



Mount Emerald Wind Farm



Northern Quoll Outcomes Strategy

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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; and
- 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- (6) Carnarvon Range (Burnett unpublished data).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.

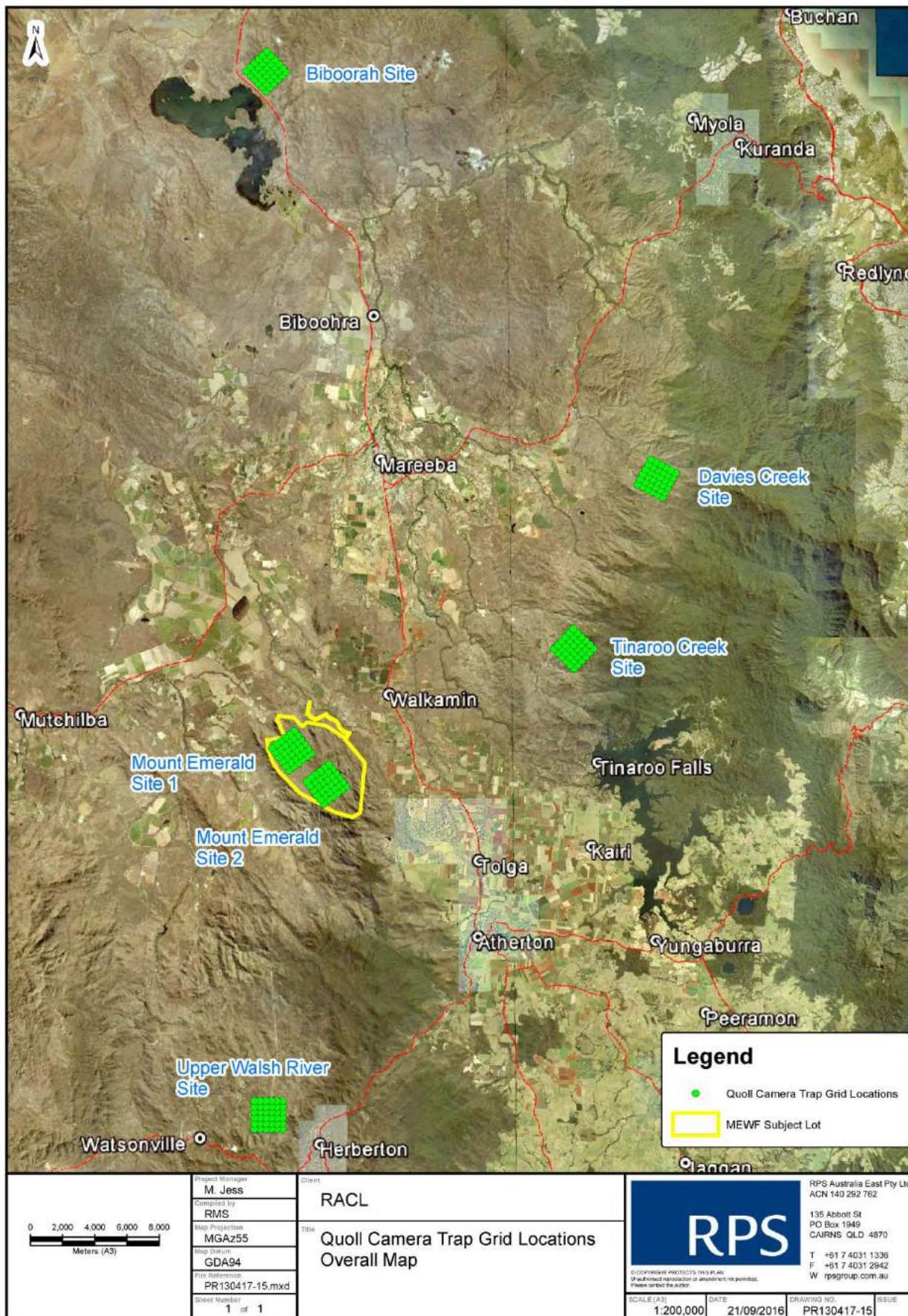


Figure 1 Quoll Camera Trap Grid Locations

1.2 Regulatory Requirements

This Northern Quoll Outcomes Strategy has been prepared to address Decision Notice Conditions (26 November 2015) for the approval EPBC 2011/6228 as issued by the federal Department of Environment and Energy

Conditions relevant to the preparation and implementation of the Northern Quoll Outcomes Strategy are detailed in **Table 1** below.

Table 1 Conditions of EPBC Referral Approval

EPBC Condition	Location in Report
7. For the protection of the Northern Quoll, the approval holder must maintain a viable population of Northern Quoll on the wind farm site.	Section 2
8. 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: <ul style="list-style-type: none"> 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. 	Appendix A Section 2 and Section 4 Section 1 and Section 3 Section 6

2.0 Statement of Outcomes

The Condition 7 of the approval issued by the Department of Environment and Energy 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; and
- 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 reference 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).

2.1 Spatially Explicit Mark -Recapture Program (SECR)

Like other statistical methods for estimating animal abundance, SECR combines a state model and an observation model to generate animal density estimates with confidence intervals. These density models are then applied to a model generated habitat mask or buffer, to provide a population size estimate. The state model describes the distribution of animal home ranges in the landscape, and the observation model (a spatial detection model) relates the probability of detecting an individual at a particular detector to the distance of the detector from a central point in each animal's home range. The distances are not observed directly (usually range centres are unknown), so conventional distance sampling methods do not apply. The distribution of range centres in the population (the state model) will usually be treated as a homogeneous Poisson point process. Density (= intensity) is the sole parameter of a homogeneous Poisson process. An inhomogeneous Poisson distribution may also be fitted; this provides a means to evaluate the effects of habitat variables on density. (Efford, 2016)

The probability of detecting an individual (the observation model) is modelled by either the half normal detection function defined by $g(d) = g_0 \exp(-d^2 / 2\sigma^2)$ or the exponential detection function by $g(d) = g_0 \exp(-d / \sigma)$.

The model of best fit will be determined (and therefore the most likely correct population estimate) during the analyses by exploring consequences of modelled time trends, learned responses, transient responses, differences between monitoring sessions and interactions of the above. Models are fitted by numerically

maximizing the likelihood. The likelihood involves integration over the unknown locations of the animals' range centres. This is achieved in practice by summation over points in the habitat mask. The default maximization algorithm is Newton-Raphson. By default, all reported variances, covariance's, standard errors and confidence limits are asymptotic and based on a numerical estimate of the information matrix.

It isn't possible to state at the outset which parameters and variables, nor model settings will be used to derive the optimum model. These can only be determined by trial and error during the modelling process.

Should data generated from the monitoring plots be insufficient for SECR modelling (i.e. insufficient spatial recaptures) and Mark-Recapture modelling, which again uses an iterative modelling procedure to arrive at population estimates. A single-season closed population model will be used in this instance. Initial inspection of the data suggests that SECR will be suitable. (Efford, 2016)

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 (**Appendix B**). 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 2**).

Table 2 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 (**Appendix C**) and Habitat Clearing (**Appendix D**) and Management Plan for protection of fauna species during MEWF Activities;
- Pest Management Plan (**Appendix E**) and Weed Management Plan (**Appendix F**);
- A Bushfire Management Plan and Emergency Evacuation Plan (**Appendix G**) 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; and
- A regular review of external factors.

Table 3 below provides Adaptive Management Actions that will be implemented when key performance targets are not being met.

Table 3 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.	<ul style="list-style-type: none"> 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).	<p>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.</p> <p>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.</p> <p>Northern Quoll not detected on the Mt Emerald sites.</p>	<p>Repeat monitoring at all sites immediately, to rule out sampling errors.</p> <p>If after repeating the monitoring (above) adaptive management is still triggered, review the habitat monitoring data to attempt to identify a possible cause.</p> <p>Modify predator control and establish additional effective controls in consultation with DEE</p> <p>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.</p> <p>Review fauna corridor areas –</p>	<ul style="list-style-type: none"> Monitoring Report Identify relevant corrective actions with 28 days of monitoring event and notify DEE. 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
				<p>set up trapping lines to determine impacts, observe edge effects and determine factors for decline.</p> <p>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.</p> <p>Reduce and enforce speed limits in the vicinity of Quoll habitat through the implementation of signage, traffic calming devices and penalties.</p> <p>Consult with DEE and DEHP and update Outcomes Strategy where required.</p> <p>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 DEE.</p> <p>Review revegetation works around culverts, dry access areas and revegetation areas (for fauna underpass areas),</p>	

Number	KPI	Monitoring	Trigger for Adaptive Management	Management Actions	Reporting
				and identify cause for slow regeneration. Reinstate replace landscaping plants if suitable, or substitute with recommended species. Refer MEWF Revegetation Plan.	
3	In the 5 th 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).	<p>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.</p> <p>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.</p> <p>Northern Quoll not detected on the Mt Emerald sites.</p>	<p>Repeat monitoring at all sites immediately, to rule out sampling errors.</p> <p>If after repeating the monitoring (above) adaptive management is still triggered, review the habitat monitoring data to attempt to identify a possible cause.</p> <p>Review fauna corridor areas – set up trapping lines to determine impacts, observe edge effects and determine factors for decline.</p> <p>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.</p> <p>Reduce and enforce speed limits in the vicinity of Quoll habitat through the implementation of signage and penalties.</p> <p>Consult with DEE and DEHP and update Outcomes Strategy</p>	<p>Identify relevant corrective actions with 28 days of monitoring event and notify DEE. Data base of Northern Quoll Encounters Locations and habitat recorded in GIS data base</p> <p>Biannual Monitoring report</p> <p>Website Update</p>

Number	KPI	Monitoring	Trigger for Adaptive Management	Management Actions	Reporting
				<p>where required.</p> <p>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 DEE.</p>	
4	In the 10 th 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).	<p>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.</p> <p>No signs of breeding (pouch young or sub adult).</p> <p>No evidence of individuals moving between sub populations.</p> <p>Northern Quoll struck by road vehicle.</p> <p>Evidence of increase in predation from exotic predators</p>	<p>Repeat monitoring at all sites immediately, to rule out sampling errors.</p> <p>If after repeating the monitoring (above) adaptive management is still triggered, review the habitat monitoring data to attempt to identify a possible cause.</p> <p>Review fauna corridor areas – set up trapping lines to determine impacts, observe edge effects and determine factors for decline.</p> <p>Review Bushfire Management Strategies to improve habitat condition if required.</p> <p>Reduce and enforce speed limits in the vicinity of Quoll habitat through the implementation of further signage and penalties.</p> <p>Consult with DEE and DEHP and update Outcomes Strategy where required.</p>	<p>Identify relevant corrective actions with 28 days of monitoring event and notify DEE.</p> <p>Monitoring Reports</p> <p>Data base of Northern Quoll Encounters</p> <p>Locations and habitat recorded in GIS data base</p> <p>Biannual Environmental report</p> <p>Website update</p>

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 DEE.

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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Appendix A

CV – Scott Burnett Nov 2016

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1988	<u>BSc</u> : Zoology.	James Cook University.
1989	<u>BSc. (Hons) 1st Class</u> : Mammal ecology.	James Cook University.
2001	<u>PhD</u> : Ecology and conservation status of Spotted tailed Quoll, <i>Dasyurus maculatus</i> .	James Cook University.

Professional Experience:

<i>Date</i>	<i>Role and duties</i>	<i>Employer</i>
Jan 2008 - present	Lecturer. Lecture in ecology and conservation. Supervision of Honours and post-graduate student projects.	University of the Sunshine Coast
Jun 05 – Dec 07	Wildlife Projects Manager. Managed the Quoll Seekers Network, PlatypusWatch and Gliders in the Spotlight community science programs. Included grant writing, implementation of programs, development of promotional materials, coordination of events and public speaking and research.	Wildlife Preservation Society of Queensland
Jan 01 to Jan 05	Project Officer. Distribution mapping and monitoring endangered fauna including Northern Bettong, Yellow-bellied glider, Cassowary	Threatened species unit, QPWS.
Jan to Dec 03.	Project officer. Owl project, promoting project and delivering milestones – increased awareness, owl boxes out on farms, spotlighting tours	Barron River Integrated Catchment Management Association.
Nov 1990 to present	Fauna Consultant. Working on various general and species specific vertebrate fauna inventory and impact mitigation projects throughout Qld. Projects include focal surveys for amphibians, reptiles, birds and mammals, and general vertebrate fauna inventory.	Private sector, Local, State and Commonwealth Govt.

Other Qualifications:

Drivers Licence: Class C.

Computers: MS DOS, Windows and Mac OS software including word processing, spreadsheets and graphics packages, ArcGIS.

Queensland Ambulance Service First Aid Certificate.

Advanced 4WD techniques certificate

4WD Sand driving certificate

Memberships:

<i>Date</i>	<i>Organisation</i>
2009 to now	Bird Conservation Nepal
90 to now	Royal Zoological Society of New South Wales.
86 to now	Australian Mammal Society.

Refereed Publications:

<i>Date</i>	<i>Title</i>
2014	M. Jones, S. Burnett, A. Claridge, B. Fancourt, G. Körtner, K. Morris, D. Peacock, S. Troy and J. Woinarski. Australia's surviving marsupial carnivores: threats and conservation, Ch 9 in Carnivores of Australia, CSIRO Publishing
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2004	Burnett, S. and Marsh, H. Conservation of the Spotted-tailed Quoll <i>Dasyurus maculatus</i> ; a conceptual model with particular reference to populations of the endangered <i>D. m. gracilis</i> . In D. Lunney (ed) <i>Conservation of Australia's forest fauna II</i> .

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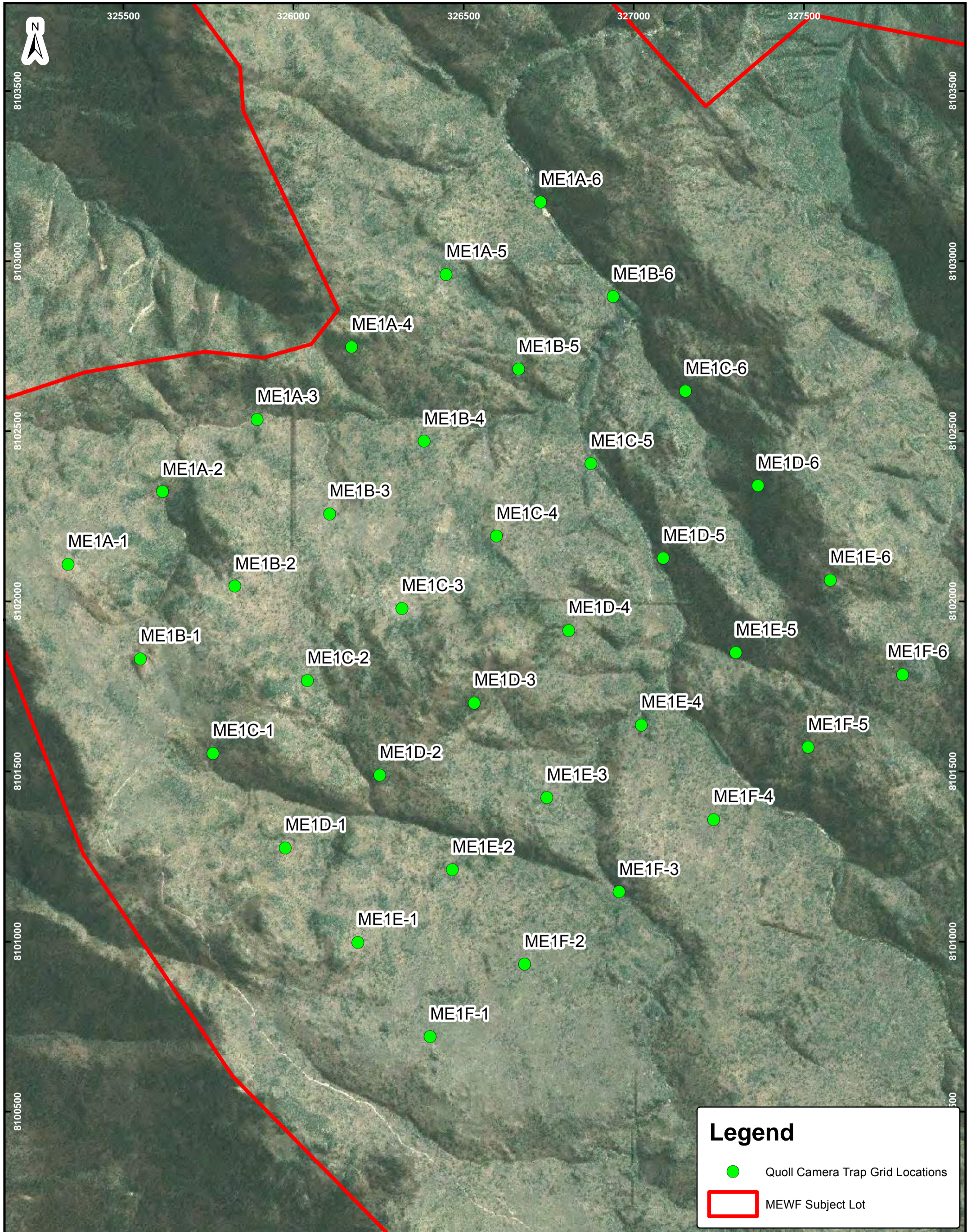
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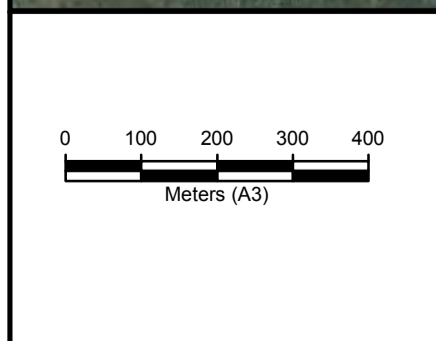
Appendix B

Quoll Camera Trap Grid Locations



Legend

- Quoll Camera Trap Grid Locations
- MEWF Subject Lot



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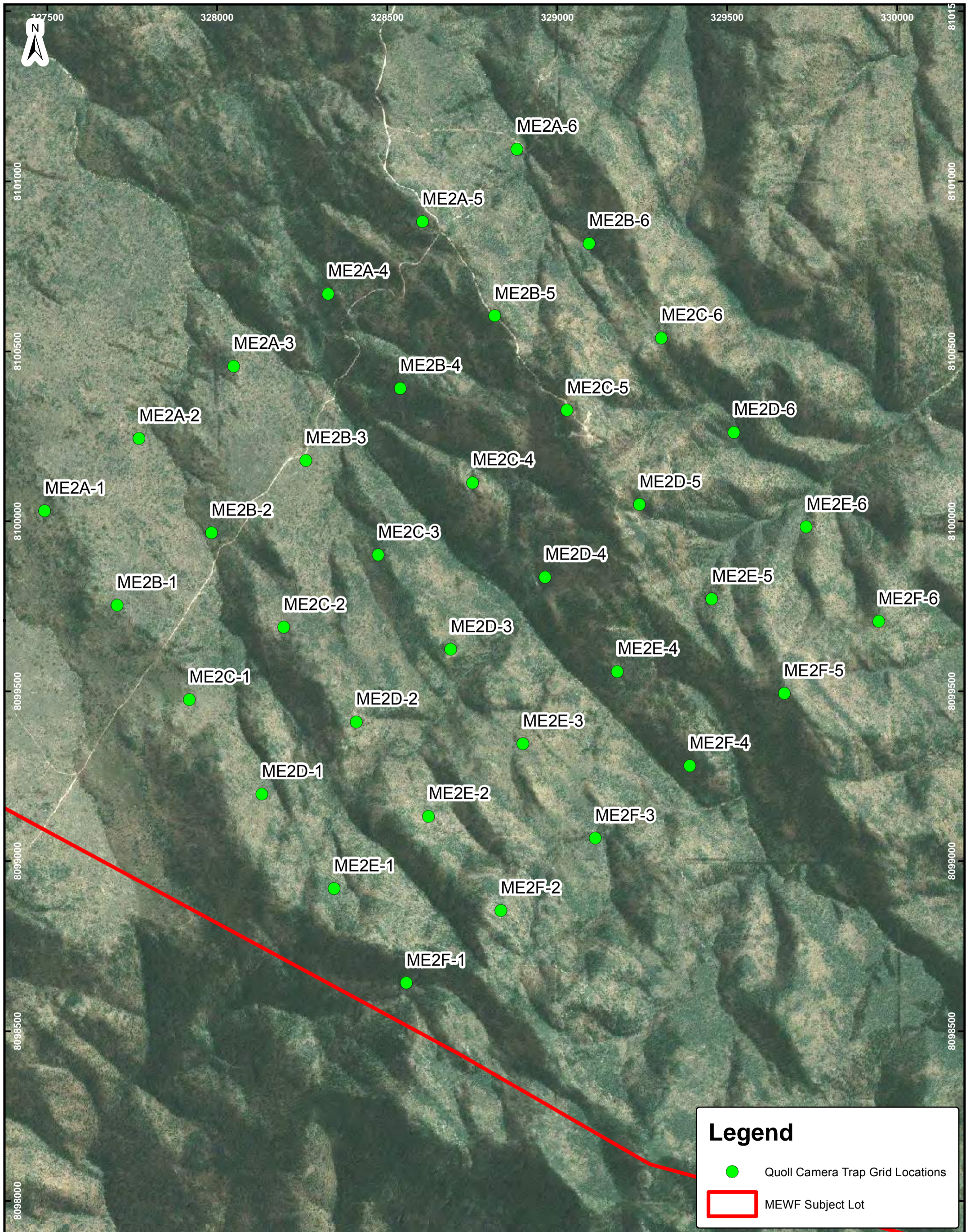
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Legend

- Quoll Camera Trap Grid Locations
- MEWF Subject Lot

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Meters (A3)

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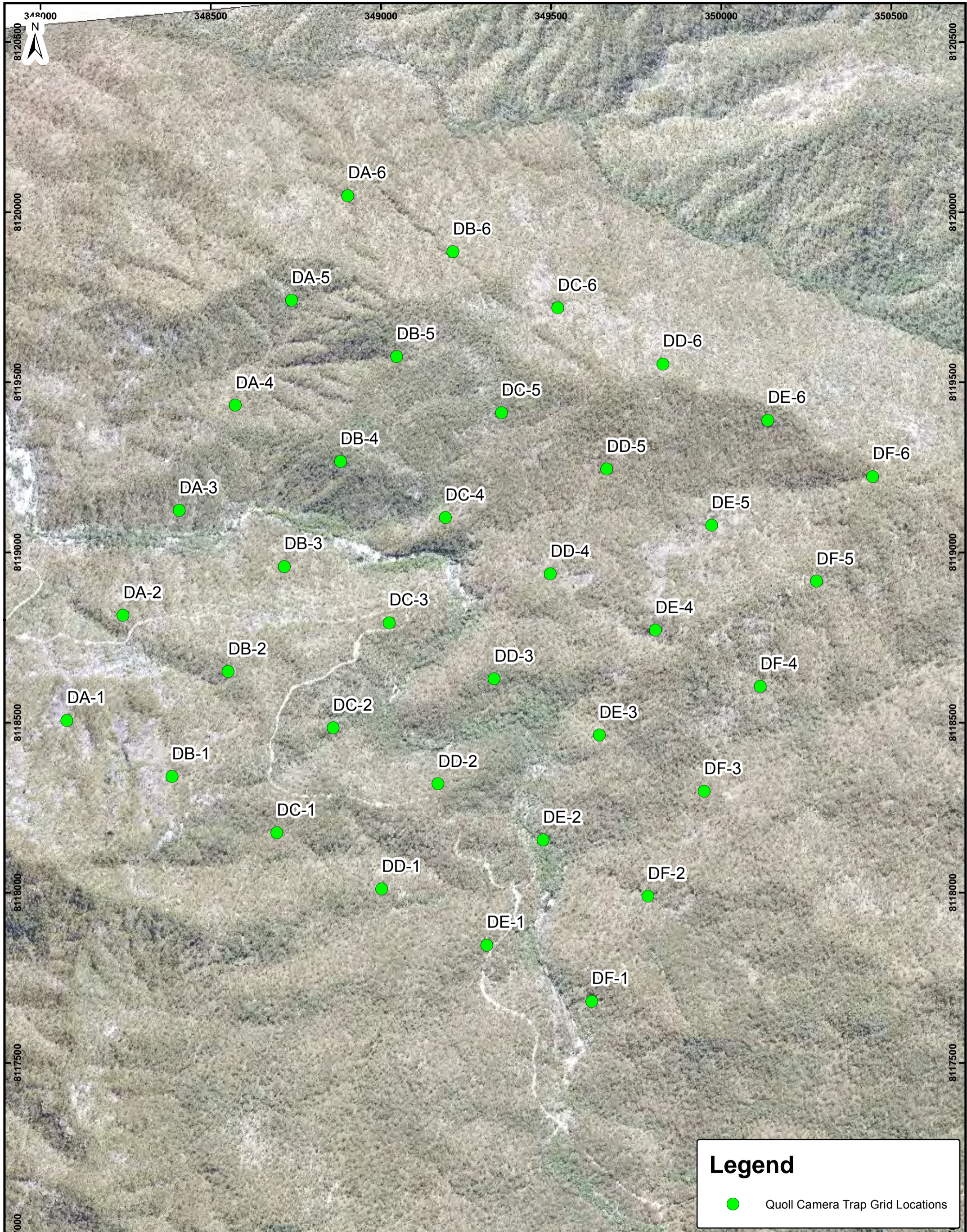
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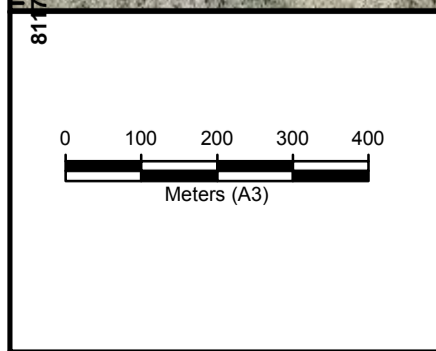
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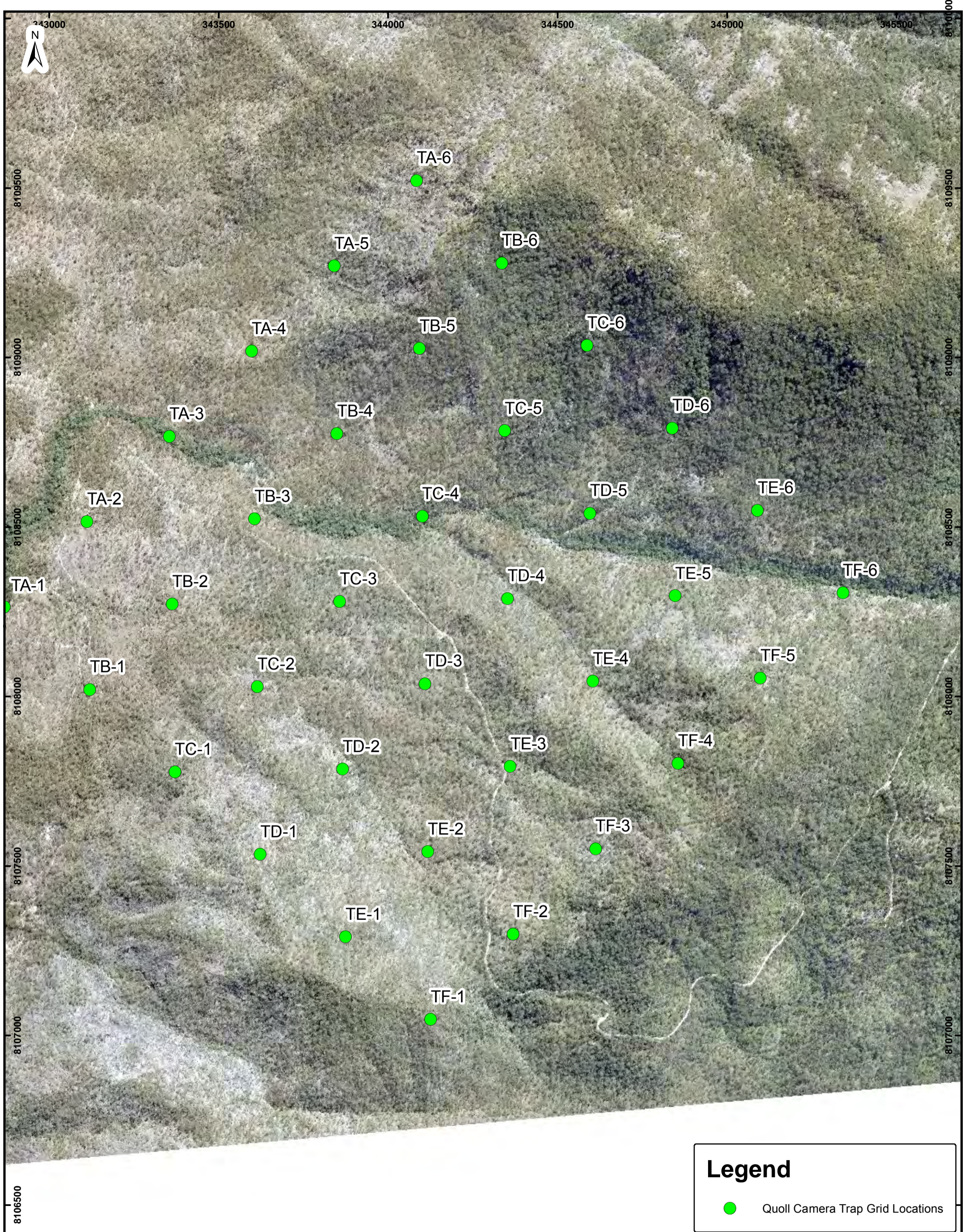
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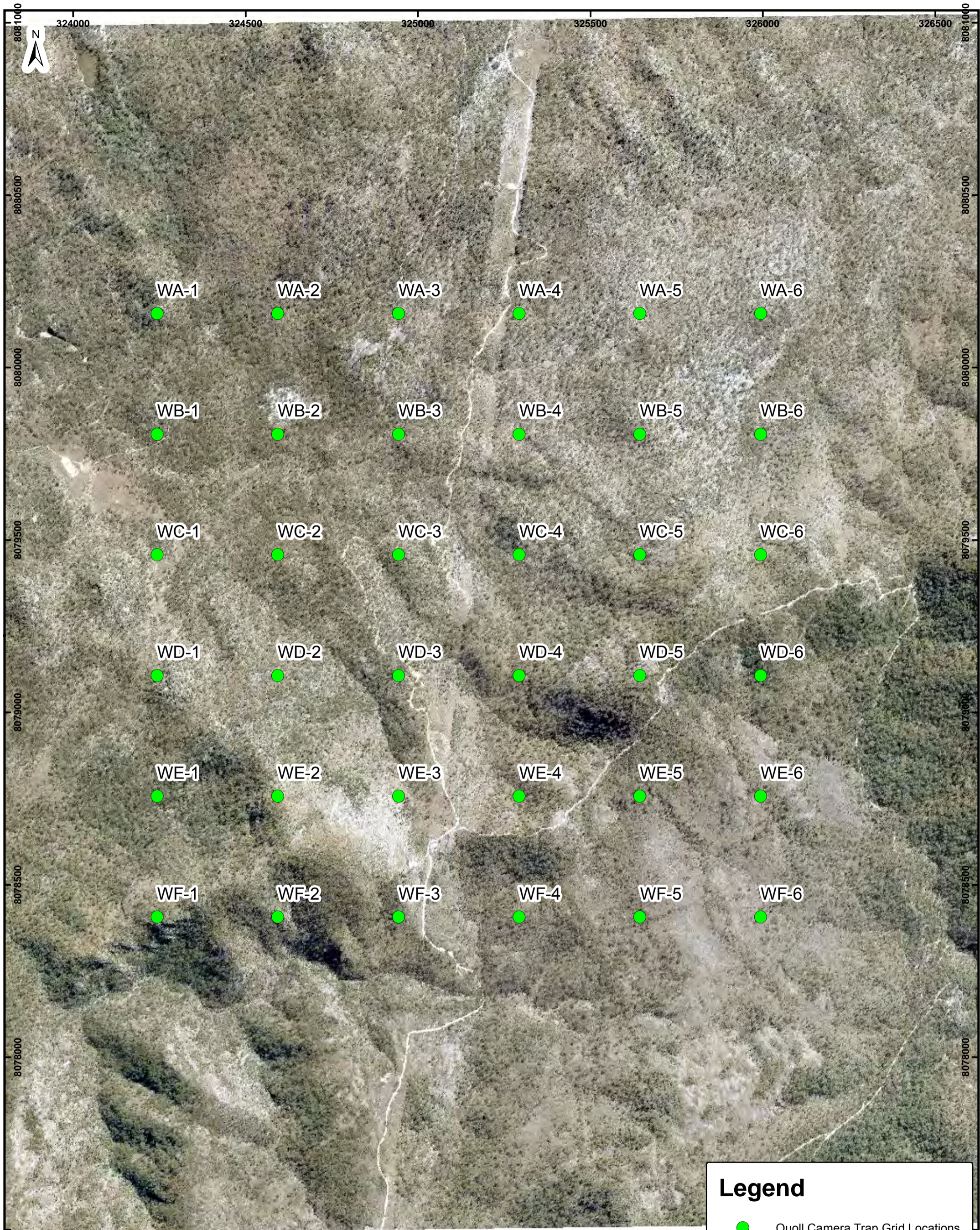
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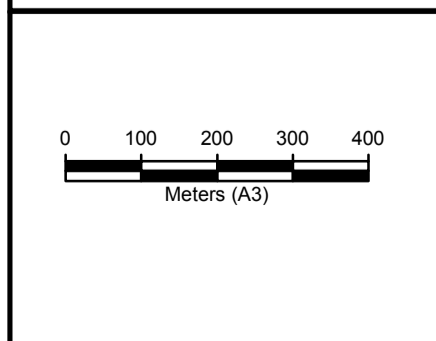
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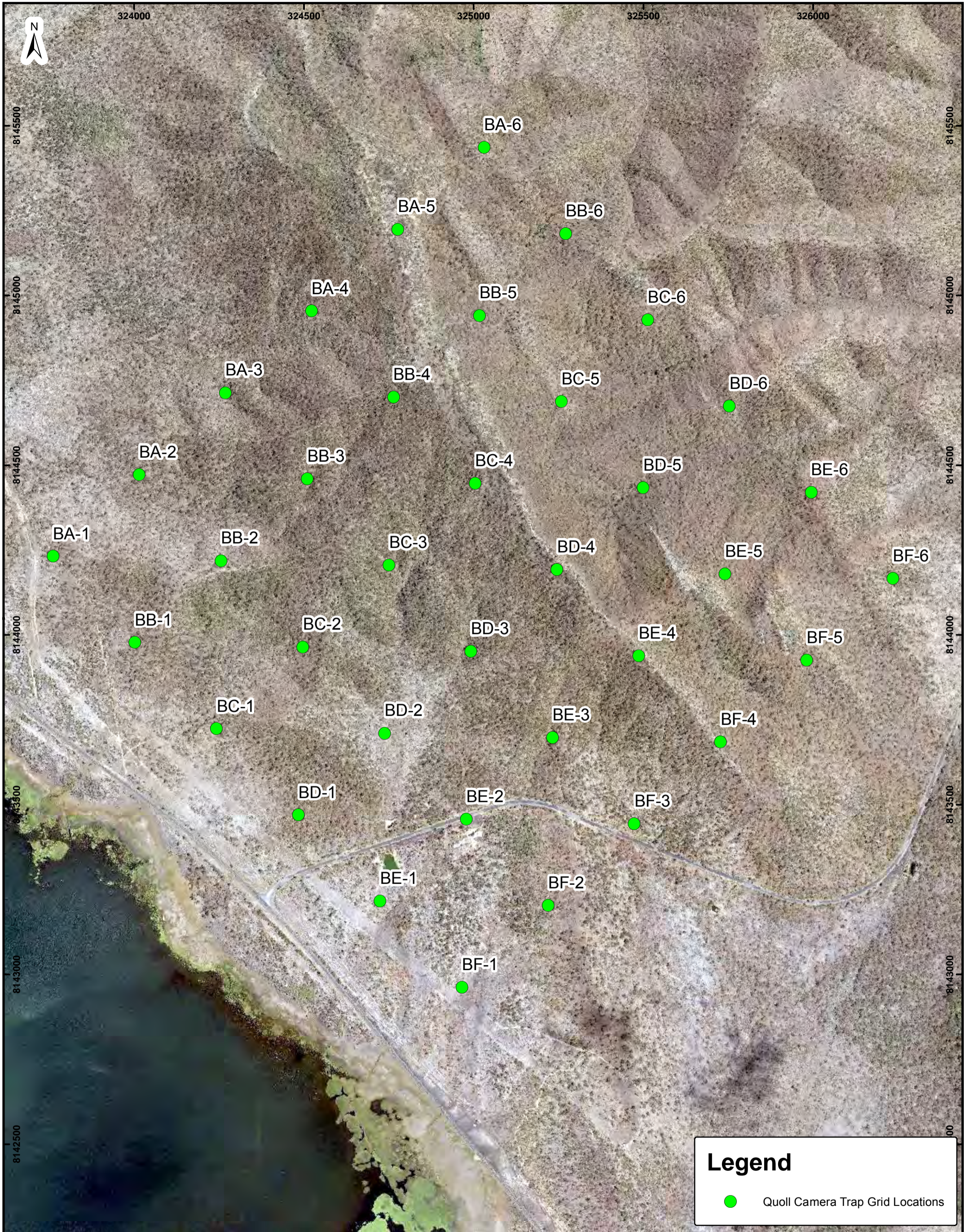
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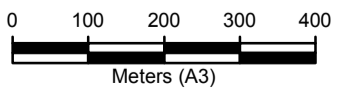
Client RACL
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Legend

- Quoll Camera Trap Grid Locations



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Client RACL
Title Quoll Camera Trap Grid Locations Biboorah Site

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Appendix C

Northern Quoll Management Plan



Mount Emerald Wind Farm



Northern Quoll Species Management Plan

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
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Approval for Issue

Name	Signature	Date
Mellissa Jess		15/11/2016

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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.

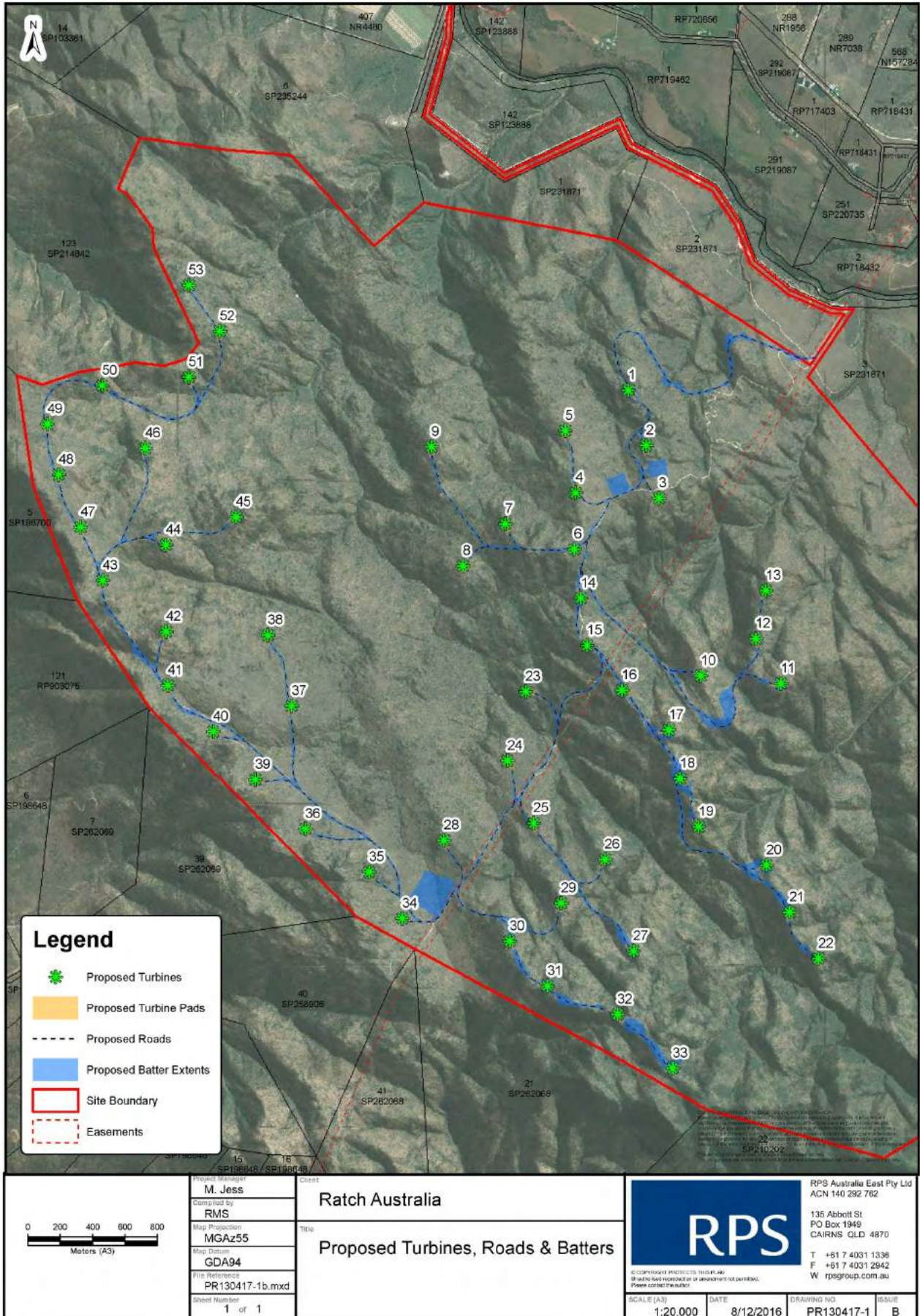


Figure 1 Site Location

1.3 Approved Entity

The following entity is approved to operate under this SMP:

Terry Johannesen
RATCH Australia
Level 4,
231 George Street
BRISBANE QLD 4000

T: +61 7 3214 3401
F: +61 7 3214 3499
E: terry.johannesen@ratchaustralia.com

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: <ul style="list-style-type: none"> (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 <i>MEWF Habitat Clearing and Management Plan</i> (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 increase 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 <i>Nature Conservation (Administration) Regulation 2006</i> .
Suitably Qualified and Experienced Person	<ul style="list-style-type: none"> ▪ 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 <i>spotter-catcher</i> 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 <i>Nature Conservation (Administration) Regulation 2006</i> .
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: <ul style="list-style-type: none"> (i) Hunt, shoot, wound, kill, skin, poison, net, snare, spear, trap, catch, dredge for, bring ashore or aboard a boat, pursue, lure, injure or harm the animal; or (ii) Attempt to do an act mentioned in subparagraph (i).

8.0 References

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- Burnett, S. and Marsh, H. (2004) Conservation of the Spotted-tailed Quoll, *Dasyurus maculatus*: a conceptual and applied model with particular reference to populations of the endangered *D. m. gracilis*. Pp. 624-638 In *Conservation of Australia's Forest Fauna (second edition)*. Ed. D. Lunney. Royal Zoological Society of New South Wales, Mosman, NSW.
- Burnett, S., & Holmes, B. (2008). The spotted-tailed quoll *Dasyurus maculatus* in Queensland's Border Ranges area.
- Burnett, S Shimizu Y and Middleton J (2013) Distribution and abundance of the Northern Quoll (*Dasyurus hallucatus*) in far North Queensland. Prepared for RATCH Australia Pty Ltd, Brisbane.
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Appendix D

Habitat Clearing Management Plan



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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.

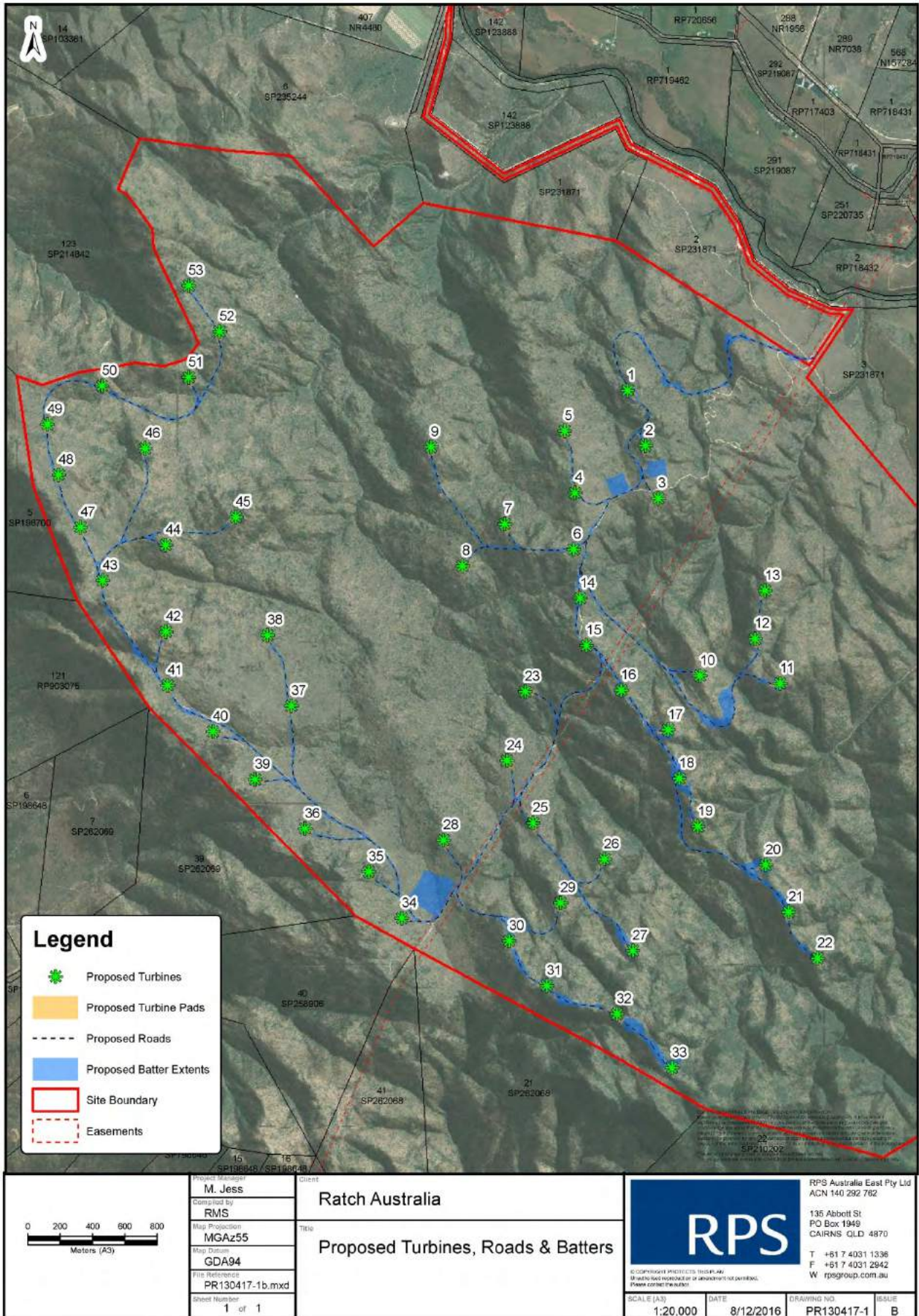


Figure 1 Project Site Location

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 Sheath-tail 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 (<i>Pteropus conspicillatus</i>) and Bare-rumped Sheathtail Bat (<i>Saccolaimus saccolaimus nudicluniatus</i>) 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	
<p>Rustyjacket Woodland Woodland to open woodland of <i>Corymbia leichhardtii</i>, <i>Callitris intratropica</i> with <i>Eucalyptus shirleyi</i> and <i>Eucalyptus granitica</i> to 8 - 12 m. Occurs mainly the centre of the site in the EU bioregion section.</p>	
<p>Silver-leaf Ironbark Woodland Woodland to low open woodland of <i>Eucalyptus shirleyi</i> to 4 m with emergent <i>Callitris intratropica</i> (12 m). Best representation is near the centre of the site close in the EU and WT bioregion sections.</p>	

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

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

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 Sheath-tail 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 Sheath-tail 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 <ul style="list-style-type: none"> ▪ Dingo ▪ Agile Wallaby ▪ Echidna Arboreal <ul style="list-style-type: none"> ▪ Common Brushtail Possum ▪ Giant White-tailed Rat Bats <ul style="list-style-type: none"> ▪ Little Bent-wing Bat ▪ Eastern Freetail Bat ▪ Northern Freetail Bat 	<ul style="list-style-type: none"> ▪ Red-tailed Black Cockatoo ▪ Rainbow Bee-eater ▪ Noisy Friarbird ▪ Laughing Kookaburra ▪ Striped Pardalote ▪ Pied Butcherbird ▪ Grey Faintail ▪ Brown Honeyeater 	<ul style="list-style-type: none"> ▪ Northern Spotted Velvet Gecko ▪ Rainbow Skink ▪ Tommy Roundhead Dragon ▪ Brown Snake 	<ul style="list-style-type: none"> ▪ 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@ratcaustralia.com W: www.ratcaustralia.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.

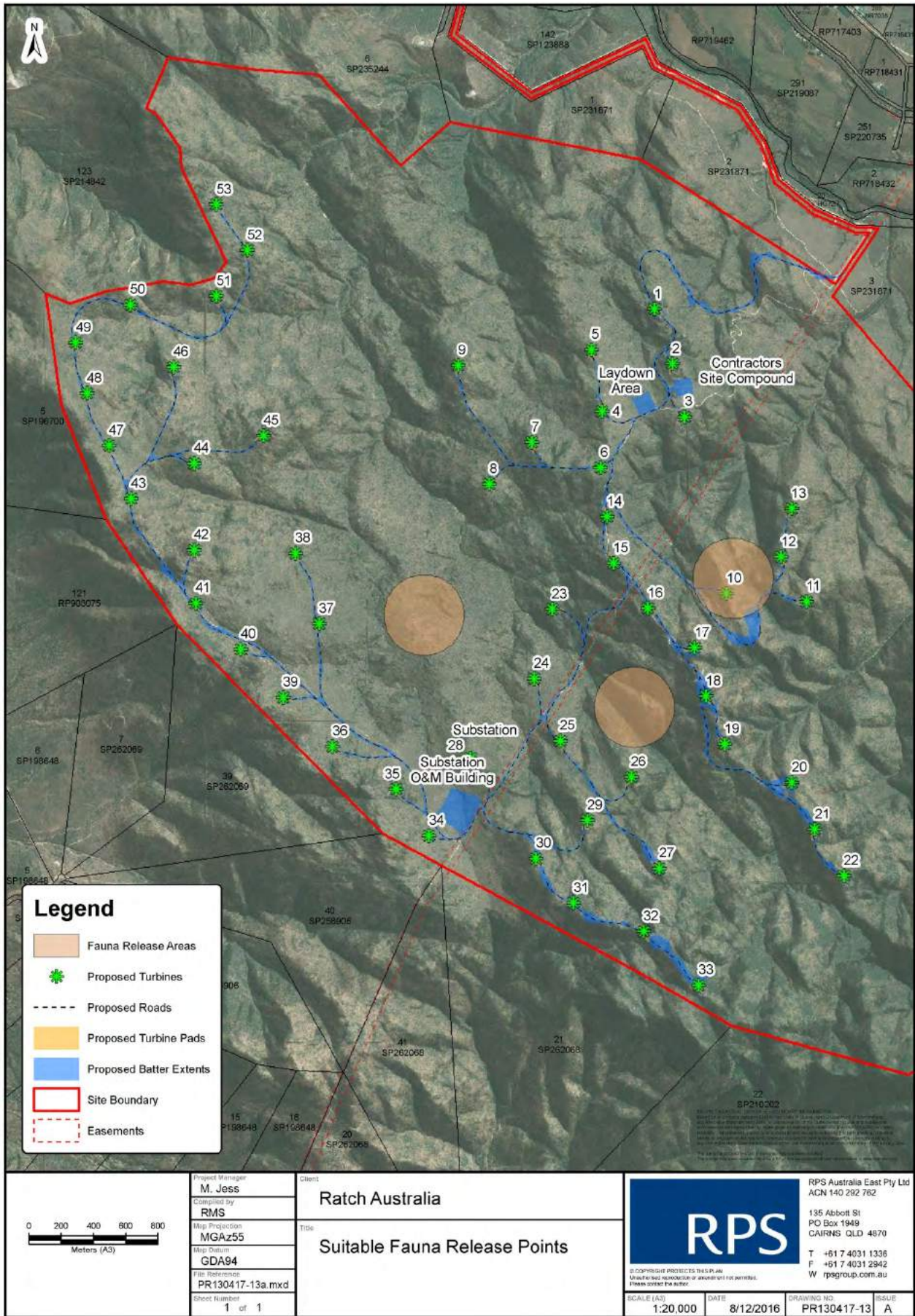


Figure 2 Fauna Release Sites

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 ANZCART 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 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	<ul style="list-style-type: none"> ▪ 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.	<p>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:</p> <ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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)	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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.

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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				
Bufo	Cane Toad	<i>Bufo marinus</i>		
Hyla	Green Tree Frog	<i>Litoria caerulea</i>		
Hyla	Floodplain Frog	<i>Litoria inermis</i>		
Hyla	Broad-palmed Frog	<i>Litoria latopalmata</i>		
Hyla	Rocket Frog	<i>Litoria nasuta</i>		
Hyla	Desert Tree Frog	<i>Litoria rubella</i>		
Myobatrach	Montane Toadlet	<i>Uperoleia altissima</i>		
BIRDS				
Acanthiza	Yellow Thornbill	<i>Acanthiza nana</i>		
Smicromys	Weebill	<i>Smicromys brevirostris</i>		
Accipiter	Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>	M	
Accipiter	Brown Goshawk	<i>Accipiter fasciatus</i>	M	
Aquila	Wedge-tailed Eagle	<i>Aquila audax</i>	M	
Elanus	Black-shouldered Kite	<i>Elanus axillaris</i>	M	
Haliaeetus	White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	M	
Haliastur	Brahminy Kite	<i>Haliastur indus</i>	M	
Haliastur	Whistling Kite	<i>Haliastur sphenurus</i>	M	
Hieraaetus	Little Eagle	<i>Hieraaetus morphnoides</i>	M	
Ceyx	Azure Kingfisher	<i>Ceyx azureus</i>		
Aerodramus	Australian Swiftlet	<i>Aerodramus terrareginae</i>		NT
Apus	House Swift	<i>Apus affinis</i>		
Apus	Fork-tailed Swift	<i>Apus pacificus</i>	M	
Hirundinidae	White-throated Needletail	<i>Hirundinidae caudacutus</i>	M	
Ardea	Cattle Egret	<i>Ardea ibis</i>	M	
Artamus	Dusky Woodswallow	<i>Artamus cyanopterus</i>		
Artamus	White-breasted Woodswallow	<i>Artamus leucorhynchus</i>		
Artamus	Little Woodswallow	<i>Artamus minor</i>		
Artamus	Masked Woodswallow	<i>Artamus personatus</i>		
Artamus	White-browed Woodswallow	<i>Artamus superciliosus</i>		
Cracticus	Pied Butcherbird	<i>Cracticus nigrogularis</i>		
Cracticus	Grey Butcherbird	<i>Cracticus torquatus</i>		
Gymnorhina	Australian Magpie	<i>Gymnorhina tibicen</i>		
Strepera	Pied Currawong	<i>Strepera graculina</i>		

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

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

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

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

Appendix B

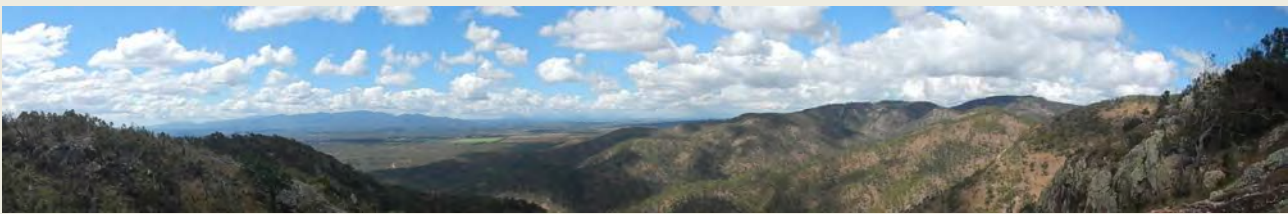
Wildlife Capture and Disposal Record

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 E

Weed Management Plan



Weed Management Plan

Mt Emerald Wind Farm

2016 - 2020



Report prepared for RPS Australia East Pty Ltd for
MEWFPL

September 2016



Weed Management Plan

2016 to 2020

Mt Emerald Wind Farm

Simon Gleed

9th September 2016

Report prepared for RPS Australia East Pty Ltd for MEWFPL

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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.

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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*).

Weed Management Plan 2016 to 2020 - Mt Emerald Wind Farm

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.

Weed Management Plan 2016 to 2020 - Mt Emerald Wind Farm

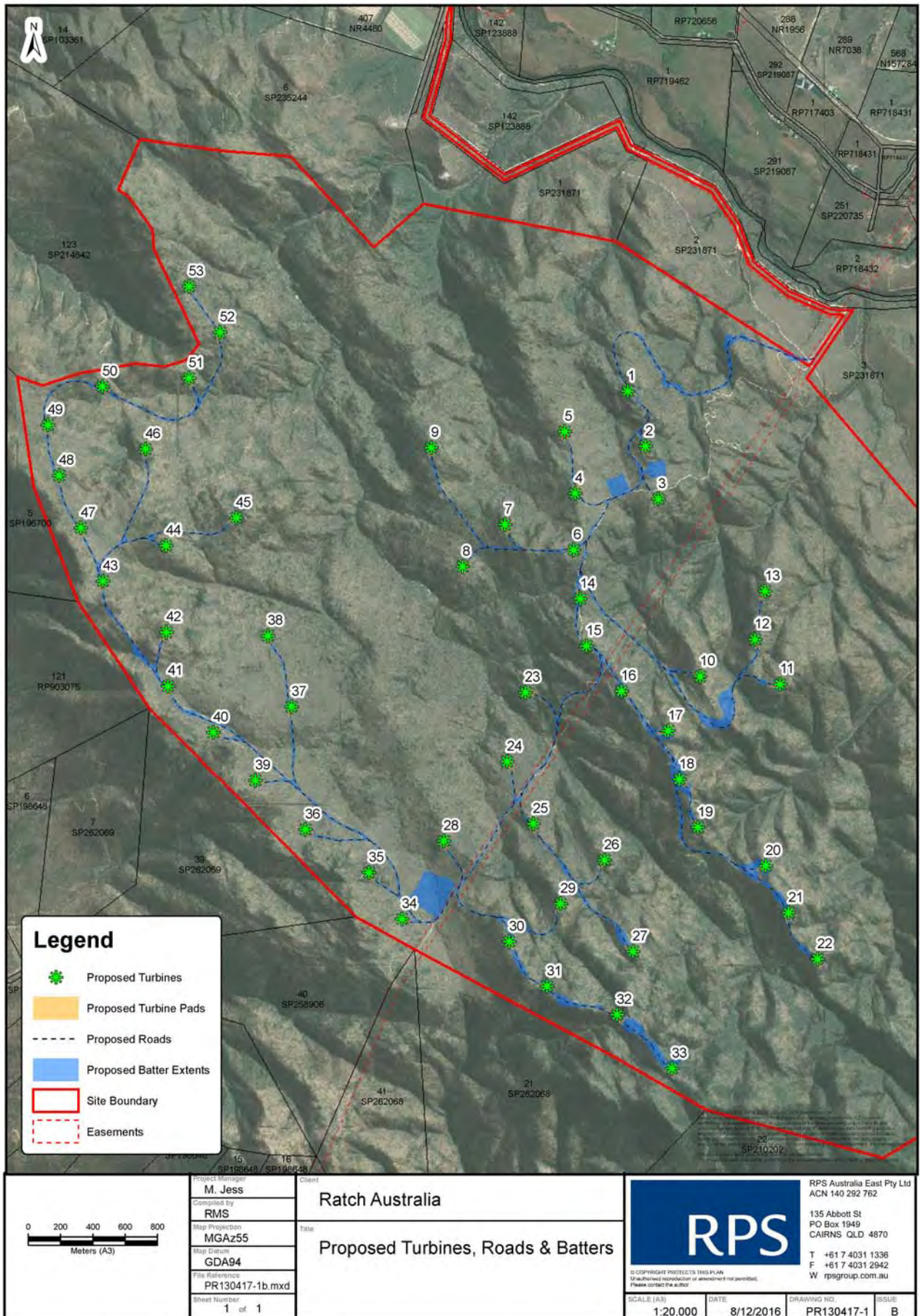


Figure 1. Layout of the Mt Emerald Wind Farm

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 a 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 (<i>Parthenium hysterophorus</i>)	35.9	Yes	Class 2	No
Bellyache Bush (<i>Jatropha gossypifolia</i>)	35.0	Yes	Class 2	No
Rubber Vine (<i>Cryptostegia grandiflora</i>)	33.2	Yes	Class 2	No
Lantana (<i>Lantana camara</i>)	29.5	Yes	Class 3	Yes

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Weed species	MSPMP Score	WONS	LP Act	On wind farm site?
Sicklepod (<i>Senna obtusifolia</i>)	27.0	No	Class 2	Yes
Giant Rat's Tail Grass (<i>Sporobolus natalensis</i>)	26.8	No	Class 2	Yes
American Rat's Tail Grass (<i>Sporobolus jacquemontii</i>)	-	No	Class 2	Yes
Cat's Claw Creeper (<i>Dolichandra unguis-cati</i>)	-	Yes	Class 3	No
Gamba Grass (<i>Andropogon gayanus</i>)	-	Yes	Class 2	No
Mother of Millions (<i>Bryophyllum</i> spp.)	-	No	Class 2	Yes
Asparagus Fern/Ground Asparagus (<i>Asparagus aethiopicus</i>)	-	Yes	Class 3	No
Captain Cook Tree / Yellow Oleander (<i>Cascabela thevetia</i>)	-	No	Class 3	No
Madeira Vine (<i>Anredera cordifolia</i>)	-	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 allowed 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).

Weed	LP Act	Threats	MEWF Management Priority		Notes
			Kippen Drive	WTG site	
Grader Grass (<i>Themeda quadrivalvis</i>)	-	Invasive. Increases unnatural fire risk. Displaces ground flora.	Very High	Very High	Encroaching into WTG site on lower slopes.
Mission Grass (<i>Cenchrus polystachyum</i>)	-	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 (<i>Sporobolus natalensis</i>)	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

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Weed	LP Act	Threats	MEWF Management Priority		Notes
			Kippen Drive	WTG site	
<i>(Hyparrhenia rufa)</i>					northern approach track into WTG site. Isolated along Kippen Drive. Control early.
American Rat's Tail Grass <i>(Sporobolus jacquemontii)</i>	Class 2	Invasive and fire risk.	Very High	Very High	Under 275 kV powerline towers in WTG site and along Kippen Drive.
Molasses Grass <i>(Melinis minutiflora)</i>	-	Invasive. Increases unnatural fire risk. Displaces ground flora.	Medium	Very High	Main area around watercourse crossing under powerline in WTG site.
Signal Grass <i>(Urochloa decumbens)</i>	-	Invasive. Increases unnatural fire risk. Displaces ground flora.	Medium	High	Only small areas in WTG site - control early.
Rhodes Grass <i>(Chloris gayana)</i>	-	Invasive, increases unnatural fire risk. Displaces native species.	High	-	Small patches along Kippen Drive.
Guinea Grass <i>(Megathyrsus maximus)</i>	-	Invasive. Increases unnatural fire risk. Displaces ground flora.	Medium	High	Isolated on WTG site. Along Kippen Drive. Control early.
Hyptis <i>(Hyptis suaveolens)</i>	-	Increases risk of hot fires. Invasive and lowers integrity.	High	High	Along Kippen Drive and encroaching up lower northern slopes.
Lantana <i>(Lantana camara)</i>	Class 3	Invasive. Increases unnatural fire risk. Displaces ground flora.	High	Very High	Isolated along Kippen Drive and under 275 kV powerline tower in WTG site.
Sicklepod <i>(Senna obtusifolia)</i>	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 be 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 Phytophthora 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.

	<p>Grader Grass (<i>Themeda quadrivalvis</i>)</p> <p>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.</p>
	<p>Mission Grass (<i>Cenchrus polystachyum</i>)</p> <p>A highly invasive grass that can grow to 3 m tall. It significantly increases the risk of hot fires and displaces native vegetation.</p>



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
<i>Ageratum conyzoides</i>	Bluetop	Forb	-	-	-	Flora displacement	Low	Low	Kippen Drive and remote ridge at south of site.
<i>Bidens pilosa</i>	Cobbler's Pegs	Forb	-	-	-	Flora displacement	Low	Medium	Kippen Drive and 80 m wind monitoring tower.
<i>Bryophyllum</i> sp.	Mother of Millions	Forb	Class 2	-	-	Invasive	-	High	Isolated population on remote access track at minor watercourse crossing.
<i>Cenchrus polystachyum</i>	Mission Grass	Grass	-	-	-	Fire; invasive	Very High	Very High	Scattered swards along Kippen Drive and under 275 kV power near watercourse crossing.
<i>Chamaecrista rotundifolia</i>	Wynn Cassia	Forb	-	-	-	Flora displacement	Low	Medium	Kippen Drive and isolated at 80 m wind monitoring tower.
<i>Conyza sumatrensis</i>	Tall Fleabane	Shrub	-	-	-	Flora displacement	Low	Medium	Kippen Drive and 80 m wind monitoring tower.
<i>Chloris gayana</i>	Rhodes Grass	Grass	-	-	-	Fire; invasive	High	-	Kippen Drive at watercourse.
<i>Chloris virgata</i>	Feathertop Rhodes Grass	Grass	-	-	-	Invasive	Medium	-	Along Kippen Drive.
<i>Crassocephalum crepidioides</i>	Thickhead	Forb	-	-	-	Flora displacement	Low	Low	Kippen Drive and very isolated occurrence along ridge.
<i>Crotalaria gorensis</i>	Gambia Pea	Shrub	-	-	-	Invasive	Medium	Medium	Along Kippen Drive and isolated incidences in remnant grassland at northern end of site.
<i>Cynodon dactylon</i>	Couch Grass	Grass	-	-	-	Lowers integrity	Low	-	Kippen Drive.
<i>Dactyloctenium aegyptium</i>	Egyptian Crowfoot Grass	Grass	-	-	-	Flora displacement	Low	High	Scattered along Kippen Drive and one occurrence at 80 m wind monitoring tower.
<i>Eleusine indica</i>	Crowfoot Grass	Grass	-	-	-	Flora displacement	Low	Low	Along Kippen Drive.
<i>Hyparrhenia rufa</i>	Thatch Grass	Grass	-	-	-	Fire; invasive	Very High	Very High	Scattered clumps along Kippen Drive and isolated on site. Presently not common.
<i>Hyptis suaveolens</i>	Hyptis	Shrub	-	-	-	Fire; invasive	High	High	Kippen Drive and expanding into site along lower slopes.
<i>Lantana camara</i>	Lantana	Shrub	Class 3	29.5	Yes	Fire; invasive	High	Very High	Isolated along Kippen Drive and only seen under 275 kV powerline tower.
<i>Macroptilium atropurpureum</i>	Siratro	Vine	-	-	-	Invasive	Medium	-	Along Kippen Drive.
<i>Megathyrsus maximus</i>	Guinea Grass	Grass	-	-	-	Fire; invasive	Medium	High	One clump on site and scattered along Kippen Drive on marginally wetter soil.
<i>Melinis minutiflora</i>	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.
<i>Melinis repens</i>	Red Natal Grass	Grass	-	-	-	Low fire threat	Low	Medium	Scattered and diffuse over site; denser along Kippen Drive.
<i>Mimosa pudica</i>	Sensitive Weed	Subshrub	-	-	-	Habitat degrading	Low	-	Along Kippen Drive.
<i>Mitracarpus hirtus</i>	White Eye	Forb	-	-	-	Flora displacement	Low	Medium	Kippen Drive and 80 m wind monitoring tower.
<i>Passiflora foetida</i>	Stinking Passionflower	Vine	-	-	-	Invasive	Medium	High	Kippen Drive and scattered on northern slopes.
<i>Praxelis clematidea</i>	Praxelis	Forb	-	-	-	Flora displacement	Medium	High	Widespread as individual plants in remnant areas, but notably denser around disturbed ground.

Weed Management Plan 2016 to 2020 - Mt Emerald Wind Farm

Species	Common Name	Habit	LP Act	MSPMP	WONS	Threats	MEWF Management Priority		Location
							Kippen Drive	WTG site	
<i>Richardia scabra</i>	Richardia	Forb	-	-	-	Flora displacement	Low	Medium	Kippen Drive and 80 m wind monitoring tower.
<i>Senna obtusifolia</i>	Sicklepod	Shrub	Class 2	27.0	-	Invasive	-	Very High	80 m wind monitoring tower. Not present in August 2016.
<i>Setaria pumila</i>	Pigeon Grass	Grass	-	-	-	Fire; invasive	Medium	-	Scattered along Kippen Drive.
<i>Sida cordifolia</i>	Flannel Weed	Shrub	-	-	-	Habitat degrading	Low	Low	Kippen Drive and isolated occurrences on northern slopes.
<i>Sporobolus jacquemontii</i>	American Rat's Tail Grass	Grass	Class 2	-	-	Invasive	High	Very High	Kippen Drive. Isolated specimens under 275 kV powerline.
<i>Sporobolus natalensis</i>	Giant Rat's Tail Grass	Grass	Class 2	26.8	-	Invasive	-	Very High	Under 275 kV powerline towers.
<i>Stachytarpheta cayennensis</i>	Dark Blue Snakeweed	Shrub	-	-	-	Habitat degrading	Low	-	Along Kippen Drive.
<i>Stachytarpheta jamaicensis</i>	Pale Blue Snakeweed	Shrub	-	-	-	Habitat degrading	Low	-	Along Kippen Drive.
<i>Stylosanthes humilis</i>	Townsville Stylo	Shrub	-	-	-	Flora displacement	Low	Low	Kippen Drive and 80 m wind monitoring tower.
<i>Stylosanthes scabra</i>	Shrubby Stylo	Shrub	-	-	-	Flora displacement	Medium	Medium	Kippen Drive and advancing into site along lower slopes.
<i>Themeda quadrivalvis</i>	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.
<i>Tridax procumbens</i>	Tridax Daisy	Forb	-	-	-	Habitat degrading	Low	Low	Kippen Drive and 80 m wind monitoring tower.
<i>Triumfetta rhomboidea</i>	Chinese Burr	Shrub	-	-	-	Habitat degrading	Low	Medium	Kippen Drive and isolated occurrences on northern slopes.
<i>Urochloa decumbens</i>	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.

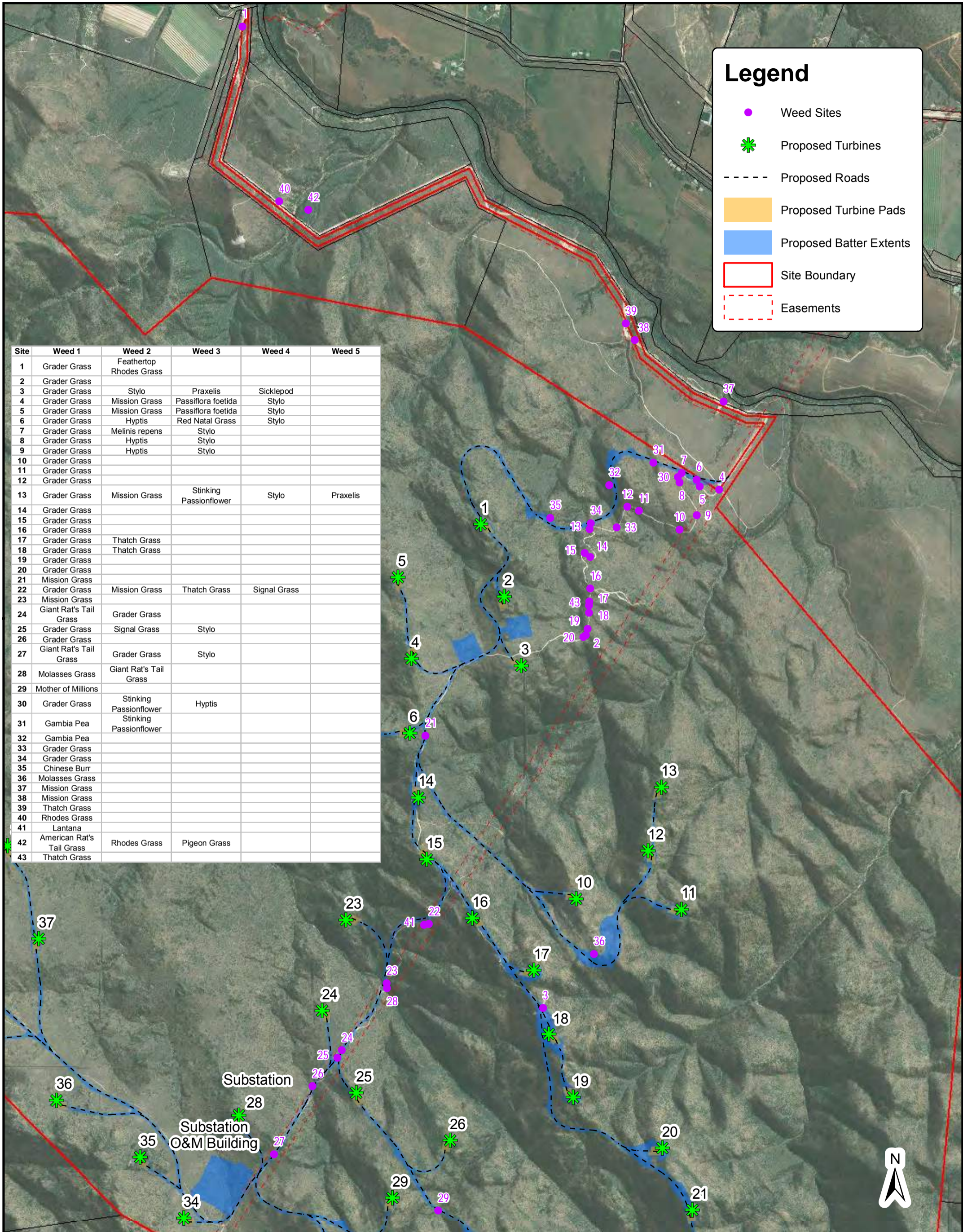
MEWF Management Priority: This is the site-specific Mt Emerald Wind Farm priority ranking for management of weeds. It is based on invasiveness, current population sizes, potential to affect fire ecology and whether a species is considered to impose a significant threat to sensitive environmental areas. **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 be 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

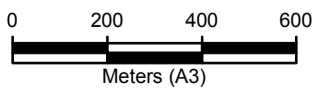
WEED DISTRIBUTION - Mt Emerald Wind Farm (including Kippen Drive)



Legend

- Weed Sites
- ★ Proposed Turbines
- Proposed Roads
- Proposed Turbine Pads
- Proposed Batter Extents
- Site Boundary
- Easements

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				



Project Manager
M. Jess

Compiled by
RMS

Map Projection
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1 of 1

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Appendix F

Pest Management Plan



Pest Management Plan

Mount Emerald Wind Farm, Herberton Range, North Queensland



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Name	Signature	Date
Melissa Jess		16 November 2016

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Appendix A Species Fact Sheets

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.

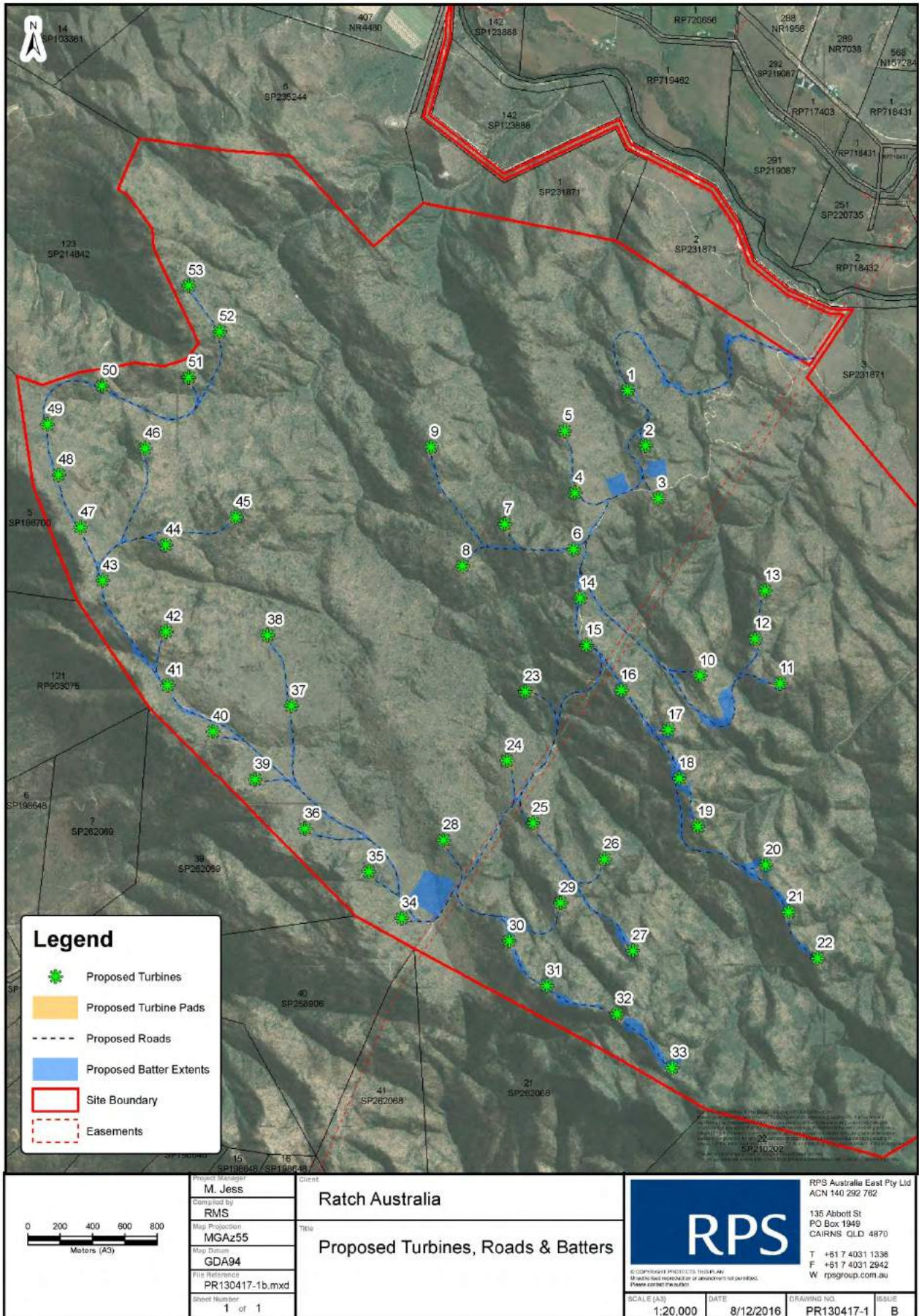


Figure 1 Project Site Location

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
<p>Nature Conservation Act 1992 and Nature Conservation (Wildlife) Regulation 2006</p>	<p>The <i>Nature Conservation Act 1992 (NC Act)</i> 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.</p> <p>The <i>Nature Conservation (Wildlife) Regulation 2006 (NC Regulation)</i> 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.</p>
<p>Land Protection (Pest and Stock Route Management) Act 2002</p>	<p>The <i>Land Protection (Pest and Stock Route Management) Act 2002 (The Act)</i> is the overarching legislation with the main purpose to provide for:</p> <ul style="list-style-type: none"> (a) pest management for land; and (b) stock route network management. <p>The purpose of the Act is to be achieved mainly through the following—</p> <ul style="list-style-type: none"> (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. <p>The Act requires that local government prepare a pest management plan for its area. The plan may include provision for the following—</p> <ul style="list-style-type: none"> (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. <p>The plan must however be consistent with the principles of pest management; the State pest management strategies; and the guidelines for pest management.</p>

Legislation	Description
Biosecurity Act 2014	<p>The <i>Biosecurity Act 2014</i> (the Act) was passed by Parliament and will come into effect on 1 July 2016 superseding the <i>Land Protection (Pest and Stock Route Management) Act 2002</i>.</p> <p>The Act deals with:</p> <ul style="list-style-type: none"> ▪ pests (such as wild dogs and weeds) ▪ diseases (such as foot-and-mouth disease) ▪ contaminants (such as lead on grazing land) <p>Decisions made under the Act will depend on the likelihood and consequences of the risk. This means risks can be managed more appropriately.</p> <p>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.</p> <p>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).</p> <p>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.</p> <p>This Act replaces the Quarantine Act of 1908.</p>
Queensland Pest Animal Strategy	<p>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.</p> <p>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.</p> <p>The following species or groups of species are covered in the strategy:</p> <ul style="list-style-type: none"> ▪ 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. <p>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.</p>
National Strategies	<p>National strategies help government, industry and the broader community manage weeds in a coordinated manner at a national level. National strategies include:</p> <ul style="list-style-type: none"> ▪ Australian Pest Animal Strategy (Department of the Environment, Water, Heritage and Arts) ▪ Threat Abatement Plans
Local Area Pest Management Plans	<ul style="list-style-type: none"> ▪ Mareeba Shire Council -Weed and Pest Management Strategy 2015-2020 <p>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.</p>

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			
<i>Rhinella marinus</i> 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			
<i>Canus lupus dingo</i> Dingo	Survey/ Desktop	Class 2	Dingoes prey on local native fauna and often carry parasites and pathogens.
<i>Canus lupus familiaris</i> Wild Dog	Survey/ Desktop	Class 2	Wild dogs prey on local native fauna and often carry parasites and pathogens.
<i>Sus Scrofa</i> 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)
<i>Felis catus</i> Feral Cat	Survey/ Desktop	Class 2	Feral cats prey on local native fauna and often carry parasites and pathogens.
<i>Oryctolagus cuniculus</i> 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 Sheath-tail 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 <i>MEWF Environmental Management Plan (2016)</i> These are specifically: <ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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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- Tablelands Regional Council (2013). *Local Area Pet Management Plan 2014-2018*. Version 1.

Appendix A

Species Fact Sheets

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

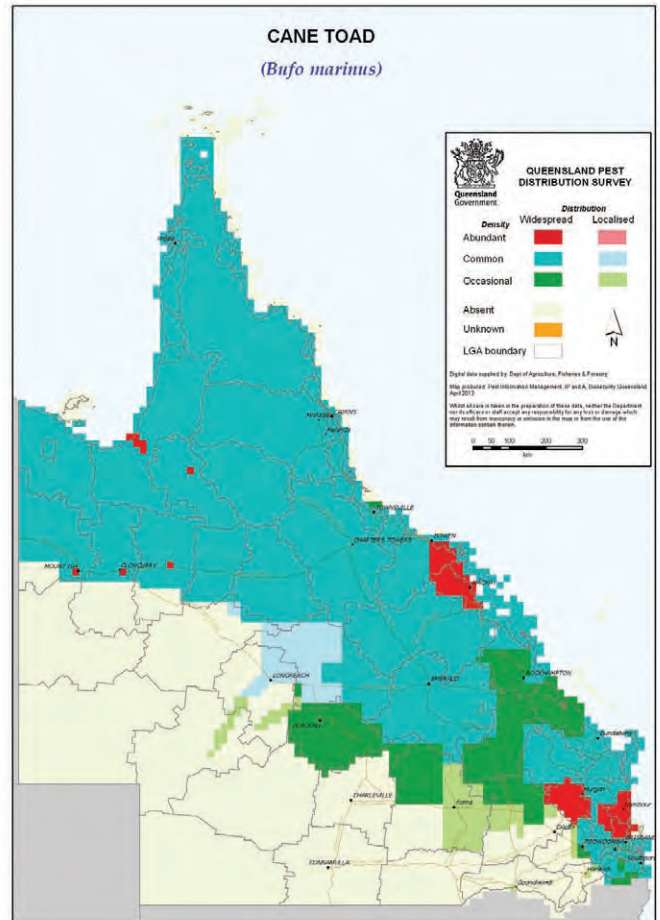
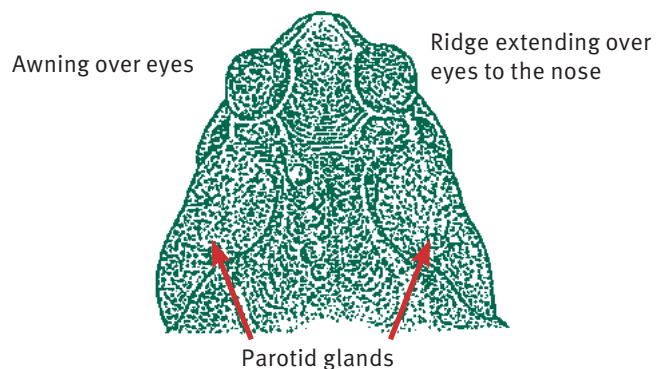


Figure 1. Distinguishing features of the cane toad



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.

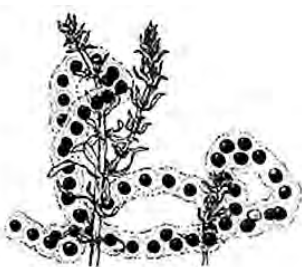
Eggs

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 *Uperoleia* species, which also have parotid glands, but all *Uperoleia* 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).



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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.



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 may 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

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Fact sheets are available from Department of Employment, Economic Development and Innovation (DEEDI) service centres and our Business Information Centre (telephone 13 25 23). Check our website at www.biosecurity.qld.gov.au to ensure you have the latest version of this fact sheet. The control methods referred to in this fact sheet should be used in accordance with the restrictions (federal and state legislation, and local government laws) directly or indirectly related to each control method. These restrictions may prevent the use of one or more of the methods referred to, depending on individual circumstances. While every care is taken to ensure the accuracy of this information, DEEDI does not invite reliance upon it, nor accept responsibility for any loss or damage caused by actions based on it.

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

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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.



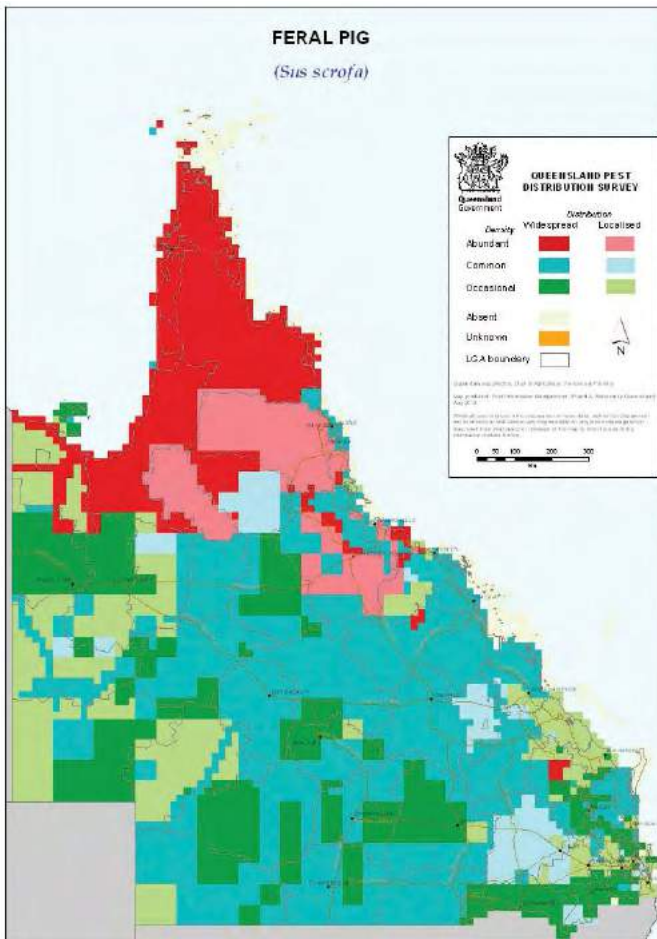


Feral pig wallow



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 km². Adult males are typically solitary, with a home range of 8–50 km². 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).

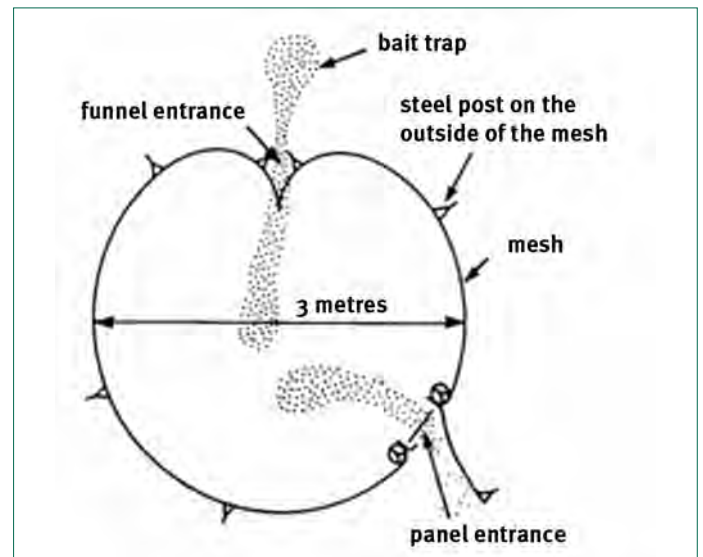


Figure 1. Alternative trap entrances – funnel entrance

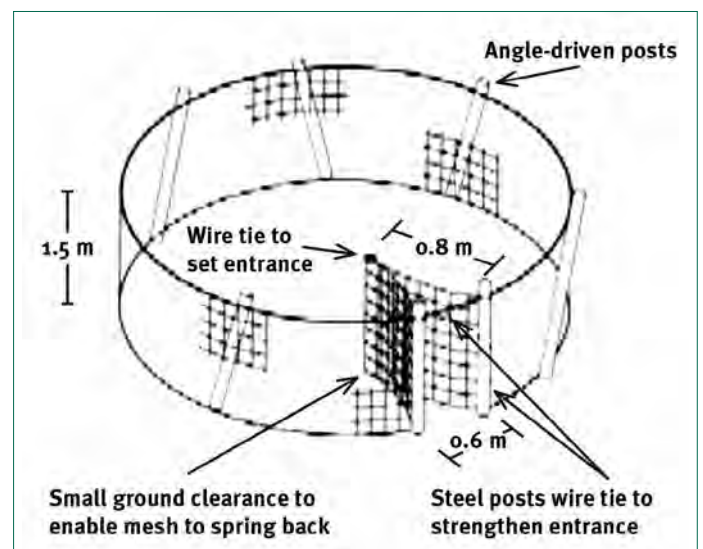


Figure 2. Silo trap with funnel entrance (14 m of silo mesh diameter about 4.5 m)

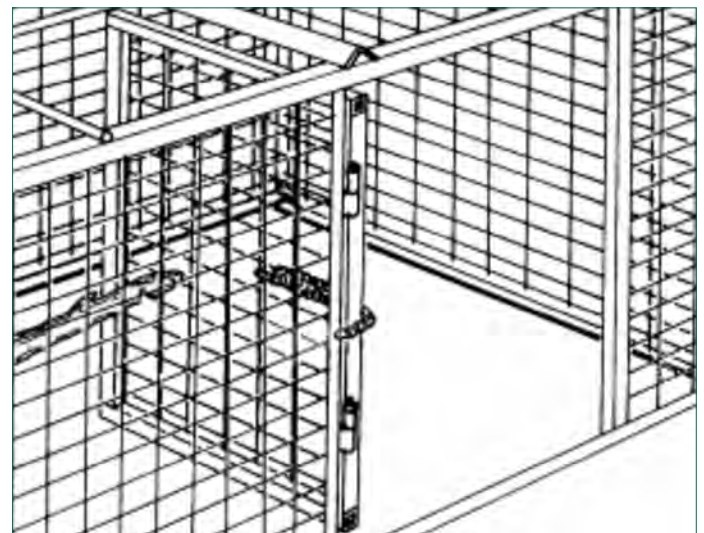


Figure 3. Pig-specific trigger

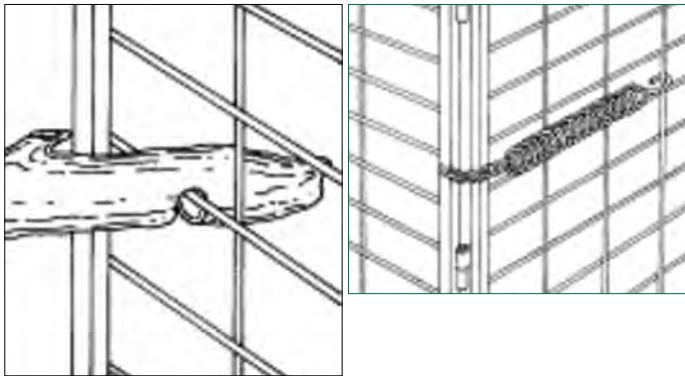


Figure 4. Close up of pig-specific trigger



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.

Biosecurity Queensland gratefully acknowledges the contribution from Choquenot, D., McIlroy, J. and Korn T. (1996) *Managing Vertebrate Pests: Feral Pigs*, Bureau of Resource Sciences, AGPS, Canberra. Commonwealth of Australia copyright reproduced by permission.



Feral pig exclusion fencing



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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.



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 km², 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.



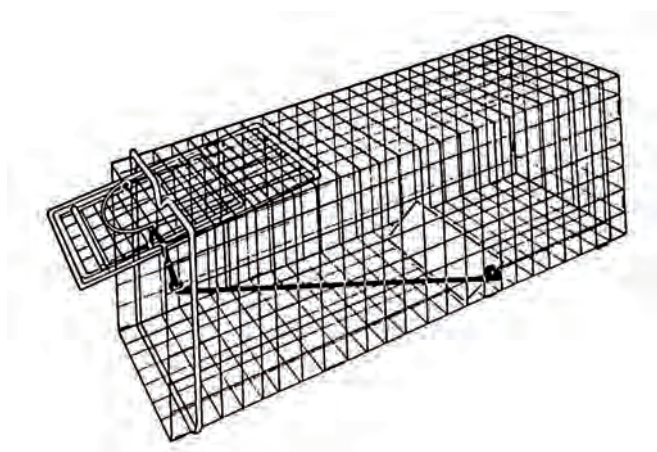
Trapping

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.

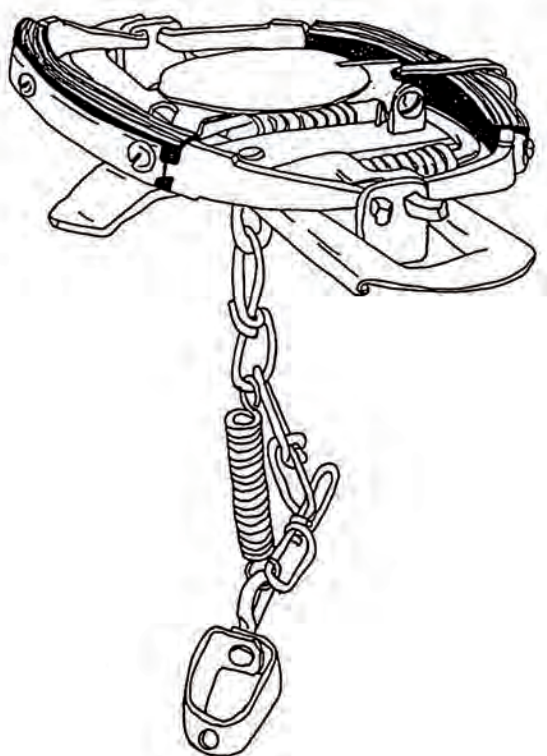
A number of local governments hire cat traps for the purpose of removing stray and feral cats in urban situations.



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).



Rubber-jawed leg-hold trap



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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').

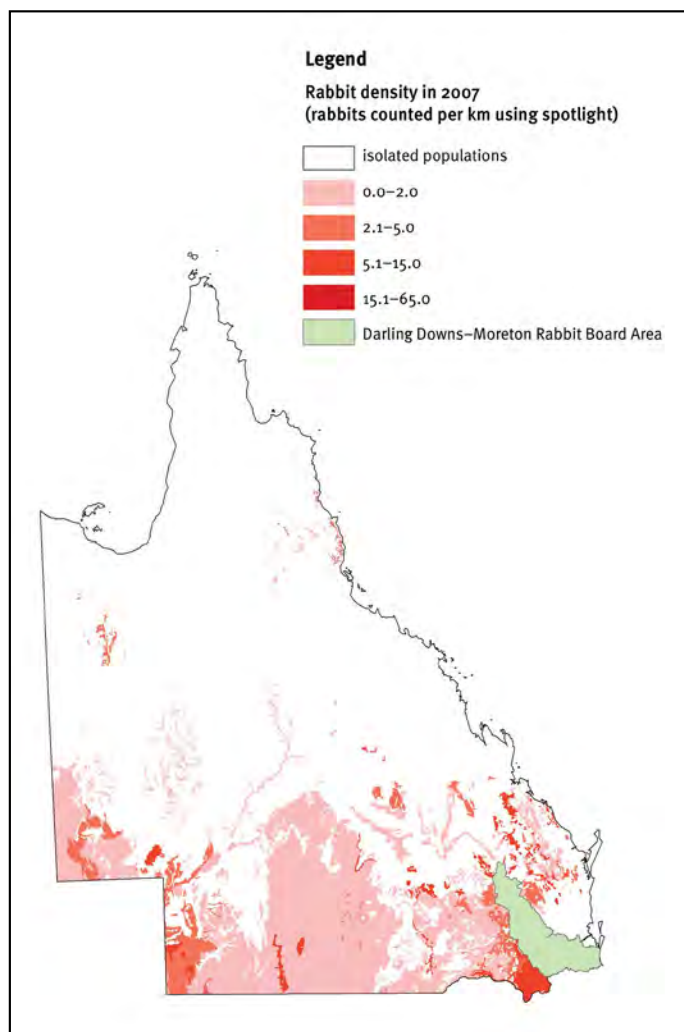
Breeding

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.

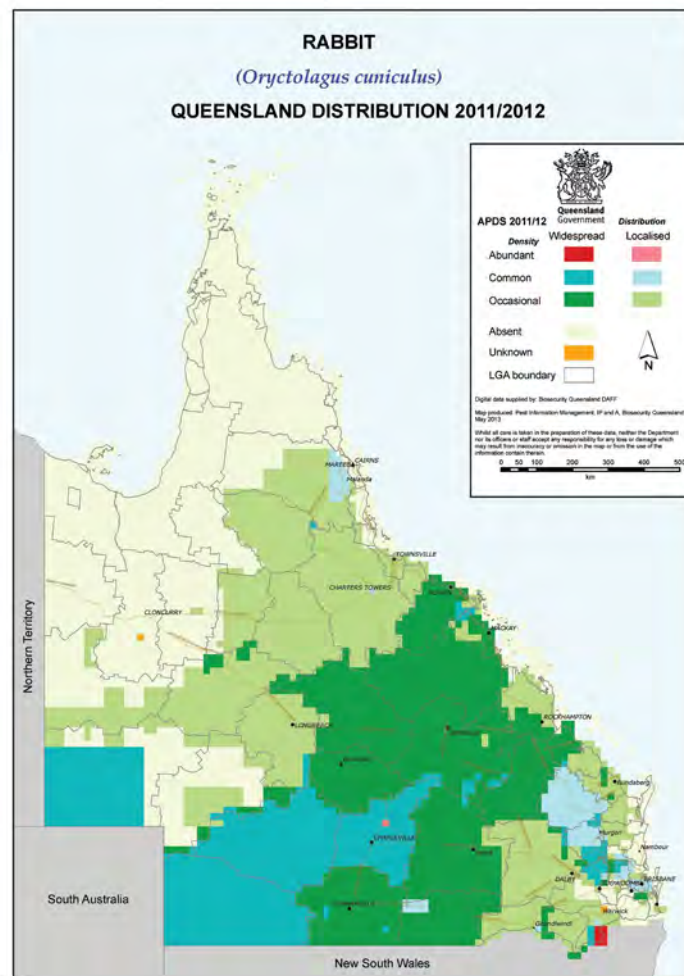
Five to six litters are possible in a good season.

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 managers 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.

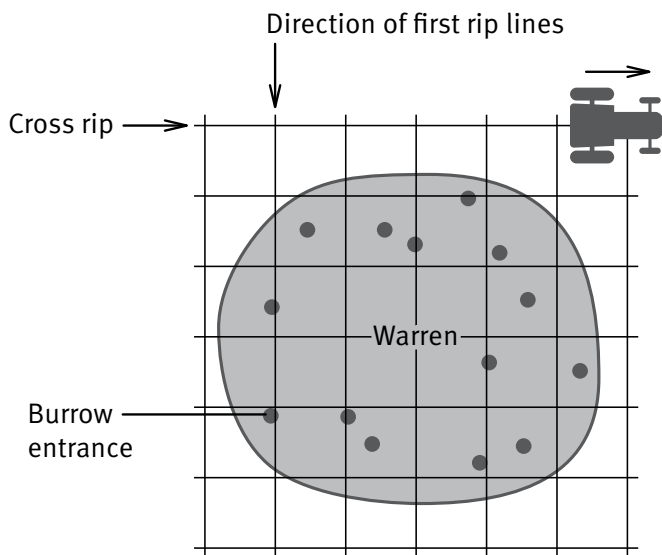
Conventional control methods, such as fumigating, ripping warrens and harbour destruction, are essential for the continued long-term reduction of rabbit numbers.

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.



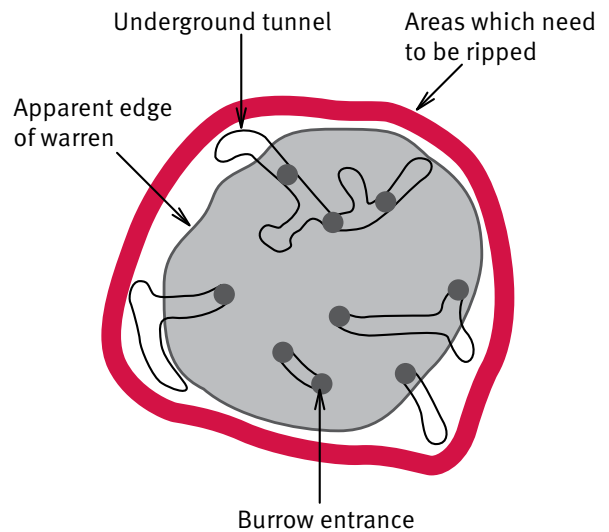
Tyne for ripping warrens (photo courtesy Mark Ridge)



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 fluoroacetate

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.

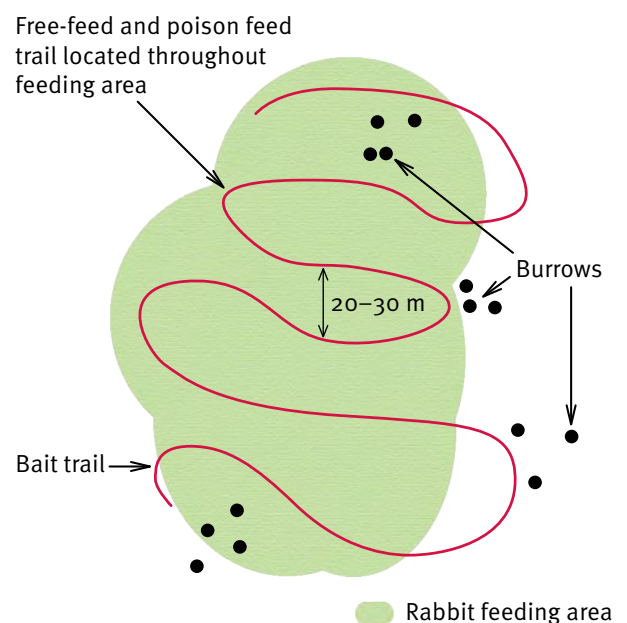
Poison bait trails

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.



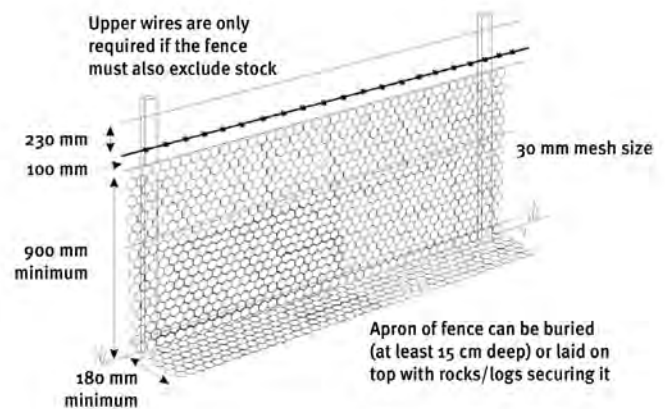
Barrel rabbit trap in hole

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.

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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).



Appendix G

Bushfire Management and Emergency Evacuation Plan



Bushfire Management and Emergency Evacuation Plan

Mt Emerald Wind Farm, Herberton Range, North Queensland



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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.

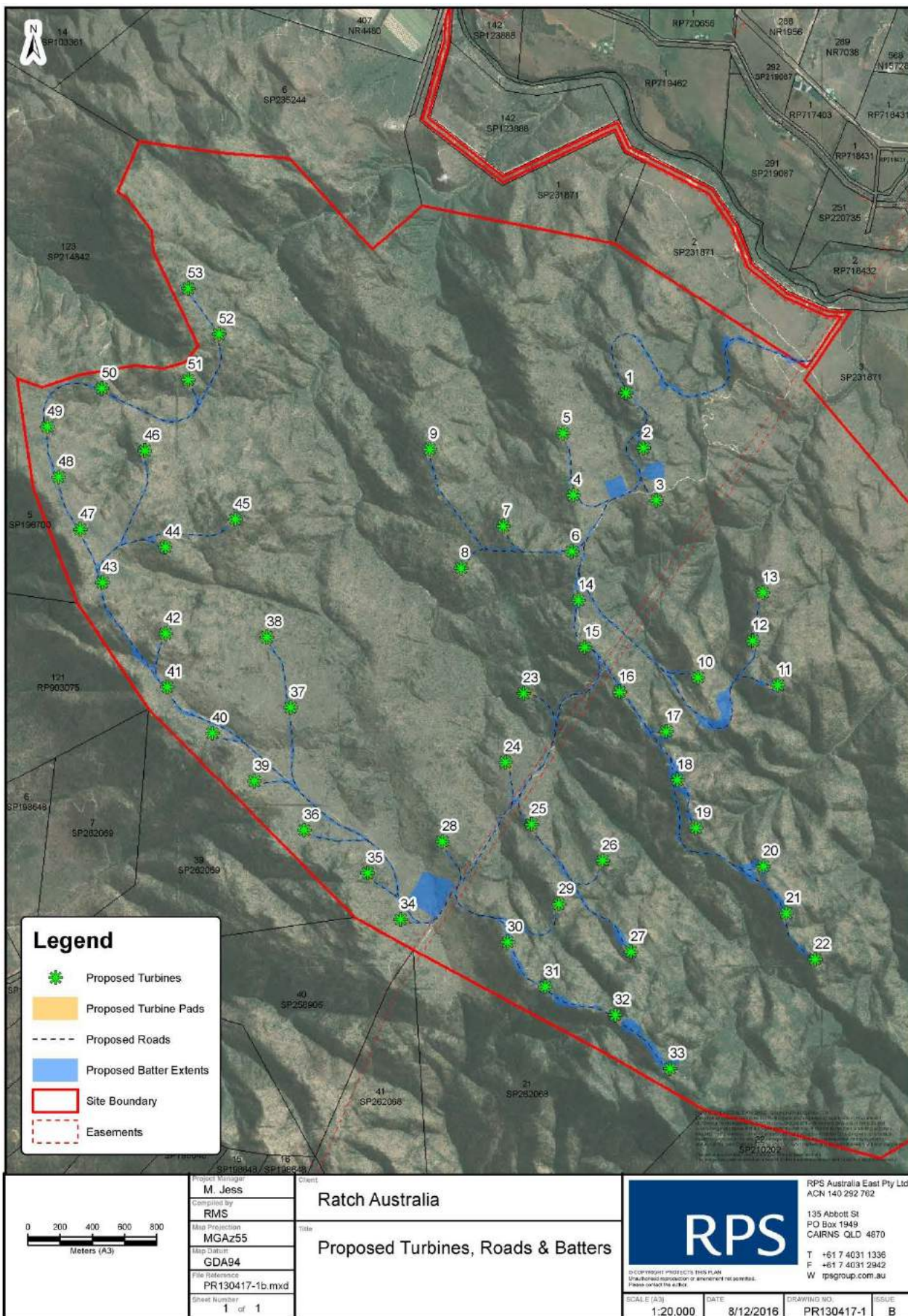


Figure 1 Project Site Location

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 70.1km². 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):

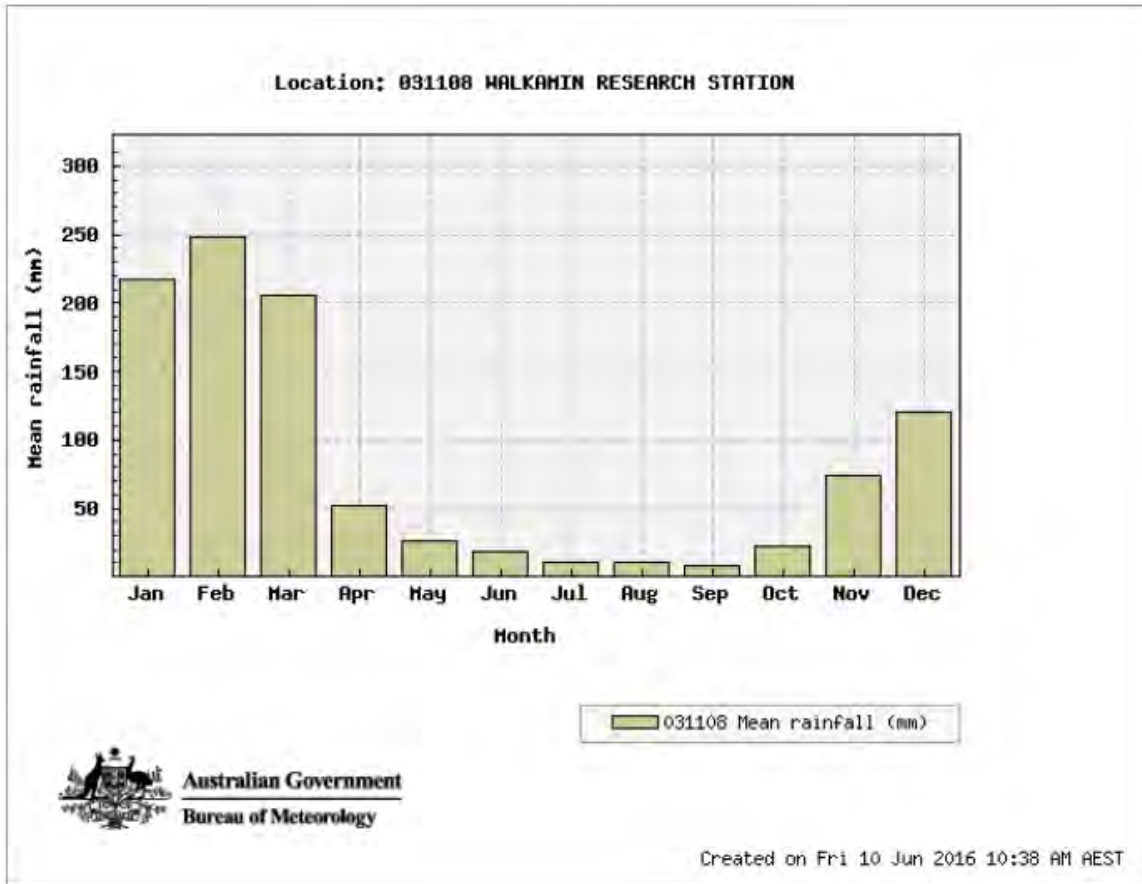


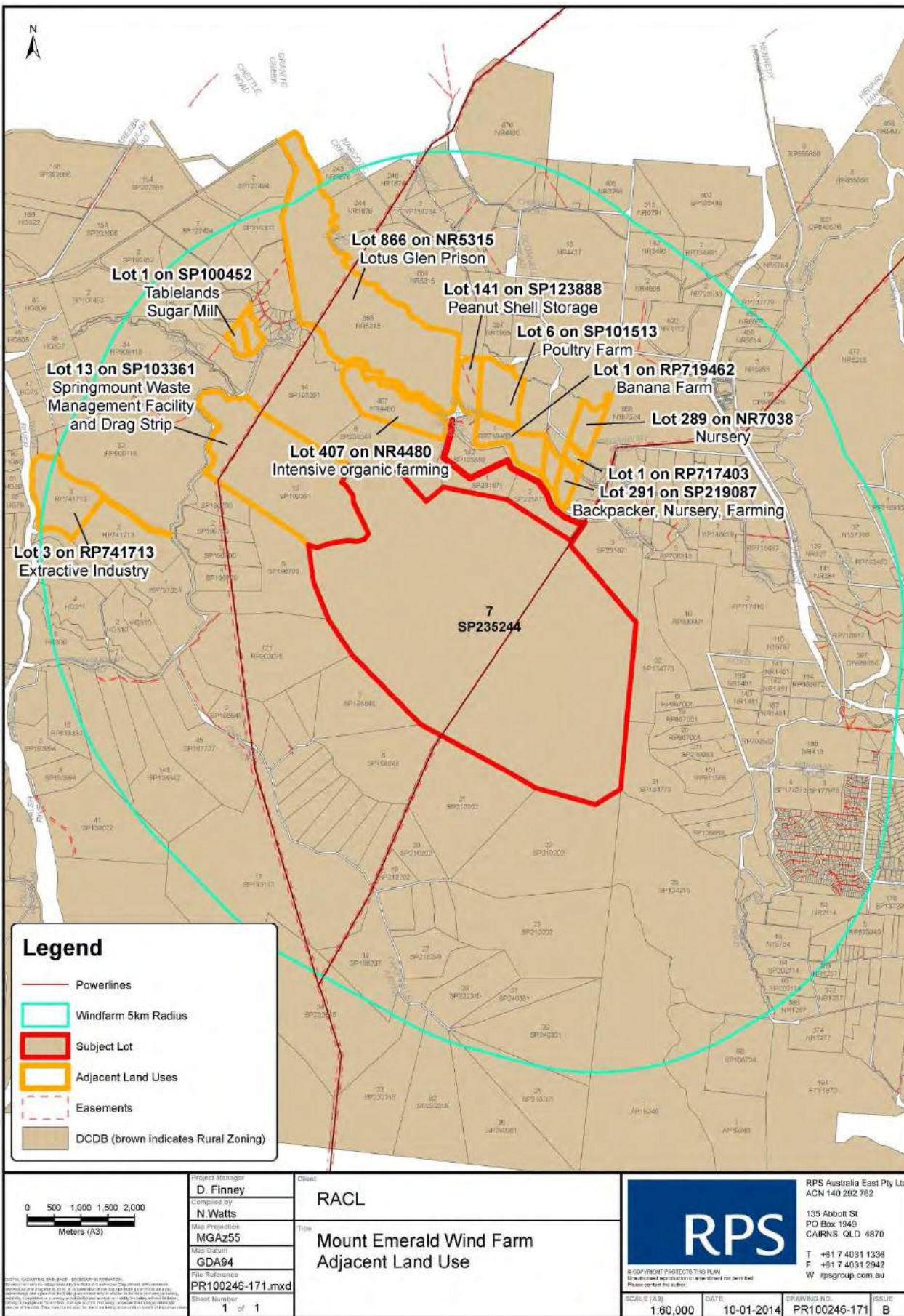
Figure 2 Mean monthly rainfall for Walkamin Research Station (BoM, 1965 – 2016)

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.



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	Compiled by N.Watts	Title Mount Emerald Wind Farm Adjacent Land Use		
Map Projection MGAz55	Max Datum GDA94	File Reference PR100246-171.mxd	SCALE (A3) 1:60,000	DATE 10-01-2014
Sheet Number 1 of 1	DRAWING NO. PR100246-171	ISSUE B		

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 m² 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.

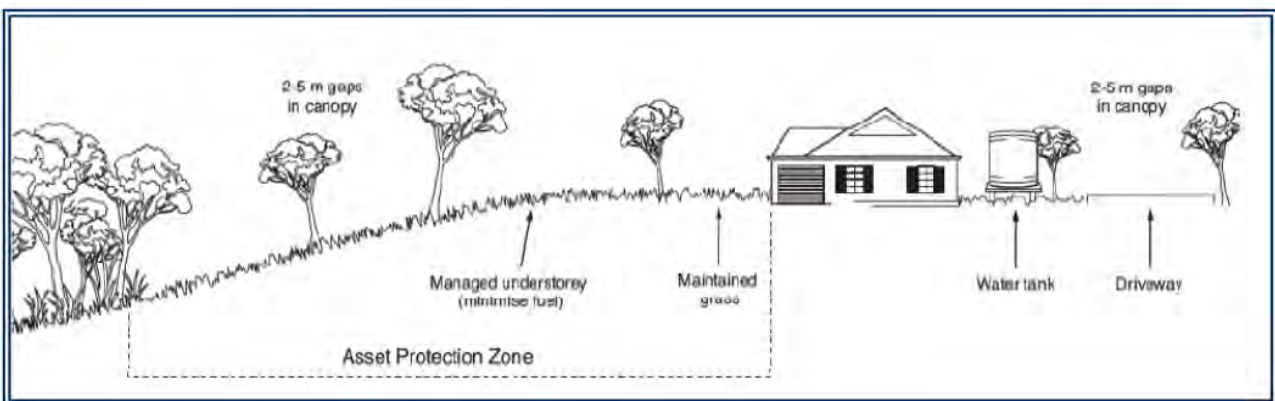


Plate 1 Asset Protection Zone

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 defensible 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 defensible 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.

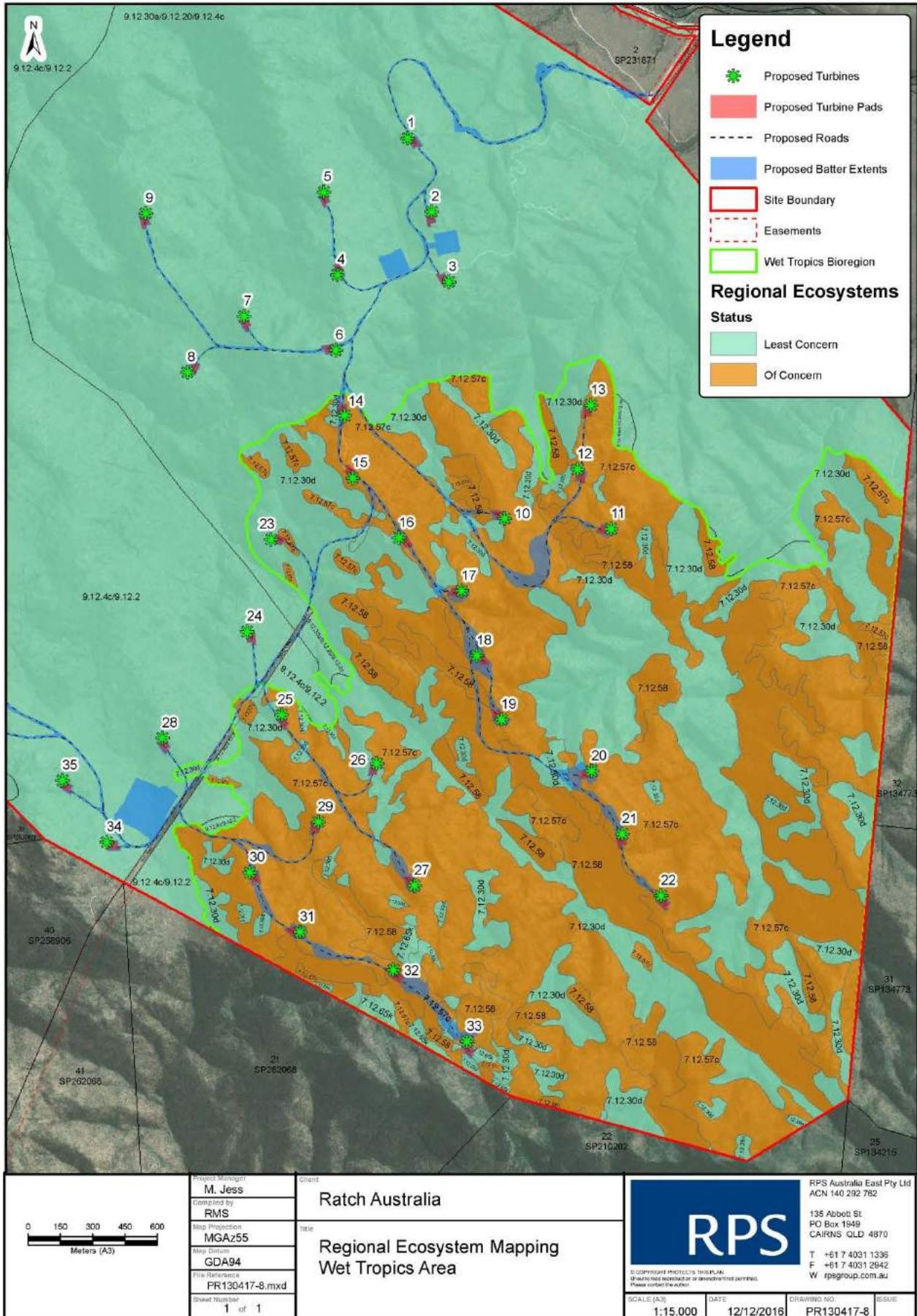


Figure 4 Regional Ecosystems on Southern Extent of MEWF.

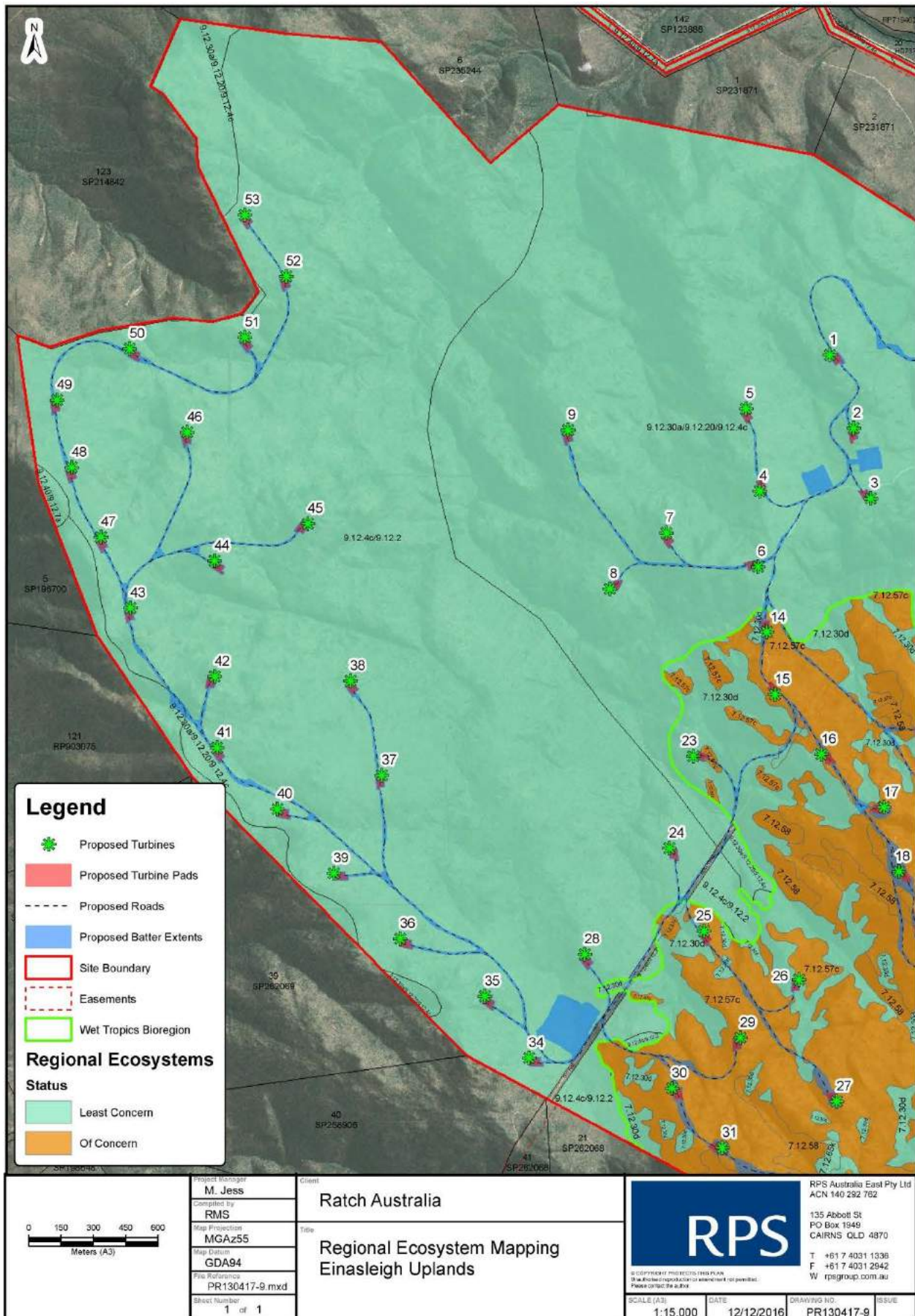


Figure 5 Regional Ecosystems on Northern extent of MEWF

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 <i>Eucalyptus cloeziana</i> , <i>Corymbia abergiana</i> , <i>C. citriodora</i> , <i>E. portuensis</i> , <i>E. reducta</i> , <i>E. lockyeri</i> , <i>C. leichhardtii</i> , <i>E. atrata</i> , <i>E. pachycalyx</i> and <i>E. shirleyi</i> , 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 <i>Syncarpia glomulifera</i> , <i>Corymbia abergiana</i> , <i>Eucalyptus portuensis</i> , <i>Allocasuarina littoralis</i> , and <i>Xanthorrhoea johnsonii</i> , on moist and dry uplands and highlands on granite and rhyolite. Shrubland/low woodland mosaic with variable dominance, often including <i>Eucalyptus cloeziana</i> , <i>Corymbia abergiana</i> , <i>E. portuensis</i> , <i>E. reducta</i> , <i>E. lockyeri</i> , <i>C. leichhardtii</i> , <i>E. atrata</i> , <i>E. pachycalyx</i> , <i>E. shirleyi</i> and <i>Homoranthus porteri</i> , 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	<i>Eucalyptus reducta</i> , <i>E. granitica</i> , <i>Corymbia dimorpha</i> , <i>C. citriodora</i> and <i>Syncarpia glomulifera</i> 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 <i>Acacia</i> spp. and/or <i>Lophostemon suaveolens</i> and/or <i>Allocasuarina littoralis</i> and/or <i>Eucalyptus lockyeri</i> subsp. <i>exuta</i> .	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.	<p>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.</p> <p>c: Mosaic burn 25-70% of the target area. Across the landscape burn different areas at different intervals to add diversity.</p> <p>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.</p> <p>Maintain appropriate mosaic burning in surrounding country. Do not protect from fire but do not burn deliberately.</p>	<p>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 <i>Banksia plagiocarpa</i>). Too frequent a fire frequency may result in a net loss of nutrients over time from an already nutrient poor system.</p> <p>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.</p> <p>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.</p> <p>This is mainly a self protecting community.</p>

Regional Ecosystem	Description	Season	Intensity	Interval	Strategy	Issues
<p>9.12.4 / 9.12.2: Einiasleigh Uplands Bioregion</p>	<p>(9.12.4) - <i>Eucalyptus shirleyi</i> or <i>E. melanophloia</i> with <i>Corymbia peltata</i> and/or <i>C. leichhardtii</i> low open woodland to low woodland on acid volcanic rocks. / (9.12.2) - Open forest commonly including <i>Eucalyptus portuensis</i>, <i>E. crebra</i> (sens. lat.), <i>Corymbia clarksoniana</i>, <i>C. citriodora</i> on steep hills and ranges on acid and intermediate volcanics close to Wet Tropics boundary.</p>	<p>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..</p>	<p>Low, with occasional moderate or high.</p>	<p>5-10 years.</p>	<p>Apply mosaic across the landscape at a range of frequencies to create varying stages of post-fire response</p>	<p>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. <i>Callitris intratropica</i> are fire sensitive. Protect from fires until plants old enough to replace seed pool.</p>
<p>9.12.30 / 9.12.20 / 9.12.4: Einiasleigh Uplands Bioregion</p>	<p>(9.12.30) - <i>Corymbia leichhardtii</i> +/- <i>Callitris intratropica</i> +/- <i>Eucalyptus shirleyi</i> low woodland to low open woodland on rhyolite hills. / (9.12.20) - <i>Eucalyptus pachycalyx</i> and <i>E. cloeziana</i> woodland on acid volcanics. / (9.12.4) - <i>Eucalyptus shirleyi</i> or <i>E. melanophloia</i> with <i>Corymbia peltata</i> and/or <i>C. leichhardtii</i> low open woodland to low woodland on acid volcanic rocks.</p>	<p>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</p>	<p>Low, with occasional moderate or high.</p>	<p>5-10 years.</p>	<p>Apply mosaic across the landscape at a range of frequencies to create varying stages of post-fire response.</p>	<p>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. <i>Callitris intratropica</i> are fire sensitive. Protect from fires until plants old enough to replace seed pool.</p>

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 I


Bushfire Hazard Mapping


Legend


Cadastre (50k)


 Cadastre (50k)

Bushfire hazard area (Bushfire prone area)

 Very High Potential Bushfire Intensity

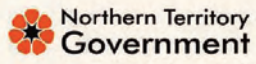
 High Potential Bushfire Intensity

 Medium Potential Bushfire Intensity

 Potential Impact Buffer

Appendix 2

Northern Australia Fire Information (NAFI) Reports



Custom area

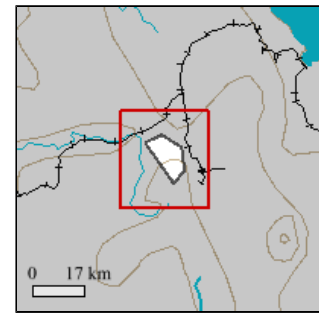
Fire History Report



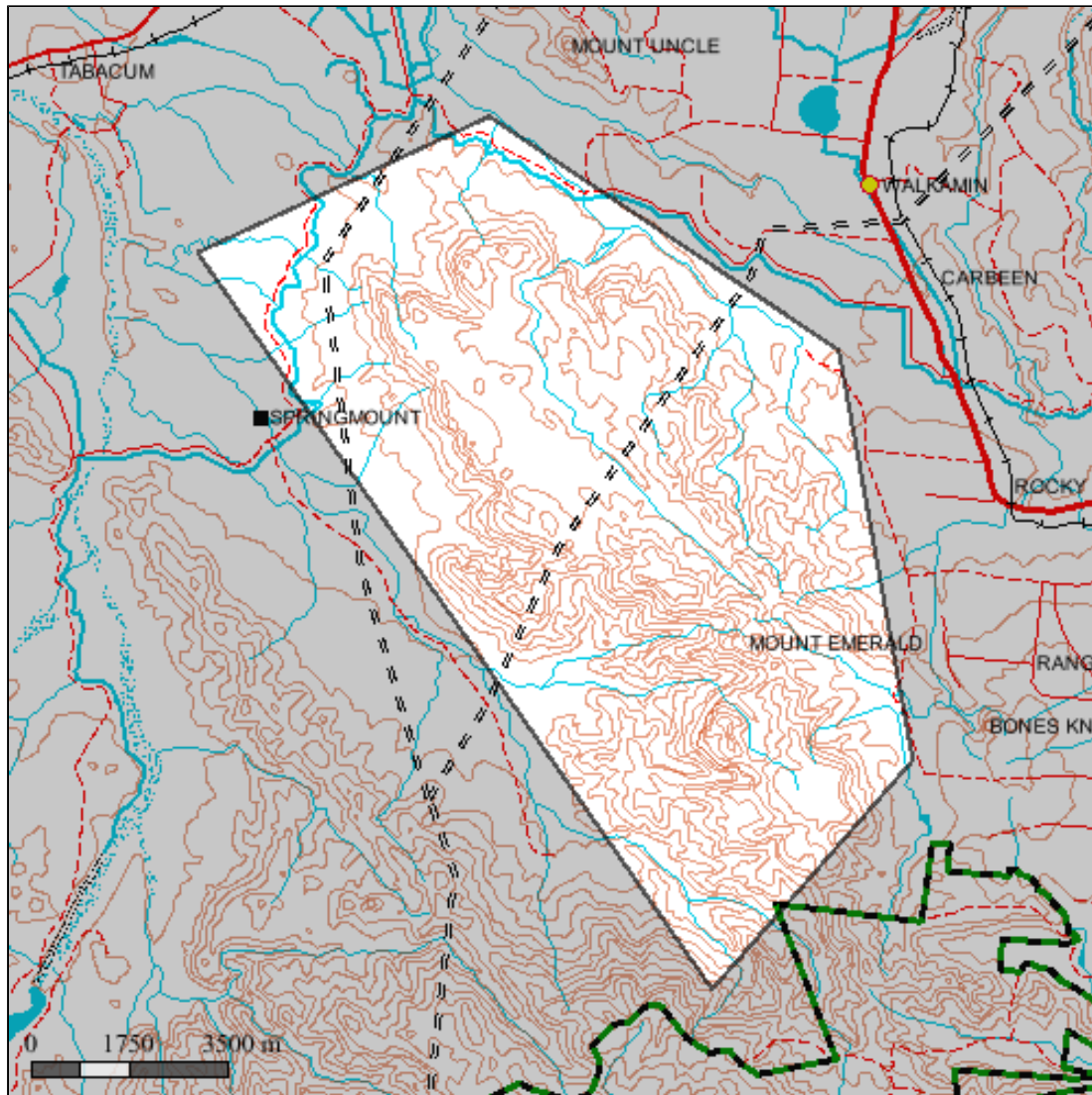
Custom area

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

Mean max temp (deg C)
 Mean min temp (deg C)
 Average rainfall (mm)
 Average days of rain

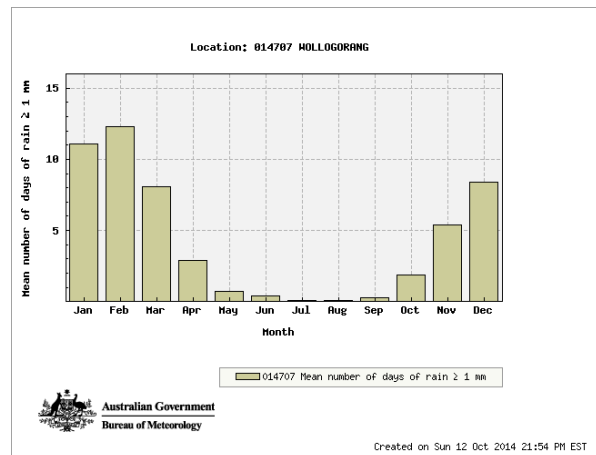
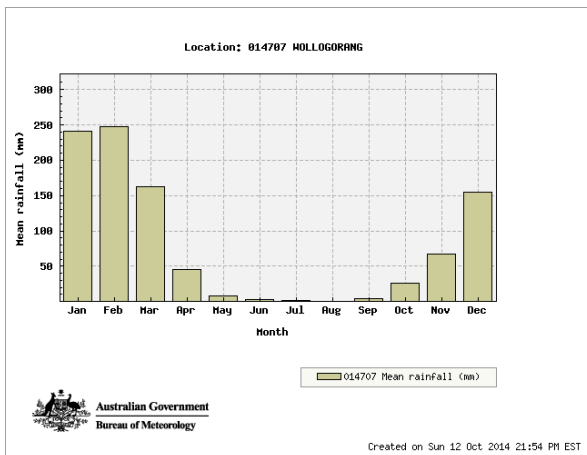
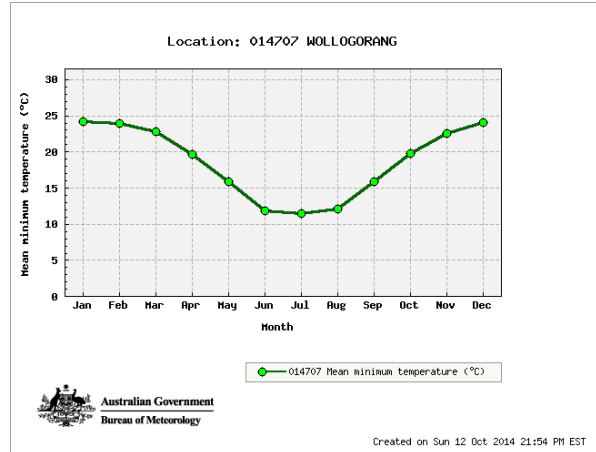
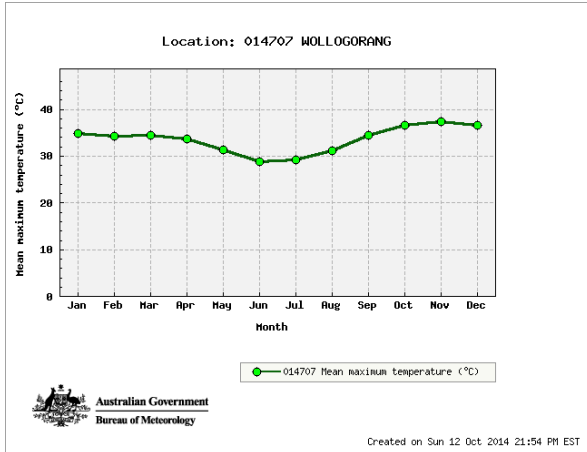
Annual Values

33.6
 18.7
 973.3
 51.7

Years of record

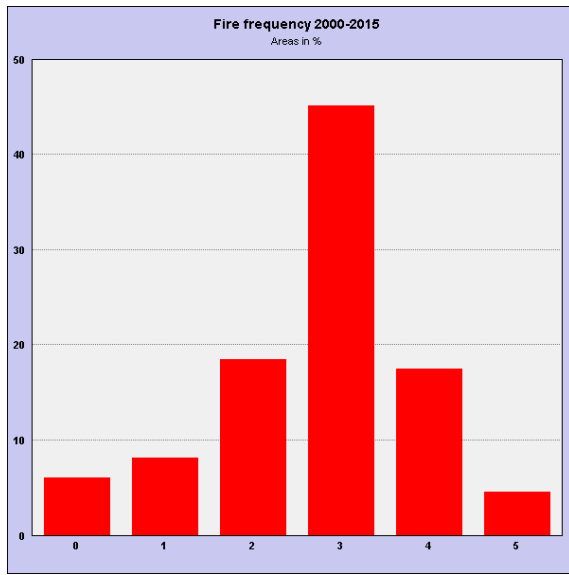
31
 31
 38
 38

Climate summaries from Bureau of Meteorology (www.bom.gov.au)



Custom area Fire History

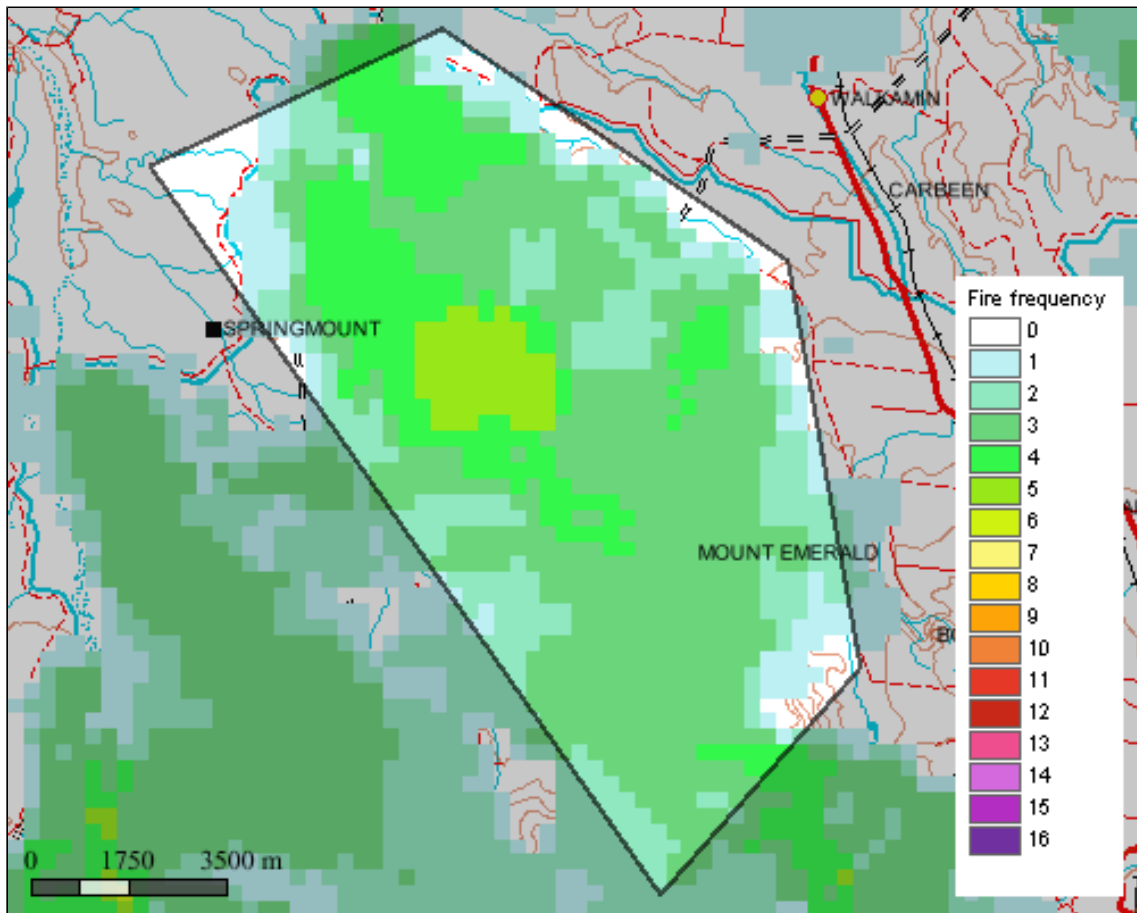
Fire frequency 2000-2015



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



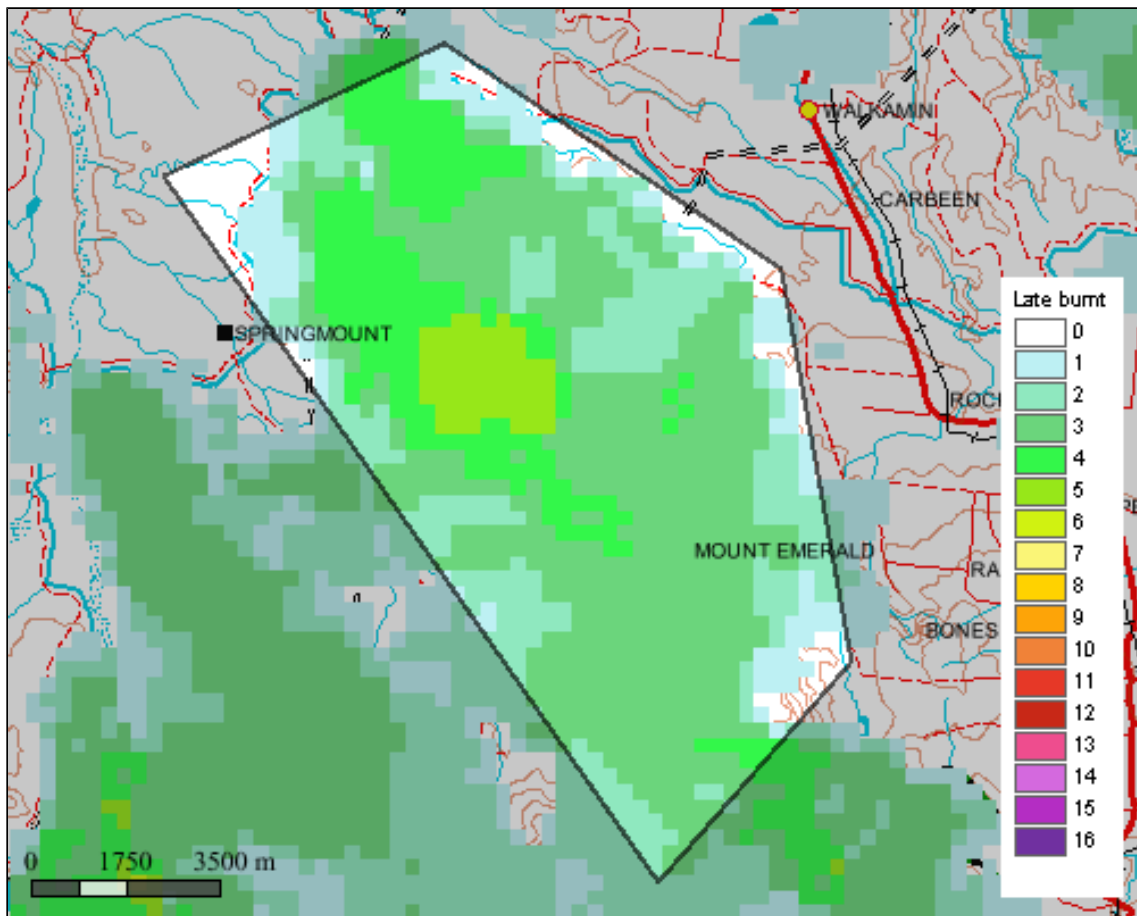
The fire frequency(250m) Layer is derived from satellite imagery sourced from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Terra satellite
Spatial Resolution: 250m x 250m pixels (at Nadir).

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

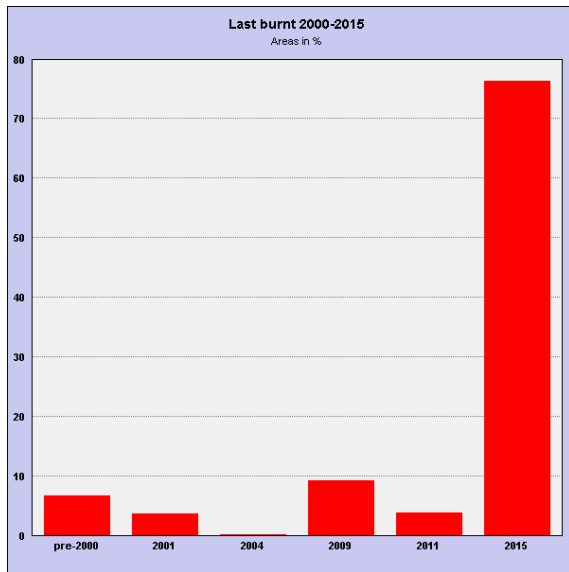
Late fire frequency 2000-2015



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).

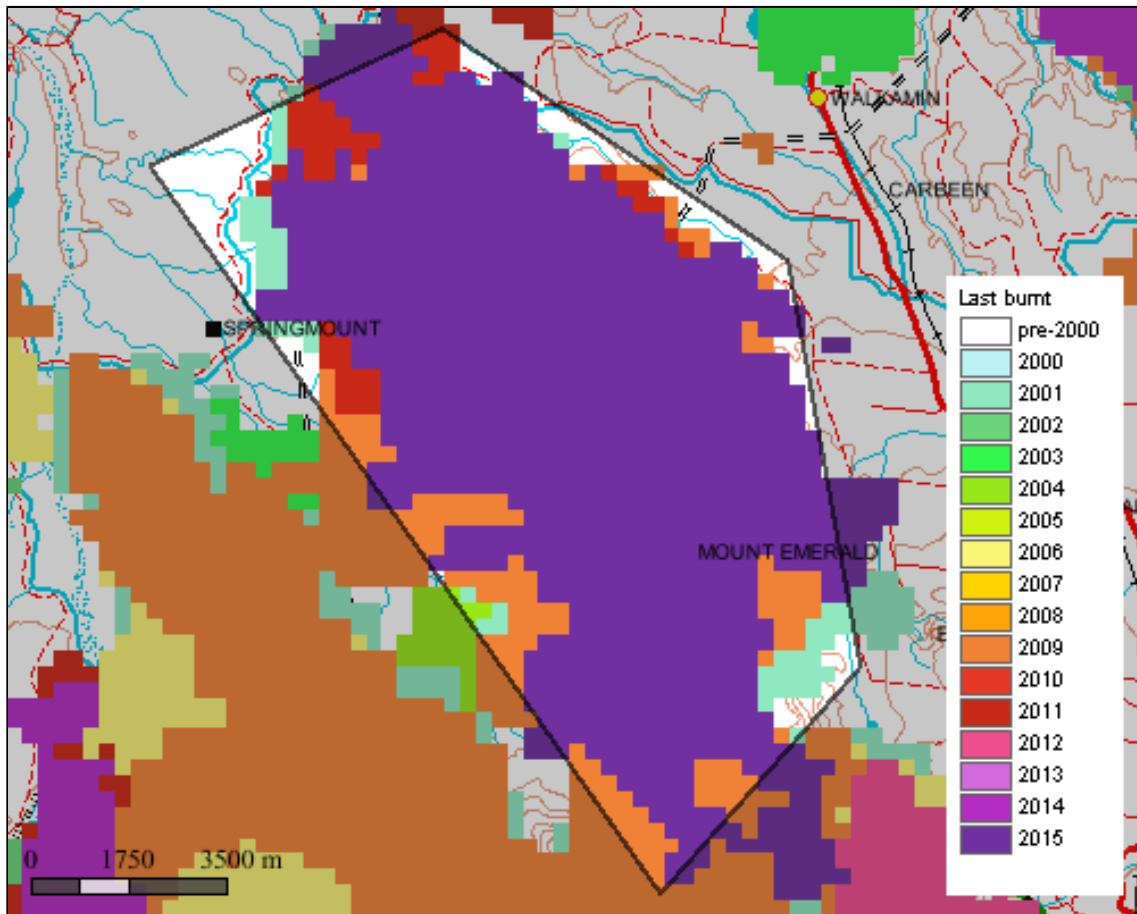
Year last burnt 2000-2015

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.	<i>[Contractor to insert]</i>	During operation
	3	The Contractor will advise RFSQ and Mareeba Shire Council of the contact details for the site (including after-hours contact details).	<i>[Contractor to insert]</i>	During operation
Fire Equipment	4	Vehicles will be regularly inspected and cleared of vegetation build-up.	<i>[Contractor to insert]</i>	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.	<i>[Contractor to insert]</i>	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.	<i>[Contractor to insert]</i>	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.	<i>[Contractor to insert]</i>	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.	<i>[Contractor to insert]</i>	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).	<i>[Contractor to insert]</i>	During operation
		Access roads are to be provided within the Project area in accordance with NSW RFS (2006).	<i>[Contractor to insert]</i>	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.	<i>[Contractor to insert]</i>	During operation
	12	Existing fence lines and access tracks will be maintained to assist in the control of fire.	<i>[Contractor to insert]</i>	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.	<i>[Contractor to insert]</i>	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.	<i>[Contractor to insert]</i>	During operation
	15	Oxygen and fuel gas cylinders will not be stored together, with a minimum of 3 metres between cylinders.	<i>[Contractor to insert]</i>	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."	<i>[Contractor to insert]</i>	During operation

PREVENTION				
Aspect	ID	Management Action	Responsibility	Timing
Other	17	Open fires will not be allowed in the Project area.	<i>[Contractor to insert]</i>	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.	<i>[Contractor to insert]</i>	During operation
	20	The contractor shall establish and maintain Managed Fuel Zones in accordance with this BMP.	<i>[Contractor to insert]</i>	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.	<i>[Contractor to insert]</i>	During operation
Equipment	2	Fire fighting equipment will be checked and maintained on a regular basis.	<i>[Contractor to insert]</i>	During operation
	3	Testing of alarm systems, escape routes and fire extinguishers will be conducted during weekly environmental inspections.	<i>[Contractor to insert]</i>	During operation
Housekeeping	4	Site personnel will maintain excellent housekeeping standards of storage areas and construction areas to minimize potential sources of flammable material.	<i>[Contractor to insert]</i>	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, <i>[contractor to insert position title]</i> 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.	<i>[Contractor to insert]</i>	During operation

RESPONSE												
Aspect	ID	Management Action	Responsibility	Timing								
		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.										
	4	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 <i>[contractor to insert position title]</i> 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.	<i>[Contractor to insert]</i>	During operation								
	5	If a fire in the Project Area is considered to be of low threat to human and environmental values by <i>[contractor to insert position title]</i> , the RFSQ will monitor the fire and liaise with other stakeholders where required.	<i>[Contractor to insert]</i>	During operation								
Communication	6	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.	All site personnel	During operation								
	7	In the event that a significant bushfire occurs within the Project area, the Contractor will follow the communication protocol outlined below. <table border="1"> <thead> <tr> <th>Service</th> <th>Location and Phone Number</th> </tr> </thead> <tbody> <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> </tbody> </table>	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	<i>[Contractor to insert]</i>	During operation
	Service	Location and Phone Number										
	Ambulance	Cairns and Hinterland Local Area Service Network: (07) 4032 8615										
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State Emergency Services (SES)	Cairns: (07) 4032 8682											
8	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 <i>[contractor to insert position title]</i> .	<i>[Contractor to insert]</i>	During operation									
9	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.	<i>[Contractor to insert]</i>	During operation									
10	It will be the responsibility of <i>[contractor to insert position title]</i> 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 <i>[contractor to insert position title]</i> will be responsible for contacting the appropriate fire fighting authorities.	<i>[Contractor to insert]</i>	During operation									

RESPONSE				
Aspect	ID	Management Action	Responsibility	Timing
Responsibility	11	It will be the responsibility of <i>[contractor to insert position title]</i> to ensure the evacuation of buildings and affected areas within the Project area to a pre-arranged emergency meeting point.	<i>[Contractor to insert]</i>	During operation
	12	<i>[Contractor to insert position title]</i> will be responsible for liaisons with local authorities such as the Fire Service and Mareeba Shire Council on a as needs basis.	<i>[Contractor to insert]</i>	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 <i>[contractor to insert position title]</i> 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.	<i>[Contractor to insert]</i>	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.	<i>[Contractor to insert]</i>	During operation
	3	The Contractor will review training needs and protocols on an annual basis.	<i>[Contractor to insert]</i>	During operation
Reporting	4	All fire incidents will be reported to <i>[contractor to insert position title]</i> . The person who observes the incident is responsible for reporting the incident.	<i>[Contractor to insert]</i>	During operation
	5	Fire and safety training undertaken by site personnel will be recorded and maintained.	<i>[Contractor to insert]</i>	During operation
	6	Relevant information will be provided in the monthly Project Report.	<i>[Contractor to insert]</i>	During operation