Vegetation Survey
Annan River prawn farm
(Lot: 4 Plan: RP887249) **Cooktown**

Prepared for:3 Science Solutions on behalf of
Aquatec Pty Ltd

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Disclaimer

This report has been prepared by Botanical North for 3 Science Solutions (3SS) and may only be used and relied on by 3SS for the assessment of vegetation pertaining to the redevelopment of the Annan River Prawn Farm, Cooktown

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The opinions, conclusions and any recommendations in this report are based on assumptions made by Botanical North when undertaking services and preparing the report ("Assumptions"), including (but not limited to):

The request to have the survey completed in a short time period negated the possibility of surveying during optimum time periods of flowering and fruiting for some of the Mangrove species.

Very few species were fruiting or flowering during the survey, reducing the ability to identify general specimens to species. Ground layer herbs and grasses were essentially senesced and no attempt was made to identify to species.

Vegetation community extents were digitised from available aerial imagery and may not reflect true extents on the ground. Several of the vegetation communities recorded during the survey did not correspond to the expected regional ecosystems for the area.

Botanical North expressly disclaims responsibility for any error in, or omission from this report arising from or connection with any of the assumptions being incorrect.

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1. Introduction

Aquatec Pty Ltd proposes the redevelopment of 23 hectares of previously cleared land within the existing freehold Annan River prawn farm **(**Lot: 4 Plan: RP887249) located approximately 4 km south of Cooktown, QLD. Part of the property is located within a flora trigger area (high risk) requiring a vegetation survey to identify endangered, vulnerable and near threatened (EVNT) species. Legislation requires a survey of both the area to be cleared and a 100 m buffer around the clearing (clearing impact area). The area also contains mangroves within the old ponds and existing drain, which will be cleared under a Marine Planning Permit.

1.1. Scope of Work

Botanical North was commissioned by 3SS to carry out an EVNT and mangrove survey within the existing pond footprint and a 100 m surrounding buffer area (Figure 1), including a survey of the proposed redevelopment of the existing drain line, to identify mangrove species present. A further two areas for a proposed road and proposed quarry site were surveyed for ENVT species.

A desktop survey was conducted prior to the ground survey to identify likely occurrence of EVNT species within a 5 km radius of the property.

- An EVNT species list was generated from the Queensland Government's wildlife online database (Queensland Government, 2018c).
- An EPBC Act Protected Matters Report was created to determine nationally threatened flora within the area.
- A Vegetation Management Report (Department of Natural Resources Mines and Energy, 2018) was supplied by the client for reference.

Ground Survey

- Walked transects, noting each species encountered, were conducted along the banks, adjacent buffer areas and proposed development areas.
- Ponds were driven (except where wet) and all species recorded within the pond. Inaccessible areas were walked to ensure all mangrove species were accounted for.
- Known EVNT species were specifically targeted within and between transects.
- Dominant species were recorded and specimens collected for identification purposes.

Figure 1. Annan River prawn farm, with proposed survey areas.

2. Physical Conditions of the Site

2.1. Location

The proposed re-development is located in the Cook Shire approximately 4 km south of Cooktown, QLD along the north bank of the Annan River. Keatings Lagoon Conservation Park is located approximately 500 m to the west of the property. (Figure 2).

Located in the Cape York Peninsula Bioregion, Starke Coastal Lowlands Subregion, within the Endeavour Catchment, the property is regarded as coastal for the State Development Assessment Provisions (SDAP). The property is zoned rural (Cook Shire Council, 2017), with a mix of non-remnant, remnant vegetation of least concern and remnant vegetation of concern (Department of Natural Resources Mines and Energy, 2018) (see Table 1 in results for regional ecosystem designations).

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Figure 2 Location of property in relation to Cooktown CBD and surrounding features

2.2. Climate

Cooktown tropical climate is characterised by generally hot and humid summer months and milder dryer winters. The monsoonal trough generally affects Cooktown from December through March, producing the higher rainfall, humidity, thunderstorms and the possibility of tropical cyclones.

The nearest weather station to log rainfall and temperature is the Cooktown airport. Median annual rainfall for the region (for the years 2000 through to 2018) is 1461 mm (Meterology, 2018).

Mean daytime temperatures range from 18 - 26˚C in July to 24 - 33˚C December.

3. Methods

3.1. Desktop assessment

A desktop assessment was conducted prior to the field assessment to identify the threatened species that may potentially occur within the vicinity of the site.

A background search was undertaken through the Queensland Government Wildlife Online search tool encompassing a 2 km radius of the survey area (Queensland Government, 2018c) to identify Endangered, Vulnerable and Near Threatened (EVNT) species listed under the *Nature Conservation Act 1992.*

An EPBC Act Protected Matters Report was generated, also within a 2 km radius of the survey area (Department of the Environment and Energy, 2018) to identify any threatened ecological communities and flora listed under the *Environment Protection and Biodiversity Act 1999* (EPBC Act).

The Vegetation Management Report (Department of Natural Resources Mines and Energy, 2018) was consulted for protected plants flora survey trigger mapping and Regional Ecosystem (RE) mapping to identify remnant vegetation mapped as Least Concern, Of Concern and Endangered.

Cook Shire online maps were queried for zoning (Cook Shire Council, 2017).

Broad vegetation types were described according to the Queensland Herbarium descriptions (Neldner et al., 2017).

3.2. Flora survey

The vegetation survey was conducted over 6 days (31/08/2018 -2/09/2018 and 14/09/2018 – 17/09/2018) by botanist, Basil Byrne and field assistants, Matthew and Callan Bernasconi.

Methodology followed the Flora Survey Guidelines for protected plants (Department of Environment and Heritage Protection, 2016) using the timed meander search technique for all areas excepting the old prawn ponds (see explanation below). When an ENTV was located, a 50 m x 20 m area was walked to determine the extent of the population. This method proved ineffectual in areas where there were high incidence of ant plants (*Myrmecodia beccarii*) as they tended to occur continuously along a transect, so densities from specific waypoints were counted (visibility was usually 20 to 30 metres at any one spot). When populations were dense, up to 50 plants could be observed, with 15 or more plants in the one tree. In dense populations, tracklogs of the outer reaches of the population were walked where possible while the field assistants counted ant plants in the denser areas. Photos were taken of hundreds of the plants and several sent to the Queensland Herbarium for identification. Dr Paul Forster, Principal Botanist at the Queensland Herbarium, Science Division, confirmed species identification of *Myrmecodia beccarii.*

All observed plant species (excepting ENVT species) were collected for identification. Plants were identified to species, where possible, using a variety of resources including (Smith, 2002, Brock, 2001, Brooker and Kleinig, 2004, Cooper, 2004, Kitamura et al., 2002, Lovelock,

1999, Beasley, 2009, Barlow, 1986, Byrnes, 1984, Byrnes, 1985, Giesen et al., 2007, Hyland et al., 2010, Centre for Australian National Biodiversity Research, 2010).

A handheld Garmin GPSMap 64s device was used to capture locational data for mapping.

The old prawn ponds were surveyed by vehicle, stopping at each new species encountered for collection. Visibility was across the entire pit for most sections. Perimeter banks and outside drains were traversed by foot, walking the entire length (when possible – water bodies and dense vegetation caused some diversions).

Vegetation communities were mapped in QGIS (version 2.18.9) using QLD Globe Imagery for the base map.

3.3. Survey Limitations

The timing of field assessments can have a marked influence on the species recorded. Species identification can be hindered due to the lack of reproductive material available. Very few fruits or flowers were observed during the survey making species distinction difficult, particularly with the Eucalypts, Melaleucas, Acacias, Mangroves and the small dry rainforest patch.

Although not a limitation of the survey but more of the reporting, the field assistants walked both the outer reaches and the inner areas of the survey areas searching for ant plants while I recorded species in the vicinity (as well as searching for ant plants) so the track log on the map does not reflect the true area covered. Particularly in the areas of dense populations where I tried to record the outer limits of a population, while denser areas were walked but are not covered by a tracklog recording.

Some mangrove areas were inaccessible due to the density of the plants. Zones (distinguished by height and visible vegetation) could be observed but not all areas in the buffer area were accessible so not all species may have been observed. Mangroves within the ponds and proposed drainage line were recorded.

In some areas of the survey the ground vegetation, such as *Lantana camara*, was extremely dense and was avoided, although this did not impair the ability to observe ant plants.

4. Results

4.1. Desktop results for Threatened Species within a 2 km radius of the tenement

The desktop results indicate that there is one World Heritage Property/ National Heritage Property (Great Barrier Reef), located within the search area, No wetlands of International Significance occur within the search area (Department of the Environment and Energy, 2018).

Two “of concern” regional ecosystems occur within the area (Table 1)

One threatened flora was identified during the state search and 6 threatened flora within the Federal EPBC (Table 2)

Table 1 Regional ecosystems/ vegetation types within Lot 4 (from Vegetation Management Property Report (Department of Natural Resources Mines and Energy, 2018)
(Corresponding map in Appendix A)

Regional Ecosystem	VMA Status	Category	Area (Ha)	Short Description	Structure Category
3.1.1	Least concern	B	11.85	Rhizophora stylosa and/or Bruguiera spp. closed forest	Dense
3.1.3	Least concern	B	11.85	Ceriops tagal and/or C. australis +/- Avicennia marina low open forest	Dense
3.1.6	Least concern	B	55.08	Sparse herbland or bare saltpans on salt plains and saline flats	Very sparse
3.11.12	Least concern	B	1.3	Eucalyptus leptophleba and E. platyphylla +/- Corymbia tessellaris woodland on rolling metamorphic hills	Sparse
3.11.13	Least concern	B	9.13	Corymbia nesophila +/- E. brassiana woodland on metamorphic hills and ranges	Sparse
3.11.6	Of concern	B	0.26	Eucalyptus platyphylla +/- E. leptophleba +/- Corymbia nesophila open forest to woodland on hill slopes	Mid-dense
3.2.4	Of concern	B	6.15	Melaleuca leucadendra +/- M. dealbata open forest in dune swales and swampy areas	Mid-dense
3.3.22	Least concern	B	49.58	Corymbia clarksoniana or C. novoguinensis woodland on alluvial plains	Sparse
3.3.28	Least concern	B	13.7	Eucalyptus platyphylla +/- Corymbia clarksoniana woodland on alluvial and colluvial plains	Sparse
3.3.63	Least concern	B	6.15	Eleocharis dulcis dominated closed sedgeland on seasonally flooded marine plains	Very sparse
7.11.51	Least concern	B	0.52	Corymbia clarksoniana and/or Eucalyptus drepanophylla open forest to woodland on metamorphics	Mid-dense
non-rem	None	X	71.46	None	None

Table 2 Threatened species potentially occurring within a 2 km radius of site

Species name	Common name	Status
Myrmecodia beccarii *	Ant Plant	Vulnerable
Acriopsis emarginata	Pale Chandelier Orchid	Vulnerable
Dendrobium johannis	Chocolate Tea Tree Orchid	Vulnerable
Phaius pictus		Vulnerable
Phlegmariurus dalhousieanus	BlueTassel-fern	Endangered
Vappodes phalaenopsis	Cooktown Orchid	Vulnerable

*State and Federal search.

4.2. Survey extent

Originally, three further areas were included within the survey extent (the three central tracklog loops) but are excluded from this report (Figure 3). Within each survey leg the dominant species within each area were collected and identified as well as incidental species encountered along the transects. Visibility within the site was usually 20 – 50 m or more. Most of the forest transects contained only a sparse shrub layer, excepting areas where weed species, such as *Lantana camara*, were present. The mangrove sections along the drain were more intensively searched to ensure all species were identified.

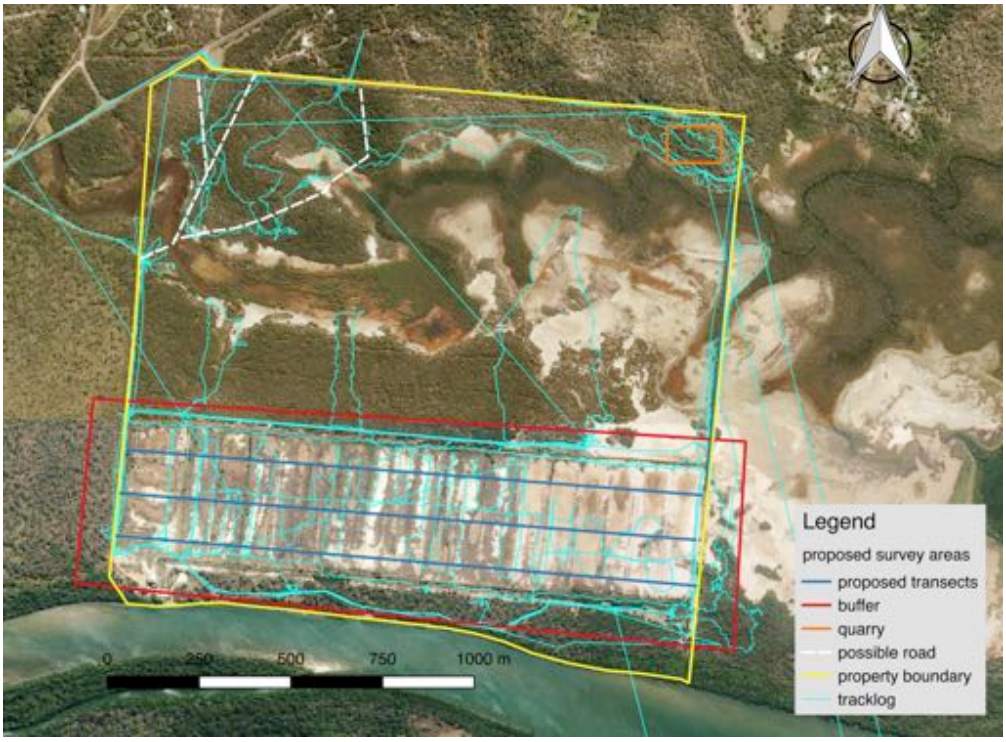

Figure 3 Tracklog of area covered within Annan Prawn Farm survey

4.3. Flora

A total of 71+ species, from 28 families were recorded within the survey area. Some species were not identifiable to species due to the lack of the reproductive material. Species are listed within Appendix 2.

4.3.1 Threatened Species

One EVNT species was recorded at several locations during the survey, the ant plant *Myrmecodia beccarii* (confirmed by the Queensland Herbarium). The ant plant was only observed within Melaleuca forest and was observed on four Melaleuca species (*Melaleuca foliolosa, M. acacioides, M. leucadendra* and *M. viridiflora*) and related *Aesteromyrtus* sp., although it was predominantly observed within individual *Melaleuca foliolosa* and *M. acacioides* trees, with only a handful of individuals in the other species. One plant was also observed on the understory species, *Hakea pedunculata,* although despite *H. pedunculata* being present in much of the *Melelauca* woodlands, no other ant plants were observed on this species. None

were recorded within the mangroves. Overall there were three major populations identified (**Figure 4**) with two populations falling either within the buffer or outside development areas. One population occurred within the development area of a road and is discussed further in section 4.3.5 – proposed road. Populations 2 and 3 were located outside the trigger map (**Figure 5**). Population numbers are given as best estimates. Exact numbers were not possible due to the high number of individuals observed (**Table 3**). Area of population 1 was estimated based on observed sightings, although may continue further east. Population 2 was surveyed in two separate sections and is likely to extend between the surveyed areas.

Of note is that there were several ant plants observed all along the walk into Keatings Lagoon Conservation Park. Actual numbers were not recorded but at least 40 plants were observed along the public walking track.

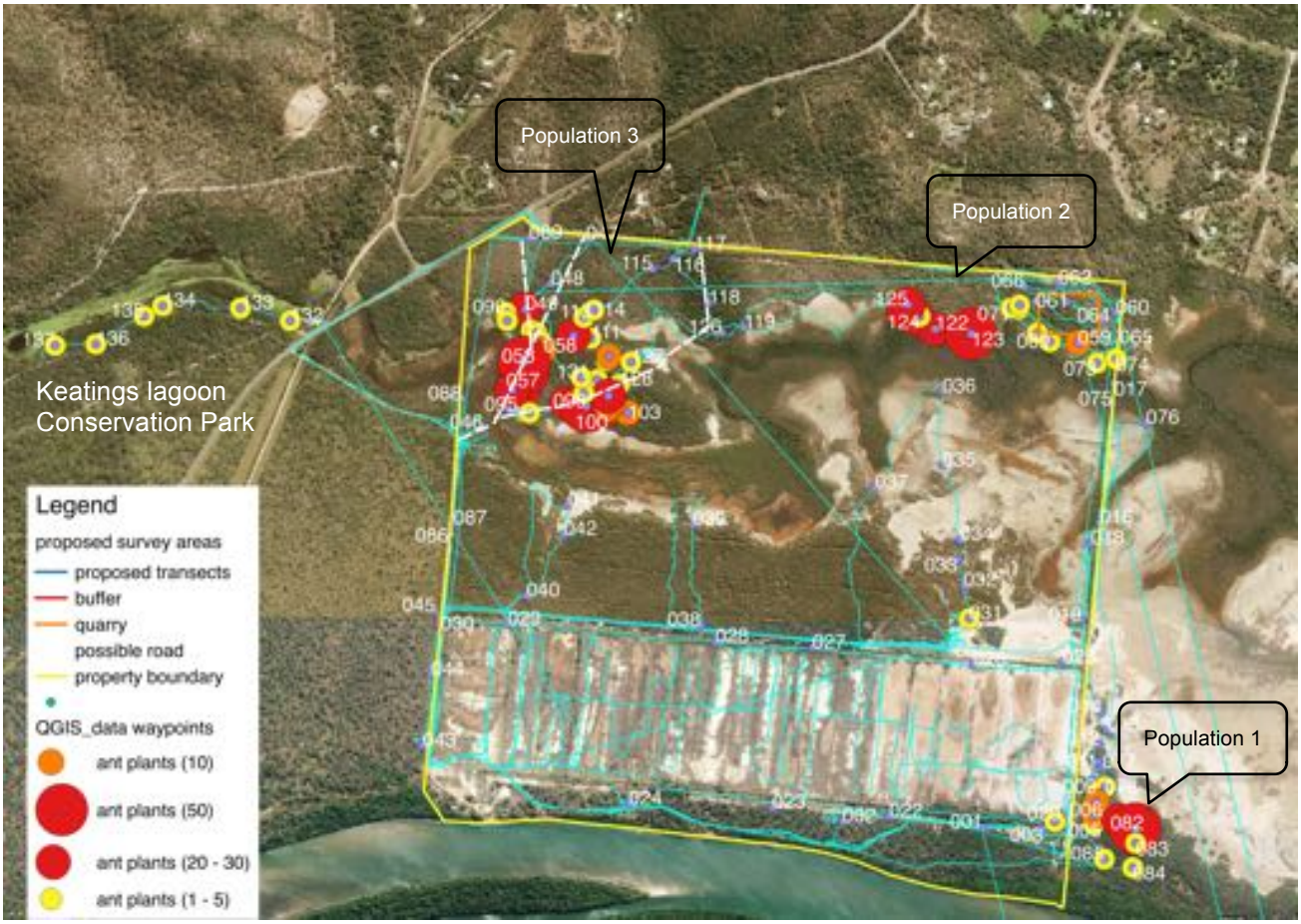

Figure 4 Populations of ant plants in and near the Annan River prawn farm

Table 3 Ant plant population densities

Population	Estimated size of population (ha)	Number of individuals
1	2.5	~100
2	1.2 (but potentially 4.4)	~170
3	8.8	500+

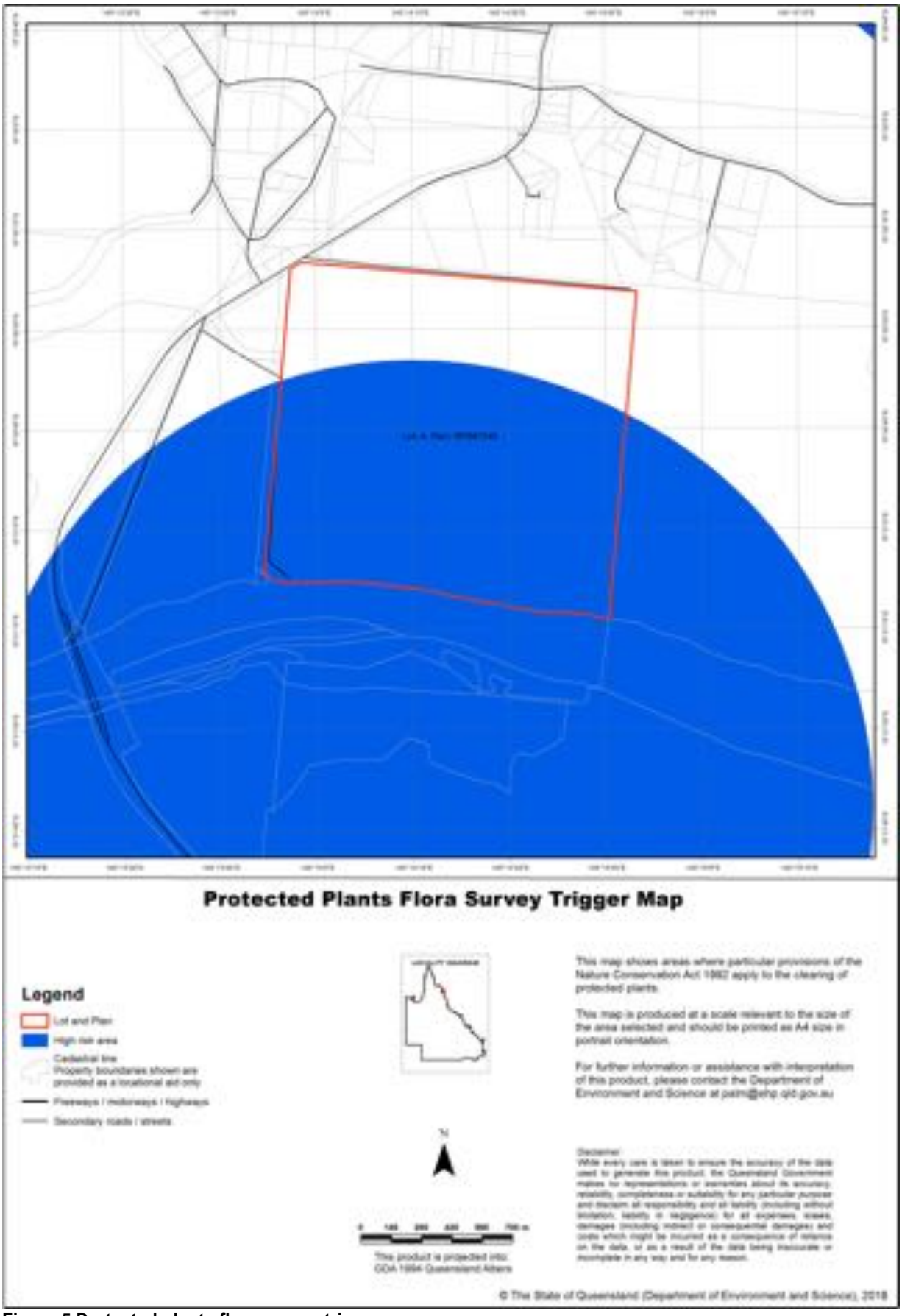

Figure 5 Protected plants flora survey trigger map

There were two instances where lone ant plants were observed outside larger populations, both were very young. One small individual was located in the *Melaleuca leucadendra* dominated drain immediately south to the prawn ponds. It was located approximately 100 m from the population to the east, and despite an extensive search of the drain, no further ant plants were observed along the Melaleuca dominated drain. The second individual was observed approximately 100 m north of the existing ponds and over 500 m from the closest population to south-east and 700 m to the north east (Figure 6). Although not reflected in the tracklog, this area was covered extensively in the afternoons as it was our camp area for several nights. Two other individuals were observed on the edge of same connected Melaleuca forests (heading north) but not waypointed. The entire area was explored and there was not an extensive population in this locality.

Figure 6 Ant plants found outside main populations

Photos are available if requested for all populations (although not all individuals as there were too many to record. Most populations had a range of age classes present from small, newly formed through to many branched individuals (see Appendix 2 for examples of age classes. All were present within each larger population).

Although several orchids were observed across the site, none from Table 2 were observed.

4.3.2 Weeds

Several weeds, including Weeds of National Significance (WONS) were recorded during the survey, particularly along pond banks (Table 4, Figure 7). Most had lost foliage and were present just as stems/stalks with a few leaves present available for identification.

Table 4 Weed species observed within the survey area – predominantly located along pond banks

Weed species	Common name	WONS	Localised Distribution
Cryptostegia grandiflora	Rubber vine	Yes	Dominant
Lantana camara	Lantana	Yes	Dominant
Stachytarpheta sp.	Snake weed	No	Sparse
Hyptis suaveolens	Hyptis	No	Dominant
Mimosa sp.	Sensitive weed	No	Dominant
Stylosanthes sp.	Stylo	No	Dominant
Passiflora foetida	Wild pasionfruit	No	Occasional

Figure 7 North bank covered in Hyptis

4.3.3 Ponds

Species within the ponds were usually sparse to non-existent with a few shrubs occurring along the edges, although more non-mangrove species were observed towards the southern edges of the ponds and the further west across the ponds. There were several weed species encountered along the banks. A total of 32 species were recorded within the ponds (not all identified to species), with 4 mangrove species present and some mangrove associates (Table 5).

Most mangroves were observed in the northern section of the ponds (between 1 – 8 from east to west), or aggregated along bank edges (Figure 8). In most cases, there were very few species present within the ponds.

Table 5 Species recorded within the ponds

Pond mangroves	**Species**
1-8 with mangrove presence	*Aegialitis annulata*
	Avicennia marina
	Excoecaria agallocha
	Lumnitzera sp.
Mangrove associates	
Ponds 12_13_15	*Acrostichum speciosum*
spasmodically throughout	*Hibiscus tiliaceus*
spasmodically throughout	*Thespesia populnea*
Other native species	
spasmodically throughout	*Acacia* spp.
	Alphitonia excelsa
	Alstonia scholaris
	Asteromyrtus sp
	Capparis lucida
	Corymbia nesophila
	Corymbia tessellaris
	Eucalyptus platyphylla
	Hakea pedunculata
	Melaleuca foliolosa
	Melaleuca leucadendra
	Melaleuca nervosa
	Mimusops elengi
	Myoporum montanum
	Terminalia muelleri
Weed species	
predominantly on bank	*Cryptostegia grandiflora*
	Hyptis suaveolens
	Lantana camara
	Urena lobata

Figure 8 Examples of pond vegetation – photos from the northern aspect looking south (pond 1 furthest east with numbers increasing heading west).

4.3.4 Proposed redevelopment of the existing drain

The proposed redevelopment of the drain will entail removing vegetation from one side to enlarge the existing channel. The drain exhibited the highest diversity of mangrove species throughout the surveyed area with nine mangrove species recorded within the channel (**Table 6**,**Figure 9**). Several of the species were either not flowering (*Lumnitzera*), close to flowering with buds present (*Ceriops*) or recently flowered but propagule development not mature (*Rhizophora* – also difficult to access) so it was difficult to determine some genus to exact species. There may well be one or more of each genus present within the area, as indicated on The Atlas Of Living Australia (ALA.org.au, 2018). Overall there appeared a higher diversity in the drain than surrounding surveyed areas BUT there were many areas outside the drain that were inaccessible due to the complexity of the mangrove habitat, particularly close to the natural waterways. Certain singular species, such as *Osborbia octodonta* and *Xylocarpus* sp. may have occurred elsewhere but were undetected in the survey. Due to their presence in the created channel, it seems likely they would appear further up the natural waterways outside of the observable buffer area.

Table 6 Mangroves of proposed drain redevelopment

Species	Family
Aegialitis annulata	Plumbaginaceae
Avicennia marina	Acanthaceae
Ceriops sp.	Rhizophoraceae
Lumnitzera sp.	Combretaceae
Osbornia octodonta	Myrtaceae
Rhizophora ?stylosa	Rhizophoraceae
Rhizophora sp.	Rhizophoraceae
Xylocarpus granatum	Meliaceae
Xylocarpus moluccensis	Meliaceae

Figure 9 Proposed drain redevelopment and adjacent saltpan

4.3.5 Proposed road

The proposed road was surveyed in two sections due to wetlands in-between. The southern section (approximately 70 m) was predominantly a Melaleuca forest (*Melaluca foliolosa, Asteromyrtus sp.*) with mangroves at the edge (*Avicennia marina*, *Excoecaria agallocha, Lumnitzera* sp.)(Figure 10). No ant plants were observed.

Figure 10 Southern proposed road access

Flagging tape marked the northern section of the proposed road and this path was investigated (Labelled Road 1 in Figure 11). Initially the path was through a mixed Eucalypt and Melaleuca forest but within about 100 m was predominantly through a Melaleuca forest. Ant plants were observed from about 200 m in from Brown Street and were observed in such numbers that total counts were not possible Usually at least 30 were observed (up to over 10 on a single tree) within a 10 to 20 m radius. The overall area had well in excess of 200 plants and was considered a 'HOT SPOT"

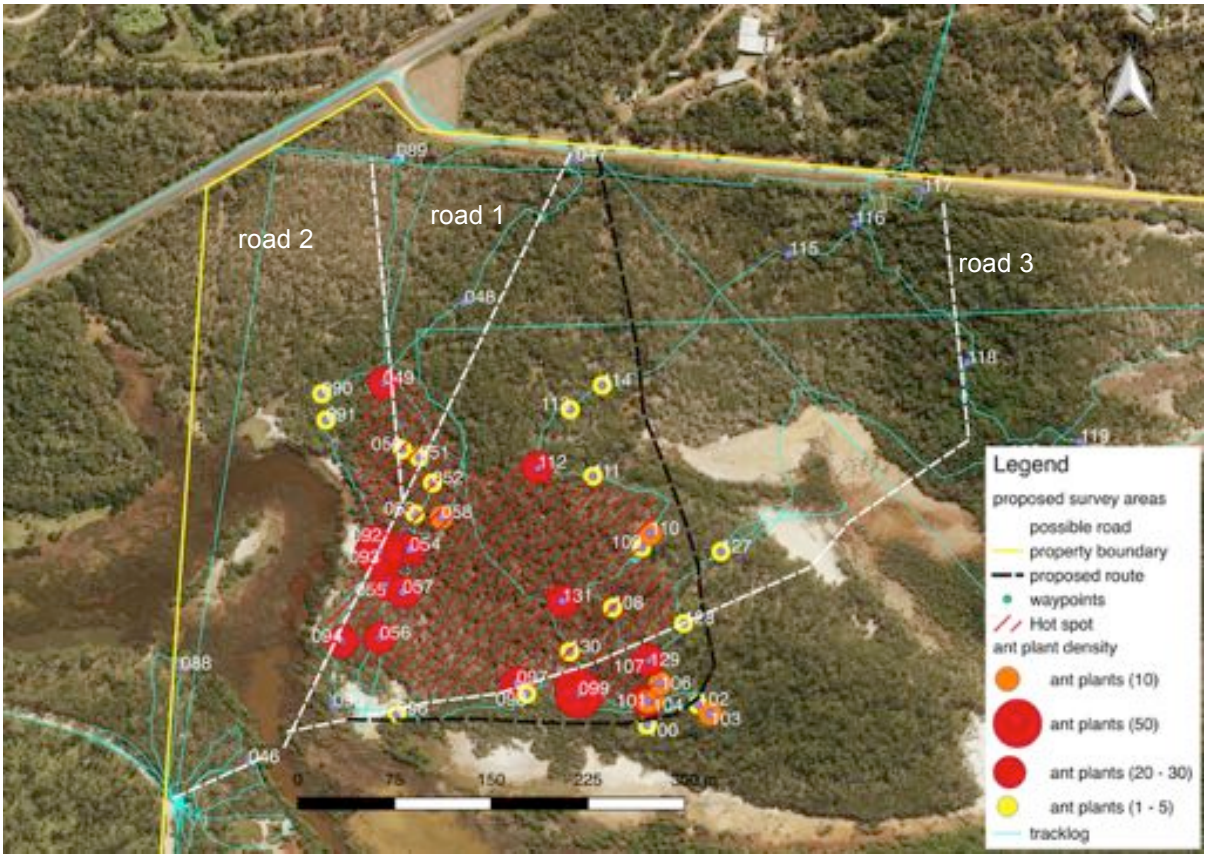

Figure 11 Potential road routes

A second survey was conducted in the area to try and find an area of less impact and was investigate both to the east and the west of original survey area. Very few ant plants were observed within the first 150 metres of Brown Street in either direction. The client provided two alternative road routes, neither of which was ideal and an alternative route is suggested in Figure 11. "Road 2" ended up connecting with the "hotspot" area while "road 3 " initiated east of a major drainage area was predominantly a dense dry rainforest until the mangrove section (Figure 12). It is not recommended to clear through the rainforest due to the density of vegetation and drainage. Species were not identified in this section due to the lack of reproductive material. (Leaf samples from approximately 10 species were collected and identification can be attempted if requested).

A revised estimate of over 500 ant plants within the "hotspot" was made after the second survey.

Figure 12 Dry rainforest patch (left) and adjacent mangroves (right)

Depending upon the width of road required, many of the ant plants could be avoided on the suggested route as many of the larger numbers occur within single large *Melaleuca leucadendra* trees with few other ant plants in the immediate vicinity (Figure 13), although this section may represent the "of concern" regional ecosystem 3.2.4.

Figure 13 Examples of obvious groups of ant plants within single trees

Ideally it would be recommended that someone familiar with the ant plant was to accompany the road surveyor on the final road designation to ensure the trees containing 10 or more individuals were avoided where possible. Along the suggested route there is 20 metres or more between the larger trees that contain several significant ant plants.

4.3.6 Quarry

Exact coordinates beyond “150 m E to W and 100 m N to S” were not provided for the quarry but as much of the slope and surrounding flat were surveyed as practicable (Figure 14). No ant plants were observed on any slope but were observed in the surrounding flats of Melaleuca forests to the south and west. No plants were observed to the east or north. The hill slopes and crest were vegetated with a mix of woodland trees and shrub species, dominated by the bloodwood, *Corymbia nesophila.* Dominant species present within the quarry area are listed in Appendix 4.

Due to the vegetation type, there is likely a connected population of ant plants between waypoint 71 and 123 (coordinates listed in Appendix 5), but this area was not included in the survey (Figure 14).

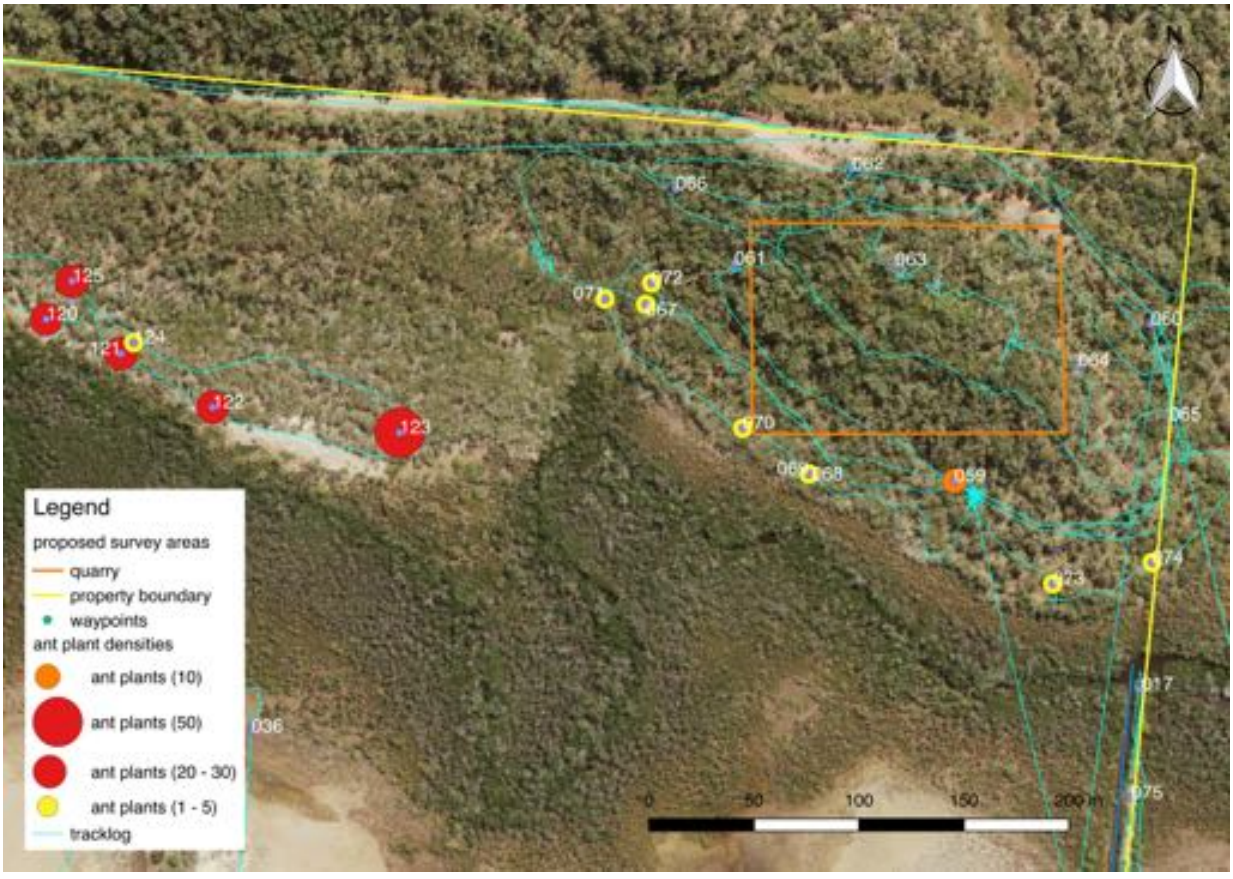

Figure 14 Proposed quarry location in relation to ant plants

4.4 Vegetation communities

A basic vegetation community survey was conducted on site (from waypoints and transect data) and mapped post survey from Queensland globe imagery (Queensland Government, 2018a).

Several vegetation communities were present (Figure 15) although all did not correspond exactly to descriptions within Table 1 or the mapped areas within Appendix 1. Areas of concern 3.11.6 and 3.2.4 (Table 1) may be present but the species observed did not correspond with the dominant species named for these vegetation communities.

More specifically, the only hill slope surveyed on the property was the quarry site and the vegetation present did not match the description of 3.11.6, *Eucalyptus platyphylla +/- E. leptophleba +/- Corymbia nesophila* open forest to woodland on hill slopes.

The dominant species on this site was *Corymbia clarksoniana,* with only the occasional *Eucalyptus platyphylla* present at the base of the hill. The mid-dense canopy and understory also contained *Erythrophleum chlorostachys, Melaleuca viridflora, Buchanania arborescens, Alphitonia excelsa, Terminalia muelleri, Cycas media, Persoonia falcata, Planchonia careya, Acacia* spp. and was more in line with the least concern RE 7.11.51.

Category 3.2.4, *Melaleuca leucadendra +/- M. dealbata* open forest in dune swales and swampy areas may be present, although the dominant Melaleuca species throughout the surveyed area tended to be *Melaleuca acacioides* and *Melaleuca foliolosa,* with some small patches of pure *Melaleuca viridflora.*

Melaleuca leucadendra was only observed as the dominant species within the highly modified drain to the south of the prawn ponds, and in a small section near the proposed road development. This may impact the suggested road route, as it diverts through the *M. leucadendra* section to avoid the high ant plant densities within the *M. acacioides/M.foliolosa* dominated forest.

A more detailed list of vegetation communities, with corresponding waypoints and photos, is listed in Appendix 4.

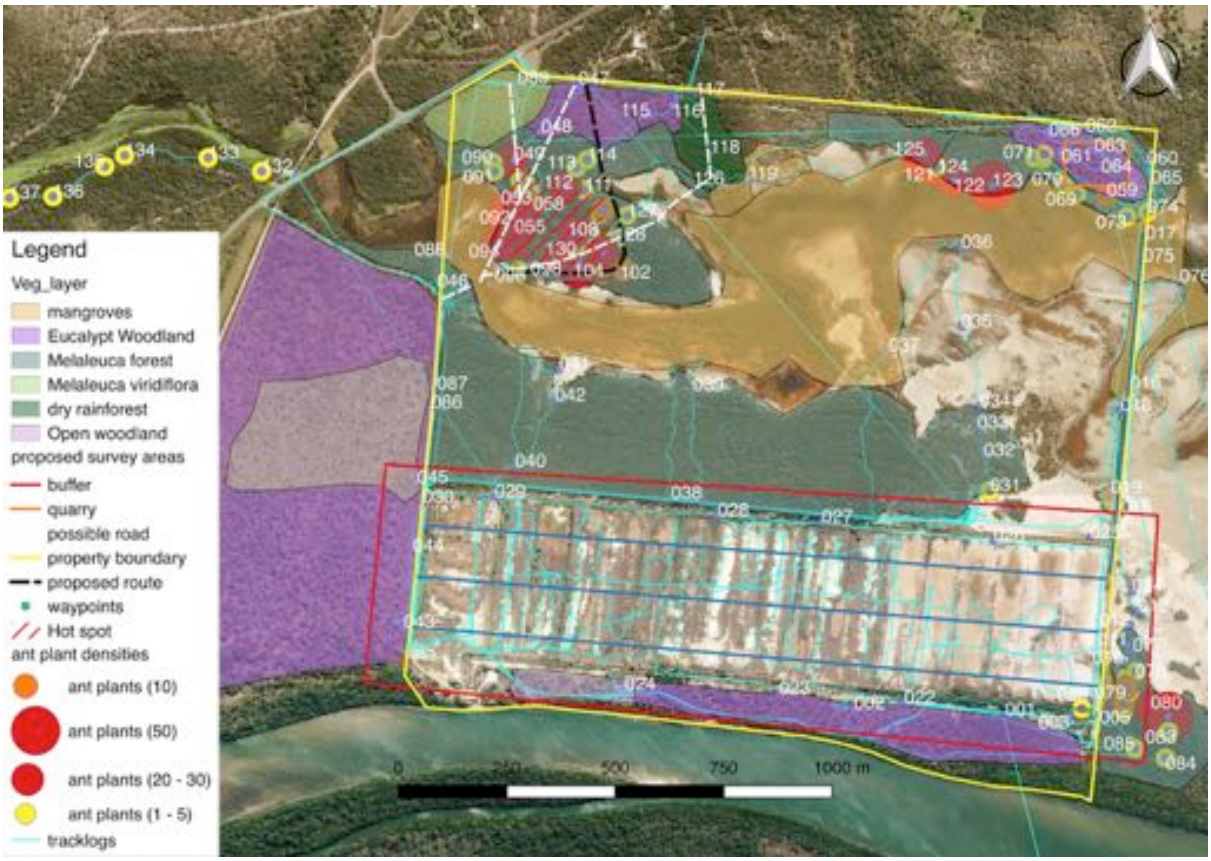

Figure 15 Vegetation present on site and within buffers of Annan Prawn Farm (Lot 4) with Ant plant locations.

5. Conclusion

Of the total 237 ha of the property, 165.6 ha is classed as remnant and 71.5 ha as non-remnant under the regulated vegetation map within the vegetation management report for the property (Department of Natural Resources Mines and Energy, 2018). Several of the observed vegetation communities did not correspond to mapped regional ecosystems.

There were two regional ecosystems (RE) of concern listed in the management report, which were not detected during the survey. The "of concern" RE 3.11.6: Eucalyptus platyphylla +/- E. leptophleba +/- Corymbia nesophila open forest to woodland on hill slopes was definitely not present in the surveyed areas although a small section of the RE 3.2.4 *Melaleuca leucadendra +/- M. dealbata* open forest in dune swales and swampy areas may be present within the proposed road development, although again, the descriptions listed on the regional ecosystem online resource (Queensland Government, 2018b) did not match. None of the listed tree or understory plants were present.

Four mangrove species were present within the ponds, and nine within the proposed drain redevelopment. The majority of species identified were observed in adjacent areas, with the exception of *Osbornia octodonta, Xylocarpus granatum* and *X. moluccensis* within the existing drain. These were all single individuals on the east side of the bank. Provided the west side of the channel was cleared, these individuals are unlikely to be affect by the redevelopment of the drain. Overall, the redevelopment of the ponds and drain are unlikely to significantly impact the health of the mangroves in the area.

There were three healthy populations of ant plants located within the property and adjacent 100 m buffer area. All three populations contained a mix of age classes.

- For population 1, the highest density of individuals observed was outside (east) of the 100 m buffer zone and should not be adversely compromised by the pond development.
- Population 2 was located adjacent to the proposed quarry and the exact area of excavation will determine the extent of adverse impact upon the population. Only small densities of ant plant individuals (1-5 at each waypoint marked) were located along the transects at the southern and eastern boundaries of the proposed quarry area. These areas traversed through a mangrove forest fringed by mangroves and is unlikely to be suitable quarry material. Higher densities were observed over 150 m east of the proposed quarry, although more ant plants are likely to be present in the Melaleuca forest. No ant plants were observed to the east and north of the quarry.
- Population 3 will be impacted by a proposed road route, but as discussed in section 4.3.5, the highest density areas can be avoided. It would be strongly suggested that the "hot spot" area in Figure 11 is set aside as a "no future development zone" and future road surveying is conducted with or by someone who can recognise ant plants, particularly trees containing large clusters.

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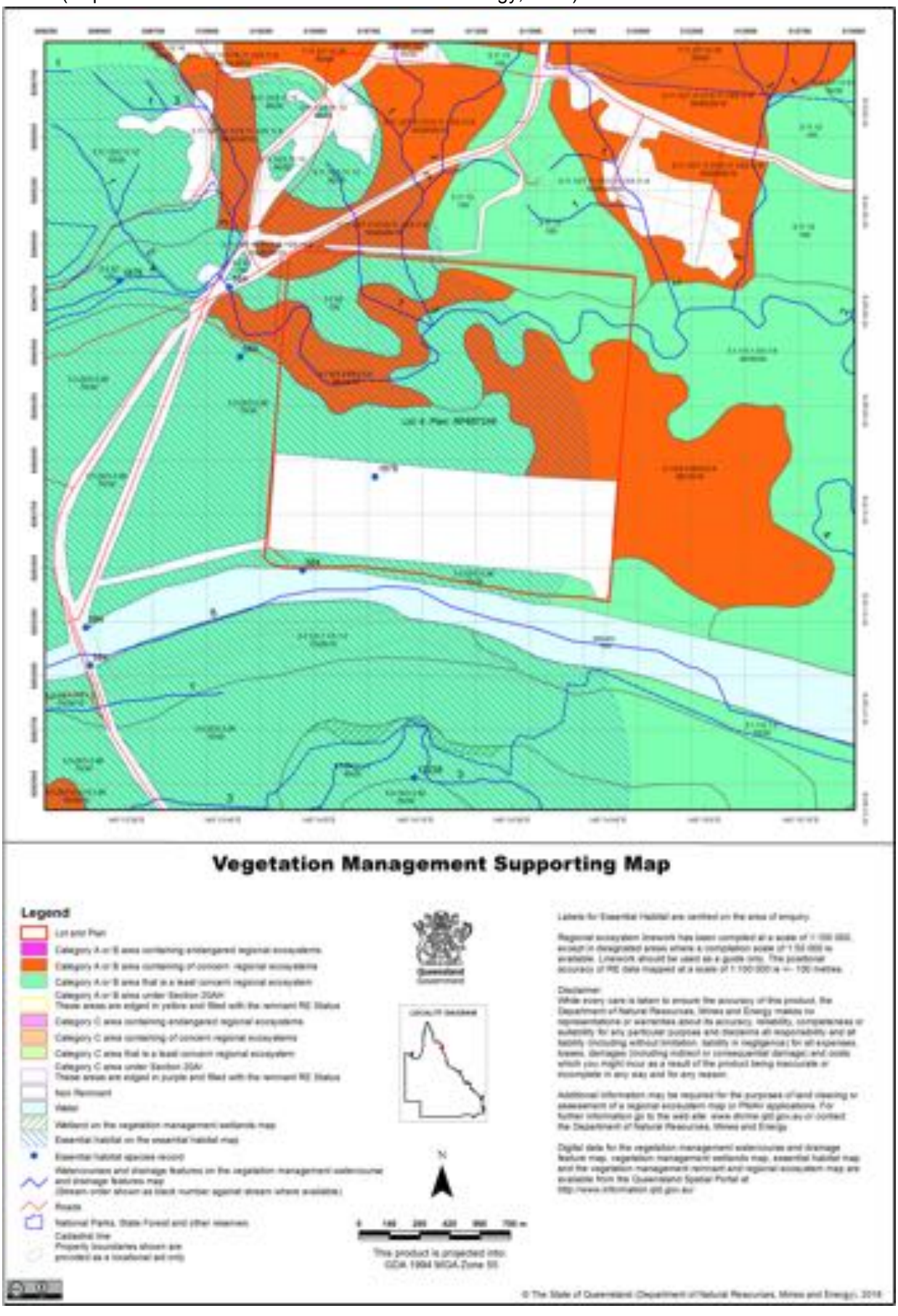
6. Appendix 1. Vegetation Management supporting map

from (Department of Natural Resources Mines and Energy, 2018)



7. Appendix 2. Species List

Family	***Species***
Acanthaceae	*Avicennia marina*
Aizoaceae	*Sesuvium portulacastrum*
Anacardiaceae	*Buchanania arborescens*
Apocynaceae	**Cryptostegia grandiflora*
Apocynaceae	*Alstonia actinophylla*
Apocynaceae	*Alstonia scholaris*
Apocynaceae	*Dischidia nummularia*
Apocynaceae	*Hoya sp. (no flowers)*
Arecaceae	*Livistona muelleri*
Capparaceae	*Capparis lucida*
Combretaceae	*Lumnitzera sp.*
Combretaceae	*Terminalia muelleri*
Cycadaceae	*Cycas media*
Euphorbiaceae	*Excoecaria agallocha*
Fabaceae	**Mimosa pudica*
Fabaceae	**Stylosanthes sp.*
Fabaceae	Acacia crescent
Fabaceae	Acacia curly
Fabaceae	*Acacia flavescens*
Fabaceae	Acacia long spear
Fabaceae	*Acacia polystachya*
Fabaceae	*Acacia* sp
Fabaceae	Acacia stringybean
Fabaceae	*Erythrophleum chlorostachys*
Lamiaceae	**Hyptis suaveolens*
Lecythidaceae	*Planchonia careya*
Malvaceae	**Urena lobata*
Malvaceae	*Hibiscus tiliaceus*
Malvaceae	*Thespesia populnea*
Meliaceae	**Azadirachta indica*
Meliaceae	*Xylocarpus granatum*
Meliaceae	*Xylocarpus moluccensis*
Moraceae	*Ficus opposita*
Myrtaceae	*Asteromyrtus sp*
Myrtaceae	*Corymbia clarksoniana*
Myrtaceae	*Corymbia nesophila*
Myrtaceae	*Corymbia tessellaris*
Myrtaceae	*Eucalyptus platyphylla*
Myrtaceae	*Eucalyptus platyphylla*
Myrtaceae	*Eucalyptus* sp.
Myrtaceae	*Lophostemon grandiflorus*
Myrtaceae	*Melaleuca acacioides*
Myrtaceae	*Melaleuca citrolens*
Myrtaceae	*Melaleuca foliolosa*

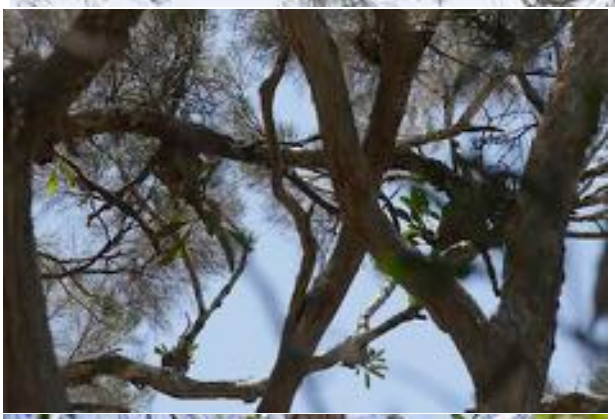
Family	***Species***
Myrtaceae	*Melaleuca leucadendra*
Myrtaceae	*Melaleuca nervosa*
Myrtaceae	*Melaleuca sp.*
Myrtaceae	*Melaleuca sp.*
Myrtaceae	*Melaleuca viridiflora*
Myrtaceae	*Osbornia octodonta*
Pandanaceae	*Pandanus sp*
Phyllanthaceae	*Breynia* sp.
Phyllanthaceae	*Flueggea virosa*
Plumbaginaceae	*Aegialitis annulata*
Proteaceae	*Hakea pedunculata*
Proteaceae	*Persoonia falcata*
Pteridaceae	*Acrostichum speciosum*
Rhamnaceae	*Alphitonia excelsa*
Rhizophoraceae	*Bruguiera cylindrica*
Rhizophoraceae	*Bruguiera exaristata*
Rhizophoraceae	*Ceriops sp.*
Rhizophoraceae	*Rhizophora ?stylosa*
Rhizophoraceae	*Rhizophora sp.*
Rubiaceae	*Atractocarpus sessilis*
Rubiaceae	*Myrmecodia beccarii*
Santalaceae	*Exocarpos latifolius*
Santalaceae	*Santalum lanceolatum*
Sapotaceae	*Mimusops elengi*
Scrophulariaceae	*Myoporum montanum*
Verbenaceae	**Lantana camara*
Verbenaceae	**Stachytarpheta sp.*
28	*71*

* denotes introduced species

8. Appendix 3. Age class range of ant plants








9. Appendix 4 – Vegetation description

wpt	Ant plant presence	Vegetation Description (Regional ecosystems listed where identified (RE))	Image
1, 3, 77	No	Fringing communities - occurred through various ecotones across the surveyed area and tended to have *Melaleuca* spp, *Terminalia muelleri, Capparis lucida,* ± *Acacia* spp. ± *Myoporum montanum,* ± *Hibiscus tiliaceus* on higher ground with *Avicennia marina, Lumnitzera* sp, saltworts and ± sedges in tidal regions. (Mixed RE)	
2, 23	No	Eucalypt woodland with a dense shrub layer and weedy understory. Species include *Eucalyptus platyphylla, Corymbia nesophila, C. tessellaris, Melaleuca spp., Acacia spp., Alphitonia excelsa, Atractocarpus sessilis, Flueggea virosa, Exocarpos latifolius.* Weeds include *Hyptis suaveolens,Lantana camara, Mimosa pudica* and *Stylosanthes* sp. (Does not correspond to mapped RE)	
24, 45	No	Open *Eucalyptus platyphylla* woodland with occasional *Corymbia nesophila, Pandanus* sp., *Livistona muelleri, Melaleuca* spp, and *Planchonia careya.* (RE 3.3.28)	
30, 43, 44	No	*Corymbia nesophila* dominated woodland with occassional *Eucalyptus platyphylla, Melaleuca spp., Lophostemon grandiflorus, Pandanus* sp. and a sparse shrub layer of *Acacia* spp., *Planchonia careya* and *Flueggea virosa.* (Does not correspond to mapped RE)	

wpt	Ant plant presence	Vegetation Description (Regional ecosystems listed where identified (RE))	Image
61-64,	No	Mixed woodland on hillslope with *Corymbia clarksoniana, Eucalyptus platyphylla Erythrophleum chlorostachys, Melaleuca viridflora, Buchanania arborescens, Alphitonia excelsa, Terminalia muelleri, Cycas media, Persoonia falcata, Planchonia careya, Acacia* spp. (RE 7.11.51?)	
116	No	Woodland of *Eucalyptus platyphylla* and *Corymbia tessellaris* with *Acacia* spp., *Santalum lanceolatum, Excocarpus latifoilius* (Does not correspond to mapped RE)	
118	No	Dry rainforest (Does not correspond to mapped RE)	
59, 67-74, 80-85, 120-125	Yes	*Melaleuca* spp. dominated woodland including *Melaleuca acacioides, M. leucadendra, M. foliosa and ±M.citrolens,* with *Hakea pedunculat*a and *Aesteromyrtus* sp. (Does not correspond to mapped RE)	

wpt	Ant plant presence	Vegetation Description (Regional ecosystems listed where identified (RE))	Image
49-58, 97-112, 129	Yes	Melaleuca forest with *Melaleuca foliosa, M. acacioides, M. leucadendra,* with occassional *Atractocarpus sessilis* as a shrub layer. **Various pockets where certain Melaleuca sp. dominate with variable ant plant densities** (Does not correspond to mapped RE)	
11, 92, 94, 96	Yes	Melaleuca forest edge near mangroves predominantley *Melaleuca foliosa* and *Hakea pedunculata* (Does not correspond to mapped RE)	
38, 40, 89,	No	*Melaleuca viridiflora* woodland (Does not correspond to mapped RE)	
46, 88, 95	No	Swamp edge - *Avicennia marina, Lumnitzera sp., Excoecaria agallocha* (RE 3.1.3)	

wpt	Ant plant presence	Vegetation Description (Regional ecosystems listed where identified (RE))	Image
21	Yes (1 only)	*Melaleuca leucadendra* lined drain south of prawn ponds. (Constructed)	
17	No	*Rhizophora* dominated channel. (RE 3.1.1)	
1, 3, 13-18, 22, 25, 26, 36, 37, 39, 46, 76, 88, 119, 126	No	Fringing mangroves, dominated by *Avicennia marina*, *Ceriops* sp. and *Lumnitzera* sp. with the occasional *Excoecaria agallocha.* (RE 3.1.3)	
10, 12 (not mapped)	No	Sparse herblands with a variety of saltworts to bare saltpans (RE 3.1.6 and 3.3.63)	

10. Appendix 5 - Waypoint coordinates

Wpt	lat	lon	ele	ENVT
1	-15.51917402	145.243977	12.50221	
2	-15.51903698	145.240736	6.962345	
3	-15.51921903	145.245361	-10.049598	
4	-15.51916497	145.246167	-6.503854	
5	-15.51911099	145.246509	-5.977069	Ant plant
6	-15.51890404	145.246533	-4.811153	Ant plant
7	-15.51869298	145.246648	-4.045534	Ant plant
8	-15.51861797	145.246509	-2.993596	Ant plant
9	-15.51837397	145.246588	-1.952882	Ant plant
10	-15.51806803	145.246521	-1.120139	
11	-15.51766302	145.246617	-1.398555	
12	-15.51725398	145.246657	-0.588568	
13	-15.51693899	145.246828	-0.950769	
14	-15.51651	145.246711	-0.056267	
15	-15.51481904	145.246468	1.295202	
16	-15.51214999	145.246661	2.016613	
17	-15.50893997	145.246991	4.022057	
18	-15.512627	145.246461	5.735898	
19	-15.51439902	145.246249	7.131716	
20	-15.51886003	145.245758	8.603919	
21	-15.51903999	145.245627	8.345451	Ant plant
22	-15.51891804	145.241816	10.528331	
23	-15.51871704	145.239121	10.703741	
24	-15.51862903	145.235814	9.287324	
25	-15.51536998	145.245805	4.543886	
26	-15.51542999	145.243734	6.048312	
27	-15.515029	145.240047	8.524034	
28	-15.51489104	145.237811	9.473888	
29	-15.51449097	145.233022	6.848689	
30	-15.51460697	145.231481	6.302694	
31	-15.51435702	145.243656	10.028829	Ant plant
32	-15.51360098	145.243521	8.212647	
33	-15.51299899	145.243386	7.219963	
34	-15.512541	145.243436	5.478345	
35	-15.51083202	145.243034	4.562487	
36	-15.50912697	145.243041	5.258977	
37	-15.51134298	145.24148	4.001017	
38	-15.51451704	145.237468	1.825577	
39	-15.512195	145.237281	2.017628	
40	-15.513835	145.233457	5.437829	
41	-15.51174296	145.23441	7.047445	
42	-15.51241896	145.234312	7.295849	
43	-15.51729203	145.231068	10.252257	
44	-15.51565102	145.231264	12.842561	
45	-15.51418302	145.231357	12.911689	
46	-15.50996801	145.232453	10.438555	
47	-15.50561797	145.234821	12.779523	
48	-15.50664903	145.234013	13.43055	
49	-15.50723299	145.233427	13.00021	Ant plant
50	-15.50771101	145.233565	11.755397	Ant plant
51	-15.50777002	145.233686	11.695704	Ant plant

Wpt	lat	lon	ele	ENVT
52	-15.507953	145.233782	12.161314	Ant plant
53	-15.50817696	145.233655	11.776702	Ant plant
54	-15.50843496	145.233619	11.900374	Ant plant
55	-15.508687	145.233448	11.016822	Ant plant
56	-15.50907299	145.2334	9.976457	Ant plant
57	-15.50874199	145.233567	9.7683	Ant plant
58	-15.50820203	145.233847	10.1616	Ant plant
59	-15.50801402	145.246161	16.63097	Ant plant
60	-15.50731799	145.247032	16.339933	
61	-15.50704801	145.245185	1.43105	
62	-15.50662899	145.245708	11.911128	
63	-15.50705404	145.245898	14.493485	
64	-15.50750197	145.246709	24.582386	
65	-15.50774203	145.247114	14.561871	
66	-15.506716	145.244923	14.461263	
67	-15.50722998	145.244791	11.634413	Ant plant
68	-15.50800698	145.245527	7.679512	
69	-15.50798301	145.245514	7.678465	Ant plant
70	-15.50778	145.245221	7.454046	Ant plant
71	-15.507206	145.24461	7.530686	Ant plant
72	-15.50713501	145.244816	7.594369	Ant plant
73	-15.508471	145.246597	8.918927	Ant plant
74	-15.50837704	145.247037	10.3126	Ant plant
75	-15.50942101	145.246945	5.172381	
76	-15.50985603	145.247728	5.127019	
77	-15.51779201	145.246724	5.12455	
78	-15.51824204	145.246779	4.844619	Ant plant
79	-15.51858402	145.246577	6.122195	Ant plant
80	-15.51902298	145.247105	5.315448	Ant plant
81	-15.51919498	145.247323	5.569984	Ant plant
82	-15.51920403	145.247481	5.568653	Ant plant
83	-15.51953704	145.247486	4.872035	Ant plant
84	-15.52010299	145.24742	5.343528	Ant plant
85	-15.51990501	145.246765	3.747554	Ant plant
86	-15.51257403	145.23166	-2.466449	
87	-15.512167	145.231779	-1.213401	
88	-15.50929301	145.231962	6.698809	
89	-15.50559299	145.233522	12.942806	
90	-15.50730902	145.232982	11.424013	Ant plant
91	-15.50749904	145.233012	11.711842	Ant plant
92	-15.508371	145.23336	11.899407	Ant plant
93	-15.50844996	145.233401	12.635201	Ant plant
94	-15.50909604	145.233131	9.997677	Ant plant
95	-15.50955998	145.233065	9.126596	
96	-15.509621	145.233525	9.321368	Ant plant
97	-15.50939502	145.234391	8.603955	Ant plant
98	-15.50947599	145.234463	8.216248	Ant plant
99	-15.50947599	145.234837	7.244102	Ant plant
100	-15.50970096	145.235333	6.481563	Ant plant
101	-15.50952896	145.235332	6.730256	Ant plant
102	-15.50955403	145.2357	6.811103	Ant plant
103	-15.50961798	145.235787	6.317325	Ant plant
104	-15.50951899	145.235371	5.659163	Ant plant
105	-15.50952896	145.235338	5.592072	Ant plant

Wpt	lat	lon	ele	ENVT
106	-15.50940097	145.235428	5.300342	Ant plant
107	-15.50923903	145.235312	4.407755	Ant plant
108	-15.50885498	145.235083	5.337464	Ant plant
109	-15.50841903	145.235294	5.131077	Ant plant
110	-15.50831904	145.235353	5.669589	Ant plant
111	-15.50790397	145.234941	4.201178	Ant plant
112	-15.50784202	145.23454	4.294094	Ant plant
113	-15.50742201	145.234776	3.595319	Ant plant
114	-15.507248	145.235008	3.403437	Ant plant
115	-15.506299	145.236357	3.875259	
116	-15.50607696	145.236837	4.267738	
117	-15.50584503	145.237326	6.954663	
118	-15.50708497	145.237646	4.250127	
119	-15.50765201	145.238458	3.03388	
120	-15.50729603	145.242131	2.948259	Ant plant
121	-15.507449	145.242462	3.240684	Ant plant
122	-15.50768704	145.242869	2.913628	Ant plant
123	-15.50780003	145.243698	3.230268	Ant plant
124	-15.50739996	145.242519	3.327068	Ant plant
125	-15.50712696	145.242245	3.082833	Ant plant
126	-15.507767	145.23795	-0.503985	
127	-15.50844904	145.235865	0.266453	Ant plant
128	-15.50896696	145.235597	-0.685548	Ant plant
129	-15.509233	145.235347	-0.883625	Ant plant
130	-15.50917198	145.234773	-0.451175	Ant plant
131	-15.50880603	145.234719	-0.248774	Ant plant
132	-15.50749803	145.228015	8.569594	Ant plant
133	-15.50720701	145.226867	9.007628	Ant plant
134	-15.50715596	145.225074	10.379131	Ant plant
135	-15.507392	145.224647	10.011591	Ant plant
136	-15.50804	145.223537	11.354319	Ant plant
137	-15.50807001	145.222598	11.931848	Ant plant