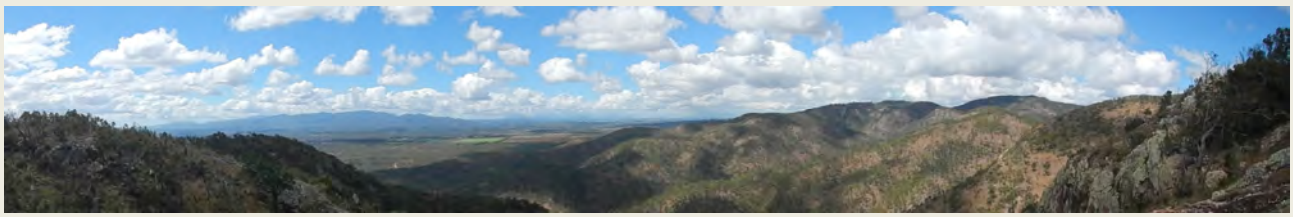
Appendix J

Weed and Pest Management Plans



Weed Management Plan

Mt Emerald Wind Farm

2016 - 2020

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

September 2016

Weed Management Plan

2016 to 2020

Mt Emerald Wind Farm

Simon Gleed

9th September 2016

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

Disclaimer

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

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

Document Status

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

Distribution

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

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1.0 SUMMARY

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

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

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

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

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

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

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

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

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

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

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

2.0 INTRODUCTION

2.1 Project Description

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

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

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

2.2 Project Components

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

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

2.3 Purpose and Objectives of Weed Management Plan

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

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

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

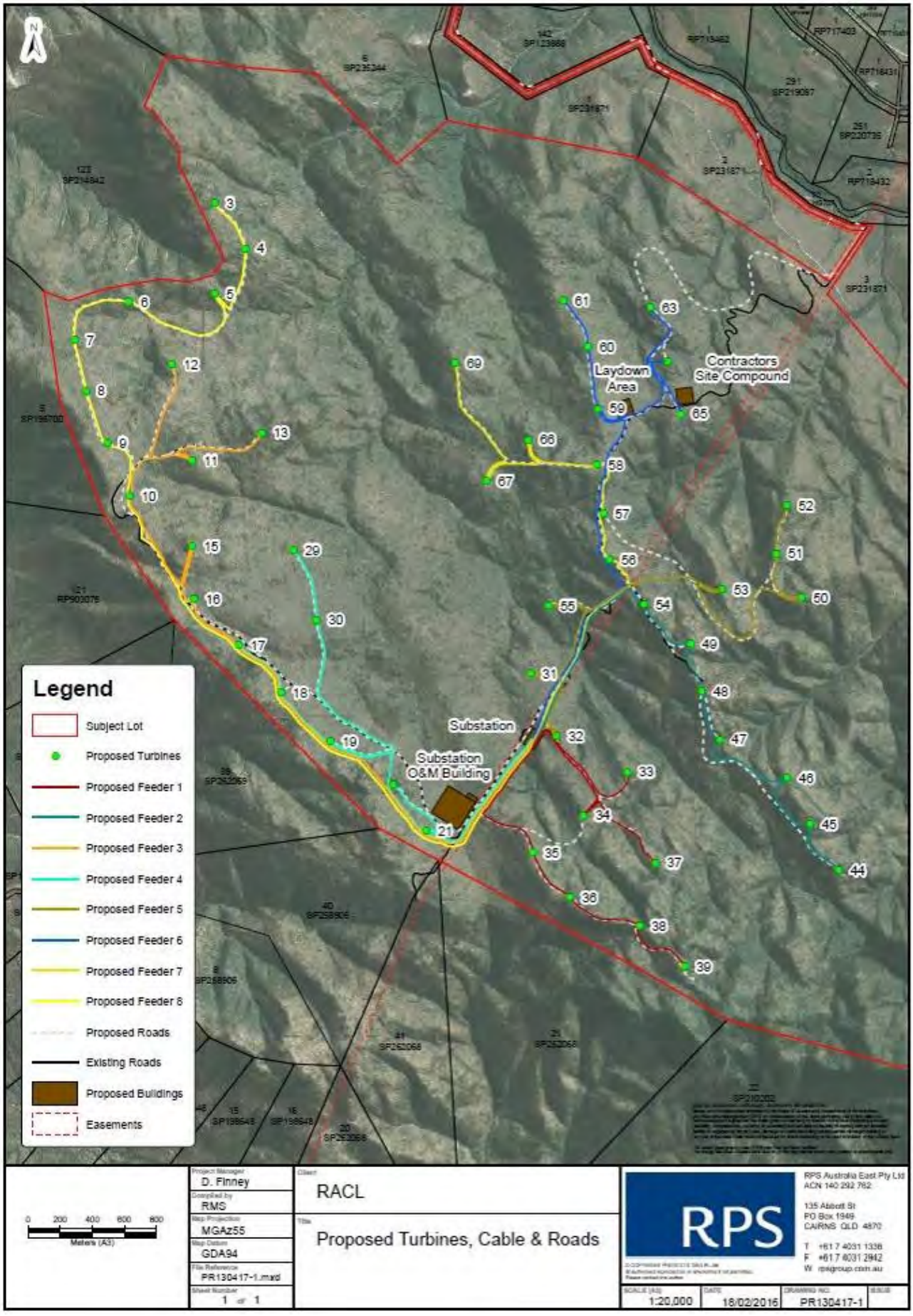


Figure 1. Layout of the Mt Emerald Wind Farm

2.4 Legislative Context

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

2.4.1 *Land Protection (Pest and Stock Route Management) Act 2002* (Queensland)

Declaration of weeds under Queensland's *Land Protection (Pest and Stock Route Management) Act* 2002 (LP Act) imposes a legal responsibility for control by all landowners on land under their management. Declared weeds are given a status of class 1, class 2 or class 3. The descriptions and legal obligations for the declared weed classes are as follows:

A Class 1 weed is one that has the potential to become a very serious weed in Queensland in the future. All landholders are required by law to keep their land free of Class 1 weeds. It is a serious offence to introduce, keep, release or sell Class 1 weeds without a permit.

A Class 2 weed is one that has already spread over substantial areas of Queensland. By law, all landholders must attempt to keep their land free of Class 2 weeds and it is an offence to possess, sell or release these weeds without a permit.

A Class 3 weed is one that is commonly established in parts of Queensland. Landholders are not required to control a Class 3 declared pest plant on their land unless a pest control notice is issued by a local government because the weed is causing or has potential to cause an negative impact on an adjacent environmentally significant area. It is an offence to supply a Class 3 weed.

Weeds not declared under the LP Act may still be declared at a local government level under local laws (see Mareeba Shire Pest Management Plan).

Declared weeds found on or in the vicinity of the Mt Emerald Wind Farm site are listed in **Table 1** under the following section.

2.4.2 Mareeba Shire Pest Management Plan 2015 to 2020

The Mareeba Shire Council lists priority pest plants in its Mareeba Shire Pest Management Plan 2015 to 2020 (MSPMP). Priority weeds are given a ranking, where weeds with higher scores are a higher priority for control. The highest score that a priority weed can be scored is 45. The priority weeds occurring in or near the Mt Emerald Wind Farm site are listed and categorised in **Table 1**.

Table1. Priority weeds listed under local law, nationally and Queensland legislation.

Weed species	MSPMP Score	WONS	LP Act	On wind farm site?
Parthenium (*Parthenium hysterophorus*)	35.9	Yes	Class 2	No
Bellyache Bush (*Jatropha gossypifolia*)	35.0	Yes	Class 2	No
Rubber Vine (*Cryptostegia grandiflora*)	33.2	Yes	Class 2	No
Lantana (*Lantana camara*)	29.5	Yes	Class 3	**Yes**

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

The following extract from the Mareeba Shire Pest Management Plan relates to the legal requirement for landholders to control class 1 and 2 declared pest plants as regulated by the LP Act. The extract also refers to priority weeds species listed in the shire's pest management plan.

> "Where an infestation of a class 1 or 2 plant or animal or one identified in the "Priority Pest Plan" is identified by Council's Pest Management Officer, a notice under the Land Protection (Pest and Stock Route Management) Act or Local Law will be served to destroy all declared weeds on the property within seven (7) and twenty-one (21) days (or other length as required by the circumstance i.e. notices will give the landholder a reasonable and sufficient period of time for each particular circumstance to take the required action). Council hereby delegates the authority to serve notice to the Chief Executive Officer and Pest Management Officer generally under the Land Protection (Pest and Stock Route Management) Act and its Local Laws."

2.4.3 Weeds of National Significance

The Australian, state and territory governments have compiled a list of thirty-two *Weeds of National Significance* (WONS). Nomination of a weed for inclusion on the WONS list is based the species' invasiveness, impacts, the potential to spread, environmental and socio-economic values.

Two species from the WONS list occur in the Mt Emerald Wind Farm project site: the shrubs Lantana (*Lantana camara*) and Bellyache Bush (*Jatropha gossypifolia*). A small population of Lantana is found under a powerline tower, and one juvenile plant of Bellyache Bush was observed around the 80 m wind monitoring tower.

Seven other WONS terrestrial weed species that occur regionally or in the vicinity, but are not found in the wind farm site include: Gamba Grass (*Andropogon gayanus*), Rubber Vine (*Cryptostegia grandiflora*), Parthenium (*Parthenium hysterophorus*), Cat's Claw Vine (*Dolichandra unguis-cati*), Climbing Asparagus Fern (*Asparagus plumosus*), Ground Asparagus (*Asparagus aethiopicus*) and Madeira Vine (*Anredera cordifolia*).

3.0 WEED MANAGEMENT PLAN

3.1 Existing Environment and Current Weed Status

The following summary information regarding the existing environment, which has been described in detail in the EIS (Environmental Impact Statement), and the current status and distribution of weeds in the wind farm project area forms the baseline information needed to form the framework of the monitoring component of this Weed Management Plan. Reference should also be made to detailed documents that have been published about the environmental characteristics of the Mt Emerald Wind Farm site, such as the EIS and any relevant supporting reports.

3.1.1 Description of existing environment

The Mt Emerald Wind Farm site is characterised by steeply dissected hills, rocky terrain and areas of precipitous ridges and ravines. The broad geology of the site is mapped as the Walsh Bluff Volcanics, which comprises fine-grained rhyolite.

The predominant vegetation cover over the project site is a mosaic of sclerophyll woodland, shrubland and heathland. Weeds are virtually absent from remnant vegetation.

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

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

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

A feature of the montane heathland and shrublands at high elevation is the presence of rock pavements and areas of poorly vegetated rock outcrops. This particular habitat supports few large species because of the near-absence of soil or growth medium on their surfaces. The soil that does develop is trapped in rock hollows and scoops and crevices between rock plates and boulders. The soil is developed from small plants such as lichens, mosses and the remains of rock ferns (Cheilanthes spp.). These plant matter integrates with weathered rock material to form a soil that has the texture of peat, where in wetter times the absorbent nature of the medium is able to store water for longer periods.

Plants on rock pavements include the Resurrection Plant (*Borya septentrionalis*), *Pseudanthus ligulatus*, scattered shrubs of *Grevillea glossadenia*, *Plectranthus* species (including the threatened *P. amoenus*) and occasionally sentinel specimens of Cypress Pine (*Callitris intratropica*). Grasses are sparsely represented and can include Five Minute Grass (*Tripogon loliiformis*) and *Eriachne humilis*. *Eriachne mucronata* is often found around the edges of rock pavements. Some rock pavements are entirely covered by Firegrass (*Schizachyrium pachyarthron*).

Land surrounding Kippen Drive from Springmount Road to the low sections of the Herberton Range before the road ascends into the wind farm site is highly modified through long-term disturbance and farming. Consequently, this section of the project site carries the highest proportion of weeds and the most serious weeds. Grader Grass (*Themeda quadrivalvis*) is considerably problematic along this section of the access into the wind farm site. Grader Grass is also gradually entering higher sections of the site and has been introduced by recent machinery operations.

3.1.2 Significance ridge environment and key plant habitats

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

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

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

3.2 Current Weed Status

Some weeds are established within the project footprint, and most probably as a result of construction of the 275 kV powerline and its associated track network. Some zones of the site have suffered longer term weed incursions as a result of grazing and regular vehicle movements at lower elevation, particularly along Kippen Drive.

The most significant manifestation of weed invasion is along and adjacent to both sides of the main access road into the site along Kippen Drive. In this section, loss of native woodlands through prior land clearing, plus road verge maintenance have resulted in large areas being infested and dominated by weedy grasses and shrubs including Grader Grass (*Themeda quadrivalvis*), Stylo (*Stylosanthes scabra* and other species), Hyptis (*Hyptis suaveolens*) and Stinking Passion Flower (*Passiflora foetida*). These are invasive weeds which pose a significant threat to the high quality environments higher up in the wind farm site if allow to establish.

Higher on the site, where traffic, machinery and human movement is less frequent, weed presence is found wherever land has been cleared and modified. Weeds observed on the site at higher elevation include Praxelis (*Praxelis clematidea*), Molasses Grass (*Melinis minutiflora*), Guinea Grass (*Megathyrsus maximus*), Thatch Grass (*Hyparrhenia rufa*) and Mission Grass (*Cenchrus polystachyum*). Occurrences of Giant Rat's Tail Grass (*Sporobolus natalensis*), American Rat's Tail Grass (*S. jacquemontii*) and Lantana (*Lantana camara*) are found in containable populations around the existing 275 kV powerline and towers.

An important baseline observation is that the invasive weeds listed above (with the exception of isolated occurrences of Praxelis) are absent from remnant vegetation areas. In this regard, ridges, rocky slopes and undisturbed land is in pristine condition and holds significantly high levels of natural integrity and condition.

3.3 Priority Weed Species on the Mt Emerald Wind Farm

For the purposes of this Weed Management Plan, priority weeds are the species that have been identified as posing the highest risk of causing environmental harm in a site-based context. Any declared weeds as listed under Queensland or National legislation, or local government laws will be managed accordingly.

3.3.1 Invasive weeds

Invasive weeds, including grasses and broadleaf plants, quickly adapt to disturbed environments and can rapidly outcompete native species and dominate a disturbed site. They spread quickly and are responsible for significant levels of environmental damage displacing native plants and habitats.

Weeds contribute to changed fire regimes, which negatively affect the structure, flora and habitat values of native vegetation. On the Mt Emerald Wind Farm site, invasive grasses and other weeds are a significant threat to the natural values of the project area. Invasive weeds place adverse and unnatural pressure on the integrity and function of the vegetation of all aspects of the wind farm site, and notably the function of threatened plant habitats. Tall weedy grasses and other lower growing introduced grasses are given priority status in this weed management plan for control and ongoing management.

Typical invasive weeds present on the Mt Emerald Wind Farm site include; Grader Grass, Thatch Grass, Guinea Grass, Molasses Grass, Signal Grass, Mission Grass, two species of Rat's Tail Grass and Lantana. The priority weeds on the site are listed in **Table 2** and reference should be made to the weed schedule in **Appendix A** for other weed management priorities.

Table 2. Priority weeds on the Mt Emerald Wind Farm site (listed in order of importance).

			MEWF Management Priority		
Weed	**LP Act**	**Threats**	**Kippen Drive**	**WTG site**	**Notes**
Grader Grass (*Themeda quadrivalvis*)	-	Invasive. Increases unnatural fire risk. Displaces ground flora.	Very High	Very High	Encroaching into WTG site on lower slopes.
Mission Grass (*Cenchrus polystachyum*)	-	Invasive. Increases unnatural fire risk. Displaces ground flora.	Very High	Very High	Main patches under 275 kV powerline in WTG site. Spot occurrences along Kippen Drive.
Giant Rat's Tail Grass (*Sporobolus natalensis*)	Class 2	Invasive and fire risk.	-	Very High	Under 275 kV powerline towers in WTG site.
Thatch Grass	-	Invasive and increase fire risk.	Very High	Very High	Only one incidence seen on

			MEWF Management Priority		
Weed	**LP Act**	**Threats**	**Kippen Drive**	**WTG site**	**Notes**
(*Hyparrhenia rufa)*					northern approach track into WTG site. Isolated along Kippen Drive. Control early.
American Rat's Tail Grass (*Sporobolus jacquemontii*)	Class 2	Invasive and fire risk.	Very High	Very High	Under 275 kV powerline towers in WTG site and along Kippen Drive.
Molasses Grass (*Melinis minutiflora*)	-	Invasive. Increases unnatural fire risk. Displaces ground flora.	Medium	Very High	Main area around watercourse crossing under powerline in WTG site.
Signal Grass (*Urochloa decumbens*)	-	Invasive. Increases unnatural fire risk. Displaces ground flora.	Medium	High	Only small areas in WTG site - control early.
Rhodes Grass (*Chloris gayana*)	-	Invasive, increases unnatural fire risk. Displaces native species.	High	-	Small patches along Kippen Drive.
Guinea Grass (*Megathyrsus maximus*)	-	Invasive. Increases unnatural fire risk. Displaces ground flora.	Medium	High	Isolated on WTG site. Along Kippen Drive. Control early.
Hyptis (*Hyptis suaveolens*)	-	Increases risk of hot fires. Invasive and lowers integrity.	High	High	Along Kippen Drive and encroaching up lower northern slopes.
Lantana (*Lantana camara*)	Class 3	Invasive. Increases unnatural fire risk. Displaces ground flora.	High	Very High	Isolated along Kipen Drive and under 275 kV powerline tower in WTG site.
Sicklepod (*Senna obtusifolia*)	Class 2	Invasive. Displaces native vegetation. Difficult to eradicate.	-	Very High	Isolated record at 80 m wind monitoring tower when first constructed. Not seen in 2016. Vigilance required.

NOTES

A hyphen (-) in the table indicates that the species has not been recorded at a location; or the species is not listed under the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act), Mareeba Shire Pest Management Plan (MSPMP) or WONS (Weeds of National Significance). If a species is indicated as not being observed at a location this does not infer that the species is absent - weed surveillance should update presence if a weed is a new detection.

LP Act: Declared weed status under the *Land Protection (Pest and Stock Route Management) Act 2002*.

MSPMP: Priority score under the Mareeba Shire Pest Management Plan.

WONS: Indicates if the species is listed as a Weed of National Significance.

Threats: Describes the main threats and potential impacts that the species could cause once established.

MEWF Management Priority: This is the site-specific Mt Emerald Wind Farm priority ranking for management of weeds. It is based on invasiveness, current population sizes, potential to affect fire ecology and whether a species is considered to impose a significant threat to sensitive environmental areas. Very High - requires to be managed as a priority; High - requires early intervention and management; Medium - requires to be managed on a regular basis; Low - requires to watched and managed if deemed problematic.

Kippen Drive: Refers to the flat, modified land that will be used as the primary access from Springmount Road to the base of the wind farm site.

WTG site: Refers to all the land in which the wind farm operational infrastructure will be located and begins at the base of the hill at the terminus of Kippen Drive and extends into all ridges and land at higher elevation where WTG's, access roads, cabling network, lay-down pads, substation and compound infrastructure will be located.

3.4 Potential Impacts of Weeds

The following impacts are relevant to the pre-construction, construction, operation and decommissioning stages of the Mt Emerald Wind Farm. The main triggers for weed invasion and outbreaks are:

- Disturbance of the natural ground surface. This provides good opportunities for weeds to occupy soil where no natural competition would otherwise exclude weeds. Disturbance or modification can be in the form of new excavation work; introduction of foreign soil material and roadbase; and trampled or flattened vegetation.
- Weeds being introduced into a site on machinery and vehicles; which often includes weed-contaminated soil and roadbase or construction materials.
- Repeated use of herbicide can modify a natural surface. Often one species of weed is killed by the herbicide, but another species of weeds replaces the former species. For example, Bluetop and Praxelis will often colonise areas that were once infested with noxious grasses.

Invasive weeds displace native plants and habitats by out-competing native plants for resources. Weeds prevent native seedling recruitment and retard germination of seed. They contribute to changed fire regimes, which affect the structure, flora composition and habitat values of native vegetation. On the Mt Emerald Wind Farm site, invasive grasses and other weeds pose a significant threat to the natural values of the project area.

The key impacts that weeds cause to natural environments are:

- **Changed fire regimes** through increased fuel loads (tall, dense grasses) and the generation of flammable fuel loads that burn hotter and more fiercely than native grasses.
- **Displacement of native plant species** by outcompeting smaller plants. For example, the critically endangered wattle *Acacia purpureopetala* (Purple-flowering Wattle) is found in the wind farm project footprint, and has a low growing habit which would quickly be smothered by invasive grasses.
- **Modification and degradation** of the quality of remnant habitats for flora and fauna. For example, on the wind farm site, many native species of flora and fauna rely on specialist habitats to survive: some species are only found on this site and in the local region.
- **Habitat destruction**: intense fire events destruct and incinerate hollow logs (important for wildlife); kill trees (nectar source for bats and birds); and destroy soil seed banks and the thin veneer of soil matter found around rock pavements.
- **Increased soil erosion**: widespread, unnaturally hot fires caused by weedy grasses can promote higher levels of soil erosion by burning out native grasses and patches of woody shrubs that protect the soil surface.
- **Pathogens and diseases** such as Phytophora root rot, scale insects, and fungal diseases can be introduced by weeds.
- **Expanding impacts**: large areas of weeds promote more weed growth and the scale of the problem increases and causes more widespread environmental impacts.

3.5 Weeds and Fire

Altered fire dynamics may occur as a result of increased fuel loads developing adjacent to newly cleared areas where weeds establish. A changed fire ecology can result in the elimination of certain native plant species or the promotion of different plant functional groups, and consequently, change the micro-habitats for species of flora and fauna.

Invasive grasses such as tall species like Grader Grass, Mission Grass, Thatch Grass, increase fuel loads and introduce unnatural fierce and intense fire events in sensitive habitats. Even a blanket covering of lower growing grasses such as Molasses Grass and Signal Grass carry very hot, unnatural fires.

The priority weeds identified within the wind farm project area and along the access road of Kippen Drive, which are considered to pose the highest threats to natural values are listed in the weed schedule for the Mt Emerald Wind Farm, are included at the end of this document.

3.6 Weed Dispersal and Sources of Contamination

Weeds are plants either not native to Australia, or species that grow outside of their natural range and become problematic. They are opportunistic and can quickly establish at disturbed sites, where for example, construction works break the natural ground surface. Once native ground covers such as grasses have been removed, a modified environment is available for weeds to quickly establish.

Weeds are dispersed and brought into previously weed-free areas by various means. Weeds can be "transported" by,

- wind dispersed seeds (daisies for example);
- animals in their fur;
- seed consumed by the animal;
- human activity.

Dispersal of weeds by humans is one of the main factors in how weeds become established at construction sites and around infrastructure such as roads, farms and powerline corridors. Examples of typical reasons why construction can lead to weeds being introduced are:

- Heavy machinery and vehicles carrying weed seed trapped in soil and mud on tyres and tracks and implements. For example, weeds can be transported by excavators, contractor light vehicles, graders, dozers, tractors, water trucks and even delivery trucks if they pass through weed contaminated roads and access points.
- Contractor vehicles such as slashing tractors pose a notable risk after working in weed infested areas. For example, a tractor slashing Grader Grass along Kippen Drive will invariably carry Grader Grass seed in the slasher and other tractor components. If allowed past an uncontrolled point to higher elevation into the site, the potential to spread the weed is high.
- Dozers, graders and any earthmoving machinery used for constructing and widening roads has a high risk of introducing new weeds into a site. For example, small turnout drains dozed within the hilly part of the wind farm site already have developing populations of Graders Grass.
- Road-base material, gravel and quarry aggregates are often a carrier of weed seed and consequently, new weed introductions.

- Vehicles and machinery that have travelled from high risk weed infected areas heighten the risk of weeds being introduced into a weed-free or low weed level sites.

3.7 Roles and Responsibilities

The Principal Contractor, contractors, sub-consultants and personnel have a responsibility to avoid and minimise the impact of weeds, which pose a threat to the condition and function of the natural landscape within the Mt Emerald Wind Farm site.

Weeds require considerable costs to eradicate and manage, particularly when infestations become large and widespread, at which stage they cannot be effectively controlled. Understanding the roles and responsibilities for good weed management helps reduce annual costs and increases management efficiency.

3.7.1 Principal contractor

The Principal Contractor of the Mt Emerald Wind Farm project is responsible for:

- Implementing and updating this Weed Management Plan.
- Designing, constructing and management of a weed washdown bay and machinery cleaning area.
- Prioritising weed management actions according to this Weed Management Plan.
- Identifying relevant weed species listed under the Queensland *Land Protection (Pest and Stock Route Management) Act 2002* and complying with the requirements for management of declared plant species.
- Identifying and directing weed management practices to the priority weed species according to this Weed Management Plan.
- Identifying appropriate site-specific training and induction materials and procedures required for weed management.
- Maintaining records of inductions and training given to contractors, sub-consultants and workers.
- Ensuring that contractors, sub-consultants and workers that use vehicles, machinery and equipment known to spread weeds undertake appropriate training.
- Investigating and taking corrective actions in relation to new records of weeds or weed population expansions being detected in the wind farm project area.
- Scheduled reporting, monitoring and maintenance of records relating to weed management in the wind farm project site.

3.7.2 Contractors, sub-consultants and personnel

Contractors, sub-consultants and personnel engaged in work practices that have the potential to transport or spread weeds into the wind farm site are responsible for:

- Fulfilling duties as directed by the Principal Contractor in relation to weed management.
- Identifying significant habitats for flora and fauna, and ensuring weed management work methods are of a standard that avoids or minimises harm to the natural environment.
- Undertaking site-specific weed management inductions and training before commencing work. All inductions must be signed off by the Principal Contractor after completion.
- Complying with the weed management requirements as directed by the Principal Contractor.

- Reporting to the Principal Contractor new weed species, and unusual or expanding weed populations.
- Requesting further advice and clarification from the Principal Contractor in relation to weed species identification, uncertainties and knowledge gaps before proceeding with the related weed management issue.
- Ensuring that the equipment and products used for weed management is legal, in safe working condition and meets current specifications and regulatory requirements.

3.8 Weed Management Actions

The following weed management actions (**Table 3**) are recommended for the early prevention of weed movement from the Kippen Drive area higher up into the wind farm site and to achieve the overall management objectives of the Weed Management Plan. Additional steps or actions may be required if considered necessary to address unexpected circumstances.

Table 3. Weed management actions and responsibilities.

	Weed Management Action	Responsibility
1	**Adopt** Weed Management Plan.	MEWFPL
2	**Implement** Weed Management Plan and follow weed management protocols and procedures.	Principal Contractor, Environment Officer, contractors and personnel.
3	**Machinery Washdown Bays**. Before heavy machinery commences work in the WTG site, construct a permanent machinery and vehicle washdown bay at the base of the wind farm site at the terminus of Kippen Drive. Implement operational procedures such as washdown log, signage and directional entry control points.	Principal Contractor
4	**Control Priority Weeds**: Before construction commences, control the following weeds inside the wind farm site (i.e. at elevation and around the 275 kV powerline and towers): Giant Rat's Tail Grass, American Rat's Tail Grass, Mission Grass, Molasses Grass, Signal Grass, Grader Grass, and Lantana. Check and control priority weeds found around the 80 m wind monitoring tower. Kippen Drive: slash, contain and control the entire length from the base of the wind farm site to Springmount Road.	Principal Contractor, contractors and personnel.
5	**Contain Weed Infestations**: Keep the access road free of weeds, with particular attention to Grader Grass and any other tall grasses. Maintain a 2 m wide weed-free clear zone each side of Kippen Drive. The weed-free clear zone should allow for 2 m clearance each side of the largest expected vehicle or machinery that will enter the site.	Principal Contractor, contractors and personnel.
6	**Before Construction of WTG Site**: At construction, establish machinery and vehicle washdown facility within the WTG site within the contractors compound or suitable area. This is to control and limit soil movement into the ridge country south of the 275 kV powerline (highly sensitive environment).	Principal Contractor
7	**Practice Good Weed Management**: Always work from the cleanest, weed-free areas towards contaminated areas.	Principal Contractor, contractors and personnel.
8	**Monitor**: monitor weeds throughout ALL stages of the wind farm.	Environmental Officer
9	**Review Weed Management Plan**: amend and adapt weed management practices as required throughout the duration of the construction and operational stages of the wind farm.	Environmental Officer, principal Contractor.

3.9 Principles of Weed Control and Management

It is recommended for the following weed management principles to apply to the Mt Emerald Wind Farm.

3.9.1 Weed prevention and early detection

Prevention of weed contamination and spread should be the first objective in weed management. Vigilance and early detection of weeds prevent small and new populations becoming problematic and uncontrollable. Any new or unusual weeds sightings should be reported immediately to allow for rapid control to occur to prevent outbreaks of new populations. Locations should then be added to a register of all known weeds locations.

Contractors and workers should be alerted to the presence and location of high priority weeds across the wind farm project area. This can be achieved through inductions and toolbox meetings.

Be vigilant of areas of weeds that have been controlled with herbicide as weeds quickly respond to changes in the soil condition and plant cover, and often a new species of weed will colonise a site treated with herbicide.

Roadbase, fill materials and sources of soil contamination should also be strictly monitored. Incidences of weed incursion or germination at newly prepared construction sites should be investigated immediately and corrective actions taken as a matter of priority.

3.9.2 Machinery washdown facility

For effective cleaning of potentially weed-contaminated vehicles and machinery it is important that the underside of the vehicle can be accessed with a high pressure water cleaner. A washdown bay with clear side access with a minimum height of 1.5 m between the lower side of vehicle and washdown base is preferred. Elevated washdown bays where the vehicle or machine stops on a grid allows users to direct high pressure cleaners to the areas of a vehicle where weed seed is most likely to adhere to the underside. High pressure cleaning and manual inspection should be completed for all accessible parts of the vehicle or machine.

The washdown bay base should be impervious and constructed with an adequate fall to allow for unimpeded drainage of washdown water and contaminated soil.

Washdown areas should be bunded to prevent overflow of washdown water and escape of contaminated soil and weed seed.

Washdown water should be drained, diverted and filtered into a suitably designed sediment trap that facilitates cleaning and disposal of seed-contaminated soil. Disposal of contaminated soil should be to a designated location, and not indiscriminately dumped at any location.

3.9.3 Prioritising weed management

Weed management is ongoing and must be performed throughout all stages of the Mt Emerald Wind Farm project: pre-construction, construction, operation and decommissioning.

All species of weeds on the wind farm site should be treated as undesirable and unwanted plants. Target control of priority weeds should be undertaken according to their ranking given in this Weed Management Plan. Reference should be made to the weed schedule in **Appendix A**. The distribution of weeds along Kippen Drive and in the WTG site is shown on the mapping in **Appendix B**.

Best results would be achieved by eradication of major weed infestations early in the project cycle, and application of progressive control measures throughout the life of the project.

The areas of the wind farm project that require urgent weed containment and control are along Kippen Drive and the lower slopes leading into the WTG site; and under or adjacent to the 275 kV powerline.

3.9.4 Managing the spread and introduction of weeds

Machinery work areas are to be minimised as much as possible and should be constrained to clearly defined and marked areas within the wind farm site. The creation of unplanned tracks, short-cuts, dump areas or random machinery movement should be treated as non-compliance.

Machinery is to be kept free of weed seed to prevent spreading weeds beyond infested areas. Use of the vehicle and machinery washdown facilities should be mandatory and records of each washdown should be kept and signed off.

Vehicles associated with the planning, surveying and construction phases of the project must be cleaned and inspected before entering the site. The number of vehicles accessing a particular section of construction during a single event should be limited to a practical minimum.

Do not use any introduced grasses, legumes or shrubs in revegetation or as soil stabilisation for erosion and sediment control in the WTG site and particularly not in environmentally sensitive areas south of the 275 kV powerline.

3.9.5 Weed control recommendations

Manually remove isolated specimens of weeds when first detected as part of the daily work routine (i.e. remove a clump of Mission Grass before it spreads).

It is important when managing priority invasive weeds such as Grader Grass to undertake mechanical (slashing) control measures before they seed. Where appropriate (i.e. along Kippen Drive. NOT in sensitive areas), the use of herbicide control over active weed growth is preferred; for example, new leaf growth of Grader Grass.

Consider all options to reduce herbicide use over time, and implement rehabilitation with native species. For example, invasive grasses along Kippen Drive could be slashed, controlled with herbicide over new growth and then the area revegetated to form thickets of native wattles as a replacement species.

Where clearing of vegetation is required, always work machinery from clean, weed-free areas and work towards weed infested areas. It is important weed seed is not carried back through reverse operation of machinery. For example, if an upgrade to Kippen Drive is required, it would be good practice to begin earthworks from the base of the wind farm site and work towards the Springmount Road intersection.

If excavated soil is required to be stockpiled from weed infected areas of the site, the soil should not be moved or stored in or near weed-free parts of the site.

A major source of new weed introductions into otherwise weed free areas is through the import and use of contaminated roadbase and fill materials. Roadbase and fill materials must be certified free of weeds as far as is practicable. It is strongly recommended suppliers' sources of these materials (from local quarries) are audited by the Environmental Officer. Serious weeds are imported into sites through contaminated quarry materials and include difficult to eradicate species such as Sicklepod and Siratro.

Weedy invasive grasses that generate higher than normal fuel loads or promote hot fires should not be allowed to establish. Considerably reduce the size or eliminate all populations of the following grasses within the WTG operational area of the project site: Mission Grass, Giant and American Rat's Tail Grass, Thatch Grass, Grader Grass, Guinea Grass, Molasses Grass and Signal Grass.

Contractors involved in weed control must be aware of the importance of the vegetation at higher elevations within the site, and should not apply herbicide in areas identified as environmentally sensitive. Appropriate training and inductions should be provided as part of the overall weed management strategy.

Weed control contractors and workers undertaking practical weed management should be suitably qualified in the areas of weed identification of target species and the appropriate level of control for each weed species. Workers must be able to apply the most appropriate control technique to any given weed situation.

The blanket application of herbicide in sensitive environmental areas is not advised or recommended. Off-target herbicide application is an unacceptable practice. The application of herbicides should be targeted, be specific to the weed, and should be kept to the minimum necessary to adequately control the weed.

The continuous use of herbicide around WTG footings or other concrete-soil interfaces should be avoided as permanent loss of plant cover often results in localised erosion of the exposed soil surface. It is recommended the establishment of low-growing forms of native grasses; for example, *Cleistochloa subjuncea* and Kangaroo Grass (*Themeda triandra*) and shrubs such as *Acacia calyculata*, *A. whitei* and *Jacksonia thesioides* and other native shrubs should always be promoted to expand into disturbed sites.

4.0 MONITORING, REVIEW AND TRAINING

4.1 Monitoring

Monitoring of weed populations, control methods, decreasing or increasing populations, problematic species and new detections should be continuous throughout all stages of the wind farm. It is the responsibility of the Principal Contractor and/or the Environmental Officer to ensure progressive records and observations of weed management are kept. The EIS describes in detail the baseline information relating to the condition of all parts of the wind farm site and recognises the weed-degraded Kippen Drive as a critical potential source of weed invasion into the relatively pristine high ridge country south of the 275 kV powerline.

The performance indicators outlined below are derived from the current condition of the wind farm site and are intended to be an important aspect of determining a successful approach to weed management on the Mt Emerald Wind Farm.

4.2 Performance Indicators

The following performance indicators will help identify that the most efficient and effective methods of weed management are being implemented throughout the construction and operational phases.

- Construction and operation of weed washdown bays. Vehicle and machinery washdown log records maintained, complete and signed off.
- Development of weed management training and induction material for contractors, sub-consultants and personnel.
- Weed management training and inductions delivered to contractors, sub-consultants and personnel.
- Ongoing weed surveillance, monitoring and reporting completed for entire wind farm site monthly or more frequently if deemed necessary throughout the construction phase, and every three months during the operational phase.
- New infestations of invasive, environmental and / or declared weeds do not occur across the wind farm site (including WTG sites, access roads and tracks, substation, maintenance facilities and construction compounds) either during or after the construction phase.
- Native flora expands into disturbed areas after construction.
- A net reduction in weed species and population sizes across the wind farm site.
- Eradication of Giant Rat's Tail Grass, Mission Grass, Molasses Grass, Grader Grass, Signal Grass and Lantana along the existing 275 kV powerline access tracks and within the WTG operational area.
- The Weed Management Plan is reviewed and amended annually or before if deemed necessary.
- Corrective actions are implemented methodically and diligently.

4.3 Review and Evaluation of the Weed Management Plan

The Mt Emerald Wind Farm Weed Management Plan has a currency life of four (4) years and is effective from 2016 to 2020. After this period a review of the plan will be undertaken. Updates, amendments and corrections to the plan will be made annually to reflect changes to weed statuses (new threats or decreases in threats) on the wind farm, changes to legislation, and other relevant amendments as deemed necessary.

It is the responsibility of the Principal Contractor and the Environmental Officer to undertake the review.

Changes, modifications and amendments to the plan may be required on an annual basis, or earlier if necessary. These changes should reflect improved management actions and reassess management priorities in terms of problematic weeds or new infestations.

4.4 Reporting and Recordkeeping

An annual Weed Management Plan Review report is to be compiled, which will report on the following:

- Records of vehicle and machinery washdowns will be required to be compiled for any facility established in relation to the site.
- Techniques and control methods and dates of weed management actions.
- Records of any new, expanding or problematic weeds.
- Records of weed-contaminated roadbase and construction materials brought into the site from external sources.
- Records of contractor non-compliance with weed management protocols.
- Recommendations for corrective actions, and if implemented prior to the annual report, the dates, types and effectiveness of the corrective actions.
- Development of a complaints recording system: dates, source of complaint and type of complaint.
- An annual weed audit and report by an independent monitoring botanist or suitably qualified person. Weeds are to be re-mapped.

4.5 Training

Staff and contractors of the Mt Emerald Wind Farm must be aware of the importance of high quality and efficient weed management.

Site-specific training and environmental awareness must be undertaken and delivered to all contractors prior to construction. New contractors who enter the project at later stages of the construction and operation of the wind farm will need to receive the same level of weed management training.

Training must be delivered as part of site induction and toolbox meetings, which should include the following components:

- An outline of why the Mt Emerald Wind Farm project site is important in a regional context; and what specific environmental values the site holds. For example, the site south of the 275 kV powerline is unique in respect to its high elevation, sensitive environment.
- Weed identification sheets or guides should be made available, and should be able to be accessed at any stage of the project.
- Training should identify the priority weeds species described in this Weed Management Plan for the Mt Emerald Wind Farm.
- Reporting procedures for informing the Environmental Officer of weed sightings, new populations or evidence of weed spread. A database of these records should be kept and regularly updated by the Environmental Officer.

5.0 PRIORITY WEED PROFILES

The following weed profiles are of the priority species identified as posing a significant threat because of their invasiveness, modification of natural fire ecology and potential to cause serious environmental impacts in the long-term.

Information regarding relevant control methods is available as a number of factsheets published by either the Queensland or Federal Government. It is recommended that these factsheets are kept on file and updated when necessary. All factsheets should be reviewed annually by the Environmental Officer.

	**Grader Grass** (*Themeda quadrivalvis*) A highly invasive grass, which often lines the sides of tracks and is introduced by machinery such as slashers and graders. The grass grows to over 1 m tall and is characteristically golden brown when the seed heads start to mature. This grass dominates both sides of Kippen Drive and is also steadily entering the site at higher elevation through increased frequency of vehicles and periodic grading of the track.
	**Mission Grass** (*Cenchrus polystachyum*) A highly invasive grass that can grow to 3 m tall. It significantly increases the risk of hot fires and displaces native vegetation.

	**Giant Rat's Tail Grass** (*Sporobolus natalensis*) - Class 2 A highly invasive grass and difficult to eradicate. grows to over 2 m tall and has a fine. narrow seed head. Increases fire risk and displaces native vegetation. Also similar to **American Rat's Tail Grass** (*Sporobolus jacquemontii*) - Class 2, which is a shorter grass to 75 cm tall and has the same degrading characteristics.
	**Thatch Grass** (*Hyparrhenia rufa*) Thatch grass can grow to 3 m tall. Because of its height, it creates an unnatural fire risk, which once established can facilitate hot wild fires. It is currently present as scattered plants along Kippen Drive and one or two incidences higher into the wind farm site.
	**Molasses Grass** (*Melinis minutiflora*) Molasses Grass forms very dense swards, which outcompete most native vegetation. The grass grows to about 1 m tall and poses a significant fire risk. It is established in linear patches along Kippen Drive and also just above the watercourse under the 275 kV powerline. It is identified by its "sticky" foliage, which also has a distinctive smell.

	**Signal Grass** (*Urochloa decumbens*) Signal grass is widespread in pastures, but is becoming increasingly problematic in woodlands where it displaces native vegetation and prevents native species from establishing. The grass forms dense patches to 60 cm tall or more. It creates an increased fire risk and once established under native woodland is difficult to eradicate.
	**Rhodes Grass** (*Chloris gayana*) This grass can grow to 2.5-3 m. It is a successful coloniser of disturbed land and when established becomes persistent in the landscape. It displaces native flora and heightens the risk of unnatural fires.
	**Guinea Grass** (*Megathyrsus maximus*) A tall invasive grasses that will favour marginally wetter conditions. It poses a high fire risk because of the size of the grass, and will easily outcompete native vegetation. Guinea Grass is presently only in small areas along Kippen Drive and one or two isolated occurrences at higher elevation.

	**Hyptis** (*Hyptis suaveolens*) An open branched, erect shrub that completely dries out during the dry season, at which time it increases the risk of unnaturally hot fires developing. It typically grows along the edges of tracks and some incursions are found on the lower slopes leading into the wind farm site. Its main occurrence is along Kippen Drive.
	**Stinking Passionflower** (*Passiflora foetida*) Stinking Passionflower is a sprawling vine which smothers native vegetation. It has tendrils which assist it to attach to other plants. It is often seen adjacent to roads and areas of frequent vehicle use. Some incursions are found on the lower northern slopes of the wind farm site and along Kippen Drive. It displaces native plants and lowers natural integrity.
	**Lantana** (*Lantana camara*) - Class 3 Lantana is a highly invasive dense, tangled shrub which can grow to 3 m tall. Its colourful flowers are a characteristic which makes it easy to identify. When established, Lantana forms thickets which can heighten fuel loads and cause unnaturally hot fires. The shrub also displaces native flora.

	**Red Natal Grass** (*Melinis repens*) This grass is not yet problematic in the wind farm site at elevation. It is often encountered as scattered individuals in woodland. But once established (as along Kippen Drive), it forms dense patches similar to that of Molasses Grass. It contributes to unnatural fires and displaces native vegetation when growing densely.
	**Sicklepod** (*Senna obtusifolia*) - Class 2 Sicklepod is an erect shrub that can grow to 2-3 m tall. When mature it forms dense stands which outcompete native vegetation. The species produces very hard-coated seeds which remain viable in the soil for several years, making this weed difficult to eradicate if allowed to establish.
	**Gambia Pea** (*Crotalaria goreensis*) Gambia Pea is an erect shrub growing to approximately 1 m tall. When established it forms dense thickets, which displace native vegetation. It produces hard-coated seeds (similar to Sicklepod), which remain viable in the soil for many years. Isolated patches are found on the northern slopes and along Kippen Drive.

APPENDIX A

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

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

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

NOTES

A hyphen (-) in the table indicates that the species has not been recorded at a location; or the species is not listed under the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act), Mareeba Shire Pest Management Plan (MSPMP) or WONS (Weeds of National Significance). If a species is indicated as not being observed at a location this does not infer that the species is absent - weed surveillance should update presence if a weed is a new detection.

LP Act: Declared weed status under the *Land Protection (Pest and Stock Route Management) Act 2002*.

MSPMP: Priority score under the Mareeba Shire Pest Management Plan.

WONS: Indicates if the species is listed as a Weed of National Significance.

Threats: Describes the main threats and potential impacts that the species could cause once established.

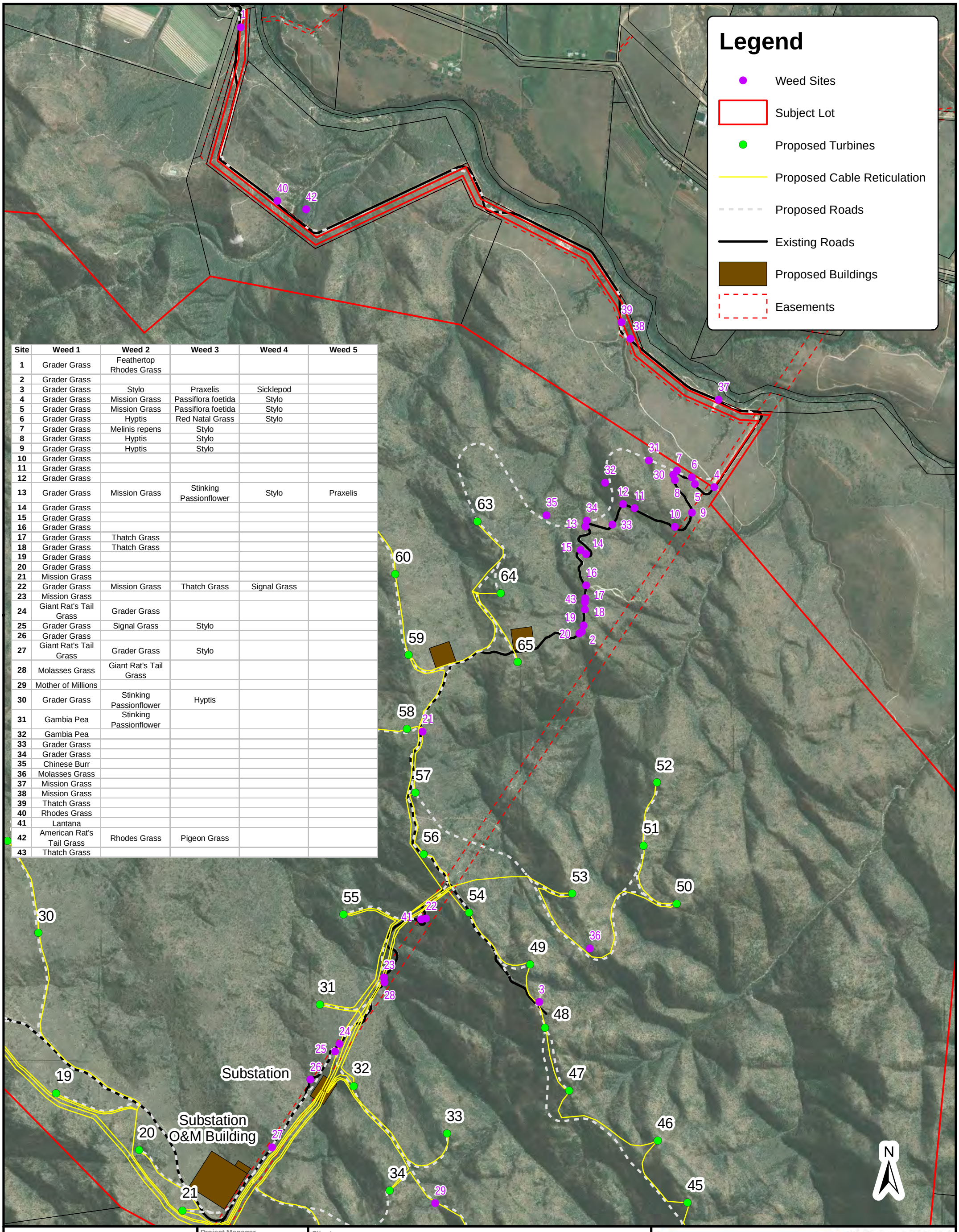
MEWF Management Priority: This is the site-specific Mt Emerald Wind Farm priority ranking for management of weeds. It is based on invasiveness, current population sizes, potential to affect fire ecology and whether a species is considered to impose a significant threat to sensitive environmental areas. **Very High** - requires to be managed as a priority; **High** - requires early intervention and management; **Medium** - requires to be managed on a regular basis; **Low** - requires to watched and managed if deemed problematic.

Kippen Drive: Refers to the flat, modified land that will be used as the primary access from Springmount Road to the base of the wind farm site.

WTG site: Refers to all the land in which the wind farm operational infrastructure will be located and begins at the base of the hill at the terminus of Kippen Drive and extends into all ridges and land at higher elevation where WTG's, access roads, cabling network, lay-down pads, substation and compound infrastructure will be located.

APPENDIX B

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



Site	Weed 1	Weed 2	Weed 3	Weed 4	Weed 5
1	Grader Grass	Feathertop Rhodes Grass			
2	Grader Grass				
3	Grader Grass	Stylo	Praxelis	Sicklepod	
4	Grader Grass	Mission Grass	Passiflora foetida	Stylo	
5	Grader Grass	Mission Grass	Passiflora foetida	Stylo	
6	Grader Grass	Hyptis	Red Natal Grass	Stylo	
7	Grader Grass	Melinis repens	Stylo		
8	Grader Grass	Hyptis	Stylo		
9	Grader Grass	Hyptis	Stylo		
10	Grader Grass				
11	Grader Grass				
12	Grader Grass				
13	Grader Grass	Mission Grass	Stinking Passionflower	Stylo	Praxelis
14	Grader Grass				
15	Grader Grass				
16	Grader Grass				
17	Grader Grass	Thatch Grass			
18	Grader Grass	Thatch Grass			
19	Grader Grass				
20	Grader Grass				
21	Mission Grass				
22	Grader Grass	Mission Grass	Thatch Grass	Signal Grass	
23	Mission Grass				
24	Giant Rat's Tail Grass	Grader Grass			
25	Grader Grass	Signal Grass	Stylo		
26	Grader Grass				
27	Giant Rat's Tail Grass	Grader Grass	Stylo		
28	Molasses Grass	Giant Rat's Tail Grass			
29	Mother of Millions				
30	Grader Grass	Stinking Passionflower	Hyptis		
31	Gambia Pea	Stinking Passionflower			
32	Gambia Pea				
33	Grader Grass				
34	Grader Grass				
35	Chinese Burr				
36	Molasses Grass				
37	Mission Grass				
38	Mission Grass				
39	Thatch Grass				
40	Rhodes Grass				
41	Lantana				
42	American Rat's Tail Grass	Rhodes Grass	Pigeon Grass		
43	Thatch Grass				

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Project Manager: M. Jess
Compiled by: RMS
Map Projection: MGAz55
Map Datum: GDA94
File Reference: PR130417-10.mxd
Sheet Number: 1 of 1

Client: RACL

Title: Weed Site Plan

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SCALE (A3)	DATE	DRAWING NO.	ISSUE
1:16,000	25/08/2016	PR130417-10	

Pest Management Plan

Mount Emerald Wind Farm, Herberton Range, North Queensland

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
V1	Report	MJ	DF	23/02/2016
V2	Report	MJ	LL	06/06/2016
Final	Report		MJ	16/11/2016

Approval for Issue

Name	Signature	Date
Mellissa Jess		16 November 2016

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1.0 Introduction

RPS Australia East Pty Ltd (RPS) has prepared the following Pest Management Plan (PMP) to minimise the potential for the spread of pest species as a result of the Mount Emerald Wind Farm (MEWF) project developed by RATCH Australia Corporation Ltd (RATCH). In particular this plan outlines how pest management will be undertaken in accordance with the requirements of the conditions issued under the Approvals listed Development Notice pursuant to the *Sustainable Planning Act 2009* (SPA) (**Section 2**).

This PMP provides an overview of the procedures required to minimise the introduction and spread of particular pests. For those species already present on the site, the plan will appropriately manage the increased risk they present to flora and fauna with the increased access to areas of the site as a result of the development. A separate Weed Management Plan has been developed for the site which will be used in conjunction with this plan where required.

This plan provides the framework to ensure controls to manage potential pest disturbance within and directly adjacent to the MEWF project in the Mareeba Walkamin district. This PMP establishes the objectives, management requirements and management actions to mitigate and manage the potential impacts that could arise from the introduction and increase in abundance of pest species within the project area.

1.1 The Project

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

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

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

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

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

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

1.2 Construction Details

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

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

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

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

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

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

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

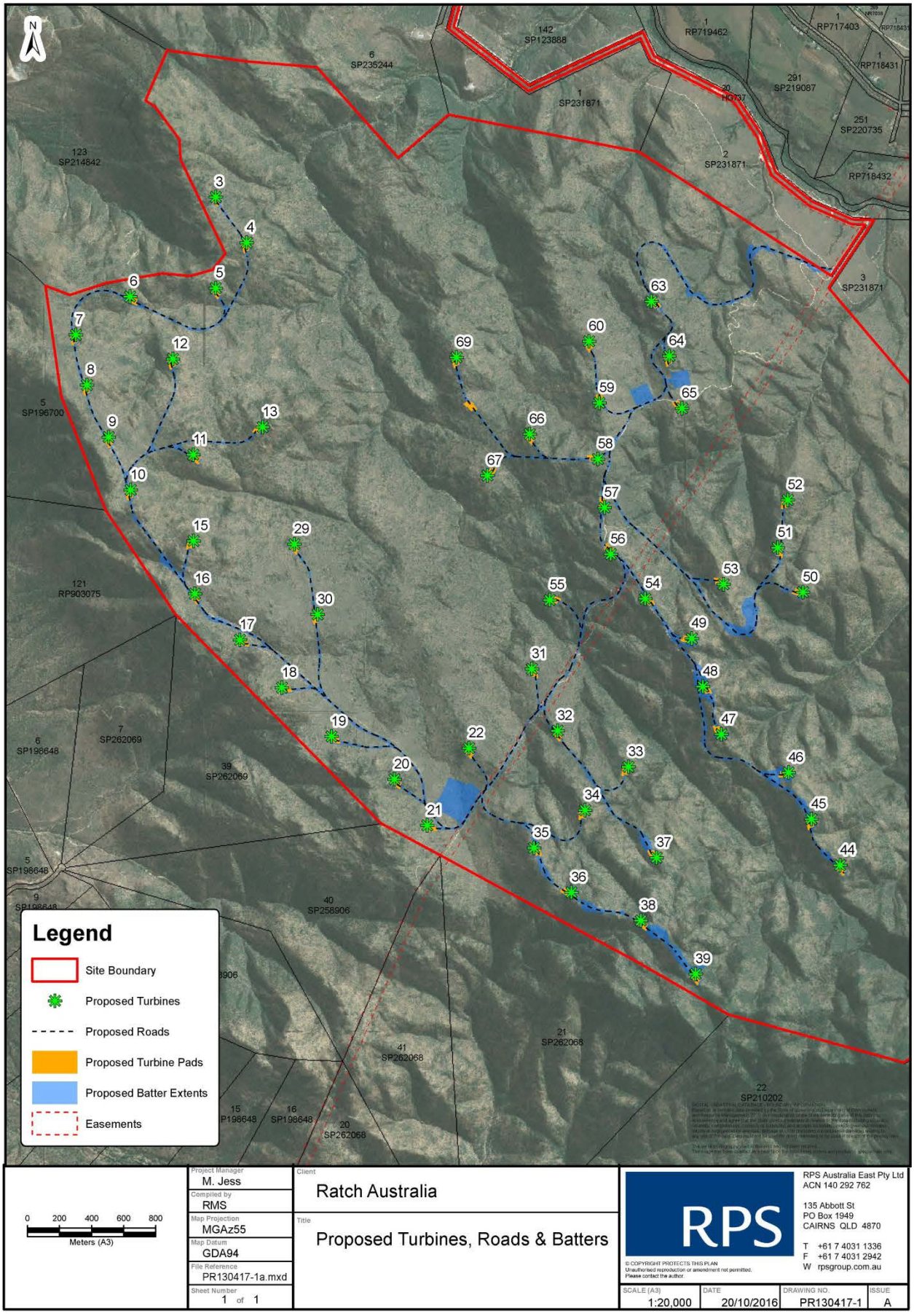

Figure 1 Project Site Location

1.3 Purpose

The objectives of the PMP are to:

- Facilitate compliance with the relevant commonwealth, state and local government legislation regulations and approvals;
- Provide a framework for MEWF to:
  - Identify, monitor and prioritise the appropriate management of pest species present at or pose a threat to the existing environment
  - Prevent and minimise the introduction and dispersal of pests onto the site and neighbouring properties;
  - Engage stakeholders including landholders and local communities in assisting in the identification and management of pests at the MEWF; and
  - Develop specific procedures as required during the project lifetime.

1.4 Scope

This report addresses all pest management planning requirements described in the MEWF Project Approval Conditions. Specifically, this report provides details-

- The incidence reporting of pest species on or near the project area;
- Impacts associated with the invasive/exotic species introduction and increase in abundance;
- Mitigation measures; and
- Evaluation of management efficacy.

2.0 Regulatory Requirements

2.1 Project Approvals

2.1.1 Sustainable Planning Act 2009

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

2.1.1.1 Ministerial Decision Notice

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

> *Submit to the chief executive administering SPA an Environmental Management Plan (EMP) prepared by a suitably qualified person(s). The EMP must:*
>
> *i. be generally in accordance with the Preliminary Environmental Management Plan prepared by RPS and dated November 2013 and the draft Statement of Commitments contained within Appendix A of the RPS Development Application Material Change of Use Report dated March 2012;*
>
> *ii. be based on the revised Turbine Location and Development Footprint Plan submitted in accordance with condition 2 of this approval;*
>
> *iii. include the following components,:*
>
> - *Weed and Pest management Plans (timing as required with the EMP).*

3.0 Roles and Responsibilities

The roles and responsibilities of the various stakeholders related to the management and actions of this PMP are outlined in **Table 1** below.

Table 1 Stakeholder Roles and Responsibilities

Role	Responsibility
Environmental Representative	Manage independent consultant and pest and weed contractors and maintain records, carry out quarterly environmental inspection of site, monitor and review the effectiveness of the PMP.
MEWF Project Manager	Manage pest contractors and maintain records of pest management for site.
All Employees	Report outbreaks and sightings of declared pests.
Pest Contractors	Implement pest control activities and ensure required specifications are met.
Independent Consultants	Implement pest control activities and ensure required specifications are met.

4.0 Relevant Legislation, Policy and Strategy

This section describes the relevant Commonwealth and Queensland legislation that applies to the management and control of pests and weeds.

Legislation	Description
Nature Conservation Act 1992 and Nature Conservation (Wildlife) Regulation 2006	The *Nature Conservation Act 1992 (NC Act)* provides for the conservation and management of Queensland's native flora and fauna. The Act prohibits the taking or destruction, without authorisation, of certain listed flora and fauna species. The *Nature Conservation (Wildlife) Regulation 2006 (NC Regulation)* lists the flora and fauna species presumed extinct in the wild, endangered, vulnerable, near threatened, least concern, international and prohibited. It states the declared management intent and the principles to be observed in any taking of or destruction for each group.
Land Protection (Pest and Stock Route Management) Act 2002	The *Land Protection (Pest and Stock Route Management) Act 2002* (The Act) is the overarching legislation with the main purpose to provide for: (a) pest management for land; and (b) stock route network management. The purpose of the Act is to be achieved mainly through the following— (a) establishing principles of pest management for land and stock route network management; (b) providing for pest management planning and stock route network management planning; (c) declaring animals and plants to be declared pests; (d) restricting the introduction, keeping or sale of declared pests; (e) preventing the spread of declared pests in the State, including, for example, preventing their spread by human activity; (f) establishing responsibilities for pest and stock route network management; (g) building and maintaining fences to prevent declared pest animals moving from a part of the State to another part; (h) establishing the Land Protection (Pest and Stock Route Management) Council to give advice and make recommendations to the Minister about managing pests and the stock route network; (i) providing for the establishment of pest operational boards; (j) constructing and maintaining travelling stock facilities on the stock route network; (k) monitoring, surveying and controlling pests and the movement of travelling stock. The Act requires that local government prepare a pest management plan for its area. The plan may include provision for the following— (a) achievable objectives under the plan; (b) strategies, activities and responsibilities for achieving the objectives; (c) strategies to inform the local community about the content of the plan and achievement of its objectives; (d) monitoring implementation of the plan and evaluating its effectiveness; (e) other matters the local government considers appropriate for management of declared pests in its area. The plan must however be consistent with the principles of pest management; the State pest management strategies; and the guidelines for pest management.

Legislation	Description
Biosecurity Act 2014	The *Biosecurity Act 2014* (the Act) was passed by Parliament and will come into effect on 1 July 2016 superseding the *Land Protection (Pest and Stock Route Management) Act 2002.* The Act deals with: ▪ pests (such as wild dogs and weeds) ▪ diseases (such as foot-and-mouth disease) ▪ contaminants (such as lead on grazing land) Decisions made under the Act will depend on the likelihood and consequences of the risk. This means risks can be managed more appropriately. The main biosecurity function of each local government will continue to be the management of invasive plants and animals in its area. A more comprehensive range of response tools and associated powers will be able to be tailored to address the unique nature and tactical challenges presented by individual biosecurity threats. Under the new Act, local governments, like other persons, will be obliged to take all reasonable and practical steps to minimise biosecurity risks posed by their activities. This is known as a general biosecurity obligation (GBO). To meet their own obligations, local governments may wish to consider formal planning processes for biosecurity risk management to demonstrate due diligence. Local government will only be able to enforce the GBO if the risk is related to invasive biosecurity matter. This Act replaces the Quarantine Act of 1908.
Queensland Pest Animal Strategy	The Queensland Pest Animal Strategy establishes a state wide planning framework, providing clear direction to government, community, industry and individuals for the management of pest and problem animals across the state. It gives a common basis for addressing current and potential pest problems that impact on primary industries, ecosystems, human health and the community's enjoyment of our natural resources. It also assists in the development of regional natural resource management planning. The following species or groups of species are covered in the strategy: ▪ introduced mammals and reptiles that have pest impact, including animals declared under the Act ▪ introduced pest birds ▪ introduced amphibians ▪ some native species in certain situations, including kangaroos, bats, native rats, native birds and locusts ▪ exotic pest fishes. The strategy is based on a number of accepted principles of pest management that have been considered for both pest and problem animals and incorporated into the desired outcomes, objectives and strategic action.
National Strategies	National strategies help government, industry and the broader community manage weeds in a coordinated manner at a national level. National strategies include: ▪ Australian Pest Animal Strategy (Department of the Environment, Water, Heritage and Arts) ▪ Threat Abatement Plans
Local Area Pest Management Plans	▪ Mareeba Shire Council -Weed and Pest Management Strategy 2015-2020 Requires that all Local Governments develop and implement a Local Government Area Pest Management Plan. The Pest Management Plan has therefore been developed in line with legislation and reflects Council's views towards natural asset management and the benefits of planning with stakeholder communication and on-ground actions.

5.0 Pest Species in the Project Area

The data used to inform this PMP has come from the following databases and reports:

- **MEWF Environmental Impact Statement**: Fauna assessments have been conducted on site since May 2010. The emphasis of the initial ecological surveys was to assess the general ecology of the site and to assess the presence/absence of Matters of National Environmental Significance (MNES) species for the referral process. Further surveys (from 2012) involved targeted surveys specific threatened species considered at risk of being impacted (i.e. Northern Quoll, Bare-rumped Sheathtail Bat and Spectacled Flying-fox). The majority of these surveys focussed on fauna; where flora surveys were undertaken at lower frequency and with less spatial coverage. Surveys occurred over a three year period; however the methodologies chosen to satisfy the requirements of the EIS Guidelines were to survey from August 2012 to September 2013 (i.e. to provide a seasonal survey effort).(RPS 2011, 2013)
- **EPBC Protected Matters Database of MNES**. This database applies a range of bio-models to predict the presence of species of flora and fauna and other MNES within a given radius of the site (a search parameter was prescribed limiting the search area to a 10 km radius around an approximate central point of the study area), as cited under the Commonwealth's *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- **Wildlife Online database**. This database is managed by the Queensland Department of Heritage and Environmental Protection (DEHP) and holds records animals that have either been sighted or collected within a given radius of the site (a search parameter was prescribed limiting the search area to a 10 km radius around an approximate central point of the study area).
- **Queensland Museum Biodiversity Database**. This database provides confirmed records of fauna species recorded within a specified area. Data from this source provides additional information on the known location of rare and threatened fauna species;

The above information determined the likelihood of a particular pest species occurring at or in the vicinity of the project site.

5.1 Pests

Following the review of available databases and reports, a number of declared (QLD) pest species were recorded from the project area (**Table 2**).

With the exception of the cane toad which was prevalent across the project site, only incidental observations were recorded of the dingo, wild dog, feral pig and feral cat. These observations were made during the wet season primarily around available watercourses.

There were **no** significant populations of any declared species on or within the vicinity of the project site.

The rabbit has only been recorded in desktop results and there were no confirmed sightings of the species on the project site.

Table 2 Pest Species Located on the Mount Emerald Wind Farm Project

Species Name	Survey/Desktop	Declared Species	# Potential Species Impact
Amphibian			
Rhinella marinus Cane Toad	Survey/ Desktop		The Cane Toad is poisonous at every stage of its life cycle and it's known to impact nearly all native frog larvae and many aquatic invertebrates. Cane toads are known to have caused a severe decline in small predatory mammal species across northern Australia since their introduction. The Northern Quoll is known to persist in FNQ despite the presence of the Cane Toad (research is yet to determine why) however there remain a large number of native vertebrate and invertebrate species that are impacted by this species (RPS, 2013).
Mammal			
Canus lupus dingo Dingo	Survey/ Desktop	Class 2	Dingoes prey on local native fauna and often carry parasites and pathogens.
Canus lupus familiaris Wild Dog	Survey/ Desktop	Class 2	Wild dogs prey on local native fauna and often carry parasites and pathogens.
Sus Scrofa Feral Pig	Survey/ Desktop	Class 2	Feral pigs damage crops, stock, property and the natural environment. They transmit disease and could spread exotic diseases such as foot and mouth if this was introduced to the country. (DAF, 2016)
Felis catus Feral Cat	Survey/ Desktop	Class 2	Feral cats prey on local native fauna and often carry parasites and pathogens.
Orictolagus cuniculus Rabbit	Desktop	Class 2	This species causes destruction of native vegetation and subsequent erosion. They compete heavily with native species for food and shelter therefore reducing the native species ability to survive predation.

#Refer to Species Fact Sheets for further information (**Appendix A**).

5.1.2 Risk of Pest Invasion

The confirmed presence of several threatened species within the MEWF project area increases the potential impact that pest species could have on the sites ecological values. In particular, the Northern Quoll and Bare-rumped Sheathtail Bat which have been confirmed on site may be impacted by the increase in pest numbers on the site. Therefore it is of particular importance to ensure the proposed project does not increase the opportunity for pest species to utilise the site.

Pest species can have been documented to have the following impact on native animals:

- Feral predators such as cats and wild dogs are known contributors to the decline of Northern Quoll across its range due to direct predation and competition for food which decreases the abundance of native prey (Oakwood, 2004). Fortunately, Northern Quolls are known to coexist with cane toads on the MEWF project site, however due to the species toxicity to a large number of native fauna, any reduction in opportunity for this species to breed is advised.
- Feral pigs are known to cause destruction of plants which results in invasion of weed species and changes to the vegetation composition and reduced water quality and availability.

Pests are known to congregate where resources are available, therefore they are likely to move into the temporary camp areas (construction phase) and permanent areas (operational phase) of the project for food and water. Therefore management strategies will be focused on these areas.

6.0 Management Strategies

All activities identified as being responsible from introducing pests will be subject to controls on site and managed under this plan

For successful management of pest species there are four principles:

(1) Identify the pests and the area of infestation;

(2) Avoid utilising and placing infrastructure in areas of know infestation;

(3) Prevent/minimise the translocation spread of pests by implementing sound work practices and promotion of risk awareness; and

(4) Control – identified pests to contain or eradicate populations as required.

A response to each of these four principles in relation to the MEWF project have been provided in **Table 3**.

Table 3 Response to of Pest Management Principles

Principle	Response
Identify	All pest species have been identified and regular monitoring of the site will continue on a quarterly basis to ensure any new species or infestations of known species are located.
Avoid	There are no areas of known infestations on the site, however no turbines or site compounds will be located near watering points or aggregation points.
Prevent/Minimise	To prevent/minimise the translocation spread of pests by implementing sound work practices and promotion of risk awareness, a number of procedures are incorporated into the *MEWF Environmental Management Plan* (2016) These are specifically: ▪ Water management procedures will require a focus on avoiding the clearing of artificial water points that provide a source of drinking water for vertebrate pests and additional breeding habitat for cane toads. ▪ Waste management will be required to ensure waste is managed at a central location on site and disposed of offsite to ensure any introduced species do no significantly increase numbers around these typical aggregate areas. This specifically relates to rat and mice species common to development and waste management areas.
Control/Eradicate	Controls are detailed in Section 4.2 below. An integrated approach in co-operation with State and Council representatives is required. The MEWF project site is relatively pest free which has been one of the factors in the persistence of several threatened species on the Mount Emerald massif.

6.2 Integrated Pest Management

Integrated pest management involves the use of a variety of control methods where a single control measure may be constrained by a number of environmental safety, spatial or logistical issues that prevent that control from working effectively on its own. There are four effective pest methods identified below, which if used in conjunction will ensure vertebrate pests are controlled. **Table 4** summarises those controls that will be typically required during construction and operation of the wind farm. Additionally, the Mareeba Shire Council provides further details on these controls in the Local Areas Pest Management Plan (2014) and the collaborations required with other stakeholders within the local government area.

6.2.1 Exclusion Fencing

Exclusion fencing is the installation of barriers including electric fencing or mesh fencing as a control option for vertebrate pests on smaller properties to exclude wild dogs and pigs, and sometimes macropod fauna (depending on the fence). It can only be used when the site is not too large or difficult to manage and there are not significant numbers of other large mammalian species that should be accessing the site. Typically

this works for species such as pigs and wild dogs as eradication is not a viable option of naturalised pests in these environments.

Due to the size of the site barrier fencing will be used in the case of protecting sensitive areas only).The most effective fences are fabricated sheep mesh held close to the ground with plain wire and supported on steel posts.

6.2.2 Baiting

Baiting for pest species is a cost effective and proven management control. However, the MEWF project site is a sensitive site for the Northern Quoll, a small endangered predatory mammal which may easily take any baits set for mice or declared pests. Therefore baiting on the MEWF project site is not recommended under any circumstances.

Pest baiting requires knowledge of what species are being targeted so that appropriate deployment and baits are utilised. Baiting requires trained and qualified personnel to utilise baits for pest control.

6.2.3 Trapping

Trapping is commonly used as an alternative to baiting due to the risks baiting poses to humans and wildlife, as it is a non-specific control. Some trapping methods are typically used domestically and can be used around the site compound for species such as rats and mice.

To date, large vertebrate species (pigs and wild dogs) have not been seen in significant numbers on site to warrant trapping on site. This control method requires trained and skilled personnel, and requires outsourcing to an expert contractor. Traps must be checked daily for success and pests must be removed in a humane and ethical manner.

6.2.4 Shooting

Shooting of pests may occasionally be required. If this is required it will be carried out by qualified persons. This control method is only effective for low numbers of pest animals and should be opportunistic. Pests must be disposed of in a humane and ethical manner.

Table 4 Control Methods Required at Each Stage of MEWF Project Development

Project Phase	Objective	Action
Preconstruction	Identify abundance of pest species on MEWF project site	▪ Record the incidental occurrence of pests at key locations on project site. ▪ Liaise with local government Pest Management Officer regarding pest species management on site and methods of control undertaken.
Construction	Ensure effective pest control is undertaken for the project area	▪ Erect the appropriate exclusion fence around sensitive areas. ▪ Manage solid and liquid waste generated from the site compounds. ▪ Avoid creating artificial water points. ▪ Dump all the non-hazardous waste in a designated location which (fenced if required) and then taken offsite. ▪ Ensure appropriate training and induction of staff on pest issues and strategies.

Project Phase	Objective	Action
Ongoing	Ensure pest control is undertaken	▪ Survey periodically (quarterly) of high risk areas. ▪ Continue management of waste products. ▪ Promote continued education and training of staff to ensure implementation and changes to plan are ongoing. ▪ Check the exclusion fence periodically for any breakdown on the barrier and wear and tear. ▪ Liaise with Local and state government to ensure management of declared pest around property remains current and in line with other property holders and council. ▪ Continue pest and weed control through management of solid and liquid waste. ▪ Report infestations to Environmental Manager. ▪ Review this plan within 2 years.

7.0 Records, Monitoring and Review

7.1 Records

Both hard and electronic copies of records from all pest control activities are kept in a central location at RATCH for a minimum of five years to allow for a comprehensive review of the PMP. The minimum is recorded for the control events:

- Date;
- Location of activity;
- Target species;
- Method utilised;
- Area treated; and
- Numbers successfully controlled.

7.2 Monitoring and Evaluation

An annual monitoring program will be undertaken to determine the current presence of pest species and their abundance within the study area. Any significant findings of the pest species or new species out break or actions resulting from incidents which will incorporated into the annual review.

The implementation and effectiveness of this management plan and its associated procedures will be regularly assessed to ensure:

- The management strategy remains relevant and up to date;
- The plan and procedures adequately manage the environmental issue.

The methods use to assess the effectiveness are outlines in **Table 5** below:

Table 5 Methods to Assess Management Plan Effectiveness

Assessment Tool	Description
Audit	Audit outcomes are used to develop corrective actions which may include changes to this plan and or procedures.
Review of Data	Analyse all relevant data collected for negative and or undesirable trends that may be prevented by procedural change or by implementation and/or process.

7.2.2 Performance Indicators

Performance against pest control measures will be assessed against the following:

- There is no net increase in the abundance or distribution of pest animal species in the project area.

This performance indicator will be met by implementing control actions outlined in **Table 4** Management Control Actions.

7.3 Review

The PMP is a living document and shall be reviewed annually or sooner if any of the following occur:

- The plan is not adequately managing the issue;
- Legislative requirements change;

- The area of activity changes;
- A previously unidentified declared pest is found within an area of activity ; and/or
- New procedures relating to pest management are developed.

Reviews and changes to the PMP are to be communicated to relevant RATCH project personnel.

8.0 Definitions

Term	Meaning
Management Plan	Management plans are specific to and environmental issue or topics.
Non declared Animal	While sometimes pests, they are sometimes considered a significant state-wide threat and do not require and enforceable response. If warranted, local governments can declare these animals using local laws.
Notifiable Pest	A plant or animal species whose presence must be notified to the Queensland Government within 24 hours of becoming aware of it. Notifiable pests are declared under Section 12 of the Plant Protection Act 1989 and associated regulation.
Procedure	Procedures are designed to assist in the implementation of the Management Plan by prescribing a series of processes and actions for a specific topic.
Vector	An agent (person, animal or microorganism), that carries/transmits pests or weeds.

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Appendix A

Species Fact Sheets

Department of Agriculture, Fisheries and Forestry
Biosecurity Queensland

Fact sheet
PEST ANIMAL
PA21 December 2013

Cane toad

Bufo marinus

The cane toad is not a declared pest in Queensland, so there is no legal requirement to control them.

Their original introduction in 1935 was to control agricultural pests, but they proved ineffective.

For the past 60 years, cane toads have been expanding their territory in Australia, and are capable of colonising at least four of the mainland Australian states.

As the toad's geographical range continues to expand, concern has increased about their detrimental environmental effects, particularly on the wetlands of the Northern Territory.

Studies into the feasibility of biological control have commenced.

History of introduction and spread

The cane toad or giant toad is an amphibian, native to Central and South America. Cane toads have been introduced throughout the world as a biological control for insect pests of agriculture, most notably sugarcane.

A consignment of cane toads from Hawaii was released into Queensland cane fields in 1935. The introduction was surrounded by controversy as to the potential costs and benefits to Australia.

It was hoped that the toad would control Frenchi and greyback beetles—pests of economic importance to the sugarcane industry.

By 1941, however, it had become evident that the cane toad was exerting only limited control over its intended prey. There were two main reasons for this:

- Greyback beetles are only rarely in contact with the ground and Frenchi beetles invade cane fields at a time when the toads are absent due to a lack of protective cover.
- The cane toad has a wide-ranging and indiscriminate diet, and it was not solely dependant upon its intended prey.

The unlimited food source, suitable environment and low rates of predation allowed dynamic reproduction and spread. Toads were recorded in Brisbane only 10 years after release. The toad continues to thrive and has now invaded the Northern Territory and New South Wales (see Map 1).

Map 1. Distribution of the cane toad in Australia

The cane toad's advance is only limited by environmental factors, such as the availability of water for breeding, tolerable temperatures, suitable shelter and availability of food.

Toads at the frontier of their range of expansion may be larger than those in established populations. This is most probably due to greater food supply, combined with a lower incidence of disease.

Description and general information

In comparison with native frog and toad species, adult cane toads have a distinctive head and face, and are large and heavily built creatures (adults may grow to 20 cm).

Following their aquatic larval stages (eggs and tadpoles), cane toads are generally encountered at night near any source of light. Cane toads are ground-dwelling—they are poor climbers and unable to jump very high.

A definite visor or awning extends over each eye and a high angular bony ridge extends from the eyes to the nose.

The parotid glands (see Figure 1) are perhaps the most characteristic feature of the adult cane toad. These glands are large, protuberant, and are situated on the head behind each ear. These glands carry a toxin.

Map 2. Distribution of the cane toad in Queensland

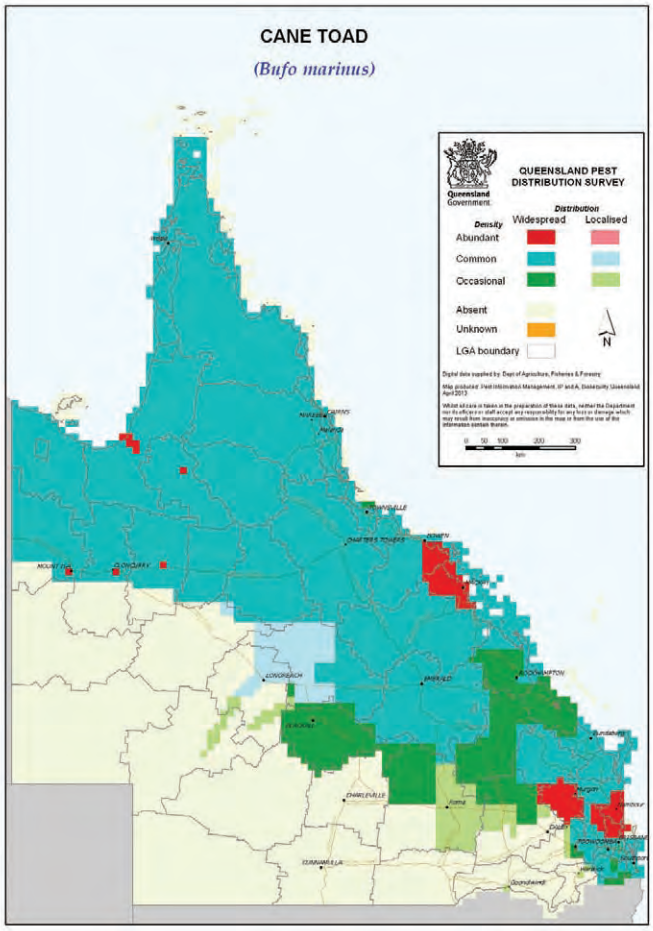
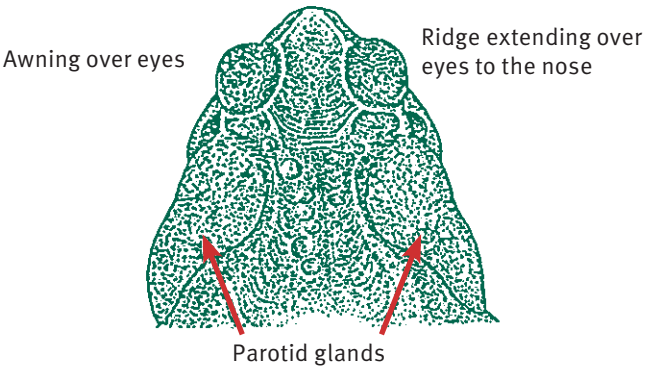


Figure 1. Distinguishing features of the cane toad



The cane toad's hands and feet are relatively small and lack discs at the tips of the digits. Webbing is absent between the fingers but is distinct and leathery between the toes.

Colouring on the dorsal (upper) surface may be brown, olive-brown or reddish-brown. The ventral (under) surface varies from white to yellow and is usually mottled with brown.

Warts are present on all cane toads; however, males possess more than females. Warts are dark brown at the caps.

Mating

Mating can occur at any time of the year and depends only on available food and permanent water. The mating call is a continuous purring trill that sounds like a running motor.

In situations where females are scarce or absent, male cane toads may have the ability to undergo a sex change to become fertile females; however, this has not been proved.

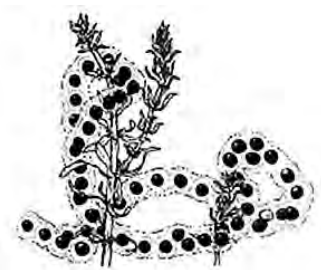
Eggs

Both cane toads and native frogs spawn in slow-moving or still water, but their eggs can be easily distinguished.

Cane toad eggs are laid in long, gelatinous 'strings' with the developing tadpoles appearing as a row of small black dots along the length. The strings are unique to cane toads, generally appearing as blobs of jelly attached to water plants or debris. Native frogs generally produce egg clusters as mounds of foam floating on the water surface.

Compared with native species, cane toad egg production is dynamic and a single clutch can contain up to 35 000 eggs. Remove any cane toad eggs found in the water and allow to dry out.

Figure 2. Drawing of toad spawn from *Wildlife of greater Brisbane*



Tadpoles

The cane toad is the only species in Australia that has a pure black tadpole. Native frogs have lighter-coloured undersides with a great range of colours and markings—cane toad tadpoles may turn paler colours to almost transparent at night.

Cane toad tadpoles are small and usually congregate in vast, slow-moving shoals. This 'shoaling' behaviour is uncharacteristic of most native species.

Unlike cane toad tadpoles, native species develop lungs at an early stage and periodically rise to the surface in order to exchange their lung gasses. Large groupings of tadpoles that do not break the water surface for air indicate cane toads.

Young toads

Following emergence from the water, the young toadlets usually congregate around the moist perimeter of the water body for about a week before they eventually disperse.

Young toads are very difficult to distinguish from the native *Uperoleiea* species, which also have parotid glands, but all *Uperolelea* species have bright red patches in the groin area.

Under ideal conditions toadlets may reach adult size within a year.

Toxicity

Bufo marinus produce venom in glands occurring in most of the skin on their upper surface. The venom is concentrated in the parotid glands as a creamy-white solution, which is released when the animal experiences extreme provocation or direct localised pressure (e.g. grasped by the mouth of a predator).

The parotid solution is highly toxic and when ingested it produces drastic acceleration of the heartbeat, shortness of breath, salivation and prostration. It is extremely painful if accidentally rubbed into the eye.

Ingestion of toads by domestic and most native animals can result in death. In some recorded cases, death has occurred within 15 minutes.

Field observations suggest that some predatory Australian species have learned how to feed safely on cane toads.

Birds have been observed flipping toads over to avoid the parotid glands. Predatory reptiles may have more trouble adapting, being unable to remove a toad from the mouth once they start feeding.

Effects on wildlife

The cane toad is poisonous at all stages of its life cycle and most native frog larvae and many aquatic invertebrates are dramatically affected by their presence.

Cane toads are voracious feeders that consume a wide variety of insects, frogs, small reptiles, mammals and even birds. Perhaps the only limiting factor to the prey taken is the width of the cane toad's mouth.

It has been suggested that cane toad competition for food and breeding grounds has been responsible for reducing the populations of some native frogs. However, many native frogs are arboreal (tree-dwelling) and occupy different niches. Cane toads don't have the native frogs' ability to 'shut down' during dry seasons when resources are limited.

Pressure from cane toads may displace native animals (frogs and other species) where they are already suffering due to manipulation of their habitat by humans and grazing animals. Animals that use waterholes as retreat sites during the dry season are especially vulnerable—toads will congregate here in large numbers.

Public health

Cane toads readily eat animal and human faecal material and, in areas of poor hygiene, they have been known to transmit disease such as salmonella.

Control

Control of cane toads is not enforced as there is currently no available effective broad scale control. Individuals and community groups have carried out removal campaigns to decrease numbers and slow the invasion front.

Fencing is recommended to keep toads out of ponds intended for native fish and frogs; a height of 50 cm is sufficient. Bird wire with 1 cm holes may keep toads out of an area.

Research indicates that spread can be delayed in semi-arid areas by blocking access to water holes.

Individual toads may be killed relatively humanely using a commercial spray available from hardware stores or may be stunned and decapitated (only by experienced operators). The removal of eggs from small water bodies such as frog ponds can be effective

Researchers have successfully mitigated impacts in recently colonised areas by 'training' predators however, large scale application of this technique is difficult.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

This fact sheet is developed with funding support from the Land Protection Fund.

Fact sheet

DECLARED CLASS 2 PEST ANIMAL

Dingoes

Canis familiaris dingo

The dingo *(Canis familiaris dingo)* is a primitive canid related to wolves and coyote. The dingo was not a part of the ancestral fauna of Australia. Though its origins are not clear, it is thought to have arrived in Australia 3500–4000 years ago.

It is the largest mammalian carnivore remaining in mainland Australia, and as such fills an important ecological niche. Females weigh about 12 kg and males 15 kg.

The dingo has been regarded as a serious predator of domestic stock since early European settlement in Australia. Early research emphasis was on control, indeed eradication of the dingo. No attempt was made to study the animal, measure predation, or to understand why the problem existed.

Declaration details

Under the *Land Protection (Pest and Stock Route Management) Act 2002* the dingo/wild dog is a declared Class 2 pest animal. It is the responsibility of landholders to reduce the number of dingoes/wild dogs on their property.

Queensland Government

PA9 July 2010

Description and general information

Red, ginger and sandy-yellow are the dominant coat colours, though dingoes can also be pure white, black and tan or solid black.

It is not difficult to distinguish between most dingoes and hybrids. The presence of domestic genes is suggested by broken colours—brindling and patchiness in the normally pure white feet and chest patch and sable colouration (black hairs along the back and sides).

Dingoes have a more heavily boned skull and larger teeth (especially the canine) than domestic dogs of similar size.

Distribution

Dingo numbers are believed to be higher today than in pre-European times. This is thought to be due to increased food availability via the introduced rabbit and cattle carcasses, and the development of permanent waters in arid areas of the state.

Dingoes/wild dogs are now present in all parts of the state.

The distribution of the wild dog in relation to purebred dingoes varies throughout the state. In far western areas, most dingoes sighted appear to be 'pure', with characteristic white points and broad heads. Closer to settled areas a greater number of feral domestic dogs produce a generally hybrid population. It has been estimated that dingoes are 50% pure in south-eastern Queensland and 90–95% pure in south-western and central Queensland.

Reproduction

Dingoes have only one breeding season per year (usually April to June), whereas domestic bitches have two or more oestrus cycles per year. However, unless seasons are particularly favourable, or human sources of food are intentionally or inadvertently provided, feral domestic dogs are unlikely to successfully rear two litters per year.

After a nine-week gestation, dingo pups (usually four to six) are born in a hollow log or cave den. Bitches tend to use the same den each year. Pups are suckled at four to six weeks and generally weaned at four months. When large enough to travel, pups are taken from the den to kills, and other dens many be used. The range of pups is increased as they are moved from den to den. In this way the pups are gradually moved around the bitch's home range.

Independence may occur as early as six months of age when parents abandon them, but this results in high juvenile mortality. Pups that become independent around 12 months appear to disperse voluntarily. Being larger and more experienced, mortality is then usually low.

Where dingoes live alone or in small groups (most pastoral and semi-settled areas), mature females will breed successfully each year.

By contrast, dominant female infanticide results in only one litter being successfully raised each year within groups containing several adult females (e.g. undisturbed areas such as the Simpson Desert). The dominant (alpha) female will kill all pups of the other females, and then use subordinate females to suckle and rear her litter.

Home range

Radio tracking studies show dingoes occupy a discrete area known as a 'home range'. The dingo visits the edge of this area frequently.

The home range can vary in size according to the productivity of the country—from 9 km² in rainforest areas to 300 km² on the Nullarbor Plain.

The edge of the home range is commonly associated with a major topographic feature (e.g. an escarpment, a major ridge or stream).

The home range is not used uniformly. Activity is centred on areas with highest food density.

Hunting movement is slow and exploratory, in contrast to frequent rapid movement around the home range boundary.

Pads follow well defined paths and are most likely associated with sociality and home range boundary maintenance. Activity is highest at dusk and dawn.

Social organisation

Dingoes in an undisturbed area generally belong to discrete packs (3–12 members), which occupy long-term, non-overlapping territories. The group rarely moves as a pack—rather, members meet and separate again throughout the day. Dingoes are most gregarious during the breeding season.

There is overlap of home ranges within a group. In contrast, boundaries between groups are more rigid, actively defended and infrequently crossed.

Olfactory communication (smell) is important in dingo social organisation. Dingo droppings are deposited along pads in specific areas where other dingoes will encounter them (creek crossings, intersections of roads and fences).

These 'scent posts' appear to delineate the home range boundary and act as a warning to neighbouring groups and individuals.

This strong site attachment of dingoes is contrary to the notion commonly held by property owners that dingoes will travel large distances to kill stock.

Diet

Dietary research of stomach content and faecal scats has shown dingoes are opportunistic predators.

Medium-size animals such as kangaroos, wallabies, rabbits and possums consistently form the major part of the dingo diet.

Studies by the Western Australia Agriculture Protection Board show dingoes in undisturbed refuge areas killed and ate kangaroos strictly according to need.

On grazing country, however, 'dingoes harassed, bit or killed sheep in large numbers, often without eating any'. The consumption of these sheep carcasses was the exception rather than the rule. Even kangaroos in these areas were sometimes killed in 'play' type behaviour rather than for food.

Such dietary studies could suggest dingo predation of domestic stock is low. There is, however, a need for caution in using such studies to assess dingo impact on stock.

Grouping increases foraging efficiency and appears necessary to exploit larger prey. Dingoes cooperating in groups are more successful in hunting kangaroos than lone dingoes are. While lone dingoes can easily kill sheep, it is less likely a solitary dingo would successfully attack a calf in the presence of a defending cow.

Disease threat

Dingoes are vectors of canid diseases (e.g. distemper, parvovirus) and parasites. The hydatid parasite *Echinococcus granulosus* is a major problem of dogs and domestic stock. It can cause illness and occasionally death in humans.

The dingo could pose a serious risk if the exotic disease rabies was introduced to Australia.

Beneficial considerations

The establishment of watering points during post-European settlement has resulted in a huge increase in the kangaroo population, with consequent strong pasture competition with domestic livestock.

Though it is widely accepted that sheep production is near impossible in the presence of dingoes, many cattle producers will tolerate dingoes because of their believed suppression of kangaroo numbers.

Research has shown that not only does the dingo have the potential to mitigate population growth of native species during abundant seasons, it could also be an important limiting factor for many feral animal populations (e.g. feral pigs and goats).

Destruction of the dingo could cause increases in other pests to the grazing industry and result in widespread degradation of environmentally sensitive areas. However, this has not been proven.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

PR10–5203

Department of Agriculture, Fisheries and Forestry
Biosecurity Queensland

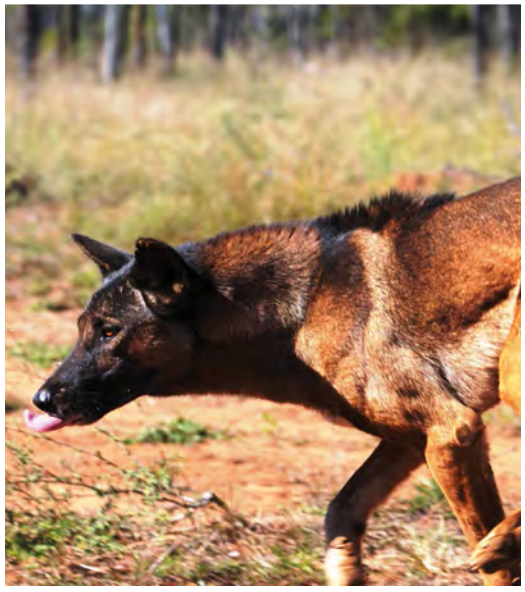
Fact sheet

DECLARED CLASS 2 PEST ANIMAL

December 2014

Wild dog control

Canis familiaris



The term wild dog refers collectively to purebred dingoes, dingo hybrids and domestic dogs that have escaped or been deliberately released.

Wild dog control methods include baiting, trapping, shooting, fencing, and the use of guardian animals to protect stock. A planned strategy using a combination of these methods that also considers wild dog behavior will enable effective management.

Declaration details

Wild dogs are a declared Class 2 pest animal under Queensland legislation. As such, all landholders in Queensland are required to reduce the number of wild dogs on their properties.

Management strategies

To increase wild dog control effectiveness, it is essential that control programs are coordinated among adjoining properties.

Queensland research has shown that in some situations wild dogs can quickly re-colonise baited areas due to a number of factors including inconsistent bait programs which do not provide comprehensive wild dog control across the landscape. Such programs may alter the dynamics of wild dog populations in the area. To prevent livestock attacks and enhance wild dog management, it is important for producers to work together using a variety of control methods.

Wild dog ecology and seasonal variations can also influence the likelihood of wild dogs coming into contact with a control tool. The timing of control should consider seasonal variations and the availability of water (where water is restricted) and then target watering points. Many land owners bait using 1080 twice a year to target wild dogs during peaks in activity associated with breeding (March/May) and then again in September/November to target pups and juveniles. However, baiting and trapping is recommended at all times when wild dogs are active.

Control

Baiting

Poison baits are the most economic, efficient and effective method of controlling wild dogs, especially in inaccessible or extensive areas. Baits can be laid quickly by hand, from vehicles and from aircraft.

Currently there are two poisons legally available for wild dog control. These are 1080 (sodium fluoroacetate) and strychnine.

Subject to restrictions, 1080 baits, either manufactured or prepared from fresh meat can only be obtained from authorised persons. A permit from the Queensland Department of Health is required for land owners to purchase strychnine. Strychnine can be used both in baits and on traps. The use of both 1080 and strychnine require adherence to the associated conditions of supply.

The use of poison baits will control some but not all wild dogs. Baits should be used in conjunction with all other control tools and not be relied on as a total control method.

Meat baits are attractive both to wild dogs and a range of non-target species. When using meat baits, they can be strategically positioned as wild dogs' keen sense of smell enables them to find baits intentionally buried in sand or otherwise hidden under bushes or in hollow logs. Meat baits may also be tied to prevent their loss to non-target species.

These meat bait placement techniques help to:

- reduce the risk of poisoning non-target species
- increase wild dog contact, hence receiving a lethal dose
- minimise bait removal by non-target scavengers
- deter ants (ant-covered baits are believed to be less attractive to wild dogs).

Heavy rain within two weeks of baiting can leach 1080 from baits, but baits may still remain toxic for a considerable time.

Trapping

A key success to trapping wild dogs (using foot-hold traps) depends on the skill of the operator. Visit www.feral.org.au to watch a PestSmart video on best practice techniques for wild dog trapping.

For humane reasons and to prevent escape, poisoning traps with strychnine is recommended to quickly kill captured wild dogs. A properly poisoned trap becomes a lethal device rather than a holding device.

A mixture of dog faeces and urine is a popular lure used by trappers. Attractiveness of lures varies with seasons and locations. No single lure has yet been found that is consistently attractive to all wild dogs and repeated use of one lure can lead to aversion amongst remaining dogs.

Traps are best placed in areas of high wild dog activity (known as leads). Here the wild dog is most likely to find and investigate the decoy/odour.

A wild dog scent post (an area where urine or faeces have been deposited) can be found by walking with a domestic dog on a lead along a known pad. Trap placement in relation to the scent post can be optimised by observing the domestic dog's behaviour as it approaches. Factors to consider are:

- where on the bush it smells
- placement of feet while urinating/defecating/sniffing
- how it approaches and where it scratches in relation to the pad and scent post.

Padded, laminated or offset foot-hold traps, in a well tuned and functioning state are recommended.

Shooting

Shooting is an opportunistic method, mostly used for control of small populations or individual problem animals.

Fencing

Property fencing suitable to exclude wild dogs is expensive to build and requires continual maintenance to repair damage caused by fallen timber, fire, floods, feral and domestic animals, as well as vegetation regrowth. However, a properly maintained fence can restrict movement into an area where wild dogs have been controlled.

Electric fences suitable for wild dogs have been developed. Electrifying a fence creates a fear of the fence itself and deters wild dogs from approaching.

For property fencing to be successful, the fence must be maintained in good order and ongoing wild dog control conducted within the protected area to limit livestock impacts.

Fencing is the most effective method of protecting livestock and pets from wild dog attack on small acreage blocks.

A fence can also be a good area to place baits and traps when wild dogs are active.

Livestock guardian animals

Livestock guardian animals have been used to protect livestock from predators in Europe, Asia and America. Some producers in Queensland have decreased predation on sheep and goats using this method. The use of trapping and poisoning in conjunction with guardian animals must be well planned and managed to ensure guardian animal safety.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

This fact sheet is developed with funding support from the Land Protection Fund.

Department of Agriculture and Fisheries
Biosecurity Queensland

Fact sheet
DECLARED CLASS 2 PEST ANIMAL
March 2016

Feral pig

Sus scrofa

Pigs were introduced to Australia by early settlers. Subsequent accidental and deliberate releases resulted in the wild (feral) population establishing throughout Australia.

Feral pigs cause environmental and agricultural damage, spread weeds and can transmit exotic diseases such as leptospirosis and could spread foot-and-mouth disease.

Declaration details

Feral pigs are declared Class 2 pest animals under Queensland legislation. Declaration requires landholders to control declared pests on land under their control.

Description

Feral pigs are typically smaller, leaner and more muscular than domestic pigs with well developed shoulders and necks, and smaller, shorter hindquarters.

The body is usually covered in sparse, coarse hair and they have a longer, larger snout, longer tusks, a straighter tail and narrower back than domestic pigs. Feral pigs are mostly black, buff-coloured or spotted black and white.

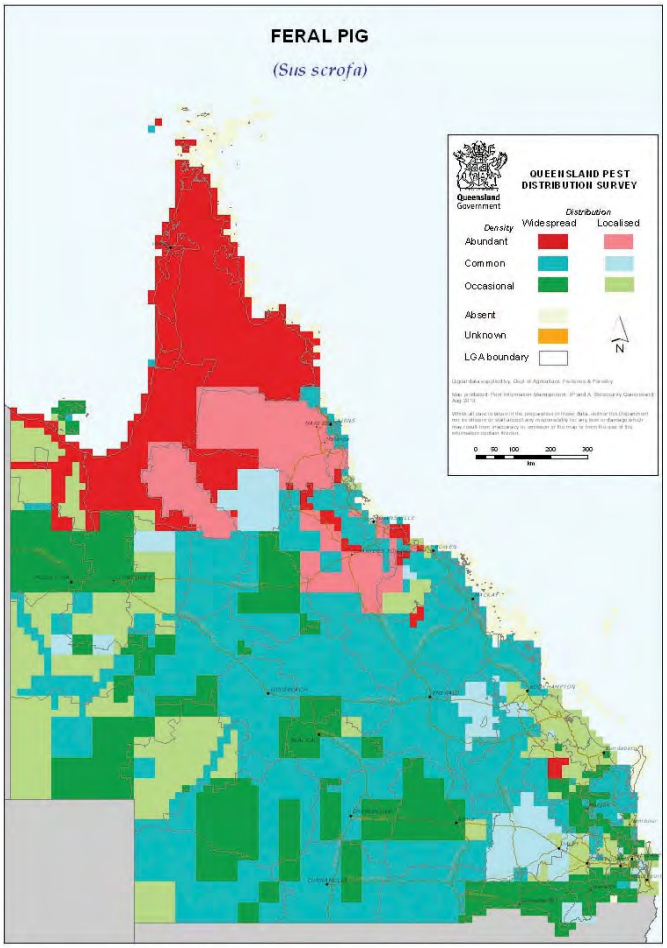
Growth potential is similar to domestic pigs, although harsh environmental conditions tend to stunt development. Adult female feral pigs usually weigh 60–75 kg, while males usually weigh 90–110 kg. Older boars (razorbacks) can have massive heads and shoulders and a raised and prominent back bone that slopes steeply down to small hams and short hind legs. Some boars develop a crest or mane of stiff bristles extending from their neck down the middle of their back.

Queensland Government

Feral pig wallow

Feral pig rooting

Map 1. Distribution of feral pigs in Queensland



Habitat and distribution

Feral pigs are found in all habitat types in Queensland. The greatest concentrations of feral pigs are on the larger drainage basins and swamp areas of the coast and inland. In hot weather, pigs need to remain near water.

Population estimates can be achieved by spotlighting, aerial survey or the use of motion cameras.

Evidence of feral pigs includes fresh digging or rooting of the ground, tracks and faeces on and off pads, mud or hair at holes in fences where pigs have pushed through, wallows, tusk marking and mud rubs on trees and fence posts and nests in vegetation made by sows before farrowing.

Biology and behaviour

Female and juvenile pigs usually live in small family groups with a home range of 2–20 km^2. Adult males are typically solitary, with a home range of 8–50 km^2. Range size varies with season, habitat, food availability and disturbance. Herds of 400 pigs have been recorded in Cape York.

Feral pigs are generally nocturnal, spending daylight hours sheltering in dense cover. Pigs are omnivorous, eating plants and animals and are extremely opportunistic feeders, exploiting any temporarily abundant food.

They prefer green feed and will eat grains, sugarcane and other crops, fruit and vegetables. They root extensively for tubers, worms and soil invertebrates.

Feral pigs have relatively high energy and protein requirements, particularly during pregnancy and lactation and often move to other parts of their home range during pregnancy.

Life cycle

Under good seasonal conditions, breeding occurs all year and sows can produce two litters per year. Adult females have a 21–day oestrus cycle, with a gestation period of about 113 days, producing a litter of 4–10 piglets. Sows can make nests of available vegetation just before farrowing. Nests sometimes have a domed roof and are usually less than 2 km from available water. Piglets normally spend the first 1–5 days of life inside the nest, with the sow nearby. Weaning occurs after 2–3 months. Sexual maturity is reached when sows weigh about 25 kg, usually around six months of age.

Mortality of juveniles is high if the mother's dietary protein intake is low (up to 100% mortality in dry seasons). Adult mortality does not vary as much with seasonal conditions, but few animals live more than five years.

Impacts

Pigs can damage almost all crops from sowing to harvest, starting with uprooting seed and seedlings to feeding on or trampling mature crop.

They feed on seed, sugar cane and grain crops (except safflower), fruit (especially banana, mango, papaw, macadamia and lychee) and vegetable crops. Research has shown feral pigs can take up to 40% of lambs.

Pastures are damaged by grazing and rooting and pigs can also transport weeds. Wallowing pigs damage and foul the water in tanks and bore drains and silt up troughs. They can also damage fences and dam walls.

Pig activity degrades water quality and the habitat for small terrestrial and aquatic animals. It also creates erosion and allows exotic weeds to establish. Predation of native fauna does occur and examination of faeces has shown remains of marsupials, reptiles, insects, and ground-nesting birds and their eggs.

Feral pig damage to river banks

Feral pig damage to sugar cane

Diseases and parasites

Feral pigs can carry many infectious diseases and internal and external parasites. Some are endemic (already present), while others are exotic to Australia.

Many of the diseases can spread to domestic pigs, other livestock and humans. Feral pigs can transmit sparganosis, melioidosis, leptospirosis, Q fever and brucellosis to humans.

To prevent contracting these diseases it is advisable to either avoid handling feral pigs or use suitable protective clothing (mask, goggles, strong rubber gloves and plastic apron and boots) to minimise contamination with blood, urine and faeces. Rare or undercooked meat should not be eaten; thoroughly cook meat to avoid contracting pathogens.

Control

Feral pigs are difficult to control because they are primarily nocturnal, breed rapidly, are generalist omnivores and have large home ranges and thus control programs need to be conducted over a wide area (often including several properties) to be effective.

Effective control requires an integrated, collaborative approach where all stakeholders participate in planning, implementation and evaluation of the actions taken.

Trapping

Trapping is an important technique that is most useful in populated areas, on smaller properties (‹5000 ha), and where there are low pig numbers. Trapping can be particularly useful in ‘mopping up’ survivors from baiting programs. It is most successful when food resources are limited.

Trigger mechanisms for pig traps can be made pig-specific and therefore pose little danger to wildlife or domestic animals.

Advantages

- This is the safest form of control and can be safely undertaken on closely populated areas.
- It’s flexible and can be incorporated into routine property activities, making economical use of labour and materials.
- Carcasses can be safely disposed.
- Traps can be moved and re-used; good trapping makes use of opportunities as they arise.
- Normal pig behaviour is not altered, which allows a greater number of the total population in an area to be targeted.
- More humane to pigs and non-target species.
- The number of animals removed can be easily monitored.

Disadvantages

- Can be time consuming and expensive to construct and maintain.
- Must be checked regularly.
- Not practical for large-scale control.
- Some pigs are trap shy.

Tips

- Stop all activities that will disturb normal feeding (i.e. do not undertake any shooting or dogging).
- Pre-feeding (i.e. ensure that pigs are visiting trap and consuming bait) prior to activating traps is an essential part of successful trapping.
- Feeding sites should be placed where feral pigs are active (i.e. water points, holes in fences, areas containing old carcasses on which pigs have been feeding).
- Bait for traps must be food that pigs usually eat in that area. Pigs feeding on one crop (e.g. sugarcane) will often not take to alternative foods. However, new, novel baits are sometimes attractive (e.g. fermented grains).
- The trap can be built around the feeding site, with feeding within the trap undertaken for several nights before it is set.
- Set the trap every night and check each day. If the trap cannot be checked daily then shade and water must be provided.
- Continue to trap until no more pigs are caught. A change of bait can be tried. Again, feed for one or two nights before re-setting the trap.
- Traps may be left permanently in locations used by pigs and can be utilised when fresh signs of pigs appear.
- If the trap is to be moved, start feeding at the new site before re-locating the trap.

Design

There are several trap designs but all are principally an enclosed area with one-way gates (see Figure 1).

The main area of the trap can be any shape and be made from materials on the property. The best material is steel mesh with a grid 100 × 100 mm, with a minimum height of at least 1.5 m. Star pickets need to be placed no more than 1.5 m apart and imbedded far enough to ensure that adult pigs cannot push them over or lift them up out of the ground.

Alternative trap entrances

Funnel entrance

Formed by the two ends of the mesh forming a funnel, the ends are tied together at the top with wire or rope. The pig moves through the funnel forcing the bottom of the mesh ends apart and once it is in the trap the ends spring back together (see Figures 1 and 2).

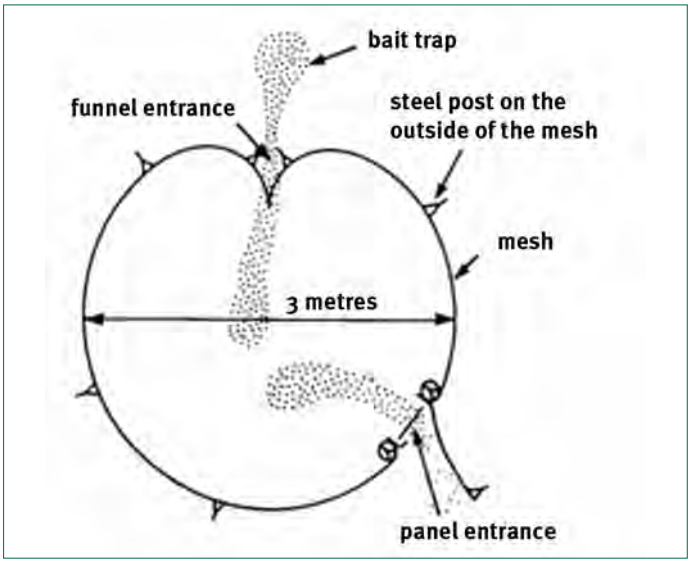


Figure 1. Alternative trap entrances – funnel entrance

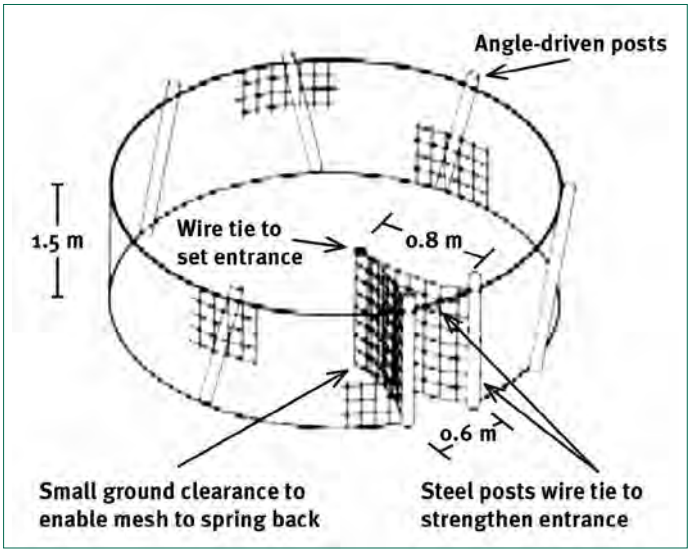


Figure 2. Silo trap with funnel entrance (14 m of silo mesh diameter about 4.5 m

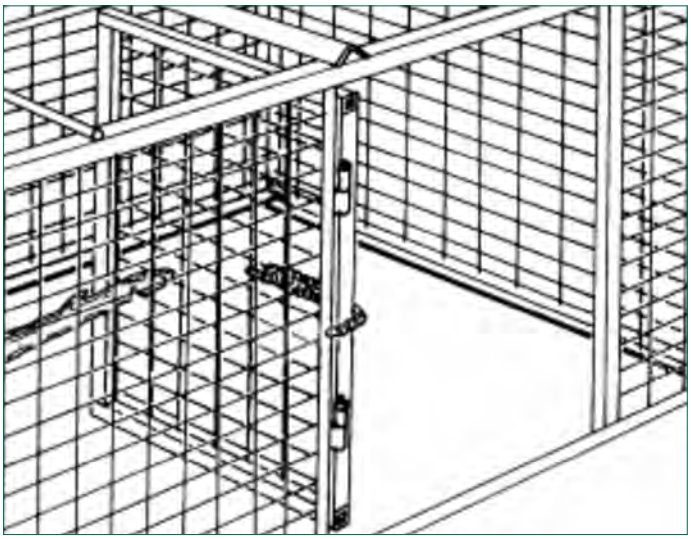


Figure 3. Pig-specific trigger

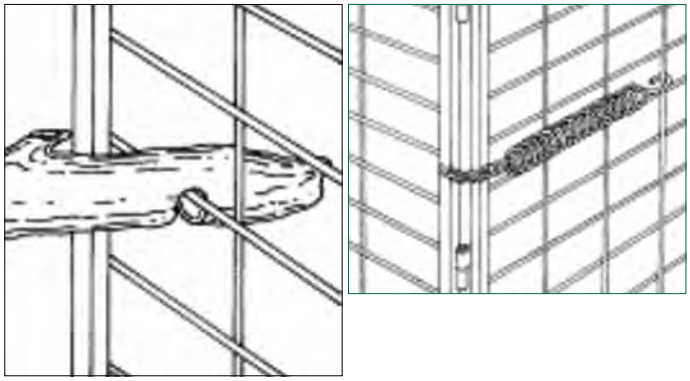


Figure 4. Close up of pig-specific trigger

Feral pig trap

Trapped feral pigs

Hog hopper – pig specific bait station

Tripped gate entrance

A side-hinged gate is pulled shut by springs and is held open by many systems that can be triggered to allow the gate to swing shut. Often trip wires or other systems are used; most of these systems are not selective for feral pigs and can be triggered by any animal attracted to the bait. Once triggered the trap is no longer effective in trapping pigs.

Pig-specific trigger

By far the simplest and most effective trigger system has the gate held open by a bar (often a branch or piece of wood) which is hooked over the wire on the gate and on the side panel (see Figure 3). For a close up of the pig specific trigger (see Figure 4).

Pigs rooting for feed in the trap lift the bar allowing the gate to swing shut. The specific feeding habit of pigs insures they are the only animals that lift the trigger bar.

The gate may be latched to prevent pigs from opening the door once triggered. However, this will prevent more pigs pushing their way in to join those inside.

Poisoning

Poisoning is the most effective control method available that can quickly reduce a pig population.

Only authorised persons can supply 1080 baits to landholders.

Pre-feeding is the most important step in ground-based poisoning operations. Free feeding with non-poisoned bait should be performed for several days prior to laying poisoned baits.

By selecting bait wisely, landholders can be species-selective in their poisoning program and avoid many of the unintentional effects of secondary poisoning.

Bait material such as fermented grains are very attractive to pigs. It is a good idea to establish a free feeding routine so that pigs are the only animals feeding, which helps to keep other non-targets away from the feeding site.

Other options (like pig-specific feeders) are now commercially available, and can assist in reducing non-target species access to bait. Other options include burying baits; feral pigs are one of the few animals that will dig up bait.

Aerial poisoning is also available and typically used for broadscale control in western and northern regional areas. Bait is distributed from an aircraft. This is particularly useful for covering large, remote, areas or restricted ground access. Aerial poisoning is a proven and cost-effective method for reducing pig populations.

A phosphorous-based poison is also available for use in Queensland.

Shooting

Shooting pigs by helicopter is effective in areas where pigs exist in reasonable numbers and are observable from the air.

Ground shooting is not effective in reducing the pig population unless intense shooting is undertaken on a small, isolated and accessible population of pigs.

Fencing

Though an expensive option, fencing can offer successful pig control especially for high value crops grown on small areas. Research has indicated that the most successful pig-proof fences are also the most expensive.

The most effective pig-proof fences use fabricated sheep mesh held close to the ground by plain or barbed wire and supported on steel posts.

Electrifying a conventional fence greatly improves its effectiveness if used before pigs have established a path through the fence.

Pigs will often charge an electric fence and unless the fence incorporates fabricated netting they often successfully breach the fence.

For crop protection or to avoid lamb predation, pig-proof fences need to be constructed before the pigs become a problem. Once pigs have adjusted to feeding on grain or lambs in a particular paddock fencing may be ineffective.

Fertility control

There are currently no available means to deliver fertility control to feral pigs. Such a technique is likely to remain unavailable for practical use given the lack of suitable contraceptives, suitable delivery mechanisms, and concerns with non-target species.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au). Visit www.biosecurity.qld.gov.au to download a copy of the feral pig control manual.

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

This fact sheet is developed with funding support from the Land Protection Fund.

Department of Agriculture and Fisheries
Biosecurity Queensland

Fact sheet

DECLARED CLASS 2 PEST ANIMAL

March 2015

Feral cat

Felis catus

A descendant of the African wild cat (*Felis silvestris lybica*), the common 'house' cat (*Felis catus*) has now been domesticated for about 4000 years. Although the domestic cat has a long history of association with humans, it retains a strong hunting instinct and can easily revert to a wild (feral) state when abandoned or having strayed from a domestic situation.

Semi-feral cats live around dump sites, alleys or abandoned buildings, relying on humans by scavenging rubbish scraps and sheltering in abandoned structures. The true feral cat does not rely on humans at all, obtaining its food and shelter from the natural environment.

Declaration details

The feral cat is a pest animal under Queensland legislation and landholders are required to control its numbers on their land. Declared pest animals represent a threat to agricultural industries and natural resources, and have a social impact on other human activities.

Legislation describes a feral cat as one that is not fed and kept by someone. The word 'kept' specifically means that the cat is housed in a domestic situation.

Queensland Government

Description and general information

The feral cat differs little in appearance from its domestic counterpart; however, when in good condition, the feral cat displays increased overall muscle development, especially noticeable around the head, neck and shoulders, which gives the animal a more robust appearance. The average body weight of male feral cats is 3–6 kg, while females weigh 2–4 kg. Body weights vary with condition, with some extremely large specimens documented.

Australian feral cats are predominantly short-haired, with coat colours that range between ginger, tabby, tortoiseshell, grey and black. White markings may be present on the feet, belly, chest and throat; completely white feral cats are extremely rare. In established populations, coat colours are the result of a natural, genetically selective process. Terrain, predators and the ability to capture prey limit coat colours to those that provide the most suitable camouflage and cause a predominance of these colours in subsequent offspring. Ginger cats are more likely to be found in the semi-arid and desert areas, while grey and black specimens generally predominate in scrub and more heavily timbered habitats.

The feral cat is most active at night, with peak hunting activity occurring soon after sunset and in the early hours before sunrise. At night the cat displays a distinctive green eyeshine under spotlight, making it easily distinguishable from other animals. During the day it will rest in any number of den sites, which may include hollow logs, dense clumps of grass, piles of debris, rabbit burrows, and even the hollow limbs of standing trees.

The most obvious and characteristic field signs of feral cats are their scats (droppings). Unlike the domestic cat, the feral cat does not bury its scats, but leaves them exposed at prominent sites to warn other cats of its territorial boundary.

History of introduction and dispersal

There is some evidence to suggest that the cat was present in Australia long before European settlement. This may have occurred as a result of Dutch shipwrecks and regular visits to northern Australia by early South-East Asian vessels as long as 500 years ago.

Post-settlement dispersal resulted from cats straying from areas of early colonisation. In the late 19th and early 20th centuries, large numbers of cats were purposely released in many rural areas to combat plague numbers of rabbits. Unwanted cats continue to be released into urban and rural areas by irresponsible pet owners.

The feral cat is now present Australia-wide, thriving under all climatic extremes and in vastly different types of terrain.

Population dynamics

Male cats attain sexual maturity at about 12 months, whereas females are capable of reproduction at approximately seven months. Annually, and under ideal conditions, an adult female can produce up to three litters—each of usually four kittens, but varying from two to seven.

As the breeding instinct is triggered by the increasing length of daylight, litters are less frequent in winter. Most reproduction occurs during the spring and summer months, and is generally limited to two litters per year. Birth follows a gestation period of 65 days, and kittens may be reared in a single den site or may be frequently shifted to other sites within the female's home range. Family and litter bonding begin to break down when the kittens are approximately seven months old. The female's ability to bear litters does not decrease with age, so reproduction continues for the course of her life.

Social organisation and behaviour

Feral cats maintain stable home ranges, the sizes of which depend upon the relative abundance of food and the availability of suitable den sites. Dominant male cats may have territories of up to 8 km^2, while the territories of females are smaller and may even be halved while kittens are being reared.

Scent glands are present on the chin, at the corners of the mouth, and in the anal region. Territorial boundaries are maintained by scent marking with the cheek glands, pole-clawing, urinating and leaving exposed faecal deposits.Although feral cats are often thought of as being solitary animals, studies show this behaviour is generally limited to hunting activities. At other times feral cats display a degree of social interaction that peaks during the breeding season. Group behaviour has been observed in semi-feral populations, and it has been suggested that such behaviour is exhibited also in feral populations.

Groups usually comprise several related adult females, their young of both sexes, and an adult male—whose range may include other groups of females. Young females usually remain in a group, while young males either leave or are driven from the group as they reach sexual maturity.

Effects on wildlife

The energy expended by an adult male cat requires it to consume 5–8% of its body weight in prey per day, while females raising kittens require 20%. Based on these figures, one study concluded that 375 feral cats on Macquarie Island would consume 56 000 rabbits and 58 000 sea birds per year. Where present on the mainland, rabbits may comprise up to 40% of a feral cat's diet. Cats are successful as a control mechanism only when rabbit densities are low. At other times cat predation does little to halt the build-up or spread of

rabbit populations; rabbits merely help to support a larger number of cats. When seasonal shortages of rabbits occur there is a corresponding rise in the number of native animals taken by cats.

The feral cat is an opportunistic predator, and dietary studies have shown that small mammals, birds, reptiles, amphibians, insects and even fish can be taken as prey. Cat predation is particularly harmful in island situations, and a number of species have become extinct due to the introduction of cats by early sealers and lighthouse keepers. On the mainland, native animals—which already suffer due to the destruction of their habitats by man and other introduced animals—may be endangered further by cat predation. Actual competition for prey can cause a decline in the numbers of native predatory species such as quolls, eagles, hawks and reptiles. Not only do native animals bear the brunt of predation, but they also suffer the effects of a parasite that reproduces only in the intestine of the cat. This disease (toxoplasmosis) is particularly harmful to marsupials, which may develop blindness, respiratory disorders, paralysis, and suffer the loss of offspring through abortion and stillbirths.

Exotic disease—rabies

Due to their widespread distribution, feral cats may prove to be a major vector for this fatal viral disease if it ever enters Australia. Overseas studies have revealed that wounds inflicted by rabid cats are more dangerous than those caused by rabid dogs. While the bites of rabid dog are generally inflicted on the arms and legs, the cat attacks the head of its victim, biting and clawing viciously. These head and facial bites reduce the time taken for the virus to enter the central nervous system, lessening the chance of success from subsequent remedial treatment.

Control

Exclusion

Fencing is the only feasible method of control when special areas need protection from cats. Feral cats have been successfully prevented from climbing over netted fences that use an electrified wire mounted 15 cm from the top and 10 cm outward from the fence. Non-electrified fencing should incorporate a netted ceiling, or a curved overhang, which prevents the cat from climbing straight up and over the fence.

Shooting

Night shooting is assisted by the cat's distinctive, green eyeshine. Cats have been successfully attracted by the use of a fox whistle.

Poisoning

Fresh meat baits containing 1080 may be used for controlling feral cats under an APVMA Permit (PER14015 effective until 30 June 2016).

Only authorised persons can supply 1080 baits to landholders.

Lures

Audible recorded lures for feral cats and other predators are available through a number of sources. These recordings mimic the distress call of a small animal and can be used to draw a predator to a bait or trap site.

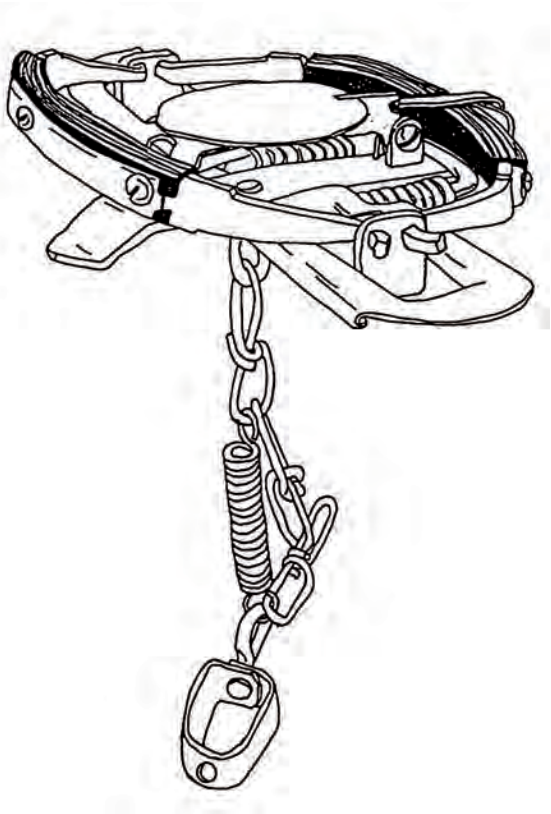
Trapping

Rubber-jawed, leg-hold traps (see below) can be laid in the same manner as they are laid for dingoes and foxes. Leg-hold traps can work well with true feral cats, which would normally avoid the live-capture box traps.

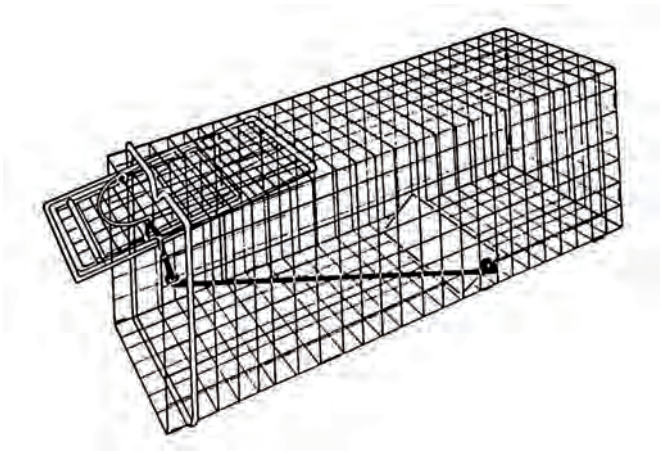
Ideal sites are those where territorial markers, such as faecal deposits and pole-clawing, are noticed. Tuna fish oil has shown some success as an attractant; however, feral cats seem more readily attracted to a site by some visual stimulus such as a bunch of bird feathers hung from a bush or stick.

Semi-feral urban cats are easily trapped in wire 'treadle-type' box traps (see diagram at right). Attractants/lures may be of meat or fish and should be placed so that they cannot be reached through the wire and be retrieved by clawing.

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



Rubber-jawed leg-hold trap



Treadle box trap

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

This fact sheet is developed with funding support from the Land Protection Fund.

Department of Agriculture, Fisheries and Forestry
Biosecurity Queensland

Fact sheet

DECLARED CLASS 2 PEST ANIMAL

December 2014

Rabbit

Oryctolagus cuniculus

Declaration details

The rabbit is a declared Class 2 pest animal under Queensland legislation. Declaration requires landholders to control declared pests on land under their control.

Description and general information

Rabbits are one of Australia's major agricultural and environmental animal pests, costing the country between $600 million and $1 billion annually. They compete with native animals, destroy the landscape and are a primary cause of soil erosion by preventing regeneration of native vegetation.

Pet rabbits

Introducing and selling rabbits in Queensland is not permitted (penalties apply). Limited numbers of permits for domestic rabbits are only available from Biosecurity Queensland for research purposes, public display, magic acts or circuses. Before a permit is granted, a number of guidelines need to be fulfilled.

Habitat

Rabbits are adaptable and sometimes live in close association with people. They live in built environments such as:

- in and under buildings
- old machinery and storage containers
- in old dumps.

In rural environments rabbits frequently live in:

- felled timber and associated windrows
- tussock grasses and rocky areas
- warrens (if soils are easy to dig).

Rabbit warrens

Rabbits prefer to live in warrens as protection against predators and extremes in temperature. However, they will survive in above-ground harbours such as logs, windrows and dense thickets of scrub (e.g. blackberry and lantana) or under built harbour, old sheds and machinery etc. In newly colonised areas without warrens, rabbits tend to live in 'scrapes' (or 'squats').

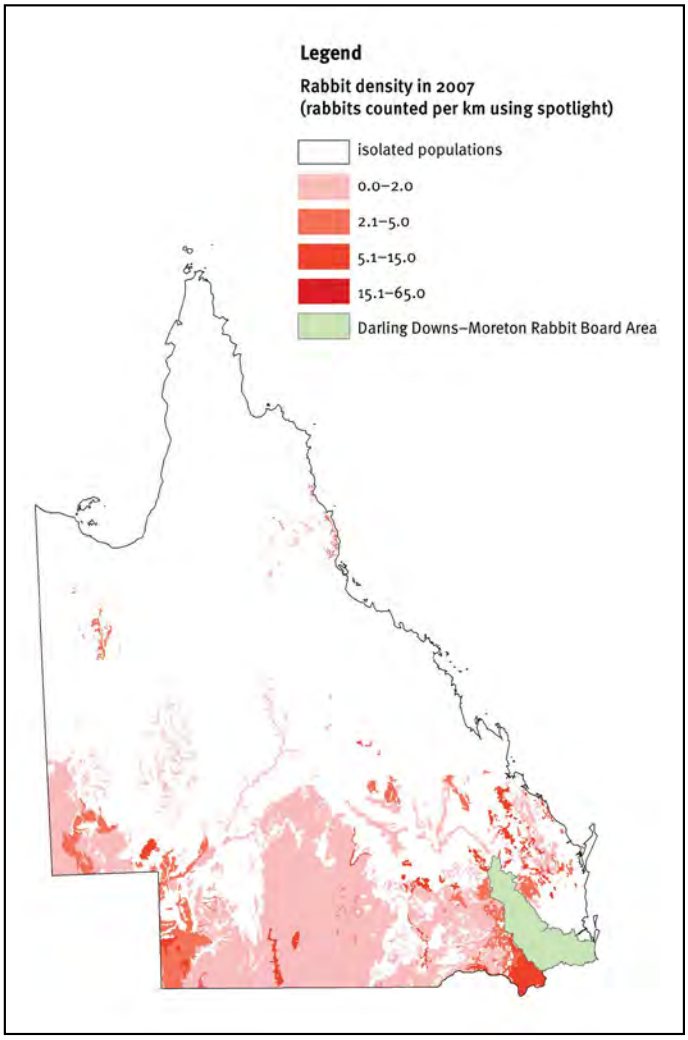
Breeding

Does (females) are pregnant for 28–30 days, but are able to mate within hours of giving birth. The average litter is 3–4 kittens but varies from two in a young doe, up to eight or more in a mature doe, and depends on the amount and quality of food available.

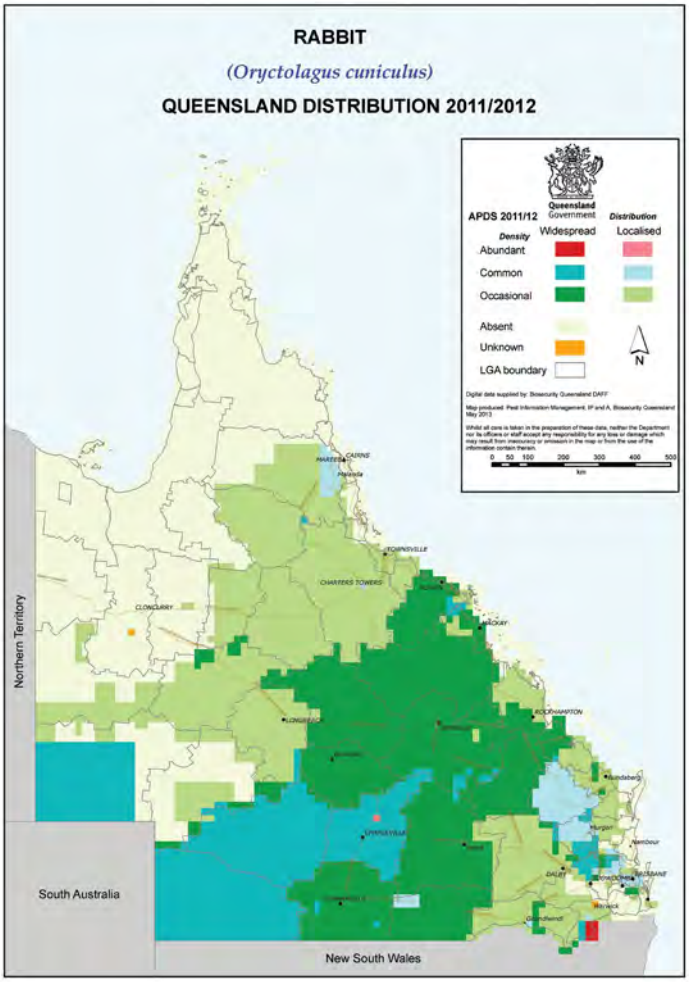
Five to six litters are possible in a good season.

Young does can breed at four months of age if conditions are suitable.

Map 1. Number of rabbits likely to be seen with a spotlight at night. Darker areas indicate more suitable rabbit habitat



Map 2. Distribution of rabbits in Queensland



Effective rabbit control cycle

Where to start control

For effective long-term rabbit control, concentrate on destroying source areas. Source areas will all have well-established warrens or ready-made structures that are cool and provide protection from predators. A source area must also have a good supply of green feed during the cooler seasons.

Coordinating control

Rabbit control is best done as a joint exercise involving all land mangers in the district. Cost-effective, long-term results can be achieved in rabbit control by following the methods outlined below.

Control

Integrated control

Landholders should adopt an integrated control approach, incorporating appropriate strategies from those listed below. Landholders must understand that

biological control agents such as myxomatosis and rabbit hemorrhagic disease virus (RHDV) are not a complete solution to rabbit problems. It is essential to incorporate them into a management strategy with other control techniques.

RHDV offers landholders a major opportunity to reduce rabbit numbers; however, failure to combine RHDV with other control strategies could cause rabbit immunity to develop (as occurred with myxomatosis).

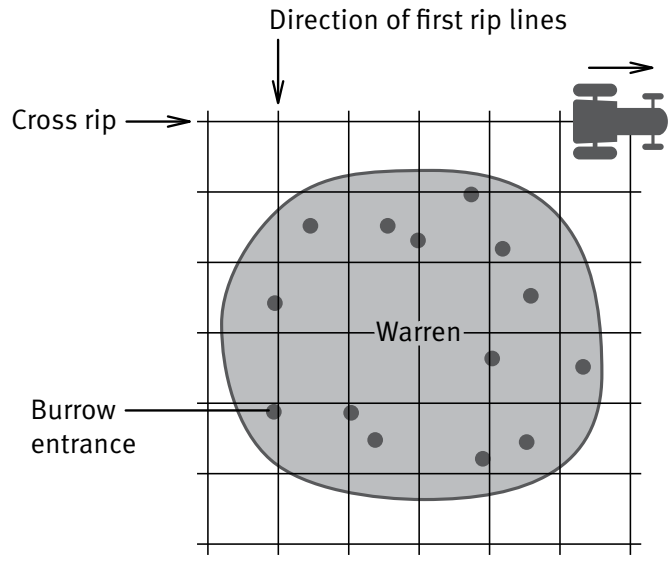
Destroying a rabbit's home (e.g. warren) is the most effective method for long-term control.

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

Warren ripping

In areas where rabbits live in warrens, ripping is the most effective method of long-term control. Ripping is so successful because warrens can rarely be reopened and rabbits are unable to recolonise these areas.

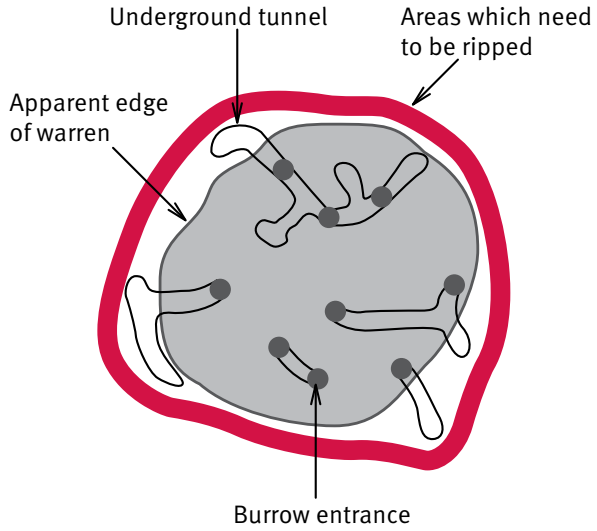
Tyne for ripping warrens (photo courtesy Mark Ridge)



Direction to rip warrens (illustration courtesy Will Dobbie)

To get the best results it is important to chase as many of the rabbits inside the warren as possible. Dogs can be used to drive rabbits into the warren before ripping starts.

The aim of ripping is to completely destroy the warren. It involves using a tractor with a tyned (sharp-pronged) implement—one tyne or many—that rips through the warren and collapses it. Larger tractors and dozers are more appropriate for properties with many warrens as they are able to move faster and rip wider.



Extent to rip warrens (illustration courtesy Will Dobbie)

Obviously, ripping is not suitable for warrens located underneath buildings or on steep rocky country. In such cases, other methods (poison baiting, releasing virus or fumigating burrows) should instead be used to reduce rabbit numbers. Warrens should then be either filled in or covered to stop rabbits from re-establishing. Burrows can be blocked with small boulders or rocks (see photo below).

Rock blocking rabbit hole

Harbour destruction

Where there is abundant surface harbour, a high proportion of rabbits may live above ground rather than in underground warrens. Rabbits can make their homes in windrows, dense thickets of shrubs (such as blackberries and lantana) and even in old machinery.

To eliminate these above-ground breeding areas, it may be necessary to:

- burn windrows and log piles
- remove noxious weeds through chemical and physical control
- remove movable objects (such as old machinery) from paddocks.

Sometimes removing harbour can expose warrens underneath. If this happens, the warrens need to be ripped.

Poison baiting

Baiting is not effective as a sole control method and will not eradicate an entire rabbit population. Numbers will quickly increase again, and you will have to continue baiting year after year with no permanent overall change in the rabbit population.

Rabbits can also become 'bait shy' and this method becomes less and less effective over time. Ideally, baiting is best used either before ripping/fumigation to reduce a population, or after ripping/fumigation as a 'mop-up'.

Baiting works best when rabbits are not breeding. During breeding season the majority of the population feeds over a larger-than-normal area, and it is the young rabbits that are most likely to take baits. While numbers will be reduced, animals of breeding age are not likely to be affected.

1080—sodium fluouroacetate

Pre-feeding is required when using 1080 because rabbits will not readily take new feed. The poison-free bait should be laid at least three times over a one-week period before the poisoned bait is laid. (1080-impregnated carrot baits are the most common form of bait used.) The practice helps to ensure that, when the poisoned bait is laid, it will be eaten by most of the rabbit population.

Only authorised persons can supply 1080 baits to landholders. Your local Biosecurity officer or your local government office should be able to assist you.

Pindone

Pindone is an anticoagulant registered for rabbit control. This poison works by preventing blood from clotting. In Queensland, it is not recommended for broadacre use and is mainly used in urban areas and near farm buildings.

Pindone works best when given as a series of small doses/feeds over a period of three days. Although pre-feeding is not essential, it does enhance the bait uptake by shy rabbits as they get used to the feed prior to any poison bait being laid. To be effective, pindone requires multiple feeds so that the poison can build up to fatal levels in the rabbit's body. Feeding over a number of nights provides plenty of opportunity for most of the rabbit population to consume the required lethal dose. Rabbits poisoned with pindone will usually die within 10–20 days.

Pindone baiting does not work well when there is a lot of green pick around for rabbits.

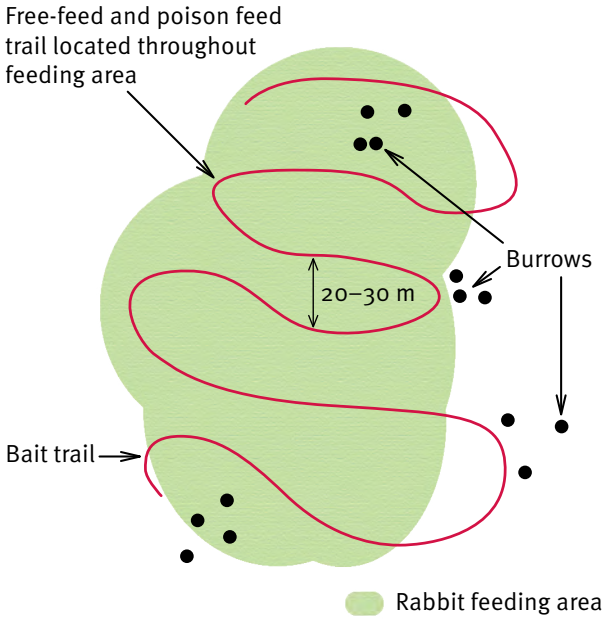
Poison bait trails

It is important that bait trails are laid properly to ensure the best results. 'Baitlayers' make it easier to put out bait trails at the correct rate, and they can be towed behind most 4WD vehicles, quad bikes and tractors.

When scratching and laying a trail, consider the following:

- Rabbits like freshly scratched/disturbed soil—this may be because rabbits are territorial and inspect newly disturbed soil, and/or the disturbed vegetation smell attracts them.
- Lay trails around warrens and in the areas where rabbits most often feed.
- Laying trails on slopes and hills requires care—it can cause erosion in some soils types (e.g. granite and traprock). Trails are best laid in a zigzag pattern in steep terrain to minimise erosion.
- A trail that has been scratched for the first feed is easy to follow for the rest of the baiting program.
- The soil should be turned only enough to scratch the surface—don't plough the ground.
- A trail that has been scratched too deep will spook the rabbits because they will not have full sight of their predators.
- Where vegetation is thick, or it is difficult to find the main feeding areas, lay bait trails in a grid pattern across the site.

As a general rule, avoid crossing the bait trail—it can cause confusion when you try to follow the same trail on subsequent occasions.



Method for laying a bait trail (illustration courtesy Animal Control Technologies)

Bait trials will be most effective if you follow these guidelines:

- Use good quality, non-contaminated bait material. (Simple rule: if you wouldn't eat it, the rabbit won't either.)
- Use enough feed to bait all the rabbits in the area. (The pre-feed will give an indication of the potential bait take.)
- Expect a greater uptake of pre-feed and bait material when vegetation is scarce, dried off or soured.
- Ensure that all the preparation equipment is clean and free of any chemical residues or smells—rabbits can be very shy of unusual odours.
- When there are kittens in a warren, lay the bait trail close to the warrens.

Fumigation

Fumigation is labour intensive and time consuming, and is not usually an effective method if used alone. However, as a 'mop-up' technique or control method for use in areas where ripping is not practical (e.g. steep and rocky terrain), it may be a good alternative.

Because this technique relies on directly affecting the rabbits, and does not affect the structure of the warren, it is crucial that as many rabbits as possible are underground when fumigation is carried out. Rabbits usually take refuge in their burrows from mid-morning to mid-afternoon and during hot weather so these are the best times to fumigate. Dogs can also be used to drive rabbits into their warrens.

For best results, fumigation should be carried out in two stages—initially, before the breeding season starts (as this reduces the breeding stock), and then again during the breeding season.

There are two types of warren fumigation—static and pressure. In Queensland, static fumigants are a more popular and safer option for controlling rabbits and will be explained below.

Static fumigation

This method is easy to use, and time- and cost-effective. Static fumigation comes in the form of aluminium phosphide (phosphine) tablets, which can be purchased from most agricultural suppliers. These tablets are small and round (about the size of a marble), and weigh 3 g. Trade names for phosphine include Pestex®, Quickphos® and Gastion®. General directions for the use of phosphine tablets appear below, but always refer to the manufacturer's specific recommendations for use.

To fumigate warrens using phosphine tablets:

1. Find all warren entrances—both active and inactive.
2. Cut back the warren entrance at right angles using a shovel.
3. Separately wrap two tablets in moistened absorbent paper (toilet paper/paper towels).
4. Insert the tablets as far down into the entrance as possible. (Polypipe and a push rod can be used to help push the tablets down.)
5. Push some scrunched-up newspaper down the hole to block the entrance and then cover it up with soil and, if possible, a rock.
6. Treat all entrances to the warren (active and inactive) the same way.
7. Check warrens about a week after fumigation and re-fumigate any reopened entrances.

Once in the warren, the moistened tablets react with air to release a toxic gas, which spreads quickly throughout the warren. The phosphine gas itself is invisible and odourless but leakages from the warren can be detected by the smell of ammonia. (This is a safety mechanism that is built into the tablet.) Any leakages need to be blocked immediately.

Biological controls

Rabbit hemorrhagic disease virus (also known as rabbit calicivirus disease)

RHDV is a virus specific to rabbits which works by infecting the lining of the throat, lungs, gut and liver.

RHDV relies primarily on direct rabbit-to-rabbit contact in order to spread. High rabbit numbers are therefore needed before this control method will be effective.

After RHDV has infected an area, it is important to use another method for follow-up control to increase the likelihood that the population is eradicated before it is able to develop resistance and increase its numbers again.

Resistance to RHDV depends primarily on the age of the rabbit. Therefore, it is better for RHDV to go through a rabbit population after rabbits have bred and the young are old enough to be affected by the virus. Rabbits that survive RHDV develop antibodies against the virus. Breeding females can also pass these antibodies on to the young (through antibodies in their milk), conferring temporary protection on rabbits up to 12 weeks old.

Myxomatosis

Myxomatosis is no longer produced as a laboratory strain but field strains are still known to recur and affect rabbit populations.

Trapping

Trapping is an extremely labour-intensive control method and requires a skilled operator to set the traps to successfully capture rabbits.

If you do plan to trap rabbits on your property, common sense and respect for animal welfare are essential. While there are currently no strict guidelines for the use of traps in Queensland, it is an area of growing concern for animal welfare advocates.

Cage trap

A cage trap has a lever that closes the cage when a rabbit steps on it. The rabbits are lured into the cage with bait—usually diced carrot. Traps need to be disabled and left open for two or three nights with bait leading into the cage. This entices rabbits to enter. A trap can be set once a rabbit has consumed a trail of bait all the way into that trap. Traps should be checked and emptied regularly—usually a couple of times a night.

This effective and humane technique is most useful for removing any remaining rabbits from places like hay sheds and after the shed has been fenced to prevent additional rabbits from entering and leaving. Free-feed then trap, and keep the shed rabbit-proof to prevent rabbits recolonising.

Barrel trap

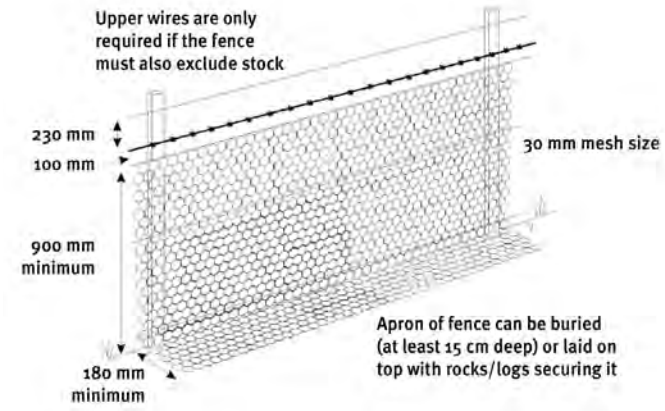
A barrel trap is designed specifically for rabbits. It is cylindrical, made of light mesh, and is about 1 m long and 15 cm in diameter. The trap has one open end with two hinged trap doors along its side. The open end is placed in the burrow, and the hinged gates close and trap the rabbit after it enters from the burrow.

The trap can be left in the burrow entrance for a number of days. However, it must be checked at least daily so that if a rabbit has been caught it does not suffer and animal welfare responsibilities are met.

Barrel rabbit trap in hole

Exclusion fencing

Rabbit exclusion fences are built with the aim of keeping rabbits out of a particular area. It is appropriate for small, high-value areas that require protection. A fully fenced area will only remain rabbit-free in the long term if all rabbits are removed from the enclosed area after fencing and the fence is regularly maintained and checked for holes.



Exclusion fence for rabbits (illustration courtesy DEWHA)

A rabbit-proof fence should be made of wire mesh netting (40 mm or smaller) and needs to be at least 900 mm high. The netting should also be buried to depth of at least 150 mm. Gates into the fenced area need to be rabbit-proof as well.

Electric fencing is a cheaper alternative, but it is not a complete physical barrier and is also prone to damage from other pest animals and stock.

Shooting

Shooting is most useful when used to 'mop up' after other control methods (such as ripping). To get the best results, shoot at the time of day when rabbits are active. This is usually in the early morning, late afternoon or at night. The best and most economical firearm to use is a .22 calibre rifle.

If your property is within an urban area, you will need to comply with local government regulations and the *Police Powers and Responsibilities Act 2000*, which restrict the use of firearms.

Further information

For further detailed reading information on specific rabbit control techniques or costing your rabbit control please refer to Rabbit control in Queensland; a guide for land managers. Download from the Biosecurity Queensland website at www.biosecurity.qld.gov.au

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

This fact sheet is developed with funding support from the Land Protection Fund.