Garners Beach
Habitat Restoration and Management Plan

September 2013

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1.0 Background

"Garners Beach is sensitive and significant. Cultural heritage still exists. It's close to our northern boundary Maria Creek, a place of resource sharing with our neighbours." Djiru people 2013

This report has been prepared to assist Terrain NRM and landholders in the Garners Beach local area in their efforts to ecologically restore and improve the value of native habitats in this area. The document seeks to provide landholders with information relating to; the distribution of habitat in the area, the threats facing these residual habitats, and the most appropriate way to manage these threats. The document may also be used to support funding applications for habitat restoration works in the study area.

2.0 Study Area

For the purposes of this report the study area contains terrestrial habitats between Garners Beach and Brookes Beach largely encircled by Bingil Bay Road to the south, but including north Bingil Bay/Ninney Point, Muff Creek and Cedar Creek (see Map 1 for an overview). This area represents 360ha, with approximately 270ha (75%) of statutory mapped native remnant vegetation (Regional Ecosystems (REs) V6.1). 120.5ha (33%) comprise public land of which 19% is National Park. 239.5ha (67%) comprise freehold land, of which 67.5ha (26%) is under some form of protective property agreement ranging across the federal; state and local government spectrum (refer to Map 2, 3 and 5).

The Garners Beach area sits within the greater Mission Beach habitat block encompassing the area between the Maria Creek and Hull River catchments. It includes the larger forest blocks of Djiru National Park, the Walter Hill Ranges and the large area of lowland rainforest near Rockingham Bay. Mesophyll vine forest i.e., rainforest is the preferred habitat for cassowaries, and the majority (69%) of the statutory, mapped remnant native vegetation (REs) within the study area is mapped as 'Essential Habitat' for this species (DERM 2010; refer to Map 3).

In addition to mesophyll vine forest, the area also contains; mangroves, Melaleuca dominated wetland vegetation, sclerophyll species and communities associated with beach-front habitats and anthropogenic (cleared) areas.

3.0 Methodology

This plan has been developed in four main phases;

- Desktop review
- On-ground survey
- Public consultation
- Geographic Information System (GIS) Analysis

3.1 Desktop Review

The desktop review included a review of on-line databases, reference material and in-house data. On-line data included searches of Commonwealth (Matters of National Environmental Significance (NES) - Protected Matters Search Tool) and State (Wildlife On-line) databases to review the potential occurrence within the study area of species listed under the *Nature Conservation Act (NCA) 1992* and/or the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. A Regional Ecosystems search relevant to the *Vegetation Management Act (VMA) 1999* was conducted to inform the planning process.

A review was completed of the following documents;

Biotropica Australia / Wet Tropics Management Authority (2005). *Habitat linkages for the Southern cassowary (Casuarius casuarius johnsonii) between Cairns and Cardwell*. Consultancy report prepared for the Australian Rainforest Foundation, Cairns.

Biotropica Australia (2006). *Land Conservation Options for the Southern Cassowary (Casuarius casuarius johnsonii) in the Bingil Bay Area*. Consultancy report prepared for the Australian Rainforest Foundation, Cairns.

Department of Environment and Resource Management (DERM), Queensland (2009). *Distribution of cassowary habitat in the Wet Tropics bioregion, Queensland (3rd Edition)*. Technical report prepared by Kutt A.S., Morgan G., Maughan M. and Latch P.

Department of Environment and Resource Management (DERM), Queensland (2010). *Spatial Dataset: Distribution of Cassowary Habitat in the Wet Tropics Bioregion*. http://dds.information.qld.gov.au/DDS/Search.aspx (accessed Feb 2012)

Gallie L. (2011). *Community Cassowary Identification and Tracking Project – December 2011 Update*. http://www.missionbeachcassowaries.com/uploads/5/9/8/7/5987112/cit_project_mbhna_dec_8_2011_mbc_version.pdf (accessed: 3 June 2013)

Goosem, S. & Tucker, N.I.J. (2013). *Repairing the Rainforest (second edition)*. Wet Tropics Management Authority and Biotropica Australia Pty Ltd. Cairns.

Hill, R., O'Malley, T., Grace, R., Williams K.J., Pert, P.L and Jenkins, S. (2010). *Mission Beach Habitat Network Action Plan*. CSIRO and Terrain NRM, Cairns.

Latch, P. (2007). *National recovery plan for the southern cassowary Casuarius casuarius johnsonii*. Report to Department of the Environment, Water, Heritage and the Arts, Canberra. Environmental Protection Agency, Brisbane.

NRA (2013). *Tanah Kita Weed and Feral Animal Management Plan*. Consultancy report to Terrain NRM.

3.2 On-ground Survey

On-ground surveys were conducted by two ecologists during June 2013. During this survey, all native vegetation was assessed for condition (quality) and restoration planning, including the dominant weed cover type, and the level of invasion. The identity and distribution of weeds across the study area was recorded, and all exotic plants were identified to species level. No botanical records were generated for native species. Where present, restoration sites were examined to evaluate past works, and suggest intervention works where required.

All point records were taken using a Garmin Nomad GPS, and data were transformed using the ArcGIS 10 platform.

3.3 Public Consultation

A public meeting was held on 8th June 2013 to canvass the views of residents within the study area. Issues, concerns and ideas generated during this forum were collected for analysis and consideration during the reporting phase.

Following this face-to-face contact residents were asked to complete a survey form. This forms sought resident's views relating to habitat threats and opportunities, project funding and other issues relating to any aspect of habitat management.

Completed forms were collated by Terrain NRM and the information was used in the preparation of the plan. A summary of the responses is provided further below in Tables 3 & 4.

3.4 GIS Analysis - Map Content Development

Existing General Habitat

The existing general habitat depicted in Map 8 is an area that was developed from a combination of three information sources: the (most current) QLD Government's remnant vegetation cover (Version 7) spatial dataset (published 2012, derived from September 2009 imagery), high resolution 2011 aerial imagery and the two day on-ground survey.

Four subset depictions are superimposed onto the main extent: existing habitat on public land and the proportion of which is protected in National Park, as well as existing habitat on freehold land and the proportion of which is protected under protective property agreements (for a detailed depiction of properties that are covered by such agreements refer to Map 5).

Eco-units Development

During a two day survey a large proportion of public land and private properties in the study area were subject to rapid visual assessment relating to vegetation cover/weed presence. In combination with this information high resolution aerial imagery was used to create polygons depicting areas that exhibit potential for improved vegetation management because of either reduced vegetation cover and/or weed presence.

Eco-units Categorisation for Management Recommendations

Once polygons were created, each was assigned an individual management recommendation, a categorised treatment method recommendation (depicted in Map 9) and a management priority, i.e. *Action Level* (also depicted in Map 9).

4.0 Study Area Environment

For an overview of the study area depicting location names, the local road network, landscape relief (elevation contours), drainage (watercourses), National Park areas and confirmed cassowary road crossings refer to Map 1.

On-line searches showed there are a number of species listed as endangered, vulnerable or near threatened potentially occurring within the study area. Table 1 below shows the results of on-line searches relating to listed species.

Table 1: Threatened Species Online Database Search Result (19th August 2013, excluding fish, sharks, whales and migratory species)

Scientific Name	Common Name	Growth Form	NCA 1992 (QLD) Status	EPBC Act 1999 (Federal) Status
Fauna				
Caretta caretta	Loggerhead turtle	Reptile	E	E
Casuarius casuarius johnsonii (southern population)	Southern cassowary (southern population)	Bird	E	E
Chelonia mydas	Green turtle	Reptile	V	V
Crocodylus porosus	Estuarine crocodile	Reptile	V	-
Cyclopsitta diophthalma macleayana	Macleay's fig-parrot	Bird	V	-
Dasyurus hallucatus	Northern quoll	Mammal	-	E
Dermochelys coriacea	Leatherback turtle	Reptile	E	E
Eretmochelys imbricata	Hawksbill turtle	Reptile	V	V
Erythrotriorchis radiatus	Red goshawk	Bird	E	V
Esacus magnirostris	Beach stone-curlew	Bird	V	-
Fregetta grallaria grallaria	White-bellied storm-petrel (Tasman Sea & Australia)	Bird	-	V
Hipposideros semoni	Semon's leaf-nosed bat	Mammal	E	E
Lepidochelys olivacea	Olive Ridley Turtle	Reptile	E	E
Litoria nannotis	Waterfall frog	Amphibian	E	E
Litoria rheocola	Common mistfrog	Amphibian	E	E

Scientific Name	Common Name	Growth Form	NCA 1992 (QLD) Status	EPBC Act 1999 (Federal) Status
Natator depressus	Flatback turtle	Reptile	V	V
Nyctimystes dayi	Australian lacelid	Amphibian	E	E
Pteropus conspicillatus	Spectacled flying-fox	Mammal	-	V
Rostratula australis	Australian painted snipe	Bird	V	E
Saccolaimus saccolaimus nudicluniatus	Bare-rumped sheathtail bat	Mammal	E	CE
Tyto novaehollandiae kimberli	Masked owl (northern subspecies)	Bird	V	V
Xeromys myoides	Water mouse	Mammal	V	V
Flora				
Arenga australasica	Australian arenga palm	Palm	V	V
Canarium acutifolium var. acutifolium	-	Tree	V	V
Carronia pedicellata	-	Vine	E	E
Phaius australis	Lesser swamp-orchid	Orchid	E	E
Rourea brachyandra	Water vine	Vine	NT	-
Streblus pendulinus	Siah's backbone Prickly fig	Small tree/shrub	-	E
Vappodes phalaenopsis (syn *Dendrobium bigibbum*)	Cooktown orchid	Orchid	V	V

The most recent statutory Regional Ecosystems mapping (V6.1 based on 2006 imagery) indicates the following Regional Ecosystems are present on the site (see Table 2 below). These Regional Ecosystem descriptions highlight the diversity of different habitats across the study area. Table 2 is colour-coded from the VMA Status (green = Least Concern, orange = Of Concern, E= Endangered) and spatial extents are depicted in Map 3.

Table 2: Regional Ecosystems of the Study Area

RE	Bio-diversity Status	VMA Status	Hectares	Description
7.1.1	NC	LC	33.06	Mangrove closed-scrub to open-forest. Sheltered coastlines, estuaries, and deep swales between dunes, on fine anaerobic silts, inundated with saline water at high tide.
7.3.5a	E	LC	5.15	*Melaleuca quinquenervia* (swamp paperbark) and/or *Melaleuca cajuputi* (cajuput) closed-forest to shrubland on poorly drained alluvial plains. Lowlands of the very wet and wet rainfall zone, on poorly drained peaty humic gley soils where the water table is near or above the ground for most of the year. Major vegetation communities include: **7.3.5a:** Palustrine wetland (e.g. vegetated swamp). *Melaleuca quinquenervia* open-forest, woodland and shrubland. Lowlands of the very wet and wet rainfall zone, on poorly drained peaty humic gley soils where the water table is near or above the ground for most of the year.
7.3.7a	E	E	0.69	*Eucalyptus pellita* (red stringybark) and *Corymbia intermedia* (pink bloodwood) open-forest to woodland (or vine forest with emergent *E. pellita* and *C. intermedia*). Poorly drained alluvial plains. Major vegetation communities include: **7.3.7a:** Contains palustrine wetland (e.g. in swales). *Eucalyptus pellita* and *Corymbia intermedia* open forest and woodland. Poorly drained alluvium, including seasonal swamps.
7.3.10a	E	OC	23.83	Simple-complex mesophyll to notophyll vine forest. Moderately to poorly-drained alluvial plains of moderate fertility. Major vegetation communities include: **7.3.10a:** Mesophyll vine forest. Moderately to poorly-drained alluvial plains, of moderate fertility. Lowlands of the very wet and wet zone.
7.3.20a	OC	OC	7.18	*Corymbia intermedia* (pink bloodwood) and *Syncarpia glomulifera* (turpentine), or *C. intermedia* and *Eucalyptus pellita* (red stringybark), or *Syncarpia glomulifera* and *Allocasuarina* spp. (sheoaks), or *E. cloeziana* (Gympie messmate), or *C. torelliana* (cadaghi) open-forest (or vine forests with these species as emergents). Moderate to steep alluvial fans at the base of ranges. Major vegetation communities include: **7.3.20a:** *Eucalyptus pellita*, *Corymbia intermedia*, *C. tessellaris*, open-forest often with *Acacia celsa*, *A. cincinnata*, *A. mangium* and *A. flavescens*. Includes small areas dominated by *A. crassicarpa*. Alluvial fans of the very wet and wet rainfall zones, of the lowlands and foothills.
7.12.1a	NC	LC	153.72	Simple-complex mesophyll to notophyll vine forest. Moderately to poorly-drained granites and rhyolites of moderate fertility of the moist and wet lowlands, foothills and uplands. Major vegetation communities include: **7.12.1a:** Mesophyll to notophyll vine forest. Lowlands and foothills of the very wet and wet rainfall zones. Granite and rhyolite.

RE	Bio-diversity Status	VMA Status	Hectares	Description
7.12.5a	E	OC	2.74	*Eucalyptus pellita* (red stringybark) +/- *Corymbia intermedia* (pink bloodwood) open-forest, or *Acacia mangium* (black wattle) and *Lophostemon suaveolens* (swamp mahogany) open-forest, (or vine forest with these species as emergents). Granites and rhyolites, of the very wet and wet rainfall zones. Major vegetation communities include: **7.12.5a:** *Eucalyptus pellita*, *Corymbia intermedia* and *C. tessellaris* open-forest with *Acacia celsa*, *A. cincinnata*, *A. mangium* and *A. flavescens*. Very wet and wet rainfall zones, on granite and rhyolite.
7.12.12a	OC	OC	6.61	*Acacia mangium* (black wattle) and *A. celsa* (brown salwood) open-forest to closed-forest or *A. polystachya* woodland to closed-forest. Granite and rhyolite foothills, of the moist rainfall zone. Major vegetation communities include: **7.12.12a:** *Acacia mangium* and *A. celsa* open to closed forest. Lowlands and foothills, of the very wet and wet rainfall zone, on granite and rhyolite.
7.12.54a	OC	OC	0.76	Complex of shrubland and low open-forest. Wind-exposed granite and rhyolite coastal headlands and islands, on skeletal soils. Major vegetation communities include: **7.12.54a:** Woodland, low woodland, low forest and shrubland with *Corymbia tessellaris*, *C. intermedia*, *Lophostemon suaveolens*, *Eucalyptus platyphylla*, *Melaleuca viridiflora*, *Acacia crassicarpa*, *A. flavescens*, *A. celsa*, *A. polystachya*, *Dillenia alata*, *Atractocarpus sessilis* and *Cyclophyllum coprosmoides*. Steep exposed coastal headlands and hillslopes, on granite and rhyolite.
TOTAL			**233.74**	

The Garners Beach community's (landholders, council staff, QPWS staff and traditional owners) perceptions of values, threats and opportunities pertaining to the local environment were captured by a public consultation meeting on 8th of June 2013. A summary of the 29 submissions is presented below in Tables 3 & 4:

Table 3: Community Perceptions Summary – Own Property

		OWN PROPERTY		
Values	**Threats**	**Opportunities**	**Future Funding**	**Other**
Cassowaries Cassowary habitat Natural vegetation	Weeds (*Annona glabra, Megathyrsus maximus, Sphagneticola trilobata*) Dogs, Pigs Lack of weed-related knowledge	High proportion of landowners interested in conservation Improve weed-related knowledge of landowners Weed management funding to be strategic and ongoing	Generally welcome, but only if weed management funding translates to efficient action and persistent, perceivable outcomes	General readiness to improve property management and willingness to work cooperatively

Table 4: Community Perceptions Summary – Garners Beach Study Area

GARNERS BEACH STUDY AREA				
Values	**Threats**	**Opportunities**	**Future Funding**	**Other**
Cassowaries High proportion of relatively intact, diverse habitat Low proportion of development Beachfront Littoral Ecosystem Wetlands Landscape Scenery / Visual Amenity Cultural Heritage	Weeds (*Annona glabra, Cocos nucifera, Megathyrsus maximus, Sphagneticola trilobata*) Weed spread (council road verge maintenance, hired machinery, garden waste dumping) Weed control/funding issues (lack of weed-related knowledge, funding discontinues before full control is achieved) Dogs, Pigs Speeding	Improve weed-related education of landowners (management plans, info-kits, workshops) Improve public land management (beachfront, powerline corridors, road verges, increase staff training) Weed management funding - only if strategic and ongoing Traditional Owner participation	Enhancement of local weed management knowledge Weed management funding - only if strategic and ongoing	n/a

5.0 Environmental Values

5.1 Biological Diversity

Garners Beach through to the northern end of Bingil Bay is an area of exceptional biological diversity. For an area of relatively small size (360ha), 75% of the study area is covered by remnant vegetation. 9 Regional Ecosystems are present within the study area ranging from mesophyll vine forest to littoral forests (including mangroves), and Melaleuca wetlands with 71% of the remnant vegetation (53% of the study area) being Least Concern, 15% of the remnant vegetation (11% of the study area) Of Concern and less than 1% of the remnant vegetation (<1% of the study area) Endangered. The area has the potential to support 28 endangered, vulnerable and/or near threatened plant and animal species. Between Bingil Bay and Garners Beach is notable for supporting up to 13 adult and juvenile cassowaries (Gallie 2011). Detailed cassowary habitat mapping (DERM Pallarenda 2010) shows that 52% of the study area is classed as primary cassowary habitat, 13% as secondary cassowary habitat, 4.3ha (1%) as rehabilitating cassowary habitat and 18ha (5%) as cleared area that cassowaries utilise to move between habitats (non-remnant cassowary corridor). Refer to Map 6 for a depiction and APPENDIX 4 for detailed definitions of those categories.

In addition to the diversity of terrestrial ecosystems, permanent fresh water is available at a number of locations: Cedar Ck, Koombooloo Creek (Tanah Kita property) and the Muff Creek tributary (running close to the Holt Rd/Garners Beach Rd intersection); several swamps and an artificial reservoir behind the esplanade at Garners Beach, as well as the drainage channels out of the elevated area behind Ninney Point. These freshwater ecosystems increase the habitat value of the area and to cassowaries in particular which rely heavily on freshwater. The study area also contains a diversity of marine ecosystems, and tidal habitats reflecting closed and open-water settings. Such sites, and their accompanying flora, add further aquatic habitat diversity.

The entire Muff Creek area (almost up to Garners Beach Rd) is mapped as estuary with adjacent Melaleuca swamps. It is also recognised in the Directory of Important Wetlands in Australia as part of the Kurrimine Area wetland complex (refer to Map 4).

5.2 Habitat Connectivity

Habitat connectivity is important for rainforest species that are dependent on continuous habitat. Internally the study area is well connected. Habitat is mostly continuous and broken mainly by Garners Beach Road and Bingil Bay Road which offer a higher speed driving environment. Internal roads generally have lower design speeds. This means faunal movement is generally unconstricted through most of the study area. Externally, the study area remains connected to the larger Djiru National Park through the Cedar Creek system at the south-western end of the area, and the Stony Creek catchment in the south. It is also connected to the Maria Creek system to the north-west initially by Muff Creek, then principally through the WTMA covenant block just west of Fig Tree Beach Rd (see Map 5). Refer to Map 7 for a landscape context depiction.

Further highlighting the significance of these landscape connectivity values the larger Garners Beach area is covered by several recognised conservation corridors which are depicted in Map 6. These recognitions span the full spectrum of Commonwealth, State and regional agencies from the local to the bioregional landscape level:

- Wet Tropics Management Authority (WTMA) 2006 Cassowary Habitat Linkages Corridor – mainly Walter Hill Range/Mission Beach area; extends to just south of study area.
- Queensland State (DEH) 2006 Consolidated Conservation Corridors – mainly covers the connection between the study area and the Maria Creek system. It includes the western part of the study area between Clump Mountain NP and Bingil Bay Rd (east/west) and Muff Ck to Cedar Ck (north/south).
- FNQ2031 Recognised Conservation Corridors
  These corridors are categorised into a state/bioregional, sub-regional and local hierarchy. Only a state/bioregional corridor covers the study area:
  - *WET TROPICS Coastal State/Bioregional Corridor (5km wide):* This follows the landward margin of remnant tidal and coastal sand dune area, and/or the watershed of the adjacent coastal ranges. Where coastal areas have been completely developed, this corridor follows the inland side of development. (It forms part of a state-wide coastal corridor.).
  - Approximately 2-3km to the west of the study area are two subregional/local corridors encompassing the South Maria Ck / Maria Ck systems. These are:
    South Maria Creek Subregional Corridor (1km wide):
    Follows remnant and disturbed vegetation associated with South Maria Creek, linking lowland and other remnant vegetation with east-west corridors across the lowlands
    Maria Creek Local Corridor (100m wide):
    Follows watercourses between the foothills corridor and the coastal corridor.

All vine forest on coastal sand deposits and immediately adjacent to the foreshore is likely to be classed as Littoral Rainforest, potentially elevating these areas into higher levels of statutory protection.

5.3 Scenic Amenity

The area is known for large patches of well-developed rainforest, Melaleuca wetlands, and distinctive littoral zone environments. This diversity creates significant scenic amenity. Similarly, the degradation of these habitats also detracts from the area's natural charm.

5.4 Cultural Heritage

There are two sites that are listed on the Queensland Heritage Register: The burial ground of the Garner family on the eastern side at the beach end of Garners Beach Road dating back to the early 20th century; and the home/memorial of early Garners Beach pioneer John Büsst at Ninney Rise bordering the southern fringe of the Clump Mountain National Park section at Ninney Point, dating back to the mid-20th century. Refer to APPENDIX 5 for detailed descriptions and location maps.

6.0 Threats to Environmental Values

Habitat fragmentation and weed invasion and are the most serious threats facing habitats within the study area, although there are other threats to the area's natural values. Whilst roads cause habitat fragmentation, they also result in wildlife mortality. At least 5 cassowaries (1992 adult female, 2006 adult female (QPWS Innisfail, pers. Comms.), 2010 adult male and 2 chicks (Gallie, 2011) have been confirmed killed in the area (for locations of cassowary fatalities refer to Map 7). Roads also result in other negative outcomes. Slashing of road margins is a key cause of weed spread, particularly weeds such as Navua sedge. However, when road margins are not slashed there is reduced visibility at the edge and an increased likelihood of wildlife road kills. It is therefore important that all groups involved in managing local area habitat (community and government) are engaged in the process of habitat management within the Garners Beach area.

6.1 Forest Fragmentation

Habitats in the study area are generally in a moderate to poor condition. The combined effects of two major cyclones in five years, and severe fragmentation from settlement and agriculture, have combined to produce a forest mosaic severely edge-affected, typified by weed invasion, climber towers of Captain Cook vine (*Merremia peltata*), and wind-damaged canopy vegetation. The degradation of habitat decreases its value to wildlife, reducing the potential for the area to sustain populations of forest-dependent species. This includes cassowaries whose diets become increasingly reliant on exotic species such as pond apple (*Annona glabra*).

Edge effects are most obvious as weed invasion into fragments and colonisation of forest margins, and a loss of large trees from the forest margin with accompanying replacement/proliferation of early successional vegetation. The loss of forest structure has allowed weed invasion at canopy, sub-canopy and ground levels.

Overcoming the effects of forest fragmentation and weed proliferation requires commitments of at least two to three years. This is the minimum time that is required to control a number of weeds that occur in the study area, and the time taken to conceptualise and complete a habitat restoration project.

Weed management and restoration are key tools in reversing the effects of forest fragmentation.

6.2 Weeds

6.2.1 Classification

Weeds are classified by Local, State and Commonwealth governments, and their classifications generally reflect control priority.

Weeds of National Significance

The 32 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.

National management plans strategies and manuals have been published for all of these species. These strategies aim to:

- Prevent spread and new infestations
- Reduce adverse impacts of existing infestations
- Establish and maintain national commitment
- Coordinate management at a national level
- Increase community awareness.

National management groups have been established for each of these species to oversee the implementation of the respective national strategic plans.

Queensland State Level

The *Land Protection (Pest and Stock Route Management) Act 2002* provides a framework and powers for improved management of weeds, pest animals and the stock route network across Queensland.

Pest Management

The *Land Protection (Pest and Stock Route Management) Regulation 2003* 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

- not commonly present or established in the State; and
- 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:

- are established in the State; and
- 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.

When deciding whether to declare an animal or plant to be a Class 2 or Class 3 pest, account is taken of:

- the significance of the animal's or plant's impact or potential impact
- the area affected, or likely to be affected, by the impact;
- the extent to which the animal or plant has spread or is likely to spread.

Under the *Land Protection (Pest and Stock Route Management) Act 2002*, a landowner must take reasonable steps to keep their land free of Class 1 and Class 2 pests, unless they hold a relevant declared pest permit. Penalties and fines are set out for non-compliance.

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 Far North Queensland Regional Organisation of Councils (FNQROC) and Hinchinbrook Shire 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 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.

6.2.2 Weeds of the Study Area

Table 5 below contains a list of most weeds in the study area that are commonly seen, and all of those species which require active control. Some minor and inconsequential weeds have not been included. Table 5 shows there are 2 species which are WoNS classified, 9 species declared under Queensland legislation, and 18 species categorised under Local PMPs.

Weeds on the list have been assigned a priority ranking based on their invasiveness and their ability to halt the natural recovery process, specifically in the study area. Priority One (P1) species require diligent control and monitoring, Priority Two (P2) species require monitoring to ensure they do not become problematic where they occur, and Priority Three (P3) species are relatively benign and do not require any intervention or monitoring.

Table 5: Weeds present in the Study Area

Scientific Name	Common Name	WoNS	QLD	FNQROC	Control Priority
*Allamanda cathartica**	Golden trumpet vine	-	-	Category 4	1
*Annona glabra**	Pond apple	X	2	Category 2	1
*Brillantaisia lamium**	Brillantaisia	-	-	Category 2	1
Calopogonium mucunoides	Calopo	-	-	-	1
Centrosema molle	Centro	-	-	-	1
*Chromolaena odorata**	Siam weed	-	1	Category 1	1
*Cyperus aromaticus**	Navua sedge	-	-	Category 4	1
Heliconia psittacorum	Parrots-beak heliconia	-	-	-	1
*Lantana camara**	Lantana	X	3	Category 2	1
Mangifera indica	Mango	-	-	-	1
Megathyrsus maximus var. maximus	Guinea grass	-	-	-	1
Pueraria phaseoloides	Kudzu	-	-	-	1
Ravenala madagascariensis	Travellers palm	-	-	-	1
*Rubus alceifolius**	Giant bramble	-	-	Category 4	1
*Senna obtusifolia**	Sickle-pod	-	2	Category 3	1
*Spathodea campanulata**	African tulip	-	3	Category 4	1
*Sphagneticola trilobata**	Singapore daisy	-	3	Category 3	1
*Thunbergia fragrans**	White thunbergia	-	1	Category 1	1
*Thunbergia grandiflora**	Blue trumpet vine	-	2	Category 2	1
Clitoria laurifolia	Butterfly pea	-	-	-	2
Dissotis rotundifolia	Spanish shawl	-	-	-	2
Ipomoea hederifolia	Red convolvulus	-	-	-	2
Ipomoea indica	Blue morning glory	-	-	-	2
Ipomoea purpurea	Morning glory	-	-	-	2

Scientific Name	Common Name	WoNS	QLD	FNQROC	Control Priority
Passiflora aurantia	Red passionfruit	-	-	-	2
Passiflora foetida	Stinking passionfruit	-	-	-	2
Passiflora suberosa	Corky passionfruit	-	-	-	2
Passiflora subpeltata	White passion vine	-	-	-	2
Senna alata	Candle-stick bush	-	-	-	2
*Stachytarpheta jamaicensis**	Light-blue snake weed	-	-	Category 4	2
*Syngonium podophyllum**	Gooses foot	-	-	Category 4	2
Thunbergia alata	Black-eyed susan	-	-	-	2
Abutilon indicum	Indian lantern flower	-	-	-	3
Aeschynomene indica	Budda pea	-	-	-	3
Crotalaria pallida	Streaked rattlepod	-	-	-	3
Delonix regia	Poinciana	-	-	-	3
Eclipta prostrata	White eclipta	-	-	-	3
Eleusine indica	Crows-foot grass	-	-	-	3
Erechtites valerianifolia	Brazilian fireweed	-	-	-	3
Hypoestes phyllostachya	Freckle-face	-	-	-	3
*Hyptis capitata**	Knob weed	-	-	Category 4	3
Macroptilium lathyroides	Phasey bean	-	-	-	3
Manihot esculenta	Cassava	-	-	-	3
Melinis minutiflora	Molasses grass	-	-	-	3
Mimosa pudica	Sensitive plant	-	-	-	3
Momordica charantia	Balsam pear	-	-	-	3
Odontonema tubaeforme	Fire spike	-	-	-	3
Polygala paniculata	Polygala	-	-	-	3
*Praxelis clematidea**	Praxelis	-	-	Category 4	3
Sida cordifolia	Flannel weed	-	-	-	3
Sigesbeckia orientalis	Indian weed	-	-	-	3
*Solanum mauritianum**	Wild tobacco bush	-	-	Category 4	3
Solanum torvum	Devil's fig	-	-	-	3
Spermacoce latifolius	White-eye	-	-	-	3
*Sporobolus spp.**	Rats tail grasses	-	2	Category 3	3
Synedrella nodiflora	Cinderella weed	-	-	-	3
Tridax procumbens	Tridax daisy	-	-	-	3
Urena lobata	Urena burr	-	-	-	3
Urochloa mutica	Para grass	-	-	-	3

*Locally, State or Commonwealth declared

Based on this ranking there are 19 Priority 1 species, 13 Priority 2 species, and 27 Priority 3 species. Information sheets are provided in APPENDIX 3 to assist with recognition and control of all Priority 1 species in the study area.

Apart from any legislative requirement, controlling and manipulating weed cover will be a key objective of this plan. The study area includes a large number of exotic plant species, and their control would have a very positive effect on the area's long term ecological integrity. Pictorial references and control information is provided in APPENDIX 3 for each Priority 1 species recorded in the study area.

6.2.3 Transformer Weeds

Transformer weeds are exotic plants that are considered capable of altering the physical structure and/or species composition of natural ecosystems. Because the area has plant communities (regional ecosystems) such as littoral vine forest that are now greatly limited in extent and integrity, such transformer weeds have the capability to further diminish their environmental values.

Terrain NRM undertook an extensive survey of weeds and their environmental effects in March, 2013. Concentrating their study in the Mission Beach area, Terrain found that pond apple, Singapore daisy, coconut palm, golden pothos, mango, bitter vine, and gooses-foot vine were the weeds most likely to transform existing habitats. This study also suggested Guinea grass was the most likely to resist the natural regeneration process. Whilst some of these species were not seen in the study area, the majority are present and classified as Priority 1 for control purposes.

Singapore daisy was identified in the Terrain study as a weed requiring more urgent and effective control. Whilst the species does not grow in full shade it can invade and dominate most sites including littoral areas. The Information Sheet (APPENDIX 3) for this species details a range of control techniques for different sites.

6.2.4 Other Plants

There are other plants in the study area whose effects are less well understood. Captain Cook vine (*Merremia peltata*) and the coconut palm (*Cocos nucifera*) are two species which display some weed characteristics (invasive, ecosystem transforming) but have other features that suggest more benign effects (rapid reaction to disturbance, soil cover/binding). The effect of such plants may therefore be naturally neutral, but become negative when the surrounding ecosystem is disturbed to a degree that the plants are less in balance with their surrounds.

Captain Cook vine is a widespread species occurring naturally throughout the Solomon Islands, Papua New Guinea and north-east Queensland. This, and the other vines which produce the familiar climber towers around the area, appear to have been a feature of the area for many years, at least since the 1950's when Prof. L.J Webb termed them 'cyclone scrubs' after the vine-dominated appearance of mountain slopes between Tully and Cape Tribulation. Such areas are invariably the product of strong winds on the coastal ranges which face into the prevailing south-easterly winds.

In the study area, Tanah Kita and a small number of other sites support larger areas of Capt. Cook vine. There is merit in conducting trials to evaluate the effect of vine control in areas that are accessible and where sustained effort can be applied if required. However, such actions must be measured against the benefits that may accrue from working in other areas where controlling exotic invasive species may be more urgent.

Coconut palms are confined to the high water mark and do not extend outside this environment. However, in this area they may become quite dense and compete with rainforest vegetation. There is merit in under-planting areas of coconut palm with rainforest species and allowing these to progressively cover areas which may have been dominated by this plant.

There are also several serious weeds which were not found within the study area, but are known from the surrounding landscape. Golden pothos (*Epipremnum aureum*) and Bitter vine (*Mikania micrantha*) are the most serious of these weeds. They should be eradicated if and when they appear on properties within the study area. Information sheets are also provided for these species in APPENDIX 3.

When managing and restoring habitat, weeds cause two main problems – invasion into natural habitat, and blocking natural regeneration of habitat.

6.3 Habitat Invasion

Plants which can invade into relatively intact forest are rare, because most weeds require high levels of light and disturbance to maintain their preferred habitat. However the effects of natural and man-made disturbance mean that forests in the area covered by this plan are not relatively intact. Forests that have been disturbed and fragmented do not have the same ability to withstand weed invasion as intact areas and are more likely to suffer weed invasion and domination.

There are plants in the area which can invade into the different habitat types within the area. In rainforest areas, species such as Singapore daisy, Spanish shawl, and Brillantaisia are capable of growing in quite dense shade. Shade such as that encountered along a forest edge or in forest gaps is typical of their range of tolerances to shade. Large gaps caused by cyclones or tree falls can be rapidly colonised and exploited by these and other weeds. Even trees such as African tulip can germinate in large gaps that are distant from clearing. In littoral (beach-front) and riparian (stream-bank) forests, pond apple and mango are common, whereas Melaleuca wetlands are favoured by traveller's palm. All of these weeds are capable of tolerating moderately deep levels of shade.

Habitat penetration by this type of shade-tolerant weed reduces biodiversity in the immediate vicinity, and allows the weed to establish a foothold from which to expand into new sites. In this way they colonise areas which would normally be covered by dense native vegetation. Vines are also adept at invading into forest using their growth habit. Some dense and vigorous species such as kudzu, white thunbergia, and golden trumpet vine use the forest margin as a ladder and then over-top their host. This has the effect of reducing the host's ability to photosynthesise and rendering it likely to collapse or fall into the forest (carrying the vine stepwise into the forest). Still other vines such as lantana and Siam weed have a scrambling habit and can invade different forest strata depending on site conditions.

Once a weed has invaded a natural area it can be very difficult to completely eradicate, often because its presence has not been detected until a patch is large enough to be visible from a track or road, or from an aerial survey. Once established, they are able to begin the process of producing and dispersing seeds into the surrounding forest. This initiates a cascade of other effects as the weed begins to change the nature of the site and the resources available to native wildlife.

Weeds which are not shade-tolerant are most typically seen in open areas, or along forest margins. These plants are unable to grow in shade, and pose only a minor threat to natural habitat.

6.4 Blocking Natural Regeneration

The second major problem stems from a weeds ability to stop or reverse natural regeneration of habitat, and to halt the regeneration of native species within a restored area. Natural regeneration is a cost-effective means to restore forest, relying on the recuperative ability of nature. It is also relied on to add diversity of life form and species into restoration areas where only a subset of plants that might be present in an area are actually planted. When weeds are present, natural regeneration is unable to effectively compete and weeds are able to lock themselves into an area.

Those weeds which can stop regeneration are most commonly grasses and vines. The grasses are very dense, competitive and fire-prone. Native plants find it very difficult to germinate and persist in tall grass, and unlike grasses, rainforest seedlings are destroyed by fire. Guinea grass and molasses grass are both very persistent and competitive. Vines are able to climb onto and over native vegetation, smothering their foliage and either stunting or killing their host. Pasture legumes such as glycine and centro are very effective at smothering seedlings in restoration plantings. More vigorous vines such as golden trumpet vine and the exotic passionfruit are problematic in forested habitats.

Different forest types are also more susceptible to weed invasion. Rainforest canopies tend to intercept most light, so the ground storey plants receive little direct sunlight. As a result, rain forest margins and gaps tend to be the main points where weeds appear. Melaleuca canopies are less dense so more light reaches the ground storey so weeds are more likely to be light-demanding species such as Guinea grass. Weeds thrive in high light environments, so areas with patchy tree cover are likely to support a greater diversity and abundance of weeds.

7.0 Weed Control Methods

There are a number of techniques to manage weeds in environments such as the study area. Each control technique is best suited to a particular type of weed, so that sometimes a number of different techniques may all be used in one small area. Regardless of technique, weed control should be undertaken as a long term commitment (e.g. two to five years) because many weeds require long control periods before they are completely eradicated from a site. Furthermore, weed control should only be done where there is a clear understanding of what will replace the weed being controlled. There is no value in controlling one weed to find it is replaced by another – unless the new weed is much easier to control and not likely to invade habitat or inhibit regeneration.

7.1 Herbicide Control

Herbicide is a common method used to treat large areas and all weeds can be controlled using herbicide. It involves one or more applications of a chemical formulation depending on the weed, the application technique, and the herbicide used. Weeds can be foliar sprayed using a knapsack for small areas, or larger, motor driven units for larger areas. Most foliar sprays work on all plant forms so avoid spraying any herbicide onto native plants, or they will also be killed. Foliar spraying is best suited to large areas of grass or low-growing weeds. Always follow the manufacturers recommended applications rate(s).

Alternatively, a cut-stump or basal bark treatment can be used on plants which do not have foliage that can be treated by foliar spraying (e.g. vines and trees). Cut stump involves making a cut into the plant's trunk or stem and painting the wound with herbicide so it is taken into the plant's system. It is an ideal way to kill woody plants such as African tulip, traveller's palm and blue thunbergia. Always follow the manufacturers recommended applications rate(s).

7.2 Mulch

Cutting or pulling weeds followed by heavy mulching is a technique well suited for use in smaller areas. Mulch can be hay, paper, cardboard or any organic product. Placing thick layers of mulch controls weeds and builds organic content in the soil surface. This is an ideal way to protect eroding slopes from erosion until vegetation is able to effectively capture a site.

7.3 Bradley Method

This technique involves hand pulling or cutting of weeds and allowing natural vegetation to recover a site. It is best suited to smaller areas, and involves leaving all plant material on site except weed seeds and plant parts that may vegetatively establish. It requires a relatively intact canopy and well established native vegetation that

is able to reclaim and cover areas that were once weed infested. The method does not work well when the surrounding area is densely infested with weeds, because these tend to re-invade treated areas.

7.4 Polyethylene Plastic Sheeting (Visqueen)

This product has been used to control a number of weeds, both grasses and broad-leaf plants, across a range of locations. It is especially suited to lower-growing weeds in small areas, but it can be adapted to larger sites with modification. Because the plastic is black and impermeable it blocks light and rainfall when laid onto any ground surface, and significantly increases soil surface temperatures. Over a sufficient period of time these features are often sufficient to kill the rootstock and surface seeds.

Whilst many plants have long lived seeds, drought-resistant tubers or other survival mechanisms that allow them to re-sprout, visqueen is nevertheless an effective way to wrest control of some weeds before they are able to spread to other parts of a property/area. It has been successfully used in north Queensland to eliminate small outbreaks of particular weeds in areas that are only occasionally visited and where other approaches are unsuitable.

Once visqueen has been removed, management should focus on ensuring areas of resulting bare soil are covered by organic material and/or re-planted with appropriate vegetation.

7.5 Weeds in Restored Areas

In the publication 'Repairing the Rainforest', the distinction is made between controlling weeds in and adjacent to standing forest, and weed control within re-planted, or restored areas.

> ***In the context of rainforest restoration, weeds are a problem in two distinct phases. The first phase relates to weeds which are present at the restoration site prior to planting and require control as an important part of the site preparation process. Before any restoration plantings are undertaken the existing weed cover should be eliminated as thoroughly as is practicable to ensure planted seedlings are established free of weed competition. The second phase relates to weeds which colonise the site after a site has been planted. Because the environmental conditions on the site change from full-sun to semi-shaded, the second phase weeds are invariably different to those present on the site prior to the restoration planting. Grasses will not be as dominant, although they will persist in those areas receiving more sunlight. Forbs, herbs and fleshy-fruited vines become more common because of the modified microclimate and the dispersal of these plants into the site, as birds begin to make use of the new opportunities presented by the developing habitat.***
>
> *(Source: Repairing the Rainforest 2nd Edition (Goosem and Tucker 2013) page92)*

Depending on the size of the re-planted area, herbicide, mulching, or the Bradley method can be utilised to undertake follow-up weed control. Whichever method is used, Priority 1 weeds (see below) should always be the first species to be controlled. These are the species which will have the most negative effect on habitat, and will generally require eradication before moving to the next step in the restoration process.

8.0 Habitat Restoration

Over the years, many individuals and organisations have contributed to a body of knowledge on the practice of restoring north Queensland ecosystems. As a result, there are many sources of knowledge and assistance from different levels of government and the community and commercial sectors. Landholders are encouraged to use all these resources and should consult Terrain NRM in the first instance.

Restoration is both a knowledge and practice-based undertaking that uses science and other forms of knowledge along with lessons learned from practical experience. This process can be active (e.g. the reintroduction of species through planting) or passive (e.g. reducing pressures and allowing or assisting natural recovery).

8.1 Passive Restoration

Natural regeneration can be an effective means to recover an area. The method is best applied where there is significant habitat present and few/no Priority 1 weeds close by. Priority 1 weeds should be controlled, and providing this is done effectively, natural recovery takes place through the process of native seed dispersal, germination and establishment. A modified form of this technique is termed 'accelerated natural regeneration', also known as 'spray and release'.

8.2 Spray and Release

In areas where native forest remains in place, seed rain from the adjacent forest provides regular inputs of new material. Much of the regeneration resulting from these inputs is unable to germinate because of weed competition. Once weed competition is reduced, the capacity of natural regeneration to reclaim areas will be greatly enhanced. The ability of natural regeneration to reclaim large areas can be even further enhanced by selective herbicide application around existing stems to speed their growth and stimulate germination of broad-leaf species in the soil seed bank.

The soil seed bank is likely to contain very large numbers of long-lived seeds from species such as Sarsaparilla (*Alphitonia* spp) and Wattle (*Acacia* spp). Exotic grasses such as Guinea Grass suppress the germination of most broad leaf species, thus grass control is an effective way to release these species from this competition and hasten site capture. A non-residual glyphosate preparation would be applied around the base of all established (e.g. >1m) regrowth, approximately one metre around the base of most stems. Rates of growth and site capture can be further enhanced by the application of fertiliser at the base of each stem post herbicide control.

In most cases herbicide control is required once or twice only, and broad leaf weeds would only be controlled where their presence was suppressing natural recovery processes. For spray and release tasks a non-residual glyphosate only will be sufficient to achieve control. Spraying should be done carefully to ensure that there is minimal damage to desirable vegetation.

This method is an ideal way to improve the large areas of forest edge that exist throughout the area, and to improve the habitat value of patches that support Priority 1 weeds. It is a very cost effective approach, with spray and release costs generally around $10-$20/m, although this may vary significantly depending on terrain and the type of weeds present.

8.3 Active Restoration

Active restoration involves planting trees and shrubs to hasten the recovery process. This method requires significantly more resources to prepare, plant and maintain the site, but planting seedlings can speed the forest recovery process by up to three decades. In the study area, it should be possible to achieve a closed canopy which resists weed germination within 18-24 months.

As noted, there are many resources available to landholders undertaking habitat management works. This includes reference material on weeds and their control, and the restoration process.

Active restoration is significantly more costly, because it is a highly interventionist technique. Be prepared to spend between $20,000-$40,000/ha, depending on terrain and the type of weeds present. These costs can be significantly reduced by landholders committing to one or more portions of the Prepare, Plant, or Maintain stages.

8.4 Habitat Diversity and Restoration

The study area contains a number of different habitat types. Each of these habitats displays different reactions to disturbance, and will require different approaches to restoration. As noted, Melaleuca forests allow more light to penetrate the forest floor, so these forests usually carry higher weed loads than rainforests.

Some habitats (e.g., vine forests of the beach-front) have been subjected to intense human disturbance over many years. These naturally rare habitats are confined to beachfront zones, and are unable to establish in other sites. They are very susceptible to weed invasion, trampling and climate change. Beach-front habitats are also important movement corridors, often being the only vegetation that remains as adjacent forests are cleared for human settlement and recreation. As noted, all rainforest on coastal sand deposits and immediately adjacent to the foreshore is likely to be classed as Littoral Rainforest, affording them a higher level of statutory protection. For these reasons, residents in the study area are encouraged to consider actions that may assist in stabilising the future of such littoral vine forests.

The littoral vine forests of Garners Beach are an example of the effects of weed invasion, trampling, and inconsistent road verge management. However, there remains the basis of a functional ecosystem in place. Reducing threats at this site would greatly improve its functionality and scenic amenity. Spray and Release or hand-pulling weeds would allow native species to reclaim much of the site. Preventing vehicle access would reduce soil compaction and improve porosity. More judicious road verge management should encourage natural regeneration by adopting a careful spray and release strategy to control grasses, rather than use of slashers in an area where vehicle speed is naturally low and slashing verges is less necessary.

There are other beach-front habitats in the study area which support alternative vegetation communities. At Brookes Beach there are sclerophyll species present, forming groups of plants (communities) that are different to the surrounding vegetation. The sclerophyll plant communities of Brookes Beach are invaded by Singapore daisy which has spread from adjacent cleared areas. It is important to recognise these different communities exist and to ensure they remain functional in the face of invasion by species such as Singapore daisy. Functionality depends largely on weed control, encouraging natural regeneration, and ensuring weeds do not reinvade.

8.5 Eco-unit Categorisation for Management Recommendations (Results)

Using a combination of on-ground survey, analysis of spatial vegetation data and high resolution aerial imagery, 85 individual polygons or ‘eco-units’ were identified/created. These were individually assessed and management recommendations were assigned. Based on this analysis, forty-one eco-units do not require remedial action.

Forty-four eco-units require management action with twenty-eight of those deemed a priority (Level 1 actions depicted in Map 9). Additionally, five treatment methods are assigned: Spray & Release (margin or whole unit), Restoration and Spray & Release combined with Restoration (margin or whole unit). A detailed overview is presented in APPENDIX 2.

8.6 Encouraging Co-operative Restoration (Action Focus Areas)

From the prioritisation process of the individual eco-units several clusters became apparent that resulted in grouping those units into action focus areas where a cooperative management approach would be particularly effective.

Action Focus Areas:

Public Land

- Public land at Muff Creek (Units 1-4);
- Individual public land parcels (Units 13, 14 (Holt Rd) & 36 (Cedar Ck));
- Littoral vine forest protection on public land (Units 12 & 27);

Freehold Land

- Cedar Creek (Units 5-11 including the lower priority Units 28,29 and 32-35);
- Holt Road (Units 15-25) and
- Tanah Kita Property (Unit 26)

There are three sites where co-operation between landholders would achieve gains that are significant to the entire study area (see Map 9). At each site there are opportunities to; reinforce habitat connectivity for cassowaries in particular, protect different habitat types, and reduce overall weed cover. These sites are Cedar Creek, Muff Creek and Holt Road. They are important in maintaining vegetation continuity between the study area and forest blocks to the west and north-west. Whilst habitats remain connected they are more likely to maintain stable wildlife populations, giving wildlife access to seasonal resources and the ability to re-colonise vacant sites.

Cedar Creek

> ***"In the less developed areas west of Bingil Bay, quality cassowary habitat exists within riparian forests and in remnant wetlands and these are vegetation and landforms that are essential in maintaining cassowary populations." Source: Biotropica (2005)***

Since 2005 there has been a loss of forest cover in this area, however Cedar Creek and its tributaries contain water resources and forest cover that are very important elements of a cassowary habitat network. Along with Stony Creek, this system is important in maintaining habitat connectivity between the study area and habitats to the south and west. Any habitat works in this catchment will be of great benefit in what is a highly fragmented portion of the study area.

Control of pond apple and Siam weed are the most urgent tasks in this catchment. Failure to control these weeds in this area will result in long term habitat decline that compromises the entire study area. The Cedar Creek crossing over Bingil Bay Road has been a historical cassowary crossing point, and the site should be considered for significant restoration given its ecological importance. There is scope for the Cassowary Coast Regional Council, Ergon Energy Corp, NRM bodies, landholders and community organisations to become involved in such a crossing.

Muff Creek

> ***"The Muff Creek catchment is dominated by wetland vegetation (Melaleuca spp) with a mesophyll influence where drainage is improved, and mangroves where there is a tidal influence. There has been very little intrusion from powerline clearing, and the main access off Bingil Bay Road at its north westerly fringe (Midgeree Bar Road) is a quiet, low traffic road. Birds are currently able to use the riparian strips of Cedar, Stony and Muff Creek's to move through the area avoiding the developed areas of Bingil Bay. There has been some restoration work along Muff Creek by the Cardwell Shire Revegetation Unit." Source: Biotropica (2005)***

Muff Creek provides links for wildlife movement through the northern portion of the study area. Existing vegetation also protects water quality within this watercourse which affects marine species in the adjacent tidal and intertidal areas. Where tributaries of Muff Creek cross Garners Beach Road and Bingil Bay Road they should be considered for remedial works. Siam weed control is an urgent task. Protecting forests on the western slopes of Holt Road and at the western end of Garners Beach are key restoration actions.

Holt Road

The forests surrounding Holt Road are fragmented, with notable invasions by shade-loving weeds including Singapore daisy and Spanish shawl, and large areas of Guinea grass. These forests also form part of the Muff Creek catchment, and assist in maintaining the quality of water entering the adjacent marine ecosystems. Whilst mangroves are an important component of this filtering process, an effort to improve water quality higher in the catchment will increase overall habitat quality. At the Brookes Beach end of Holt Road, invasion by Singapore daisy into the beachside forests poses a risk to what is a limited area of sclerophyll vegetation within the study area.

9.0 Landholder Incentives

The community consultation process indicated there are a number of incentives which landholders wish to access to increase the level of habitat management on their properties. The main incentives which respondents nominated were as follows;

- Financial assistance for herbicide and restoration works
- Training programs in weed identification and control
- Technical advice and assistance relating to habitat restoration
- Rate concessions for habitat retention and restoration
- Preparation of Habitat Management Plans to guide habitat management

As noted, there are parts of the study area where co-operative efforts between NRM bodies such as Terrain, all levels of government, and landholders would achieve significant gains for biodiversity. The incentives noted above would all assist in further securing these gains. It would be important to ensure these gains are catalytic in generating outcomes that include land covenants and other protection mechanisms. As a precursor however, the forms of incentive assistance noted above are considered realistic and achievable expectations.

9.1 Protective Property Agreements

There are several avenues available to landholders that are interested in progressing the protection of environmental values of their property to officially recognised/statutory levels through protective property agreements. Some offer financial incentives if the landholder formalises and officially documents (i.e. registers) his/her long-term commitment to the protection of their property against environmental degradation with authorities. Some categories are listed below and existing arrangements in the study area are depicted in Map 5:

- Property Title Conservation Covenant (DCDB)
- Registered Nature Refuge
- Council-negotiated Consent Agreement
- Council Voluntary Conservation Agreement

9.2 Habitat Management Plans (HMP) to assist landholders with identification and conservation of environmental values of their property.

A HMP can provide detailed property-specific information on: Ecological context (functional role in the landscape), vegetation types present, threatened species ID, weed ID, priority areas for management and/or improvement and advice on methods to achieve this.

A local example: Tanah Kita

The Tanah Kita property (Unit 26, Map 9) provides important north-south habitat connectivity between North Bingil Bay and the extensive forests to the south within Djiru N.P. It also provides a freshwater resource (Koombooloo Ck) running east-west through the property. Virtually the entire property is mapped as Essential Habitat (V3.1 DERM 2011; refer Map 3), and has High Ecological Significance (Areas of Ecological Significance DERM 2012) with about a third of the property is classed as being an Of Concern Regional Ecosystem. The property has had a Habitat Management Plan produced which confirms the presence of threatened species (e.g. Arenga Palm and Water Vine), areas for improved weed management and priority rehabilitation areas which were clearly identified and presented in maps.

9.3 Habitat Conservation Support Schemes for Landholders

Landholders who are interested in habitat conservation should be aware that there are established schemes/organisations that provide incentives and resources for this activity. A number of incentives could be provided to enhance landholder interest in habitat conservation. Incentives may include technical information and resources to improve habitat management outcomes, financial assistance to purchase plants or hire contractors, and/or direct supply of consumables such as herbicide, or fencing materials.

During ground survey landholders expressed a range of views regarding what they valued as incentives. More independent landholders were interested in better access to information on habitat management, principally information relating to weeds identification and control. Other landholders expressed an interest in technical information that can be passed onto contractors, and others were interested in accessing grant funds that could be used for habitat restoration works.

Landholders should be encouraged to apply for funding to undertake restoration projects, and be aware of the co-operative efforts which are supported by natural resource management agencies.

9.4 Assistance and Obligations - Terrain's post-HIP habitat maintenance guideline

If landholders commit a part of their lands to a Terrain Habitat Investment Property (HIP) Project they can expect to receive appropriate financial and technical assistance, but landholders are also expected to commit to a maintenance standard or guideline. Given that grant monies are designed to provide for community investment, this is a reasonable expectation and a logical way to secure public investment in private land works.

The guideline details a wide range of issues including;

- Project description
- Works completed
- Future works required
- Techniques for managing project environmental issues
- Long-term site protection and monitoring
- Financial incentives and responsibilities

Landholders considering co-operative efforts with Terrain NRM should familiarise themselves with Terrain's post-HIP habitat maintenance guideline.

10.0 Recommendations

All levels of government and NRM agencies should consider committing to providing strategic and on-ground support for littoral vine forest protection, throughout the study area.

Cassowary Coast Regional Council and Qld Parks and Wildlife Service should consider committing to more regular maintenance and protective effort for littoral vine forest and margins, along the Garners Beach foreshore.

Cassowary Coast Regional Council, Wet Tropics Management Authority, and Terrain NRM should consider committing to purchase three to four 200l electric spray units to loan out for landholder weed control initiatives.

Cassowary Coast Regional Council should consider committing to a road verge management plan to better manage margin weeds, in particular Guinea grass and Singapore daisy in the Garners Beach and Brookes Beach areas.

Ergon Energy Corp should consider committing to a more strategic approach to vegetation maintenance in the entire study area, supporting works that are consistent with line safety clearances and Cassowary Coast Regional Council road verges management.

Far North Queensland Regional Organisation of Councils should consider committing to a review of the nominated Priority 1 weeds in this document and consider adding selected species to its existing lists.

Training is required for landholders in weed identification and control. Terrain NRM could consider developing targeted workshops and training for landholders to improve these skills.

Landholders should take greater responsibility for weed control across the study area once they are provided with better weed identification and control training, and have access to control equipment that is appropriate for the task.

Terrain NRM should engage with landholders whose properties have been nominated as Level 1 Action sites, and landholders with properties in the Cedar Creek, Muff Creek and Holt Road areas.

Landholders should consider an informal group to initiate cross-boundary efforts in the Cedar Creek, Muff Creek and Holt Road areas where significant gains can be made for the study area and its relationship to the surrounding terrestrial and marine environments.