

# Wongaling Creek Habitat Linkages

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## Executive Summary

This report examines the location and quality of habitat linkages for cassowary movement in the Wongaling Creek area of far north Queensland, and specifically the linkages and connectivity gaps between the main blocks of State land in the Wongaling area.

The report summarises fragmentation and linkage concepts particularly in relation to cassowaries, and discusses the issues surrounding habitat linkage design and restoration. Whilst the linkage proposals are designed specifically for cassowaries, the report notes that all native species would be expected to benefit from a secure habitat network in this biologically diverse area.

Based on desktop and on-ground survey, six habitat linkages are described, comprising four primary linkages and two secondary linkages. Primary linkages are seen as critical to the safe traversal of cassowaries between State land habitats, and secondary linkages provide movement within, as opposed to between, habitat blocks. These linkages are described as follows:

Habitat Linkage 1: Clump Mountain National Park to Marcs Park (2 sections)

Habitat Linkage 2: Marcs Park to Reserve 214

Habitat Linkage 3: Marcs Park through Oasis development

Habitat Linkage 4: Sartori Resort to Reserve 214

Habitat Linkage 5: Reserve 214 to Tam O'Shanter National Park (north section)

Habitat Linkage 6: Reserve 214 to Tam O'Shanter National Park via Lot 802 SP110366

Other linkages exist however these are not formally described. Although they are not detailed they do form part of a habitat network. Generally however their more tenuous nature, and the need to commit genuine resources to more urgent works, precludes these small outliers from this report.

**Linkage 1** is a primary linkage comprising two sections and encompassing a number of privately owned properties. The linkage consists of high value mesophyll vine forest habitats between Clump Mt. National Park, and the riparian forests of Wongaling Creek at the rear of Marcs Park. A connectivity gap exists where the linkage crosses the El Arish-Mission Beach Road. Management actions required include weed control and restoration around the connectivity gap and riparian zones, and the provision of incentives for protection of some habitat on private lands.

**Linkage 2** is also a primary linkage consisting of riparian forest, mesophyll vine forest and swamp/wetland communities. Linkage habitat is of high quality and allows cassowaries to move between the Marcs Park fragments and Reserve 214. There are no gaps within this linkage. Incentives for protection are recommended over key parcels of privately owned lands within this linkage.

**Linkage 3** is a secondary linkage allowing an alternative pathway into Reserve 214 from the Marcs Park area. This linkage traverses the proposed Oasis development and features a linear patch of mesophyll vine forest that is protected under covenant. Significant restoration works are required at the connectivity gap in addition to some selective covenants.

**Linkage 4** is another secondary linkage into Reserve 214 from the proposed Sartori Resort development. The linkage traverses a range of tenures and protection incentives are recommended over habitats on some privately owned lands. Restoration is required particularly in the Conch St area where a connectivity gap exists.

**Linkage 5** is a primary linkage between Reserve 214 and the Tam O'Shanter National Park. Significant restoration works are proposed for this linkage, particularly along and adjacent to riparian zones, in conjunction with covenants. Proposed residential development may compromise this linkage and some modifications to the proposal are recommended.

**Linkage 6** is also a primary linkage between Reserve 214 and the Tam O'Shanter National Park, and includes State land set aside for linkage purposes. The linkage includes a variety of habitats but is wholly dependent on privately owned lands to maintain the linkage. Some restoration is suggested but securing linkage habitat on privately owned lands is recommended as a high priority.

It is recommended that all existing linkages be protected, regardless of whether they are formally described within this document.

Significant works are identified at most road crossing points where linkages intersect. It is recommended that close attention is given to the design and management of known crossing points where these intersect with linkage habitats.

## 1 Scope

This document represents work completed by Biotropica Australia on behalf of Terrain NRM, aimed at identifying and enhancing habitat continuity within, and surrounding the Wongaling Creek catchment, at Mission Beach, north Queensland.

The purpose of this report is to;

- Detail the existing Wongaling Creek habitat matrix which includes the forests of the Tam O'Shanter Range, Clump Mountain and two Lots of State land colloquially known as Reserve 214
- Identify the key habitat linkages and connectivity gaps within this matrix, specifically those connecting Reserve 214 to Tam O'Shanter National Park and Clump Mt. National Park focusing on the utility of these linkages to the Southern Cassowary (*Casuarius casuarius johnsonii*)
- Identify opportunities for the long term protection and restoration of linkages, and management of their associated connectivity gaps.

The full scope of the report requested by Terrain NRM is attached as Appendix 1.

## 2 Background

The management of wildlife in fragmented landscapes generally aims to preserve species within ecologically discrete, often isolated areas, which face a range of other human-induced threats. Locally, improving landscape connectivity involves analysis of patch/es distribution, composition and size, the level of ecological connectivity between patches, and the development of plans to enhance ecological connectivity (using a variety of tools). In analysing the elements of ecological connectivity there are two main features that are common in all fragmented landscapes, habitat linkages and connectivity gaps. Both habitat linkages and connectivity gaps are referred to within this document and are defined as below.

Habitat Linkages can be defined as linear networks of habitat which link otherwise isolated patches of structurally similar habitats (commonly known as wildlife corridors in the sense that they provide an avenue for movement). Connectivity gaps are generally the narrowest sections of a linkage, so the impact of edge effects such as weed invasion, mortality from predation or road-kill, and the risk of competitive exclusion and antagonistic encounters are more pronounced. Generally, the management of these two areas requires different approaches. Habitat linkages can be generally managed using either passive or active restoration, whilst connectivity gaps generally require possible land acquisition or protection incentives, ecological restoration, hard and soft engineering, in addition to road user and community education programs.

Habitat continuity is a species specific parameter, and for the purposes of this study, the relevant species is the Mission Beach icon – the endangered Southern Cassowary (*Casuarius casuarius johnsonii*), although the identification of individual birds and their utilisation of existing linkages in the Wongaling area is a major project in itself. For this reason the density of cassowaries in the nominated areas, and their utilisation of the resources in these areas, is not discussed. For the purpose of this report it is assumed that birds are using all of the areas discussed to some degree, including the habitat linkages identified within this report.

### 3 Fragmentation and Linkages

Fragmentation results in a loss of native vegetation, which reduces remaining patch size, and produces a concomitant increase in isolation as distance between patches expands. Non-forested lands in the Wongaling area comprise a patchwork of urban and rural settlements, service corridors (roads, powerlines) agricultural land (tree crops and bananas, sugar cane, grazing lands) and habitat fragments such as paddock trees, fence-line regrowth, gullies, and abandoned old fields. Fragmentation also acts internally in the area, as roads, powerline corridors and tracks bisect larger habitat patches.

The resulting patchwork and a species tolerance of the patchwork is a key indicator of their persistence (Laurance 1997). An un-constricted patchwork allows fauna to exploit a wider range of resources, including in the case of cassowaries isolated feeding trees. Fragment permeability is influenced not only by the quality, size and location of habitat resources, but the additional risks involved in moving between patches. Predators, roads and disease are all additional risks faced by wildlife during movement across open areas, and therefore their persistence within a given territory.

There are a number of features which place cassowaries at greater risk from fragmentation, including their solitary nature. Fragmentation of large territories increases the chances of antagonistic encounters with other birds, potentially leading to stressed social structures. Hand feeding further erodes social structures by encouraging birds to congregate. A clear motive of any long term conservation strategy must be to provide cassowaries with the ability to avoid such encounters by providing additional habitat, alternative pathways, and escape routes.

The potential disruption to seed dispersal caused by the loss and decline of cassowaries is a most commonly cited issue (QPWS 2007). Cassowaries play a key role in ecosystem dynamics, dispersing the fruit of many rain forest plants for which they may be the sole disperser, or playing a crucial role in enhancing germination via gut passage (Webber and Woodrow 2004). If birds are lost from an area, a process of 'habitat simplification' is likely to occur as patches no longer receive inputs of new, particularly large fruited, plant species that were dependant on cassowaries for dispersal.

Habitat linkages promote movement/dispersal of a species between one or more otherwise isolated, though structurally similar/identical habitat patches, and also function as habitat for a sub-set of species whose ecology allows them to establish and maintain a territory in the linkage (Rosenberg *et al* 1997, Tucker 2000). Under scenario one, fauna moves through the linkage which forms part of their territory, and fauna exploit resources or niches. This includes seeds dispersed across the landscape and/or juvenile animals seeking available territory. Under scenario two animals establish overlapping territories, and movement and genetic mixing occurs as a stepwise process. Linkage configurations in the Wongaling area must therefore fulfill both functions and this duality must be implicit in any planning strategy.

### 4 Linkage Design and Utility

Because of the difficulties inherent in re-building rain forest, a clear first principle must be to protect existing habitat linkages. For this reason, reducing the size of existing linkages by allowing clearing of existing vegetation should be avoided at all costs. Existing linkages are less costly to establish and maintain, and provide a wide array of habitat resources.



In contrast, restoring habitat is expensive and, in the case of restored rain forest ecosystems, its outcomes are uncertain for decades. Restoring linkage habitat requires significant pre-planning to identify factors including location and dimensions, target species requirements, potential for increased exposure to human influence (domestic animal attack or disease, roads, hand feeding), potential weed spread, and linkage restoration cost (Tucker 2000). Constructing linkages that lead to nowhere, provide minimal resources, and expose native species to further stress must be avoided.

A linear shaped linkage with fewer connectivity gaps, whilst having a greater edge to area ratio, provides a direct path and line-of-sight for most terrestrial fauna. Configurations such as corners forcing fauna to realign are likely to be more stressful and less effective. For this reason, a whole-of-catchment approach should be adopted where there is a greater chance of integrating habitat linkages across property boundaries. Linkages would encompass all existing habitat and as few as possible connectivity gaps such as roads. Where roads must be crossed, design of crossing points must be carefully considered. Pipes, culverts and bridges, with appropriate fencing and funneling provide the most logical means of facilitating safe traverse, where these are of appropriate dimensions, despite the paucity of empirical data supporting the effectiveness of these structures. If a continuous linear feature is not possible, a series of smaller patches could be considered. These should be circular or square shapes with a reduced edge to area ratio.

There is no optimum restored linkage width, simply because what may fit on one part of the landscape is unlikely to be appropriate at other sites. Moreover, most land managers are greatly constrained by site availability for re-planting in areas where land values are at a premium, and appropriate configurations are almost impossible to achieve. As noted above, the revitalisation of isolated fragments requires that the maximum value is obtained over the smallest areas, and strategies such as riparian restoration with high value food plants are clearly the key to ensuring that even narrow habitat strips contain viable habitat resources. However, although a wider linkage should be preferred over a narrow configuration, restored linkages of 50 metres should provide the minimum desirable width along a riparian zone, but in other areas minimum widths of 100 metres may be required. Laurance and Gascon (1997) have suggested that linkage width should be 10% of length, but this figure relates more directly to retention of habitat where adjacent large scale deforestation is planned.

The utility of a linkage network to other species in the Mission Beach area is outside the scope of this report, because what constitutes habitat continuity for cassowaries will not provide the same level of continuity required by other rain forest species. A sub-set of rain forest species are unlikely to use existing linkages less than 100 metres wide, and where urban areas are close by, an effective linkage for all local species may have to be as wide as 400 metres. However, many other rain forest species will use linkages which are designed primarily for cassowaries, simply because the quality of resources available is sufficient to sustain many other vertebrate and invertebrate species.

It must also be accepted that cassowaries are known to cross areas of cleared open country to access favoured food plants. Whilst this occurs, it is outside the scope of this document to assess and document the value or likelihood of open area paths to isolated trees or small patches. To encourage this form of movement places cassowaries at greater risk of predators, and in particular chicks and juvenile cassowaries are potentially at far greater risk in open areas with little or no cover.

## 5 Site Descriptions

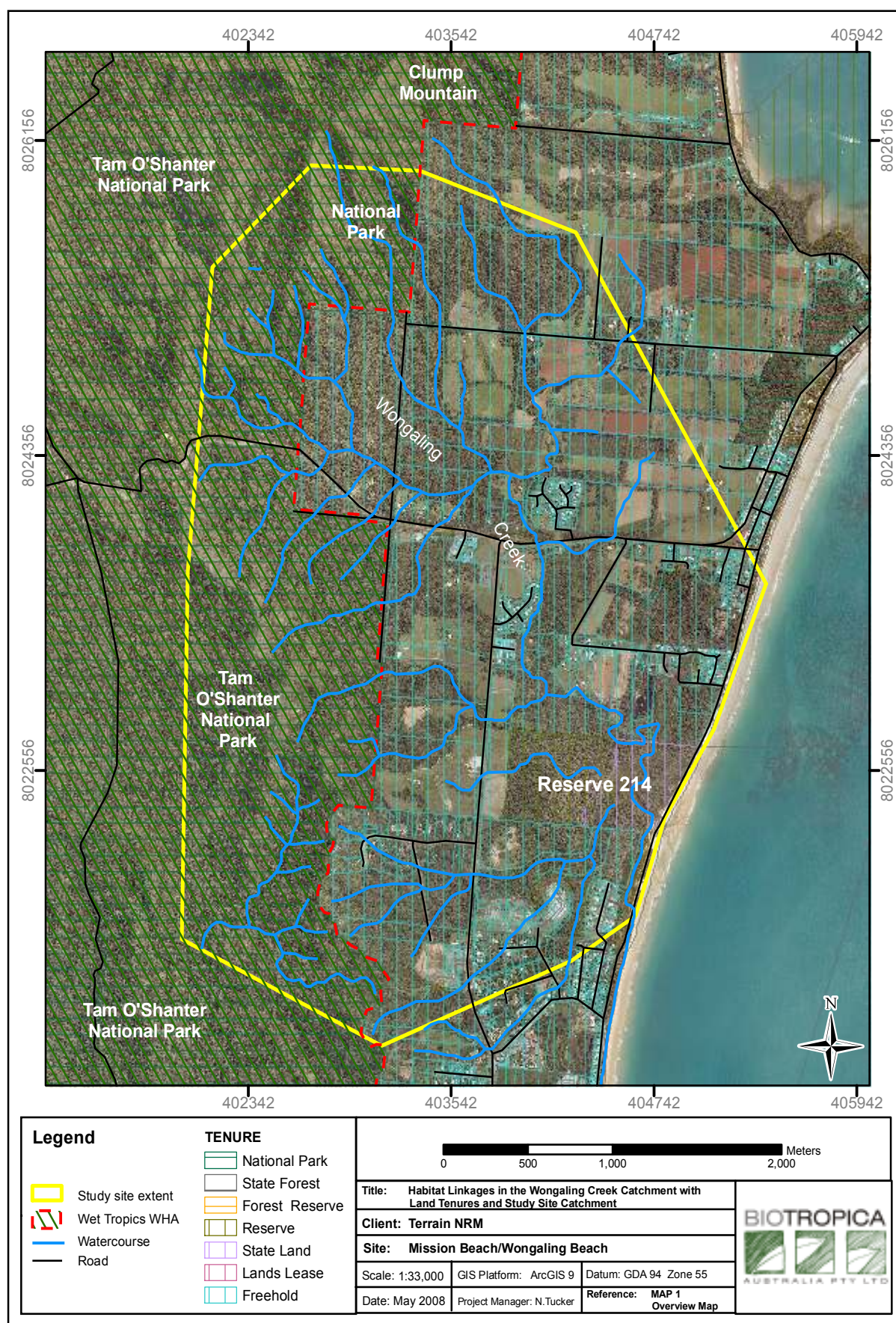
Wongaling Creek is a perennial stream arising from the mesophyll vine forests on the southern slopes of Tam O'Shanter National Park and Clump Mountain National Park. The stream is joined by a number of small tributaries and flows through a vegetation and development mosaic before terminating into the Coral Sea off Wongaling Beach. The vegetation surrounding the headwaters of the stream, and the forests at its termination, are in a condition which generally reflects natural disturbance only. Intervening lands are a mixture of degraded and fragmented natural vegetation, exotic vegetation and human settlement (see Maps 1-3).

The study area contains the eastern portion the forest fragment represented by the Tam O'Shanter National Park and Clump Mountain National Park, both contained within the Wet Tropics World Heritage Area. This is the largest habitat block within the Wongaling Creek catchment and is poorly connected through cleared lands, roads and intensive settlement to the second-largest block represented by Reserve 214 (comprising Lot 634 CWL3519 and Lot 109 CWL3519) to the south-east.

The 51 hectare Reserve 214 is located between the Tully Mission Beach Road and Wongaling Beach, and is also connected to the Tam O'Shanter National Park to the west via a series of small habitat linkages that are restricted primarily to drainage lines. Reserve 214 is poorly connected by the strand and littoral vegetation to the beach vegetation fringing Bingil Bay, Wongaling, Mission and South Mission Beaches. These linkages are a mosaic compromised of agricultural and residential development.



Figure 1: **MAP 1** - Overview Map (Land Tenure and Study Site Catchment)



## 6 Flora

Natural vegetation through the Wongaling area is comprised of a number of Regional Ecosystems, with distribution reflecting changes in soil and drainage. The dominant vegetation type on the slopes and foothills of the upper catchment is classified as regional ecosystem 7.12.1a (Mesophyll to notophyll vine forest of the very wet and wet lowlands and foothills – Not of Concern). The north-eastern portion of the Wongaling Creek catchment also includes patches of Regional Ecosystem 7.8.1 (Complex mesophyll vine forest of the very wet and wet lowlands and foothills, on krasnozems soils derived from basalts and basic volcanic parent material – Not of Concern).

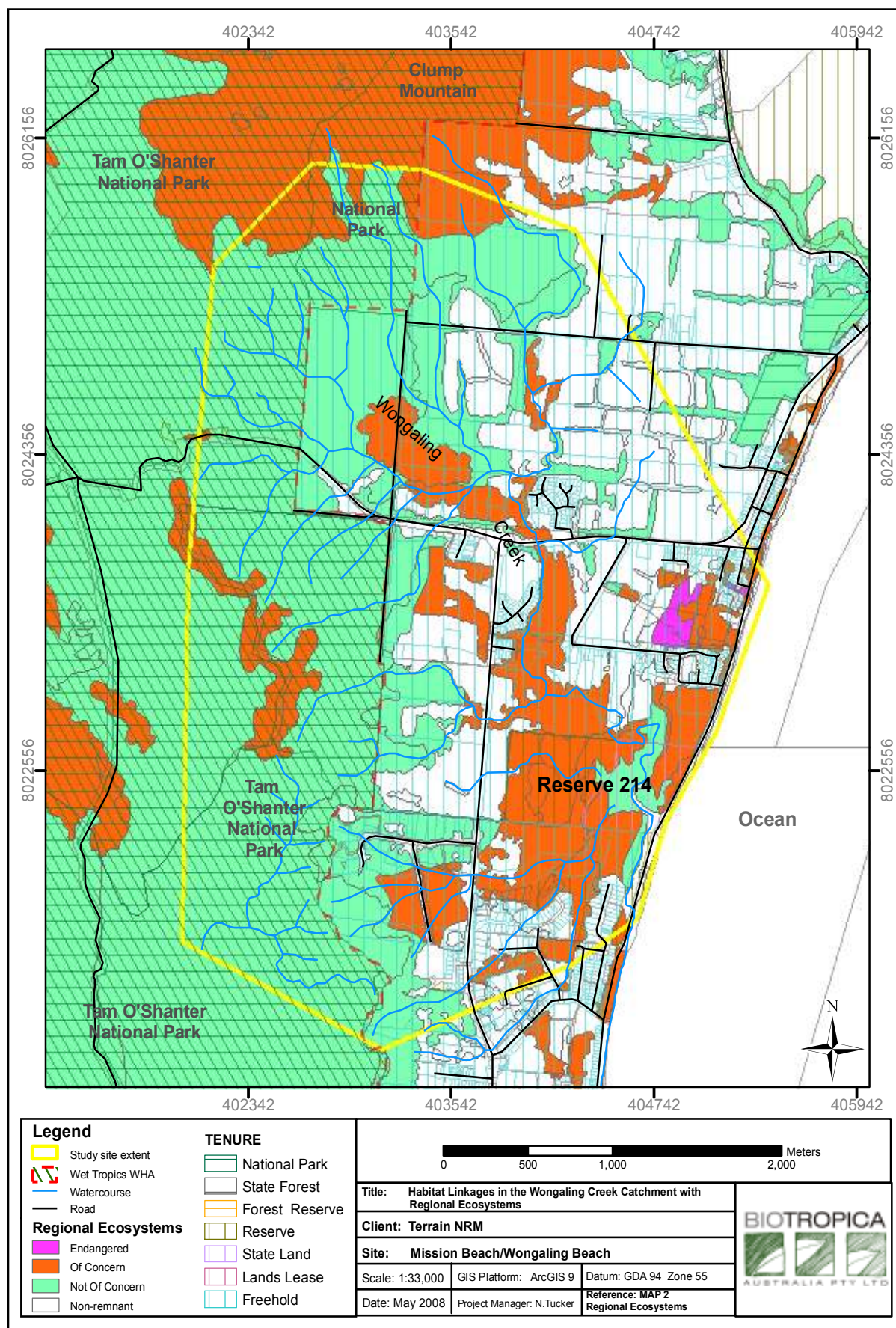
The lower sections of the area are characterised by Regional Ecosystems 7.3.3a (Mesophyll vine forest with feather palm (*Archontophoenix alexandrae*) on very wet lowland swamps on gleyed podzolic alluvial soils derived from basaltic and granitic parent material – Of Concern), and 7.3.10 (Simple-complex mesophyll to notophyll vine forest on moderately to poorly-drained alluvial plains of moderate fertility – Of Concern).

In addition to mesophyll/notophyll vine forests, there are sclerophyll dominated systems including 7.2.3c (*Corymbia tessellaris* and *Corymbia clarksoniana* [or *C. intermedia*], woodland or open forest, with a very well developed vine forest understorey, occurring on beach ridges, predominantly of Holocene age – Endangered), and 7.2.8 (Narrow-leaf Paperbark [*Melaleuca leucadendra*] open forest to woodland on sands of beach origin – Endangered). These forests are flanked by significantly diverse mangroves (7.1.1 – Not of Concern), and by wetlands, both of which are protected under the Fisheries Act 1994 (Qld). A full list of Regional Ecosystems within the area is detailed in Chenoweth (2007).

Much of the diversity within the study area is concentrated within Reserve 214 (Lot 109 CWL 3519 - 28.4ha and CWL 3519 Lot 634 [USL] - 22.8ha), a 51ha fragment of forest which survived the clearing process, probably due to its poorly drained nature and unsuitability for residential or agricultural development. The reserve contains at least eight Regional Ecosystems and mosaics, supporting an array of microhabitats and their associated resources (see Map 2 next page).



Figure 2: **MAP 2** - Overview Map (Regional Ecosystems)



## 7 Weeds

Exotic species are present in all areas with the exception of core habitats within Tam O'Shanter National Park and Clump Mt. National Park. Species such as Siam Weed (*Chromolaena odorata*) which is known from the area, require immediate control to ensure they do not degrade linkage habitats, whilst ubiquitous species such as Guinea Grass require control as resources become available. Apart from clearing, weed invasion poses the most immediate threat to linkage habitat.

## 8 Cultural Significance

The diversity of topography and the resources it provides are of significant cultural importance to the Djiru people. Close cultural association with the area is maintained by this group, principally through their stewardship of the Clump Mountain Aboriginal Camp adjacent to Clump Mountain National Park. This facility also forms an integral part of the Wongaling Creek catchment and as such plays an important role in the conservation of species associated with the catchment.

The retention and enhancement of native vegetation will also contribute to the scenic amenity of the area, providing a more aesthetically appealing landscape for both residents and tourists. This is an important consideration given the increasing levels of urban development and the key role played by tourism in the local economy. The tourism value of the cassowary is implicit in this economic value.

## 9 Legislative and Policy Instruments

To protect the significant biological and cultural resources of the Wongaling area, a number of Local, State and Commonwealth regulations are in place. Moreover, Terrain NRM, CSIRO and the Reef and Rainforest Research Centre are currently collaborating on a project examining the effects of land-use and population growth in the Mission Beach area. Findings from this study, along with other projects currently underway, will provide additional information on threats and opportunities relevant to the management of habitat linkages and connectivity gaps in the area. Table 1 below lists the planning instruments relevant to the protection of Wongaling's natural values, including biological, aesthetic and cultural values. This table includes elements of the Planning Schemes for the former Cardwell and Johnstone Shires, which now encompass the Cassowary Coast Regional Council.

**Table 1: Relevant Legislative and Policy Instruments – Wongaling Beach Area**

Planning Instrument	Comment
Cardwell Shire Council (CSC) Planning Scheme (2005 - with amendments 2007)	Determines specific outcomes for former CSC precincts within the Wongaling area and includes habitat linkage proposals
Johnstone Shire Council (JSC) Planning Scheme and Natural Areas Plan (2005)	Determines specific outcomes for former JSC precincts within the Wongaling area, and includes habitat linkage proposals
Wet Tropical Coast Regional Coastal Management Plan (WTC-RCMP) (2005)	Details coastal resources, their values and desired (management) outcomes

Cardwell Hinchinbrook Regional Coastal Management Plan (2005)	Details 'Key Coastal Sites' within the WTC-RCMP
FNQ 2025 Regional Plan (Draft) (2008)	Specifies development and conservation objectives and spatial zoning to achieve these objectives
Wet Tropics Regional Plan for Natural Resource Management 2004-2008 (2004)	Details Natural Resource Management objectives and measurable outcomes for north Qld developed by the Regional body and the Rainforest CRC
Nature Conservation Act (1992) (Qld)	Provides for protection of all native plants and animals in the State of Queensland
Environment Protection and Biodiversity Conservation Act (1999; Commonwealth)	Provides for protection of species on Commonwealth schedules, and species and communities within the Wet Tropics World Heritage Area
Wet Tropics Management Plan (1998) (Qld)	Specifies conservation objectives, and zoning plans to achieve these objectives, within the Wet Tropics World Heritage Area [containing sections of the Wongaling catchment]
Vegetation Management Act (1999) (Qld) (includes a non-legislative biodiversity assessment of each RE provided by the Qld EPA)	Assigns varying levels of protection to native plant communities (Regional Ecosystems) depending on pre and post-European extent
Land Act 1994 (Qld)	Provides frameworks for management and allocation of local State Reserves and Unallocated State lands, including for 'beach protection and coastal management' and for 'environmental purposes'
Fisheries Act 1994 (Qld)	Provides framework for protection of fish habitats including mangroves and wetlands.
Integrated Planning Act 1997 (Qld)	Provides framework for the application and administration of planning on all lands in the State of Queensland
Recovery Plan for the Southern Cassowary (Latch 2007)	Details Recovery Objectives, Performance Criteria and Actions for the period 2007-2012

Key documents in this section include the Cardwell-Hinchinbrook Regional Coastal Management Plan, the FNQ Draft 2025 Regional Plan, and the Planning Schemes for the former Johnstone and Cardwell LGA's. The protection and enhancement of habitat linkages in the Wongaling area is specifically identified within the Cardwell-Hinchinbrook Regional Coastal Management Plan (2005) as follows:

#### Coastal locality 1.1 Wongaling Beach to South Mission Beach

##### *Desired coastal outcomes*

*Future use of the following State Land on the coast conserves the high environmental values and features, including remnant lowland native vegetation and critical habitat for the southern cassowary, and avoids significant impacts on coastal processes, through the implementation of an appropriate management regime:*

- USL Lots 1 and 2 on Plan SP125434
- USL Lot 2 on Plan SP125433
- USL Lots 3, 38 and 39 on Plan USL42219; and
- State Land Lot 634 on Plan CWL3519 (part of Reserve 214)



*Future use of the listed reserves is consistent with their dedicated purpose and includes the community purpose of 'beach protection and coastal management' and 'environmental purposes'. The reserves are properly and effectively managed in accordance with an approved management plan:*

- Reserve Lots 3, 4, 5 and 7 on Plan SP125434; and
- Reserve Lot 109 on Plan CWL3519 (part of Reserve 214)

*The wildlife corridor for southern cassowaries is retained and managed as a major link between the coast at Wongaling Beach and the Walter Hill Range.*

[Source: Cardwell-Hinchinbrook Regional Coastal Management Plan - p100.]

Furthermore, the values of Wongaling Creek and its linkages are recognised within the Wet Tropical Coast Regional Coastal Management Plan, as follows:

#### Coastal locality 1.3: Clump Point

##### *Desired coastal outcomes*

*Remnant areas of complex mesophyll vine forest and associated native vegetation and the Wongaling Creek estuary with its adjoining sclerophyll woodlands and forests are conserved.*

[Source: Wet Tropical Coast Regional Coastal Management Plan p123.]

#### Coastal locality 1.4: Walter Hill

##### *Desired coastal outcomes*

*The vegetation mosaic and wildlife corridors supporting the southern cassowary population and other significant species are maintained and extended where possible, in particular Tam O'Shanter National Park remains connected to the coast.*

*The threats to the southern cassowary by moving vehicles are minimised by giving special consideration to road design and vehicle speed limits in known areas where cassowaries cross roads.*

*The remnant vegetation provides important and critical habitat for the highest concentration of the southern cassowary in Australia. There are high densities of cassowaries of all ages and this locality is one of their main nesting and breeding areas. Refer to Map 3.*

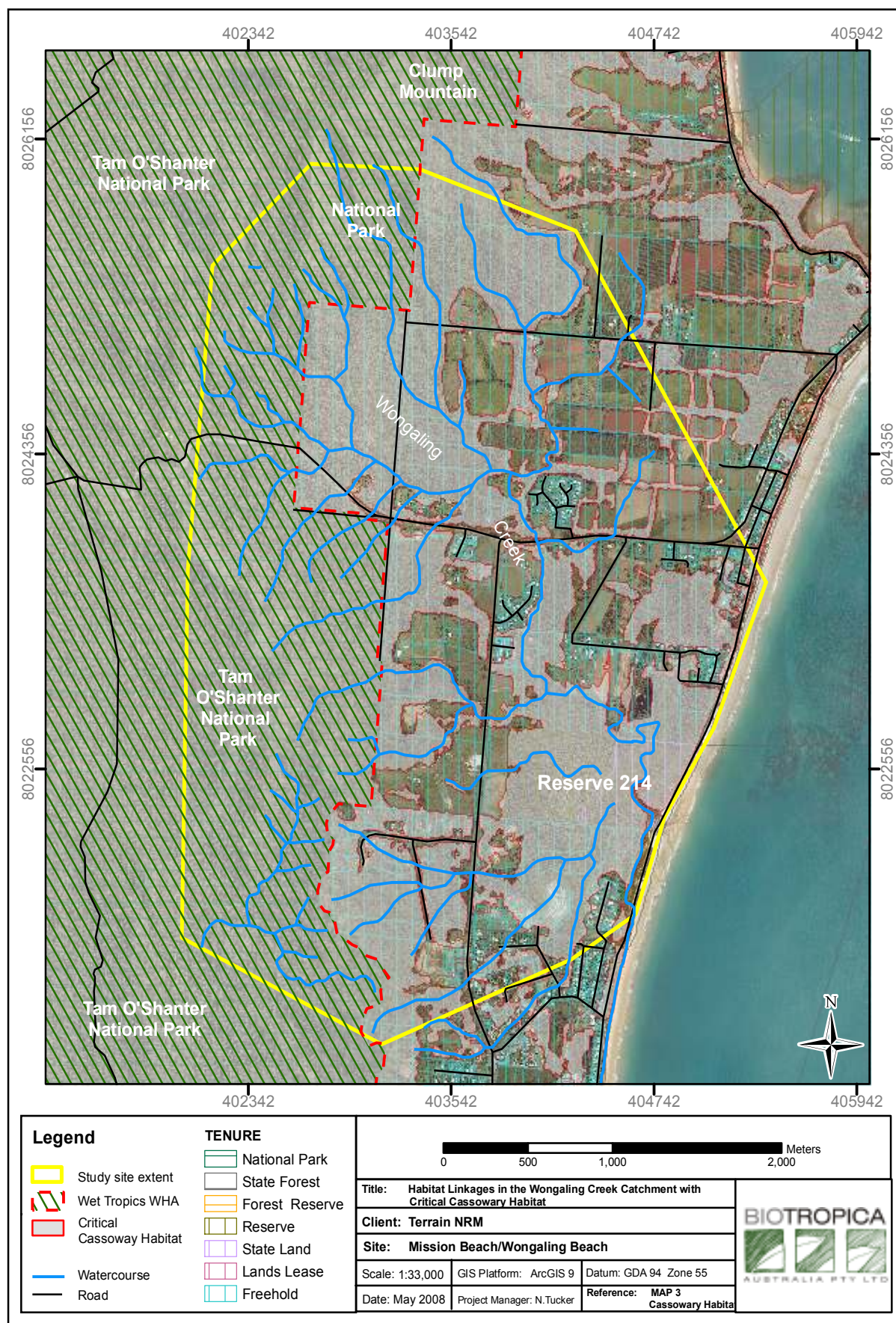
[Source: Wet Tropical Coast Regional Coastal Management Plan p124, 125.]

Other site specific planning detail can be found in other documents including the former Johnstone Shire Council- Natural Areas Plan. Wildlife Crossing Points within the Natural Areas Plan are generally in agreement with the connectivity gaps outlined in the current document.

Each of these legislative and policy instruments is important in some way to the ongoing protection of the significant biological diversity of the area, and all include, to some extent, the aspirations of the human community dwelling within the area. In order for biological processes to be maintained, the local community must be included in the vision inherent in legislative mechanisms, and be aware of the compliance implications of each Act.



Figure 3: **MAP 3** - Overview Map (Critical Cassowary Habitat)



## 10 Linkages of the Wongaling Creek / Reserve 214 Area

Bentrupperbaumer (1992) and Crome (1995) have described the habitat values of the Wongaling area, particularly as they relate to cassowary utilisation. Bentrupperbaumer (1992) estimated a population of five birds using Reserve 214, whilst Crome's (1995) study estimated between three and six birds were using and traversing the same area. Crome's (1995) analysis of scats and footprints indicated at least one sub-adult cassowary was present at Reserve 214. It seems likely that any sub-adults within the Reserve 214 patchwork would use linkages as habitat when 'at foot', and as movement conduits when they are (hopefully) displaced by the following generation. There is no more recent data available, apart from anecdotal records, however the area retains significant habitat diversity that has re-established since the 2006 cyclone, and it is likely that Reserve 214's habitat resources will continue to form part of the permanent cassowary population's territory, providing incremental development pressures do not result in more complete ecological decline.

There are a number of land parcels associated with linkages in the Wongaling area and these are generally identified and protected in Local Government Planning Schemes. These linkages, both existing and potential, have been identified in other Local and State government reports and plans, and their protection on State Lands is, as noted, generally assured. However, the security and function of these linkages through adjacent tenures is required to ensure their full utility. This is imperative given the unprecedented levels of development currently being experienced, and the threats to species persistence that this development represents.

A review of planning information relating to the Wongaling area (refer to Table 1 and References) shows there are a number of areas which have been identified as important for cassowary movement within the area. Other reports (Bentrupperbaumer 1990, Goosem 1992b, Crome 1995, Moore 2001, Biotropica 2005) have also discussed cassowary distribution, threats to persistence and the conservation role of privately owned lands. Based on existing data and on-ground survey, a number of habitat linkages have been identified and/or proposed to enhance ecological connectivity, for cassowaries in particular. The linkages identified in this report are all assumed to be used by cassowaries at some time, based on anecdotal information, road kill data, and sightings of cassowaries provided by stakeholders.

The scope of this report specifically excludes study of the road network in the Wongaling area, although the identification of connectivity gaps along various roads is also, inevitably, a necessity within this document. These points are shown in Maps 4 - 11 and their management should be carefully considered. In most, if not all instances, retro-fitting road infrastructure such as larger culverts or overpasses to suit wildlife is impossible without significant planning, very high cost, and traffic disruption. The effectiveness of these structures also requires further consideration given the paucity of reliable data particularly in relation to cassowaries. Goosem *et al* (2001) demonstrated utilisation of a road underpass on the Atherton Tablelands by a range of rain forest species suggesting these structures can play a positive role. Nevertheless, it is likely that traffic effects will ultimately be the main planning issue to be solved in the context of cassowaries in the Wongaling area. The identification of, and habitat utilisation by, cassowaries in the Wongaling area is also outside the scope of this report. It is assumed that birds are present within the areas nominated. The linkages proposed, whilst useful to many other plants and animals, are expressly required to facilitate the persistence of a local cassowary population.



In most cases the elements of habitat linkage are already present, and what is required is to better manage connectivity gaps along each linkage to enhance their functionality, and to physically expand the area of each linkage. Improved connectivity gap management also involves protection, ecological restoration with/without a significant weed control effort, and assumes that such works will be secured through some form of covenant or protection incentive where they are recommended on privately owned lands.

## 11 Methodology

The identification and documentation of linkages identified in this report has been gleaned from a desktop review of previous reports, stakeholder discussions and on-ground survey. Desktop review showed that a number of linkages have been previously identified by stakeholders within the Wongaling area. Properties forming these linkages were then identified from the latest DCDB, and property vegetation cover was cross-checked against Regional Ecosystem mapping (NRW 2005), 2006 aerial photography (provided by Terrain NRM), and cassowary habitat mapping compiled by the Qld EPA (EPA 2007).

In the context of this report, linkages were considered to be linear, continuous native vegetation which provides existing habitat between Reserve 214 and the more intact (core) habitats represented by Tam O'Shanter National Park and Clump Mt. National Park. Linkage survey included an examination of the level of connectivity within each linkage to determine;

- Spatial extent / configuration (wider, continuous vegetation vs. fragmented patches)
- Degree of legislative protection (habitat protected vs. unprotected)
- Number and location of connectivity gaps (few points vs. many)
- Resource diversity (heterogeneous vs. homogeneous habitats)
- Quality of linkage habitat (intact vegetation vs. disturbed)
- Proximity to high density settlement (distant vs. directly adjacent)

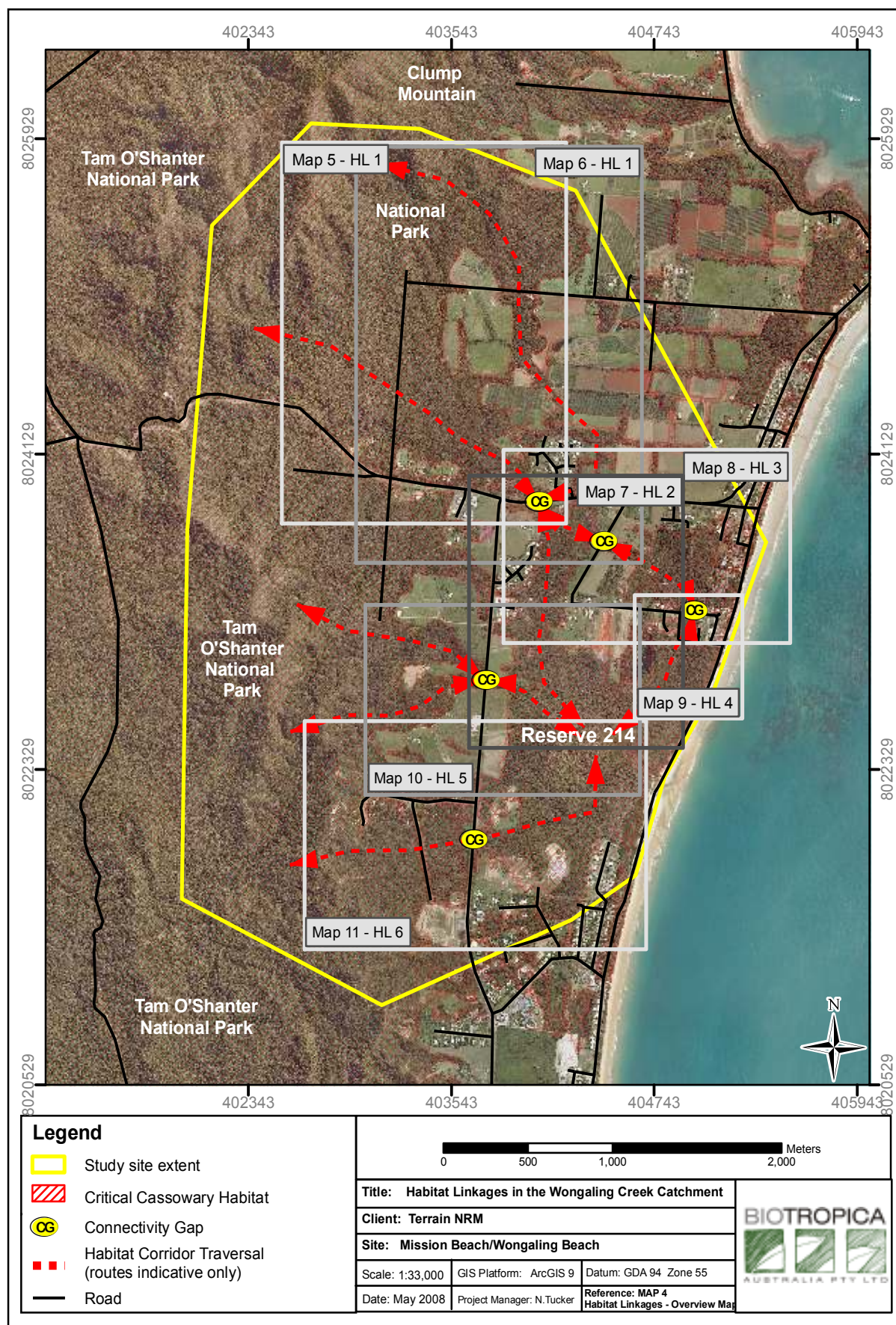
Based on a desktop review six linkages were considered to permit cassowary movement at present and into the future, and two linkages were considered less suitable because of close proximity to intensive settlement, narrow configuration and/or problematic connectivity gaps. On-ground surveys were completed over two days to confirm the desktop review and involved an examination of each linkage from various (gazetted) access points. No formal scoring system was adopted, although based on all the above, the linkages can be assigned an arbitrary ranking for management purposes.

For the purposes of this report a number of primary (4) and secondary (2) habitat linkages, and their connectivity gaps have been identified, and each of these will be discussed separately. Primary linkages are those that are considered critical to maintenance of habitat continuity between Reserve 214 and the Tam O'Shanter and Clump Mt. National Parks (Linkages 1, 2, 5 and 6). Secondary linkages (Linkages 3 and 4) do not provide direct links between State lands, however they provide alternative internal pathways and habitat in their own right and are therefore considered as habitat linkages.

The six linkages described are listed below (refer to Map 4 (next page) for an overview)

- Habitat Linkage 1: Clump Mountain N.P to Marcs Park (2 sections)
- Habitat Linkage 2: Marcs Park to Reserve 214
- Habitat Linkage 3: Marcs Park to Oasis Resort
- Habitat Linkage 4: Oasis Resort to Reserve 214
- Habitat Linkage 5: Reserve 214 to Tam O'Shanter National Park (north section)
- Habitat Linkage 6: Reserve 214 to Tam O'Shanter National Park via Lot 802 SP110366

Figure 4: **MAP 4** - Overview Map (Habitat Linkages)





## 12 Detailed Descriptions of Habitat Linkages

### Habitat Linkage 1: Clump Mountain N.P to Marcs Park via Wongaling Creek

This primary linkage is comprised of two sections, though the easterly section is of considerably less value and is included only in recognition of the habitat resources within small patches of RE 7.8.1 which constitute most of the native vegetation in this section. Width of the linkage varies between 500m and 300m, narrowing to 150m at the connectivity gap, with a total length from State tenure to the El Arish-Mission Beach Road of around 1km. Commencing within Clump Mountain National Park, the linkage includes two main tributaries of Wongaling Creek and encompasses principally mesophyll vine forest communities which appear relatively intact with little weed encroachment. (refer to maps 5 and 6). The western section of the linkage is a key linkage includes a number of privately owned blocks on the northern side of the El Arish Mission Beach Road, some of which contain high quality habitat, whilst others are more degraded.

All properties within this linkage are privately owned lands. Adjacent land-uses are unlikely to place cassowaries at risk, with the exception of dogs wandering from adjacent residences. Fencing is not required to funnel cassowaries through this linkage.

Table 2 below details the properties within the north-western section of this linkage.

**Table 2: Properties forming Linkage 1 - Clump Mountain N.P to Marcs Park via Wongaling Creek (north-western section)**

Lot & Plan	Area	Comment
Lot 6 NR5195 SEGPART 31321143	57ha	Clump Mt. Aboriginal Reserve. Most significant habitat patch outside the WTWHA. Contains high quality habitat and riparian forests.
Lot11 NR3787	34.1ha	Includes two main tributaries of Wongaling Creek and borders Lot 6 NR5195.
Lot 2 RP740214	25.5ha	Significant habitat in the western end of the property and borders Lot 6 NR5195. Riparian vegetation permits entry via the forests north of Boyett Road.
Lot 3 RP740214	30ha	Significant habitat in the western end of the property and borders Lot 6 NR5195. Riparian vegetation permits entry via the forests north of Boyett Road.
Lot 2 RP894601	4.6ha	Contains high quality habitat and one major tributary of Wongaling Creek.
Lot 4 RP894601	1.1ha	Disturbed lands requiring edge effect management – marginal habitat. Zoned future rural residential.
Lot 3 RP894601	1.1ha	Disturbed lands requiring edge effect management – marginal habitat. Zoned future rural residential.
Lot 1 RP800946	1.1ha	Disturbed lands requiring edge effect management – marginal habitat. Zoned future rural residential.

Lot 3 RP746356	4.0ha	Habitat remains along rear of the property, with some riparian elements
Lot 4 RP747504	3.9 ha	Generally high quality habitat with significant riparian vegetation.
Lot 50 SP105605	4.1ha	Disturbed lands requiring edge effect management – marginal habitat
Lot 49 SP105605	1.0ha	Generally high quality habitat, edge affected
Lot 1 RP747216	2.1ha	Generally high quality habitat, edge affected. Riparian restoration underway.
Lot 47 RP800963	3.7ha	Almost entirely cleared – riparian restoration recommended
Lot 48 RP800963	5.6ha	Almost entirely cleared – riparian restoration recommended
Lot 4 SP117176	10.1ha	Almost entirely cleared – riparian restoration recommended

Of these properties the following blocks can be considered the highest value areas, combining fresh water with higher quality vine forest habitat: Lot 6 NR5195, Lot 11 NR3787, Lot 2 RP894601, Lot 3 RP746356, Lot 4 RP747504, Lot 49 SP105605, and Lot1 RP747216. All of these properties should be considered for a higher level of protection incentive.

With the exception of the Clump Mt. Aboriginal Reserve, all properties within Linkage 1 would benefit from selective weed control and revegetation, especially along riparian zones (see Table 3 below). Guinea Grass (*Megathyrsus maximus*) is the main weed to be controlled.

The table below details those properties within the eastern section of this linkage. This section is characterised by small fragments between Boyett Road and the residential subdivision adjacent to Wongaling Creek. Clearing continues in this area adding to its already tenuous nature.

**Table 3: Properties forming Linkage 1 - Clump Mountain N.P to Marcs Park via Wongaling Creek (eastern section)**

Lot & Plan	Area	Comment
Lot 11 NR3787	34.1ha	Includes two main tributaries of Wongaling Creek and borders Lot 6 NR5195.
Lot 2 RP740214	25.5ha	Significant habitat in the western end of the property and borders Lot 6 NR5195. Scope for widening existing riparian cover to provide better linkage function.
Lot 3 RP740214	30ha	Significant habitat in the western end of the property and borders Lot 6 NR5195. Scope for widening existing riparian cover to provide better linkage function.

Lot1 RP712557	64.1ha	Contains significant habitat and the most likely source of cassowaries entering this section of the linkage. Borders WTWHA and contains significant riparian forests.
Lot 9 RP886381	17.9ha	Contains both forest habitat and fresh water supply.
Lot 510 NR5816	27.6ha	Largely cleared; vegetation confined to small linear patches
Lot 12 RP859334	4 1.0ha	Small patches in agricultural matrix
Lot 10 RP886381	1.2ha	Small patches in agricultural matrix

Of the properties within this section of the linkage, only Lot 1 RP712557 (64.1ha) contains a full range of habitat resources. The Lot is mapped as Essential cassowary habitat, and vegetation is classified as 'Not of Concern'. Protection incentives would be appropriate for Lot 1 RP712557.

### *Connectivity gap*

The crossing of Wongaling Creek over the El Arish Mission Beach Road is the main connectivity gap to be considered for Habitat Linkage 1. C4 has undertaken tree planting works in this area over a number of years and this has significantly improved the safety of this cassowary crossing point through control of Guinea Grass. However, birds continue to cross the road above rather than below the bridge, suggesting an aversion either to the structure or its surrounds.

There is scope to improve this connectivity gap by continuing to re-plant the riparian zone. The assistance of Ergon Energy Corp Ltd should be sought in relation to the establishment of appropriate low growing species beneath the 22kV feeder lines on the northern side of the El Arish Mission Beach Road. Habitat on the southern side of the road at this point is also highly degraded and requires both weed control and active restoration as part of an overall plan for management of this connectivity gap.

### *Recommendations*

Protection of existing high quality habitat should always precede restoration efforts, and for this reason, properties comprising the western section of this linkage should be a higher management priority. All existing linkage vegetation on these properties is of value and protection incentives are recommended for nominated properties.

Guinea Grass control and restoration is required to widen riparian zones through the eastern section of the linkage, and selectively through the western section along existing forest margins. Weed control is also required on properties on the southern side of the El Arish-Mission Beach Road.

Restoration works are suggested at the Connectivity gap to encourage cassowaries beneath the Wongaling Creek bridge on the El Arish-Mission Beach Road, by considering landform and vegetation surrounding the structure. Fencing and funnelling should also be considered at this point.

A Plan of Management, including a Landscape Plan, should be considered for the connectivity gap associated with this linkage. This would contribute to both amenity and linkage functionality.

Figure 5: **MAP 5** - Habitat Linkage 1 (NW-Section)

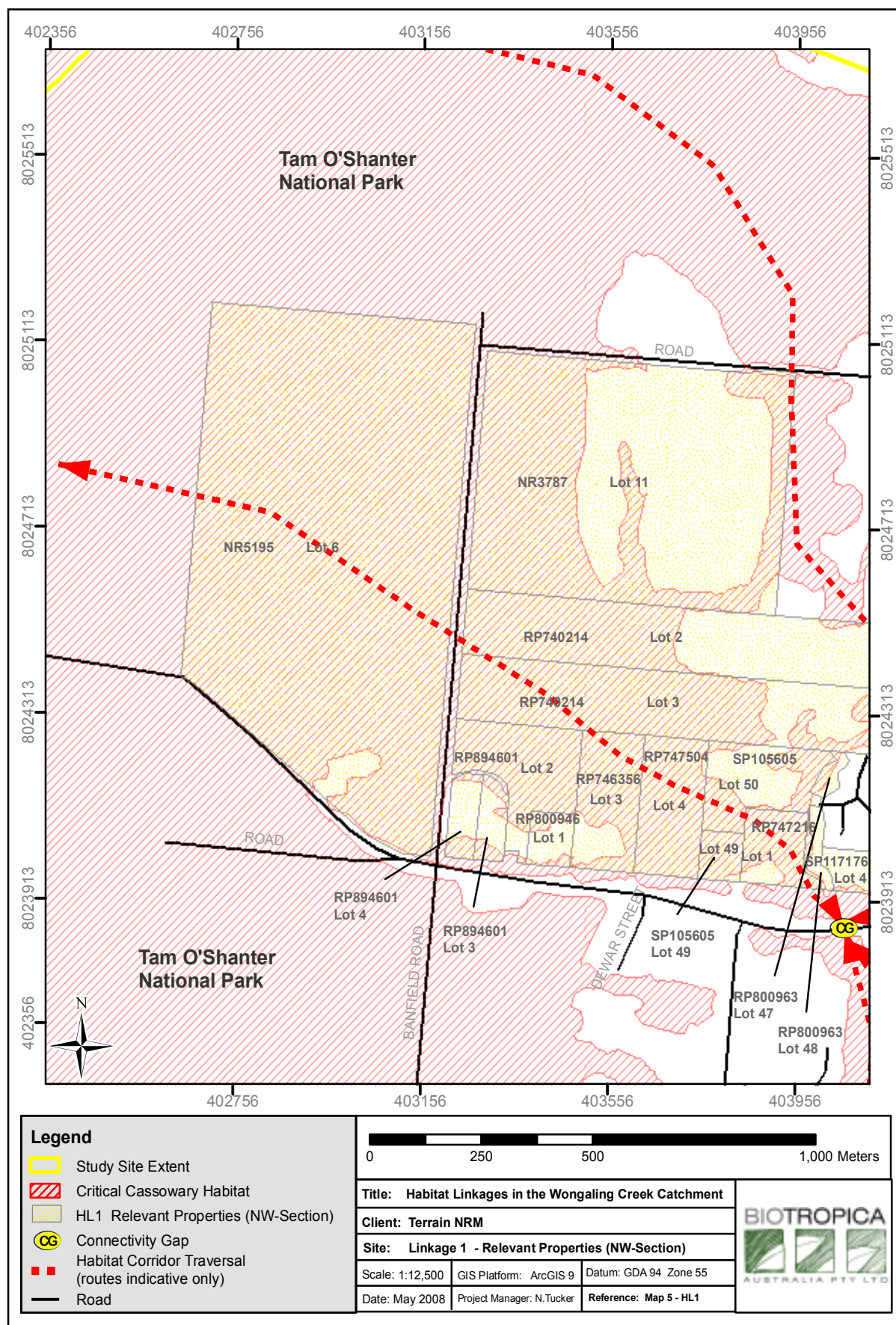
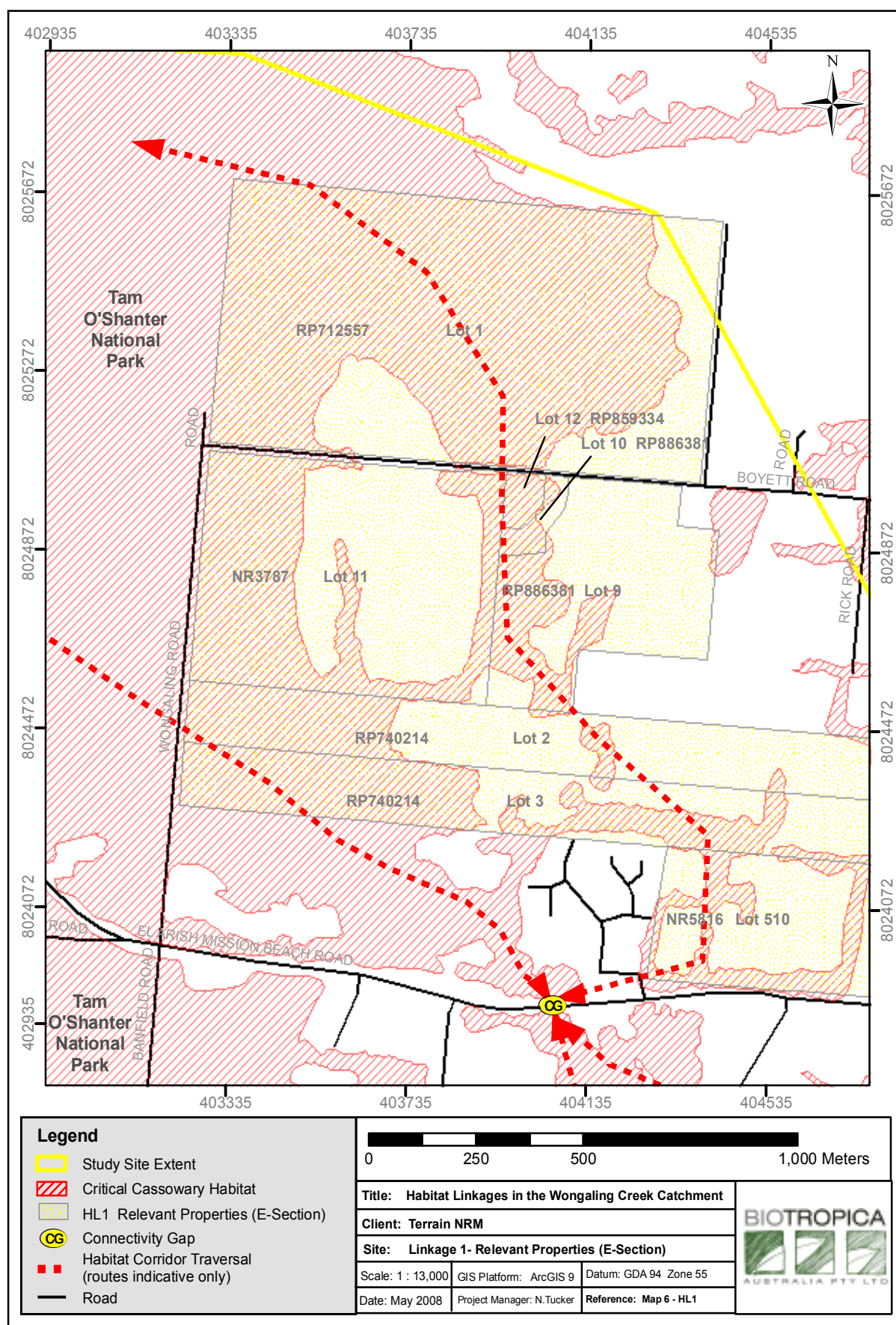




Figure 6: **MAP 6** - Habitat Linkage 1 (E-Section)



## Habitat Linkage 2: Marcs Park to Reserve 214

This primary linkage is comprised of both State lands and privately owned lands. Regardless of tenure, all habitats within this linkage have 'Of Concern' status under the Vegetation Management Act 1999. Vegetation is a combination of mesophyll vine forest and swamp/wetland communities. The linkage averages over 200m in width and is around 1.1kms in length, and provides all fauna with continuous habitat between the fragments of Marcs Park directly into Reserve 214. The table below details lots within this linkage.

**Table 4: Properties forming Linkage 2 - Marcs Park to Reserve 214**

Lot & Plan	Area	Comment
Lot 98 RP749504	7.6ha	Marcs Park reserve. Requires restoration to recover large patches of Guinea grass, and re-plant margins
Lot 2 RP721421	17.5ha	Critical linkage patch. Requires some restoration to recover large patches of Guinea grass, re-plant margins and better connect with Habitat Linkage 3
Lot 1 RP900280	1.4ha	Embedded within critical linkage habitat.
Lot 11 RP904361	1.4ha	Embedded within critical linkage habitat.
Lot 12 RP904361	20.7ha	Directly adjacent to Reserve 214 and a critical linkage patch. Requires restoration to recover large patches of Guinea grass, and re-plant margins
Lot 1 RP721421	0.4 ha	Small patch between El Arish Mission Beach Road and habitats along Wongaling Creek and Marcs Park. Patch is heavily weed invaded.

All of these properties play a critical role in allowing access from the core habitats of the Clump Mt. area into Reserve 214. All are affected by Guinea grass invasion, and this species dominates the margins of virtually the entire linkage. The species is occupying potential habitat, and its replacement would significantly improve visual amenity in this area, increase the total area of habitat and reduce further incursions into disturbed portions of the linkage. The critical lots in this linkage are Lot 98 RP749504, Lot 2 RP721421 and Lot 12 RP904361. These properties should be considered a high priority for ongoing restoration works, and protection incentives.

### *Connectivity gap*

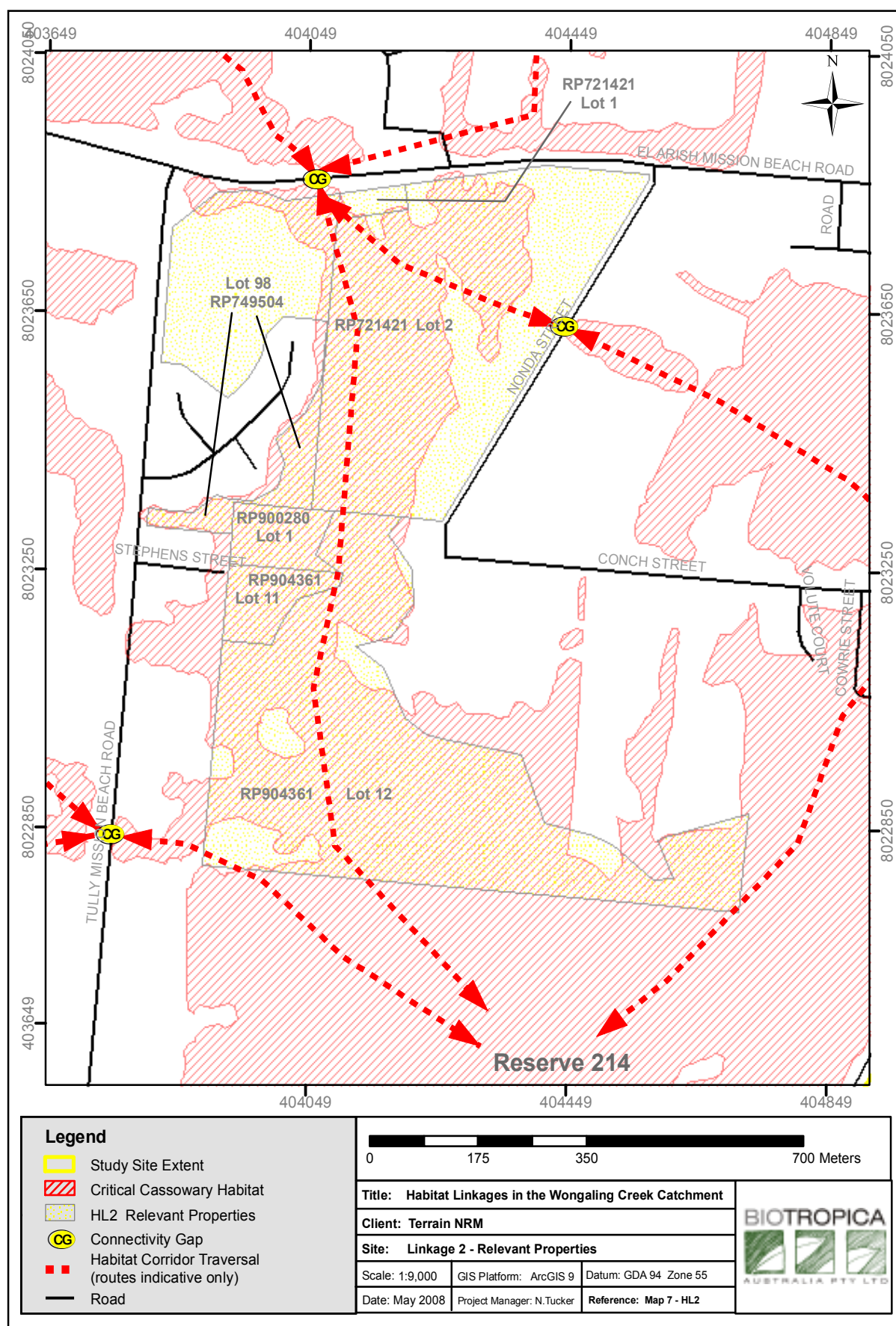
There is no connectivity gap associated with this linkage. Lot 1 RP900280 and Lot 11 RP904361 are adjacent to the narrowest sections of Linkage 2 and inappropriate development on these blocks may generate a bottleneck. Both are mapped as containing Essential habitat, and forest on both blocks carries "Of Concern" status under the Vegetation Management Act 1999. Protection incentives may also be offered for forests on these properties.

### *Recommendations*

Guinea Grass control and restoration is required on the margins of most properties in this linkage.

Protection incentives are recommended over all habitats occurring on privately owned lands within this linkage.

Figure 7: **MAP 7 - Habitat Linkage 2**



### Habitat Linkage 3 – Marcs Park through Oasis and Sartori Resort developments

This secondary linkage is also comprised of State and privately owned lands, encompassing both mesophyll vine forests and swamp/wetland communities. Total length is around 1.1kms which narrows to a 50m x 250m linear strip on Lot 103 SP177188. A key feature of this linkage is this fenced section on Lot 103 SP177188 to facilitate ongoing movement by cassowaries from residual forests to the east (encompassing Oasis and Sartori Resort development sites), to the mesic and sclerophyll communities on Lot 2 RP721421 to the west (see table below). Lands containing the Oasis Development are comprised of two sections of Lot 97 SP177188 [SEGPART 62464217 (northern); SEGPART 62464156 (southern)]. The actual Sartori Resort development (2.8ha) is sectioned out from the five parcels and three easements on Lot 103 SP177188 as shown in Maps 8 and 8a (Detail).

**Table 5: Properties forming Linkage 3 - Marcs Park through Oasis development**

Lot & Plan	Area	Comment
Lot 2 RP721421	17.5ha	Critical component of Linkage 2 - Marcs Park to Reserve 214. Contains high quality habitat and degraded areas.
Lot 103 SP177188	19.2ha	Contains variety of habitats and also contributes to Linkage 4 - Sartori Resort to Reserve 214

Both properties perform a critical role in the context of this section of the landscape. Edge effects (weed invasion, wind turbulence) are likely to require regular management along the fenced section. An amenity planting along this strip would lessen these effects.

#### *Connectivity gap*

The road crossing and associated disturbance between Lot 2 RP721421 and Lot 103 SP177188 is the connectivity gap associated with this linkage. Clear and obvious passage between the two habitat patches is severely affected by Guinea grass invasion on the eastern side of Lot 2 RP721421. This large area compromises the efficacy of the dedicated linkage traversing west from Lot 103 SP177188, by effectively isolating these two patches with 80-90 metres of Guinea grass. This restoration is urgently needed to improve linkage utility in this area.

Restoration should begin as soon as possible on Lot 2 RP721421 with a strip at least as wide as the adjacent linkage emanating from Lot 103 SP177188, commencing directly opposite this linkage, and traversing to the edge of the *Melaleuca* dominated communities on Lot 2 RP721421. Restoration would aim to plant a mesophyll vine forest which merged into *Melaleuca* wetland where soil and drainage begin to alter. As noted, this strip should be at least as wide as the existing habitat to the east, but preferably much wider to produce higher value core habitat opposite the linear patch on Lot 103 SP177188.

Given the inevitable traffic increases resulting from adjacent development, driver education and crossing design will need careful scrutiny at this connectivity gap.



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### *Recommendations*

The restoration of guinea grass-infested areas on Lot 2 RP721421 is a high priority for restoration in the Wongaling area, and critical to linkage function.

An amenity planting along the linear patch on Lot 103 SP177188 is recommended to reduce edge effects along this narrow section.

If this linear patch is considered for recreational purposes (such as walking tracks) infrastructure should be tied into amenity plantings and not within the strip, to limit potential human-cassowary interactions and ensure its value is directed primarily at cassowaries.

Fencing and funneling should be considered adjacent to the connectivity gap given the likely pressure from adjacent land-uses.

Figure 8: MAP 8 - Habitat Linkage 3

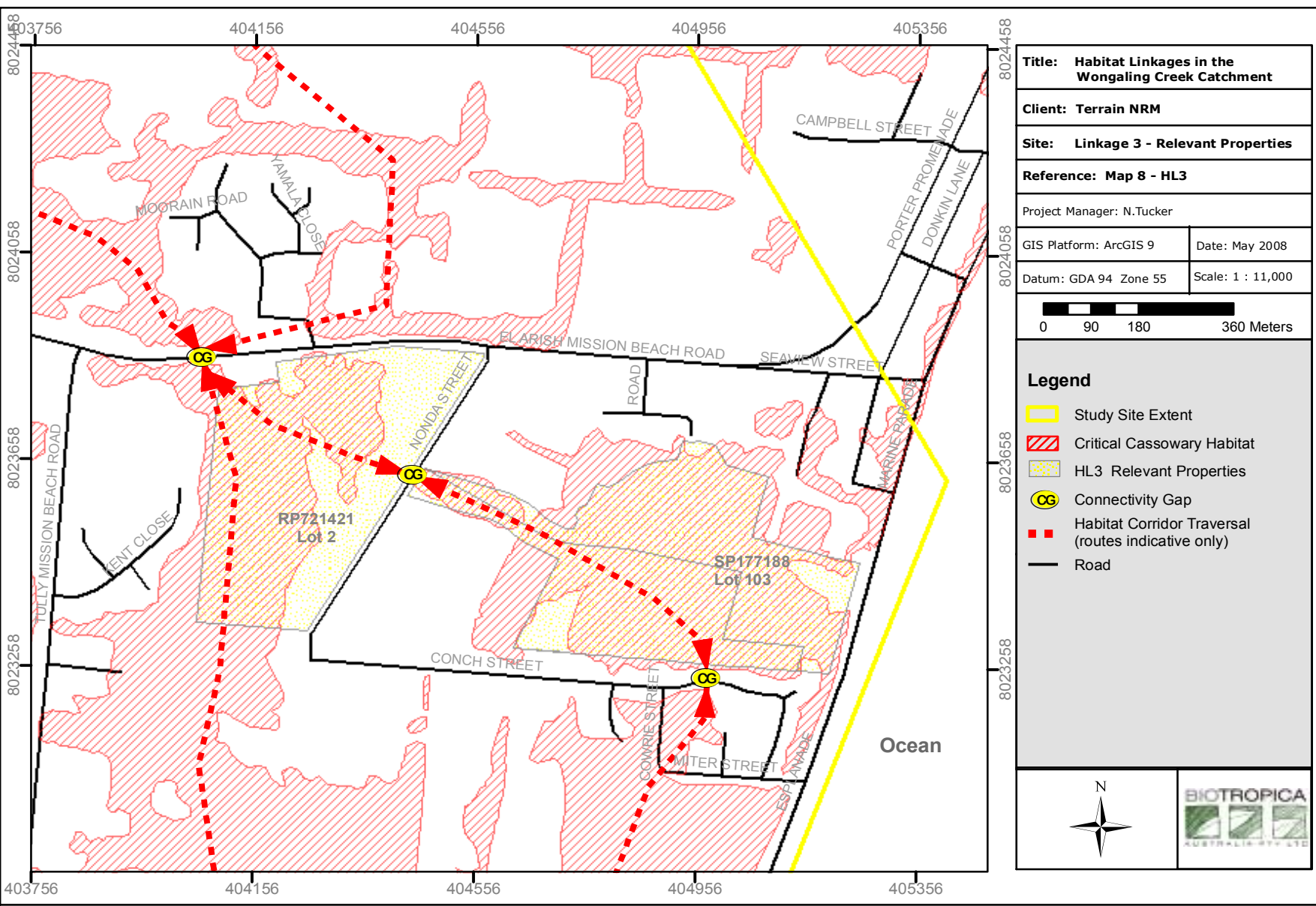
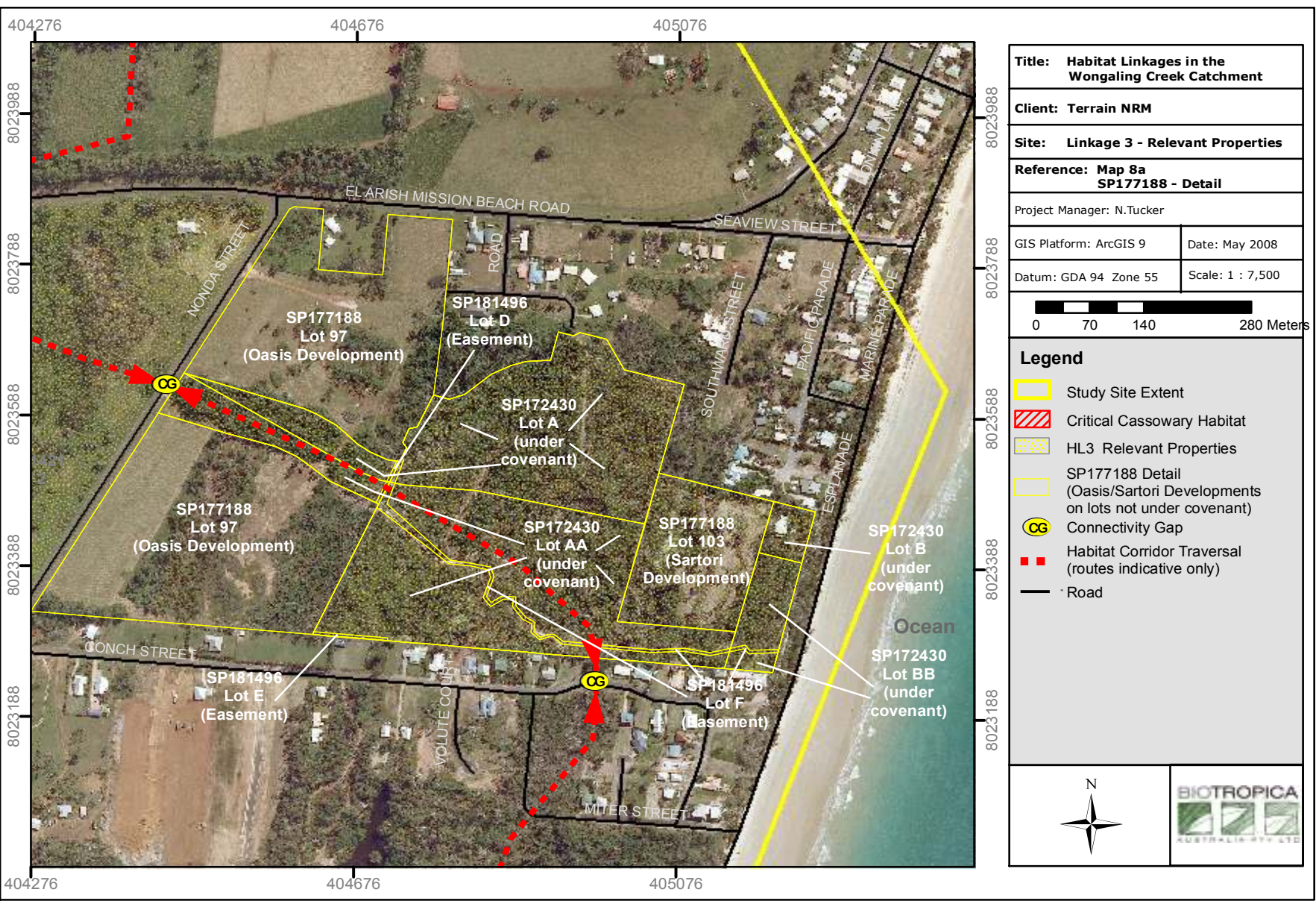


Figure 9: MAP 8a - Habitat Linkage 3 (SP177188 Detail)





#### Habitat Linkage 4: Sartori Resort development to Reserve 214

This secondary linkage is comprised of privately owned lands and State lands and will be partially embedded within the Sartori Resort development when this project is completed. Total distance between the proposed resort and Reserve 214 is around 600m and width varies significantly between 400m at the widest point reducing to around 20m on the Conch Street crossing. Forests are a combination of mesophyll/notophyll vine forests with sclerophyllous components, and at their widest points in the linkage they are in very good condition. The table below details properties within Habitat Linkage 4, and these are shown visually in Map 9.

**Table 6: Properties forming Linkage 4 - Sartori Resort development to Reserve 214**

Lot & Plan	Area	Comment
Lot 999 RP898592	0.4ha	Drainage Reserve
Lot 5 NR7162	4.0ha	Parks and Recreation Reserve
Lot 103 SP177188	19.2ha	Sartori Resort and associated development. Property contains significant high quality habitat and moderately degraded linkages to the west and south
Lot 2 RP898555	8.5 ha	Critical linkage block
Lot 512 NR6056	33.5 ha	Ongoing clearing observed. High quality vegetation.
Lot 2 RP722577	81.5 ha	Critical linkage block

In a landscape context, habitats on the Sartori Resort property may be accessed from either Reserve 214 through intervening north south aligned fragments, or through the linkage traversing west into Lot 2 RP721421, described above. Access into Reserve 214 is more tenuous from Lot 103 SP177188, resulting from surrounding residential development on Conch Street.

Lot 2 RP898555, Lot 512 NR6056 and Lot 2 RP722577 are critical blocks to the functionality of this linkage. Appropriate covenants over forested habitats should be sought on these three lots. The anticipated development within this area will diminish its value over time unless human-cassowary interactions are managed.

#### *Connectivity gap*

The connectivity gap associated with the linkage to Reserve 214 is the Conch Street crossing, and the weed colonisation associated with the riparian strips on the reserve tenure blocks (Lot 999 RP898592 and Lot 5 NR7162) at these crossings. There is permanent freshwater available close by, adding to the habitat values of this area.

Replacing Guinea grass with native species would improve the utility of this linkage. The watercourses providing native cover are heavily degraded and unless effort is made to re-plant weedy areas with appropriate native species they are unlikely to provide any significant functionality.

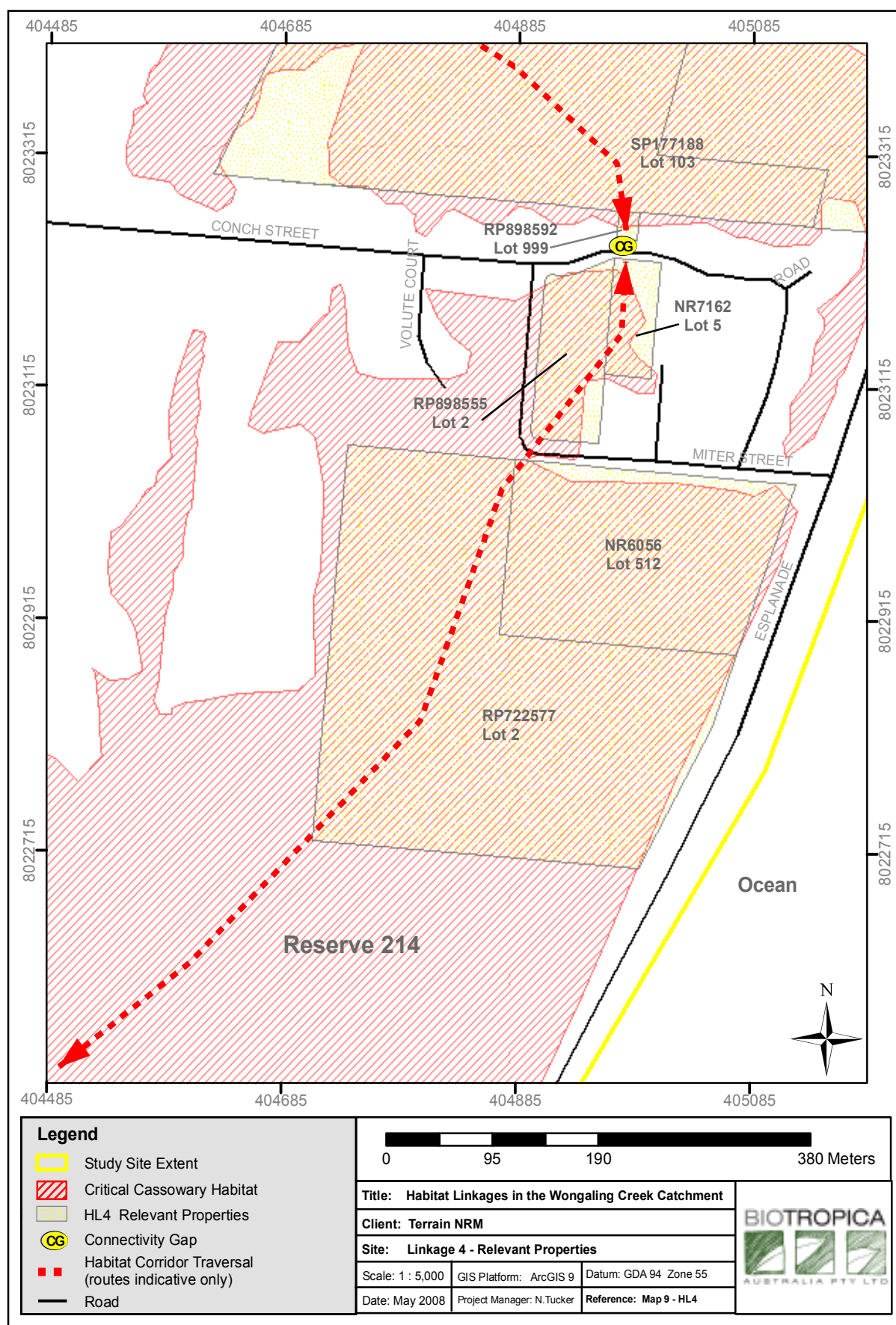
#### *Recommendations*

Protection incentives are recommended over the three Lots noted above (Lot 2 RP898555, Lot 512 NR6056 and Lot 2 RP722577). Weed control and restoration works are required on the drainage/parks and recreation reserves listed in Table 6.

Fencing and funneling may be required in future to manage both traffic and human interaction at the connectivity gap.



Figure 10: **MAP 9** - Habitat Linkage 4



## Habitat Linkage 5 – Reserve 214 to Tam O'Shanter National Park

This is one of two primary linkages connecting Reserve 214 to the extensive forests of the Tam O'Shanter National Park to the west, and is the more northerly of the two linkages. It is also the more tenuous of the two linkages with significant connectivity gap issues between the two forest blocks at either end of the linkage. Despite this, this is possibly the second most important linkage in the Wongaling Area, after Habitat Linkage 6: Reserve 214 to Tam O'Shanter National Park via Lot 802 SP110366.

The linkage is around 800m in length from the edges of the two State land tenures. Width varies significantly between 650m at its widest point, narrowing to around 40m near the connectivity gap. This linkage also comprises State lands and privately owned lands, and encompasses both 'Not of Concern' and 'Of Concern' Regional Ecosystems. The linkage traverses through mesophyll forests on the western side with more swamp/wetland habitats to the east. Whilst the narrowest strips have been affected by cyclone damage, habitat is relatively intact. The table below details properties within Habitat Linkage 5 which are also shown on Map 10.

**Table 7: Properties forming Habitat Linkage 5 - Reserve 214 to Tam O'Shanter National Park**

Lot & Plan	Area	Comment
Lot 4 RP747525	13.6ha	Contains significant linkage vegetation concentrated on a tributary of Wongaling Creek.
Lot 1 RP747525	13.5ha	Contains significant linkage vegetation concentrated on a tributary of Wongaling Creek.
Lot 3 RP732964	11.2ha	Largely cleared however riparian vegetation provides natural linkage to two Lots listed above
Lot 2 RP732964	27.0ha	Contains significant linkage vegetation concentrated on a tributary of Wongaling Creek.
Lot 12 RP904361	20.7 ha	Large patch directly adjacent to Reserve 214 forming a natural linkage to all the properties listed above

This linkage could be significantly expanded on the western side of the Tully Mission Beach Road, through restoration and widening of the riparian zones. This would be especially beneficial if Lot 1 RP747525, Lot 2 RP732964 and Lot 4 RP747525 were treated as an integrated unit based on the riparian zones flowing through the three Lots. Widening the riparian zones by re-planting out to flatter grades would increase both habitat quality (by reducing edge effects), and the funnelling effect of the linkage by directing birds through potentially higher quality habitat on more preferred grades.

The linear clearing that represents Lot 3 RP732964 also includes two riparian zones which connect to Lot 1 RP747525, Lot 2 RP732964 and Lot 4 RP747525 directly opposite the Tully-Mission Beach Road. The riparian zone of the southernmost watercourse has better vegetation cover and is more distant from intensive land-use, increasing its relative value. The value of the northernmost watercourse as linkage habitat would be improved by restoration of habitat directly opposite on Lot 4 RP747525. Lot 4 RP747525 and Lot 3 RP732964 can therefore play a key role in the functionality of this linkage by providing cassowaries with at least two east-west aligned pathways. The intensive land-use adjacent to the northern boundary of Lot 3 RP732964 may increase human and traffic interactions, and for this reason the southernmost watercourse should receive higher priority. Vegetation along this watercourse should be widened substantially to at least 100 metres, in recognition of its importance to the functionality of this linkage.

It was noted during the course of this survey that a subdivision development is underway on Lot 2 RP732964:

**Figure 11: Subdivision Layout for Lot 2 RP732964**



Lots for sale included the forested section in the north-western corner of the property (proposed Lot 41). Clearing on these blocks would increase the fragmentation of this linkage and compromise its value. Moreover, it would be advantageous to re-plant the north-eastern corner of this block (proposed Lots 1 and 40 – see Figure 1) to thicken the existing riparian vegetation to add to the proposed restoration on the adjacent Lots to the north (Lot 1 RP747525 and Lot 4 RP747525).

There are two linear areas of habitat which also provide linkage habitat north of Linkage 5, adjacent to the Stephens Street area. These areas have also been nominated as critical habitat in the former Johnstone Shire Council Planning Scheme: Natural Areas Plan. Whilst these do have some linkage functionality, and may be considered for future protection, their size, proximity to more intensive land-use, and condition relative to other linkages, suggests they would be a lower priority. This is not to dismiss their value, now or into the future, and any future developments should be cognizant of their potential.

#### *Connectivity gap*

The Tully Mission Beach Road is the major connectivity gap within this linkage. Unpublished data sourced from the Qld EPA indicates there have been at least two known cassowary deaths caused by car strike (1992-2006) in the vicinity of the connectivity gap despite the presence of warning signage. Cassowary crossings occur at this point on a regular basis (C4, pers comm.). Unless this connectivity gap can be better managed the value of this linkage is compromised.

This area is the second connectivity gap which requires significant restoration effort to maximise its value. As noted above, the joint restoration of riparian zones on Lot 1 RP747525, Lot 3 RP732964 and Lot 4 RP747525, and parts of Lot 2 RP732964, would achieve a number of positive conservation outcomes, and this includes management of the connectivity gap.

A fencing strategy may be required to limit negative interactions, particularly from established and proposed residential developments. Fencing of the main subdivision component on Lot 2 RP732964 should be reviewed. The fencing of road-side sections may also be warranted and would need to be examined in the context of riparian restoration works.

### *Recommendations*

Habitat within this linkage that is mapped as 'Essential' cassowary habitat, and any areas that may be restored as part of the connectivity gap re-planting process, should be secured under protection incentives.

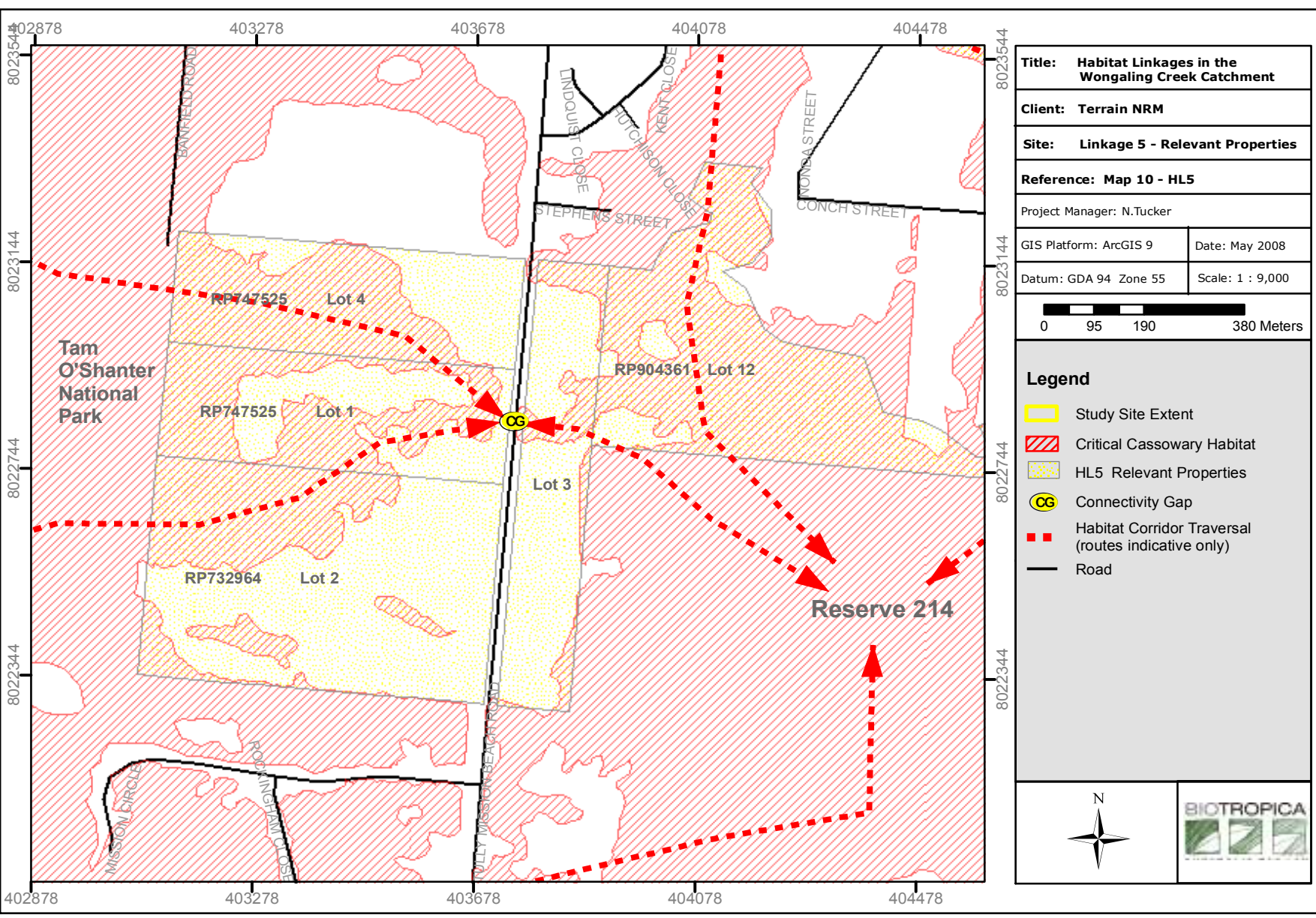
Proposed subdivision arrangements on Lot 2 RP732964 should include a component of restoration works to widen that portion of the linkage. Clearing on Lot 2 RP732964, and on any adjacent Lots, would increase the fragmentation of this linkage and should not be supported.

Restoration works are recommended on Lot 1 RP747525, Lot 2 RP732964, Lot 3 RP732964 and Lot 4 RP747525 to increase the effectiveness of this linkage. The riparian zones on Lot 3 RP732964 should be significantly widened.

Additional traffic calming measures are required, potentially in conjunction with fencing and funneling to address cassowary mortality through the connectivity gap.



Figure 12: **MAP 10** - Habitat Linkage 5



### Habitat Linkage 6: Reserve 214 to Tam O'Shanter National Park via Lot 802 on SP110366

This primary linkage provides continuous habitat between Reserve 214 and the Tam O'Shanter National Park, and is considered the most significant linkage within the Wongaling area. This is derived from spatial extent and configuration, area within State land, number and location of connectivity gaps, resource diversity and quality of linkage habitat. The total distance between the two State land parcels at either end of the linkage is around 900m, and the linkage is between 150m and 400m in width.

The linkage includes State lands and privately owned lands and vegetation that is mapped as remnant, under both 'Not of Concern' and 'Of Concern' classifications, as well as 'Essential' cassowary habitat. Linkage habitat on the eastern side of the Tully Mission Beach Road is State land but adjacent forests are privately owned lands. Vegetation includes mesophyll vine forest, riparian forest and swamp/wetlands which are all of high value, affected only by weed colonisation along the margins, and some interior damage resulting from Cyclone Larry in 2006. The table below details properties forming Habitat Linkage 6; also shown in Map 11.

**Table 8: Properties forming Habitat Linkage 6 - Reserve 214 to Tam O'Shanter National Park**

Lot & Plan	Area	Comment
Lot 501 SP 110366	13.8ha	Critical block linking Reserve 214 to Crown linkage block Lot 802 SP110366
Lot 802 SP110366	10.1ha	Freehold block. Critical to long term movement of all fauna in and out of Reserve 214.
Lot 803 SP190509	6.5ha	State Land (Reserve). Adjacent to Reserve 214 – embedded within residential lands.
Lot 25 SP119161	5.4ha	Freehold adjacent to Reserve 214 providing important habitat per se
Lot 66 SP164474 (2 parcels divided by Rockingham Close)	24.5ha	Significant habitat on western side of the Tully Mission Beach Road. Critical to long term movement of all fauna in and out of Reserve 214.

The security of linkage habitat on State lands is assumed, although this security rests entirely on achieving appropriate levels of protection for the very significant linkage habitat represented by Lot 66 SP164474. These two parcels contain very high quality vegetation, including riparian vegetation fringing two watercourses that flow into Reserve 214. If these parcels are developed there is a high risk that this critical linkage will become dysfunctional and degraded. The long term future of Lot 66 on SP164474 requires careful consideration given its critical position, high quality habitat and continuity between State lands. Protection incentives should be considered and some acquisition may also be warranted.

Lot 501 SP 110366 contains valuable habitat which extends the width of the habitat on State lands within Lot 802 on SP110366. Protection incentives should be offered over forested sections of this property. This property would also benefit from selective weed control and restoration.

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### *Connectivity gap*

The Tully Mission Beach Road represents the major connectivity gap along Linkage 6. Unpublished data sourced from the Qld EPA indicates there have been at least two known cassowary deaths caused by car strike (1992-2006) in the vicinity of the connectivity gap, again despite the presence of warning signage. Linkage function is also compromised by a second connectivity gap represented by Rockingham Close which provides the main thoroughfare for traffic emanating from residential subdivisions to the south. The low density residential development to the north of Lot 66 SP164474 (Mission Circle) retains high quality habitats, particularly along low lying areas, although interior roads are also potential car strike points.

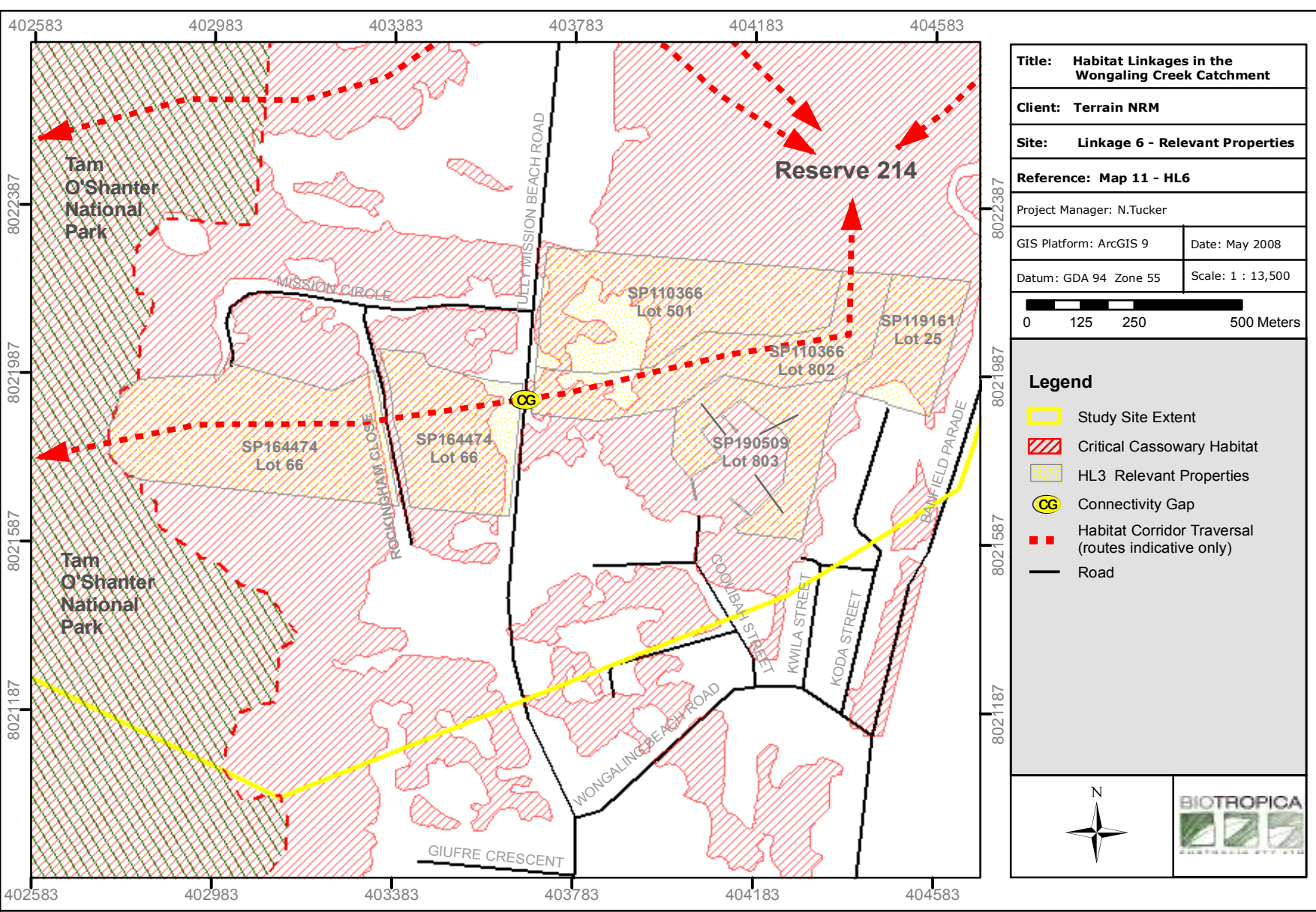
However, of these three roads the Tully Mission Beach Road is clearly the most dangerous for cassowaries accessing Linkage 6. Hard and soft engineering are both required. The cooperation of Ergon Energy Corp Ltd should be sought to improve the quality of habitat beneath the 22kV feeder line and to enhance the visual amenity of the power-line corridor. Fencing, signage and road surfacing are also likely to be key ongoing components of connectivity gap management.

### *Recommendations*

Existing habitats on privately owned lands within this linkage should be offered protection incentives.

Additional traffic calming measures are required, potentially in conjunction with fencing and funneling to address cassowary mortality through the connectivity gap.

Figure 13: **MAP 11** - Habitat Linkage 6





### 13 Esplanade/Other Linkages

As noted, there are also fragments of strand vegetation along the shore-line north and south of Reserve 214. This vegetation is heavily disturbed and its linkage value is unlikely to be high at any time due to the ongoing human pressures on this zone. This is not to say that this vegetation has no value and is not worth preserving, because it has other significant values including its scenic amenity and an important beach protection role. These areas should be more carefully considered for these reasons, and any movement which they facilitate should be seen as another benefit.

As noted above, there are also existing linkages in the Stephens Street area. These are considered of lesser value than the nominated linkages south of Stephens Street. This reduced value results from their proximity to intensive settlement, traffic interactions with less flexibility in traffic management, less rehabilitation potential, and more degraded habitat. This suggests that these linkages, whilst of some value, are less critical and other more critical linkages are more deserving of significant planning and financial resources.

### 14 Summary

This report has identified six habitat linkages providing varying levels of connectivity between Reserve 214 and the more extensive forest massif to the north and west. Associated with each of these linkages are a number of connectivity gaps which require management to improve the quality of each linkage. A combination of management tools will be required to achieve security and functionality across all linkages. These include voluntary protection covenants, hard and soft engineering at connectivity gaps, and ecological restoration to improve habitat quality and increase native cover. Achieving these objectives will also require cooperation between all stakeholders, including landholders, road users and the Wongaling community.

The following general recommendations can also be made;

- All habitat and associated linkages should be retained wherever possible.
- Habitat linkages should be as wide as possible. Existing linkages should be widened by restoration of adjacent cleared or degraded areas wherever possible.
- Nominated linkages should be identified in relevant planning tools and management plans.
- Habitat linkages could be protected, enlarged, restored and managed as a condition of approval of assessable development in the study area.
- Protection incentives should be offered to private landholders with habitat or linkages to encourage voluntary protection and/or restoration.
- Habitat linkages on public land should be explicitly protected and managed for conservation.
- Appropriate wildlife crossing points should be developed where habitat linkages are affected by roads.
- Habitat linkages should be protected and managed for all biodiversity values including cassowaries.
- Where habitat linkages are in place or are augmented by restoration, agreements should ensure that vegetation is protected in perpetuity and adjacent land uses are carefully considered.

## 15 References

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## 16 Appendix

### Appendix 1: Full Scope of Project

#### **PORTERS AND WONGALING CREEK ECOLOGICAL CORRIDORS**

##### **Project Brief**

**March 2008**

##### **Introduction**

Terrain NRM wishes to engage a consultant to prepare a report on ecological corridors in the Porters/Wongaling Creek area at Mission Beach.

##### **Study area**

The study area is shown in Figure 1. It consists of the area between North Mission Beach and Wongaling Beach from the foreshore west to Tam O'Shanter National Park. It includes Porters Creek, Wongaling Creek and R214\*

\*R214 is a term used to describe the State land at the mouth of Wongaling Creek.

##### **Background**

The study area is considered to be a significant ecological area with tenuous corridors that connect rich coastal habitat to the National Park foothills. Land use includes conservation, rural and residential. The area straddles the Johnstone/Cardwell Shire boundary and is experiencing increasing development and motor traffic. Many stakeholders are involved in determining the future of area (eg farmers, developers, Traditional Owners, community groups, Council, EPA, NRW, Main Roads, DEW, etc). A coordinated strategic approach to protecting and restoring ecological corridors in the study area will help maintain the outstanding biodiversity significance of Mission Beach.

##### **Scope**

The report will consider corridors for the diversity of native plant and animal species and communities, with a focus on cassowaries because of their endangered status. The issue of roads crossing ecological corridors will be addressed in a separate report.

##### **Contents of report**

The report will:

- describe the environment in the study area
- describe the function and importance of ecological connectivity in the study area
- make recommendations for preferred corridor locations and characteristics.

##### **Purpose of report**

The purpose of the report is to bring together existing information to encourage a coordinated strategic response to corridor conservation in the study area.

The report could be described as a pilot project of the Mission Beach Habitat Network Action Plan, focusing on a small but important part of Mission Beach.

The report will have no statutory authority.

Terrain and other organisations may choose to direct resources to priority areas and issues identified in the report (eg revegetation grants, conservation covenant incentives, funding of wildlife crossing studies).

Local land managers may choose to consider the report when making land use decisions. The report could assist land managers to consider whether their land might contribute to a corridor.

##### **Description of existing environment in study area**

The report should include statements/descriptions on the following:

- biodiversity significance of wider Mission Beach (refer to Chenoweth)
- biodiversity significance of Tam O'Shanter National Park
- biodiversity significance of R214 area (refer to Biotropica, Crome, Bentrupperbaumer)
- general security of habitat in Tam O'Shanter National Park (i.e. its NP and WHA so its verysecure)

- general security of habitat in R214 area (extent of state land, Reserve purposes, planning scheme zoning, extent of remnant vegetation regulated by VMA, extent within Coastal Management District in Regional Coastal Management Plans, recommendations in South Mission Beach Wongaling State Land Strategy, conservation covenants, etc)
- importance of ecological connectivity between R214 area and Tam O'Shanter NP (what species, functions, values depend on the corridors and how important are the corridors, eg NP contains large protected area but R214 has excellent cassowary habitat different to that in NP and cassowaries need to move between the two areas)
- existing on-ground corridors between R214 area and Tam O'Shanter NP (what do existing corridors consist of, eg remnant vegetation and/or open paddocks; how wide are they; do the corridors generally follow waterways; how many cassowaries use the corridors; are there barriers eg roads; is road kill a problem; etc)
- existing protection of corridors (Johnstone Shire Planning Scheme Zoning and Natural Areas Plan, Cardwell Shire Planning Scheme Zoning, Regional Coastal Management Plan [eg Coastal locality 1.1 in Cardwell Hinhinbrook RCMP], VMA, EPBC, existing covenants, cassowary crossing signage, 80kph speed limit)
- rate and type of change in local land use and impact on corridors (eg, cleared rural areas are being developed for residential and light industrial purposes; remnant veg is generally protected through this process; traffic is increasing; revegetation opportunities are being lost; fencing is increasing; ability of cassowaries to move through landscape is being reduced; etc)

### **Recommendations for corridors**

Recommendations should be based on the following givens:

- Mission Beach has been identified as a Priority Biodiversity Area (FNQ2010 and FNQNRM Regional Plan)
- Mission Beach has the highest density of cassowaries in Australia
- Mission Beach coastal lowlands are core cassowary habitat
- Cassowaries are listed as endangered under federal and state legislation
- There is community support for protection and restoration of a habitat network that is ecologically viable.

Recommendations should address the following:

- Provide a map showing the location of recommended corridors between R214 area and Tam O'Shanter NP. Does the map show the centreline of the corridor or the full width of the corridor?
- Outline any general corridor principles applicable in the study area, eg cassowaries are solitary and territorial therefore individual corridors are required for individual birds or its better to have one big wide corridor that multiple birds can use.
- Is it important to protect every one of the recommended corridors?
- Are some corridors more important than others? If so, which ones and why?
- What would be the functions of the corridors?\* Do all corridors have the same purpose or might some corridors have different purposes?
- How wide should corridors be?
- Can existing corridors that are wider than the recommended width be cleared down to the recommended width? If not, why not?
- Should some existing corridors be widened?
- Should corridors be fully vegetated or are open areas acceptable?
- Is exotic vegetation acceptable within corridors? Are weedy or vine dominated corridors acceptable or should they be restored?
- Is adjacent land use significant?
- Should corridors be fenced?
- Should corridors be buffered?
- Should the primary corridor purpose be ecological connectivity or are other land uses compatible in corridors, eg walkways?

### **\*Corridor functions**

Functions of the corridors might include the following:

- movement pathways for fauna and flora in the short and/or long term
- dispersal routes for juvenile cassowaries seeking territory



- habitat in themselves
- access to fresh water (because corridors are often associated with waterways and cassowaries need to drink frequently)
- linking the Wet Tropics World Heritage Area and Great Barrier Reef World Heritage Area
- contribution to water quality (because corridors are often associated with waterways)
- cultural values (Traditional Owner values, scenic amenity, greenspace separating townships, etc)

**Budget**

\$5000

**Process**

Terrain provides project brief to consultant

Consultant prepares draft report

Terrain comments on draft

Consultant considers comments

Final report produced

**Timeframe**

ASAP

**Method**

Desk top only

No field work or new research required

**References\***

Bentrupperbaumer, 1990, Environmental Assessment of R214

Biotropica, reports to ARF and WTMA

CSC Planning Scheme

Chenoweth, 2007, Biodiversity Significance of Mission Beach

C4, maps of cassowary sightings and corridors

Crome, 1995, Survey of Cassowary Habitat in the Mission Beach and Garner's Beach Districts 1995.

Damon Sydes, map of cassowary corridors

Department of Lands, 1992, South Mission Beach Wongaling State Land Strategy

EPA, Cardwell Hinchinbrook and Wet Tropical Coast Regional Coastal Management Plans

EPA, FNQ Areas of Ecological Significance (new mapping showing Conservation JSC Planning Scheme

QPWS, map of cassowary road kill

RE mapping and cassowary habitat mapping

Corridors, etc)

\*Terrain can provide copies of most of these references to the consultant on request