

AQUIS RESORT AT THE GREAT BARRIER REEF PTY LTD
**ENVIRONMENTAL IMPACT
STATEMENT**

VOLUME 2

**CHAPTER 19
BIOSECURITY**

19. BIOSECURITY

19.1 PEST PLANTS

19.1.1 Existing Situation

The detailed ecological site survey (refer **Chapter 7** – Flora and Fauna) found that there is a relatively low diversity and abundance of weeds across the study area. Weeds that are present are typically those associated with agriculture and / or abandoned areas, and the detailed assessment of areas of natural vegetation reveals that weed penetration into native ecosystems is rare to absent. A total of 64 exotic species and their relative abundance were recorded on the site. Relative abundance is recorded as 'rare' (one or two individuals), 'occasional' (scattered patches), or 'common', where the species is widespread. A list of all weeds encountered during the survey is provided in **Table 19-1**.

a) Listed Weeds

Table 19-1 below details the listed weed species found on-site and their level of classification.

TABLE 19-1 WEED SPECIES LOCATED ON-SITE

Species	Common Name	Abundance	WoNS	Land Protection (Pest and Stock Route Management) Act			FNQROC			
				C1	C2	C3	C1	C2	C3	C4
<i>Allamanda cathartica</i>	Golden allamanda	R								✓
<i>Cyperus aromaticus</i>	Navua sedge	C								✓
<i>Lantana camara</i>	Lantana	R	✓			✓		✓		
<i>Opuntia stricta</i>	Prickly pear	R	✓			✓				✓
<i>Praxelis clematidea</i>	Praxelis	C								✓
<i>Senna obtusifolia</i>	Sickle-pod	R			✓				✓	
<i>Sphagneticola trilobata</i>	Singapore daisy	C				✓			✓	
<i>Sporobolus africanus</i>	Rats tail grass	R			✓					
<i>Sporobolus fertilis</i>	Rats tail grass	R			✓					
<i>Stachytarpheta jamaicensis</i>	Light-blue snake weed	C								✓

Source: Appendix G (Table 6).

R – Rare – one or two individuals
O – Occasional – scattered patches
C – Common – species is widespread

In the above table:

- **National:** Weeds of National Significance (WoNS) have been identified by the Australian government based on their invasiveness, potential for spread, and environmental, social and economic impacts. They have been nominated as they require coordinated action among levels of government and between states to effectively control the species.
- **State:** The *Land Protection (Pest and Stock Route Management) Regulation 2003* under the *Land Protection (Pest and Stock Route Management) Act* declares pest plants and pest animals for control and management in the State of Queensland, and divides them by priority for control into Class 1, Class 2 or Class 3 pests based on the following classification system:
 - Class 1 Pests:
 - o are not commonly present or established in the state
 - o have potential to cause an adverse economic, environmental or social impact in the state, another state or a part of the state or another state
 - Class 2 and 3 Pests:
 - o are established in the state
 - o are causing, or have the potential to cause, an adverse economic environmental or social impact in the state, another state or a part of the state or another state.
- **Regional:** Far North Queensland Regional Organisation of Councils (FNQROC). The FNQ Regional Pest Management Plan is the result of integration of the individual Pest Management Plans (PMPs) across the member councils of the FNQROC and Hinchinbrook Regional Council. This regional PMP allows better use of resources available within the community and government to strategically address priority pests and provide for more efficient and cost-effective meeting of local government responsibilities under the *Land Protection (Pest and Stock Route Management) Act 2002*. Weed species from the regional planning area that attracted high to medium priority control attention within individual PMPs are prioritised under 4 categories:
 - Category 1: To be eradicated.
 - Category 2: To be contained and reduced with a long term view of eventual elimination from the region if possible.
 - Category 3: Isolated outbreaks to be eliminated, populations reduced and spread suppressed.
 - Category 4: Control to be effected consistent with level of declaration and / or local adverse impact.

Key findings regarding weeds are:

- WoNS:
 - *Lantana camara* and *Opuntia stricta* are the only WoNS located during survey.
 - They occur in very small numbers and are restricted to well-drained sand soils on the eastern side of the site. The plants are not blocking natural regeneration nor are they actively expanding where they occur.
 - *Lantana camara* prefers more fertile soils and is unlikely to require ongoing management once initial control was exerted.
 - *Opuntia stricta* is also a Class 3 pest under Queensland legislation and a Category 4 pest under the FNQROC.

- Land Protection (Pest and Stock Route Management) Act:
 - There are no Class 1 (*Land Protection (Pest and Stock Routes Management) Act 2002*) species present within the study area.
 - *Senna obtusifolia* and *Sporobolus fertilis* / *S. africanus* are Class 2 species present.
 - *Senna obtusifolia* occurs at three locations in isolated patches on Lot 100 NR3818, Lot 2 RP745120 and Lot 4 RP713690. At these sites, it is located within open cleared areas and does not appear to be significantly expanding. The plant can however rapidly expand following disturbance and may invade into surrounding properties.
 - *Sporobolus fertilis* and *S. africanus* were only found in the wet season survey along cane headland tracks abutting riparian vegetation on Lot 60 RP835486 and Lot 4 RP749342
 - In addition to *Lantana camara* and *Opuntia stricta* (see above), *Sphagneticola trilobata* is the only Class 3 weed recorded on the site. *Sphagneticola trilobata* is restricted to a number of small patches in well-developed Melaleuca dominated areas adjacent to Yorkeys Knob Road. This plant is capable of arresting natural regeneration in this ecological situation, and should be a high priority for control.
- FNQROC:
 - There are no Category 1 species present within the study area.
 - The Category 2 *Lantana camara* is present (see above).
 - *Senna obtusifolia* and *Sphagneticola trilobata* (see above) are the only Category 3 FNQROC species present.
 - In addition to *Opuntia stricta* (see above), there are four weed species that are listed as Category 4 (FNQROC PMP). These are *Allamanda cathartica*, *Cyperus aromaticus*, *Praxelis clematidea* and *Stachytarpheta jamaicensis*.

b) Unlisted Weeds

Unlisted weeds recorded during the survey pose a risk to the integrity of natural areas. Species identified are as listed below:

- *Dysoxylum lutescens*
- *Heliconia psittacorum*
- *Ixora coccinea*
- *Mangifera indica*
- *Ravenala madagascariensis*.

There are also three native species that are considered weeds where they were recorded, namely:

- *Corymbia torelliana*
- *Leptospermum madidum* ssp. *madidum*
- *Ptychosperma elegans*.

Mangifera indica is also a known weed of the Wet Tropics. No wild specimens were recorded but the tree has been planted within the three fruit orchards found in the project area.

There are a number of small, ephemeral weeds within cane cultivation. None of these are considered a threat to native plant communities.

c) Distribution

Table 19-2 below shows the occurrence of weeds by habitat type and gives a good indication of species distribution on the site.

TABLE 19-2 OCCURRENCE OF WEEDS BY HABITAT TYPE

GENUS / SPECIES	COMMON NAME	WEED CATEGORY	HABITAT					
			Mangroves	Grassland	Woodland	Shoreline	Aquaculture Ponds	Melaleuca wetland
<i>Alternanthera brasiliana+</i>	Brazilian joyweed	E		X	X			
<i>Amaranthus viridis+</i>	Green amaranth	E		X				
<i>Mangifera indica+</i>	Mango	E		X			X	
<i>Allamanda cathartica+</i>	Golden allamanda	Cat 4						X
<i>Catharanthus roseus+</i>	Madagascar periwinkle	E			X			
<i>Dypsis lutescens+</i>	Golden cane	E						X
<i>Ageratum conyzoides+</i>	Blue top	E		X				
<i>Cyanthillium cinereum+</i>	Veronia	E		X	X			
<i>Emilia sonchifolia+</i>	Emilia	E	X				X	
<i>Praxelis clematidea+</i>	Praxelis	Cat 4		X	X			
<i>Sphagneticola trilobata+</i>	Singapore daisy	Class 3, Cat 3	X	X	X		X	X
<i>Synedrella nodiflora+</i>	Cinderella weed	E		X		X		
<i>Tridax procumbens+</i>	Tridax daisy	E		X				
<i>Opuntia stricta+</i>	Prickly pear	WoNS, Class 2, Cat 4			X			
<i>Delonix regia+</i>	Poinciana	E		X				
<i>Ipomoea hederifolia+</i>	Red convolvulus	E		X				
<i>Momordica charantia+</i>	Balsam pear	E			X			
<i>Cyperus aromaticus+</i>	Navua sedge	Cat 4		X				
<i>Euphorbia heterophylla+</i>	Milkweed	Cat 4		X				
<i>Calopogonium mucunoides+</i>	Calopo	E		X				
<i>Centrosema molle+</i>	Centro	E		X				
<i>Chamaecrista rotundifolia+</i>	Wyncassia	E		X				
<i>Clitoria ternatea+</i>	Butterfly pea	E		X				
<i>Crotalaria pallida var. obovata+</i>	Bird flower	E		X				
<i>Macroptilium atropurpureum+</i>	Siratro	E		X				
<i>Macroptilium lathyroides+</i>	Phasey bean	E		X				
<i>Neonotonia wightii+</i>	Glycine	E		X				

GENUS / SPECIES	COMMON NAME	WEED CATEGORY	HABITAT					
			Mangroves	Grassland	Woodland	Shoreline	Aquaculture Ponds	Melaleuca wetland
<i>Pueraria phaseoloides</i> +	Tropical kudzu	E			X			
<i>Senna obtusifolia</i> +	Sickle-pod	Class 2, Cat 3		X				
<i>Stylosanthes humilis</i> +	Stylo	E		X				
<i>Heliconia psittacorum</i> +	Parrots beak heliconia	E						X
<i>Hyptis suaveolens</i> +	Horehound	E		X				
<i>Sida cordifolia</i> +	Flannel weed	E		X	X			
<i>Sida retusa</i> +	Sida	E		X				
<i>Triumfetta rhomboidea</i> +	Triumfetta	E		X	X			
<i>Mimosa pudica</i> var. <i>hispida</i> +	Sensitive plant	E		X				
<i>Psidium guajava</i> +	Guava	Cat 4			X			
<i>Ludwigia octovalvis</i> +	Pond primrose	E						X
<i>Passiflora foetida</i> +	Stinking passionfruit	E		X	X	X	X	X
<i>Passiflora suberosa</i> +	White passionfruit	E			X			X
<i>Passiflora subpeltata</i> +	White passionflower	E		X	X			X
<i>Arundo donax</i> +	Giant cane	E						X
<i>Chloris gayana</i> +	Rhodes grass	E		X				
<i>Cynodon dactylon</i> +	Blue couch grass	E		X				
<i>Digitaria ciliaris</i> +	Hairy crabgrass	E		X				
<i>Eleusine indica</i> +	Crows-foot grass	E		X				
<i>Eragrostis tenella</i> +	Eragrostis	E		X				
<i>Leersia hexandra</i> +	Swamp rice grass	E		X				
<i>Megathyrsus maximus</i> +	Guinea grass	E		X	X			
<i>Melinis repens</i> +	Red Natal grass	E		X	X			
<i>Sporobolus africanus</i> +	Rats-tail grass	Class 2		X				
<i>Sporobolus fertilis</i> +	Rats-tail grass	Class 2		X				
<i>Urochloa decumbens</i> +	Signal grass	E		X	X			
<i>Urochloa mutica</i> +	Para grass	E		X				
<i>Portulaca pilosa</i> +	Pigweed	E	X					
<i>Ixora coccinea</i> +	Jungle geranium	E						X
<i>Mitracarpus hirtus</i> +	Small square weed	E		X				
<i>Solanum torvum</i> +	Devils fig	E		X				
<i>Ravenala madagascariensis</i> +	Travellers palm	E						X

GENUS / SPECIES	COMMON NAME	WEED CATEGORY	HABITAT					
			Mangroves	Grassland	Woodland	Shoreline	Aquaculture Ponds	Melaleuca wetland
<i>Lantana camara</i> +	Lantana	WoNS, Class 3, Cat 2			X			
<i>Stachytarpheta jamaicensis</i> +	Light-blue snake weed	Cat 4		X	X			
<i>Ptychosperma elegans</i>	Solitaire palm	E*			X		X	X
<i>Corymbia torelliana</i>	Cadaghi	E*						X
<i>Leptospermum madidum</i> ssp. madidum	Weeping ti-tree	E*						X
Number		64	3	45	20	2	5	14

Source: Appendix G. (Appendix 4).

Legend (see also Section 19.1.1a)

WoNS = Weeds of National Significance

Class XX = Queensland Declared Species

Cat XX = FNQROC Listed Species

E = Environmental Weed

E* = Native species considered exotic at that location

This table shows that:

- overall, 64 species of weeds were located
- the habitat type with the greatest number of weed species is the anthropogenic grassland
- the least number of weed species occur in the shoreline and mangrove forest habitats.

d) **Exotic Plants**

A number of exotic fruit trees have been established in three locations – adjacent to the main residence on Lot 100 NR3818, and in two small clearings located between Richters Creek and the aquaculture ponds. Apart from *Mangifera indica*, none of the fruit trees under cultivation are known invaders of natural areas in the Wet Tropics. There are also a number of exotic palms planted around the aquaculture ponds / residence. These have no residual habitat values.

19.1.2 Impacts

The site contains 61 species of listed and unlisted pest plants. Of these, the most important are discussed below.

- Declared pest plants such as *Lantana camara* and *Senna obtusifolia* are serious threats to agriculture and their timely control is a benefit to agriculture across the local area. While landholders have a legal responsibility to control certain weeds, unlisted weeds are causing a greater degree of environmental harm within the natural habitats of the study area.

- The control of *Ravenala madagascariensis* and *Leptospermum madidum* var. *madidum* presents an opportunity to control significant potential weeds before they have an opportunity to commence transformation within an increasingly at risk ecosystem.

Developing the Aquis Resort will involve removal of the anthropogenic grassland and aquaculture pond habitats and replacement of these with restoration (native species), lake, Resort Complex Precinct, or golf course. All of these uses will be less prone to weed invasion.

The construction and operation of the lake will involve a new weed management regime as discussed in **Chapter 11** (Water Quality). In particular, the lake has the potential to introduce algal blooms and these will require management. This is proposed to be via the *Lake Management Strategy* outlined in **Section 23.3.3**. The saline lake environment will not support pest plants such as *Salvinia*, *Water hyacinth*, and *Cabomba* that are known to be in the general area.

During construction, there is a high potential for mobile equipment to transport pest plants onto the site. Seeds and plant material can be dislodged from material that has collected on the undersides and crevices of mobile plant equipment, and can then become a nuisance to the area. Where mobile plant machinery, including boats and other aquatic vessels, is washed down by certified weed wash-down personnel off-site, this risk will be minimised.

Weeds and exotic plantings are an impact of the existing land use and it is expected that this threat will largely disappear with the construction of the Aquis Resort due to the conversion of weed-infested habitat to intensively landscaped and managed areas. That is as long as the new land use involves active weed management as described below.

With these controls in place the development is considered to provide a net beneficial impact with respect to weeds.

19.1.3 Mitigation and Management

a) Construction

The required response for all pest plants is management. A *Weed and Pest Management Strategy* is incorporated into the EMP (Planning) and implemented in the project's EMP (Construction) (see **Section 23.4.4**). This management will lead to a net beneficial impact of the development.

The management plan will be consistent with CRC's Pest Management Plan and include the results of negotiations with CRC regarding the alignment of coordinated weed and pest management with Council's priorities. This includes ensuring any local pest management work addresses all locally-important weeds (e.g. pond apple), that were not located on-site but could still be of concern.

b) Operation

The design of the lake and subsequent management will take into account the likely presence of potential weed species. This is proposed to be via the *Lake Management Strategy* outlined in **Section 23.3.3**.

19.1.4 Residual Impacts

Weeds are an impact of the existing land use and it is expected that this threat will largely disappear with the construction of the Aquis Resort due to the conversion of weed-infested habitat to more managed areas. The new land use involves active weed management. With these controls in place, the development is considered to provide a net beneficial impact with respect to pest plants.

A *Weed and Pest Management Strategy* is incorporated into the EMP (Planning) and will be implemented in the project's EMP (Construction) (see **Section 23.4.4** and EMP (Operation & Maintenance) (see **Section 23.4.5**). This management will lead to a net beneficial impact of the development with respect to pest plants.

19.2 PEST ANIMALS

19.2.1 Existing Situation

a) Terrestrial Pests

The following seven species of pest animals were recorded:

- *Canis lupus familiaris* (Domestic dog)
- *Hemidactylus frenatus* (Asian house gecko)
- *Lonchura punctulata* (Nutmeg mannikin)
- *Passer domesticus* (House sparrow)
- *Rhinella marina* – formerly *Bufo marinus* (Cane toad)
- *Sus scrofa* (Pig)
- *Sturnus tristis* (Common mynah).

All of these animals are common in domestic and agricultural areas, and a number are acknowledged as beyond control in the local area (Cairns City Council Pest Management Plan [CCC PMP] 2013-2017 Draft). The following comments are relevant:

- The exotic birds *Lonchura punctulata* (nutmeg manikin), *Sturnus tristis* (Indian mynah) and *Passer domesticus* (house sparrow) are ubiquitous surviving mostly on food scraps and invertebrates. Only *Sturnus tristis* is acknowledged within the CCC PMP (*Acridotheres tristis*) but is not Declared.
- *Rhinella marina* (cane toad) is also listed but not Declared within the CCC PMP.
- The locally common *Hemidactylus frenatus* (Asian house gecko) may also be a permanent colonist. The species is dependent on built structures. This species is acknowledged within the CCC PMP but is not Declared.
- Single individuals of *Sus scrofa* (feral pig) and *Canis lupus familiaris* (feral dog) have been sighted on the property. Both these species are Declared as Class 2 pests under the *Land Protection (Pest and Stock Route Management) Act 2002* and also appear within the CCC PMP. Landholders are required to eradicate these pests on private tenures.

Sus scrofa and *Canis lupus familiaris* were only recorded as individual animals, and *Hemidactylus frenatus* (though abundant) was restricted to one site only. The remaining species occur commonly across all disturbed habitats, and are abundant in the disturbed portions of the project area. All of these animals are ubiquitous in disturbed habitats, and with the exception of *Rhinella marina*, *Sus scrofa*, and *Canis lupus familiaris*, this exotic fauna is only found in man-made habitats.

b) **Distribution**

Table 19-3 shows the occurrence of pest animals by habitat type and gives a good indication of species distribution on the site.

TABLE 19-3 OCCURRENCE OF PEST ANIMALS BY HABITAT TYPE

GENUS / SPECIES	COMMON NAME	HABITAT					
		Mangroves	Grassland	Woodland	Shoreline	Aquaculture Ponds	Melaleuca wetland
<i>Rhinella marina</i> +	Cane Toad		X	X		X	X
<i>Hemidactylus frenatus</i> +	Asian House Gecko	X				X	X
<i>Lonchura punctulata</i> +	Nutmeg Mannikin		X	X			
<i>Passer domesticus</i> +	House Sparrow		X				
<i>Sturnus tristis</i> +	Common Mina		X			X	
<i>Canis lupus familiaris</i> +	Feral dog		X				
<i>Sus scrofa</i> +	Pig		X	X			
Number		1	6	3		3	2

Source: Appendix G. (Appendix 4).

The table shows that:

- overall, seven species of pest animals were located
- the habitat type with the greatest number of pest animal species is the anthropogenic grassland
- the least number of pest animal species occur in the shoreline and mangrove habitats.

c) Aquatic Pests

Nine exotic non-indigenous species were recorded from the Barron River catchment with one species, mosquitofish, observed in the site). Several other pest species are likely to occur on the site. These are list in **Table 19-4**.

TABLE 19-4 NON-INDIGENOUS AQUATIC SPECIES

FAMILY	SPECIES	COMMON NAME	UNLIKELY	LIKELY BUT NOT OBSERVED	OBSERVED
Cichlidae	<i>Astronotus ocellatus</i>	Oscar	X		-
Cichlidae	<i>Oreochromis mossambicus</i>	tilapia / Mozambique mouthbrooder	-		X
Cichlidae	<i>Tilapia mariae</i>	spotted tilapia / black mangrove cichlid	-	X	-
Poeciliidae	<i>Gambusia holbrooki</i>	mosquitofish	-	-	X
Poeciliidae	<i>Poecilia reticulata</i>	guppy	X	-	-
Poeciliidae	<i>Xiphophorus helleri</i>	swordtail	X	-	-
Poeciliidae	<i>Xiphophorus maculatus</i>	platy	X	-	-
Salmonidae	<i>Oncorhynchus 1 mykiss</i>	rainbow trout	X	-	-
Salmonidae	<i>Salmo trutta 1</i>	brown trout	X	-	-

Source: Appendix F (Table 4-8). Tilapia record added from wet season survey (Addendum to **Appendix F**).

¹ These species were last recorded in the Barron catchment in 1959. Both species prefer cool, upland streams and lakes, and are highly unlikely to be in the region. The validity of the record is questionable.

Mosquitofish and tilapia (both observed) are both declared noxious species listed under the Fisheries Regulation 2008. Declared noxious fish cannot be kept, hatched, reared or sold, and must be destroyed if caught. They must not be returned to the water in any form, and cannot be used as bait (alive or dead).

d) Other Pest Animals of Concern

In addition to the pest animals located on-site, it is known that electric ants have been found in the Yorkeys Knob and other parts of the Cairns region. According to the Department of Agriculture, Fisheries and Forestry (Commonwealth) fact sheet (<http://www.phytosanitary.info/node/1502>):

In July 2012, three areas in Smithfield and a residential area at Kewarra Beach were declared successfully eradicated from electric ants. The invasive electric ant pest was first discovered in Smithfield in May 2006, and later detected in Kewarra Beach, Trinity Beach, Caravonica and Redlynch in Cairns in Far North Queensland. Even more recently, the ants have been detected in Yorkeys Knob, Kamerunga, Kuranda, Smithfield, Craigie/Port Douglas, Freshwater and Bingil Bay near Mission Beach. Biosecurity Queensland is working with the community to eradicate this pest. It is continuing to undertake treatment rounds and post-treatment surveillance in all infested areas. There are huge environmental, residential, agricultural and tourism impacts if electric ants take hold, which is why it's everyone's responsibility to help eradicate electric ants.



Photo 19-1 Electric ants.

Source: <http://www.daff.qld.gov.au/plants/weeds-pest-animals-ants/pest-animals/a-z-listing-of-pest-animals/photo-guide-to-pest-animals/electric-ants>

Electric Ant Movement Control Areas have been declared under the *Plant Protection Act 1989* to prevent the spread of electric ants from known infested areas of Queensland (and this includes the general Yorkeys Knob area). The current electric ant movement control areas map is shown on **Figure 19-1**.

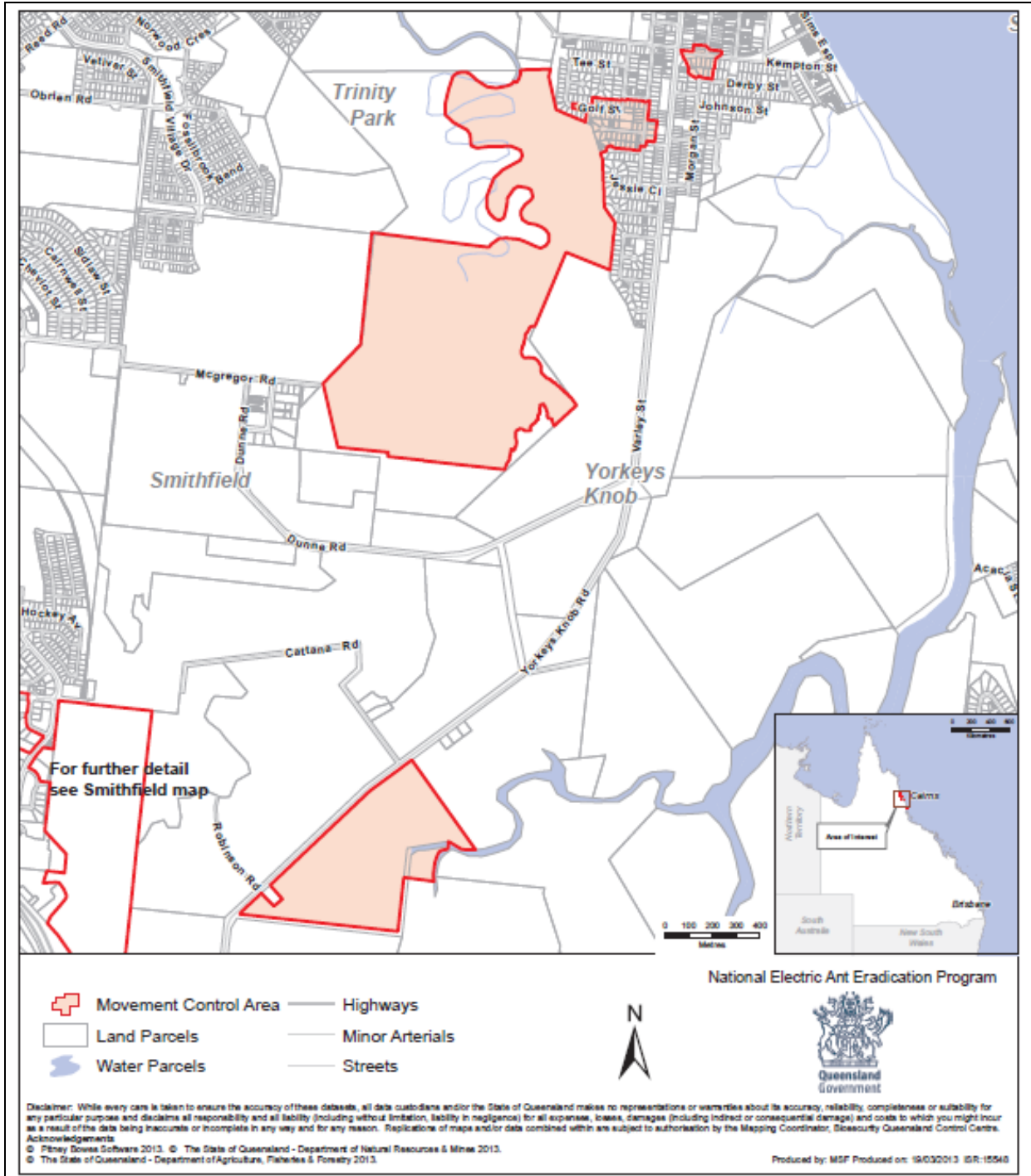


Figure 19-1 Electric ant movement control areas (Yorkeys Knob).

Source: http://www.daff.qld.gov.au/data/assets/pdf_file/0003/59043/EA_RAMap_YorkeysKnob.pdf

19.2.2 Impacts

The site contains a small number of terrestrial and aquatic pest animal species including electric ants.

- The majority of these species are unable to exist within intact ecosystems. Only *Sus scrofa*, *Canis lupus familiaris* and *Rhinella marina* are not dependent on anthropogenic disturbance. Management of *Sus scrofa* and *C. lupus familiaris* would receive a level of appropriate assistance and response from the CRC through the CCC PMP however other species will require management within the Resort's Pest Management Plan. There are no effective controls to exclude *Rhinella marina* however it is possible to limit numbers by ensuring that breeding places are minimised. During lake construction, numbers of this species may expand considerably due to freshwater availability, their rapid maturation, the availability of rest/escape sites within materials storage areas, and in response to invertebrate swarms attracted to security lighting. Dramatic population increases are likely to be a temporary phenomenon, however the species is likely to persist over time in lower numbers. In the interim, surface freshwater availability should be limited.
- There are also other pest animals, in particular the exotic rodents *Rattus rattus* (black rat) and *Mus domesticus* (house mouse) that may potentially inhabit the site in the future. These are generally managed under relevant Public Health legislation and are not considered within the CCC PMP.
- The two main pest animals (Cane toad and Nutmeg manikin) are common in the Cairns area and no specific management is considered practical. However, there are opportunities to include some pest management actions in the site management regime and this will lead to a net beneficial impact of the development.
- Restrictions apply to the movement of materials that pose a high risk of spreading electric ants within and from these control areas. Regarding electric ants, Biosecurity Queensland manages the National Electric Ant Eradication Program that includes surveillance, treatment, and containment components. All responsibilities required under the program will be incorporated into the Aquis Resort Pest Management Plan.

No design solutions for pest animals are available, with the exception of pest fish. The construction and operation of the lake will introduce the risk of introduction of pest fish (especially tilapia). The design of the lake and subsequent management will take the likely presence of these species into account via the *Lake Management Strategy* outlined in **Section 23.3.3**. Initial recommendations for tilapia are set out in **Section 19.2.3a**).

Terrestrial Pests

The presence of large numbers of people at the Aquis Resort has the potential to encourage the establishment for a range of pest animals. The most likely species are birds such as the Common mynah (*Sturnus tristis*) and the House sparrow (*Passer domesticus*).

The impacts of such species could include the spread of disease and a range of nuisance behaviours such as eating food off tables.

Tilapia

Over time, the lake may be colonised by two species of tilapia (*Tilapia mariae* and *Oreochromis mossambicus*), both declared noxious under Queensland Government legislation and identified in the CRC's Pest Management Plan (2005) as a pest species of the local government area. Consequently, both species have been given a critical threat rating and control of these species rated as 'high priority'.

Both species of tilapia are known to occur in lowland areas of the wet tropics and are established in the Barron River catchment. The two primary vectors of dispersal for these species are human

assisted (i.e. the release of aquarium fish into waterways) and the connection of waterways containing tilapia during overland / sheet flood flows, with the latter occurring in the local catchment.

Both species of tilapia prefer vegetated, shallow, still waters approximately 4 m deep and with no shallow margins, the lake will not provide ideal habitat.

Tilapia may already be present in the waterways on-site, or may colonise the lake via:

- the inlet and outlet pipes (although screening will reduce this opportunity)
- overland / sheet flood flows in extreme flood events
- human intervention.

Once established in the lake, they may potentially disperse to the surrounding waterways in flood flows. Screening the outlet pipe where it leaves the lake will mean significant numbers of adult fish are unlikely to leave the lake under normal operating conditions. However in flood conditions, these fish are likely to leave the lake via the overflows.

In addition to tilapia, the lake may become colonised by large native predatory fish such as barramundi (*Lates calcarifer*). The screens on the inlet and outlet pipes will prevent significant numbers of adult fish leaving the lake under normal operating conditions. However, during flood conditions, these fish are likely to leave the lake and colonise the surrounding estuaries. The introduction of large numbers of introduced pest fish or large native predatory fish may negatively impact fish and fisheries in the surrounding estuaries via competition for food and habitat, and via disease transfer. Further, some introduced species may also negatively impact habitat and water quality. While the estuaries surrounding the proposed lake are relatively small, the overflows from the proposed lake are relatively close to the mouths of the estuaries. This may aid in the dispersal of large numbers of predatory fish such as barramundi, reducing the impact on the estuary.

Electric Ants

According to DAFF (<http://www.daff.qld.gov.au/plants/weeds-pest-animals-ants/pest-animals/a-z-listing-of-pest-animals/photo-guide-to-pest-animals/electric-ants>),

The principal effect of electric ants is on the environment and humans. A large proportion of their diet comes from honeydew from scale insects which they farm, creating an agricultural nuisance. Electric ants can cause declines in the numbers of invertebrates and small vertebrates and compete with other ant species.

Electric ants are thought to have caused a decrease in reptile populations in New Caledonia and in the Galapagos Archipelago where they eat tortoise hatchlings and attack the eyes and cloacae of adult tortoises. They may sting and possibly blind domestic pets.

19.2.3 Mitigation and Management

a) General Pest Animals

The most appropriate responses to any ongoing issues presented by exotic vertebrates will be to limit breeding success and reduce required habitat resources (food, rest, reproductive, and escape resources):

- Food scraps and any domestic waste will be removed from site on a daily basis with strict hygiene provisions around temporary food consumption areas.
- Bins will be provided across the site at the onset of construction, and be an integral part of the resort landscaping.
- Use of native plants in landscaping will tend to favour native birds that will more effectively compete with and exclude exotic birds, and also prey on *Hemidactylus frenatus*.

- Materials storage areas will be designed to ensure they are regularly disturbed so that exotic fauna habitat is less likely to be available.

The required response for pest animals is management. A *Weed and Pest Management Strategy* is incorporated into the EMP (Planning) and implemented in the project's EMP (Construction) (see **Section 23.4.4**). This management will lead to a net beneficial impact of the development.

b) Tilapia

There are a number of control measures to manage colonisation of the proposed lake by tilapia species. These include:

- biological controls
- physical removal
- poisoning
- environmental management.

Management options are summarised in **Table 19-5**.

TABLE 19-5 POTENTIAL MANAGEMENT OPTIONS FOR TILAPIA

METHOD	COMMENTS	PROS	CONS
Biological control	There are a number of large native predatory fish in north Queensland estuarine and freshwaters. These include barramundi, mangrove jack, eels, sleepy cod, tarpon, fork-tailed catfish and various grunter species, of which some species undoubtedly prey on tilapia in creeks, at times. Nevertheless, tilapia have colonised north Queensland waters in the presence of such predators. In south-east Queensland, tilapia have established in impoundments with high densities of predatory fish, including stocked Australian bass and golden perch, and wild populations of long-finned eels and fork-tailed catfish. Stocking the lake with native predators may suppress the abundance of tilapia, but is unlikely to result in their eradication.	Can be advantageous as they will disperse on their own and provide a lasting management solution. Barramundi (<i>Lates calcarifer</i>) successfully used in control of tilapia aquaculture in the Philippines (Fortes 1979). Large native fishes may add to the 'amenity' of the lake feature.	Can adversely affect non-target species. Will become homeostatic with the target species population, if it is the only available food source, mirroring its rises and falls in abundances (Mack et al. 2000).

(Continued over)

METHOD	COMMENTS	PROS	CONS
Physical removal	Physical removal could be considered for control of tilapia if they establish in the Aquis Resort lake. There are numerous methods for the removal of invasive fish, with nets being the most effective.	Netting is the most widely used and effective method of physical removal. Gill nets, in particular, provide a simple, size selective mechanism for fish removal (Lagler 1978). Seine netting could be an effective option given the preference of these species to nest in relatively shallow waters, if suitable substrates are present.	Their use for long term control is labour intensive and not species selective (Hopkins & Cech 1992) potentially resulting in secondary stress responses (handling) and / or physical damage to non-target species.
Poisoning	The use of piscicides for controlling fish has had variable success to date. Complete removal of a target species is only achievable at small spatial scales.	Useful at small spatial scales in closed systems that are shallow and free from aquatic vegetating (Hill & Chichra 2005; Lazur et al. 2006).	Complete dispersal of piscicides throughout a water body can be hampered by difficulties in dispersing the toxicant into deeper waters or where there is a heavy cover of aquatic vegetation (Ling 2003).
Environmental management	Minimise the key ecological requirements for breeding by having deep water (> 2 m), steep banks, hard substrate particularly in shallow water, minimising vegetation in and around the waterbody and minimising fluctuations in water level.	Limiting the availability of preferred habitat for breeding is likely to reduce breeding in the lake, and limit population growth.	Unforseen design elements or amendment of an already progressed lake design to incorporate those elements that would remove key habitat requirements.

Source: Appendix F (Table 13.1). See this source of references cited.

A long-term pest fish management plan, will be developed in consultation with Queensland Fisheries and combining a number of these management elements to minimise the risk of the proposed lake becoming a focal point for tilapia dispersion in the Yorkeys Knob region.

Consideration will be given to the introduction of native predatory fish such as barramundi to the lake as a pest management control. However, this could result in undesirable outcomes and will need careful consideration and liaison with DAFF prior to implementation.

c) *Electric Ants*

The required response is management. A *Weed and Pest Management Strategy* is incorporated into the EMP (Planning) and implemented in the project's EMP (Construction) (see **Section 23.4.4**). This strategy will include an element to manage electric ants and will be developed in consultation with Biosecurity Queensland.

19.2.4 Residual Impacts

The presence of pest animals is an impact of the existing land use and it is expected that this threat will largely disappear with the construction of the Aquis Resort due to the conversion of pest-infested habitat to more managed areas with active pest management.

With these controls in place, the development is considered to provide a net beneficial impact with respect to pest animals. Care will be taken in, for example, refuse management to ensure that pest animals associated with human use do not infest the resort.

The required response for all pest animals is management. A *Weed and Pest Management Strategy* is incorporated into the EMP (Planning) and will be implemented in the project's EMP (Construction) (see **Section 23.4.4**) and EMP (Operation & Maintenance) (see **Section 23.4.5**). This management will lead to a net beneficial impact of the development with respect to pest animals.

The management of tilapia and other pest fish is expected to be largely successful although there is little that can be done to prevent the spread of these fish during flooding. Both tilapia species are already present throughout the Barron River delta so the Aquis Resort is unlikely to create any new impacts.