m	3.5m	20%	55m	11m
8%	28m	2.2m	35%	10m	3.5m	25%	40m	10m
10%	25m	2.5m	40%	9m	3.5m	30%	30m	9m
12%	22m	2.6m	50%	6m	3.0m	> 36%	Case specific	

Photo 3 – Flow diversion berm used to minimise road runoff flowing down a steep, unstable section of the embankment

Photo 4 – Sandbag flow diversion berm used to minimise surface flow over a recently seeded embankment

Photo 5 – Earth flow diversion bank used to direct runoff towards the entrance of a *Slope Drain*

Photo 6 – Turf-lined flow diversion bank with grass-lined outlet chutes at regular intervals along the embankment

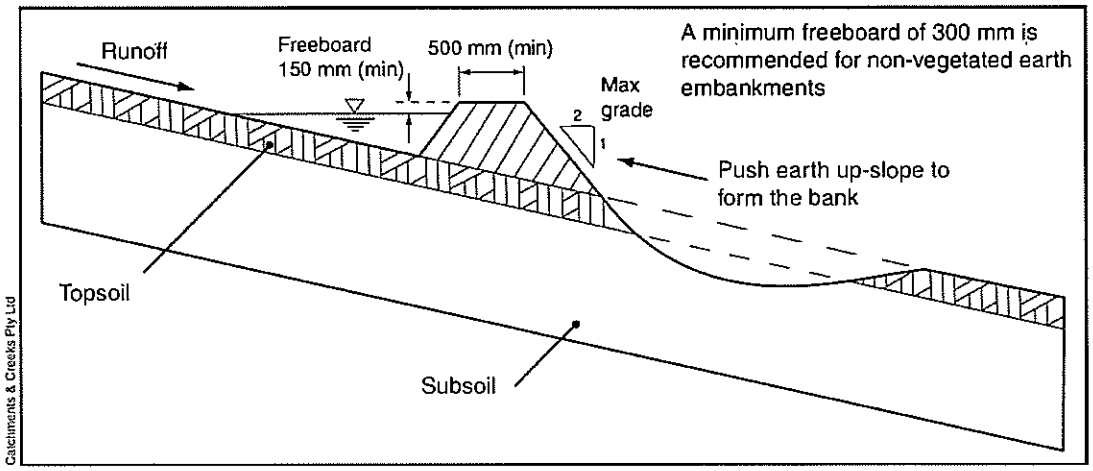
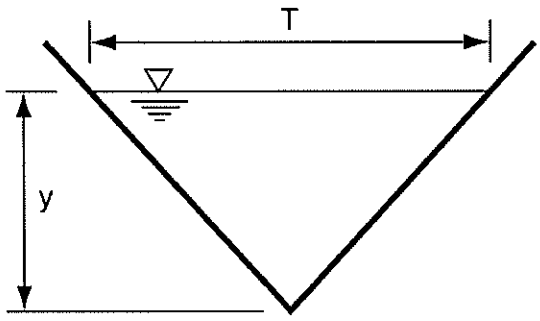
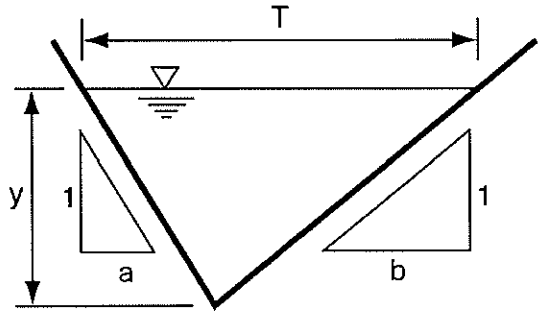


Figure 1 – Profile of 'back-push' bank

The hydraulic capacity of a flow diversion bank normally needs to be assessed on a case-by-case basis; however, the associated fact sheets *"Part 2: On earth slopes"* and *"Part 3: On grassed slopes"* provide the hydraulic capacity for drains with a standard triangular profile established on earth and grassed slopes respectively.

The geometric properties of triangular drainage channels formed by the construction of a flow diversion bank are provided in Table 3.

Table 3 – Geometric properties of triangular drainage profiles

Symmetrical or asymmetric V-drain: 	**Area (A):** $A = 0.5\,T\,y$
	Wetted perimeter (P): $P = \sqrt{T^2 + 4y^2}$
	Hydraulics radius (R): $R = \dfrac{Ty}{2\sqrt{T^2 + 4y^2}}$
Asymmetric V-drain: **where flow top width, T = y(a + b)** 	**Area (A):** $A = \left(\dfrac{a+b}{2}\right)y^2$
	Wetted perimeter (P): $P = y\left[\sqrt{(1+a^2)} + \sqrt{(1+b^2)}\right]$
	Hydraulics radius (R): $R = \dfrac{0.5(a+b)y}{\sqrt{(1+a^2)} + \sqrt{(1+b^2)}}$

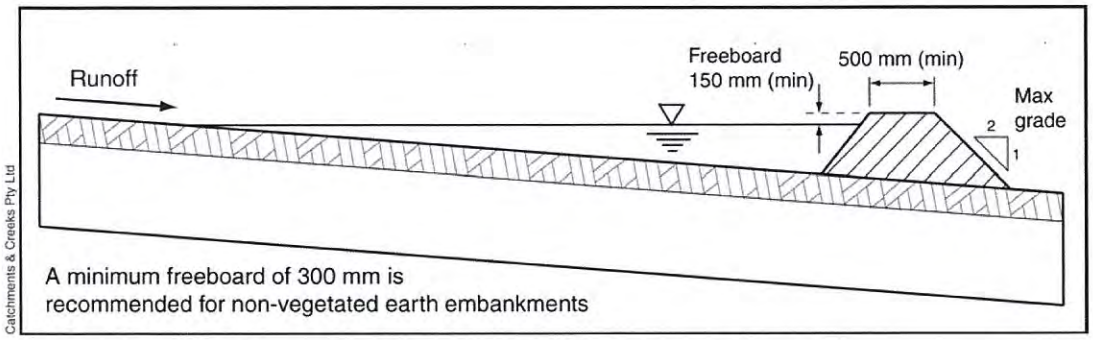


Figure 2 – Flow diversion bank formed from earth

Photo 7 – Flow diversion banks placed each side of drainage line passing through road construction site

Types of flow diversion banks:

The following provides a brief description of some of the flow diversion banks used within rural and construction land management.

Absorption bank	A level bank turned up at each end to promote water infiltration.
Back-push bank	A bank formed by moving in-situ earth up a slope.
Conventional bank	A bank formed by moving in-situ earth down thus forming an excavated drain up-slope of the bank. Also known as a 'catch bank'.
Diversion bank	A graded bank used to collect and divert water away from a soil disturbance, or to a dam, drainage channel, or sediment trap.
Graded bank	A bank constructed with a positive gradient to promote water movement.
Level bank	A bank constructed along a contour. Discharge usually occurs at each end of the bank.
Perimeter bank	A bank located along the upper or lower perimeter of a well-defined area, such as a building site, or along the top edge of a batter.
Trainer bank	A bank used to divert water away from unstable land.
Water-spreading bank	Banks used to collect and distribute surface runoff over an increased flow width. Typically used on low-gradient, marginal arable land.

Description

Flow diversion banks typically consist of a raised earth embankment normally placed along level or near level ground. Minor flow diversion berms can also be formed from tightly packed sandbags, or compost.

Short-term flow diversion banks can also be constructed from tightly packed straw bales. Such banks are often constructed prior to an impending storm.

The term *perimeter bank* is often used to describe an embankment constructed around the 'perimeter' of a work site. These are used to either prevent clean water entering the site, or to prevent the uncontrolled release of dirty water from a site.

The term *back-push bank* is used to describe an embankment formed by pushing in-situ soils up a slope to from an earth embankment.

Purpose

Flow diversion banks and berms are used as temporary drainage systems to:

- collect sheet runoff (clean or dirty) from slopes and transport it across the slope to a stable outlet (Photo 1);
- divert up-slope runoff around a stockpile or soil disturbance (Photo 2);
- divert stormwater away from an unstable slope (Photos 3 & 4);
- direct water to the inlet of a *Chute* or *Slope Drain* (Photos 5 & 6);
- control the depth of ponding around a sediment trap such as a stormwater drop (field) inlet.

Flow diversion banks can also act as a form of topsoil stockpile. Topsoil can be stripped from a site and used to form flow diversion banks either up-slope and/or down-slope of the soil disturbance (Photo 1). Such a practice can be very space effective when conducting 'strip' construction such as roadways and pipeline installation.

Limitations

Catchment area is limited by the allowable flow capacity of the diversion bank and the allowable flow velocity of the surface material.

Not used on slopes steeper than 10% (10:1).

Advantages

Quick to establish or re-establish if disturbed.

Generally inexpensive to construct and remove.

Allows for the management of stormwater flow without the need to excavate a drainage channel. This can be a significant advantage in areas that have highly erosive or dispersive subsoils.

Disadvantages

Can cause sediment problems and flow concentration if overtopped during a severe storm.

Can restrict the movement of equipment around the site.

Can be highly susceptible to damage by construction equipment.

Common Problems

Damaged by construction traffic.

Scour along the base of the embankment caused by excessive flow velocity or an unstable outlet.

Overtopping flows caused by the deposition of sediment up-slope of the bank.

Special Requirements

All flow diversion banks must have a stable outlet.

Flow diversion banks should be seeded and mulched if their working life is expected to exceed 30 days, or as required by the erosion control standard.

Banks should **not** be constructed of unstable, non-cohesive, or dispersive soil.

Location

When flow diversion banks are required and their locations are not shown on the approved plans, their location on the ground should be determined after taking into consideration the following:

- the bank must discharge to a stabilised outlet;
- the bank should drain to a sediment trap if the diverted water is expected to be contaminated with sediment;
- stormwater must not be unnaturally diverted or concentrated onto an adjacent property.

Site Inspection

Check for slumps, wheel track damage, or loss of freeboard.

Check for excessive sediment deposition.

Check for erosion along the bank.

Installation

1. Refer to approved plans for location, extent, and construction details. If there are questions or problems with the location, extent, or method of installation, contact the engineer or responsible on-site officer for assistance.
2. Clear the location for the bank, clearing only the area that is needed to provide access for personnel and equipment.
3. Remove roots, stumps, and other debris and dispose of them properly. Do not use debris to build the bank.
4. Form the bank from the material, and to the dimension specified in the approved plans.
5. If earth is used, then ensure the sides of the bank are no steeper than a 2:1 (H:V) slope, and the completed bank must be at least 500mm high.
6. If formed from sandbags, then ensure the bags are tightly packed such that water leakage through the bags is minimised.
7. Check the bank alignment to ensure positive drainage in the desired direction.
8. The bank should be vegetated (turfed, seeded and mulched), or otherwise stabilised immediately, unless it will operate for less than 30 days or if significant rainfall is not expected during the life of the bank.
9. Ensure the embankment drains to a stable outlet, and does not discharge to an unstable fill slope.

Maintenance

1. Inspect flow diversion banks at least weekly and after runoff-producing rainfall.
2. Inspect the bank for any slumps, wheel track damage or loss of freeboard. Make repairs as necessary.
3. Check that fill material or sediment has not partially blocked the drainage path up-slope of the embankment. Where necessary, remove any deposited material to allow free drainage.
4. Dispose of any collected sediment or fill in a manner that will not create an erosion or pollution hazard.
5. Repair any places in the bank that are weakened or in risk of failure.

Removal

1. When the soil disturbance above the bank is finished and the area is stabilised, the flow diversion bank should be removed, unless it is to remain as a permanent drainage feature.
2. Dispose of any sediment or earth in a manner that will not create an erosion or pollution hazard.
3. Grade the area and smooth it out in preparation for stabilisation.
4. Stabilise the area by grassing or as specified in the approved plan.

Flow Control Berms

DRAINAGE CONTROL TECHNIQUE

Low Gradient	✓	Velocity Control		Short Term	✓
Steep Gradient		Channel Lining		Medium-Long Term	✓
Outlet Control		Soil Treatment		Permanent	[1]

[1] It is common practice for the berms to be retained on-site and allowed to integrate into the general topography. Over time the height and hydraulic impact of the berms diminishes until their existence completely disappears.

Symbol → CB →

Photo 1 – Flow diversion berm used to minimise road runoff flowing down a steep, unstable section of the embankment

Photo 2 – Sandbag flow diversion berm used to minimise surface flow over a recently seeded embankment

Key Principles

1. Key design parameters are the effective flow capacity of the structure, and the scour resistance of the berm.
2. Key operational features are the height and alignment of the berms such that water flow is directed to the appropriate location in a non-erosive manner.

Design Information

The recommended dimensional requirements of flow control berms are outlined in Table 1.

Table 1 – Recommended dimensional requirements of flow control berms

Parameter	Topsoil berms	Compost berms [1]	Sandbag berms
Height (min)	300mm (450mm)	300mm (450mm)	N/A
Top width (min)	100mm (100mm)	100mm (100mm)	N/A
Base width (min)	600mm (900mm)	600mm (900mm)	N/A
Side slope (max)	1:1 (H:V)	1:1 (H:V)	N/A
Hydraulic freeboard	100mm	100mm	50mm

[1] Values in brackets apply to berms placed across land slopes steeper than 4:1 (H:V).

The fact sheets prepared for *Flow Diversion Banks* provide guidance on estimating the hydraulic capacity of flow control berms.

Description

Flow control berms typically consist of minor earth, compost or sandbag embankment placed in a manner to collect and divert minor flows.

Purpose

Flow control berms are used as temporary drainage systems to:

- divert up-slope runoff around a stockpile or soil disturbance;
- divert stormwater away from an unstable slope;
- direct minor flows to the inlet of a drainage *Chute*.

Limitations

Allowable catchment area is usually very limited due to the very limited flow capacity of a berm. Formally design *Flow Diversion Banks* are normally required to manage runoff from large catchment.

Catchment area is limited by the allowable flow capacity of the berm and the allowable flow velocity of the surface material.

Not used on slopes steeper than 10% (10:1).

Advantages

Quick to establish or re-establish if disturbed.

Generally inexpensive to construct and remove.

Allows for the management of stormwater flow without the need to excavate a drainage channel. This can be a significant advantage in areas that have highly erosive or dispersive subsoils.

Disadvantages

Can cause sediment problems and flow concentration if overtopped during a severe storm.

Can restrict the movement of equipment around the site.

Can be highly susceptible to damage by construction equipment.

Common Problems

Damaged by construction traffic.

Scour along the base of the embankment caused by excessive flow velocity or an unstable outlet.

Overtopping flows caused by the deposition of sediment up-slope of the bank.

Special Requirements

All flow control berms must have a stable outlet.

Earth berms should **not** be constructed of unstable, non-cohesive, or dispersive soil.

Location

When flow control berms are required and their locations are not shown on the approved plans, their location on the ground should be determined after taking into consideration the following:

- the berm must discharge to a stabilised outlet;
- the berm should drain to a sediment trap if the diverted water is expected to be contaminated with sediment;
- stormwater must not be unnaturally diverted or concentrated onto an adjacent property.

Site Inspection

Check for slumps, wheel track damage, or loss of freeboard.

Check for excessive sediment deposition.

Check for erosion along the berm.

Installation

1. Refer to approved plans for location, extent, and construction details. If there are questions or problems with the location, extent, or method of installation, contact the engineer or responsible on-site officer for assistance.
2. Clear the location for the berm, clearing only the area that is needed to provide access for personnel and equipment.
3. Remove roots, stumps, and other debris and dispose of them properly.
4. Form the berm from the material, and to the dimension specified in the approved plans.
5. If formed from sandbags, then ensure the bags are tightly packed such that water leakage through the bags is minimised.
6. Check the alignment of the berm to ensure positive drainage in the desired direction.
7. Ensure the berm discharges to a stable outlet.
8. Ensure the berm does not discharge to an unstable fill slope.

Maintenance

1. Inspect flow control berms at least weekly and after runoff-producing rainfall.
2. Inspect the berm for any slumps, wheel track damage or loss of freeboard. Make repairs as necessary.
3. Check that fill material or sediment has not partially blocked the drainage path up-slope of the embankment. Where necessary, remove any deposited material to allow free drainage.
4. Dispose of any collected sediment or fill in a manner that will not create an erosion or pollution hazard.
5. Repair any places in the berm that are weakened or in risk of failure.

Removal

1. When the soil disturbance above the bank is finished and the area is stabilised, the flow control berm should be removed, unless it is to remain as a permanent drainage feature.
2. Dispose of any sediment or earth in a manner that will not create an erosion or pollution hazard.
3. Grade the area and smooth it out in preparation for stabilisation.
4. Stabilise the area by grassing or as specified in the approved plan.

Diversion Channels

DRAINAGE CONTROL TECHNIQUE

Low Gradient	✓	Velocity Control		Short Term	✓
Steep Gradient		Channel Lining		Medium-Long Term	✓
Outlet Control		Soil Treatment		Permanent	[1]

[1] The design of permanent diversion channels requires consideration of issues not discussed within this fact sheet, such as safety and maintenance requirements.

Symbol → DC →

Photo 1 – Temporary diversion channel collecting 'dirty' water down-slope of a soil disturbance

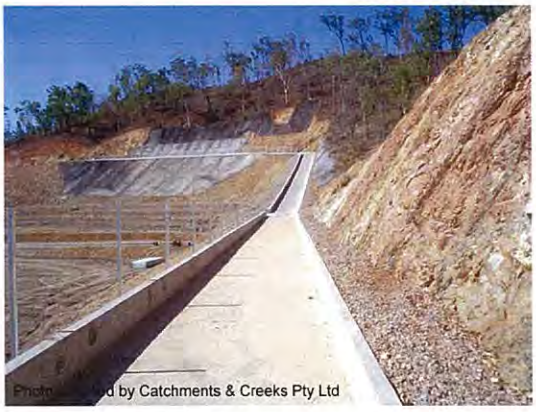


Photo 2 – Permanent diversion channel collecting stormwater runoff up-slope of a subdivision

Key Principles

1. Diversion channels are sized for a specific design flow rate based on the catchment area, topography, soil and hydrologic conditions.
2. Critical design parameters are the choice of surface lining, hydraulic capacity and stability of the discharge point.
3. Critical operation issues are usually related to controlling sediment, vegetation and debris collection within the channel, and maintaining a stable outlet.

Design Information

Diversion channels are usually major hydraulic structures requiring design input from an experienced hydraulics specialist. This fact sheet does **not** provide sufficient information to allow diversion channels to be designed by inexperienced persons.

The design of permanent drainage channels requires consideration of issues not discussed within this fact sheet, such as safety and maintenance requirements.

The design discharge (Q) must reflect the specified drainage control standard of the site. Refer to the relevant regulating authority for relevant design standards. Where such standards do not exist, then refer to IECA (2008) Chapter 4 – *Design standards and technique selection*.

Typical design standards are presented in Table 1.

Refer to the various fact sheets under the sub-heading *Channel Linings* for velocity calculations and guidelines on the design of rock, grass or mat lining of the channel.

Recommended maximum bank slopes are provided in Table 2.

Table 1 – Typical design standards for temporary diversion channels

Parameter	Design standard
Design discharge	• Refer to IECA (2008) Table 4.3.1, Chapter 4 – *Design standards and technique selection*
Channel depth	• Minimum channel depth of 300mm
Freeboard	• Minimum freeboard being the greater of 150mm, 10% of channel depth, or the velocity head ($V^2/2g$) • Allow embankment settlement of 10% of fill height (in addition to freeboard) if the embankment's design life exceeds 1 year
Embankment	• Optional embankment formed down-slope of the channel (Figure 1). • Minimum crest width of 600mm, and down-slope bank gradient of 2:1 for reasons of stability against overtopping flows
Safety	• Safety requirements, such as the depth*velocity product (d.V), generally do not apply to drainage channels • Safety considerations generally focus on allowing good egress from the channel, and ensuring safety risks are obvious
Maintenance berm	• Desirable 1.5m wide (min) maintenance berm on at least one side of the channel (not always practicable in short-term projects)

Table 2 – Typical maximum bank slopes [1]

Site conditions	Max bank slope (H:V)
Highly compacted clay (hard, pick required)	1:1 to 1.25:1
Medium compact sandy clay	1.2:1 to 1.5:1
Slightly compact silty clay or sandy clay (soft, spade required)	1.5:1 to 2:1
Non-cohesive fine sandy soil or soils with humus or peat content	2:1 to 3:1
Non mowable vegetated slopes	3:1
Permanent, mowable, grass slopes (maximum grade)	4:1
Permanent, mowable grass slopes (recommended grade)	6:1
Rock lined channels	1.5:1 [2]

[1] Bank slopes provided as a guide only. Actual bank slope should be based on geotechnical and landscaping advice wherever practicable.

[2] Desirable maximum bank slope is 2:1 for dumped rock; however, with increased placement effort and skills, rock may be placed on bank slopes up to 1.5:1 in low velocity channels.

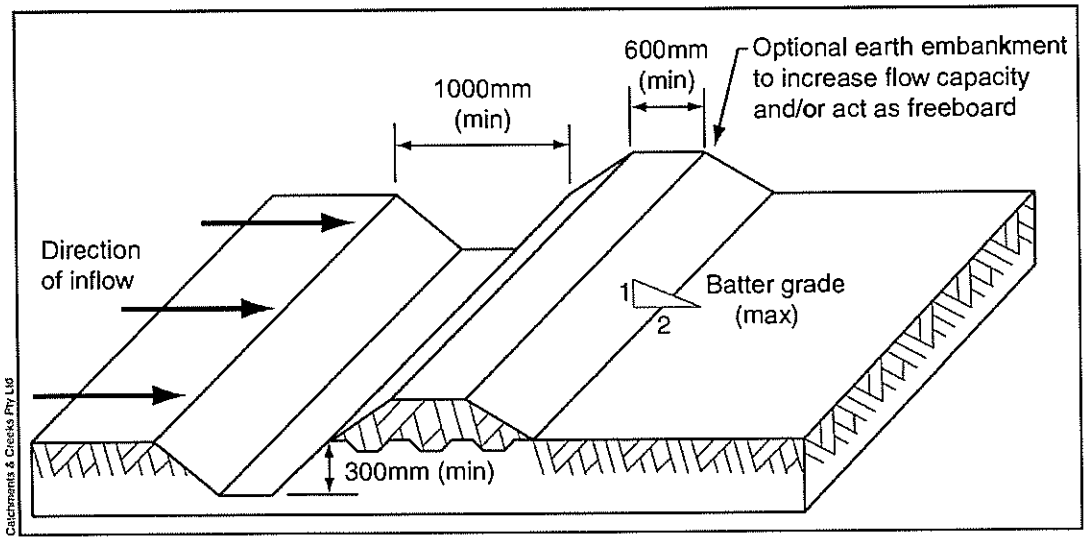


Figure 1 – Typical profile of temporary diversion channels

Hydraulic design of diversion channels:

Step 1 Determine the required design discharge (Q).

If the channel gradient varies significantly along its length, then it may be desirable to split the channel into individual sections and determine an appropriate design discharge at the downstream end of each of these sections.

Step 2 Nominate the channel profile: parabolic or triangular (V-drain). Parabolic channel are generally less susceptible to invert erosion.

Step 3 Choose the preferred surface condition of the channel (e.g. earth, grass, rock).

The design information provided in the *Catch Drain* fact sheets can be used as a guide in selecting a surface lining and trial channel size.

Step 4 Select a bank slope (m) using Table 2 as a guide. Do **not** necessarily select the maximum bank slope, but consider such issues as safety and maintenance access.

Step 5 Determine the Manning's roughness (n) and allowable flow velocity (V_{allow}) using the relevant fact sheet (refer to channel linings) or Tables A17 to A20, and Tables A23 to A28 in IECA 2008, Appendix A – *Construction site hydrology and hydraulics.*

For grass and rock-lined channels it may be necessary to estimate a channel depth, and hydraulic radius (Steps 6 to 8) before determining Manning's roughness.

Step 6 Determine the minimum required flow area ($A = Q/V_{allow}$).

The design flow area does not have to be equal to this minimum flow area, but of course it must not be less than this area. It depends on how confident the designer is in the determination of the design discharge and the allowable flow velocity.

Step 7 Choose a trial channel size (depth, y; bed width, b; and flow top width, T) and the required freeboard (refer to Table 1).

Ultimately this may require an iterative process where various channel profiles are tested for hydraulic capacity.

Step 8 Determine the hydraulic radius (R) of the channel (based on flow area, **not** the overall channel dimension, which would include freeboard). Refer to Table A30 in IECA (2008) Appendix A.

Step 9a **If the channel gradient is <u>not</u> set by site conditions, then:**

Determine the channel gradient (S) using Manning's equation.

$$S = (n.V)^2/(R)^{4/3} \qquad \text{(S has units of m/m)}$$

Step 9b **If the channel gradient is set by site conditions, then:**

Determine the actual flow velocity (V) and compare this with the allowable flow velocity (V_{allow}).

$$V = (1/n)\, R^{2/3}\, S^{1/2}$$

If $V < V_{allow}$, then accept the design, or repeat Steps 7 & 9 for a smaller channel.

If $V > V_{allow}$, then repeat Steps 7 & 9 selecting a larger channel.

Step 10 Confirm final freeboard requirements given final depth and velocity head (Table 1).

Step 11 Ensure suitable conditions exist (e.g. machinery access) to construct and maintain the channel, otherwise a narrower channel width may be required.

Step 12 Given the final channel depth and velocity, check the required freeboard.

Specify the overall dimensions of the diversion channel, including freeboard.

Step 13 Ensure appropriate, non-erosive, flow conditions exist at the points of flow entry into the channel.

Step 14 Ensure the channel discharges to an appropriate, stable outlet structure.

Step 15 Appropriately consider all likely safety issues, and modify the channel design and/or surrounding environment where required.

Design example:

Design an earth-lined channel of trapezoidal cross-section to carry $0.5m^3/s$ located within a moderately erodible soil.

Step 1 The required design discharge is given as, $Q = 0.5m^3/s$.

Step 2 The question specifies a trapezoidal channel profile.

Step 3 The surface condition has been specified as earth-lined.

Step 4 For a slightly compacted soil (typical for a temporary drain), the maximum bank slope is likely to be around 1.5:1 or 2:1 (from Table 2).

If the drain was going to be deep (say, $y > 0.5m$) a flatter slope of 3:1 would be desirable for reasons of safety; however, this drain is likely to be relatively shallow, so choose a bank slope of 2:1 (i.e. $m = 2$).

Warning: 'm' is the term used for both bank slope, and the metric unit of metres!

Step 5 Select a Manning's "n" for an earth lined channel, $n = 0.02$ from Table A17 of IECA (2008) Appendix A – *Construction site hydrology and hydraulics*.

For a moderately erodible soil, choose a maximum allowable velocity, $V_{allow} = 0.6m/s$ from Table A23 of Appendix A.

Step 6 The minimum required flow area, $A_{min} = Q/V_{allow} = 0.5/0.6 = 0.833m^2$.

Step 7 For this example it will be assumed that the designer has confidence in the determination of the design discharge and the selection of an allowable flow velocity for the given soil conditions. Therefore, a design flow area of $0.84m^2$ is chosen (only slightly greater than the minimum value determined in Step 6).

Choose: $A = 0.84m^2$

Trial flow depth and bed width: Given that maximum depth of the excavated channel may be limited by existing site conditions, a first guess of the channel dimensions can be obtained by adopting one of the following options:

(i) try a flow depth, y = maximum allowable channel depth - 150mm; or

(ii) try a bed width, $b = (A/(1 + m))^{1/2}$

If we choose the latter option, then: $b = \sqrt{\frac{A}{(1+m)}} = \sqrt{\frac{0.84}{(1+2)}} = 0.53m$

For small channels it is good practice to select a bed width equal to the width of a typical excavator bucket. The most common bucket widths are 450, 600 and 900mm. So, for this example a bed width, $b = 0.6m$ will be chosen.

If a flow depth (y) is chosen, then $b = \frac{A}{y} - y(m)$

If a bed width (b) is chosen, then: $y = \frac{\sqrt{(b^2 + 4(m)A)} - b}{2m}$

Thus for this example: $y = \frac{\sqrt{(0.6^2 + 4(2)0.84)} - 0.6}{2(2)} = 0.515m$

Step 8 From Table A30 of Appendix A, the hydraulic radius (R) is given by:

$$R = \frac{y(b + my)}{b + 2y\sqrt{(1+m^2)}} = \frac{0.515(0.6 + (2)0.515)}{0.6 + 2(0.515)\sqrt{(1+2^2)}} = 0.289m$$

Step 9a If its assumed that the channel slope is not governed by existing site conditions (i.e. the designer is free to determine a preferred channel slope), then the desired channel slope can be determined from Manning's equation:

Desired channel slope: $$S = \frac{n^2.V^2}{R^{4/3}} = \frac{(0.02)^2.(0.6)^2}{(0.289)^{4/3}} = 0.00075$$

The above equation provides slope in units or [m/m], thus the channel slope is equivalent to, S = 0.075%.

Step 10 Freeboard requirements will be defined by the greater of:

(i) 150mm

(ii) 10% of channel depth, = 0.1(0.515 + 0.15) = 0.067m, or

(iii) the velocity head ($V^2/2g$) = $(0.6)^2/19.6$ = 0.018m

Therefore, choose a freeboard of 150mm.

Final channel dimension:

Discharge, Q = $0.5m^3/s$

Channel slope, S = 0.075%

Bank slope, m = 2 or (2:1) (H:V)

Maximum design flow depth, y = 0.515m

Freeboard = 0.15m

Excavated channel depth = 0.515 + 0.15 = 0.665m

Bed width, b = 0.6m

Top width of excavated channel = 0.6 + 2(2)(0.515 + 0.15) = 3.26m

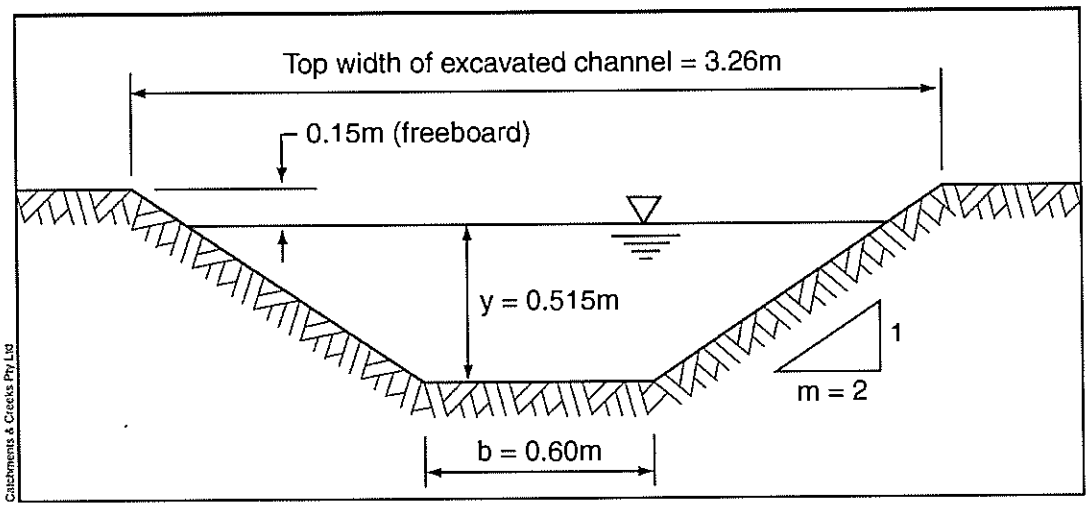


Figure 2 – Final channel dimensions

Description

Diversion channels are formally designed temporary or permanent excavated drainage channels usually with well-defined bed and banks.

Diversion channels are normally stabilised with a healthy and complete coverage of vegetation, primarily consisting of grasses. However, this should not prevent the use of alternative channel lining as appropriate for the site conditions.

Diversion channels can be formed with or without an associated down-slope flow diversion bank. The inclusion of a down-slope bank can significantly increase the hydraulic capacity of the channel.

Purpose

Diversion channels are used to:

- collect and transport stormwater runoff around or through a work site;
- collect sediment laden runoff down-slope of a disturbance and direct it to a sediment trap;
- temporarily divert a existing drainage channel while construction activities are occurring.

Limitations

Channel size and gradient are governed by the allowable flow velocity of the surface material.

Advantages

Low maintenance requirements.

On larger catchments, the cost savings resulting from the diversion of uncontaminated 'clean' flow around a soil disturbance and/or sediment trap can be significant.

Disadvantages

May restrict vehicular movements around the site, possibly requiring the construction of *Temporary Watercourse Crossings* over the channel.

Can cause significant erosion problems and flow concentration if overtopped during heavy storms.

Common Problems

The low channel gradient can cause long-term ponding and mosquito breeding.

Soil erosion at points of water inflow and at the channel outlet.

Special Requirements

The erosion-resistance of the local subsoils should be investigated before planning or designing any drainage channels.

Diversion channels should be vegetated if the expected working life exceeds 30 days. Exception may apply in arid and semi-arid regions.

If the channel is to be vegetated using grass seeding, then the channel should be established well before high flows are expected within the channel.

All diversion channels **must** have a stable outlet.

The channel must have positive gradient along its full length to allow free drainage.

Sufficient space must be provided to allow construction and maintenance access.

Site Inspection

Check that the drain has a stable, positive grade along its length.

Check for a stable drain outlet.

Check if the associated embankment is free of damage (e.g. damage caused by construction traffic).

Check that the drain has adequate hydraulic capacity given the catchment area (general observations based on past experience).

Check for sediment accumulation within the channel.

Check for excessive settlement of any associated fill embankments.

Check the channel lining (if any) for damage or displacement. If *Erosion Control Mats* have been used, check that they are correctly overlapped in direction of flow.

If the channel is lined with rock, check that the rock is not reducing the channel's required hydraulic capacity.

Installation

1. Refer to approved plans for location, extent, and construction details. If there are questions or problems with the location, extent, or method of installation, contact the engineer or responsible on-site officer for assistance.
2. Ensure all necessary soil testing (e.g. soil pH, nutrient levels) and analysis has been completed, and required soil adjustments performed prior to planting.
3. Clear the location for the channel, clearing only what is needed to provide access for personnel and construction equipment.
4. Remove roots, stumps, and other debris and dispose of them properly. Do not use debris to build any associated embankments.
5. Excavate the diversion channel to the specified shape, elevation and gradient. The sides of the channel should be no steeper than a 2:1 (H:V) if constructed in earth, unless specifically directed within the approved plans.
6. Stabilise the channel and banks immediately unless it will operate for less than 30 days. In either case, temporary erosion protection (matting, rock, etc.) will be required as specified within the approved plans or as directed.
7. Ensure the channel discharges to a stable area.

Additional requirements for turf placement:

1. Turf should be used within 12 hours of delivery, otherwise ensure the turf is stored in conditions appropriate for the weather conditions (e.g. a shaded area).
2. Moistening the turf after it is unrolled will help maintain its viability.
3. Turf should be laid on a minimum 75mm bed of adequately fertilised topsoil. Rake the soil surface to break the crust just before laying the turf.
4. During the warmer months, lightly irrigate the soil immediately before laying the turf.
5. Ensure the turf is not laid on gravel, heavily compacted soils, or soils that have been recently treated with herbicides.
6. Ensure the turf extends up the sides of the drain at least 100mm above the elevation of the channel invert, or at least to a sufficient elevation to fully contain expected channel flow.
7. On channel gradients of 3:1(H:V) or steeper, or in situations where high flow velocities (i.e. velocity >1.5m/s) are likely within the first two week following placement, secure the individual turf strips with wooden or plastic pegs.
8. Ensure that intimate contact is achieved and maintained between the turf and the soil such that seepage flow beneath the turf is avoided.
9. Water until the soil is wet 100mm below the turf. Thereafter, watering should be sufficient to maintain and promote healthy growth

Maintenance

1. During the site's construction period, inspect the diversion channel weekly and after any increase in flows within the channel. Repair any slumps, wheel track damage or loss of freeboard.
2. Ensure fill material or sediment is not partially blocking the channel. Where necessary, remove any deposited material to allow free drainage.
3. Dispose of any collected sediment or fill in a manner that will not create an erosion or pollution hazard.

Removal

1. When the construction work above a temporary diversion channel is finished and the area is stabilised, the area should be appropriately rehabilitated.
2. Dispose of any collected sediment or fill in a manner that will not create an erosion or pollution hazard.
3. Grade the area and smooth it out in preparation for stabilisation.
4. Stabilise the area as specified in the approved plan.

Catch Drains Part 1: General Information

DRAINAGE CONTROL TECHNIQUE

Low Gradient	✓	Velocity Control		Short Term	✓
Steep Gradient		Channel Lining		Medium-Long Term	✓
Outlet Control		Soil Treatment		Permanent	[1]

[1] The design of permanent catch drains requires consideration of issues not discussed within this fact sheet, such as maintenance requirements. This fact sheet should not be used for the design of permanent drains.

Symbol → CD →

Photo 1 – Unlined catch drain

Photo 2 – Large rural catch drain (channel-bank)

Key Principles

1. Catch drains typically have standardised cross-sectional dimensions. Rather than uniquely sizing each catch drain to a given catchment, standard-sized drains are used based on a maximum allowable catchment area for a given rainfall intensity.
2. The **maximum** recommended spacing of catch drains down a slope (Table 3) is based on the aim of avoiding rill erosion within the up-slope drainage slope. It should be noted that the **actual** spacing of catch drains down a given slope may need to be less than the specified maximum spacing if the soils are highly erosive soils, or if rilling begins to occur between two existing drains.
3. The critical design parameters are the spacing of the drains down a slope, the maximum allowable catchment area, the choice of lining material (e.g. earth, turf, rock or erosion control mats), and the required channel gradient.

Design Information

Catch drains are drainage structures, as such, their design (i.e. maximum catchment area and horizontal spacing) must be based on local hydrologic and soil conditions.

Catch drains must have sufficient cross-sectional dimensions to fully contain the design flow with a minimum freeboard of 0.15m. This fact sheet provides design information on three standard parabolic-profile catch drains referred to as Type-A, Type-B and Type-C, and three triangular-profile V-drains; Type-AV, Type-BV and Type-CV.

The minimum dimensions of these catch drains are provided in Tables 1 and 2.

The cross-sectional profile can be parabolic (U-shape), trapezoidal, or triangular (V-drain). Cut slopes (channel banks) should be no steeper than 1.5:1(H:V) and fill slopes (typically associated with a down-slope embankment) no steeper than 2:1 (H:V).

Table 1 – Dimensions of standard parabolic catch drains (Figures 1 & 3)

Catch drain type	Max top width of flow (T)	Maximum flow depth (y)	Top width of formed drain [1]	Depth of formed drain	Hyd. rad. (R) at max flow depth	Area (A) at max flow depth
Type-A	1.0m	0.15m	1.6m	0.30m	0.094m	0.100m^2
Type-B	1.8m	0.30m	2.4m	0.45m	0.186m	0.360m^2
Type-C	3.0m	0.50m	3.6m	0.65m	0.310m	1.000m^2

[1] Top width of the formed drain assumes the upper bank slope is limited to a maximum of 2:1.

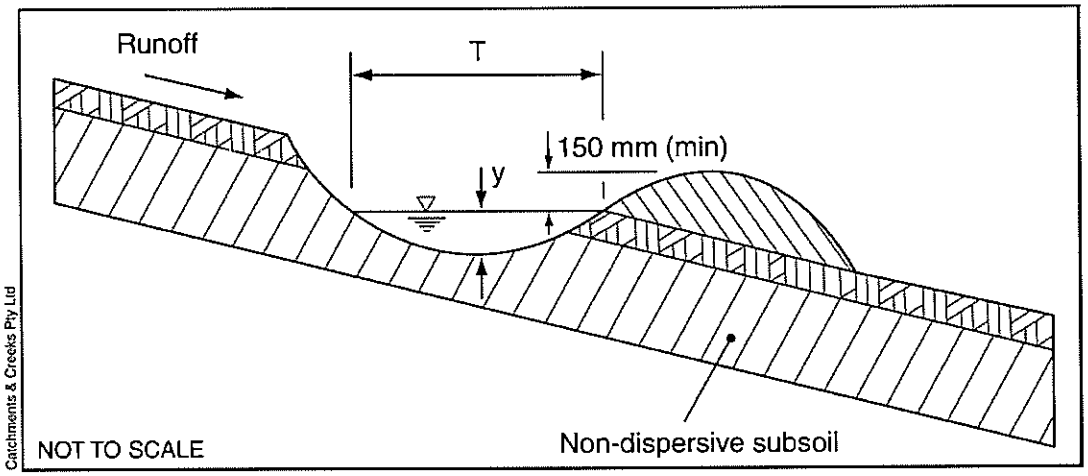


Figure 1 – Parabolic catch drain with bank

Table 2 – Dimensions of standard triangular V-drains (Figure 2)

Catch drain type	Max top width of flow (T)	Maximum flow depth (y)	Top width of formed drain	Depth of formed drain	Hyd. rad. (R) at max flow depth	Area (A) at max flow depth
Type-AV	1.0m	0.15m	2.0m	0.30m	0.072m	0.075m^2
Type-BV	1.8m	0.30m	2.7m	0.45m	0.142m	0.270m^2
Type-CV	3.0m	0.50m	3.9m	0.65m	0.237m	0.750m^2

Maximum spacing of catch drains:

Maximum recommended spacing of catch drains down slopes is presented in Table 3. The actual spacing specified for a given site may need to be less than that presented in Table 3 if the soils are highly susceptible to erosion, or if intense storm events are expected (i.e. northern parts of Australia during the wet season).

Table 3 – Maximum recommended spacing of catch drains down slopes

Open Earth Slopes						Vegetated Slopes		
Slope	**Horiz.**	**Vert.**	**Slope**	**Horiz.**	**Vert.**	**Slope**	**Horiz.**	**Vert.**
1%	80m	0.9m	15%	19m	2.9m	< 10%	No maximum	
2%	60m	1.2m	20%	16m	3.2m	12%	100m	12m
4%	40m	1.6m	25%	14m	3.5m	15%	80m	12m
6%	32m	1.9m	30%	12m	3.5m	20%	55m	11m
8%	28m	2.2m	35%	10m	3.5m	25%	40m	10m
10%	25m	2.5m	40%	9m	3.5m	30%	30m	9m
12%	22m	2.6m	50%	6m	3.0m	> 36%	Case specific	

Table 4 – Drain profile parameters for catch drains

Parabolic: $y = C_1.T^2$	C_1	V-drain: $y = C_2.T$	C_2
Type-A	0.1500	**Type-AV**	0.1500
Type-B	0.0926	**Type-BV**	0.1667
Type-C	0.0556	**Type-CV**	0.1667

Channel lining:

If high flow velocities are expected, then the drain must be appropriately stabilised with geotextile fabric, *Erosion Control Mats/Mesh*, grass or rock. Alternatively, *Check Dams* can be placed at appropriate intervals to control the flow velocity; however, the impact of these *Check Dams* on the hydraulic capacity of the drain **must** be considered.

Photo 3 – Rock lined catch drain

Photo 4 – Permanent catch drain

Gradient:

The longitudinal gradient of catch drains primarily depends on the allowable flow velocity and Manning's roughness of the drainage channel. Excess channel gradient can initiate undesirable erosion (Photos 5 & 6).

Photo 5 – Upper limit of erosion within a catch drain

Photo 6 – Velocity-induced bed scour within a catch drain

Outlet Structures:

Catch drains must discharge to a stabilised outlet, such as a road, permanent drainage channel, *Chute*, *Slope Drain*, or *Level Spreader*. *Level Spreaders* are used when the flow is to be released as 'sheet' flow.

At the immediate outlet of the catch drain it may be necessary to construct an energy dissipater or rock pad to control soil scour (refer to the Fact Sheet on *Outlet Structures*).

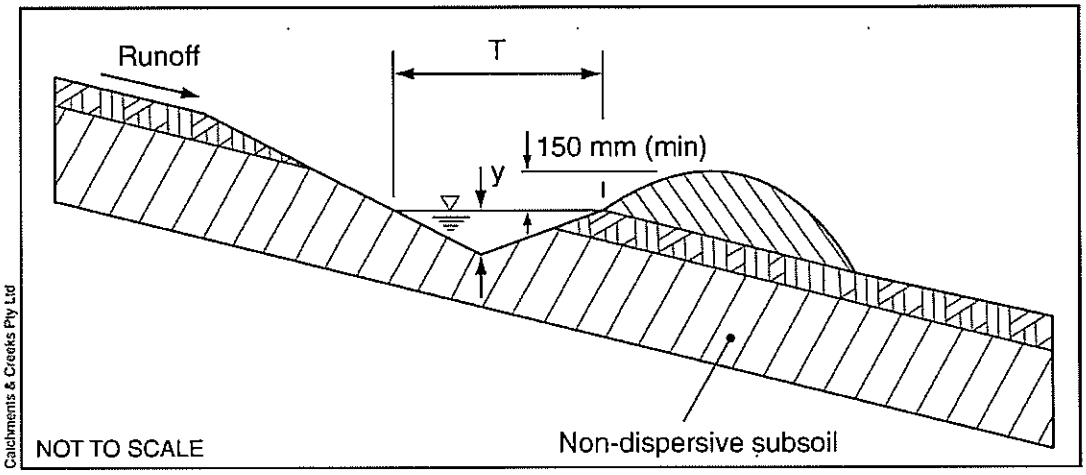


Figure 2 – Triangular V-drain with down-slope bank

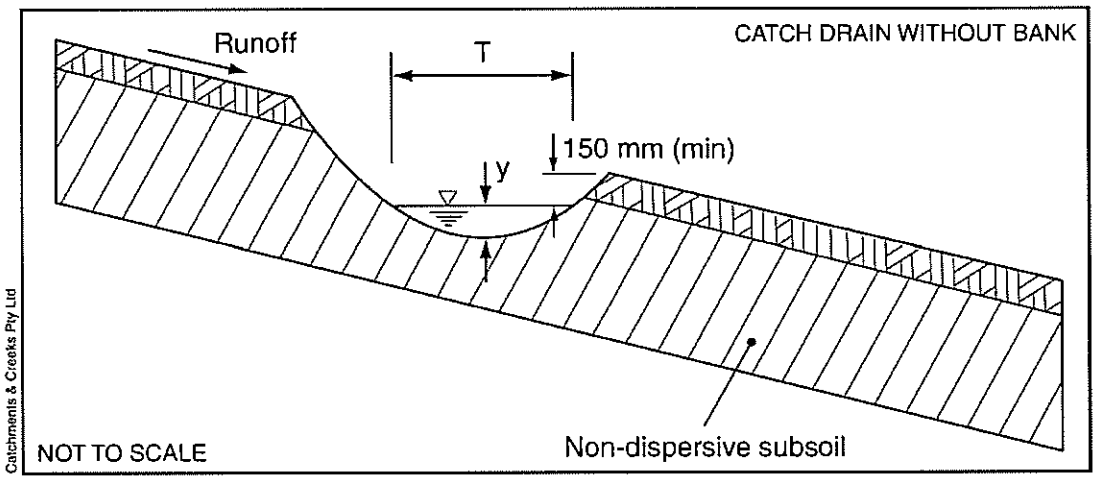


Figure 3 – Parabolic catch drain without bank

Types of drains:

The following provides a brief description of some of the drains used within rural and construction land management.

Berm drain:	A drain formed by a berm located between the top and bottom of a batter.
Catch drain:	A drain adjacent to a batter or embankment. Also, the generic term used for all temporary drains on construction sites.
Contour drain:	A drain formed along the contour (zero fall). Such drains act as infiltration trenches, similar (but not the same) as contour furrowing or deep ripping.
Cross drain:	A drain directing surface runoff across a road or track.
Diversion drain:	A drain used to collect and divert water from an adjacent catchment.
Mitre drain:	A drain used to direct road runoff away from the road alignment.
Spoon drain:	A minor drain of semi-circular cross-section and no associated embankment.
Table drain:	A drain that has one bank consisting of the shoulder of a roadway.
Windrow drain:	A drain formed by an earth windrow located along the edge of a road or trail.
Rubble drain:	A sub-surface drain formed by a gravel-filled trench.

Description

Catch drains are small open channels formed at regular intervals down a slope, or immediately up-slope or down-slope of a soil disturbance. They are usually excavated with a grader blade, or U-shaped cutting/excavation tools.

Catch drains can be formed with or without an associated down-slope bank. The inclusion of a down-slope bank significantly increases the hydraulic capacity of the drain; however, these banks are susceptible to damage by vehicles resulting in hydraulic failure of the drain.

Channel-banks (push-down) catch drains are formed by pushing the excavated material down-slope of the drain. These drains should only be used in areas that have good, erosion-resistant subsoils.

'Back-Push' banks are formed by pushing the excavated material up-slope to form a *Flow Diversion Bank*. In such cases the diverted water flows up-slope of the embankment instead of within the excavated trench (refer to the fact sheet on *Flow Diversion Banks*).

Back-push banks are used in preference to catch drains in areas that have highly erosive or dispersible subsoils.

Catch drains are usually significantly smaller than formally designed *Diversion Channels*.

The term 'catch drain' is also used in the stormwater industry to refer to permanent drainage channels placed above cut batters to prevent uncontrolled discharge down the batter.

Purpose

Catch drains can be used to:

- direct stormwater runoff around a soil disturbance, or an unstable slope;
- collect sheet-flow runoff from an unstable slope before it is allowed to concentrate and cause rill erosion;
- collect sediment laden runoff down-slope of a disturbance and direct it to a sediment trap;
- collect and divert up-slope water around stockpiles and excavations.

Limitations

Catch drains are only suitable for relatively small flow rates. For the management of high flow rates a formally designed *Diversion Channel* may be required.

The maximum catchment area depends on the type of drain (i.e. Type A/AV, B/BV or C/CV), and the local hydrologic conditions.

Advantages

Quick and inexpensive to establish, or re-establish if disturbed.

Usually do not require complex formal design if based on standard design tables.

If constructed at appropriate gradients, flow velocities are usually small enough to avoid the need for special channel linings.

Disadvantages

Can cause significant erosion problems and flow concentration if overtopped during heavy storms.

Can restrict the movement of earthmoving equipment around the site, including access to stockpiles. Thus, catch drains may have limited use within active construction areas until earthworks are completed.

Common Problems

Installed at incorrect gradient. If the gradient is too shallow, it causes a reduction in the hydraulic capacity, if too steep it causes an increase in flow velocity.

Damage to associated flow diversion bank (rutting) caused by vehicles.

Catch drains that do not discharge to a stable outlet, causing downstream erosion, or initiating scour within the drain (Photo 5).

Special Requirements

The erosion-resistance of the local subsoils should be investigated before planning or designing any excavated drains.

Straw bales or other sediment traps should **not** be placed within these drains due to the risk of causing surcharging of the drain.

Catch drains need to be appropriately stabilised (e.g. compacted and/or lined with a suitable channel lining) within a specified period from the time of construction.

Catch drain should drain to a suitable sediment trap if the diverted water is expected to contain sediment. 'Clean' water should divert around sediment traps.

The drain must have positive gradient along its full length to allow free drainage.

Sufficient space must be provided to allow maintenance access.

Location

Typically used up-slope of cut batters, intermittently down long, exposed slopes, and up-slope of those stockpiles located within overland flow paths.

Catch drains are generally required up-slope of all cut and fill batters with a height greater than 2 metres and where run-on water is expected.

Site Inspection

Check that the drain has a stable, positive grade along its length.

Check for a stable drain outlet.

Check if the associated embankment is free of damage (e.g. damage caused by construction traffic).

Check that the drain has adequate hydraulic capacity given the catchment area (general observations based on past experience).

Check if rill erosion is occurring within the catchment area up-slope of the drain. If rilling is occurring, then the lateral spacing of the drains will need to be reduced. However, some degree of rill erosion should be expected if recent storms exceeded the intensity of the nominated design storm.

Inspect for evidence of water spilling out (overtopping) of the drain, or erosion down-slope of the drain.

Inspect for erosion along the bed (invert) of the drain. Investigate the reasons for any erosion before recommending solutions. Bed erosion can result from either excessive channel velocities, or an unstable outlet, which causes bed erosion (head-cut) to migrate up the channel.

Possible solutions to channel erosion include:

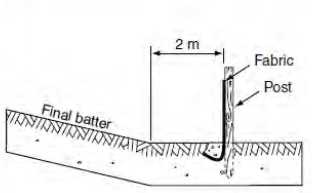
- reduce effective catchment area;
- increase channel width;
- increase channel roughness;
- stabilise bed with mats or mesh;
- stabilise bed with turf or rock;
- stabilise the outlet.

Check the channel lining (if any) for damage or displacement. If *Erosion Control Mats* have been used, check that they are correctly overlapped in direction of flow.

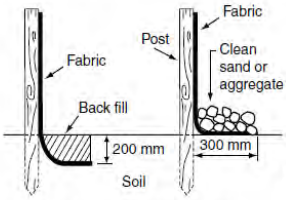
If the drain is lined with rock, check that the rock is not reducing the drain's required hydraulic capacity.

Appendix 2

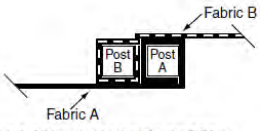
Sediment Fence Detail



(a) Location of fence relative to base of slope

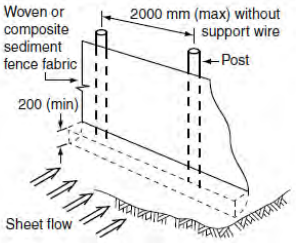


(b) Anchoring base of fabric

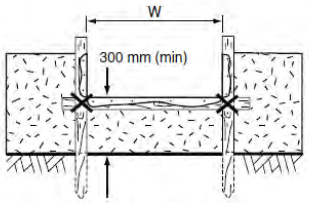


Fabric to fold around each stake one full turn.
Stake B to be drive tightly against Stake A.
The tops of both stakes to be secured with wire.

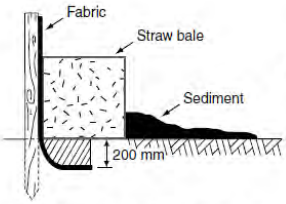
(c) Joining fabric - Method 1



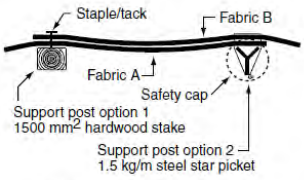
(d) Installation without backing support



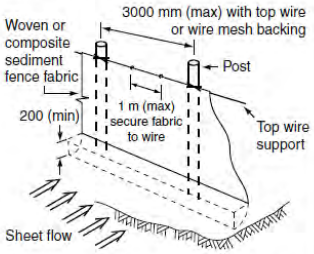
(e) Spill-through weir



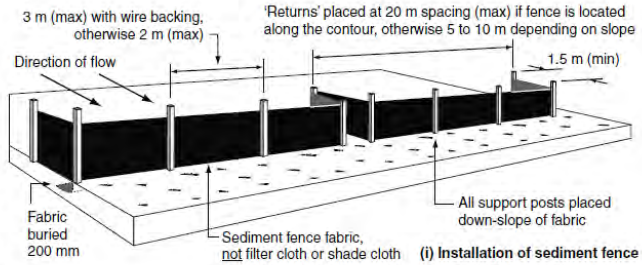
(f) Placement of up-slope straw bale



(g) Joining fabric - Method 2



(h) Installation with top wire support



(i) Installation of sediment fence

Notes:

1. Sediment fence to be installed along a line of constant ground elevation wherever practical.
2. Both end of the sediment fence to extend up the slope at least 1m.
3. Support post to be spaced a maximum 2m unless the fence is supported by a top wire or wire mesh backing, in which case 3m maximum spacing.
4. Fence 'returns' shall be installed at maximum 20m spacing if fence is installed along the contour, otherwise 5 to 10m maximum spacing.
5. Minimum 4 staples or tie wires per stake.

Drawn:	Date:		
GMW	Dec-09	Sediment Fence	SF-01

Catchments & Creeks Pty Ltd

MATERIALS

FABRIC: POLYPROPYLENE, POLYAMIDE, NYLON, POLYESTER, OR POLYETHYLENE WOVEN OR NON-WOVEN FABRIC, AT LEAST 700mm IN WIDTH AND A MINIMUM UNIT WEIGHT OF 140GSM. ALL FABRICS TO CONTAIN ULTRAVIOLET INHIBITORS AND STABILISERS TO PROVIDE A MINIMUM OF 6 MONTHS OF USEABLE CONSTRUCTION LIFE (ULTRAVIOLET STABILITY EXCEEDING 70%).

FABRIC REINFORCEMENT: WIRE OR STEEL MESH MINIMUM 14-GAUGE WITH A MAXIMUM MESH SPACING OF 200mm.

SUPPORT POSTS/STAKES: 1500mm^2 (MIN) HARDWOOD, 2500mm^2 (MIN) SOFTWOOD, OR 1.5kg/m (MIN) STEEL STAR PICKETS SUITABLE FOR ATTACHING FABRIC.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND REQUIRED TYPE OF FABRIC (IF SPECIFIED). IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, FABRIC TYPE, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. TO THE MAXIMUM DEGREE PRACTICAL, AND WHERE THE PLANS ALLOW, ENSURE THE FENCE IS LOCATED:
(i) TOTALLY WITHIN THE PROPERTY BOUNDARIES;
(ii) ALONG A LINE OF CONSTANT ELEVATION WHEREVER PRACTICAL;
(iii) AT LEAST 2m FROM THE TOE OF ANY FILLING OPERATIONS THAT MAY RESULT IN SHIFTING SOIL/FILL DAMAGING THE FENCE.

3. INSTALL RETURNS WITHIN THE FENCE AT MAXIMUM 20m INTERVALS IF THE FENCE IS INSTALLED ALONG THE CONTOUR, OR 5 TO 10m MAXIMUM SPACING (DEPENDING ON SLOPE) IF THE FENCE IS INSTALLED AT AN ANGLE TO THE CONTOUR. THE 'RETURNS' SHALL CONSIST OF EITHER:
(i) V-SHAPED SECTION EXTENDING AT LEAST 1.5m UP THE SLOPE; OR
(ii) SANDBAG OR ROCK/AGGREGATE CHECK DAM A MINIMUM 1/3 AND MAXIMUM 1/2 FENCE HEIGHT, AND EXTENDING AT LEAST 1.5m UP THE SLOPE.

4. ENSURE THE EXTREME ENDS OF THE FENCE ARE TURNED UP THE SLOPE AT LEAST 1.5m, OR AS NECESSARY, TO MINIMISE WATER BYPASSING AROUND THE FENCE.

5. ENSURE THE SEDIMENT FENCE IS INSTALLED IN A MANNER THAT AVOIDS THE CONCENTRATION OF FLOW ALONG THE FENCE, AND THE UNDESIRABLE DISCHARGE OF WATER AROUND THE ENDS OF THE FENCE.

6. IF THE SEDIMENT FENCE IS TO BE INSTALLED ALONG THE EDGE OF EXISTING TREES, ENSURE CARE IS TAKEN TO PROTECT THE TREES AND THEIR ROOT SYSTEMS DURING INSTALLATION OF THE FENCE. DO NOT ATTACH THE FABRIC TO THE TREES.

7. UNLESS DIRECTED BY THE SITE SUPERVISOR OR THE APPROVED PLANS, EXCAVATE A 200mm WIDE BY 200mm DEEP TRENCH ALONG THE PROPOSED FENCE LINE, PLACING THE EXCAVATED MATERIAL ON THE UP-SLOPE SIDE OF THE TRENCH.

8. ALONG THE LOWER SIDE OF THE TRENCH, APPROPRIATELY SECURE THE STAKES INTO THE GROUND SPACED NO GREATER THAN 3m IF SUPPORTED BY A TOP SUPPORT WIRE OR WEIR MESH BACKING, OTHERWISE NO GREATER THAN 2m.

9. IF SPECIFIED, SECURELY ATTACH THE SUPPORT WIRE OR MESH TO THE UP-SLOPE SIDE OF THE STAKES WITH THE MESH EXTENDING AT LEAST 200mm INTO THE EXCAVATED TRENCH. ENSURE THE MESH AND FABRIC IS ATTACHED TO THE UP-SLOPE SIDE OF THE STAKES EVEN WHEN DIRECTING A FENCE AROUND A CORNER OR SHARP CHANGE OF DIRECTION.

10. WHEREVER POSSIBLE, CONSTRUCT THE SEDIMENT FENCE FROM A CONTINUOUS ROLL OF FABRIC. TO JOIN FABRIC EITHER:
(i) ATTACH EACH END TO TWO OVERLAPPING STAKES WITH THE FABRIC FOLDING AROUND THE ASSOCIATED STAKE ONE TURN, AND WITH THE TWO STAKES TIED TOGETHER WITH WIRE; OR
(ii) OVERLAP THE FABRIC TO THE NEXT ADJACENT SUPPORT POST.

11. SECURELY ATTACH THE FABRIC TO THE SUPPORT POSTS USING 25 X 12.5mm STAPLES, OR TIE WIRE AT MAXIMUM 150mm SPACING.

12. SECURELY ATTACH THE FABRIC TO THE SUPPORT WIRE/MESH (IF ANY) AT A MAXIMUM SPACING OF 1m.

13. ENSURE THE COMPLETED SEDIMENT FENCE IS AT LEAST 450mm, BUT NOT MORE THAN 700mm HIGH. IF A SPILL-THOUGH WEIR IS INSTALLED, ENSURE THE CREST OF THE WEIR IS AT LEAST 300mm ABOVE GROUND LEVEL.

14. BACKFILL THE TRENCH AND TAMP THE FILL TO FIRMLY ANCHOR THE BOTTOM OF THE FABRIC AND MESH TO PREVENT WATER FROM FLOWING UNDER THE FENCE.

ADDITIONAL REQUIREMENTS FOR THE INSTALLATION OF A SPILL-THROUGH WEIR

1. LOCATE THE SPILL-THROUGH WEIR SUCH THAT THE WEIR CREST WILL BE LOWER THAN THE GROUND LEVEL AT EACH END OF THE FENCE.

2. ENSURE THE CREST OF THE SPILL-THROUGH WEIR IS AT LEAST 300mm THE GROUND ELEVATION.

3. SECURELY TIE A HORIZONTAL CROSS MEMBER (WEIR) TO THE SUPPORT POSTS/ STAKES EACH SIDE OF THE WEIR. CUT THE FABRIC DOWN THE SIDE OF EACH POST AND FOLD THE FABRIC OVER THE CROSS MEMBER AND APPROPRIATELY SECURE THE FABRIC.

4. INSTALL A SUITABLE SPLASH PAD AND/OR CHUTE IMMEDIATELY DOWN-SLOPE OF THE SPILL-THROUGH WEIR TO CONTROL SOIL EROSION AND APPROPRIATELY DISCHARGE THE CONCENTRATED FLOW PASSING OVER THE WEIR.

MAINTENANCE

1. INSPECT THE SEDIMENT FENCE AT LEAST WEEKLY AND AFTER ANY SIGNIFICANT RAIN. MAKE NECESSARY REPAIRS IMMEDIATELY.

2. REPAIR ANY TORN SECTIONS WITH A CONTINUOUS PIECE OF FABRIC FROM POST TO POST.

3. WHEN MAKING REPAIRS, ALWAYS RESTORE THE SYSTEM TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED OR SPECIFIED.

4. IF THE FENCE IS SAGGING BETWEEN STAKES, INSTALL ADDITIONAL SUPPORT POSTS.

5. REMOVE ACCUMULATED SEDIMENT IF THE SEDIMENT DEPOSIT EXCEEDS A DEPTH OF 1/3 THE HEIGHT OF THE FENCE.

6. DISPOSE OF SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

7. REPLACE THE FABRIC IF THE SERVICE LIFE OF THE EXISTING FABRIC EXCEEDS 6-MONTHS.

REMOVAL

1. WHEN DISTURBED AREAS UP-SLOPE OF THE SEDIMENT FENCE ARE SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE FENCE MUST BE REMOVED.

2. REMOVE MATERIALS AND COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. REHABILITATE/REVEGETATE THE DISTURBED GROUND AS NECESSARY TO MINIMISE THE EROSION HAZARD.

Drawn:	Date:		
GMW	Apr-10	Sediment Fence	SF-02

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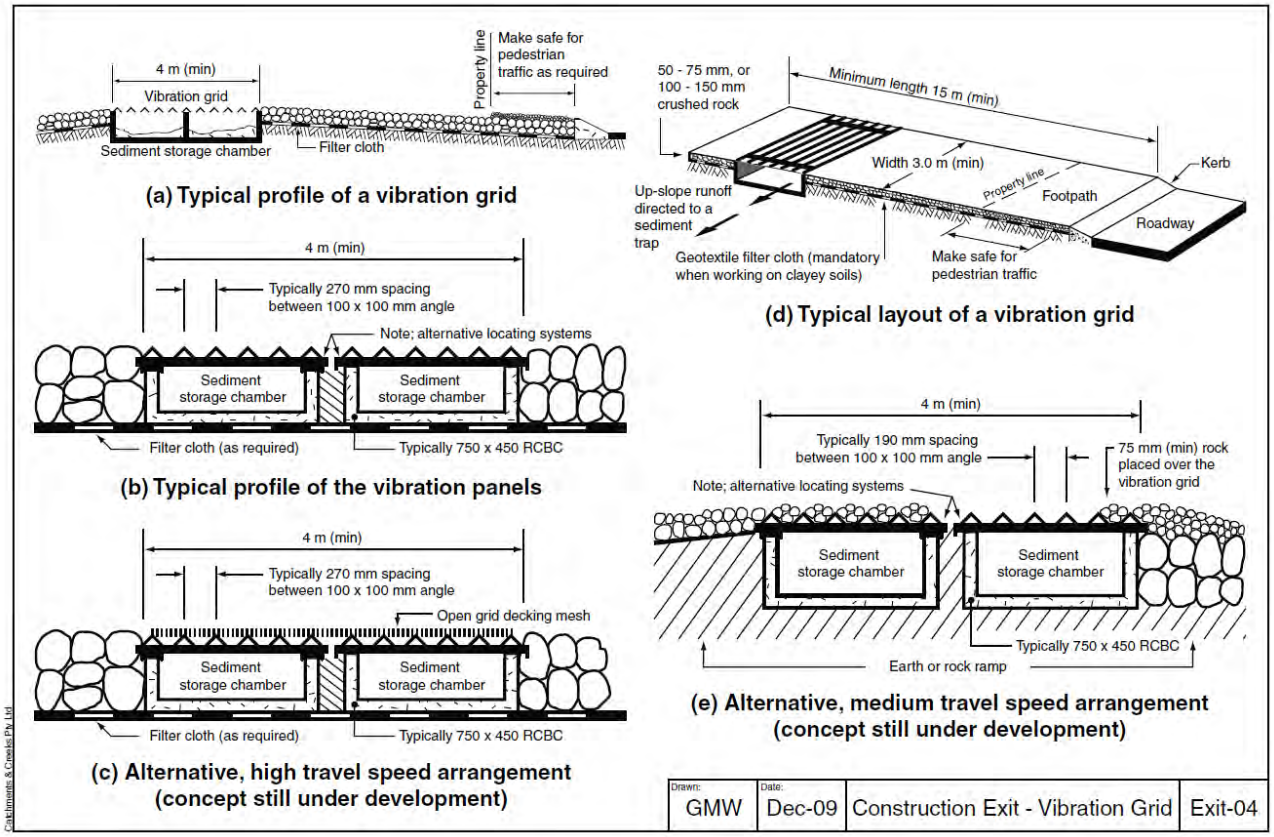
Appendix 3

Entry/Exit Detail



MATERIALS

ROCK: WELL GRADED, HARD, ANGULAR, EROSION RESISTANT ROCK, NOMINAL DIAMETER OF 50 TO 75mm (SMALL DISTURBANCES) OR 100 TO 150mm (LARGE DISTURBANCES). ALL REASONABLE MEASURES MUST BE TAKEN TO OBTAIN ROCK OF NEAR UNIFORM SIZE.

FOOTPATH STABILISING AGGREGATE: 25 TO 50mm GRAVEL OR AGGREGATE.

GEOTEXTILE FABRIC: HEAVY-DUTY, NEEDLE-PUNCHED, NON-WOVEN FILTER CLOTH ('BIDIM' A24 OR EQUIVALENT).

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND DIMENSIONAL DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, DIMENSIONS, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE LOCATION OF THE VIBRATION GRID, REMOVING STUMPS, ROOTS AND OTHER VEGETATION TO PROVIDE A FIRM FOUNDATION SO THAT THE ROCK IS NOT PRESSED INTO SOFT GROUND. CLEAR SUFFICIENT WIDTH TO ALLOW PASSAGE OF LARGE VEHICLES, BUT CLEAR ONLY THAT NECESSARY FOR THE EXIT. DO NOT CLEAR ADJACENT AREAS UNTIL THE REQUIRED EROSION AND SEDIMENT CONTROL DEVICES ARE IN PLACE.

3. GRADE THE LOCATION OF THE VIBRATION GRID SO THAT RUNOFF FROM THE UNIT WILL NOT FLOW INTO THE STREET, BUT WILL FLOW TOWARDS AN APPROPRIATE SEDIMENT-TRAPPING DEVICE.

4. ENSURE THAT THE INSTALLATION OF THE VIBRATION GRID HAS ADEQUATE SEDIMENT STORAGE VOLUME UNDER THE GRID. WHERE NECESSARY, INSTALL SUITABLE PRECAST SEDIMENT COLLECTION CHAMBERS.

5. PLACE A ROCK PAD/RAMP FORMING A MINIMUM 200mm THICK LAYER OF CLEAN, OPEN-VOID ROCK OVER THE ROADWAY BETWEEN THE VIBRATION GRID AND THE SEALED STREET TO PREVENT TYRES FROM PICKING UP MORE SOIL AFTER THEY HAVE BEEN CLEANED.

6. THE TOTAL LENGTH OF THE VIBRATION GRID AND ROCK RAMPS SHOULD BE AT LEAST 15m WHERE PRACTICABLE, AND AS WIDE AS THE FULL WIDTH OF THE ENTRY OR EXIT AND AT LEAST 3m. THE ROCK RAMP SHOULD COMMENCE AT THE EDGE OF THE OFF-SITE SEALED ROAD OR PAVEMENT.

7. FLARE THE END OF THE ROCK PAD WHERE IT MEETS THE PAVEMENT SO THAT THE WHEELS OF TURNING VEHICLES DO NOT TRAVEL OVER UNPROTECTED SOIL.

8. IF THE FOOTPATH IS OPEN TO PEDESTRIAN MOVEMENT, THEN COVER THE COARSE ROCK WITH FINE AGGREGATE OR GRAVEL, OR OTHERWISE TAKE WHATEVER MEASURES ARE NEEDED TO MAKE THE AREA SAFE

MAINTENANCE

1. INSPECT VIBRATION GRID PRIOR TO FORECAST RAIN, DAILY DURING EXTENDED PERIODS OF RAINFALL, AFTER SIGNIFICANT RUNOFF-PRODUCING RAINFALL, OR OTHERWISE AT FORTNIGHTLY INTERVALS.

2. IF SAND, SOIL, SEDIMENT OR MUD IS TRACKED OR WASHED ONTO THE ADJACENT SEALED ROADWAY, THEN SUCH MATERIAL MUST BE PHYSICALLY REMOVED, FIRST USING A SQUARE-EDGED SHOVEL, AND THEN A STIFF-BRISTLED BROOM, AND THEN BY A MECHANICAL VACUUM UNIT, IF AVAILABLE.

3. IF NECESSARY FOR SAFETY REASONS, THE ROADWAY SHALL ONLY BE WASHED CLEAN AFTER ALL REASONABLE EFFORTS HAVE BEEN TAKEN TO SHOVEL AND SWEEP THE MATERIAL FROM THE ROADWAY.

4. WHEN THE VOIDS BETWEEN THE ROCK BECOMES FILLED WITH MATERIAL AND THE EFFECTIVENESS OF THE ROCK RAMPS ARE REDUCED TO A POINT WHERE SEDIMENT IS BEING TRACKED OFF THE SITE, A NEW 100mm LAYER OF ROCK MUST BE ADDED AND/OR THE ROCK PAD MUST BE EXTENDED.

5. ENSURE ANY ASSOCIATED DRAINAGE CONTROL MEASURES ARE MAINTAINED IN ACCORDANCE WITH THEIR DESIRED OPERATIONAL CONDITION.

6. DISPOSE OF SEDIMENT AND DEBRIS IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

REMOVAL

1. THE VIBRATION GRID SHOULD BE REMOVED ONLY AFTER IT IS NO LONGER NEEDED AS A SEDIMENT CONTROL DEVICE.

2. REMOVE MATERIALS AND COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. RE-GRADE AND STABILISE THE DISTURBED GROUND AS NECESSARY TO MINIMISE THE EROSION HAZARD.

Drawn:	Date:		
GMW	Apr-10	Construction Exit - Vibration Grid	Exit-05

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Appendix 4

Field Data Sheet

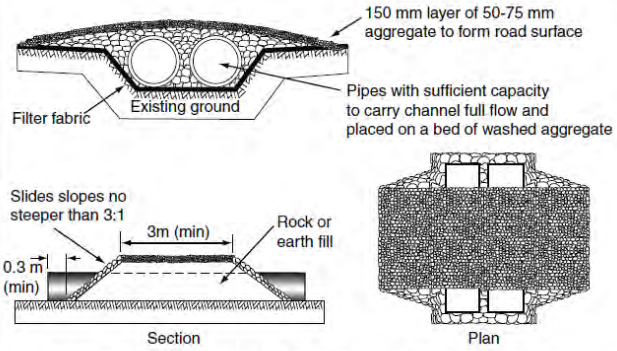
RATCH **Mt Emerald Windfarm**

Sampler Name :		Weather:	
Date:		Comments:	

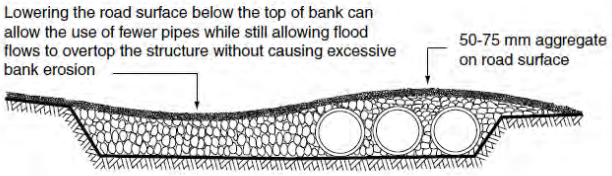
Parameter	SW1 (downstream)	SW2	SW3	SW4	SW5 (upstream)
pH					
ORP (mv)					
DO % sat					
DO mg/L					
Turbidity (ntu)					
Temp					
EC (us/cm)					
Salinity (ppt)					
Sample taken?					
Comments:					

Appendix 5

Temporary Culvert Crossing Detail

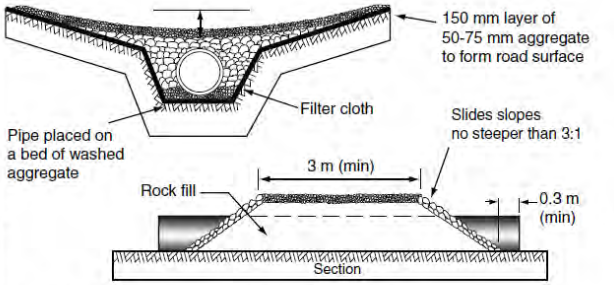


(a) Preferred arrangement for temporary culvert crossings

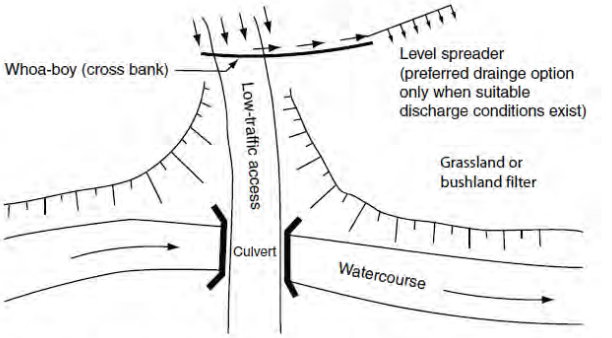


(b) Typical profile of temporary culvert crossings of wide channels

In situations where it is not practicable to allow overflows to initially passing around the culvert on a stable (well vegetated) stream bank, then the center must be set low to allow flow to pass over the culvert along the centreline of the channel



(c) Alternative layout for the crossing of confined channels



(d) Typical arrangement of surface runoff controls associated with approach ramps

Drawn:	Date:		
GMW	Dec-09	Temporary Culvert Crossing	TCC-01

Catchments & Creeks Pty Ltd

MATERIALS

CULVERTS: ANY COMMERCIAL CONDUIT THAT IS SUITABLE FOR THE REQUIRED TRAFFIC LOADING.

ROCK: MINIMUM 150mm NOMINAL ROCK SIZE.

AGGREGATE: 50–75mm CLEAN AGGREGATE.

GEOTEXTILE FABRIC: HEAVY-DUTY, NEEDLE-PUNCHED, NON-WOVEN FILTER CLOTH (MINIMUM BIDIM A34 OR EQUIVALENT).

INSTALLATION

1. PRIOR TO COMMENCING ANY WORKS, OBTAIN ALL NECESSARY APPROVALS AND PERMITS REQUIRED TO CONSTRUCT THE TEMPORARY WATERCOURSE CROSSING, INCLUDING PERMITS FOR THE DISTURBANCE OF BANK VEGETATION, AQUATIC VEGETATION (e.g. MANGROVES) AND ANY TEMPORARY INSTREAM FLOW DIVERSION BARRIERS OR SEDIMENT CONTROL MEASURES.

2. REFER TO APPROVED PLANS FOR LOCATION AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

3. ENSURE THAT THE LOCATION OF THE CROSSING WILL NOT INTERFERE WITH FUTURE CONSTRUCTION WORKS.

4. PRIOR TO SIGNIFICANT LAND CLEARING OR CONSTRUCTION OF THE APPROACH RAMPS, ESTABLISH ALL NECESSARY SEDIMENT CONTROL MEASURES AND FLOW DIVERSION WORKS (INSTREAM AND OFF-STREAM AS REQUIRED), CLEARING ONLY THOSE AREAS NECESSARY FOR INSTALLATION OF THESE MEASURES.

5. TO THE MAXIMUM DEGREE PRACTICABLE, CONSTRUCTION ACTIVITIES AND EQUIPMENT MUST NOT OPERATE WITHIN OPEN FLOWING WATERS.

6. MAINTAIN CLEARING AND EXCAVATION OF THE WATERCOURSE BED AND BANKS TO A MINIMUM. INITIALLY CLEAR ONLY THE AREA NECESSARY TO ALLOW ACCESS FOR CONSTRUCTION. CLEAR THE REMAINDER OF THE APPROACH RAMPS ONLY WHEN ADEQUATE DRAINAGE AND SEDIMENT CONTROLS ARE IN PLACE.

7. IF FLOW DIVERSION SYSTEMS CANNOT BE INSTALLED, THEN CONDUCT BANK EXCAVATIONS BY PULLING THE SOIL AWAY FROM THE CHANNEL.

8. WHERE PRACTICABLE, CONSTRUCT THE WATERCOURSE CROSSING PERPENDICULAR TO THE CHANNEL.

9. WHERE PRACTICABLE, THE APPROACH RAMPS SHOULD BE STRAIGHT FOR AT LEAST 10m AND SHOULD BE ALIGNED WITH THE CROSSING.

10. WHERE PRACTICABLE, DIRECT STORMWATER RUNOFF FROM THE APPROACH RAMPS INTO STABLE DRAINS, ADJACENT VEGETATION, OR APPROPRIATE SEDIMENT TRAPS TO MINIMISE THE RELEASE OF SEDIMENT INTO THE WATERCOURSE.

11. SHAPE THE CHANNEL, IF NECESSARY, TO RECEIVE THE PIPE/S.

12. IF HIGHLY EROSIVE SOILS ARE DETECTED, THEN APPROPRIATELY STABILISE SUCH SOILS AS SOON AS PRACTICABLE.

13. COVER THE CROSSING FOOTING WITH HEAVY-DUTY FILTER CLOTH.

14. COVER THE FILTER CLOTH WITH A MINIMUM 150mm OF CLEAN, 50 TO 75mm AGGREGATE.

15. PLACE THE SPECIFIED SIZE AND NUMBER OF CULVERT CELLS AND ALIGN THEM WITH THE DIRECTION OF THE DOWNSTREAM CHANNEL.

16. ENSURE THE PIPES EXTEND AT LEAST 300mm BEYOND THE PROPOSED EXTEND OF ROCK FILL.

17. FILL BETWEEN THE PIPE/S WITH 75 TO 100mm AGGREGATE.

18. COVER PIPE/S WITH SUFFICIENT ROCK (MINIMUM 300mm LAYER) TO SATISFY MANUFACTURER'S LOADING REQUIREMENTS TO AVOID DAMAGE TO THE PIPE/S RESULTING FROM THE EXPECTED TRAFFIC LOAD. SLOPE OF ROCK FACE UPSTREAM AND DOWNSTREAM OF THE CULVERT NO STEEPER THAN 3:1 (H:V).

19. FORM THE SHAPE OF THE ROAD SURFACE IN ACCORDANCE WITH THE PLANS AND/OR STANDARD DRAWINGS.

20. APPLY A SUITABLE COVER OF AGGREGATE OVER THE ROCK FILL TO FORM THE TRAFFICABLE ROAD SURFACE.

21. FINISH CONSTRUCTION AND STABILISATION OF THE APPROACH ROADS INCLUDING THE APPROACH RAMPS EACH SIDE OF THE BRIDGE CROSSING.

22. TAKE ALL REASONABLE MEASURES TO PREVENT EXCESS ROCK, DEBRIS AND CONSTRUCTION MATERIAL FROM ENTERING THE WATERCOURSE, ESPECIALLY ANY STILL OR FLOWING WATER.

23. IF IT IS NOT PRACTICABLE TO STABILISE THE ACCESS RAMPS AGAINST EROSION, THEN INSTALL FLOW DIVERSION BANKS ACROSS THE WIDTH OF EACH ACCESS RAMP ADJACENT THE TOP OF THE CHANNEL BANK, AND AT REGULAR INTERVALS DOWN THE RAMPS (AS REQUIRED) TO PREVENT OR MINIMISE SEDIMENT-LADEN RUNOFF FLOWING DIRECTLY INTO THE WATERCOURSE.

24. APPROPRIATELY STABILISE ANY DISTURBED WATERCOURSE BANKS.

25. STABILISE ALL DISTURBED AREAS THAT ARE LIKELY TO BE SUBJECTED TO FLOWING WATER, INCLUDING BYPASS AND OVERFLOW AREAS, WITH ROCK OR OTHER SUITABLE MATERIALS.

MAINTENANCE

1. TEMPORARY WATERCOURSE CROSSINGS SHOULD BE INSPECTED WEEKLY AND AFTER ANY SIGNIFICANT CHANGE IN STREAM FLOW.

2. DEBRIS TRAPPED ON OR UPSTREAM OF THE CROSSING SHOULD BE REMOVED.

3. REPAIR ANY DAMAGE CAUSED BY CONSTRUCTION TRAFFIC. IF TRAFFIC HAS EXPOSED BARE SOIL, STABILISED AS APPROPRIATE. MAINTAIN A MINIMUM 200mm COVER OVER THE CULVERTS.

4. CHECK FOR EROSION OF THE FORMED EMBANKMENT, CHANNEL SCOUR, OR ROCK DISPLACEMENT. MAKE ALL NECESSARY REPAIRS IMMEDIATELY.

5. CHECK THE BYPASS FLOODWAY MAKING SURE THE BANKS ARE STABLE.

6. CHECK FOR EXCESSIVE EROSION ON THE APPROACH ROADS.

7. CHECK THE CONDITIONS OF ANY FLOW DIVERSION CHANNELS/BANKS AND THE OPERATING CONDITIONS OF ASSOCIATED SEDIMENT TRAPS.

REMOVAL

1. TEMPORARY WATERCOURSE CROSSINGS SHOULD BE REMOVED AS SOON AS POSSIBLE AFTER ALTERNATIVE ACCESS IS ACHIEVED OR THE CULVERT IS NO LONGER NEEDED.

2. REMOVE ALL SPECIFIED MATERIALS AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. RESTORE THE WATERCOURSE CHANNEL TO ITS ORIGINAL CROSS-SECTION, AND SMOOTH AND APPROPRIATELY STABILISE AND REVEGETATE ALL DISTURBED AREAS.

Drawn:	Date:		
GMW	Dec-09	Temporary Culvert Crossing	TCC-02

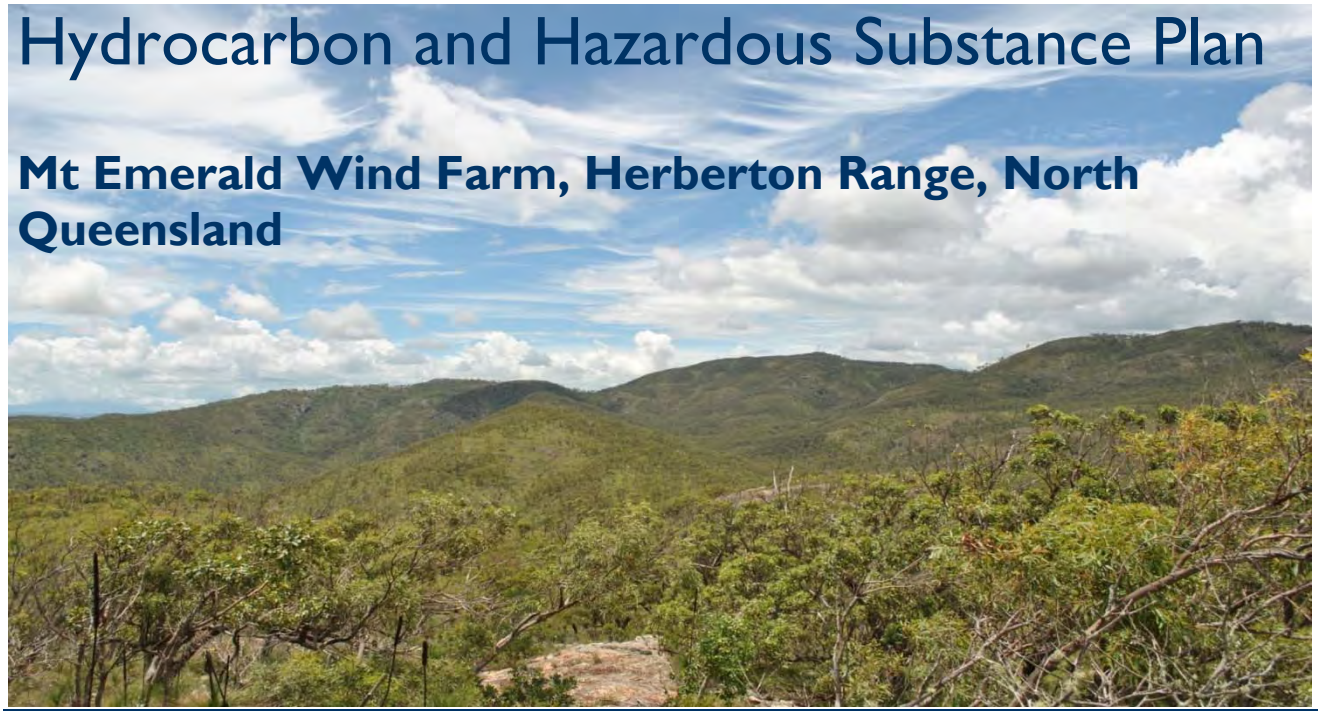
Catchments & Creeks Pty Ltd

Appendix M

Hydrocarbon and Hazardous Substance Plan

Hydrocarbon and Hazardous Substance Plan

Mt Emerald Wind Farm, Herberton Range, North Queensland



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IMPORTANT NOTE

We have prepared this report for the sole purposes of RATCH Australia Corporation Ltd ("**Client**") for the specific purpose of only for which it is supplied ("**Purpose**"). This report is strictly limited to the purpose and the facts and matters stated in it and does not apply directly or indirectly and will not be used for any other application, purpose, use or matter.

In preparing this report we have made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

This report is presented without the assumption of a duty of care to any other person (other than the Client) ("**Third Party**"). The report may not contain sufficient information for the purposes of a Third Party or for other uses. Without the prior written consent of RPS Australia East Pty Ltd:

(a) this report may not be relied on by a Third Party; and

(b) RPS Australia East Pty Ltd will not be liable to a Third Party for any loss, damage, liability or claim arising out of or incidental to a Third Party publishing, using or relying on the facts, content, opinions or subject matter contained in this report.

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In this note, a reference to loss and damage includes past and prospective economic loss, loss of profits, damage to property, injury to any person (including death) costs and expenses incurred in taking measures to prevent, mitigate or rectify any harm, loss of opportunity, legal costs, compensation, interest and any other direct, indirect, consequential or financial or other loss.

Document Status

Version	Purpose of Document	Orig	Review	Review Date
1	Draft	BC	MJ	01/08/2016
2	Review	BC	TJ	15/08/2016
3	Final	TJ	BC	17/11/2016

Approval for Issue

Name	Signature	Date
Mellissa Jess		18/11/2016

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1.0 Introduction

This Hydrocarbon and Hazardous Substance Plan (the plan) is prepared for RATCH Australia Corporation Limited (RACL) for construction and operational activities proposed to be carried out on the Mount Emerald Wind Farm (MEWF) site.

The project area comprises Lot 7 on SP235224, Easements A, C & E in Lots 1, 2 & 3 on SP231871 and part of Lot 905 on CP896501. The project involves the construction and operation of a wind farm located approximately 20km SSW of Mareeba on the Atherton Tablelands in north Queensland. The project approval allows for the construction of up to 63 wind turbines, associated access tracks and an electricity substation that will feed into the main electricity grid (Powerlink's Chalumbin – Woree 275 kV transmission line).

This plan provides procedures for any on site, permanent post construction storage of fuels lubricants waste oil or other hazardous substances or potential contaminants to be in bunded areas on the MEWF project in the Mareeba Walkamin district.

The plan also includes contingency measures to ensure that any chemical or oil spills are contained on site and cleaned up in accordance with the Council requirements.

2.0 Regulatory Requirements

2.1 Project Approvals

2.1.1 Sustainable Planning Act 2009

Conditions relevant to the preparation and implementation of the Hydrocarbon and Hazardous Substance Plan (HHSP) are detailed in Condition 13 of the Ministerial Decision Notice.

2.1.1.1 Ministerial Decision Notice

The Development Notice (dated 18 December 2015) in accordance with the SPA included a number of conditions relating to the preparation of a *Hydrocarbon and Hazardous Substance Plan* (HHSP). *Condition 13 - Environmental Management* which relates to the HHSP, states the following:

> *Submit to the chief executive administering SPA an Environmental Management Plan (EMP) prepared by a suitably qualified person(s). The EMP must:*
>
> *i. be generally in accordance with the Preliminary Environmental Management Plan prepared by RPS and dated November 2013 and the draft Statement of Commitments contained within Appendix A of the RPS Development Application Material Change of Use Report dated March 2012;*
>
> *ii. be based on the revised Turbine Location and Development Footprint Plan submitted in accordance with condition 2 of this approval;*
>
> *iii. include the following components as further detailed in Attachment 1:*
>
> - *a hydrocarbon and hazardous substances plan (timing as required with the EMP).*

3.0 Storage of Hydrocarbons and Hazardous Substances

Environmental Legislation and standards relevant to the project and to be used in conjunction with this management plan include:

Table 1 Relevant Legislation and Standards

Element	Legislative and Other Requirements
Storage and Handling of Dangerous Goods	*Environmental Protection Act 1994 (Qld)* *Environmental Protection Regulation 2008 (Qld)* *Workplace Health and Safety Act 1995 (Qld*) AS1940 – The Storage and Handling of Flammable and Combustible Liquids
Transport of Dangerous Goods	Australian Code for Transport of Dangerous Goods by Road and Rail AS 1678 – Emergency Procedure Guide, Transport Series, AS 2809 – Road Tank Vehicles for Dangerous Goods

Hydrocarbons and hazardous substances will be stored at the Contractors Site Compound, Laydown Area or O&M Building as shown in **Figure 1**. Hydrocarbons and hazardous substances will be stored in accordance with AS1940 and specifically with:

- An on-site set of the relevant MSDS for all flammable and combustible substances and dangerous goods used during construction and operation. This will be maintained and available.
- Waste flammable and combustible substances which cannot be recycled will be transported to a licensed waste disposal facility such as Springmount landfill.
- All hydrocarbon and hazardous chemicals will be stored in bunded areas which can contain 110% of the largest container.
- No refuelling of plant and equipment over or within 100m of watercourses.
- The storage area shall be adequately ventilated.
- Appropriate signage warning flammable liquids/dangerous goods are present.
- Spill kits containing absorbent and containment material (e.g. absorbent matting) will be available where hazardous materials are used and stored and personnel trained in their correct use.
- Spills of flammable and combustible substances will be rendered harmless and collected for treatment and / or remediation or disposal at an approved landfill, including cleaning materials, absorbents and contaminated soils and reinstatement made to the affected area.
- Personal protective equipment (PPE) appropriate to the materials in use will be provided.

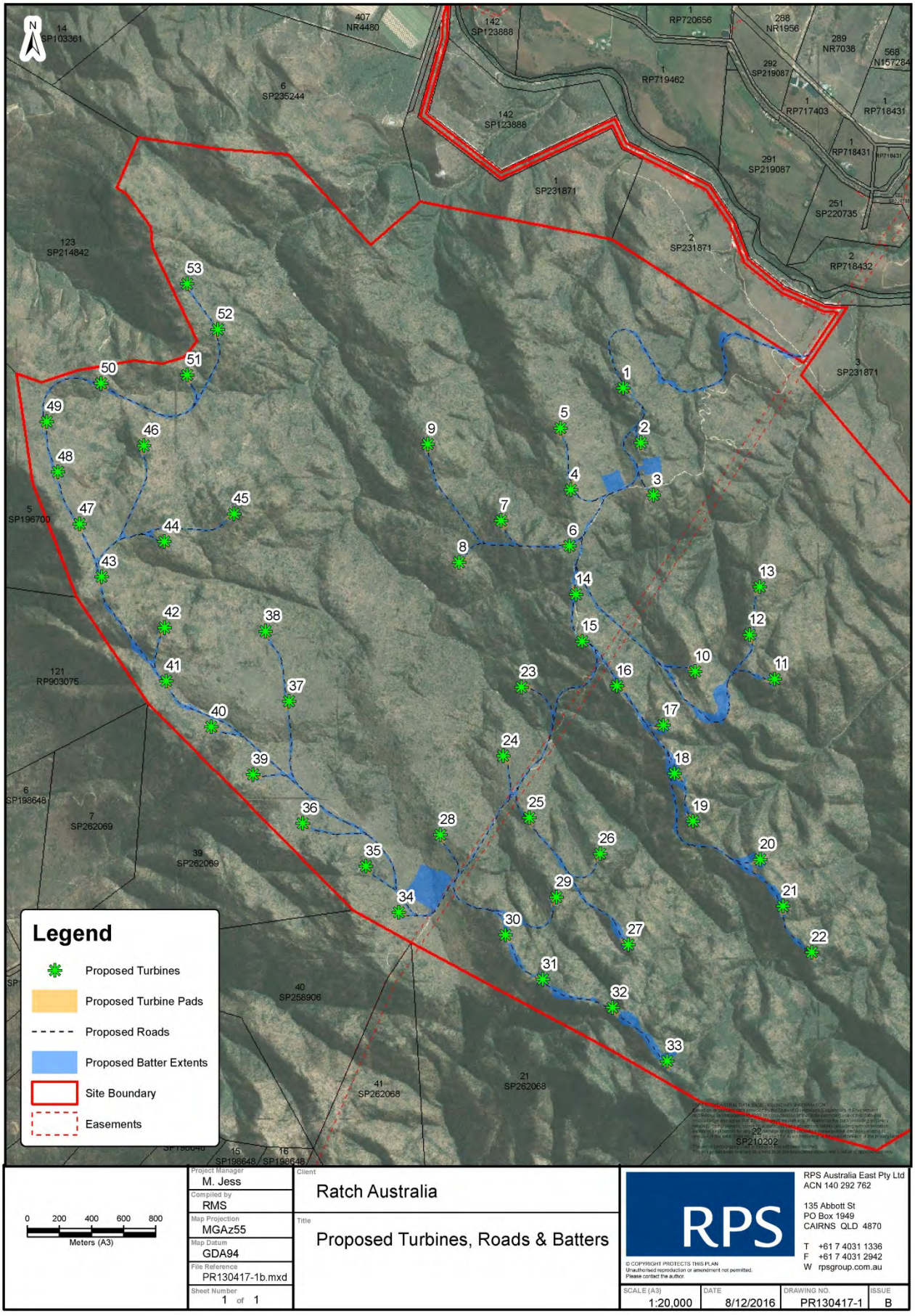

Figure 1 Site Infrastructure Overview

4.0 Incident Response

4.1 Site Contacts

Relevant site contacts are detailed in **Table 2**.

Table 2 Site Contacts Details

Issue	Organisation	Person	Position	Contact Details
Implementation and management of this Plan	Vestas	TBA	Project Manager / HSEQ Coordinator	
Receiving the following reports; monitoring, remedial action, environmental complaints and emergencies	Vestas	TBA	Project Manager / HSEQ Coordinator	
Ensuring measures/action plans are implemented	Vestas	TBA	Project Manager / HSEQ Coordinator	
Reporting	Vestas	TBA	Project Manager / HSEQ Coordinator	

4.2 Records Management

A copy of this Plan shall be kept in the site office at all times.

Any record or document required as an outcome of this Plan, or requested by a regulatory authority, must be kept at the site for a period of 5 years and be available to an authorised person upon request.

Records must be kept of the key environmental performance indicators, monitoring results, corrective actions, environmental incidents and complaints, reports to management, and any records required by law such as regulated waste tracking.

4.3 Training Requirements

It will be the Project Manager / HSEQ Coordinator's responsibility to ensure all employees and sub-contractors are fully formally inducted into this Plan. An employee and sub-contractor training register is located in **Appendix 1**.

Inductions will cover the following:

- Spill kit use and response;
- Equipment and maintenance;
- This Plan's requirements; and
- The general duty of environmental care.

4.4 Incident Management

4.4.1 What is an Incident

An incident is any non-compliance with this Plan. This may include but is not limited to:

- Complaints regarding hydrocarbons and hazardous substances;
- Spilling of hydrocarbon or hazardous products; and
- Unauthorised waste disposal.

4.4.2 Incident Investigation

All incidents shall be investigated by the Project Manager / HSEQ Coordinator to determine:

- Nature, type, location and extent of the incident and the affected area;
- Actual and/or potential environmental impacts of the incident;
- Suspected cause of the incident;
- Measures required to mitigate any further environmental harm;
- Remedial measures required to correct any environmental harm; and
- Measures to be implemented to prevent a recurrence of the incident.

4.4.3 Incident Reporting

All personnel are responsible for reporting all incidents to the Project Manager / HSEQ Coordinator. The Project Manager / HSEQ Coordinator will be responsible for reporting environmental incidents to the Department of Environment and Heritage Protection (DEHP) and any other appropriate agencies. All incidents are to be recorded on the Incident Report Form provided in **Appendix 3**. All persons attending the site are required to sign in and be provided with the contact details for emergencies (refer to **Table 3**).

The Project Manager / HSEQ Coordinator shall telephone DEHP's pollution hotline as soon as practical after becoming aware of any release of contaminants not in accordance with the DEHP Permits. Following this, a written notice detailing the following information must be provided to DEHP within 14 days of the initial notification:

- The name of the operator, including their approval / registration number;
- The name and telephone number of a designated contact person;
- Quantity and substance released;
- Vehicle and registration details;
- Person/s involved (driver and any others);
- The location and time of the release;
- The suspected cause of the release;
- A description of the effects of the release;
- The results of any sampling performed in relation to the release,
- Actions taken to mitigate any environmental harm caused by the release; and
- Proposed actions to prevent a recurrence of the release.

Table 3 Incident/Emergency Contact Details

Issue	Person/Organisation	Contact Details
Incident / Emergency / Spills	Project Manager	TBA
	Department of Environment and Heritage	Pollution Hotline – **1300 130 372**
Fire or other emergency	QLD Fire and Rescue	000
	QLD Ambulance	000
	QLD Police	000

4.5 Emergency Response

4.5.1 Spill Response

If a spill threatens the safety or health of people, creates a fire hazard or has the potential to cause or causes serious environmental harm then the site emergency procedure shall be followed.

4.5.1.1 Chemical Spills

Where a chemical spill occurs, consult the Material Safety Data Sheet (MSDS) for spill procedures. If the MSDS indicates a requirement for containment and clean up then the following steps should also be considered:

(1) Stop the source and spread of the spill if safe to do so:

- Check for danger;
- Prevent the spill from getting larger (turn off valves, block damaged tanks or pipes), and
- Use any suitable material or equipment to confine the spill by “damming it off” (e.g. use available spill response equipment such as booms or absorbent or if unavailable then use soil or other suitable material).

(2) Clean up the spill

- Once the spill has been contained, retrieve as much of the spilled liquid as possible and place in an appropriate container (e.g. 20 L drum or 1000 L pod). The liquid should then be disposed of;
- Absorb remaining spill with absorbent material and place used absorbent in the appropriate waste bin; and
- Where applicable, replenish equipment used from Spill Response Kit.

(3) Report the spill

- Report and investigate all spills in accordance with Incident Reporting and Analysis (see above).

4.5.1.2 Spill Kits

Spill kits and/or spill cleanup equipment should be available at all locations hydrocarbons and hazardous substances are being handled or stored. Equipment contained in spill response kits shall be replenished upon use, equal to the specified list contained within the kit. The Project Manager / HSEQ Coordinator will ensure that Spill Response Kits are inspected regularly and missing items replenished when necessary.

5.0 Monitoring and Review

5.1 Non Compliance and Corrective Action

The Project Manager / HSEQ Coordinator shall assume responsibility for implementation of this Plan. Where the Project Manager / HSEQ Coordinator becomes aware of a site or operational condition that does not comply, a Corrective Action Report (CAR) form is to be completed and actioned. An example CAR form is provided in **Appendix 4** of this Plan. CAR for any non-compliance is to be actioned within 24 hours of receiving confirmation of the non-compliance.

Appendix 1

Environmental Site Induction / Training Register

All personnel entering/ working on the site must receive an induction covering all relevant environmental issues. The induction will provide information on known environmental risks relating to site activities and site emergency plans.

DATE	NAME	COMPANY NAME	COMPANY ADDRESS	SIGNATURE	TRAINING PROVIDER SIGNATURE

Appendix 2

Non-conformance & Complaints Register

Record the complaint in this register, and action the Non Conformance Corrective Action Record for each complaint.

Date	Issue / Complaint	Affected Neighbours	Activity Date	Follow-up/Complaints	
				Action	Date

Appendix 3

Incident Report Form

DATE:		**TIME:**	
INCIDENT REPORTED BY:			
AREA WHERE INCIDENT OCCURRED:			
DETAILS OF INCIDENT:			
ACTIONS FOLLOWING INCIDENT: (date, method, personnel)			
RECOMMENDED FURTURE ACTIONS: (date, method, personnel)			
RELEVANT PERSONNEL INFORMED: (names and signatures)			
SITE SUPERVISOR:			
COPY SENT TO DEHP: (date and initial)			

Appendix 4

Corrective Action Report

Report No:	
Date:	

Details of Non-conformance:

Inspected by:

Details of Recommended Corrective Action:

Recommended completion date:

Preventative/ Corrective Action to Prevent Issue Recurring

Date action required by (if applicable):

Signed (by Principal Contractor): Date:

Authority to Proceed

Sign: Date:

Action Carried Out

Sign: Date:

Element Re-inspected by

Sign: Date:

Copy Issued to Principal Contractor

Sign: Date:

Appendix N

Bushfire Management and Emergency Evacuation Plan

Bushfire Management and Emergency Evacuation Plan

Mt Emerald Wind Farm, Herberton Range, North Queensland

Prepared by:

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Report Number: PR130417-3/R75917
Version / Date: Final December 2016

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IMPORTANT NOTE

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
1	Draft	BC	MJ	04/08/2016
2	Review	BC	TJ	15/08/2016
3	Draft for Contract Review	BC	MJ	18/11/2016
Final	Final Report	MJ		08/12/2016

Approval for Issue

Name	Signature	Date
Mellissa Jess		08/12/2016

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1.0 Introduction

This Bushfire Management and Emergency Evacuation Response Plan (the plan) is prepared for RATCH Australia Corporation Limited (RACL) for construction and operational activities proposed to be carried out on the Mount Emerald Wind Farm (MEWF) site. The Plan is prepared in accordance with State Planning Policy 1/03 - *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* (SPP 1/03).

The project area comprises Lot 7 on SP235224, Easements A, C & E in Lots 1, 2 & 3 on SP231871 and part of Lot 905 on CP896501. The project involves the construction and operation of a wind farm located approximately 20 km SSW of Mareeba on the Atherton Tablelands in north Queensland. The project approval allows for the construction of up to 63 wind turbines, associated access tracks and an electricity substation that will feed into the main electricity grid (Powerlink's Chalumbin – Woree 275 kV transmission line).

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

The purpose of this Plan is to focus on preventing fires on the MEWF site and to be prepared should a bushfire be ignited or pass through the site.

1.1 The Project

The Mount Emerald Wind Farm (MEWF) is approved for the construction of up to 63 wind turbines on an elevated site approximately 20 km SSW of Mareeba on the Atherton Tablelands in north Queensland (**Figure 1**). The towers will be approx 80-90m high with approximately 55-60m blades, utilising 3.3-3.45 MW machines.

The site where the wind turbines, interconnecting tracks and associated infrastructure are to be established is on land formally described as Lot 7 on SP235224, which encompasses an area of 2,422ha. 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 540m up to 1089m 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. Although land to the north of the transmission line (including the landmark of Walsh Bluff) possesses lower floristic diversity, it is recognised for its habitat value for the endangered Northern Quoll (which is also expected to occur south of the transmission line).

The wind farm project estimates to deliver up to 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. 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.

1.2 Construction Details

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 approximately 10m. The interconnecting tracks will form the routes for the inter-turbine underground cabling – expected to be buried in trenches at approximately 1m deep.

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

Wind turbines will be "micro-sited" – a technique which involves selecting a position in the landscape where the, environmental, constructability and other impacts area considered and weighed up. 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 (MEWF) 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 Environmental Impact Statement (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.

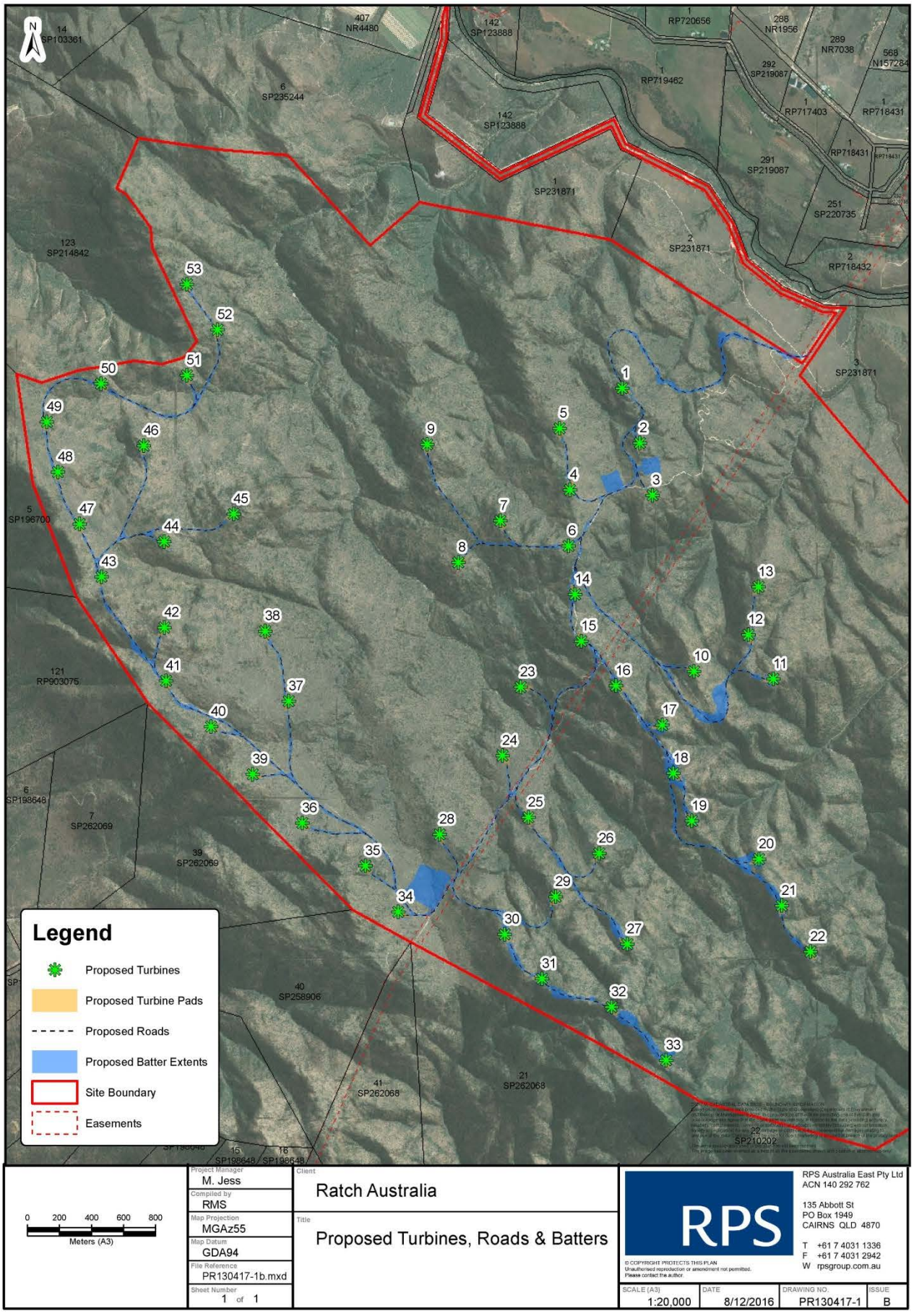


Figure 1 Project Site Location

1.3 Site Details

Lot 7 is a large rural allotment, situated (at its closest point) approximately 3.5km south-west of Walkamin, off Springmount Road at Arriga on the Atherton Tablelands. The site is characterised by rugged terrain with elevations of between 540m up to 1089m above sea level (ASL). Virtually the entire site is covered by remnant vegetation, as defined under Queensland's *Vegetation Management Act 1999* (VMA).

Bushfire hazard mapping which considers factors such as vegetation type, slope and aspect to determine the level of bushfire hazard is shown in **Appendix 1**. This map shows the majority of the eastern portion of the site (east of the powerline) is rated high and very high potential bushfire intensity risk. Northern extents of the site where the slope gradient is high also have significant areas of very high potential bushfire intensity risk. The correlation between slope gradient and bush fire potential is clear.

Fire mapping based on interpretation of satellite imagery obtained from the Northern Australia Fire Information (NAFI, 2016) indicates that the entire site was burnt most recently in a September 2015 event which covered 70.1km^2. Previous to this, a summary of recent fires recorded is provided in **Table 1**:

Table 1 Major Fires Summary (NAFI 2016).

Fire Date and Month	Area of Site Burnt
August 2011	21.8km^2
2009 (Month Unknown)	8.75km^2
December 2006	2.7km^2
November 2004	0.1km^2
October 2003	7.9km^2
November 2001	72km^2

From visual assessments of the extent of scorching on trees, the fires are presumed to have been relatively hot and ferocious – extending completely into the crowns of trees in the canopy of vegetation to 10m high. This was particularly evident on hill slopes and at the crest of hills however evidence of powerful fire was found across the entire site.

The 2009 fire does not appear to have affected the whole project area. For example, the flat-bottomed valley in the interior and the western ridgeline remained relatively unburnt and showed fewer signs of severe fire impact. In this sense, it is believed fire passes through the project area on a periodic basis – enough to limit the development of excessive fuel loads.

1.4 Climate and Rainfall

The dominant rainfall pattern of the local area is monsoonal, with alternating wet and dry seasons that typically last for four and eight months respectively. The Walkamin Research Station (Bureau of Meteorology station number 031108, elevation 594m) has been selected as a suitable reference site, due to its close proximity (situated 6km from the wind farm) and availability of long term climate records. A summary of the weather data from this station is presented in **Table 2**.

Table 2 Summary of Weather Data for Walkamin Research Station (BoM, 1965 - 2016)

Weather Conditions	Measurements
Mean Annual Rainfall	1022.3mm
Highest Annual Rainfall	1750.5mm (1974)
Lowest Annual Rainfall	470.2mm (2002)
Highest Monthly Rainfall	894.1mm (Feb 2000)
Lowest Monthly Rainfall	0.0mm (May 2001)
Mean Annual Minimum/Maximum Temperature	17.0°C/27.4°C
Highest Temperature	39.8°C (19 Nov 1990)
Lowest Temperature	2.6°C (4 July 1984)

Bureau of Meteorology (2016).

Average annual rainfall in the area is 1022.3mm with the wettest month being February (248.9mm), and the driest month being September (8.4mm). The majority of rain (80%) falls within the months of December to March. This rainfall distribution over the year is displayed in **Figure 2** (BoM, 1965 – 2016):

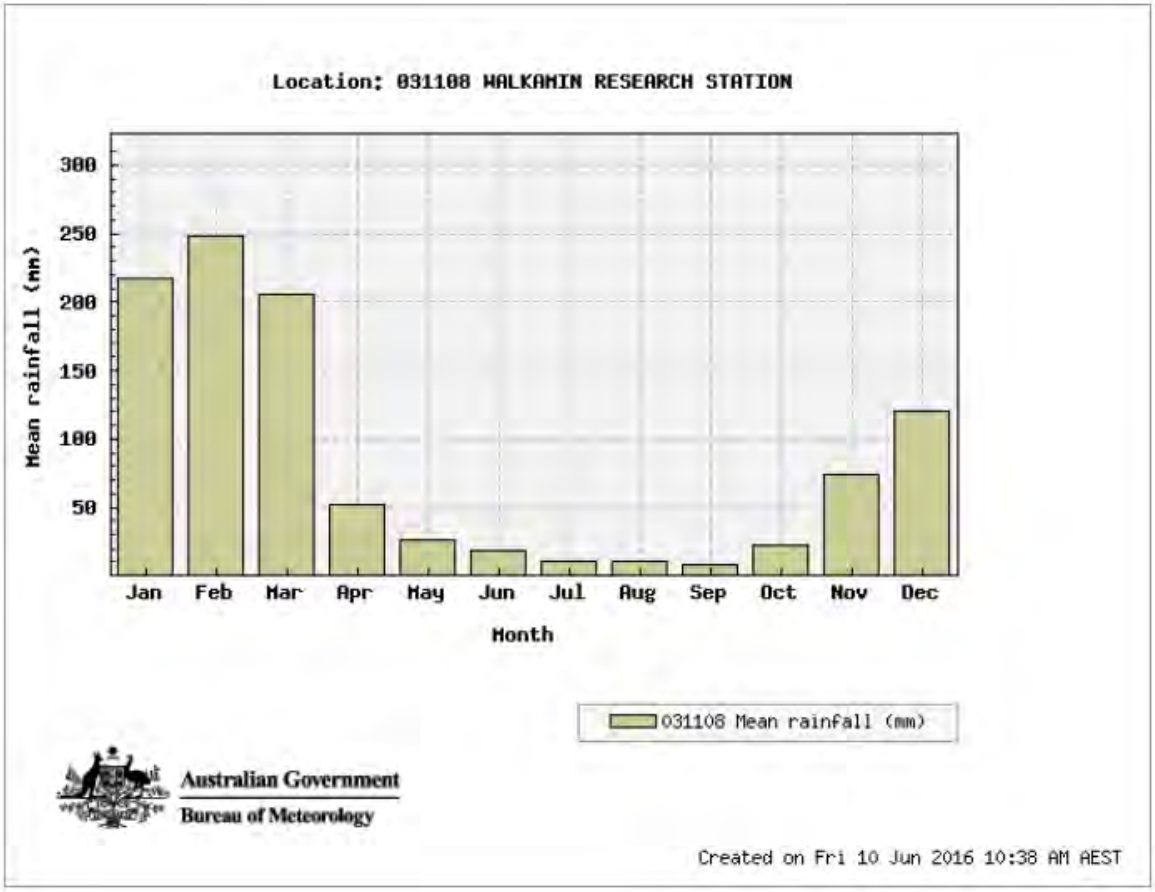


Figure 2 Mean monthly rainfall for Walkamin Research Station (BoM, 1965 – 2016)

The highest aspects of the site are 1089m ASL, which are 550m higher in altitude than the Walkamin Monitoring Station. The change in temperature as a function of elevation is typically between 0.6°C and 1°C per 100m increase in altitude (BOM, 2013), but this can vary significantly by factors such as wind speed, moisture and daily temperatures. Some of the highest elevated parts of the site also experience higher precipitation and ground moisture due to cloud stripping, as clouds intersect the landform.

1.5 Surrounding Land Uses

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 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. A representation of these land uses is shown in **Figure 3**. There are approximately 118 receptors (representing individual residences, or in some cases groups of residences) in total, associated with both farming and other uses located within a 5 km radius of the windfarm.

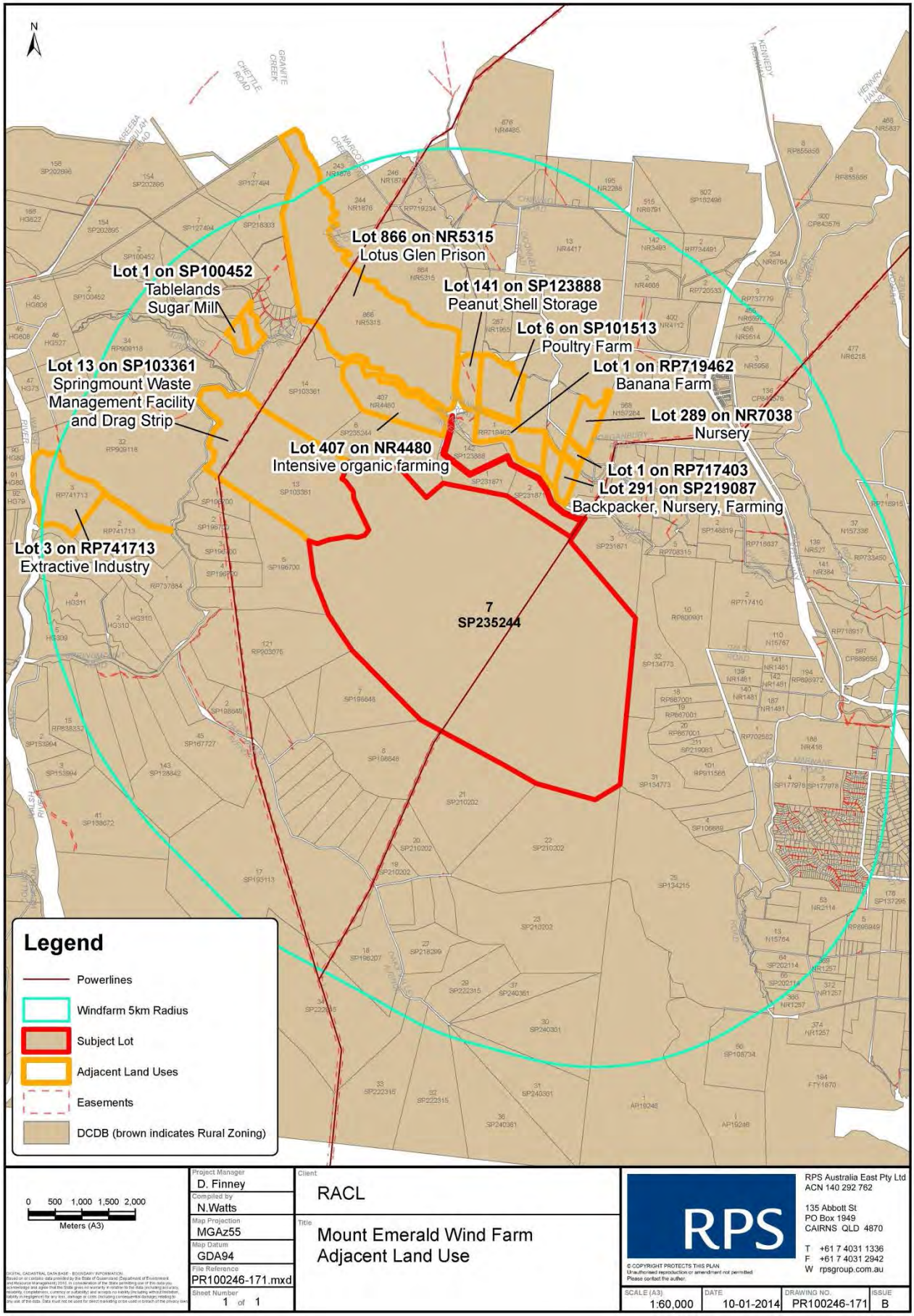


Figure 3 Surrounding Land Uses

1.6 Topography

The project site is situated over mountainous terrain coinciding with the northern extent of the Herberton Range. The site is characterised by acid igneous rhyolite geology forming windswept ridges and rock outcrops interspersed with rock pavements, which support skeletal soils. Between these prominent features are undulating valleys. The site is broadly divided in terms of the degree of surface relief. This has bearing on the landforms and vegetation types. To the south of the Chalumbin to Woree 275 kV transmission line the land is conspicuously dissected, rugged and characterised by narrow, high ridges and in some instances, precipitous slopes. The land to the north of the transmission line exhibits less surface relief, dissected ridges and steep slopes. The landform generally becomes more undulating in this northern area, until the escarpment edges of the mountainous range is reached.

1.7 Vegetation

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

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

The Wet Tropics bioregion to the south of the transmission line is characterised by shrubland and low woodland with open canopies. The shrub layer can at times be quite thick, covering the ground layer. The canopy layer is dominated by Eucalyptus and Corymbia species with canopies typically 5-10m in height. These areas are typically higher in elevation and experience cloud stripping in many areas above 900m and therefore experience cooler environments with increased precipitation.

The Einasleigh Uplands to the north of the transmission line are characterised by low woodland to low open woodland. The ground layer is dominated by grass species and has a sparse shrub layer. Eucalyptus and Corymbia species again dominate the canopy layer with heights up to 8-12 meters. These areas typically have less relief, remain below 900m and hence do not receive extra precipitation due to cloud stripping and consequently are typically drier than to the south of the transmission line.

1.8 Fire History

As discussed in **Section 1.1**, fire mapping based on interpretation of satellite imagery obtained from the Northern Australia Fire Information (NAFI, 2016) indicates the entire site was burnt most recently in 2015. It should be noted that the pixel size of the MODIS satellite imagery is approximately 250 m^2 so the mapping is unable to provide an accurate indication of the degree of the spatial heterogeneity of fires. Summary reports obtained from NAFI can be found in **Appendix 2**.

From visual assessments of the extent of scorching on trees, the fires are presumed to have been relatively hot and ferocious – extending completely into the crowns of trees in the canopy of vegetation to 10 m high.

1.8.1 Wind Farms and Fire

Research and operations over the past 20 years suggest that there is little chance of operational wind farms to create a fire risk (Macintosh and Downie, 2006) in Australia. Wind turbines have the potential to create fire hazard in two ways (Flynn 2004):

- mechanically in which turbine bearings wear out, electrical shorts occur or cables are damaged for example; and
- lightning strikes due to the turbines height.

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.

The impact of a bushfire on WTG's at MEWF should be limited. Fires will be hot and fast but are unlikely to burn for long enough periods in the vegetation surrounding a turbine to cause damage, especially if asset protection zones and other aspects of this plan are followed. It is unlikely that damage from flames could reach the nacelle or blade tips (lowest point is approximately 30m above ground level) given past fires height estimated at being no higher than 10m above ground level. 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.

2.0 Regulatory Requirements

2.1 Project Approvals

2.1.1 Sustainable Planning Act 2009

Conditions relevant to the preparation and implementation of the Bushfire Management and Emergency Evacuation Plan (BMP) are detailed in Condition 13 of the Ministerial Decision Notice.

2.1.1.1 Ministerial Decision Notice

The Development Notice (dated 18 December 2015) in accordance with the SPA included a number of conditions relating to the preparation of a BMP. *Condition 13 - Environmental Management* which relates to the BMP, states the following:

Submit to the chief executive administering SPA an Environmental Management Plan (EMP) prepared by a suitably qualified person(s). The EMP must:

i. be generally in accordance with the Preliminary Environmental Management Plan prepared by RPS and dated November 2013 and the draft Statement of Commitments contained within Appendix A of the RPS Development Application Material Change of Use Report dated March 2012;

ii. be based on the revised Turbine Location and Development Footprint Plan submitted in accordance with condition 2 of this approval;

iii. include the following components, as further detailed in Attachment 1:

- *a bushfire risk management plan and emergency evacuation plan (timing as required with the EMP).*
- *an ecological fire management plan (timing as required with the EMP).*

3.0 Bushfire Management Plan

Fire risk can be minimised through strategically managed vegetation and landscaping, and this Plan considers the use of Asset Protection Zones around buildings (where turbine infrastructure are also considered buildings), whereby a range of landscape features such as mature trees, can be retained to maintain elements of the natural character of the site.

3.1 Maintenance of Vegetation

Traditionally and in accordance to guidelines of SPP 1/03, vegetation is cleared around buildings to a distance of 1.5 times the average height of the adjacent trees. Vegetation is up to 12m in height; therefore in some instances a clearance distance of 18m will be required around buildings/substation/switchyard/wind turbine generators. Roadways and regularly maintained landscaped grounds with low-growing and shrubby plants can be included as part of the cleared zone (see Asset Protection Zones).

3.2 Asset Protection Zones

Where it is considered safe to do so, an Asset Protection Zone (APZ) can be incorporated as a landscaping feature into the vegetation clearing area around buildings and other wind farm infrastructure that requires protection from fire. The concept of Asset Protect Zones aims to retain natural characteristics of the ground such as trees and patches of vegetation, whilst reducing the potential for high intensity bushfire contacting with buildings and other fire sensitive wind farm infrastructure. Subsequently, the Asset Protection Zone is a low fuel load area surrounding buildings and other wind farm infrastructure.

Any Asset Protection Zones should be managed so that the fire hazard is substantially reduced and in particular to reduce the chance of a fire damaging wind farm infrastructure. For example, large and healthy trees can be retained as isolated, stand-alone specimens surrounded by areas of mowed grass or other 'fire proof' surfaces. Likewise, small pockets of natural shrubby vegetation can be preserved providing they are of a manageable area and also surrounded by mowed grass or 'fire-proof' surfaces such as pathways or short-growing vegetation with low flammable properties. This is shown diagrammatically in **Plate 1** below.

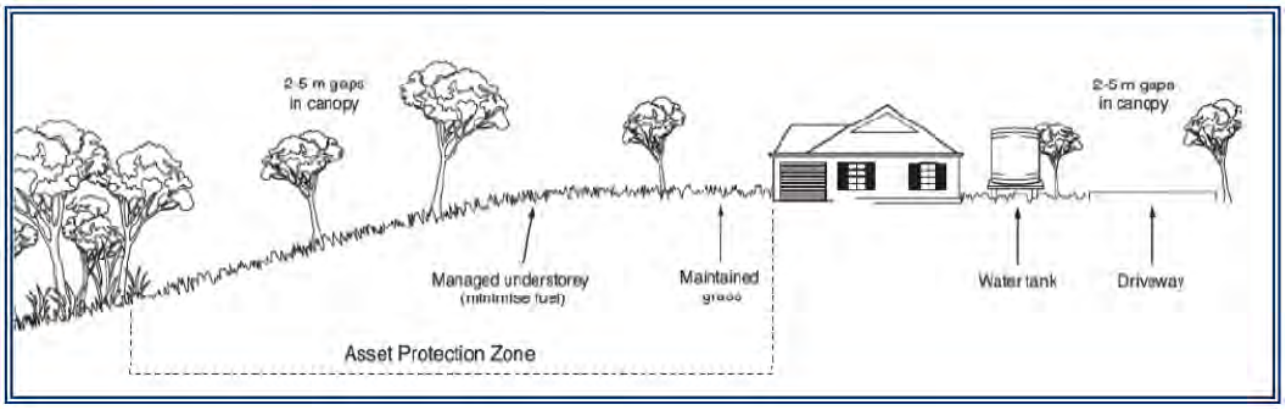


Plate 1 Asset Protection Zone

Mowed grass areas or other fire proof surfaces or short vegetation with low flammability to ensure that wind farm infrastructure is separated from contiguous and subsequently hazardous, fire-prone areas of vegetation; thereby reducing the overall fire hazard and intensity. Mowed grass areas also allow for more free-flowing pathways for emergency vehicles, and can serve as emergency evacuation points.

Where trees such as Eucalypts are to be retained, their canopies should be separated by at least 2m and ideally up to 5m to avoid crown fires developing.

4.0 Bushfire Hazard Reduction Measures

Reduction of fuel loads in an APZ does not have to be as drastic as removing all vegetation, particularly in sensitive receptor environments. Bushfire fuel loads can be reduced, removed or changed through several means as discussed below.

Bushfire Mitigation and Management Measures for the Operation Phase of the Project are contained with **Appendix 3**.

4.1 Maintenance of APZ

The following suggested recommendations for gardens and landscaping are given in relation to the maintenance of the APZ:

- Low-cut lawns or other fire resistant surfaces should be maintained adjacent to buildings.
- Areas under and along fences and gates should be maintained free of fuel (i.e. tall grasses and weeds).
- Do not allow tall, weedy grasses such as Guinea Grass (*Megathyrsus maximus*) to establish in the APZ.
- Trees and shrubs should not overhang dwellings and should be pruned as necessary.
- Tree canopies should not be continuous in the APZ (should be spaced as per section 3.2).
- Gutters and valleys should be kept clear of leaves at all times and regularly inspected.
- Minimise mulched areas, or mulch where irrigation is installed.
- Keep gardens well-watered.
- Ensure that the access is maintained entirely unobstructed around the buildings.

4.1.1 Clearing and Pruning

The management of existing vegetation involves both selective fuel reduction (removal, thinning and pruning) and the retention of vegetation. The majority of the leaves and groundcover should be removed from the surface. Valuable native trees and shrubs (such as threatened species) should be retained as clumps or islands. In selecting vegetation for removal the following features should be considered in order:

- Species that are listed by the local authority, as noxious or environmental weeds should be removed in preference to other species.
- Non-native woody plants should be removed in preference to other species.
- Species with rough, flaky or stringybark should be removed in preference to those with smooth or tightly held bark.
- Small trees without hollows should be removed in preference to larger trees and trees with hollows.
- Locally common species should be removed in preference to species listed by the authorities as threatened, regionally significant, or valuable for habitat or food source.
- Trees that have been determined to be structurally dangerous should be removed in preference to other trees.

4.1.2 Mowing and Slashing

Slashing and trittering are economical methods of reducing fuel. However, for these methods to be effective, the cut material must be removed or allowed to rot well before summer starts. Grass needs to be kept short and mowed regularly. Slashing and trittering is only practical in some situations. Alternative means of hazard reduction may be necessary where it is unsafe to implement a particular method of fuel reduction.

4.1.3 Fire Break

As clearing restraints are applicable, firebreaks around the entire site are not possible. Access tracks will help provide a break and defendable space which will assist in arresting any fires.

4.1.4 Hazard Reduction

Hazard reduction burning may be undertaken to assist in reducing fire danger, as mechanical means may be constrained by the rocky terrain. A Permit to Light Fire is required to be obtained from a Fire Warden prior to undertaking any hazard reduction burning. Local fire wardens are able to be contacted through the Mareeba Office, contact details are provided in **Table 3**.

Table 3 Mareeba Area Office Contact Details

Street Address	20 Mammino Street, Mareeba
Phone	(07) 4092 1044

Alternatively the Queensland Fire and Emergency Services can be contacted on:

Street Address	Corner of Grogan and Gatton Streets, Westcourt
Phone	(07) 4232 5468

Regional ecosystem descriptions provided by the Queensland Department of Environment and Heritage Protection (EHP) recognise the fuel loads of this vegetation community and that of surrounding country needs to be maintained so that wildfires will be limited in extent. The fire management guidelines provided by EHP are directed at maintaining the regional ecosystems biodiversity. It is recommended that annual inspections are conducted by a suitably qualified person to determine fuel load quantities and conditions (weed invasion, etc) and therefore the optimal burning interval and timing. Burning intervals and timing are likely to change depending on the annual rainfall and weed invasion. Refer to **Section 5.0**.

4.1.5 Inspections

A pre (June) and post (November) bushfire season maintenance program to reduce fuel loads (e.g. mowing and slashing) should be undertaken. An additional annual inspection to determine the requirement for hazard reduction burning should also be undertaken. This should be undertaken in conjunction with an Ecological Fire Management Strategy as outlined in **Section 5.0**.

4.2 Fire Fighting Equipment

Provision of fire fighting equipment during declared fire danger periods;

All project vehicles will contain a fire extinguisher and CB radios. A specific project vehicle will be fitted with a water tank, diesel pump, 30m fire hose and a knapsack spray. Each Wind Turbine Generator contains a fire extinguisher in the base of the tower and up in the nacelle.

4.2.1 Water Supply Tanks

Criteria for the provision of static water supply tanks solely for fire fighting processes including minimum capacities, appropriate connection and signage;

An adequate supply of water is essential for fire fighting purposes when considering all forms of development. As reticulated water supply is not available on site, two static water supplies will be available for fire fighting purposes, located centrally and which are easily accessible.

One storage container will be located at the Substation, Operation and Maintenance Building with the other at the Contractors Site Compound. Each will contain a water tank (approx. 50,000 litres capacity) collecting

water from the buildings in the compound. The tank will be fitted with outlets allowing fire trucks to connect to the tank. Should the water level drop below a minimum set point a water truck will deliver water to the tank. Guidance from Rural Fire Services Queensland (RFSQ) will be sought on what the minimum level within these tanks should be. The storage tanks shall be of non-combustible construction and fitted with a 65mm outlet completed a 65mm ball valve and Stortz coupling; or the preferred connections approved by the RFSQ. Adjacent to the water tanks will be a fire hose reel (30m) and a diesel pump to provide coverage in and around the buildings. All buildings will be fitted with smoke detectors and contain portable fire extinguishers. All fire extinguishers will be checked on a 12 monthly basis.

4.3 Emergency Services Access

Procedures for vegetation management, fuel control and the minimum standards for access roads and tracks to allow access for fire fighting vehicles including criteria for access to static water supply tanks for fire fighting vehicles;

Property and internal access roads should enable safe access, egress and defendable space for emergency services. Traffic that will require access to the site includes light vehicles, semi tippers or truck dog combinations. The access roads and manoeuvring areas throughout the site need to ensure safe access for vehicles. The following identifies road widths and design aspects to enable safe access for vehicles:

- Have a minimum cleared width of 6m and a formed width of 4m.
- Dead end roads, incorporate a minimum 12m outer radius turning circle, and be clearly sign posted as a dead end and direct traffic away from the hazard.
- A minimum vertical clearance of four metres to any overhanging obstructions, including tree branches.
- Internal roads provide a loop road around any office or incorporate a turning circle with a minimum 12m outer radius.
- Curves have a minimum inner radius of six metres and are minimal in number to allow for rapid access and egress.
- The minimum distance between inner and outer curves is 6m.
- The crossfall is not more than 10 degrees. Where a 10 degree crossfall is unachievable, either an alternate route is to be provided or the access road is sufficiently formed to prevent erosion and slope instability.
- Access road shall be designed to carry a fully laden RFSQ tanker of 15 tonnes GVM.

All onsite access roads are to provide safe, all weather access to structures and allow safe access for fire fighters while employees and contractors are evacuating the site. Directional signage should be installed to identify major tracks and the most direct route to the site office and emergency egress points.

4.3.1 Evacuation Routes

Consideration needs to be given to the safety of employees and contractors occupying the site during an incident. It may be safer to remain on site and seek shelter in a safe place. A designated assembly area should be nominated greater than 300m from the nearest significant bushfire hazard and greater than 100m from major electrical infrastructure.

4.4 Building Standards

Details of a lighting and earthing system to mitigate against the risk of bushfires caused by direct lightning strikes on the turbines

Wind Turbines and Substation

The wind farm design shall ensure all wind turbine and wind farm substation equipment is shielded and protected against direct lightning strike as detailed in International Standard *IEC61400-24 Wind Turbine Generator Systems – Part 24: Lightning Protection* and Australian Standard *AS1768 Lightning Protection*. The wind turbines, wind farm substation and associated equipment shall be suitably protected against damage caused from lightning and over-voltages due to lightning.

The lightning protection systems together with the grounding system shall:

- Minimise any danger to people in the immediate surroundings of the wind turbines and wind farm substation;
- Prevent fire / overheating; and
- Prevent any mechanical damage.

Buildings

The following recommendations for the construction of buildings and other structures have been prepared to ensure that an adequate level of protection to life and property on the site is provided.

- All exposed external cabling is adequately secured to prevent physical damage/breakage which may cause ignition of vegetation.
- All cabling within 100m of the nearest bushfire hazard is to be protected by a non-combustible conduit that is heat resistant and unlikely to melt or warp due to radiant heat.
- Any new buildings shall comply with the Bushfire Attack Exposure specifications of BAL-FZ construction in accordance with Australian Standard *AS3959-2009 Construction of buildings in bushfire prone areas*.
- External openings such as vents/louvres, skylights, cable entry ducts and air-conditioning intake grills shall be protected against the entry of flying embers. These openings shall be fitted with external mesh screens comprising stainless steel mesh with a maximum aperture of 2.0mm.

5.0 Ecological Fire Management

Fire is an integral component of many landscapes in far north Queensland and has been continually impacting on the MEWF site at interval. It plays an important role in biodiversity and ecosystem function and for some species it is a necessary dynamic in their lifecycle. Fire ecology (intensity, timing, duration etc) is critical for the successful regeneration of some plant communities and also brings a change to the fauna composition due to attraction of new species to seeding and flowering ground cover, for example.

Inappropriate fire regimes may occur due to the development and their impact can be severe. Changed fire ecology can often result in species elimination and / or the promotion of different plant functional groups, and consequently change the habitat micro-environment.

On the sensitive ridge top environments obligate seeder species are killed by fire and regenerate through germination of seed stored in the soil seed bank; whereas, resprouters recuperate after fire by reshooting from stems or rootstock. As many rock areas are considered refuges, inappropriate fire regimes that breach the natural level of protection afforded by rock pavements and outcrops are likely to have a deleterious effect at least in the short-term, with further possibility in the longer-term if the fire event is unnaturally severe. These impacts can extend to altering the habitat structure thus reducing food availability, and subsequently impacting on fauna species lifecycles.

It is therefore crucial that fire management of vegetation communities be undertaken on the MEWF project site to ensure both the project and the environmental values of the property are protected.

5.1.1 Regional Ecosystems

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

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

The RE vegetation mapping for these bioregions is at a scale 1:50,000 and 1:100,000 respectively. A summary of the mapped RE's of the project area is given in **Table 4** below.

The Wet Tropics Bioregion is not considered to contribute to the Wet Tropics World Heritage Area (WTWHA). The Wet Tropics bioregion and the WTWHA are unrelated biophysical mapping areas. Mapping of the boundaries of these entities (**Figure 4** and **Figure 5**) indicates the physical separation of the Wet Tropics bioregion section of the wind farm site (see inset), 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.

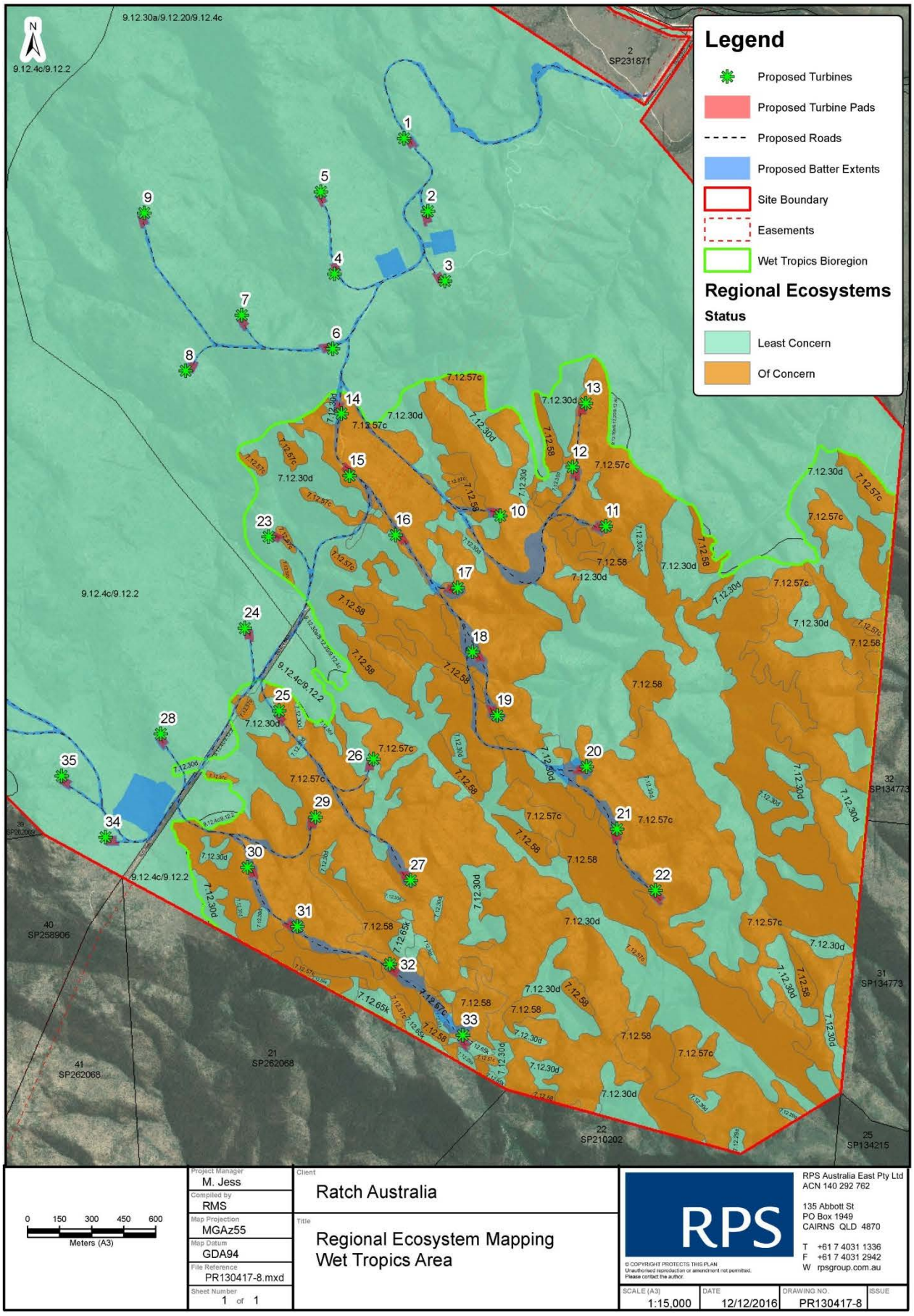


Figure 4 Regional Ecosystems on Southern Extent of MEWF.

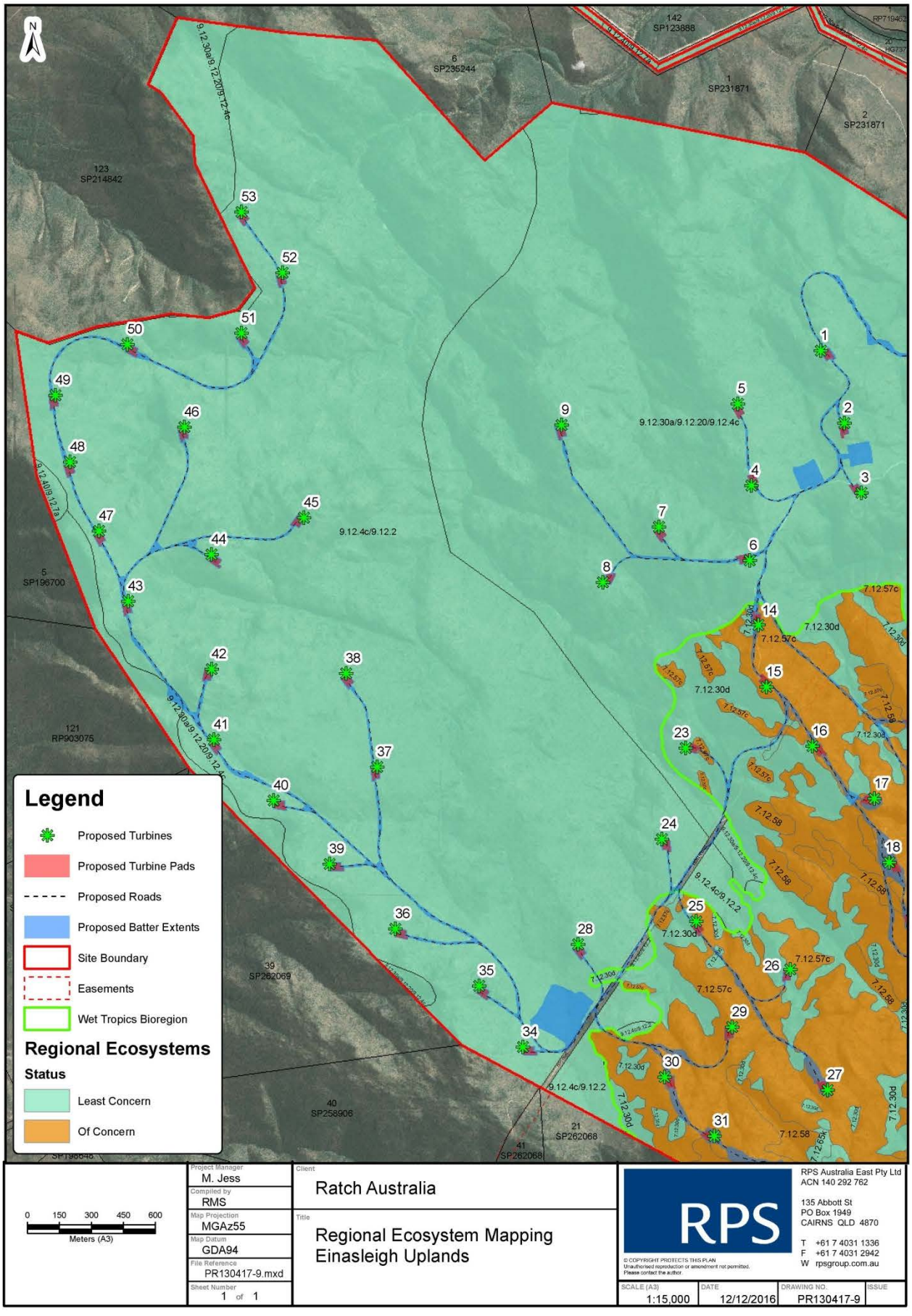


Figure 5 Regional Ecosystems on Northern extent of MEWF

5.1.2 Fire Management Guidelines

Fire management guidelines are provided below (**Table 4**) which indicates the optimal season, intensity, interval and strategy for regional ecosystems.

The objectives of these management strategies are to assist in protecting the flora and fauna habitats represented on the MEWF site and to manage the fuel load to prevent intense dangerous fires that may impact human life and property. This information is based on current knowledge and expert opinion.

Issues are also presented in the table to identify the problems associated with fire not occurring within the prescribed time frames etc.

All Rare and Threatened flora species that have been found on the MEWF site have been located within *Of Concern RE* vegetation of the Wet Tropics Bioregion. These ecosystems (7.12.57 and 7.12.58) are also the least tolerant to fire on the site.

5.1.2.1 Implementation of Guidelines

Prescribed burning will meet the ecological objectives of the management strategies presented in **Table 4** and maintain the ecological integrity of the MEWF site.

These strategies will be reviewed and evaluated with all other MEWF documentation on an annual monitoring process ensuring uptake of new information from relevant Queensland government resources.

Table 4 Fire Management Guidelines for Regional Ecosystems found on the MEWF Project Site

Regional Ecosystem	Description	Season	Intensity	Interval	Strategy	Issues
7.12.30: Wet Tropics Bioregion	Woodland to open forest mosaic with variable dominance, often including *Eucalyptus cloeziana, Corymbia abergiana, C. citriodora, E. portuensis, E. reducta, E. lockyeri, C. leichhardtii, E. atrata, E. pachycalyx* and *E. shirleyi*, on rhyolite and granite.	Cool, dry season (April-Sep).	Low to moderate	2-5 years.	Mosaic burn < 30%. Begin burning early in the fire season, with progressive patch fires burnt through the year. Stop burning when the network of fires and other breaks is sufficient to impede fire spread later in the year. Storm-burning may be used to add further diversity to the fire mosaic.	An occasional moderate severity fire may be used to manage overabundant recruitment of trees. Maintaining a fire mosaic will ensure protection of animal habitats and mitigate against wildfires.
7.12.57: Wet Tropics Bioregion	Shrubland and low woodland mosaic with *Syncarpia glomulifera*, *Corymbia abergiana*, *Eucalyptus portuensis*, *Allocasuarina littoralis*, and *Xanthorrhoea johnsonii*, on moist and dry uplands and highlands on granite and rhyolite. Shrubland/low woodland mosaic with variable dominance, often including *Eucalyptus cloeziana*, *Corymbia abergiana, E. portuensis*, *E. reducta*, *E. lockyeri*, *C. leichhardtii*, *E. atrata*, *E. pachycalyx*, *E. shirleyi* and *Homoranthus porteri*, on rhyolite and granite Of Concern	Avoid dry conditions or fires will spread too much. April to July or as early as March, conditions permitting.	Moisture and topography affect severity. With Low to high. intensity	6-10 years with some areas burnt at longer intervals. Fire intervals less than 6 years are too short to allow replenishment of obligate seeders.	Mosaic burns will be achieved through use of natural features such as topography and creek-lines. Burn in association with surrounding vegetation. Protection relies on the broad-scale management of surrounding country with numerous small fires throughout the year so that wildfires will be very limited in extent. Fire exclusion and buffering from fire are not necessary.	Any planned burning should be conducted in association with plans for surrounding vegetation. Often contains obligate seed regenerating species and as such, the application of frequent fire may reduce species richness if the intervals between fire are not sufficient for plants to produce seed. Too frequent a fire frequency may result in a net loss of nutrients over time from an already nutrient poor system. Burn when water and moisture are present on the ground.
7.12.58: Wet Tropics Bioregion	*Eucalyptus reducta, E. granitica, Corymbia dimorpha, C. citriodora* and *Syncarpia glomulifera* woodland, on granite and rhyolite. Of concern	April-May or in some years through until Sep.	Low to occasional moderate.	6-10 years.	Mosaic burn 25-70% of the target area. Across the landscape burn different areas at different intervals to add diversity.	Occasional moderate fire can assist management of overabundant tree recruitment. Too frequent fire can eliminate shrubs which require several years before they set seed.

Regional Ecosystem	Description	Season	Intensity	Interval	Strategy	Issues
7.12.65 Wet Tropics Bioregion	Rock pavements or areas of skeletal soil, on granite and rhyolite, mostly of dry western or southern areas, often with shrublands to closed forests of *Acacia* spp. and/or *Lophostemon suaveolens* and/or *Allocasuarina littoralis* and/or *Eucalyptus lockyeri* subsp. *exuta*.	Avoid dry conditions or fires will spread too much. April to July or as early as March, conditions permitting. c: April-May or in some years through until Sep. d: Cool, dry season (April-Sep).	Moisture and topography affect severity.	6-10 years with some areas burnt at longer intervals. Fire intervals less than 6 years are too short to allow replenishment of obligate seeders.	Mosaic burns will be achieved through use of natural features such as topography and creek-lines. Burn in association with surrounding vegetation. Protection relies on the broad-scale management of surrounding country with numerous small fires throughout the year so that wildfires will be very limited in extent. Fire exclusion and buffering from fire are not necessary. c: Mosaic burn 25-70% of the target area. Across the landscape burn different areas at different intervals to add diversity. d: Mosaic burn < 30%. Begin burning early in the fire season, with progressive patch fires burnt through the year. Stop burning when the network of fires and other breaks is sufficient to impede fire spread later in the year. Storm-burning may be used to add further diversity to the fire mosaic. Maintain appropriate mosaic burning in surrounding country. Do not protect from fire but do not burn deliberately.	Any planned burning should be conducted in association with plans for surrounding vegetation. Often contains obligate seed regenerating species and as such, the application of frequent fire may reduce species richness if the intervals between fire are not sufficient for plants to produce seed (e.g., loss of Banksia plagiocarpa). Too frequent a fire frequency may result in a net loss of nutrients over time from an already nutrient poor system. c: Occasional moderate fire can assist management of overabundant tree recruitment. Too frequent fire can eliminate shrubs which require several years before they set seed. d: An occasional moderate severity fire may be used to manage overabundant recruitment of trees. Maintaining a fire mosaic will ensure protection of animal habitats and mitigate against wildfires. This is mainly a self protecting community.

Regional Ecosystem	Description	Season	Intensity	Interval	Strategy	Issues
9.12.4 / 9.12.2: Einasleigh Uplands Bioregion	(9.12.4) - *Eucalyptus shirleyi or E. melanophloia* with *Corymbia peltata* and/or *C. leichhardtii* low open woodland to low woodland on acid volcanic rocks. / (9.12.2) - Open forest commonly including *Eucalyptus portuensis*, *E. crebra* (sens. lat.), *Corymbia clarksoniana*, *C. citriodora* on steep hills and ranges on acid and intermediate volcanics close to Wet Tropics boundary.	Early dry season and storm time. Timing of early dry season burns will vary depending on seasonal conditions; it may sometimes commence as early as March. Avoid burning August-October when south-easterly winds are typically strongest..	Low, with occasional moderate or high.	5-10 years.	Apply mosaic across the landscape at a range of frequencies to create varying stages of post-fire response	These ecosystems contain shrubs that germinate after fire. Seedlings typically take a number of years to mature. Avoid repeated fires at short intervals and high intensity burns of broad areas. Leave areas of long unburnt vegetation to maintain a diversity of habitat for wildlife. Shrub species diversity will decline if areas are left long unburnt. Callitris intratropica are fire sensitive. Protect from fires until plants old enough to replace seed pool.
9.12.30 / 9.12.20 / 9.12.4: Einasleigh Uplands Bioregion	(9.12.30) - *Corymbia leichhardtii +/- Callitris intratropica +/- Eucalyptus shirleyi* low woodland to low open woodland on rhyolite hills. /(9.12.20) - *Eucalyptus pachycalyx* and *E. cloeziana* woodland on acid volcanics. / (9.12.4) - *Eucalyptus shirleyi* or *E. melanophloia* with *Corymbia peltata* and/or *C. leichhardtii* low open woodland to low woodland on acid volcanic rocks.	Early dry season and storm time. Timing of early dry season burns will vary depending on seasonal conditions; it may sometimes commence as early as March. Avoid burning August-October when south-easterly winds are typically strongest	Low, with occasional moderate or high.	5-10 years.	Apply mosaic across the landscape at a range of frequencies to create varying stages of post-fire response.	These ecosystems contain shrubs that germinate after fire. Seedlings typically take a number of years to mature. Avoid repeated fires at short intervals and high intensity burns of broad areas. Leave areas of long unburnt vegetation to maintain a diversity of habitat for wildlife. Shrub species diversity will decline if areas are left long unburnt. *Callitris intratropica* are fire sensitive. Protect from fires until plants old enough to replace seed pool.

Source: environment.ehp.qld.gov.au/regionalecosystems/detail. (2016).

6.0 Emergency Evacuation Procedures

Emergency evacuation procedures, plans and strategies, including associated documentation and signage should be prepared in accordance with the guidelines outlined by the RFSQ. This could include a Fire & Evacuation Plan. The RFSQ provide examples and templates of these types of documents, with useful fire emergency guidelines. The RFSQ website is **http://www.fire.qld.gov.au**.

6.1 Contacts - Roles & Responsibilities

The following people are responsible for the evacuation of the site and emergency response.

Title	Name	Telephone Number
Fire Warden	On-site Manager	TBA
First Aid	On-site Manager	TBA

6.2 Employee and Contractor Communication

All employees whilst working within the site (and away from the main office) are required to be contactable at all times. Means of communication may be by way of mobile phone, two-way radio (closed channel) or GPS trackers installed on company vehicles. Any contractors entering the site shall be inducted to the site and made aware of the emergency evacuation procedures. Contractors may, for example, also be issued with a GPS tracker for the duration of their stay within the site.

All vehicles shall be fitted with portable fire extinguishers suitable for extinguishing small grass fires.

6.3 Storage of Fuels and Hazardous Materials

All materials that are flammable and combustible should be stored in a secure and enclosed area away from the site office or any electrical infrastructure. An area of cleared land of all vegetation including grasses of no less than 20m shall be maintained surrounding the storage enclosure.

6.4 Emergency Contacts

For all fires and emergencies call 000

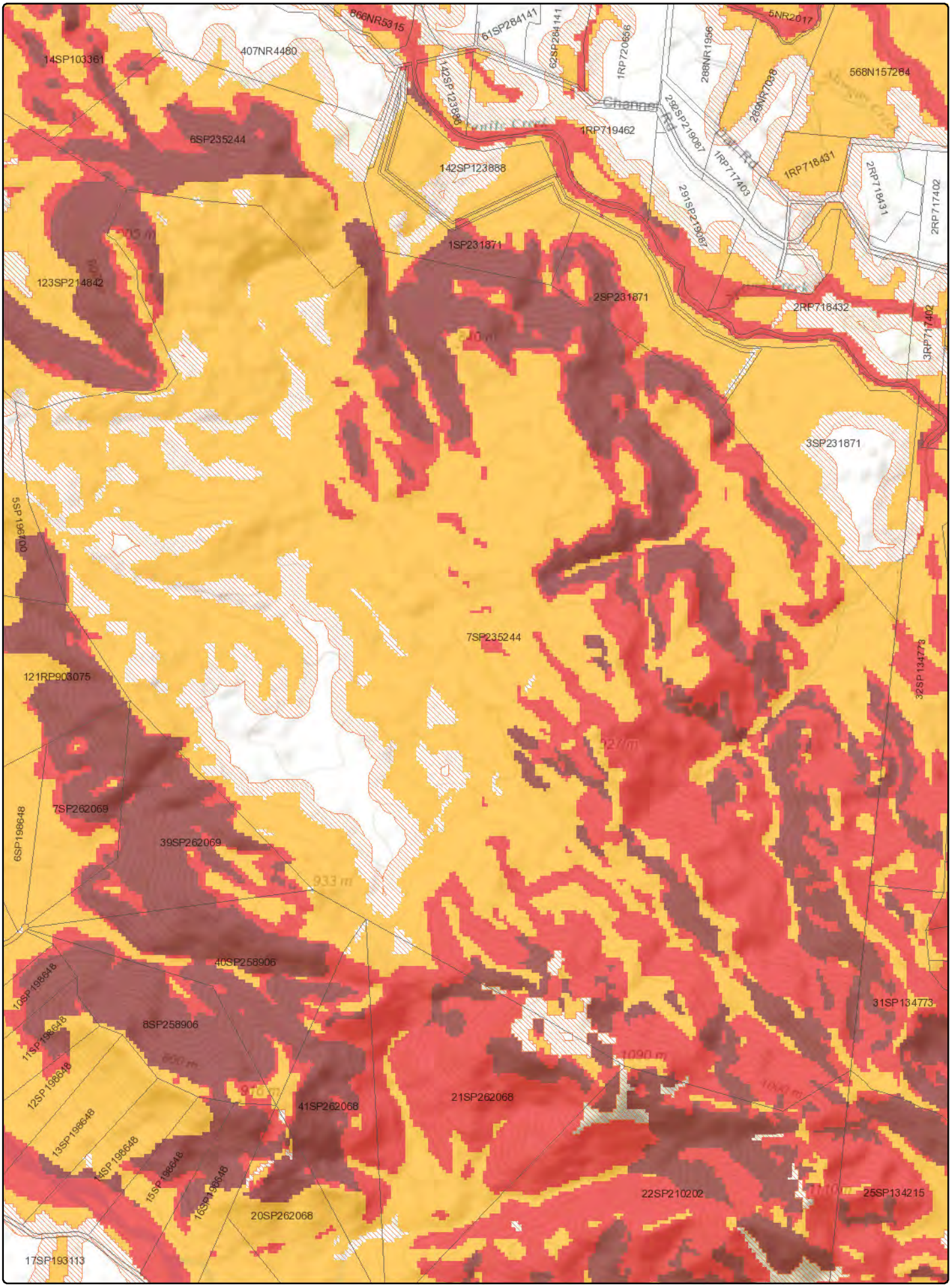
In the instance that it is not an urgent emergency the following contact details may be of assistance.

Emergency Services Contacts

Service	Location and Phone Number
Ambulance	Cairns and Hinterland Local Area Service Network: (07) 4032 8615
Fire Warden (Urban Fire Brigade)	Atherton Fire Station: (07) 4091 9290 Mareeba Fire Station: (07) 4092 1044
State Emergency Services (SES)	Cairns: (07) 4032 8682

Appendix 1

Bushfire Hazard Mapping



State Planning Policy

Local government development assessment

Date: 15/07/2016

Department of Infrastructure, Local Government and Planning

Queensland Government

0 580 1,160 1,740 2,320

Metres

Disclaimer:
This map has been prepared with due care based on the best available information at the time of publication. The State of Queensland holds no responsibility for any errors, inconsistencies or omissions within this document. Any decisions made by other parties based on this document are solely the responsibility of those parties.

Legend

Cadastre (50k)

Cadastre (50k)

Bushfire hazard area (Bushfire prone area)

Very High Potential Bushfire Intensity

High Potential Bushfire Intensity

Medium Potential Bushfire Intensity

Potential Impact Buffer

Queensland Government

Date: 15/07/2016

Department of Infrastructure, Local Government and Planning

State Planning Policy

Local government development assessment

Appendix 2

Northern Australia Fire Information (NAFI) Reports

Territory Natural Resource Management

Northern Territory Government

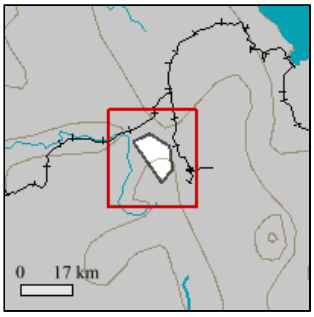
CHARLES DARWIN UNIVERSITY

Custom area

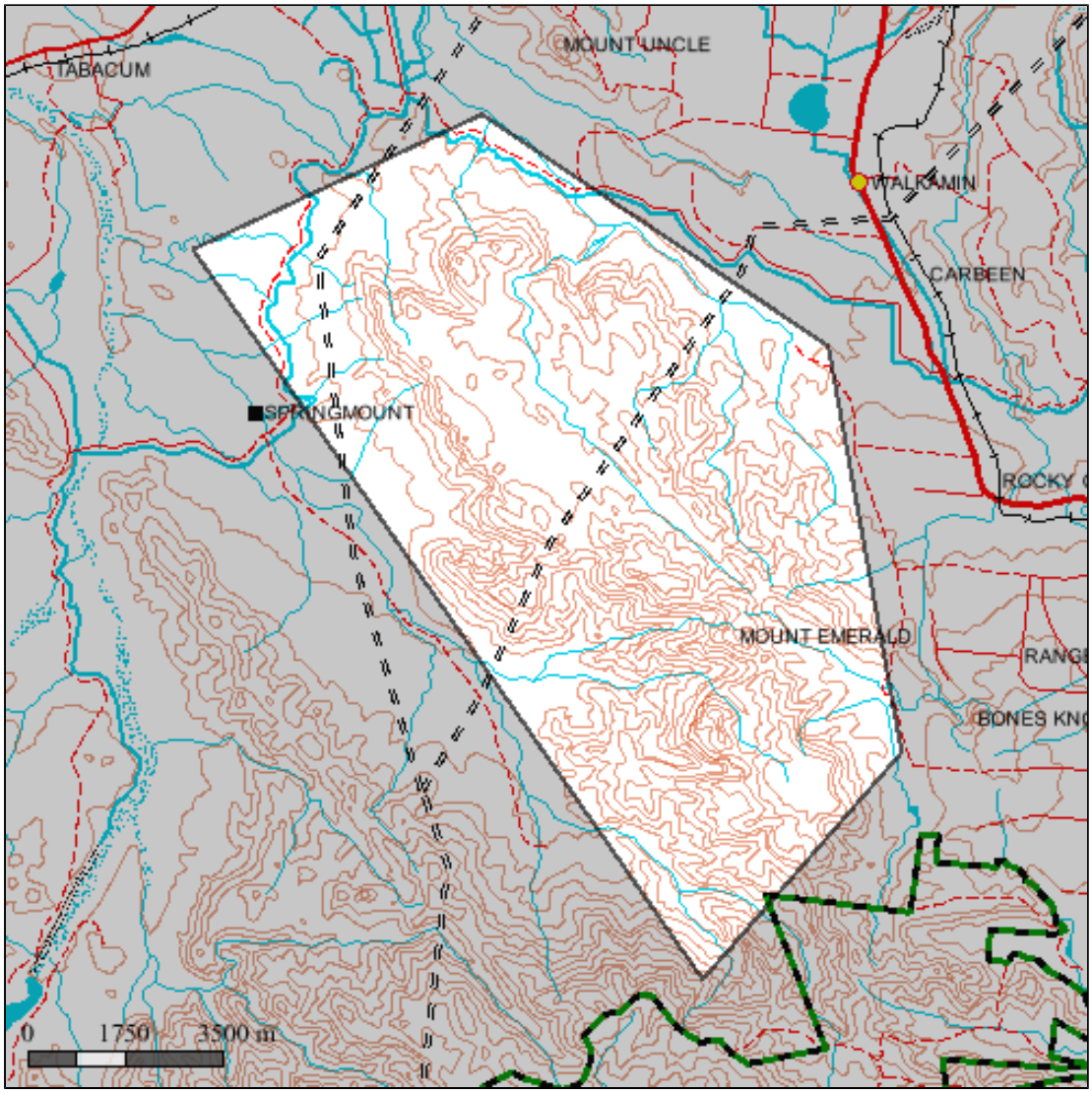
Fire History Report

Custom area

Custom area encompasses an area of 94.58 sq km extending from 17 deg 7.0 min to 17 deg 15.0 min S and 145 deg 19.0 min to 145 deg 26.0 min E.
Custom area is located in the Wet Tropics, Einasleigh Uplands, bioregion(s)



Location of Custom area

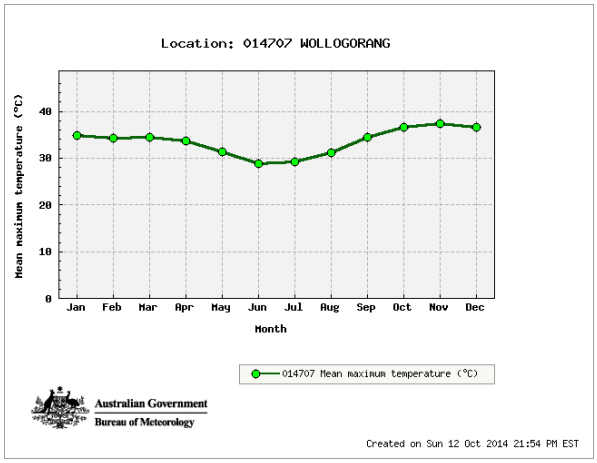


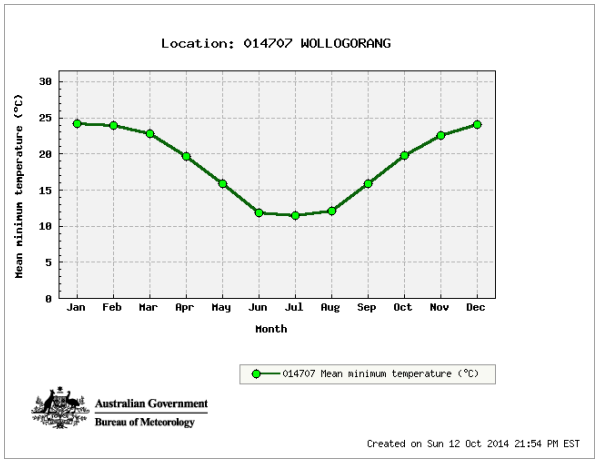
Custom area Climate

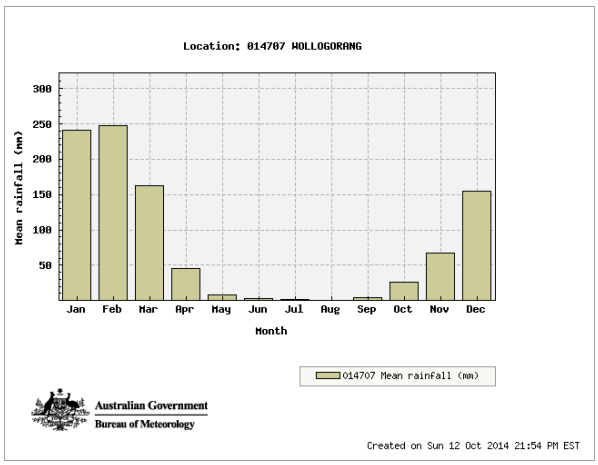
The closest long-term weather station is WOLLOGORANG (17 deg 12.0 min S, 137.9462E) 790 km W of the center of selected area

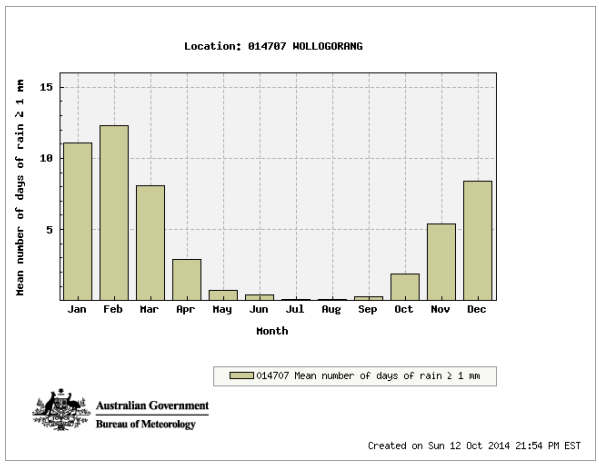
Statistics	Annual Values	Years of record
Mean max temp (deg C)	33.6	31
Mean min temp (deg C)	18.7	31
Average rainfall (mm)	973.3	38
Average days of rain	51.7	38

Climate summaries from Bureau of Meteorology (www.bom.gov.au)



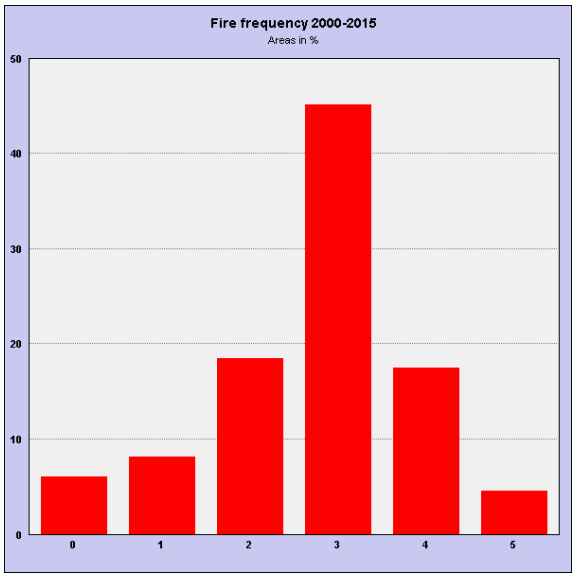






Custom area Fire History

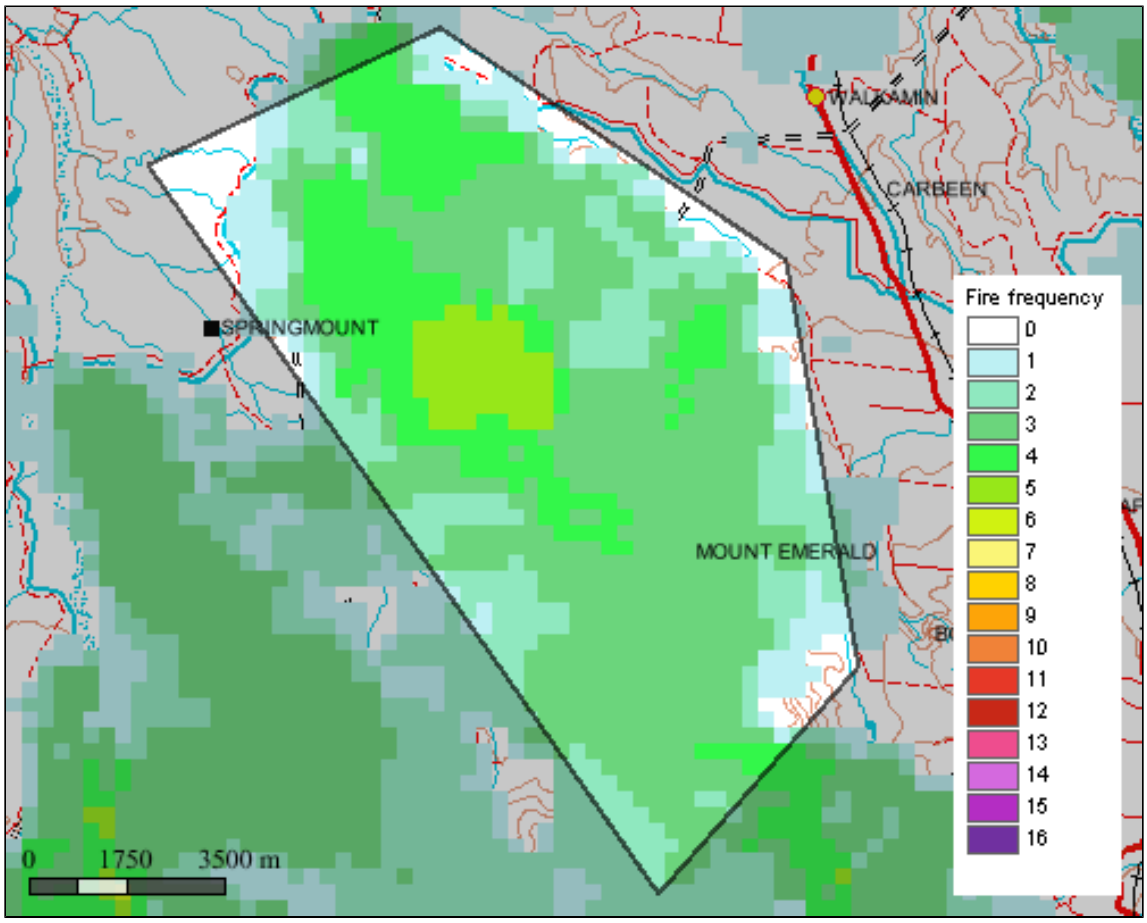
Fire frequency 2000-2015



area burnt for each fire frequency category 2000-2015

Category	Area sq km	Area%
0	5.75	6.08
1	7.71	8.15
2	17.53	18.54
3	42.71	45.16
4	16.53	17.48
5	4.35	4.60

Fire frequency 2000-2015



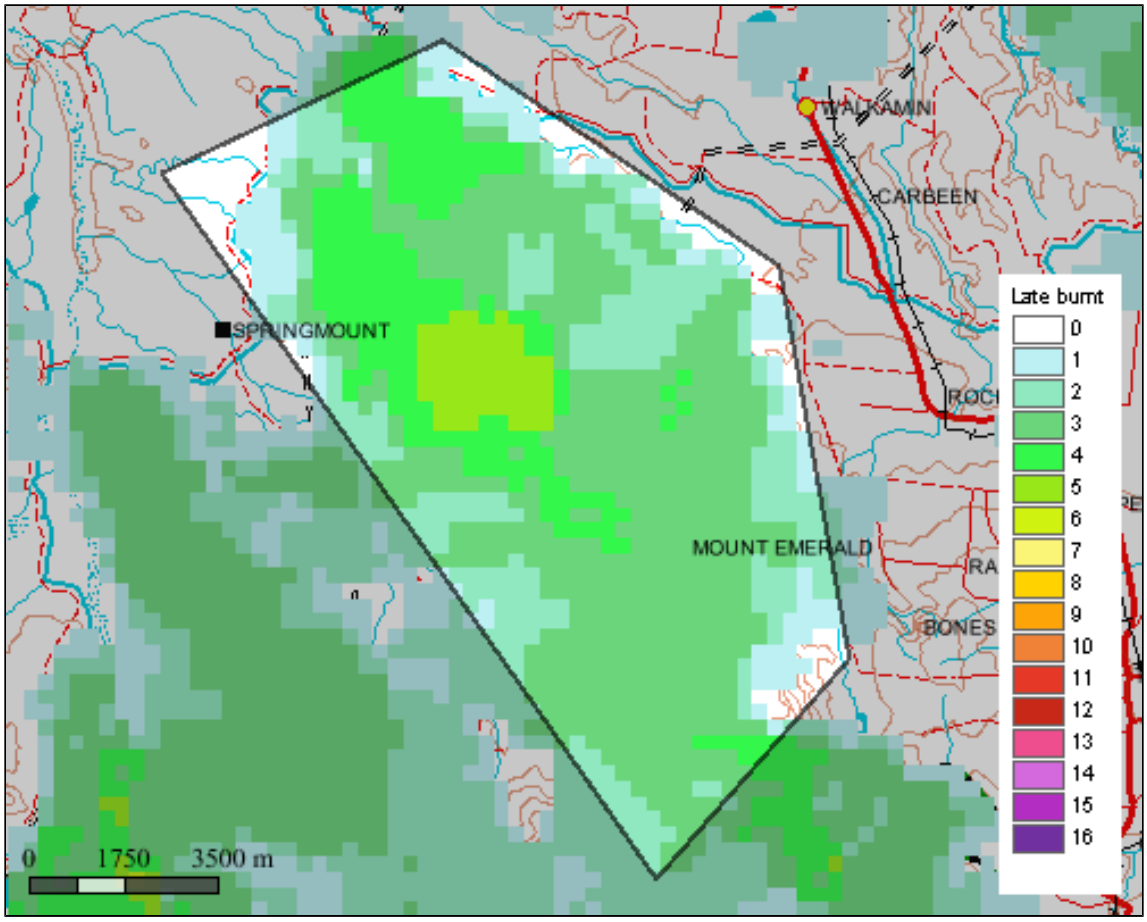
The fire frequency(250m) Layer is derived from satellite imagery sourced from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Terra satellite
Spatial Resolution: 250m x 250m pixels (at Nadir).

Late fire frequency (after July 31) 2000-2015

area burnt in each late fire frequency category 2000-2015

Selected area is too small to produce reliable statistics

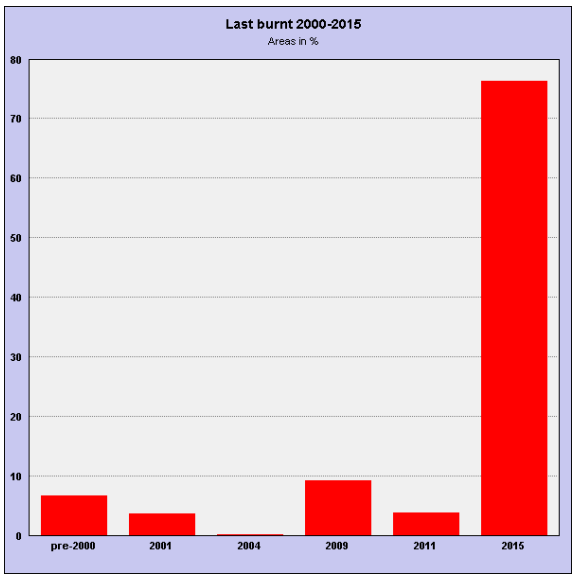
Late fire frequency 2000-2015



The fire frequency(250m) Layer is derived from satellite imagery sourced from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Terra satellite
Spatial Resolution: 250m x 250m pixels (at Nadir).

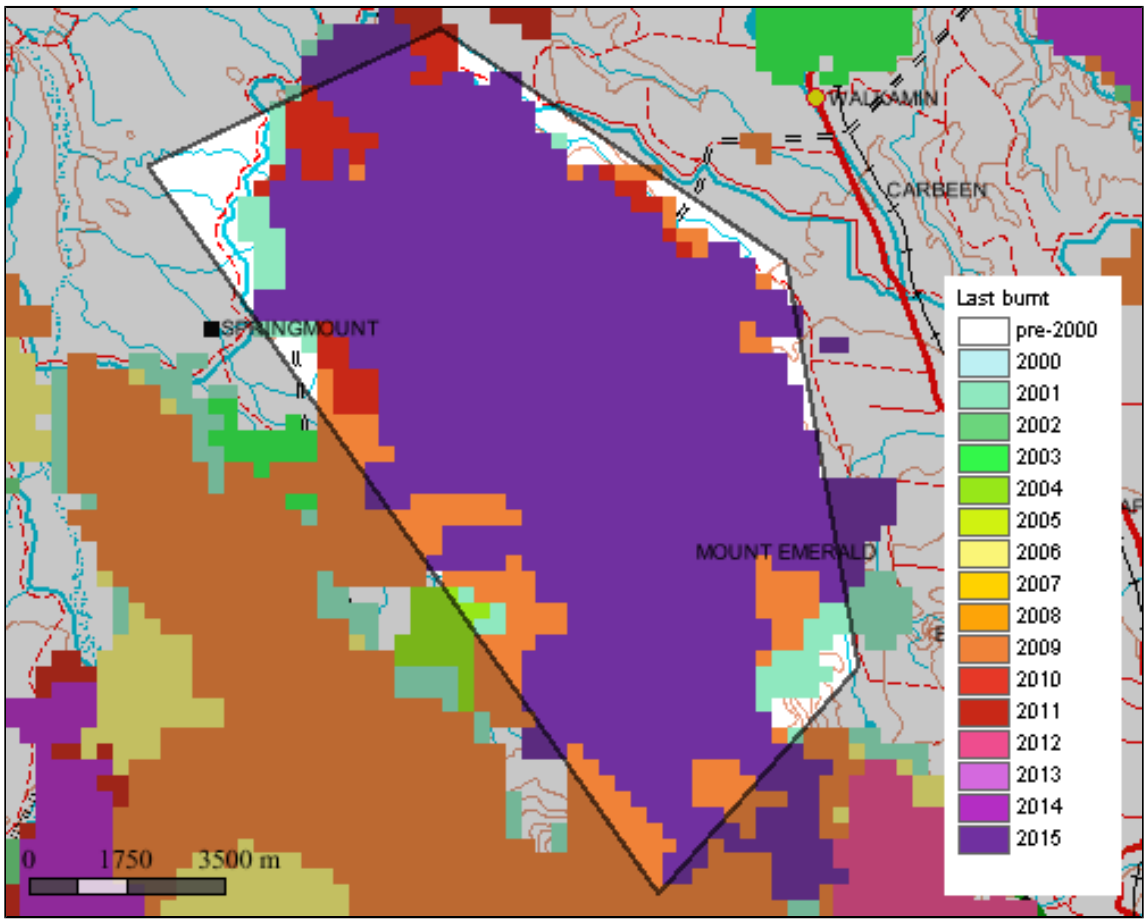
Year last burnt 2000-2015

and area of each year last burnt category



Category	Area sq km	Area%
pre-2000	6.35	6.71
2001	3.52	3.72
2004	.17	.18
2009	8.75	9.25
2011	3.64	3.84
2015	72.16	76.30

Year last burnt 2000-2015



The fire frequency(250m) Layer is derived from satellite imagery sourced from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Terra satellite
Spatial Resolution: 250m x 250m pixels (at Nadir).

Soils and vegetation graphs and tables refer to area of soils and vegetation only. Fire graphs and tables refer to entire selected area including sea if present. Calculations are derived from map images or vector data, and should be taken as a guide only. Accuracy cannot be guaranteed. For small areas, figures should be rounded to the nearest whole number.

Appendix 3

Bushfire Mitigation and Management Measures – Operation Phase

Table A-1 Prevention

PREVENTION				
Aspect	**ID**	**Management Action**	**Responsibility**	**Timing**
Fire Detection	1	Site personnel will report fires within the area of the Project. Site personnel will also rely on detection and reporting of bush fires in the region by neighbours, Mareeba Shire Council or RFSQ alerts.	All site personnel	During operation
	2	Identify potential sources of ignition e.g. fuel storage areas.	*[Contractor to insert]*	During operation
	3	The Contractor will advise RFSQ and Mareeba Shire Council of the contact details for the site (including after-hours contact details).	*[Contractor to insert]*	During operation
Fire Equipment	4	Vehicles will be regularly inspected and cleared of vegetation build-up.	*[Contractor to insert]*	During operation
	5	All machinery capable of causing a fire during operation will be fitted with appropriate guards to prevent accidental ignition of vegetation from sparks or heat sources.	*[Contractor to insert]*	During operation
	6	A water truck fitted with a water tank and pump system capable of initial attack of spot fires will be located on-site.	*[Contractor to insert]*	During operation
	7	The Contractor will supply sufficient fire fighting equipment (fire extinguishers, protective gear) to vehicles, machinery and amenities areas and provide a plan for employees to locate necessary equipment in the event of an emergency.	*[Contractor to insert]*	During operation
	8	Fire equipment will be checked and tested regularly to ensure it is in good working order and will be replaced or repaired where necessary.	*[Contractor to insert]*	During operation
Access	9	Access roads within the site will be regularly inspected and graded to ensure rapid deployment of fire fighting vehicles and earthmoving equipment to roll vegetation at the fire's edge (if required).	*[Contractor to insert]*	During operation
		Access roads are to be provided within the Project area in accordance with NSW RFS (2006).	*[Contractor to insert]*	During operation
	10	At least two evacuation routes will be maintained from each work area and these will be identified to all personnel working on the Project.	*[Contractor to insert]*	During operation
	12	Existing fence lines and access tracks will be maintained to assist in the control of fire.	*[Contractor to insert]*	During operation
	13	Evacuation doors, points and routes will be clearly marked and maintained around temporary construction facilities and office and amenities buildings. These will be inspected weekly as a part of the environmental inspection.	*[Contractor to insert]*	During operation
Storage	14	The Contractor will comply with all relevant regulations and the Dangerous Goods Safety Act 2004 (equivalent QLD statutory document) for fuel transport, containment and storage. All fuel will be stored in accordance with the relevant Australian Standards.	*[Contractor to insert]*	During operation
	15	Oxygen and fuel gas cylinders will not be stored together, with a minimum of 3 metres between cylinders.	*[Contractor to insert]*	During operation
	16	Flammable materials (solid, liquid or gases) shall not be stored within 5 metres of any occupied building. These materials will be suitably secured and correctly signposted "Danger, Highly Flammable."	*[Contractor to insert]*	During operation

PREVENTION				
Aspect	**ID**	**Management Action**	**Responsibility**	**Timing**
Other	17	Open fires will not be allowed in the Project area.	*[Contractor to insert]*	During operation
	18	For all work involving heat, sparks or flame, such as welding and grinding, all flammable materials will be cleared away from the area of works, whilst minimising disturbance to vegetation where possible. Fire extinguishers will be fitted to vehicles to extinguish spot fires. Where necessary a water cart and pump will be provided.	*[Contractor to insert]*	During operation
	20	The contactor shall establish and maintain Managed Fuel Zones in accordance with this BMP.	*[Contractor to insert]*	During operation

Table A-2 Preparedness

PREPAREDNESS				
Aspect	ID	**Management Action**	**Responsibility**	**Timing**
Training	1	Site induction will include information from this BMP. Employees will be shown the location and use of fire fighting equipment. Contractors will be briefed on relevant fire management practices and emergency response and evacuation procedures. Fire drills will be carried out on a quarterly basis to ensure all personnel are familiar with the procedures. These will be addressed in the site induction.	*[Contractor to insert]*	During operation
Equipment	2	Fire fighting equipment will be checked and maintained on a regular basis.	*[Contractor to insert]*	During operation
	3	Testing of alarm systems, escape routes and fire extinguishers will be conducted during weekly environmental inspections.	*[Contractor to insert]*	During operation
Housekeeping	4	Site personnel will maintain excellent housekeeping standards of storage areas and construction areas to minimize potential sources of flammable material.	*[Contractor to insert]*	During operation

Table A-3 Response

RESPONSE				
Aspect	ID	**Management Action**	**Responsibility**	**Timing**
Fire Suppression	1	Upon becoming aware of a fire, the observer will alert all bystanders and then attempt to extinguish the fire, if this can be done safely with adequately trained personnel. If the fire can be suppressed without additional resources, then personnel will suppress the fire, make the area safe and organise a patrol to monitor the suppressed fire.	All site personnel present at the fire	During operation
	2	The site personnel senior person at the fire will co-ordinate fire fighting activities and will be responsible for ensuring that all personnel are kept safe at all times.	All site personnel	During operation
	3	In the event that a fire is reported within the Project Area, *[contractor to insert position title]* will assess the situation and will decide whether to enact fire emergency procedures depending on the severity of the fire, current conditions and its potential to impact on infrastructure, or human and environmental values.	*[Contractor to insert]*	During operation

<table>
<tr><th colspan="5">RESPONSE</th></tr>
<tr><td>Aspect</td><td>ID</td><th>Management Action</th><th>Responsibility</th><th>Timing</th></tr>
<tr><td></td><td></td><td>Alternatively, if the fire is assessed as non-threatening and is not likely to impact on infrastructure, or human and environmental values, it will be closely monitored and allowed to burn out.</td><td></td><td></td></tr>
<tr><td></td><td>4</td><td>In the event that a fire occurs adjacent to the Project area, site personnel will contact the RFSQ and other relevant authorities to report the fire. The [contractor to insert position title] will assess the fire and whether it has the potential to migrate into the Project area and impact on infrastructure, or human and environmental values. If this is the case, the Contractor will implement emergency response procedures and liaise with RFSQ and other relevant authorities where necessary.</td><td>[Contractor to insert]</td><td>During operation</td></tr>
<tr><td></td><td>5</td><td>If a fire in the Project Area is considered to be of low threat to human and environmental values by [contractor to insert position title], the RFSQ will monitor the fire and liaise with other stakeholders where required.</td><td>[Contractor to insert]</td><td>During operation</td></tr>
<tr><td>Communication</td><td>6</td><td>In the event that control of the situation is taken by fire fighting authorities, the site personnel will follow the directions of the relevant authorities and assist where possible.</td><td>All site personnel</td><td>During operation</td></tr>
<tr><td></td><td>7</td><td>In the event that a significant bushfire occurs within the Project area, the Contractor will follow the communication protocol outlined below.
<table>
<tr><th>Service</th><th>Location and Phone Number</th></tr>
<tr><td>Ambulance</td><td>Cairns and Hinterland Local Area Service Network: (07) 4032 8615</td></tr>
<tr><td>Fire Warden (Urban Fire Brigade)</td><td>Atherton Fire Station: (07) 4091 9290
Mareeba Fire Station: (07) 4092 1044</td></tr>
<tr><td>State Emergency Services (SES)</td><td>Cairns: (07) 4032 8682</td></tr>
</table></td><td>[Contractor to insert]</td><td>During operation</td></tr>
<tr><td></td><td>8</td><td>If a bushfire occurs on or near the Project area, the response time to communicate with the relevant agencies will be dependent on the severity of the fire. The RFSQ and other relevant stakeholders will be notified immediately of a significant fire by [contractor to insert position title].</td><td>[Contractor to insert]</td><td>During operation</td></tr>
<tr><td></td><td>9</td><td>In the event of a significant bushfire requiring agency assistance, it is anticipated that the response time to communicate with these agencies will be less than 30 minutes.</td><td>[Contractor to insert]</td><td>During operation</td></tr>
<tr><td></td><td>10</td><td>It will be the responsibility of [contractor to insert position title] to communicate with the appropriate personnel to coordinate the necessary fire fighting equipment required for the first response of the fire. In the event that the fire is not immediately suppressed and further intervention is required [contractor to insert position title] will be responsible for contacting the appropriate fire fighting authorities.</td><td>[Contractor to insert]</td><td>During operation</td></tr>
</table>

RESPONSE				
Aspect	ID	**Management Action**	**Responsibility**	**Timing**
Responsibility	11	It will be the responsibility of *[contractor to insert position title]* to ensure the evacuation of buildings and affected areas within the Project area to a pre-arranged emergency meeting point.	*[Contractor to insert]*	During operation
	12	*[Contractor to insert position title]* will be responsible for liaisons with local authorities such as the Fire Service and Mareeba Shire Council on a as needs basis.	*[Contractor to insert]*	During operation

Table A-4 Assessment

ASSESSMENT				
Aspect	ID	**Management Action**	**Responsibility**	**Timing**
Recovery	1	Once the site has been deemed safe to re-enter *[contractor to insert position title]* will assess the extent of damage to the site and equipment and determine if works can resume. Part of the assessment will be to determine if the resumption of works will cause increased environmental damage, such as increasing the susceptibility of erosion.	*[Contractor to insert]*	During operation
Review	2	The BMP will be reviewed 12 monthly following the date of implementation, or earlier if a significant fire event has occurred to warrant a procedural review.	*[Contractor to insert]*	During operation
	3	The Contractor will review training needs and protocols on an annual basis.	*[Contractor to insert]*	During operation
Reporting	4	All fire incidents will be reported to *[contractor to insert position title]*. The person who observes the incident is responsible for reporting the incident.	*[Contractor to insert]*	During operation
	5	Fire and safety training undertaken by site personnel will be recorded and maintained.	*[Contractor to insert]*	During operation
	6	Relevant information will be provided in the monthly Project Report.	*[Contractor to insert]*	During operation

Appendix O

Cultural Heritage Management Plan

MT EMERALD WIND FARM PROJECT

CULTURAL HERITAGE MANAGEMENT PLAN

AGREEMENT DATED 24 January 2013/14

BETWEEN **Mt Emerald Wind Farm Pty Ltd** (the "**Sponsor**"), part of RATCH Australia ~~Pty Ltd~~ Corporation Limited

AND **John Wason** (the "**Endorsed Party**"), an *Aboriginal party* for the Project Area

AND **Bar-Barrum Aboriginal Corporation RNTBC**

RECITALS

A. The Sponsor proposes to develop the Project in the Project Area.

B. On 10 December 2010, the Sponsor notified its intention to develop a *cultural heritage management plan* in relation to the Project.

C. On 9 January 2011, John Wason of the Bar-Barrum People responded to the notification stating that he was an *Aboriginal party* to the Project Area as defined under section 35(7) of the Act. Mr Wason was subsequently endorsed by the Sponsor as an *endorsed party* under Part 7 of the Act.

D. The Endorsed Party wishes to take part in the development of a *cultural heritage management plan*.

AGREED TERMS

1. DEFINITIONS AND INTERPRETATION

1.1 In this Plan, where necessary and unless the contrary intention appears or the context otherwise requires, words and phrases used in this Plan are defined in Schedule 4.

2. COMMENCEMENT AND DURATION

2.1 This Plan commences on the Commencement Date and terminates on the earlier of:

(a) the completion of the Project; or

(b) the parties agreeing in writing to terminate the Plan,

unless otherwise extended, terminated or amended subject to the terms of this Plan.

2.2 For the avoidance of doubt, in the event that a person who is a Bar-Barrum Person becomes a *native title party* for all or part of the Project Area, this Plan will continue with full force and effect, unless otherwise agreed between the parties.

3. PRINCIPLES OF CULTURAL HERITAGE MANAGEMENT PLAN

3.1 The principles of this Plan are to:

(a) establish a timely and efficient process to recognise, protect, manage and conserve *Aboriginal cultural heritage* within the Project Area, and

(b) provide for each party to use its best endeavours to seek agreement with the other party:

(i) to avoid *harm* to *Aboriginal cultural heritage*; and

(ii) to the extent that *harm* can not reasonably be avoided, to minimise harm to *Aboriginal cultural heritage*; and

(iii) to provide help and advice in a way directed at maximising the suitability of the Plan for the effective protection and conservation of *Aboriginal cultural heritage*.

3.2 The parties will cooperate in good faith and in a genuine effort to apply the Plan in the exercise of the *cultural heritage duty of care* to ensure activities do not *harm significant Aboriginal areas* and *significant Aboriginal objects*.

3.3 The parties acknowledge and agree that any Project Activities undertaken by Mt Emerald Wind Farm or any Associated Entity must be undertaken in accordance with this Plan. Project Activities undertaken in accordance with this Plan are compliant for purposes of the *cultural heritage protection provisions* once this Plan constitutes an *approved cultural heritage management plan*.

3.4 During the time between the Commencement Date and the date that the Chief Executive approves this Plan in accordance with section 107 of the Act, the parties must take all reasonable and practicable measures to avoid *harm* to *Aboriginal cultural heritage* under sections 23(1), 24(2)(a)(v), 25(2)(a)(v) and 26(2)(a)(v) of the Act.

4. APPROVAL OF CULTURAL HERITAGE MANAGEMENT PLAN

4.1 The parties have agreed to submit this Plan to the Chief Executive for approval pursuant to section 107 of the Act. The Endorsed Party agrees, as contemplated in section 107(1)(b) of the Act, that the Chief Executive may approve the Plan, and that it will (if the Sponsor requests) confirm that agreement in writing to the Chief Executive.

5. THE PROJECT AREA

5.1 This Plan will extend to and cover the Project Activities in the Project Area.

6. THE PROJECT

6.1 This Plan will extend to and cover the Sponsor's Project Activities as identified in Schedule 6.

6.2 Even if not expressly mentioned in this Plan, this Plan will extend to and cover all of the Sponsor's activities necessary for and ancillary to the Project within the Project Area.

6.3 The Sponsor will as project owner build into its tender process specific requirements to provide for employment opportunities for the Bar Barrum People through the Nominated Body. Opportunities will be sought both during construction and through the long term operation of the project.

7. COORDINATING COMMITTEE

7.1 As soon as practicable after the Commencement Date, and in any case no later than 20 Business Days after the Commencement Date, the parties must set up a Coordinating Committee for the purposes of the implementation, management and future conduct of all matters arising out of this Plan.

7.2 The Coordinating Committee will be made up of:

(a) at least two, and a maximum of three, members appointed by the Sponsor;

(b) The Endorsed Party or an appointed representative of the Endorsed Party;

(c) and at least one, and a maximum of two, members appointed by the Nominated Body.

7.3 Meetings and decision making of the Coordinating Committee will be as follows:

(a) A quorum for a meeting of the Coordinating Committee must be two combined members appointed by the Endorsed Party and/or the Nominated Body and two members appointed by the Sponsor;

(b) Unless this Plan states differently, all decisions, approvals, advice, directions and recommendations of the Coordinating Committee must be made unanimously.

7.4 The Coordinating Committee will review, monitor and coordinate the implementation of the Plan, and in particular, must:

(a) meet at least once per year until the completion of the Project;

(b) make recommendations for the identification, assessment, protection and management of *Aboriginal cultural heritage* in the Project Area;

(c) nominate a Technical Advisor as required under clause 7.5;

(d) develop a communications protocol pursuant to clause 8;

(e) develop a set of understandings regarding delay in accordance with clause 20.2;

(f) continuously evaluate how this Plan is working;

(g) receive and respond to notices from the Sponsor;

(h) develop, oversee and implement any Cultural Heritage Survey, Cultural Heritage Survey Report and any Cultural Heritage Management Strategy;

(i) provide ongoing advice and guidance to the parties on *Aboriginal cultural heritage* matters in relation to all aspects of any Project Activities;

(j) assist the Sponsor to meet its schedules, deadlines and timetables under any Work Program;

(k) assist the Sponsor to comply with the requirements of all Laws governing *Aboriginal cultural heritage*;

(l) provide a forum for the parties to discuss opportunities for the Endorsed Party and the Nominated Body to educate the community about the Bar-Barrum People and their cultural heritage;

(m) discuss ideas about how the Bar-Barrum People might be involved in some aspects of Project's design, place naming and land management.

7.5 The Coordinating Committee must, within 20 Business Days of the establishment of the Coordinating Committee under clause 7.1, nominate a Technical Advisor who will assist Cultural Heritage Survey Teams if requested under clause 10.7.

7.6 If the Coordinating Committee fails to nominate a Technical Advisor in accordance with clause 7.5, the Sponsor may appoint a Technical Advisor of its choice.

7.7 The Coordinating Committee may change the Technical Advisor from time to time.

7.8 The Coordinating Committee will ensure all written records and reports (including but not limited to any daily work reports, salvage and excavation reports, and detailed analytical reports required pursuant to a Cultural Heritage Management Strategy) generated under this Plan are kept for review by the parties, and that a copy of those written records and reports are given from time to time to the Sponsor and appropriate persons authorised to receive them by the Endorsed Party or the Nominated Body.

7.9 If a Coordinating Committee has not been established or is dissolved at any stage, the Nominated Body will fulfil any role that would have been undertaken by the members appointed by the Nominated Body on the Coordinating Committee as required to implement this Plan.

8. COMMUNICATIONS PROTOCOL

8.1 Communications between the parties must occur in accordance with a communications protocol that will be developed and agreed by the Coordinating Committee at its first meeting ("Approved Communications Protocol").

8.2 Unless and until otherwise agreed in the Agreed Communications Protocol:

(a) the members of the Coordinating Committee appointed by the Sponsor under clause 7.2(a) will communicate decisions of the Coordinating Committee to the Sponsor; and

(b) the members of the Coordinating Committee appointed by the Nominated Body under clause 7.2(c) will communicate decisions of the Coordinating Committee to the Bar-Barrum People.

8.3 Until the Coordinating Committee develops the Approved Communications Protocol:

(a) the persons listed in clause 19.3 are the contact persons in relation to all matters under this Plan; and

(b) the communications protocol in Schedule 8 applies.

9. WORK PROGRAMS

9.1 Subject to clause 9.4, the Sponsor must give the Coordinating Committee a Work Program before Project Activities are carried out in a Work Area.

9.2 Each Work Program must contain:

(a) the proposed time frame and commencement date for the Project Activities;

(b) sufficient detail to identify the proposed Project Activities; and

(c) a map of the Work Area.

9.3 A Work Program may include:

(a) a topographic map at a scale of 1:100 000 or other appropriate scale of the Work Area, and/or aerial/satellite images showing with reasonable accuracy the Work Area; and

(b) with respect to the Work Area, details of:

(i) the nature and extent of the proposed Project Activities;

(ii) the estimated duration of the proposed Project Activities;

(iii) the means of access to undertake the proposed Project Activities;

(iv) any other information considered relevant by the Sponsor.

9.4 The Sponsor is not required to provide a Work Program pursuant to clause 9.1, and may undertake Project Activities without a Cultural Heritage Survey being undertaken or a Cultural Heritage Management Strategy being prepared, where the Project Activities:

(a) are in areas where there is existing infrastructure:

(b) are necessary for, or incidental to, the conduct of soil testing and other geotechnical investigations;

(c) are associated with the repair and maintenance of existing roads;

(d) do not cause Significant Ground Disturbance, including:

(i) the use and maintenance of existing roads, tracks and powerlines within the existing infrastructure alignment or other infrastructure footprint;

(ii) the use, maintenance and protection of services and utilities (such as electricity infrastructure, water or sewerage disposal) on an area where such services and utilities are currently being provided;

(iii) the use, maintenance and protection of services and utilities (such as electricity infrastructure, water or sewerage disposal) on an area immediately adjacent to where such services and utilities are currently being provided, providing the activity does not involve additional surface disturbance; and

(e) are in areas which were subject to Significant Ground Disturbance before the Commencement Date.

9.5 For the avoidance of doubt, nothing in clause 9.4 releases the Sponsor from otherwise complying with it obligations under this Plan.

10. CULTURAL HERITAGE SURVEYS

10.1 Within 20 Business Days of the Sponsor's provision of the first Work Program to the Coordinating Committee under clause 9.1, or as otherwise agreed, the parties must ensure that a meeting of the Coordinating Committee is convened.

10.2 At the meeting referred to in clause 10.1 the Coordinating Committee will develop and agree on standard Terms of Reference ("ToR") for the conduct of all Cultural Heritage Surveys.

10.3 The ToR must include the following:

(a) a requirement that the relevant Work Program be annexed to the ToR;

(b) proposed dates and timeframes for Project Activities, Cultural Heritage Surveys, Cultural Heritage Survey Reports and other arrangements;

(c) how Cultural Heritage Surveys will be carried out, in accordance with the requirements of this Plan;

(d) the personnel required to undertake Cultural Heritage Surveys which, unless otherwise agreed, will be up to four representatives of the Bar-Barrum People ("Cultural Heritage Survey Team");

(e) how collected information will be reported and managed;

(f) occupational health and safety requirements and other site specific workplace policies, including relevant inductions, required by the Sponsor, which will comply with clause 15;

(g) communications while a Cultural Heritage Survey Team are conducting activities within the Project Area;

(h) accommodation, meals and vehicle hire, which will comply with the Sponsor's obligations in Schedule 10;

(i) hours of work and payment, which will comply with Schedule 10;

(j) a list of equipment and assistance to be provided by the Sponsor;

(k) contact details for each work program; and

(l) an outline of the parties' responsibilities under clause 20.

10.4 Within the timeframes provided under the ToR, or at an alternative date as agreed between the parties, the Nominated Body must ensure that a Cultural Heritage Survey Team undertakes a Cultural Heritage Survey in accordance with the ToR for each Work Area the subject of a Work Program. The objectives of the Cultural Heritage Survey are:

(a) to provide an opportunity for the members of Cultural Heritage Survey Teams to inspect Work Areas and to consider the *Aboriginal cultural heritage* values in Work Areas; and

(b) to identify, document, determine the geographical coordinates of and report upon any *Aboriginal cultural heritage* within Work Areas.

10.5 If requested by the Nominated Body and agreed by the Sponsor, a Cultural Heritage Survey Team may be assisted by the Technical Advisor nominated under clause 7.5 or appointed under clause 7.6 whose role will be to:

(a) provide technical assistance to a Cultural Heritage Survey Team and the Nominated Body during the Cultural Heritage Survey;

(b) to collate all information recorded by a Cultural Heritage Survey Team; and

(c) to assist the Nominated Body to prepare a Cultural Heritage Survey Report and Cultural Heritage Management Strategy.

10.6 The costs of the Technical Advisor who undertakes work pursuant to clause 10.7 will be met by the Sponsor in accordance with Schedule 10.

10.7 The Sponsor may appoint a representative to accompany each Cultural Heritage Survey Team while it performs a Cultural Heritage Survey.

11. CULTURAL HERITAGE SURVEY REPORTS AND CULTURAL HERITAGE MANAGEMENT STRATEGIES

11.1 Within 20 Business Days or as otherwise agreed after the completion of a Cultural Heritage Survey, the Nominated Body must provide the Coordinating Committee with a complete report about the Cultural Heritage Survey ("Cultural Heritage Survey Report").

11.2 A Cultural Heritage Survey Report must detail, in relation to the relevant Work Area:

(a) any *Aboriginal cultural heritage* identified ("Reported Site");

(b) the location, described by geographical co-ordinates, of any Reported Sites;

(c) an assessment of the *Aboriginal cultural heritage* values of any Reported Sites;

(d) mitigation measures and management recommendations for the avoidance or the minimisation of *harm* to any Reported Sites during the conduct of Project Activities, including but not limited to flagging, pegging, fencing and removal recommendations; and

(e) if no Reported Sites were identified and no mitigation or management measures recommended, advice to that effect.

11.3 Within 20 Business Days after the receipt of a Cultural Heritage Survey Report, a meeting of the Coordinating Committee will be convened for the purpose of seeking agreement over:

(a) the contents of the Cultural Heritage Survey Report; and

(b) a Cultural Heritage Management Strategy for the relevant Work Area that gives effect to the mitigation measures and management recommendations recorded in the Cultural Survey Report and the Avoidance Principle.

11.4 If the Coordinating Committee cannot reach agreement over the contents of a Cultural Heritage Report or a Cultural Heritage Management Strategy, the Sponsor may refer the issues in question to an Expert to assist the parties in reaching agreement on the contents of the Cultural Heritage Report and Cultural Heritage Management Strategy for the relevant Work Area. The Expert must take into account the Cultural Heritage Survey Report and the activities required under the relevant Work Program and provide an opinion.

11.5 If, taking into account the Expert's opinion, and following a further meeting of the parties, the Coordinating Committee have not agreed on the terms of a Cultural Heritage Report or the Cultural Heritage Management Strategy within 20 Business Days of the delivery of the Expert's opinion, the parties will request the Expert to determine the terms of the a Cultural Heritage Report or Cultural Heritage Management Strategy or any part thereof that may be in dispute. The parties agree to be bound by those terms determined by the Expert except where other terms are settled prior to the Expert tendering a determination.

11.6 The final Cultural Heritage Survey Report and Cultural Heritage Management Strategy agreed pursuant to clause 11.3 or as determined pursuant to clause 11.5 will be provided to the Coordinating Committee and the Cultural Heritage Management Strategy will be implemented by the Sponsor during the conduct of the Work Program to which it relates.

11.7 The Cultural Heritage Management Strategy will give effect to the Avoidance Principle and must include:

(a) measures to avoid physical contact with any Reported Sites and to leave the Reported Sites in the state in which they existed before any Project Activities; or

(b) measures relating to the relocation or removal of Reported Sites within and from the Project Area respectively as a last resort; and

(c) measures to deal with New Cultural Heritage Sites.

11.8 The Coordinating Committee may vary a Cultural Heritage Management Strategy that has previously been agreed pursuant to clause 11.3 or determined pursuant to clause 11.5:

(a) upon receipt of a further Work Program in relation to the same Work Area; and

(b) where the relevant Work Area was the subject of a Cultural Heritage Survey,

or as otherwise agreed by the Coordinating Committee.

12. ABORIGINAL HUMAN REMAINS

12.1 If human remains are identified in the course of undertaking the Project Activities, the parties agree to apply the procedures contained in Schedule 9.

12.2 If either the Sponsor, the Nominated Body or the Endorsed Party knows or ought to reasonably know that the human remains are *Aboriginal human remains* it will:

(a) as soon as practicable, advise the Chief Executive, of the existence and location of the *Aboriginal human remains*; and

(b) provide the Chief Executive with details about the nature and location of the *Aboriginal human remains* that the Chief Executive reasonably requires.

13. INFORMATION PROTECTION PROVISION

13.1 The Sponsor agrees that any knowledge or information provided by the Endorsed Party or the Nominated Body which is identified as being of a secret and sacred nature:

(a) will remain the property of the Endorsed Party or the Nominated Body, as appropriate; and

(b) will not be included in any report or other document unless agreed to by the Endorsed Party or the Nominated Body, as appropriate.

14. INTELLECTUAL PROPERTY, CONFIDENTIAL INFORMATION

14.1 Any intellectual property or confidential information disclosed by a party to another or discovered by another remains the property of the disclosing party.

14.2 Subject to legal and cultural considerations, the parties will exchange all intellectual property and confidential information necessary to achieve the principles of this Plan.

14.3 Any intellectual property or confidential information supplied by a party to another will be kept confidential by the other party, except where such information is:

(a) already in the public domain,

(b) disclosed as required by law, or

(c) disclosed as part of seeking approval and registration of the Plan under the Act or for the purpose of giving effect to this Plan or of undertaking the Project.

15. HEALTH AND SAFETY

15.1 The Sponsor will have the responsibility for health and safety of persons in the Project Area as already exists under the Safety Laws and any other applicable Laws and industry codes.

15.2 The Sponsor will be responsible for the provision of any induction or training required by the Endorsed Party, the Nominated Body or the Bar-Barrum People that relates to Project Area work procedures and any workplace health and safety requirements, with all associated costs to be borne by the Sponsor.

15.3 The Nominated Body, must use their best endeavours to ensure that their officers, employees, contractors, subcontractors and agents and all members of the Cultural Heritage Survey Team comply with the Safety Laws and the directions and requirements of the Sponsor's site senior executive while on the Project Area.

16. ACCESS TO LAND

16.1 The Sponsor agrees that it has all necessary approvals and authority for it to access the Project Area.

17. CULTURAL HERITAGE AWARENESS TRAINING

17.1 The Sponsor undertakes to ensure that all employees, contractors and subcontractors employed or engaged by the Sponsor in relation to the Project undertake cultural heritage awareness training in accordance with this Plan prior to their commencement of work within the Project Area.

17.2 Cultural heritage awareness training is designed to provide:

(a) the Bar-Barrum People with an opportunity to explain the nature and significance of its *Aboriginal cultural heritage*;

(b) the Sponsor with an opportunity to better understand and appreciate the Bar-Barrum People's concerns;

(c) an opportunity for each party to establish a more substantive relationship;

(d) satisfaction to the Bar-Barrum People that the Sponsor's employees, contractors and subcontractors know what items or attributes they need to bear in mind in the course of the Project Activities and throughout the Project's operations.

17.3 Cultural heritage awareness training will be conducted by at least two [2] BarBarrum people at a time and place to be agreed by the Coordinating Committee, acting reasonably, and where possible will be conducted as part of the full site induction. Cultural heritage awareness training will be provided to existing employees, contractors and subcontractors before the commencement of the Project Activities, and then periodically as new employees, contractors and subcontractors are employed or engaged.

17.4 The Nominated Body undertakes to provide the cultural heritage awareness training by persons duly authorised or approved by the Nominated Body to the reasonable acceptance of the Sponsor.

17.5 Payment for cultural heritage awareness training will be made in accordance with Schedule 10.

17.6 The parties agree that part of the cultural heritage awareness training will be conducted by way of the viewing of a visual presentation aid. The Coordinating Committee will discuss the format and production of a visual presentation aid for this purpose. The Sponsor agrees to pay reasonable costs for the production of this visual presentation aid.

17.7 To avoid any doubt, the visual presentation aid remains the intellectual property of the BarBarrum People.

18. DISPUTES

18.1 In the event that a party considers that the Plan is not being adhered to or that the rights and obligations of a party are being infringed (the "Dispute"), that party may give notice of the Dispute (the "Dispute Notice") to the other party or its representative and the Coordinating Committee.

18.2 The Dispute Notice should, as far as possible, identify the:

(a) exact nature of the dispute,

(b) date and location of the activity or omission giving rise to the Dispute,

(c) names or positions of any persons involved in the activity or omission giving rise to the Dispute, and

(d) suggested manner or means to resolve the Dispute.

18.3 Within five Business Days of the Dispute Notice the Coordinating Committee must use best endeavours and take all reasonable and practical steps to resolve the dispute, including conducting all meetings, communications and negotiations in good faith and in keeping with principles of the Plan.

18.4 If there is no resolution within five Business Days of the Dispute Notice, then without limiting the rights available under the Act the parties to the Dispute must seek during 14 days, to agree on a process for resolving the Dispute through means other than litigation or arbitration (including further negotiations, mediation, conciliation or independent expert determination).

18.5 If the parties to the Dispute fail to agree on a process, any party to the Dispute can apply for the appointment of a mediator to the:

(a) Dispute Resolution Centre (Mediation Service),

(b) Bar Dispute Resolution Centre,

(c) the Institute of Arbitrators & Mediators or the Queensland Law Society, or

(d) another body/organisation as agreed between the parties.

18.6 If the parties to the Dispute do not agree to refer the matter to formal mediation, each party to the Dispute retains the rights to have the matter referred to an appropriate court or tribunal.

18.7 Provided that the nature of the Dispute does not allege that the Project will *harm Aboriginal cultural heritage*, the Sponsor may continue with Project Activities in the area the subject of the Dispute Notice and the parties will continue to perform their rights and obligations under the Plan until the Dispute is resolved or a determination/agreed result/order is made directing the parties to resolve the Dispute.

18.8 If the nature of the dispute alleges the Project will or is threatening to *harm Aboriginal cultural heritage*, the Sponsor must ensure that Project Activities are suspended in the area subject of the Dispute Notice until the Dispute is resolved or a determination/agreed result/order is made directing the parties to resolve the Dispute. The Sponsor may continue Project Activities in the remainder of the Project Area in accordance with this Plan.

19. NOTICES

19.1 A notice, consent or other communication under this Plan is only effective if it is:

(a) in writing, signed by or on behalf of the person giving it;

(b) addressed to the person to whom it is to be given; and

(c) either:

(i) delivered;

(ii) sent by pre-paid mail (by airmail, if the addressee is overseas) to that person's address;

(iii) transmitted by electronic mail; or

(iv) transmitted by facsimile to that person's facsimile number and the machine from which it is sent produces a report that states that it was sent in full.

19.2 A notice, consent or other communication that complies with this clause is regarded as given and received:

(a) if it is delivered, transmitted by facsimile or transmitted by electronic mail:

(i) by 5.00 pm (local time in the place of receipt) on a Business Day – on that day; or

(ii) after 5.00 pm (local time in the place of receipt) on a Business Day, or on a day that is not a Business Day – on the next Business Day; and

(b) if it is sent by pre-paid mail, on the day that is three Business Days from the day the notice, consent or other communication is posted.

19.3 A person's address and facsimile number are those set out below, or as the person notifies the sender:

The Sponsor
Address: Level 4, 231 George Street Brisbane 4000

Electronic mail: Terry.Johannesen@ratchaustralia.com
Attention: Terry Johannesen
Project Development Manager

Endorsed Party
Address: 37 Tait Street, Mutchilba Qld 4872
Electronic mail: johnwason@skymesh.com.au
Attention: John Wason

Bar-Barrum Aboriginal Corporation RNTBC
Address: 37 Tait Street, Mutchilba Qld 4872
Electronic mail: johnwason@skymesh.com.au
Attention: John Wason

20. DELAY

20.1 Each party must use reasonable endeavours to avoid delay in administering the protocols of this Plan including attending meetings, responding to correspondence and being available for agreed activities.

20.2 The Sponsor must promptly notify the Nominated Body by telephone in the event that a member of the Cultural Heritage Survey Team:

(a) does not attend within one hour of the scheduled commencement of a Cultural Heritage Survey; or

(b) is to be removed because the member fails to comply with the requirements in clause 15.3.

20.3 The Nominated Body must appoint a substitute member of the Cultural Heritage Survey Team to attend the Cultural Heritage Survey within two hours (or such other reasonable period agreed) of receiving telephone notice from the Sponsor under clause 20.2. During this time the Cultural Heritage Survey may continue.

20.4 If no alternative member of the Cultural Heritage Survey Team is appointed and attends the Cultural Heritage Survey within the timeframe set out in clause 20.3 or as otherwise agreed, the Sponsor may direct that the Cultural Heritage Survey continue.

20.5 The rights and obligations in clauses 20.2 and 20.3 apply equally where a Bar-Barrum Person has been engaged to undertake work pursuant to a Cultural Heritage Management Strategy. If no alternative person is appointed and attends to undertake the work, the relevant Project Activities may continue, subject at all times to the Sponsor complying with its obligations under the Act.

21. REASONABLENESS AND EXERCISE OF DISCRETION

21.1 The parties will do all that is reasonable and practicable to fulfil the purposes of and determine any matter under this Plan.

21.2 If a party is granted discretion or the ability to determine any matter under this Plan, that discretion or ability must be exercised reasonably.

22. AUTHORITY TO ENTER INTO PLAN AND WARRANTY

22.1 The Sponsor warrants that it has the authority to enter into this Plan.

22.2 The Endorsed Party warrants that it has the authority to enter into this Plan:

(a) for and on behalf of all Bar-Barrum People, and

(b) in accordance with the traditional law, custom and responsibility of the Bar-Barrum People.

23. NO AGENCY

23.1 The parties agree that nothing contained in this Plan constitutes any of them as agent or partner of any of them, or creates any agency or partnership for any purpose whatever or represents the views of another party.

23.2 Any undertaking, comment or statement by a party is not binding on any course of conduct or promise undertaken or given by any party.

23.3 No party has the right or authority to represent the rights and obligations of any other party.

24. AMENDMENT AND VARIATION

24.1 The parties agree that the suitability and applicability of this Plan will be reviewed at the end of the first year following the Commencement Date.

24.2 The parties may agree to amend or vary this Plan at any time in writing executed by the parties.

24.3 The Sponsor will notify the Chief Executive of any agreed amendment within a reasonable time of the amendment being executed.

25. ASSIGNMENT

25.1 Subject to clause 25.2, no party may assign their rights under this Plan to any other party.

25.2 The Sponsor may assign its rights and obligations under this Plan to a person to whom it transfers an equivalent proportion of its interests in the Project in the Project Area, provided it executes a deed whereby the assignee agrees to be bound by the obligations of this Plan, to the extent of the rights and obligations assigned, from the date of the assignment.

25.3 The Sponsor must provide written notice to all other parties to this Plan and the Chief Executive at least 14 days before the date of assignment, and must provide the parties with a copy of the deed of assignment as soon as reasonably practicable after the date of the assignment.

25.4 With effect from the date of the assignment, the Sponsor will no longer be bound by the obligations of this Plan to the extent of the rights and interests assigned.

26. APPLICABLE LAW

26.1 This Plan will be governed by and construed according to the law of the State of Queensland, and the parties agree to submit to the jurisdiction of the courts of Queensland.

27. FORCE MAJEURE

27.1 No party will be liable for any delay or failure to perform its obligations to the extent that the failure or delay is due to a Force Majeure Event.

27.2 A party claiming a Force Majeure Event must use its reasonable endeavours to remove, overcome or minimise the effects of that Force Majeure Event as quickly as possible.

28. SEVERANCE

28.1 If any provision of this Plan is prohibited, void, invalid or unenforceable, the provision will be ineffective and severed from this Plan to that extent without affecting any other provision of this Plan.

29. WAIVER

29.1 No failure to exercise nor any delay in exercising any right, power or remedy under this Agreement operates as a waiver.

29.2 No right under this Plan is to be taken as being waived except by notice in writing signed by the party waiving the right.

29.3 The waiver by a party of a breach of a clause by another party will not be a waiver of any other clause or subsequent breach of that clause.

30. ENTIRE PLAN

30.1 This Plan constitutes the entire agreement between the parties with respect to its subject matter and supersedes all previous negotiations, commitments and writings with respect to that subject matter.

31. INSURANCE

31.1 The Nominated Body will take out and maintain all appropriate workers' compensation, public liability and motor vehicle insurance as required by law in respect of all Bar-Barrum People who participate as;

a. members of a Cultural Heritage Survey Team,

b. the Coordinating Committee,

c. providers of cultural heritage awareness training or

d. those engaged to undertake work pursuant to a Cultural Heritage Management Strategy.

31.2 If the Nominated Body is unable to, or otherwise does not, meet the requirements of clause 31.1, the Sponsor may take out the relevant insurance policies on behalf of the Nominated Body, and the Sponsor will be entitled to set-off the costs of taking out such insurance policies against any payments which become due to the Nominated Body under this Plan.

31.3 A Technical Advisor must hold their own professional indemnity insurance.

32. COSTS

32.1 Subject to clauses 32.2 and 32.3, each party shall bear its own costs of and incidental to the preparation, negotiation and signing of this Plan.

32.2 The Sponsor shall be responsible for any duty assessed on this Plan.

32.3 The Parties acknowledge that the Sponsor has contributed to the reasonable costs of the Endorsed Party and the Nominated Body obtaining independent legal advice in respect of this Plan.

33. GOODS AND SERVICES TAX

33.1 If GST is payable on a Taxable Supply made under, by reference to or in connection with this Plan, the party providing the Consideration for that Taxable Supply must also pay the GST Amount as additional Consideration provided it receives a valid Tax Invoice including the GST Amount such that the party providing the Consideration is eligible to claim Input Tax Credits equal to the amount of GST. This clause does not apply to the extent that the Consideration for the Taxable Supply is expressly stated to be GST inclusive.

33.2 Any reference in the calculation of Consideration or of any indemnity, reimbursement or similar amount to a cost, expense or other liability incurred by a party, must exclude the amount of any Input Tax Credit entitlement of that party in relation to the relevant cost, expense or other liability.

33.3 The GST Amount is payable on the date 20 Business Days after the date on which a Tax Invoice is issued in relation to the Taxable Supply.

33.4 Any reference in this Plan (other than in the calculation of Consideration) to cost, expense or other similar amount (**Cost**), is a reference to that Cost exclusive of GST.

33.5 This clause will continue to apply after expiration or termination of this Plan.

33.6 In this clause:

(a) **Adjustment Event** has the meaning given by the GST Law;

(b) **Adjustment Note** has the meaning given by the GST Law;

(c) **Consideration** has the meaning given by the GST Law.;

(d) **GST** has the meaning given by the GST Law but for the avoidance of doubt does not include penalties or interest;

(e) **GST Amount** means in relation to a Taxable Supply the amount of GST payable in respect of that Taxable Supply;

(f) **GST Group** has the meaning given by the GST Law;

(g) **GST Law** has the meaning given by the *A New Tax System (Goods and Services Tax) Act 1999* (Cth), or, if that act does not exist means any act imposing or relating to the imposition or administration of a goods and services tax in Australia and any regulation made under that Act;

(h) **Input Tax Credit** has the meaning given by the GST Law and a reference to an Input Tax Credit entitlement of a Party includes an Input Tax Credit for an acquisition made by that Party but to which another member of the same GST Group is entitled under the GST Law;

(i) **Representative Member** has the meaning given by the GST Law;

(j) **Supplier** means the party that provides the Taxable Supply to the Recipient and includes the Representative Member of the GST Group if the Supplier is a member of a GST Group;

(k) **Tax Invoice** means a document that constitutes a tax invoice under the GST Law;

(l) **Taxable Supply** has the meaning given by the GST Law excluding the reference to section 84-5 of the *A New Tax System (Goods and Services Tax) Act 1999* (Cth).

33.7 If the Sponsor is required to withhold any amount in respect of tax from a payment to be made to the Supplier under this Plan, it is entitled to do so and such withholding and payment to the relevant taxing authority will be a good discharge of its obligation to pay the relevant amount to the Supplier. In the event that the Sponsor pays an amount to the Supplier without withholding an amount in respect of tax, the Sponsor will be indemnified by the Supplier for any loss suffered by it as a result of failing to withhold.

Executed as an Agreement on the date written on page 1 of this Agreement

Signed for and on behalf of Mount Emerald Wind Farm Pty Ltd by its duly authorised officer)

Witness

Andy Johnston
Full Name of Witness

Level 7, 111 Pacific Highway, North Sydney NSW 2060
Address of Witness

Officer

GEOFFREY DUTTON
Full Name of Officer

Signed for and on behalf of Mount Emerald Wind Farm Pty Ltd by its duly authorised officer)

Witness

Andy Johnston
Full Name of Witness

Level 7, 111 Pacific Highway, North Sydney NSW 2060
Address of Witness

Officer

Patricia Clifford
Full Name of Officer

SIGNED

by John Wason on his own behalf and on behalf of the BarBarrum People

this 11TH day
of DECEMBER 2013
in the presence of:

..... (signature)

..... (signature)

...Ricardo Martinez (Solicitor)...
(print name of witness)

Under Section 99-5 of the Corporation (Aboriginal and Torres Strait Islander) Act 2006

Bar-Barrum Aboriginal Corporation RNTBC

this 11th day
of DEC 2013
by Doreen P. DUONG ..... D. P. Duong .....
(full name) (signature)

Director ARCHIE
and by (CONRAD) KYNUNA ..... A C Kynuna .....
(full name) (signature)

Director

SCHEDULES

Schedule 1 Copy of public notice

Schedule 2 Copy of written notice to the Chief Executive

Schedule 3 Copy of response from Endorsed Party

Schedule 4 Dictionary

Schedule 5 Project Area

Schedule 6 Project Activities

Schedule 7 Aboriginal Cultural Heritage Database/Register Search Result

Schedule 8 Communications Protocol

Schedule 9 Human Remains

Schedule 10 Rates for services

Schedule 11 Invoicing

SCHEDULE 1 COPY OF PUBLIC NOTICE

PUBLIC NOTICE
CULTURAL HERITAGE MANAGEMENT PLAN
Aboriginal Cultural Heritage Act 2003 (Queensland)
Aboriginal Party

Transfield Services intends to develop a Cultural Heritage Management Plan for the Project pursuant to Part 7 of the Aboriginal Cultural Heritage Act 2003.

Project: Arriga Wind Farm. The project will include construction of approximately 74 wind turbines across the top of the escarpment which forms the Great Dividing Range in the Springmount area, a network of underground cables to an onsite substation, connection to the Powerlink 132 kV concrete tower line, and a system of access and service roads.

Sponsor's name: Transfield Services
Contact details: Karen Townrow Ph 07 4031 2355
Address for service: c/- Converge Heritage + Community
PO Box 2666
Cairns, Q, 4870

For the purpose of this notice, the Notice Day is: **8 January 2011.**
The Cultural Heritage Management Plan will be conducted over the following area:
Extent of lot bounded by the following co-ordinates:

Point	Easting	Northing	Point	Easting	Northing	Point	Easting	Northing
3	145.380	-17.134	**22**	145.405	-17.198	**41**	145.361	-17.144
4	145.380	-17.133	**23**	145.395	-17.196	**42**	145.362	-17.141
5	145.380	-17.135	**24**	145.389	-17.193	**43**	145.367	-17.142
6	145.379	-17.140	**25**	145.378	-17.186	**44**	145.371	-17.142
7	145.383	-17.143	**26**	145.374	-17.185	**45**	145.376	-17.147
8	145.390	-17.140	**27**	145.362	-17.173	**46**	145.379	-17.145
9	145.391	-17.141	**28**	145.358	-17.167	**47**	145.390	-17.147
10	145.396	-17.144	**29**	145.356	-17.160	**48**	145.401	-17.154
11	145.397	-17.146	**30**	145.355	-17.154	**49**	145.403	-17.151
12	145.398	-17.148	**31**	145.356	-17.155	**50**	145.402	-17.151
13	145.400	-17.150	**32**	145.358	-17.154	**51**	145.400	-17.150
14	145.402	-17.151	**33**	145.360	-17.154	**52**	145.398	-17.148
15	145.403	-17.151	**34**	145.362	-17.154	**53**	145.397	-17.146
16	145.404	-17.151	**35**	145.363	-17.154	**54**	145.395	-17.144
17	145.403	-17.151	**36**	145.365	-17.153	**55**	145.390	-17.142
18	145.401	-17.155	**37**	145.365	-17.152	**56**	145.390	-17.140
19	145.412	-17.168	**38**	145.363	-17.147	**57**	145.383	-17.143
20	145.410	-17.184	**39**	145.363	-17.146	**58**	145.379	-17.140
21	145.409	-17.196	**40**	145.361	-17.144	**59**	145.380	-17.135

Located within the Tablelands Regional Council, the Project Area lies within freehold lot 7 on Crown Plan SP235244. The Project area lies approximately 18.5km southwest of Mareeba and comprises the top of the escarpment which forms the Great Dividing Range in the Springmount area which lies generally to the south side of the Springmount Road on the west side of the Kennedy Highway in the vicinity of Walkamin.

If you are or have been nominated as an Aboriginal Party (as defined by Part 4 of the Aboriginal Cultural Heritage Act 2003) **to act on their behalf and you wish to take part in the Cultural Heritage Management Plan, you must give written notice to Transfield Services advising that you wish to take part by Tuesday, 8 February 2011.**

Transfield Services may elect not to endorse any Aboriginal Party if Transfield Services is not advised in writing within the required time.

SCHEDULE 2 COPY OF WRITTEN NOTICE TO THE CHIEF EXECUTIVE

22 December 2009

The Chief Executive
Department of Natural Resources and Water,
C/- Cultural Heritage Coordination Unit
Locked Bag 40
Coorparoo DC. QLD 4151

Dear Sir,

Transfield Services are proposing to develop a wind farm in the area of the Springmount/Arriga Tablelands (The Project Area -see attached map). The current proposed project is to establish a wind farm within Lot 7 on Crown Plan SP235244 which lies approximately 18.5km southwest of Mareeba in the Walsh Bluff area.

Project: Arriga Wind Farm. The project will include construction of approximately 74 wind turbines across the top of the escarpment which forms the Great Dividing Range in the Springmount area, a network of underground cables to an onsite substation, connection to the Powerlink 132 kV concrete tower line, and a system of access and service roads.

Transfield Services intends to prepare a Cultural Heritage Management Plan (CHMP) for the Project pursuant to Part 7 of the *Aboriginal Cultural Heritage Act 2003*.

Sponsor's name: Transfield Services

Contact details: Karen Townrow Ph 07 4031 2355

Address for service: c/- Converge Heritage & Community
PO Box 2666
Cairns, Q, 4870

Notification sent to: 1. Barbarrum People
c/- Mr John Wason, 37 Tait St, Mutchilba Qld 4872
2. Muluridji People
C/-North Queensland Land Council Aboriginal Corporation

For the purpose of this notice, the Notice Day is: 8 January 2011

The CHMP will be conducted over the following area:

Bounded by the following co-ordinates:

Point	Easting	Northing	Point	Easting	Northing	Point	Easting	Northing
3	145.380	-17.134	**22**	145.405	-17.198	**41**	145.361	-17.144
4	145.380	-17.133	**23**	145.395	-17.196	**42**	145.362	-17.141
5	145.380	-17.135	**24**	145.389	-17.193	**43**	145.367	-17.142
6	145.379	-17.140	**25**	145.378	-17.186	**44**	145.371	-17.142
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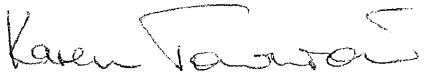
16	145.404	-17.151	**35**	145.363	-17.154	**54**	145.395	-17.144
17	145.403	-17.151	**36**	145.365	-17.153	**55**	145.390	-17.142
18	145.401	-17.155	**37**	145.365	-17.152	**56**	145.390	-17.140
19	145.412	-17.168	**38**	145.363	-17.147	**57**	145.383	-17.143
20	145.410	-17.184	**39**	145.363	-17.146	**58**	145.379	-17.140
21	145.409	-17.196	**40**	145.361	-17.144	**59**	145.380	-17.135

Located within the Tablelands Regional Council, lies within freehold lot 7 on Crown Plan SP235244:

The Project area lies approximately 18.5km southwest of Mareeba and comprises the top of the escarpment which forms the Great Dividing Range in the Springmount area which lies generally to the south side of the Springmount Road on the west side of the Kennedy Highway in the vicinity of Walkamin.

Attached, are copies of the notices that have been sent to the Aboriginal parties and the relevant landowners.

Yours faithfully,



Karen Townrow
Converge Heritage + Community
Cairns

Encl. - Figures 1 and 2: Locality Maps

SCHEDULE 3 COPY OF RESPONSE FROM ENDORSED PARTY

Barbarrum People
c/- Mr John Wason
37 Tait St
Mutchilba Q 4872

9 January 2011

Karen Townrow
Converge Heritage + Community
PO Box 2666
Cairns, Q 4870

Dear Ms Townrow

Re: Mount Emerald Wind Farm CHMP

In response to your notification of 8 January 2011, I wish to inform you that I am an Aboriginal person for the BarBarrum People, and am an Aboriginal Party pursuant to Sections 35 (7) of the *Aboriginal Cultural Heritage Act 2003*. I am responding to your notification before 10 February 2011, the date you advised as the time by which you require written notice that I wish to take part in developing the Cultural Heritage Management Plan for the Mount Emerald Wind Farm.

I request that you endorse me as an Aboriginal Party, and look forward to hearing from you. My contact number is (07) 4093 1233.

Yours sincerely,

John Wason

SCHEDULE 4 DICTIONARY

34. DEFINITIONS

34.1 In this Plan, unless the contrary intention appears or the context otherwise requires:

"**Act**" means the *Aboriginal Cultural Heritage Act 2003* (Qld).

"**Associated Entity**" has the meaning given to that term in the *Corporations Act 2001* (Cth).

"**Avoidance Principle**" means, collectively, the principles outlined in clause 3.1(b).

"Bar-Barrum People" means the common law holders of native title referred to in the Native Title Determination, in accordance with the traditional laws acknowledged and traditional customs observed by them. In defining Bar-Barrum People in this way, it is acknowledged that, as at the Commencement Date, there is no native title determination application registered over the Project Area.

"**Business Day**" means a day that is not a Saturday, Sunday, public holiday or bank holiday in a place where a notice is sent.

"**Chief Executive**" means the chief executive of the Queensland Government agency with responsibility for the administration of the Act, which at the Commencement Date is the Queensland Department of Aboriginal and Torres Strait Islander and Multicultural Affairs.

"**Commencement Date**" means the date on which this Plan was executed by the last of the parties.

"**Cultural Heritage Management Strategy**" means the management strategy for a particular Work Area agreed pursuant to clause 11.3 or determined pursuant to clause 11.5.

"**Cultural Heritage Survey**" means a survey undertaken pursuant to clause 10.4.

"Cultural Heritage Survey Report" means a report drafted pursuant to clause 11 and agreed pursuant to clause 11.3 or determined pursuant to clause 11.5.

"Cultural Heritage Survey Team" has the meaning given in clause 10.3(d).

"**Expert**" means a suitably qualified and experienced anthropologist or archaeologist agreed to by the Coordinating Committee or, in the absence of such agreement, a person who is nominated for the purpose by the President for the time being of the Australian Archaeological Association Inc and who has not previously been contracted by any of the parties in relation to the Project.

"**Force Majeure Event**" means anything outside a party's reasonable control including, but not limited to, fire, storm, flood, earthquake, explosion, war, invasion, rebellion, sabotage, epidemic, labour dispute, labour shortage, failure

or delay in transportation, cultural obligations of the Bar-Barrum People (including obligations to attend funerals or other meetings due to deaths of friends or relatives), and act or omission (including Laws, regulations, disapprovals or failures to approve) of any third person (including, but not limited to, subcontractors, customers, governments or government agencies).

"**Law**" means any law (including subordinate or delegated legislation or statutory instruments of any kind) of Australia or the state of Queensland.

"**Native Title Determination**" means the approved determination of native title made in the Bar-Barrum People's claimant application (Federal Court File No. QUD6222/98) made by the Federal Court of Australia on 28 June 2001 and which came into force and effect on the same day.

"**New Cultural Heritage Site**" means any *Aboriginal cultural heritage* identified within a Work Area that is not a Reported Site and was not identified as part of a Cultural Heritage Survey.

"**Nominated Body**" means, at the Commencement Date, Bar-Barrum Aboriginal Corporation RNTBC ICN 3362 and otherwise an incorporated body that:

(a) is established by or on behalf of the Bar-Barrum People to be the Nominated Body under this Plan;

(b) executes, and agrees to be bound by, a deed of assumption; and

(c) is joined as a party to this Plan upon the commencement of the deed of assumption.

"**Plan**" means this *cultural heritage management plan*.

"**Project**" means the undertaking of the Project Activities within the Project Area.

"**Project Activities**" means the activities listed in Schedule 6.

"**Project Area**" means the area described in Schedule 5, and which for the purposes of the Act is taken to be the *study area*.

"**Reported Site**" has the meaning given in clause 11.2.

"**Safety Laws**" means the *Work Health and Safety Act 2011* (Qld), as applicable.

"**Schedule**" means a Schedule, named as such, to this Plan.

"**Significant Ground Disturbance**" means:

(a) disturbance by machinery of the topsoil or surface rock layer (excluding consolidated rock or solid sheet rock) of the ground, such as by grading, bulldozing, trenching, ploughing, drilling or dredging; and

(b) the removal of vegetation by disturbance of the root systems and exposing underlying soil.

"**Technical Advisor**" means a person nominated under clause 7.5 or appointed under clause 7.6 possessing sufficient knowledge of *Aboriginal cultural heritage* and the requisite skills to identify and assess *Aboriginal cultural heritage*, and may include and anthropologist or archaeologist.

"**Work Area**" means the area in which Project Activities will be undertaken pursuant to a Work Program.

"**Work Program**" means a program drafted pursuant to clause 9 that outlines the Project Activities proposed to be undertaken in a Work Area.

1.2 In this Plan, except to the extent the context otherwise requires:

(a) the singular includes the plural and vice versa and a gender includes other genders,

(b) a reference to a party is to be construed as a reference to a party to this Plan,

(c) a reference to a party to this Plan or any other document or agreement includes its successors and permitted assigns,

(d) references to this Plan include its schedules and any annexures,

(e) a reference to "AUD", "dollars" or "$" is a reference to Australian currency,

(f) where a word or phrase is given a particular meaning, other parts of speech or grammatical forms of that word or phrase have corresponding meanings, and

(g) a reference to a document or agreement including this Plan includes a reference to that document or agreement as amended, novated, supplemented, varied or replaced from time to time.

1.3 In the interpretation of this Plan, headings are to be disregarded.

1.4 In this Plan, the following terms where stated in italics *like this* have the meaning given in the Act:

(a) Aboriginal cultural heritage;

(b) Aboriginal human remains;

(c) Aboriginal party;

(d) approved cultural heritage management plan;

(e) cultural heritage duty of care;

(f) cultural heritage management plan;

(g) cultural heritage protection provisions;

(h) database;

(i) harm;

(j) register;

(k) significant Aboriginal area;

(l) significant Aboriginal object;

(m) study area.

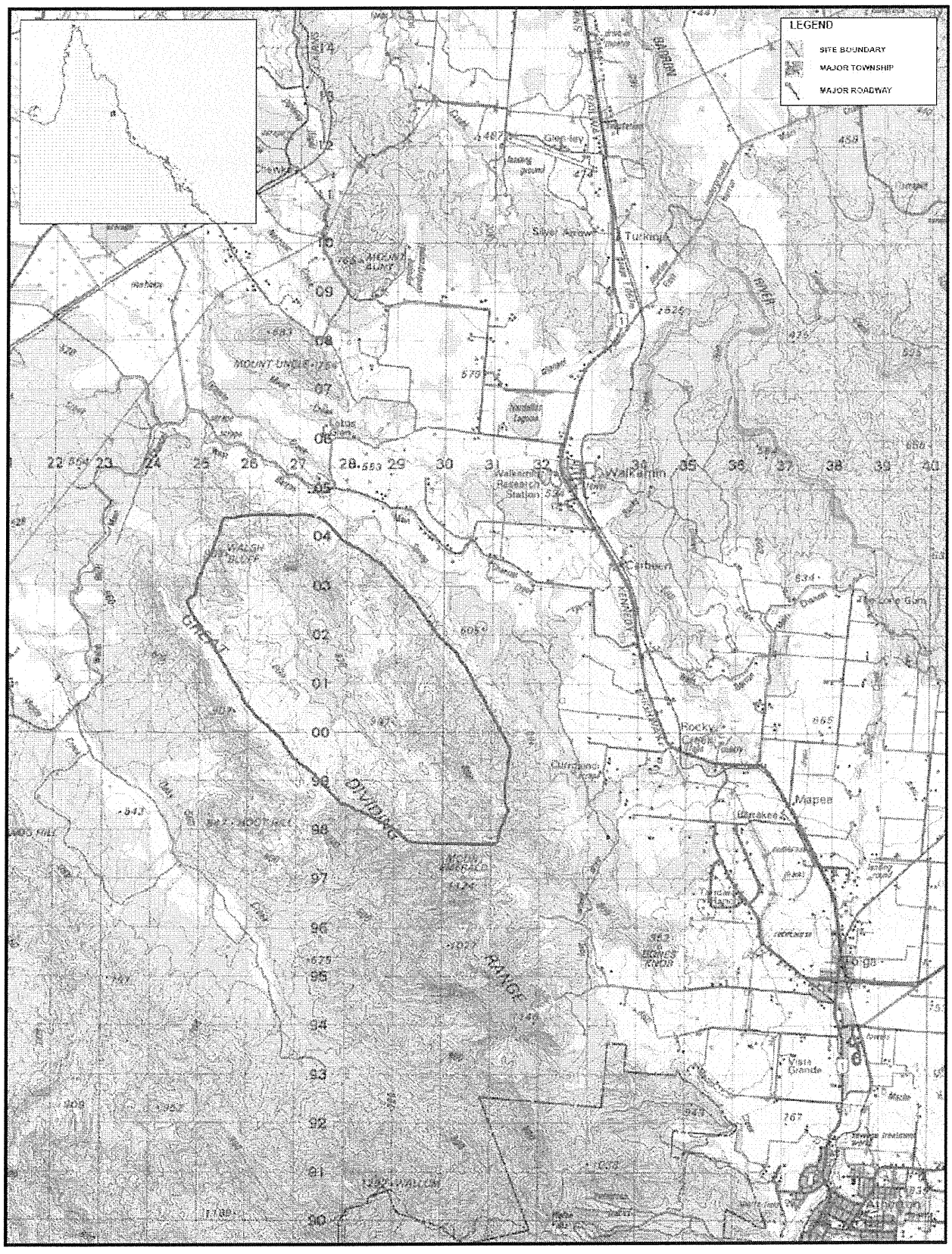
SCHEDULE 5 PROJECT AREA

Mount Emerald Wind Farm Pty Ltd are proposing to develop a wind farm in the area of the Springmount/Arriga Tablelands. The current proposed project is to establish a wind farm within Lot 7 on Crown Plan SP235244 which lies approximately 18.5km southwest of Mareeba in the Walsh Bluff area.

The Mt Emerald Wind Farm Project will include construction of up to 70 wind turbines across an area of land which forms part of the Great Dividing Range in the Springmount area, a network of underground cables to an onsite substation, connection to the Powerlink transmission line, and a system of access and service roads.

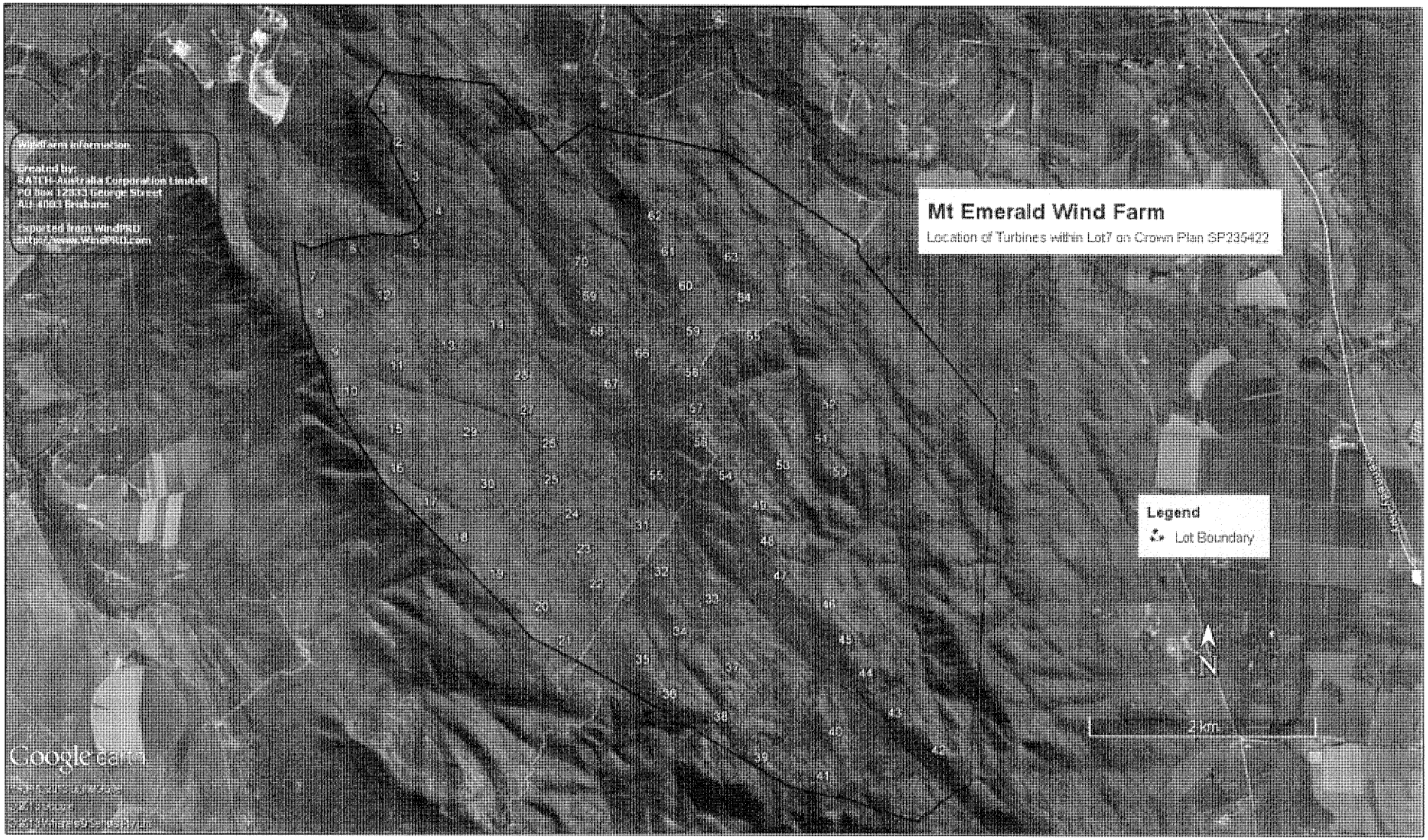
The Project Area covers all of the turbine areas, their access roads and cable routes.

The Project Area is shown in the figures below.



Springmount Wind Farm, Arriga
Location Map

CONICS


WindFarm Information
Created by:
RATCH-Australia Corporation Limited
PO Box 12653 George Street
Exported from WindPRO
Mt Emerald Wind Farm
Location of Turbines within Lot7 on Crown Plan SP235422
Legend
Lot Boundary
2 km
N
Google Earth

SCHEDULE 6 PROJECT ACTIVITIES

Proposed civil works at the project site comprises:

- Wind turbine generators (up to 75) including foundation and hardstand area
- Access tracks/roads
- Underground electrical connections
- Operations and maintenance building
- Up to four(4) permanent meteorological monitoring towers of lattice type structure
- Temporary construction and batching plant
- Transmission line connecting the proposed wind farm development to the established electricity grid
- Substation and compound comprising various support buildings

SCHEDULE 7 ABORIGINAL CULTURAL HERITAGE DATABASE/REGISTER SEARCH RESULT

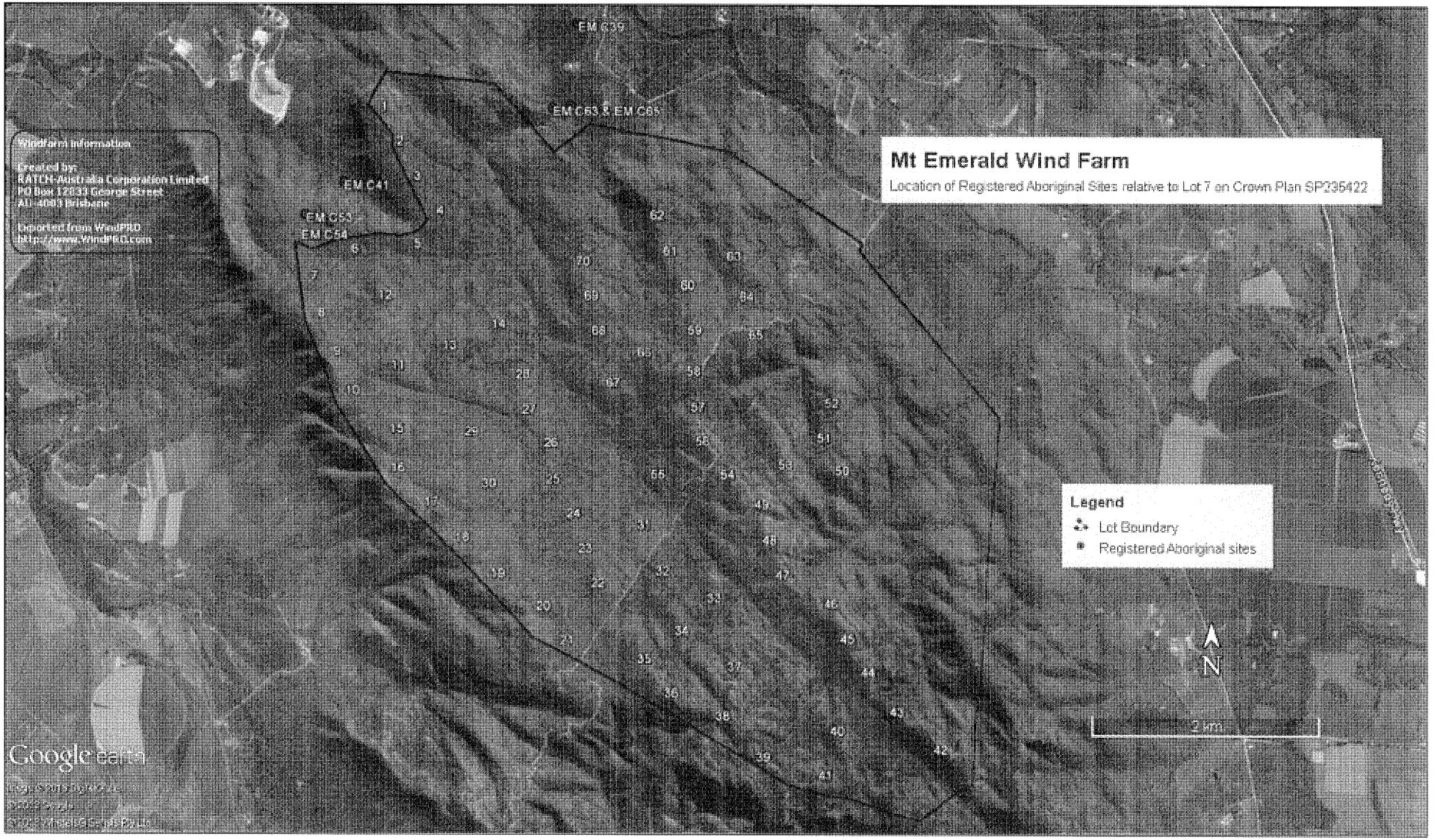
A search of the Department of Aboriginal and Torres Strait Islander and Multicultural Affairs (DATSIMA), Cultural Heritage Coordination Unit's register and the database undertaken in 23 October 2013. This search included a 500m buffer around Lot 7 on Crown Plan SP235422. This indicated that six (6) sites, located in close proximity to Lot 7 on Crown Plan SP235244, are entered into the Register. The sites comprised a landscape feature, two artefact scatter engravings, and painting. The location of these sites is indicated in the following figure.

No sites have been recorded within the Project Area.

Details:

Site Id	Latitude	Longitude	Record Date	Attribute	Aboriginal Party
EM:C39	-17.136926	145.377635	1/10/1993	Engraving, Painting	No Registered Party
EM:C63	-17.14347	145.375548	1/07/2000	Painting	No Registered Party
EM:C64	-17.143189	145.37666	1/07/1995	Painting	No Registered Party
EM:C65	-17.17.14347	145.375548	1/07/1995	Artefact Scatter	No Registered Party
EM:C41	-17.149423	145.358635	20/05/1998	Landscape Feature	No Registered Party
EM:C53	-17.152112	145.355886	1/05/1998	Artefact Scatter	No Registered Party
EM:C54	-17.152579	145.357762	1/05/1998	Artefact Scatter	No Registered Party
Part of area without recorded sites					No Registered Party

Data as supplied by the Cultural Heritage Coordination Unit, DATSIMA, 23 October 2013.


Mt Emerald Wind Farm
Location of Registered Aboriginal Sites relative to Lot 7 on Crown Plan SP236422
Legend
Lot Boundary
Registered Aboriginal sites
N
2 km
EM C39
EM C63 & EM C65
EM C41
EM C53
EM C54
Publication Information
Exported by:
RATCH-Australia Corporation Limited
PO Box 12033 George Street
Exported from WindPRO
Google earth

SCHEDULE 8 COMMUNICATIONS PROTOCOL

1. The Endorsed Party and the Nominated Body reserve their right to discuss information which is of a secret or sacred nature on their own terms in private without the presence of the Sponsor or its agents.

2. The Endorsed Party and the Nominated Body reserve the right to set their own procedures regarding the intervention in and discussion of places which are of significance to one or other gender within the group, and will set its meeting and monitoring procedures with due regard to these issues.

3. The Endorsed Party and the Nominated Body warrant that they will discuss with the Sponsor the impact on Project Activities caused by the existence of places that are of a secret or sacred nature but may choose not to reveal the detail of the sensitive nature of the place.

4. The Endorsed Party and the Nominated Body must be allowed to take decisions back to the Bar-Barrum People for discussion, confirmation or further instructions on the nature and outcome of any decisions. Costs of establishing and holding a meeting of the relevant Bar-Barrum People in accordance with this clause should be borne by the Sponsor.

5. The Endorsed Party and the Nominated Body reserve the right to establish which of the Bar Barrum People 'speaks for country' for certain areas. The Sponsor should respect the determination.

6. Initial communications between parties will be made by telephone or email to the North Queensland Land Council and followed up by a confirmatory telephone or email whichever was not used first.

7. When applicable, the parties agree to provide a full explanation of any technical-industry specific terms or any cultural paradigms/sensitivities, with due regard to the sensitivity of the information.

9. Communications between the parties should always be mindful of the expectations of the other parties, including that:

    - The Sponsor expects that it will be able to communicate and cooperate with the Endorsed Party and the Nominated Body to achieve a successful wind farm project which is devoid of unnecessary delays and will include the Bar-Barrum People as an important stakeholder in this process.

    - The Bar-Barrum People expect that their *Aboriginal cultural heritage* values will be respected and that they will be welcomed to participate as an important stakeholder in the project.

SCHEDULE 9 HUMAN REMAINS

THE DISCOVERY, HANDLING AND MANAGEMENT OF HUMAN REMAINS UNDER PROVISIONS OF THE *ABORIGINAL CULTURAL HERITAGE ACT 2003* AND *TORRES STRAIT ISLANDER CULTURAL HERITAGE ACT 2003*

If you find bones and suspect that they are human it is **essential that you do not disturb the material. You must report the findings to the Queensland Police Service**. The Police will determine if the remains represent a crime scene. If it is established that the remains are not a crime scene and the Coroner is satisfied that the remains are Aboriginal or Torres Strait Islander the Department of Environment and Resource Management procedure on *The Discovery, Handling and Management of Human Remains under Provisions of the Aboriginal Cultural Heritage Act 2003 and Torres Strait Cultural Heritage Act 2003* will apply.

1 General Guiding Principles

Death in all human societies is a significant event. It occurs on a regular but unpredictable basis, removing individuals from family, close relations and friends. Death is often associated with complex rituals. This was and is still the case with Aboriginal and Torres Strait Islander people. Disturbance to burials and human remains is therefore of major concern to them, as it is for all members of Australian society.

Aboriginal and Torres Strait Islander people have been in Australia for more than 40,000 years. In that time they have buried hundreds of thousands of their ancestors in a variety of ways. In some cases people were cremated; in others their bones were placed in hollowed-out logs or trees or wrapped in bark cylinders and placed in rock shelters. Many were also buried in the ground with grave goods. Burials commonly occurred in sand dunes and alluvial deposits, which were easy to dig. However, wind and water easily erode such locations and frequently these natural processes expose remains. Other common burial locations are rock shelters, rocky overhangs and hollow trees. All are vulnerable to human disturbance. The close proximity of scarred or carved trees and stone arrangements and the remains of fireplaces, stone artefacts and food refuse may be suggestive of an Aboriginal or Torres Strait Islander burial.

In view of possible natural or human disturbance to Aboriginal or Torres Strait Islander places the Queensland Government has in place a legislative framework that will ensure such burials are treated in a manner consistent with legal requirements and Aboriginal and Torres Strait Islander traditions.

There is also provision for Aboriginal or Torres Strait Islander people who have traditional or familial links with human remains to seek ownership of these remains regardless of who claimed previous ownership.

2 Desired Outcomes

This procedure has a number of general desired outcomes:-

- While natural or human processes can inadvertently expose Aboriginal or Torres Strait Islander human remains, all attempts will be made to limit further disturbance.
- If further investigation and disturbance is required, procedures are in place for the proper handling of such remains.
- All such procedures are sensitive to the wishes of the Aboriginal or Torres Strait Islander owners of the remains.
- That Aboriginal or Torres Strait Islanders who have traditional or familial links with human remains are able to claim ownership of those remains.

3 Legislative Framework

Criminal Code Act 1899

All persons **must** be aware that under the ***Criminal Code Act 1899*** (s236) it is an offence to improperly or indecently interfere with a human body or human remains, whether buried or not. An offence under this provision can result in imprisonment for up to two years.

Coroners Act 2003

Provisions of the ***Coroners Act 2003*** provide that when a person becomes aware of a reportable death it is the duty of the person finding the reportable death to report the findings to a police officer or coroner (Part 2 s7). A reportable death is defined in Part 2 s8 and would include Aboriginal and Torres Strait Islander human remains (**NB** Part 4, Division 4 Section 82 (1) defines every magistrate as a coroner (a "local Coroner").

The Coroner starts having control of human remains when the Coroner starts investigating the deceased person's death (Part 3 s26 (1)). The Coroner must stop investigating a death if the Coroner's investigation shows that the body is Aboriginal or Torres Strait Islander traditional burial remains (Part 3 s12(2)(a)). Where this occurs, a Coroner will authorise for the remains to be released to the Minister responsible for administering the *Aboriginal Cultural Heritage Act 2003* and *Torres Strait Islander Heritage Act 2003* (See Part 3 s26(2) (a)) and Form 12 version 2- Order for release of Traditional remains. Published Queensland Government Gazette 23 October 2009 p586.

To ensure best practice in the coronial system, the State Coroner must develop guidelines in respect to certain matters, including those dealing with investigations of deaths involving human remains found in a suspected traditional burial site, and in particular, must provide for the early notification and involvement of the Aboriginal or Torres Strait Islander community having a connection with the burial site (Part 3 s14 (3) (b)).

Aboriginal Cultural Heritage Act 2003 and Torres Strait Islander Cultural Heritage Act 2003

The basic intent of the ***Aboriginal Cultural Heritage Act 2003*** and ***Torres Strait Islander Cultural Heritage Act 2003*** ('the Acts') is that Aboriginal and Torres Strait cultural heritage should be protected.

It is also the intent of the Acts that (as far as practicable) Aboriginal and Torres Strait cultural heritage should be owned and protected by Aboriginal and Torres Strait Islander people with traditional or familial links to the cultural heritage if it is comprised of any of the following-

(a) Aboriginal human remains;
(b) Secret or sacred objects; or
(c) Aboriginal heritage lawfully taken away from an area.

It is a further intent of the Acts that Aboriginal and Torres Strait Islander cultural heritage that is in the custody of the State, including the Queensland Museum, should continue to be protected by the State until it can be transferred into the protection of its Aboriginal or Torres Strait Islander owners (Part 2 Division 1 s14 (1-4)).

Under the Acts, Aboriginal or Torres Strait Islander people who have a traditional or familial link with Aboriginal human remains are the owners of those remains regardless of who may have owned the Aboriginal or Torres Strait Islander human remains before commencement of the Act (Part 2 Division 2 s15 (1-2)).

An Aboriginal or Torres Strait Islander person who owns human remains may at any time ask the State (or an entity that represents the State) who holds custody of the remains to continue to be the custodian of the human remains or return the human remains to them (Part 2 Division 2 s16 (1-4)).

If a person, other than the State has in their possession Aboriginal or Torres Strait human remains to which they do not have traditional or familial links then the person must take all reasonable steps to ensure that the human remains are taken into the custody of the chief executive as soon as practicable. Penalties apply if a person fails to do this (Part 2 Division2 s17 (1-2)).

If a person knows of the existence and location of Aboriginal human remains and is not the owner of those remains, or knows or ought reasonably to know the human remains are Aboriginal or Torres Strait Islander human remains or knows or suspects the chief executive does not know of the remains, the person must as soon as practicable (and after advising the Police or Coroner) advise the chief executive of the extent of the human remains and provide all the details about the nature and location of the human remains the chief executive reasonably requires. Penalties apply if a person fails to do this (Part 2 Division 2 s18).

Procedures for dealing with Aboriginal and Torres Strait Islander human remains

In all cases when human remains are located it is important to remember that:

- **The discovery of any human remains must as soon as possible be reported to the nearest police.**
- **It is an offence to interfere with human remains, whether buried or not.**

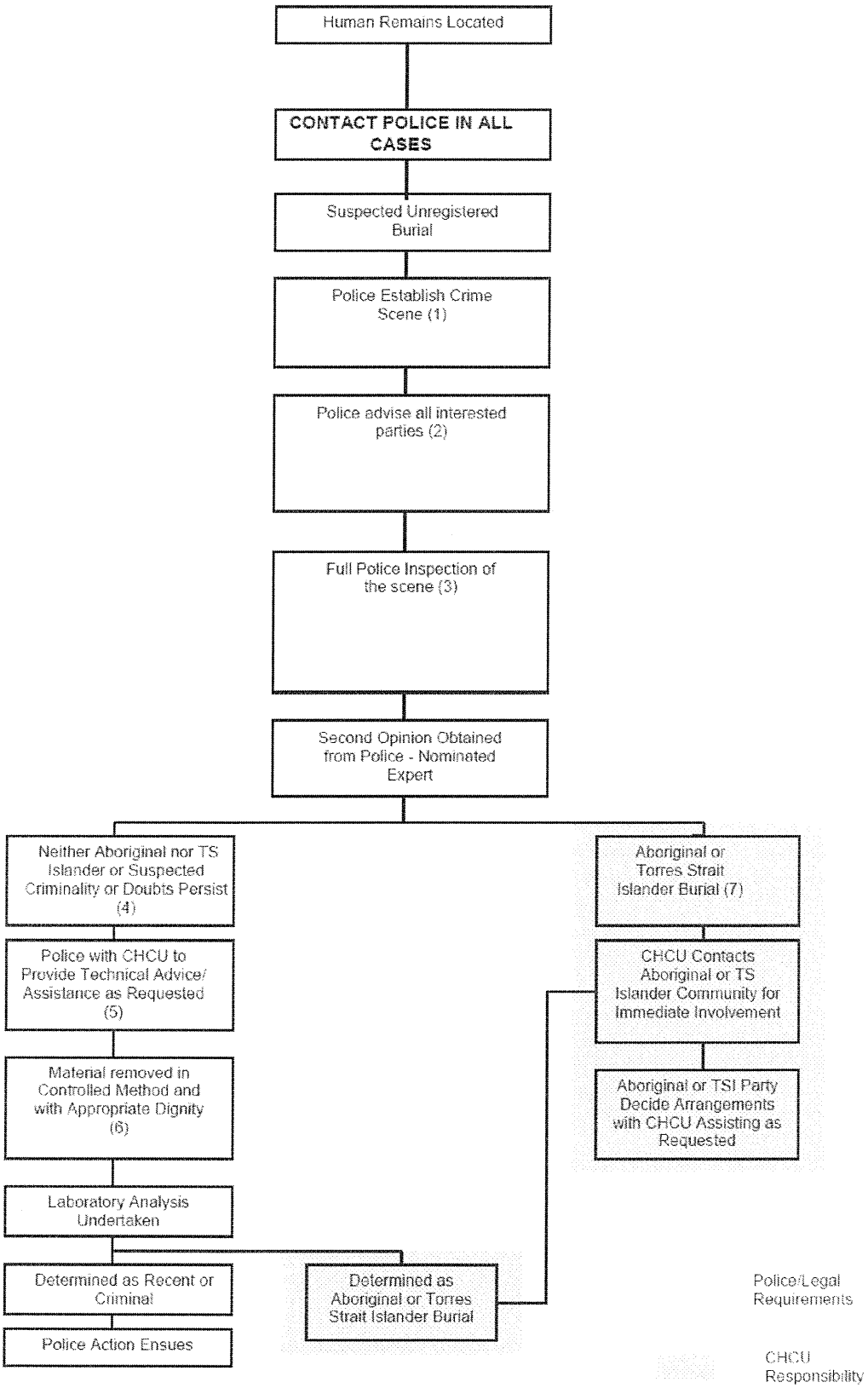
The Police or Coroner must be advised of the presence of any human remains. An appropriate officer or officers will then establish the area of discovery as a potential crime scene and are responsible for preserving and securing the area.

If a determination is made that satisfies the Coroner that the remains are not a crime scene and that the remains could constitute an Aboriginal or Torres Strait Islander burial site, Police will contact the Cultural Heritage Coordination Unit of the Department of Environment and Resource Management. Officers of the Cultural Heritage Coordination Unit (or their representatives) may attend the scene and along with the Police and Scenes of Crime Officers collect appropriate data on ethnicity, antiquity and evidence of criminal activity or otherwise for submission to the Coroner. Further advice might be sought from forensic osteologists/pathologists or physical anthropologists.

If the remains are thought to be neither Aboriginal nor Torres Strait Islander, related to criminal activity or are of doubtful determination, Officers of the Department of Environment and Resource Management (or their representatives) may assist the Police in further determinations. This may require controlled removal and analysis by a suitable forensic expert as ordered by the Coroner. In all cases of possible criminal activity the requirements of the Police and Coroner for data collection and site security will have priority. If the remains are determined, to the satisfaction of the Police and Coroner, to be Aboriginal or Torres Strait Islander, Officers of the Department of Environment and Resource Management will then take responsibility for liaison and reburial with the appropriate Aboriginal or Torres Strait Islander community.

At all stages minimal disturbance to the remains will be a priority and they will be dealt with in a sensitive and caring manner. Advice and guidance from Aboriginal or Torres Strait Islander elders will be taken as soon as the possibility of criminal activity is dismissed.

Where an offence under provisions of the *Aboriginal Cultural Heritage Act 2003* or *Torres Strait Islander Heritage Act 2003* is suspected to have occurred then the Regional Compliance Team of the Department of Environment and Resource Management must be advised. Where an offence is suspected the scene must be kept secure until handed over to Department of Environment and Resource Management compliance officers.


Human Remains Located
CONTACT POLICE IN ALL CASES
Suspected Unregistered Burial
Police Establish Crime Scene (1)
Police advise all interested parties (2)
Full Police Inspection of the scene (3)
Second Opinion Obtained from Police - Nominated Expert
Neither Aboriginal nor TS Islander or Suspected Criminality or Doubts Persist (4)
Police with CHCU to Provide Technical Advice/ Assistance as Requested (5)
Material removed in Controlled Method and with Appropriate Dignity (6)
Laboratory Analysis Undertaken
Determined as Recent or Criminal
Police Action Ensues
Determined as Aboriginal or Torres Strait Islander Burial
Aboriginal or Torres Strait Islander Burial (7)
CHCU Contacts Aboriginal or TS Islander Community for Immediate Involvement
Aboriginal or TSI Party Decide Arrangements with CHCU Assisting as Requested
Police/Legal Requirements
CHCU Responsibility

Explanation of procedures

(1) Police Officers maintain authority and responsibility for a potential crime scene at all times.

(2) Cultural Heritage Coordination Unit Officers (or their representatives) may attend the scene and provide advice as required by Police and Scenes of Crime Officers.

(3) Police will nominate a person to provide a second opinion if appropriate. Such opinion may be available on-site if a suitable forensic expert is available. However, if a suitable forensic expert is unavailable to travel to the site, digital images may be sent to them to provide an opinion. All data required for first and second opinions is to be collected on site.

(4) Final decision on this rests with Police, on advice from the Coroner.

(5) Officers of the Cultural Heritage Coordination Unit will, on request, assist Police in technical aspects of evidence retrieval.

(6) Advice on handling may be sought from appropriate sources where this does not compromise integrity of crime scene or quality of evidence.

Additional procedures and information

Where the remains are determined to be Aboriginal or Torres Strait Islander the Coroner will authorise for the remains to be released and will complete *Form 12 Order for the Release of Traditional Remains*. This provides for the release of the remains to the Minister responsible for administering the *Aboriginal Cultural Heritage Act 2003* and the *Torres Strait Islander Heritage Act 2003*.

Should any Police Officer or Officer of the Department of Environment and Resource Management (or their representative) be in any doubt as to the requirements of the relevant Coroner for their region, then it is essential that the Coroner be directly consulted. Alternatively, as the State Coroner is responsible for all Coroners any perceived difficulties in implementing the policy/procedure should be referred to him/her.

The excavation of human burial remains for whatever reason is not encouraged. However, this may occur if directed by the Coroner of if requested in writing by an Aboriginal or Torres Strait Islander Body.

If a researcher acting under an authority or agreement from the Cultural Heritage Coordination Unit and with the Aboriginal or Torres Strait Islander Body for an area discovers burial remains in the process of excavating a site, they shall immediately stop excavation, cover the remains and contact an Officer of the Cultural Heritage Coordination Unit, who will then follow the procedures set out in this document.

The Queensland Museum acquired human remains from the 1870's to 1972 including some legally recovered under the *Aboriginal Relics Preservation Act 1967*. However, by 1972 it was no longer considered appropriate to deposit human remains with the Queensland Museum except in exceptional circumstances and with the permission of the relevant Aboriginal or Torres Strait Islander community. The Museum has now developed a repatriation policy for human remains still in its collection (see – *Queensland Museum Policy on Ancestral Remains and Burial Goods* – May 2004, Queensland Museum Policy on Secret Sacred Objects – May 2004). These policies commit the Queensland Museum to returning to Aboriginal and Torres Strait Islander communities, family groups, and individuals, ancestral remains and burial goods, and secret sacred objects held in Museum collections.

SCHEDULE 10 RATES FOR SERVICES

The parties acknowledge that the Sponsor will pay to the Nominated Body (or as directed), other than payments to be made directly to the Technical Advisor, fees calculated at the following rates

1 Cultural Heritage Rates

Role	Rates ($)
Bar-Barrum People who are members of a Cultural Heritage Survey Team	$660 per day*
Bar-Barrum People who are engaged to undertake work pursuant to a Cultural Heritage Management Strategy	$660 per day*
The Endorsed Party and/or members nominated by the Nominated Body participating in Coordinating Committee meetings	$700 per day*
Bar-Barrum People conducting cultural heritage awareness training	$700 per day*
* the daily base rate includes a $60 per day travel allowance.	

2 A working day comprises an eight hour period (generally 8:30am to 4:30pm) inclusive of short breaks and a half hour lunch break. A full days rate will be payable on completion of the full working day. If less than a full eight hours work is undertaken then a half days rate is payable.

3 If the Sponsor requests work be undertaken exceeding eight hours in one day, an overtime rate of $100 per hour (or part thereof) will apply.

4 Where a Cultural Heritage Survey Team has presented for previously arranged work and is prevented from carrying out this work by circumstances beyond their control, such as wet weather or a matter attributable to the Sponsor, each member of the team will be paid half the daily rate listed above.

5 Miscellaneous Rates

Activity	Supplementary Information on Payments	Rates ($)
Vehicle hire	Vehicle hire where reasonably necessary for Cultural Heritage Surveys, inclusive of fuel and insurance	$250 per day Amounts over $250 will be paid on receipt of a tax invoice
Accommodation	Actual costs of accommodation with receipts and not to exceed Government Accommodation Rates as determined by the ATO for the relevant town or region. If there is no accommodation available at the ATO rate in the relevant town or	Actual costs

Activity	Supplementary Information on Payments	Rates ($)
	region, then the actual costs of accommodation will be paid.	
Meals Allowance & Incidentals #	Breakfast, lunch, dinner and incidentals	ATO Rates
Administration Fee	On the total amount of all the above items (excluding GST)	20%

Meals Allowance and Incidentals:

1. If the individual is required to leave home before 6.30am because of the work they are doing for the Sponsor an allowance for breakfast is reasonable.
2. If the individual is away from home for at least six hours because of the work they are doing for the Sponsor then an allowance for lunch is reasonable.
3. If the individual does not get home until after 6.30pm because of the work they are doing for the Sponsor then an allowance for dinner is reasonable.
4. Incidentals are payable when the individual is working away from home.

SCHEDULE 11 INVOICING

1. PROVISION OF BUDGET ESTIMATES

1.1 Where the Nominated Body responds to:

(a) a Work Program;

(b) a notice of a meeting of the Coordinating Committee;

(c) a request for members of the Bar-Barrum People to undertake work pursuant to a Cultural Heritage Management Strategy; or

(d) a request for the provision of cultural heritage awareness training,

the Nominated Body must include in the response an itemised budget in relation to the costs associated with the relevant activity, the rates in any such budget to be in accordance with Schedule 10.

1.2 If the Sponsor accepts the draft budget, the Sponsor will notify the Nominated Body within two Business Days from the date of receiving the draft budget and the budget will be an ***Approved Budget.***

1.3 If the Sponsor does not accept the draft budget then the provisions of clause 18 of the Plan will apply. If the Parties reach agreement on the draft budget through either one of these processes, the draft budget will be an ***Approved Budget.***

2. TIMING OF PAYMENTS

2.1 The Sponsor will pay to the Nominated Body the fees for attendance, travel expenses, meals, accommodation and incidentals in accordance with Schedule 10 and the Approved Budget.

2.2 Monthly correctly rendered tax invoices shall be forwarded to the Sponsor and will be paid within 20 Business Days of receipt of the invoice.

2.3 The Nominated Body may submit an initial invoice for up to 50% of an Approved Budget, in accordance with this clause, prior to the commencement of activities outlined in the Approved Budget.

2.4 The Nominated Body shall compile a record of attendances and provide that record to the Sponsor on a monthly basis to accompany the payment claim.

2.5 The Sponsor acknowledges that there may be costs associated with the preservation and management of culture and heritage sites, objects or remains as a result of the works or in the follow-up works consequent to the completion of the Project, and undertakes to meet the reasonable costs of such preservation and management as may be agreed between the Parties.

2.6 All amounts referred to are exclusive of GST.

2.7 Despite anything else in this agreement all payments made are subject to due performance of the services. If the Nominated Body fails to perform the services to an adequate standard then the Sponsor is relieved of all payment obligations.

Appendix P

Outcomes Strategy

Mount Emerald Wind Farm

Northern Quoll Outcomes Strategy

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
Draft	Outcomes Strategy	Scott Burnett	MJ / TJ	21/09/2016
Final	Outcomes Strategy	Scott Burnett	MJ / TJ	5/12/2016

Approval for Issue

Name	Signature	Date
M Jess		05/12/2016

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Appendices

1.0 Introduction

The Northern Quoll *Dasyurus hallucatus* is the smallest species of the quolls, a group of predominantly carnivorous marsupials found only in Australia and New Guinea (Van Dyck and Strahan, 2008).

The species is regarded as Endangered under the EPBC Act (1999), and is the subject of a recovery plan - National Recovery Plan for the Northern Quoll *Dasyurus hallucatus* (Hill and Ward 2010). The main aim of the recovery plan is to;

> *"minimise the rate of decline of the Northern Quoll in Australia, and ensure that viable populations remain in each of the major regions of distribution into the future. The recovery actions proposed here emphasise protecting key populations from colonization by cane toads and cats (especially through quarantine of offshore islands); fostering recovery of populations that have collapsed following cane toad arrival; managing secure populations (including captive and translocated); identifying and managing the threats to the Northern Quoll in the absence of cane toads; raising public awareness and native (sic) support of Northern Quoll in the absence of cane toads; raising public awareness and active support of northern quolls; and enhancement of cane toad management, including quarantine."*

Key listed threats include;

- cane toads,
- feral predators,
- inappropriate fire regimes,
- habitat degradation,
- habitat destruction,
- weeds,
- disease,
- hunting,
- population isolation

The disparity between historical records and the known contemporary distribution of *D. hallucatus* suggests that their populations underwent a catastrophic collapse during the 20th century, resulting in the disjointed range of the species in Australia and Queensland today (Braithwaite and Griffiths 1994, Oakwood 2008). Northern quolls in Queensland are known from only six disjunct populations;

(1) Weipa,

(2) eastern Einasleigh uplands/western and northern Wet Tropics boundary from Ravenshoe – Cooktown,

(3) Townsville- Bowen,

(4) Mackay/Whitsunday region and hinterland,

(5) Rockhampton region and hinterland and,

(6) Carnarvon Range (Burnett unpublished data),

It is possible that further survey effort in the southern and central Queensland regions will locate more populations.

The Mt Emerald quoll population forms part of the eastern Einasleigh upland/western wet tropics quoll population and like all remnant Queensland quoll populations, has survived there in sympatry with cane

toads, and during more than 100 years of European occupation with slight modification of their habitat (e.g. Woinarski *et al.* (2008), S. Burnett, University of the Sunshine Coast, unpublished data).

Studies by Burnett *et al.* (2013) suggest that the western and northern Atherton Tablelands, extending north to Cooktown, is a hot spot for Northern Quolls in Queensland and the area within a 55km radius of Mt Emerald contains 72% of the remaining Northern Quolls in the Einasleigh Uplands/Wet Tropics region. Conroy and Lamont (2013) further identify that the Mt Emerald quoll population experiences gene flow to and from adjacent populations in the upper Walsh River about 20km to the south-west, and the Lamb Range (Tinaroo and Davies Creeks) about 20km to the east and that Mt Emerald is likely a route through which gene flow from the Lamb Range through to the Herberton Range occurs.

An attempt was made to model the population viability (PVA) of the Mt Emerald quoll population using a suite of parameters derived by direct observation of this and nearby quoll populations, and parameters inferred from quoll populations across the species range (Shimizu and Conroy 2013). This PVA was hampered by a lack of detailed data on critical aspects of quoll population ecology and dispersal patterns, and the major recommendation of that report was to undertake studies to collect more of this data.

Further research has built on these studies and have been particularly focussed on establishing the best methods of detecting and enumerating quoll populations. Hemmings (2015) compared the efficiency of cage trapping versus camera trapping for detecting and enumerating the size of Northern Quoll populations at six sites between Townsville and Mareeba, revealing that camera trapping is at least as efficient as cage trapping. Given the much lower effort required to conduct a camera-trap versus a cage-trapping survey he recommends the use of trail cameras to locate and count quolls.

Current research (N. Foster, University of the Sunshine Coast, unpublished data) is exploring the most effective camera trap deployment for detection and population estimation of Northern Quolls. Foster (unpublished) has tested a variety of camera trap spacings on each of nine, 1-km-long transects between Mackay and Mareeba on the Atherton Tablelands. While these analyses are ongoing, the preliminary results suggest that even at 100-m-spacings, insufficient recaptures are had to permit strong mark-recapture derived population estimates to be obtained on these single transect-lines of camera traps.

The methods proposed below to effectively monitor Northern Quoll populations are derived from the above studies and suggest that for effective population estimation of Northern Quolls, a grid-based approach, at which cameras are spaced no more than 350-m-apart, and in which cameras are left in-situ for a minimum of 14 days are required to maximise the number of individuals detected, the number of recaptures, and hence to maximise the accuracy of spatially-explicit mark-recapture estimation of population size. **Figure 1** identifies the locations of the Mt Emerald Wind Farm and associated grid locations in the regional landscape.

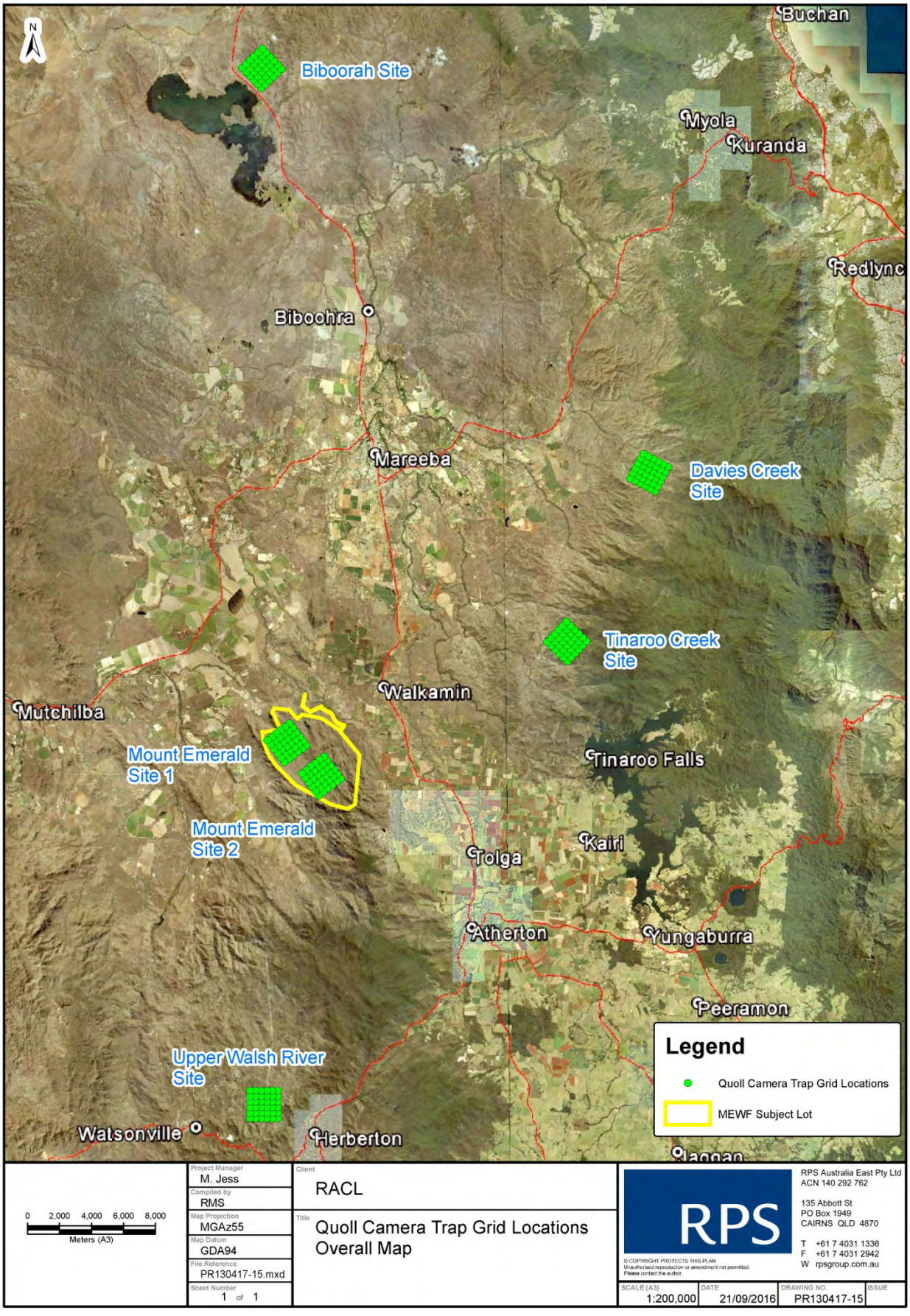

Figure 1 Quoll Camera Trap Grid Locations

2.0 Statement of Outcomes

The Condition 7 of the approval issued by the Department of the Environment under the EPBC Act for the Mount Emerald wind farm states “for the protection of the Northern Quoll, the approval holder must maintain a viable population of Northern Quoll on the wind farm site.”

The nature of the approval condition is in-line with the broader objectives of the National Recovery Plan for the Northern Quoll (Hill and Ward, 2010), particularly;

- Specific Objective 2 - Foster the recovery of Northern Quoll sub-populations in areas with cane toad;
- Specific Objective 5 - Maintain secure populations and source animals for future reintroductions / introductions, if they become appropriate

It is unknown what population size reflects a viable population, however the viability of the population can be inferred if changes in the size and distribution of the windfarm population remains within the range of values recorded at references sites outside of the project area. Therefore, the key outcomes for the work outlined in this strategy are to identify any statistically significant changes in;

(1) quoll population size between windfarm and reference sites between each monitoring occasion, and

(2) site occupancy by quolls on the windfarm site compared to the reference sites.

Such changes will be determined by statistical comparison of the proportional change in population size and/or site occupancy between the windfarm and reference sites during each triannual monitoring occasion during construction, during each biannual monitoring event in each of three years following the construction phase, and at a single monitoring event in each of 5 and 10 years following completion of construction.

Numerical size of each quoll population will be defined through mark-recapture modelling (White and Burnham 1999), or where insufficient captures and recaptures are reasonably achievable, through the minimum number known to be alive method (Krebs 1966). Site occupancy will be estimated using occupancy modelling (McKenzie et al 2003).

3.0 Milestones

(a) In the 12 months prior to construction, baseline data on quoll population size, site occupancy, population vital statistics and habitat condition is collected from two sampling sites on Mt Emerald and in four regional reference sites within a 50km radius of Mt Emerald.

(b) In the first 12 months of the project, two funded PhD studies commence; Study 1: The distribution and population ecology of the Northern Quoll; Study 2: Spatial ecology and habitat selection by the Northern Quoll.

(c) In each year of construction, triannual monitoring of quoll populations and their habitat at the project site and at least four reference sites will be monitored using the methods established at Milestone A.

(d) In each year for three years post construction, triannual monitoring of quoll populations and their habitat at the project site and at all reference sites (identified above) will be undertaken using the methods of Milestone A.

(e) In the fifth year post-construction, annual monitoring of quoll populations and their habitat will be undertaken at the project site and at the four regional sites using the methods of Milestone A.

(f) In the tenth year post construction, annual quoll population and habitat monitoring will be undertaken at the project site and the four regional sites using the methods of Milestone A.

4.0 Performance Criteria

The following Performance Criteria are proposed for assessing the relevant performance of the Northern Quoll Management and associated environmental management in regards to the Mount Emerald wind farm.

PC 1 During the preconstruction stage a monitoring program is established and baseline quoll population size, occupancy and population vital statistics and habitat data are collected for at least four regional reference sites and two Mt Emerald monitoring sites.

PC 2 During and for three years after the construction phase, any detected proportional decreases in the size of the quoll population, decreases in site occupancy, or changes in population vital statistics on the two Mt Emerald monitoring sites are not statistically significantly greater than at the four regional sites over the same period.

PC 3 In the 5th year after completion of construction, any detected proportional decreases in the size of the quoll population, decreases in site occupancy, or changes in population vital statistics on the two Mt Emerald monitoring sites are not statistically significantly greater than at the four regional sites over the same period.

PC 4 In the 10th year after completion of construction, any detected proportional decreases in the size of the quoll population, decreases in site occupancy, or changes in population vital statistics on the two Mt Emerald monitoring sites are not statistically significantly greater than at the four regional sites over the same period.

5.0 Monitoring

Monitoring of Northern Quolls and their habitats will occur on six permanent study grids (Error! Reference source not found.). Each study grid will consist of 36 equidistant quoll and habitat monitoring points arranged on a 6 x 6 grid, with points 350m-apart (total grid dimensions 1750m x 1750m = 306.25ha). This approach to quoll monitoring is based on the findings of Hemmings (2015) and Foster (in prep).

Quoll monitoring will utilise a single incandescent flash, Reconyx™ 550 Hyperfire trail camera (or equivalent) simultaneously at each of the 36 points of each monitoring grid. Deployment, timing and programming of cameras must be consistent between each monitoring grid and each time, to ensure comparability of monitoring data. Trail cameras will be mounted 1.5m above ground level on a 90° bracket fixed to a vertical tree trunk with hex-head timber screws resulting in a vertical orientation (i.e. pointing directly down onto the target area). The target area will consist of an approximately 75-cm-square area cleared of grass and other obstructions, in the centre of which (i.e. immediately below the camera) is a 10-cm-length of 50mm PVC pipe with a cap at one end and a mesh cowling at the other, containing as many chicken necks as will fit (usually between 3 and 5). The container is preferably spray-painted black to minimise the risk of over-exposed photos caused by the camera's flash on a white object, and pegged to the ground so it can't be removed by scavengers.

Each camera will be programmed to take three images per trigger event, at medium/high sensitivity with no delay between trigger, and deployed for a minimum 14 days, without refreshing/replacing the bait.

Monitoring of quoll habitat will utilise the method outlined in the Queensland BioCondition Reference Site and Assessment Guideline (Eyre *et al.* 2011; Eyre *et al.* 2015) and will occur at half of the camera trap points on each grid, each time that quoll monitoring is undertaken.

The grids will be located on Mt Emerald (2 monitoring grids within the impact area), and at four reference grids within known Northern Quoll populations within 45km of Mt Emerald and within the same general climatic zone and broad vegetation community (**Table 1**).

Table 1 Indicative location of each 1750 x 1750m monitoring grid used to monitor quoll populations, quoll occupancy, feral carnivore occupancy and habitat attributes

Site	Type	Indicative grid centre point
Mt Emerald 1	Impact site	-17.181362, 145.38741
Mt Emerald 2	Impact site	-17.157438, 145.366421
Davies Creek	Reference site	-17.009332, 145.583918
Tinaroo Creek	Reference site	-17.101861, 145.534146
Upper Walsh River	Reference site	-17.366243, 145.354304
Biboorah	Reference site	-16.778739, 145.357973

6.0 Adaptive Management

This section outlines the adaptive management strategies that will be implemented to ensure that outcomes based conditions can be met more effectively. The following approach will be followed:

- General mitigation measures including management actions, significant species management plans and threatened species inductions developed for clearing, construction and operation of the MEWF;
- Northern Quoll Management Plan and Habitat Clearing and Management Plan for protection of fauna species during MEWF Activities;
- Pest Management Plan and Weed Management Plan;
- A Bushfire Management Plan promoting a regime of mosaic burns;
- Collection of Northern Quoll monitoring data which will be systematically evaluated and compared to baseline and reference site data on a regular basis (triannually up to 5 years) in a process of adaptive management to verify whether there are any responses to the immediate and long-term impact of construction;
- A regular review of external factors.

Table 2 below provides Adaptive Management Actions that will be implemented when key performance targets are not being met.

Table 2 Adaptive Management Actions

Number	KPI	Monitoring	Trigger for Adaptive Management	Management Actions	Reporting
1	During the preconstruction stage a monitoring program is established and baseline quoll population size, occupancy and population vital statistics and habitat data are collected for at least four regional reference sites and two Mt Emerald monitoring sites.	Monitor quoll populations (using trail cameras and using mark recapture modelling methods) and site occupancy (using occupancy modelling), and quoll habitat condition (using Bio-condition Index) at two sites at Mt Emerald, and at least four regional reference sites (Tinaroo Creek, Davies Creek, upper Walsh River, and Biboorah).	One round of monitoring not completed prior to construction.	Prioritise monitoring so that all monitoring on Mt Emerald is completed prior to any construction (roads, wind turbines or other infrastructure). Monitoring at regional reference sites can happen immediately after Mt Emerald monitoring is completed.	▪ Monitoring Report; ▪ Database of Northern Quoll detections created; ▪ Quoll locations resulting from monitoring recorded in GIS database.
2	During and for three years after the construction phase, any detected proportional decreases in the size of the quoll population, decreases in site occupancy, or changes in population vital statistics on the two Mt Emerald monitoring sites are not statistically significantly greater than at the four regional sites over the same period.	Triannually monitor quoll populations (using trail cameras and using mark recapture modelling methods) and site occupancy (using occupancy modelling), and quoll habitat condition (using Biocondition Index), at two sites at Mt Emerald, and at least four regional reference sites (Tinaroo Creek, Davies Creek, upper Walsh River, and Biboorah).	At any of the Mt Emerald monitoring sites, monitoring indicates that the quoll population has undergone a proportionally greater decrease in population size than the mean proportional population decrease on the four regional reference sites, over the same time interval. At any of the Mt Emerald monitoring sites, monitoring indicates that the quoll population has undergone a greater decrease in site occupancy than on the four regional reference sites, over the same time interval. Northern Quoll not detected on the Mt Emerald sites.	Repeat monitoring at all sites immediately, to rule out sampling errors. If after repeating the monitoring (above) adaptive management is still triggered, review the habitat monitoring data to attempt to identify a possible cause. Modify predator control and establish additional effective controls in consultation with DotE Where impacts to breeding are suspected or observed, implement management strategies including revised night time construction hours, directional lighting and use of low noise machinery in affected areas to minimise further disturbance. Review fauna corridor areas – set up trapping lines to determine impacts, observe edge effects and determine factors for decline. Review Bushfire management strategies to improve habitat condition where required to prevent premature	▪ Monitoring Report ▪ Identify relevant corrective actions with 28 days of monitoring event and notify DotE. ▪ Database of Northern Quoll detections created ▪ Quoll locations resulting from monitoring recorded in GIS database ▪ Input into Annual Environmental reports each year. ▪ Update website each year

Number	KPI	Monitoring	Trigger for Adaptive Management	Management Actions	Reporting
				burn for example. Where insufficient habitat considers decreasing fire intervals to increase areas of variable fuel load to prevent wild fire and maintain a mosaic distribution. Refer to MEWF Bushfire Management Plan for further advice. Reduce and enforce speed limits in the vicinity of Quoll habitat through the implementation of signage, traffic calming devices and penalties. Consult with DotE and DEHP and update Outcomes Strategy where required. Assess the potential cause of reduction in habitat and Implement quarantine protocols, as detailed in the Northern Quoll Recovery Plan (2007) to prevent the spread of weed species into the MEWF project area (refer to MEWF Weed Management Plan. Notify DotE. Review revegetation works around culverts, dry access areas and revegetation areas (for fauna underpass areas), and identify cause for slow regeneration. Reinstate replace landscaping plants if suitable, or substitute with recommended species. Refer MEWF Revegetation Plan.	

Number	KPI	Monitoring	Trigger for Adaptive Management	Management Actions	Reporting
3	In the 5th year after completion of construction, any detected proportional decreases in the size of the quoll population, decreases in site occupancy, or changes in population vital statistics on the two Mt Emerald monitoring sites are not statistically significantly greater than at the four regional sites over the same period.	Biannually monitor quoll populations (using trail cameras and using mark recapture modelling methods) and site occupancy (using occupancy modelling), and quoll habitat condition (using Biocondition Index) at two sites at Mt Emerald, and at least four regional reference sites (Tinaroo Creek, Davies Creek, upper Walsh River, and Biboorah).	At any of the Mt Emerald monitoring sites, monitoring indicates that the quoll population has undergone a proportionally greater decrease in population size than the mean proportional population decrease on the four regional reference sites, over the same time interval. At any of the Mt Emerald monitoring sites, monitoring indicates that the quoll population has undergone a greater decrease in site occupancy than on the four regional reference sites, over the same time interval. Northern Quoll not detected on the Mt Emerald sites.	Repeat monitoring at all sites immediately, to rule out sampling errors. If after repeating the monitoring (above) adaptive management is still triggered, review the habitat monitoring data to attempt to identify a possible cause. Review fauna corridor areas – set up trapping lines to determine impacts, observe edge effects and determine factors for decline. Review Bushfire management strategies to improve habitat condition where required to prevent premature burn for example. Where insufficient habitat considers decreasing fire intervals to increase areas of variable fuel load to prevent wild fire and maintain a mosaic distribution. Refer to MEWF Bushfire Management Plan for further advice. Reduce and enforce speed limits in the vicinity of Quoll habitat through the implementation of signage and penalties. Consult with DotE and DEHP and update Outcomes Strategy where required. Assess the potential cause of reduction in habitat and identify relevant corrective actions with 28 days of monitoring event. Implement quarantine protocols, as detailed in the Northern Quoll Recovery Plan (2007) to prevent the spread of weed species into the MEWF project area (refer to MEWF Weed Management Plan. Notify DotE.	Identify relevant corrective actions with 28 days of monitoring event and notify DotE.Data base of Northern Quoll Encounters Locations and habitat recorded in GIS data base Biannual Monitoring report Website Update

Number	KPI	Monitoring	Trigger for Adaptive Management	Management Actions	Reporting
4	In the 10th year after completion of construction, any detected proportional decreases in the size of the quoll population, decreases in site occupancy, or changes in population vital statistics on the two Mt Emerald monitoring sites are not statistically significantly greater than at the four regional sites over the same period.	Biannually monitor quoll populations (using trail cameras and using mark recapture modelling methods) and site occupancy (using occupancy modelling), and quoll habitat condition (using Biocondition Index) at two sites at Mt Emerald, and at least four regional reference sites (Tinaroo Creek, Davies Creek, upper Walsh River, and Biboorah).	Trap success (i.e. capture rate) and estimated population X % of baseline data collected on Burnett et al (2013). Northern Quoll only recorded in regional sites. No signs of breeding (pouch young or sub adult). No evidence of individuals moving between sub populations. Northern Quoll struck by road vehicle. Evidence of increase in predation from exotic predators	Repeat monitoring at all sites immediately, to rule out sampling errors. If after repeating the monitoring (above) adaptive management is still triggered, review the habitat monitoring data to attempt to identify a possible cause. Review fauna corridor areas – set up trapping lines to determine impacts, observe edge effects and determine factors for decline. Review Bushfire Management Strategies to improve habitat condition if required. Reduce and enforce speed limits in the vicinity of Quoll habitat through the implementation of further signage and penalties. Consult with DotE and DEHP and update Outcomes Strategy where required.	Identify relevant corrective actions with 28 days of monitoring event and notify DotE. Monitoring Reports Data base of Northern Quoll Encounters Locations and habitat recorded in GIS data base Biannual Environmental report Website update

7.0 Record keeping

The approval holder will provide a summary of findings arising from the monitoring data, and any corrective actions implemented annually to DotE.

The approval holder will establish a dedicated webpage that is publicly available for the lifetime of the project. The webpage must include a copy of the raw monitoring data and a descriptive of any corrective action undertaken.

All wildlife spatial data collected during monitoring will be provided to the Queensland Government Wildlife Online database and to the Commonwealth Atlas of Living Australia.

Data arising from research funded by the approval holder will be published in peer reviewed journals during the lifetime of the project.

8.0 References

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Oakwood, M. 2008. Northern Quoll *Dasyurus hallucatus* in Van Dyck, S. and Strahan, R. (eds). The mammals of Australia. New Holland Publishers, Sydney.

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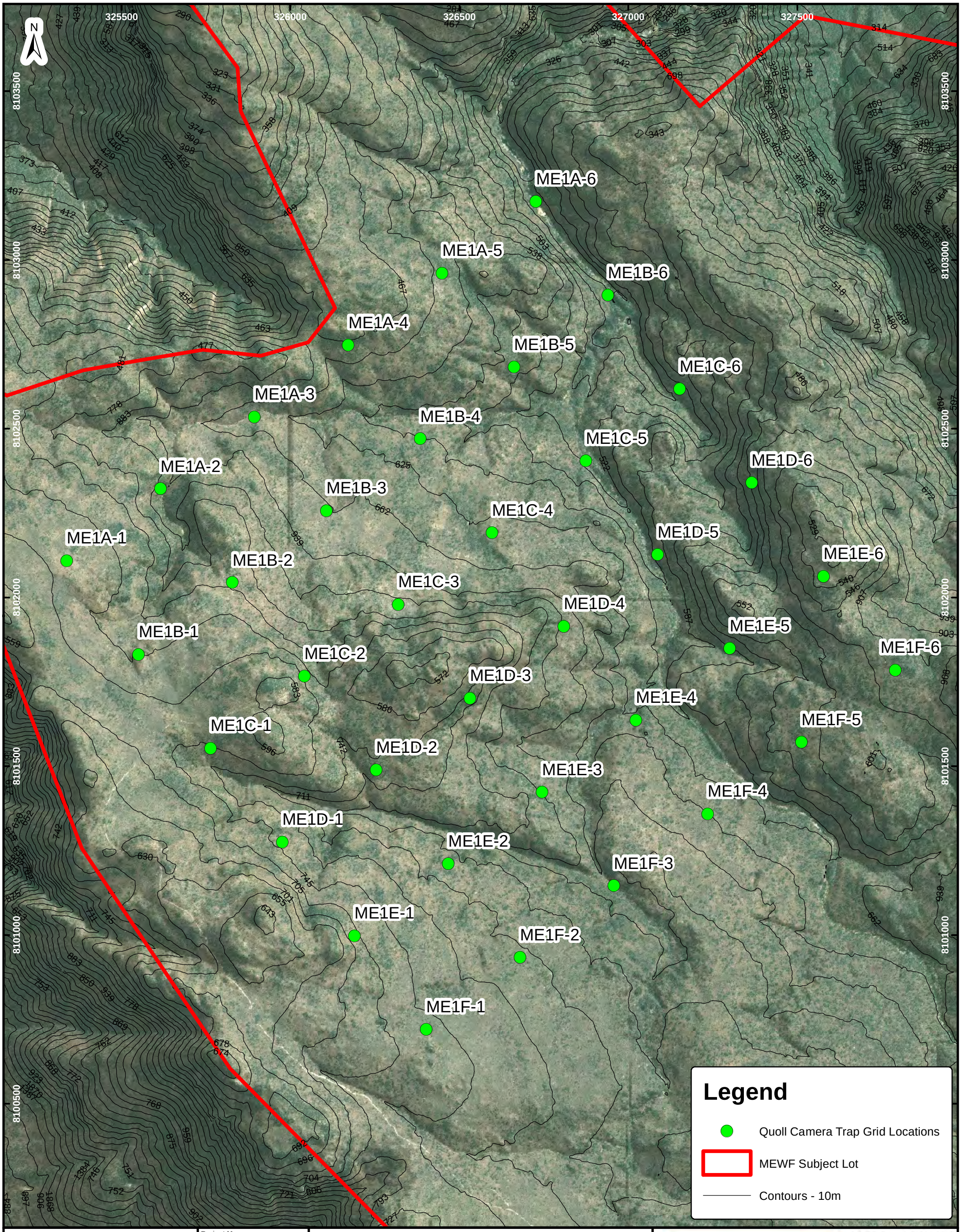
Van Dyck, S. and Strahan, R. 2008. The mammals of Australia. New Holland Publishers, Sydney.

White G.C &Burnham, K. P. 1999 *Program MARK: survival estimation from populations of marked animals.* Bird Study, 46:sup1, S120-S139, DOI: 10.1080/00063659909477239 To link to this article: http://dx.doi.org/10.1080/00063659909477239

Woinarski1 J.C.Z., Oakwood M., Winter J., Burnett S., Milne D., Foster P., Myles H. and Holmes B. (2008) Surviving the toads: patterns of persistence of the Northern Quoll *Dasyurus hallucatus* in Queensland. Report submitted to the Natural Heritage Trust Strategic Reserve Program.

Appendix 1

Quoll Camera Trap Grid Locations



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Map Datum	GDA94
File Reference	PR130417-16.mxd
Sheet Number	1 of 1

Client: Ratch Australia

Title: Quoll Camera Trap Grid Locations
Mount Emerald Site 1

RPS Australia East Pty Ltd
ACN 140 292 762

135 Abbott St
PO Box 1949
CAIRNS QLD 4870

T +61 7 4031 1336
F +61 7 4031 2942
W rpsgroup.com.au

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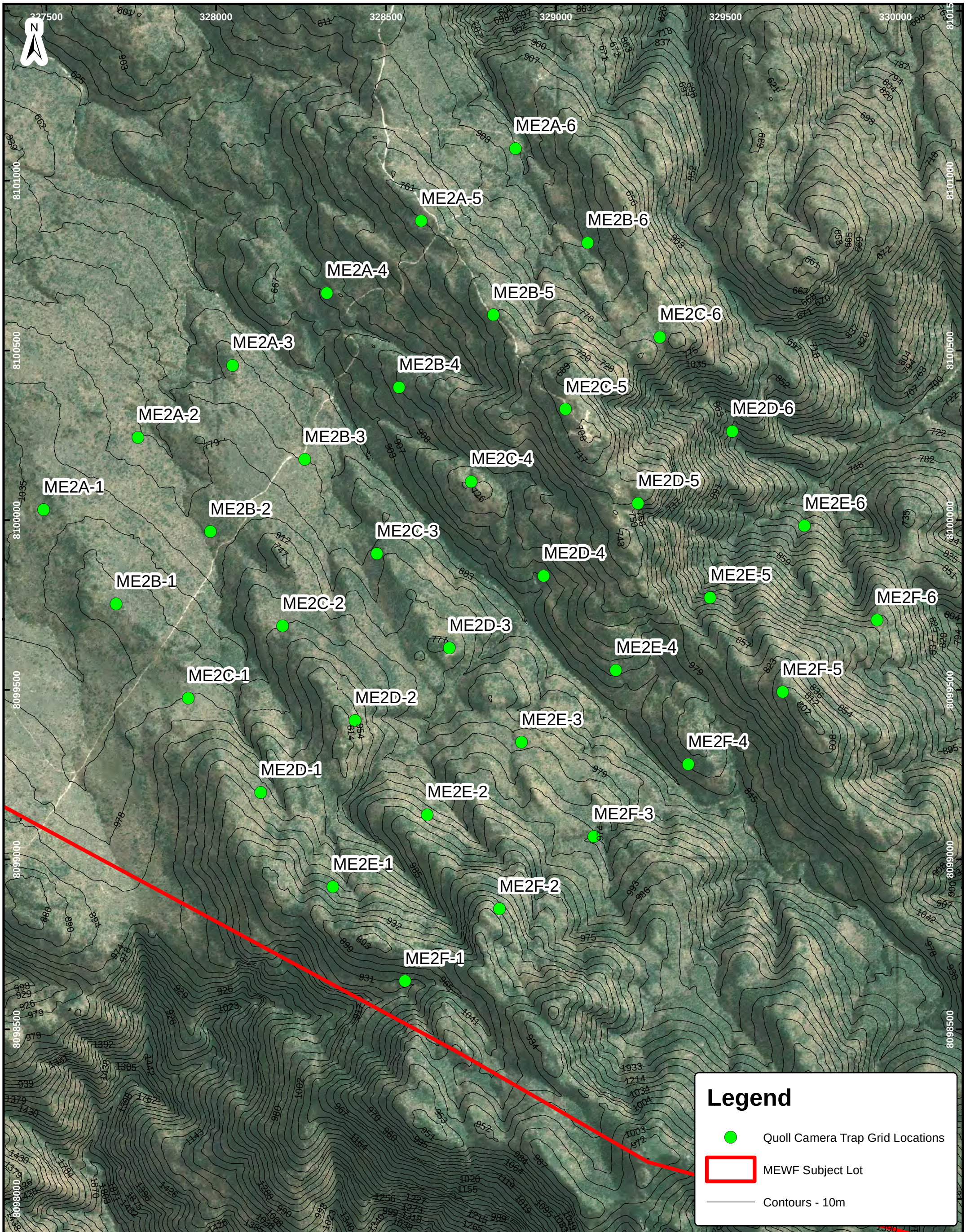

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Client: Ratch Australia

Title: Quoll Camera Trap Grid Locations
Mount Emerald Site 2

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135 Abbott St
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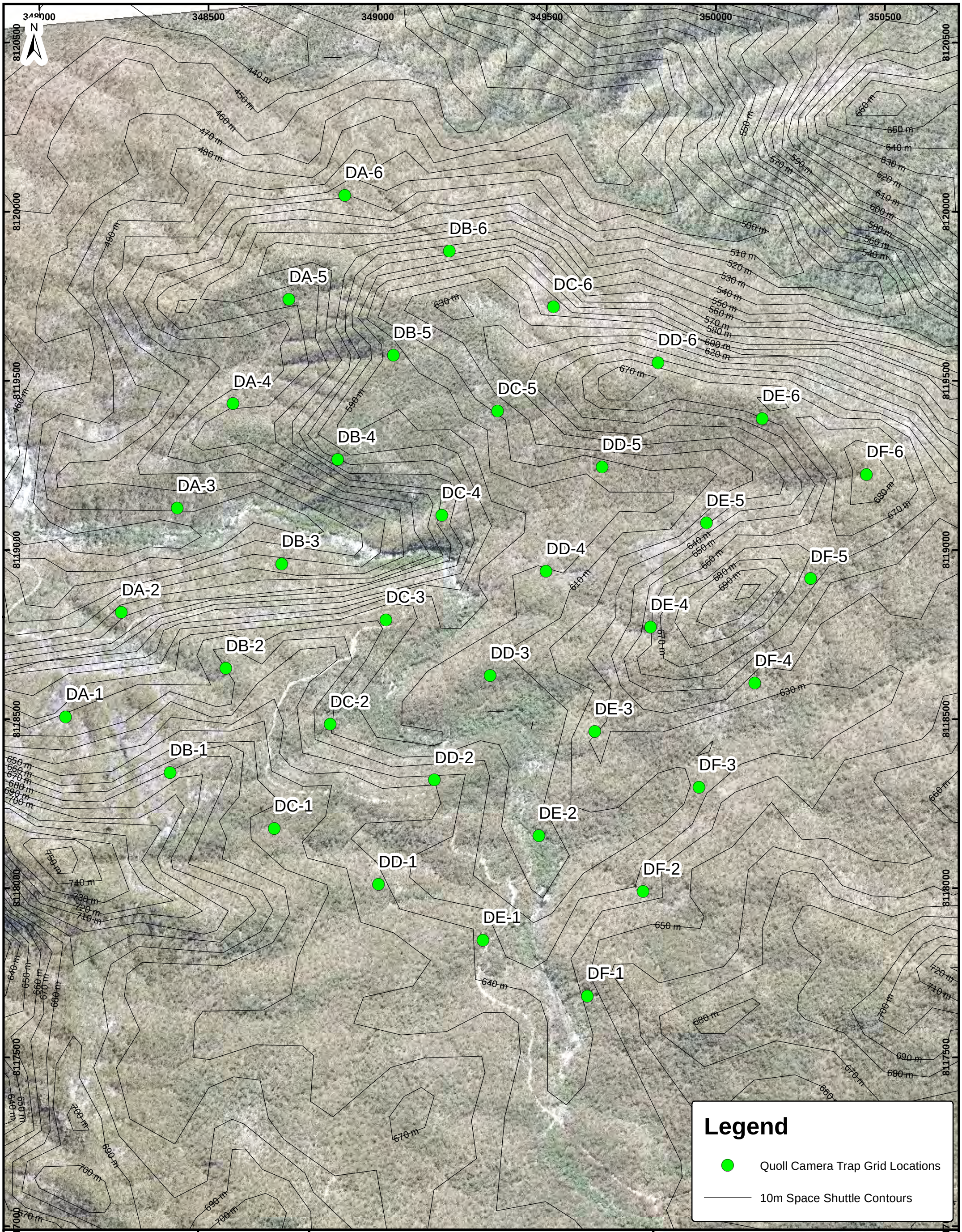

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Client

Ratch Australia

Title

Quoll Camera Trap Grid Locations
Davies Creek Site

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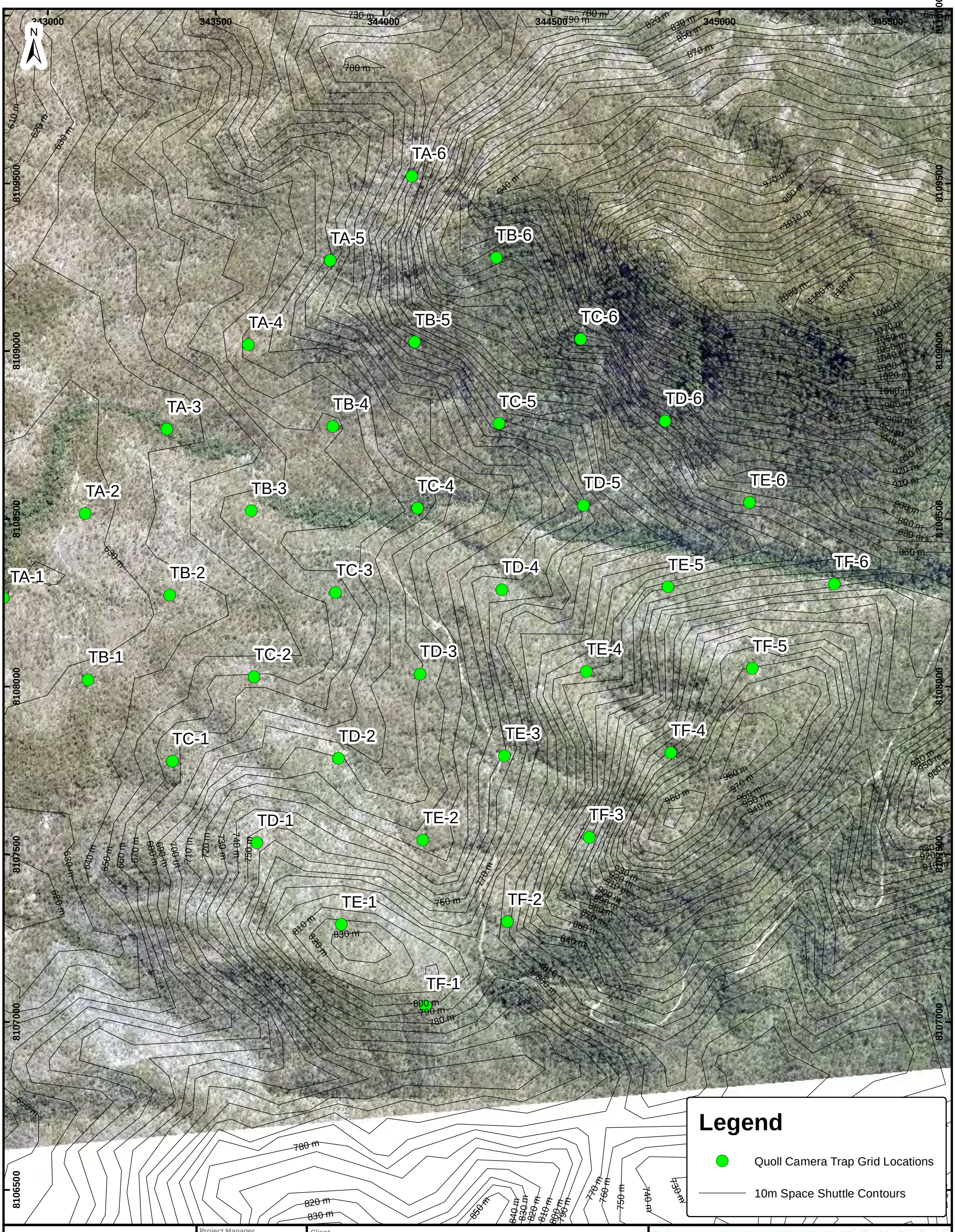

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Sheet Number	1 of 1

Client

Ratch Australia

Title

Quoll Camera Trap Grid Locations
Tinaroo Creek Site

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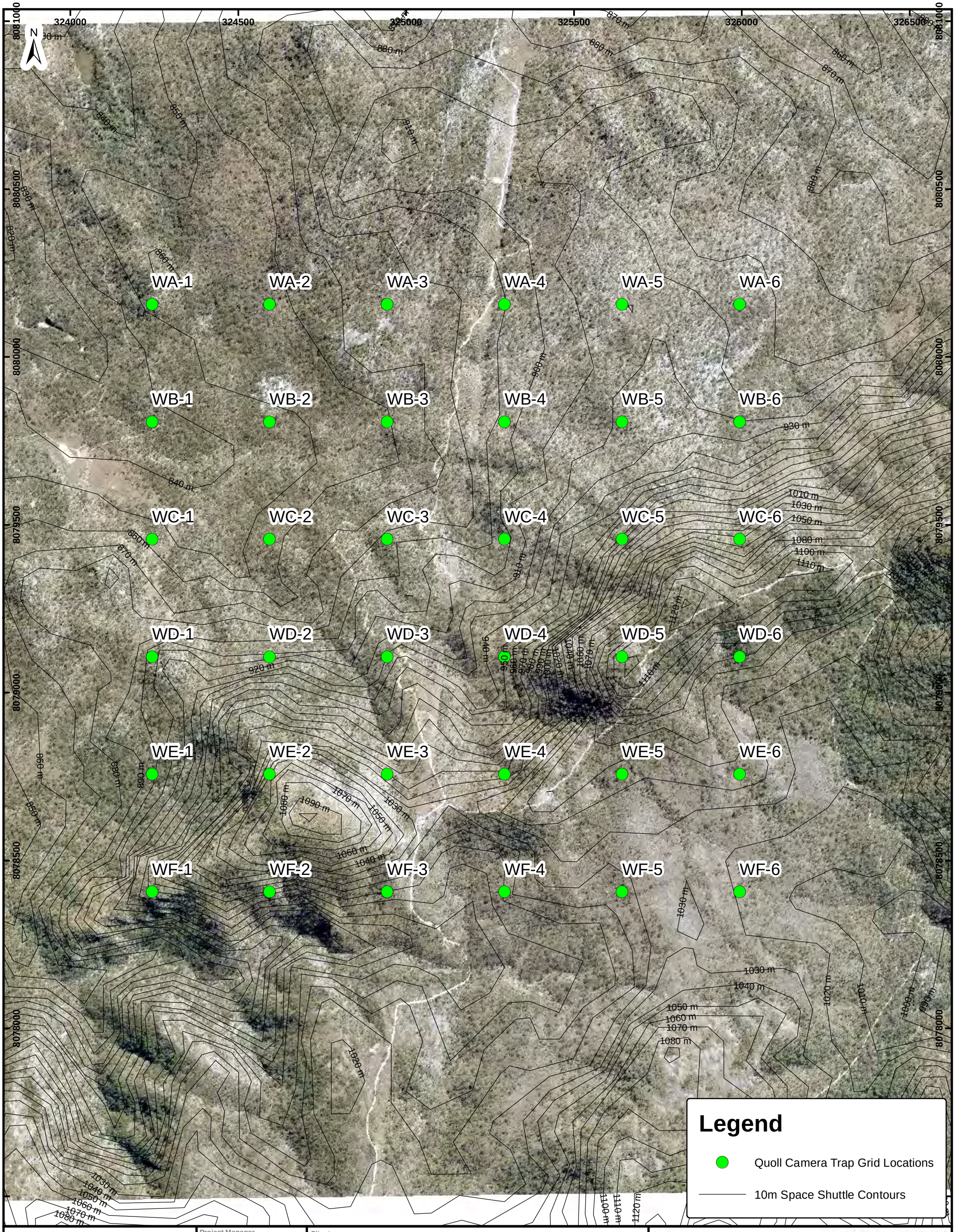

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Sheet Number	1 of 1

Client: Ratch Australia

Title: Quoll Camera Trap Grid Locations
Upper Walsh River Site

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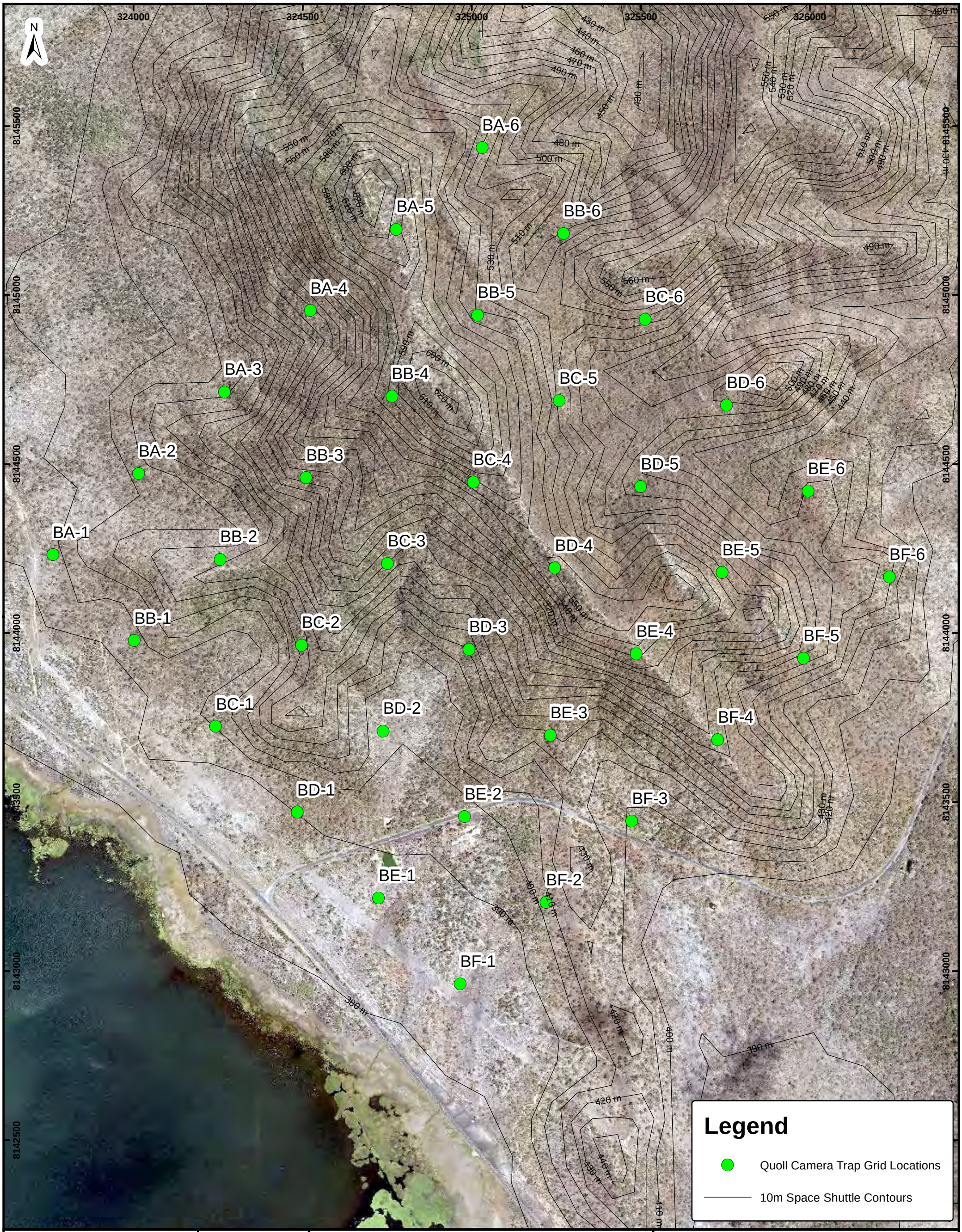

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Map Datum	GDA94
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Sheet Number	1 of 1

Client: Ratch Australia

Title: Quoll Camera Trap Grid Locations
Biboorah Site

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