Biodiversity Significance of Mission Beach

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EXECUTIVE SUMMARY

Nestled at the junction of the Wet Tropics and the Great Barrier Reef World Heritage Areas, Mission Beach has long been recognised for its beauty and environmental values. The outstanding natural and cultural significance of the area has been recognised in a number of studies including as a Priority Biodiversity Area in the 'Sustaining the Wet Tropics' regional plan and the Far North Queensland Regional Plan 2010.

The natural values of the area are under pressure, particularly from residential and tourist development. Opportunities for improved environmental protection and restoration at Mission Beach are emerging, such as the Terrain Natural Resource Management's Mission Beach Habitat Network Action Plan and the Department of Infrastructure and Planning's Far North Queensland Regional Plan 2025. In order to plan for the future at Mission Beach, a detailed understanding of the attributes and significance of the overall environment is necessary. This report has been commissioned by Terrain Natural Resource Management to better define what makes Mission Beach a priority biodiversity area, to assist with future planning exercises to enhance decision-making, and to raise awareness in the wider community of the area's outstanding significance.

To assess the 'Biodiversity Significance' of Mission Beach, the natural environment attributes of the area were assessed against criteria that integrate Natural World Heritage and National Heritage Criteria. To gain an understanding of the relative significance of the natural environment attributes, values were assessed at the Shire (Cardwell and Johnstone), Wet Tropics Bioregion, Far North Queensland Region, state, national, and global scales.

The study identified that the Mission Beach area supports numerous attributes that confirm its significance at a local, regional, national, and in some instances, global scale including:

- Unique geological features such as the basaltic headland at Clump Point and Ordovician Tam O'Shanter Granite at Tam O'Shanter Point;
- 12.8% of all remaining lowland rainforest in the Wet Tropics and the largest contiguous 'block' of lowland rainforest south of the Daintree River;
- 50% of Australia's remaining Licuala Fan Palm Forests, incorporating the largest single stand;
- At least 5% of all Australian vascular plant species;
- 13% of the recorded plant species of Mission Beach occur nowhere else but the Wet Tropics, with one species of orchid occurring nowhere else but Dunk Island;
- Habitat for approximately 36% of Australia's bird species;
- Australia's highest concentration of Cassowaries;
- Marine areas support 20% of the world's seagrass species and close to 35% of the world's mangrove species;
- The largest suite of mainland fringing reefs between Port Douglas and Bowen;
- Wetlands of National and, in the case of the Great Barrier Reef, international significance;
- Very high diversity in vegetation communities and both flora and fauna species;

- Relatively extensive stands of lowland forest ecosystems;
- The most integral and widest east-west corridor in between Cairns and Cardwell; and
- The best coastal to highlands rainforest corridor in the Wet Tropics.

The diversity in vegetation communities and both flora and fauna species is driven by the complexity of landscapes, geology and differences in weather patterns across the area. The relatively extensive stands of lowland forest ecosystems in combination with the continuity of rainforest habitat to the west as far as Atherton is unique in the Wet Tropics.

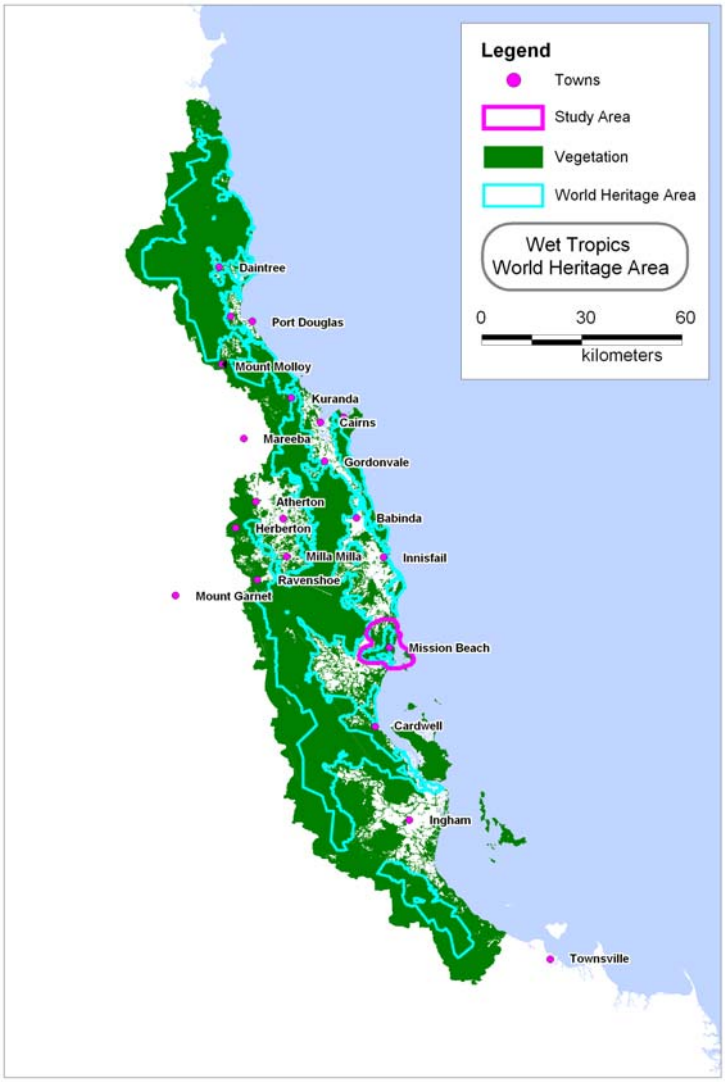
Mission Beach has many significant environmental attributes. Some of these individual attributes alone, such as the highest cassowary concentration in Australia, justify that Mission Beach has very high biodiversity significance. What is outstanding is that these attributes are all contained within a small area representing only around 0.005% of the continental area of Australia or about one third the area of mainland Brisbane City.

1.0 INTRODUCTION

1.1 MISSION BEACH

Mission Beach has been described by some as a 'special' place (Weston, 2006). It is a place where beautiful sandy beaches are fringed by dense coastal rainforests. It is an area of extreme diversity in terms of vegetation structure and species (Goosem, 1992). The forests contain 'Endangered' and 'Of Concern' regional ecosystems which provide important habitat for threatened species, most notably the Southern Cassowary (*Casuarius casuarius johnsonii*). The Great Barrier Reef is close to shore where there are vistas to the Family Group of islands (including Dunk) and the Barnard Islands.

FIGURE 1 – LOCATION



Mission Beach is located at the junction of two of Australia's 14 World Heritage Areas, being the Wet Tropics and the Great Barrier Reef. The setting of wet tropical rainforests adjacent to a fringing reef is an unusual feature found only in a few Pacific Islands, in Indonesia and Belize. In no other case is there the prospect of a protected tropical forest World Heritage site alongside a major marine/reef World Heritage site.

The 'Sustaining the Wet Tropics' regional plan (FNQ NRM & Rainforest CRC, 2004) maps Mission Beach and Hinterland as one of the four "Priority Biodiversity Areas" in the Wet

Tropics region, reproduced here as Figure 2. The 'FNQ Regional Plan (FNQRPAC, 2000) similarly maps Mission Beach and Hinterland as one of the three "Priority Biodiversity Areas" in the FNQ region.

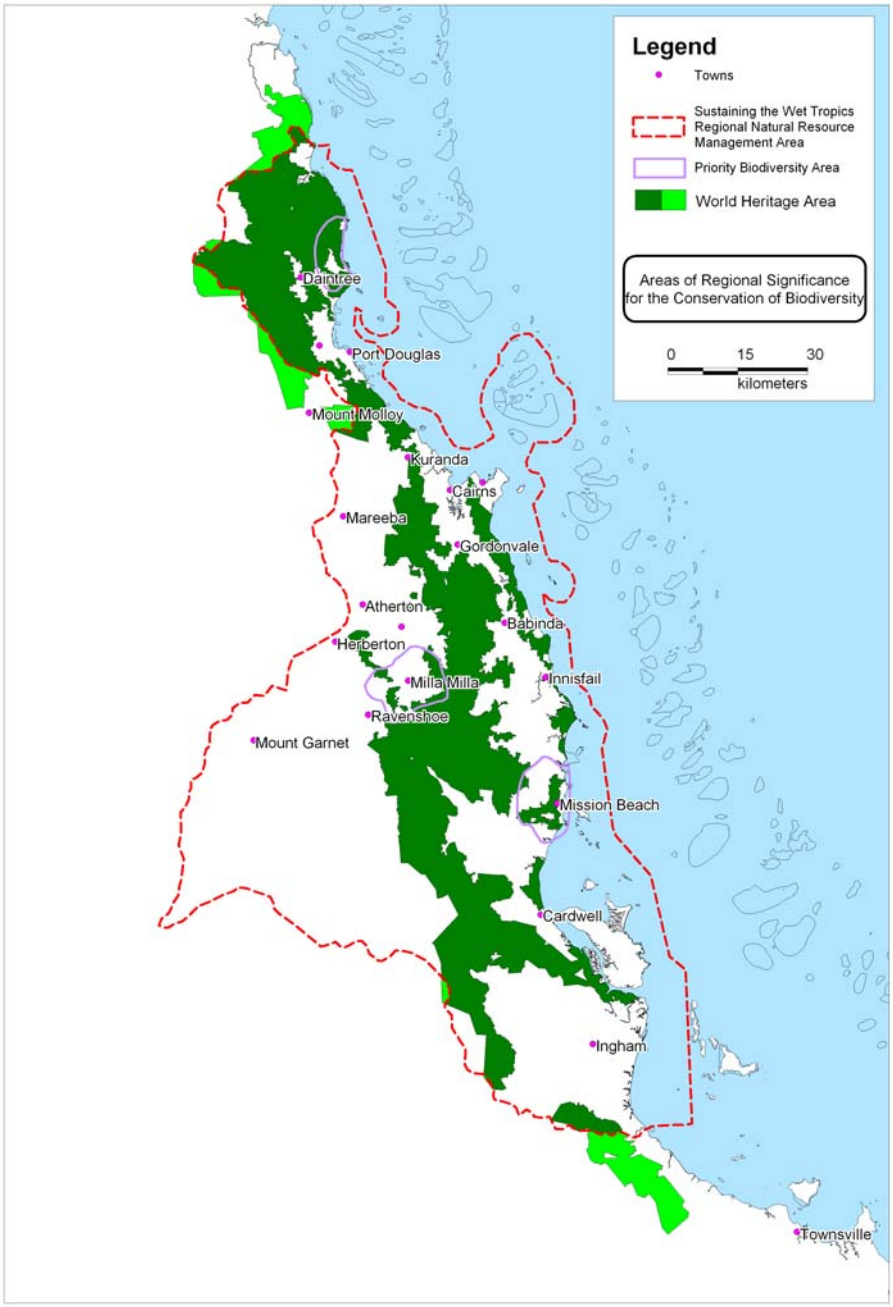
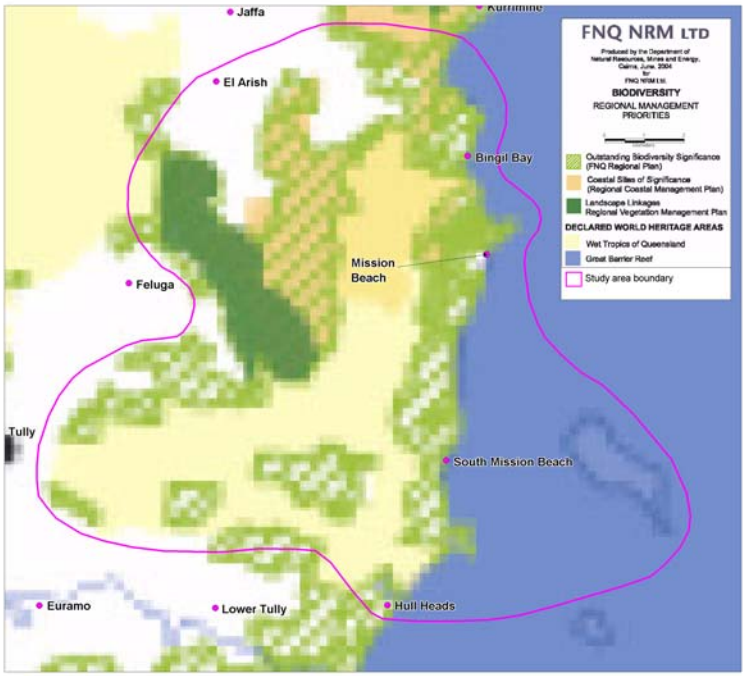


FIGURE 2 – Areas of Regional Significance for the Conservation of Biodiversity

FIGURE 3 – FNQ NRM plan biodiversity map



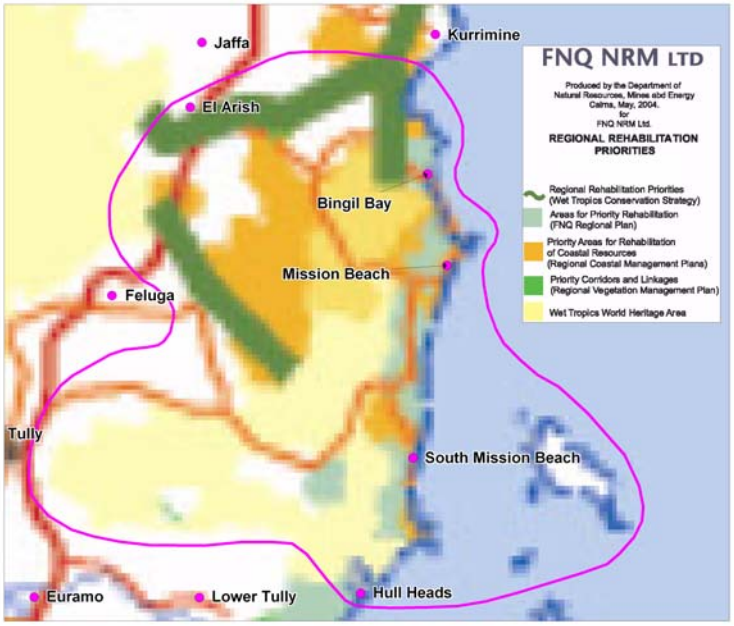
The values of the area have been long recognised and identified in numerous plans and studies. Specifically, the following (illustrated in Figure 3) are of note:

Mapped as of 'Outstanding Biodiversity Significance' in the FNQ regional plan (FNQ NRM & Rainforest CRC, 2004; FNQRPAC, 2000);

- Including 'Coastal sites of Significance' in the Regional Coastal Plan (FNQ NRM & Rainforest CRC, 2004); and
- Supporting 'Landscape Linkages' in the Regional Vegetation Management Plan (FNQ NRM & Rainforest CRC, 2004).

The Recovery Plan for the southern cassowary identifies that a Cassowary Conservation Local Area Plan for Mission Beach be developed as a priority (Latch, 2007). Large tracts of Mission Beach have been mapped in the Johnstone Shire Council's Natural Areas Plan including large tracts of 'Critical' and 'Important Habitat'.

FIGURE 4 – FNQ NRM plan rehabilitation priorities map extract



In terms of management input to conserve and enhance the values of Mission Beach, other studies have identified rehabilitation priorities (as illustrated in Figure 4):

- Regional Rehabilitation Priorities of the Wet Tropics Conservation Strategy (FNQ

NRM & Rainforest CRC, 2004);

- Areas for Priority Rehabilitation of the FNQ Regional Plan (FNQ NRM & Rainforest CRC, 2004;FNQRPAC, 2000);
- Priority Areas for Rehabilitation of Coastal Resources of the Regional Coastal Management Plans (FNQ NRM & Rainforest CRC, 2004); and
- Priority Corridors and Linkages in the Regional Vegetation Management Plan (FNQ NRM & Rainforest CRC, 2004)

The Mission Beach area supports a broad mix of land tenures including National Parks, Forest Reserves, Unallocated State Land and freehold. Parcels of State controlled land of note include:

- Tam O'Shanter National Park;
- Mount Mackay National Park;
- Clump Mountain National Park;
- Hull River National Park (incorporating Kennedy Reserve);
- Family Islands National Park;
- Walter Hill Conservation Park; and
- Mount Myrtle Forest Reserve (pending transfer to National Park).

Of these reserves Tam O'Shanter, Mount Mackay and most of Clump Mountain and Hull River National Parks are included in the Wet Tropics World Heritage Area.

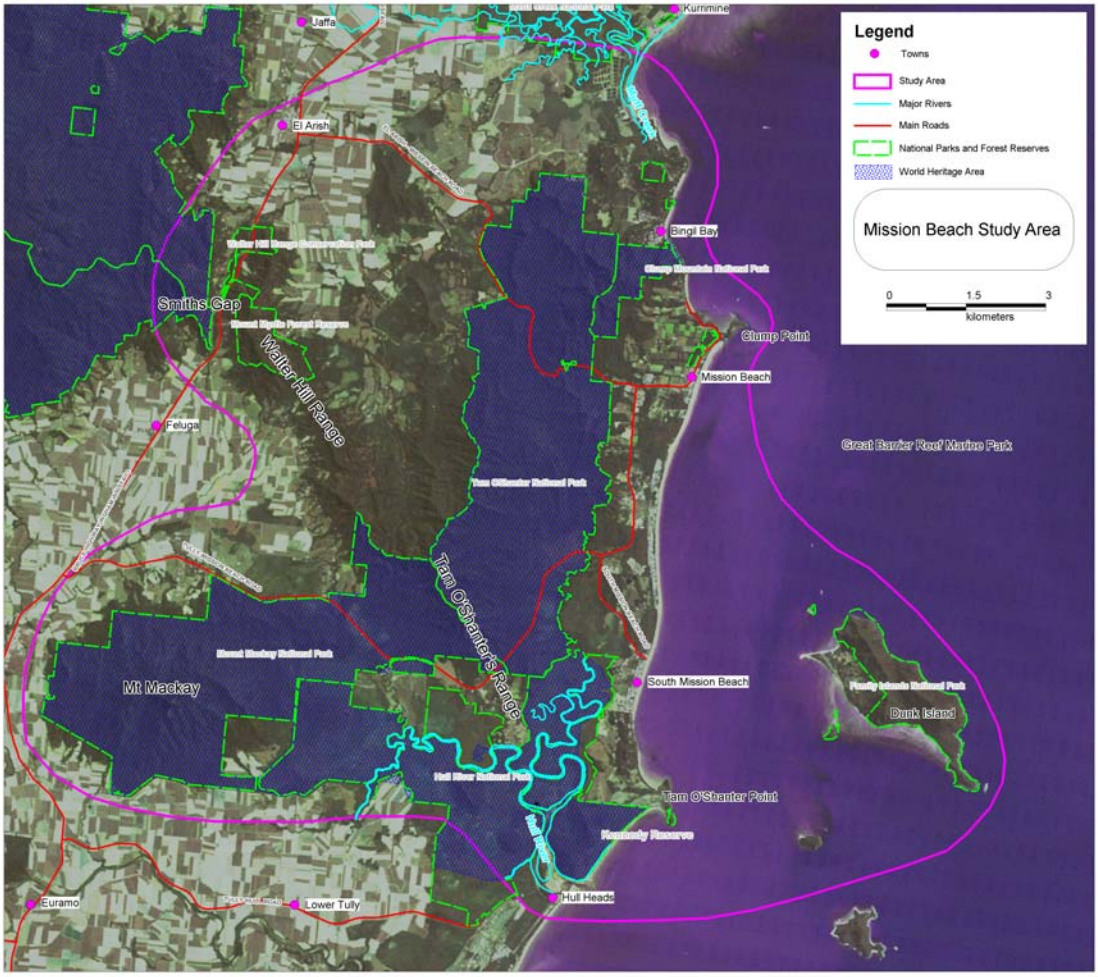
The values of Clump Mountain National Park, Hull River National Park and Kennedy Reserve (section of the Hull River National Park) have also been recognised through their inclusion on the Register of the National Estate for the following reasons (DEWR, 2007a):

- Clump Mountain National Park has been included under the 'Natural' class. The National Estate states the significance of Clump Mountain National Park – "*Clump Mountain National Park contains relatively large areas of wet and very wet lowland mesophyll vine forest, which is an endangered vegetation community in Australia having been largely cleared for agriculture. The vegetation contains several species of restricted occurrence that are endemic to the Wet Tropics area (Criterion B.1)*".
- Hull River National Park has been included under the 'Natural' class. The National Estate states the significance of Hull River National Park – "*Representative sample of lowland vegetation developed on granite soils of the west coastal plains. Rich bird habitat. This Park also preserves the habitat character of this area. The swamplands of the wet tropical lowlands are a unique feature in the Australian context*".
- Kennedy Reserve (section of the Hull River National Park) has been included under the 'Historic' class. The National Estate states the significance of Kennedy Reserve – "*This is the landing site of the Edmund Kennedy expedition, 24 May 1848. It is one of the few places left in Australia where one can stand on the site where an explorer's expedition commenced and yet observe nothing in the surroundings to indicate the subsequent passage of time and the settlement and development that has taken place since then*". Although not strictly registered for its 'Natural' values, the integrity of vegetation is integral to its 'Historic' listing.

The study area also includes the southern extent of the Maria Creek Wetland complex, which is largely associated with the Maria Creek National Park. The National Park is also included on the Register of the National Estate under the 'Natural' class for "*the large numbers of vegetation communities form an important bird habitat*".

The marine areas of Mission Beach are in the Cairns Marine Park and the Great Barrier Reef World Heritage Area. Figure 5 shows the study area.

FIGURE 5 – Mission Beach Study Area



The biodiversity of the Mission Beach area extends beyond these protected areas. Biological processes that are integral to the maintenance of biodiversity are not restricted to cadastral boundaries. Many localities external to the protected area estate in the Mission Beach district are also important not only for their intrinsic values, but also for the role they play in maintaining the overall biodiversity of Mission Beach and two World Heritage areas.

1.2 WORLD HERITAGE AREAS

As discussed, Mission Beach is located at the junction of the Wet Tropics and the Great Barrier Reef World Heritage Areas. World Heritage listing is recognition by the international community that an area is such an outstanding example of the world's natural heritage that its conservation is of concern to all people. Our responsibility is to transmit to future generations such environmental treasures undiminished by the enjoyment and use of our generation recognising that there are limits to the amount of growth and impact they can absorb without compromising their integrity. The Mission Beach area is located at the interface of two World Heritage Areas of global importance.

PLATE 1 – The meeting of two World Heritage Areas

The Wet Tropics region has the highest level of biodiversity and endemism within Australia, and per unit area, possibly has one of the highest level of biodiversity (particularly at higher taxonomic levels) in the world. This in association with the Great Barrier Reef, one of the world's most species rich and diverse marine systems, arguably makes the region one of the richest and most significant parts of the world with respect to biodiversity (FNQRPAC, 2000).

The value of the Wet Tropics and the Great Barrier Reef World Heritage Areas is further discussed in the following.

1.2.1 Wet Tropics World Heritage Area

The Wet Tropics of Queensland World Heritage Area has outstanding natural values, meeting all four natural criteria for World Heritage listing and fulfilling the necessary conditions of integrity. The criteria current at the time of listing (December 1988) and specified in the nomination were:

- Outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;
- Outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;
- Superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance; and

- The most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

The Wet Tropics bioregion (Sattler & Williams, 1999), although accounting for only 0.26 percent of the total area of the Australian continent, conserves a large proportion of Australia's biodiversity (Goosem, 2002) (Table 1).

Table 1 - Importance of the Wet Tropics to Australia's biodiversity

Taxonomic group	Percentage of Australia's total
Plants	
fern species	65
cycad species	21
conifer species	37
orchid species	30
vascular plant species	26
Animals	
mammal species including: • marsupials • bats • rodents	35 30 58 25
bird species	40
frog species	29
reptile species	20
freshwater fish species	42
butterfly species	58

Within the Wet Tropics World Heritage Area there are over 2,800 known species of vascular plants, representing at least 1,037 genera and 221 families (Goosem, 2002). Seventy-five genera are endemic to Australia and 43 genera and over 700 species are restricted to the Wet Tropics. The Wet Tropics possesses 41% of all Queensland's vascular plant species in slightly over 1% of the State's land area (Goosem, 2002).

All these are indicators of the biological uniqueness of the area which sets it apart within the Australian and world context.

The Wet Tropics region is distinguished by (FNQRPAC, 2000):

- Extraordinary botanical richness and significance, unsurpassed in the Australian context (more than 700 endemic plant species);
- The continents largest range of fern species and the world's highest concentration of ancient flowering plant taxa;
- The greatest concentration of endemic mammalian fauna of any region in Australia;
- Almost half of Australia's bird species in less than 1% of Australia's area;
- Most of the known Australian rainforest reptiles most of which are endemic;
- Contains 29% of Australia's frog species with more than 20 species found nowhere else on Earth;
- A greater diversity of freshwater fishes than any other region in Australia;
- Contains around 58% of Australia's butterflies; and
- Outstanding invertebrate diversity. Land and marine invertebrates are poorly known, however, a survey of one rainforest stream revealed the highest diversity of aquatic

invertebrates to date found anywhere in the world (Pearson *et al*, 1986). The area also contains some of the continents most spectacular invertebrate species.

1.2.2 Great Barrier Reef World Heritage Area

The Great Barrier Reef (GBR) was nominated as a World Heritage property in 1981, meeting all four of the World Heritage criteria for listing as a natural property as identified in 1.2.1.

The Great Barrier Reef is the largest coral system on the planet incorporating 2,500 reefs extending over approximately 2,000km (DEWR, 2007b). It has the highest species diversity of any known ecosystem (NRA, 2004), including (CSIRO, 2001):

- six of the world's seven species of marine turtles;
- 54% of the world's mangrove diversity;
- 359 species of hard coral;
- more than 1,500 species of fish;
- 1,500 species of sponges (30% of Australia's diversity);
- 800 species of echinoderms (13% of the world's diversity);
- over 5000 species of molluscs; and
- over one-third of the world's species of soft coral and sea-pens.

1.3 PURPOSE OF STUDY

Mission Beach has been identified as an area of outstanding natural and cultural significance in a number of studies. These natural values are under pressure, particularly from residential and tourist development. Opportunities for improved environmental protection and restoration at Mission Beach are emerging, such as the Terrain Natural Resource Management's Mission Beach Habitat Network Action Plan, the Department of Infrastructure and Planning's Far North Queensland Regional Plan 2025 and possible State Planning Policy on Cassowaries. In order to plan for the future at Mission Beach, a detailed understanding of the attributes and significance of the overall environment is necessary. This report has been commissioned by Terrain Natural Resource Management to better define what makes Mission Beach a priority biodiversity area, to assist with future planning exercises to enhance decision-making, and to raise awareness in the wider community of the area's outstanding significance.

2.0 BIODIVERSITY SIGNIFICANCE

2.1 WHAT IS BIODIVERSITY?

The FNQ Regional Plan environment supporting document (FNQRPAC, 2000) defines Biodiversity, also referred to as Biological Diversity, as follows:

> *"….the natural diversity of life forms comprising ecosystem diversity, species diversity and genetic diversity.*
>
> *(This) refers to the variety of life forms that exist in natural areas. This includes the different plants, animals and micro-organisms, the genes they contain, and the ecosystems they form. 'Biological diversity' is the natural diversity of native wildlife, together with the environmental conditions necessary for their survival, and includes:*
> - *regional diversity i.e. the diversity of the landscape components of a region, and the functional relationships that affect environmental conditions within the ecosystems;*
> - *ecosystem diversity i.e. the diversity of the different types of communities formed by living organisms and the relations between them;*
> - *species diversity i.e. the diversity of species; and*
> - *genetic diversity i.e. the diversity of genes within each species*
>
> *'Landscape components' as referred to above, include landforms, soils, water, climate, wildlife and land uses."*

For the purpose of this study Biodiversity is taken to be all 'attributes' that contribute to biological values in the natural environment.

The supporting environment document to the FNQ Regional Plan (FNQRPAC, 2000) also gives guidance to the 'special characteristics of biodiversity':

> *"Biodiversity has a number of special characteristics which differentiates it from more general resource management issues. It is important that these characteristics are appreciated in regional planning considerations.*
> - *In many situations biodiversity loss is irreversible – species loss is forever;*
> - *much of the biodiversity loss that is occurring is of species we have yet to discover (eg. Especially the invertebrates and microscopic biota). This is one of the prime reasons for protecting biodiversity in general;*
> - *ecosystem diversity exhibits threshold effects ie. There are limits to the resilience of ecosystems to withstand the stresses imposed by environmental degradation. If stressed beyond these limits, ecosystems will breakdown;*
> - *information about the responses of biota to biodiversity loss is extremely limited;*
> - *many biodiversity problems cannot be solved merely by removing threatening processes, but may require ongoing active management intervention: hence the importance of developing the stewardship ethic;*

- *much of biodiversity has no immediate direct economic value, giving rise to substantial tensions between public and private interests and difficulties in designing appropriate environmental accounting systems; and*
- *the causes of genetic, species and ecosystem biodiversity losses are extremely complex and diffuse and involve many different types of activity. Furthermore, impacts to biodiversity may be caused by either on-site and/or off-site activities."*

2.2 ASSESSING BIODIVERSITY SIGNIFICANCE

Defining the significance of natural environment values or the attributes of biodiversity at a landscape scale is complex. Approaches that have been commonly adopted require the assessment of examples of attributes of biodiversity (e.g. plant species, geological feature etc) against set criteria. The Wet Tropics World Heritage Area, for instance, includes examples of attributes of biodiversity that clearly demonstrate how it meets all four of the natural criteria for World Heritage listing and fulfil the necessary conditions of integrity.

It is important to recognise that the World Heritage Values of the Wet Tropics are not restricted to the examples used to satisfy the criteria for listing. In effect, the outstanding examples only provide sufficient evidence that, in relation to the four criteria, the Wet Tropics is of global natural heritage importance. That is, there are other attributes, many of which have not yet been described or adequately mapped, that contribute to achieving each of the criteria. Furthermore, as the elements of biodiversity are the result of natural, dynamic processes, past or present, change is an essential and inherent component of their value.

It is not valid to look at an individual small area or site within the Wet Tropics Area and dismiss it as not having attributes of biodiversity that achieve the criteria – it must be viewed in the context of both its spatial relationship to its surrounding landscapes and its temporal relationships to past evolutionary processes. Interpretations of significance, particularly on a localised site or area basis need to address the threats of reductionism, or, as it has been eloquently put by others – we mustn't loose sight of the leopard by looking only at its spots.

2.3 DETERMINING BIODIVERSITY SIGNIFICANCE

A number of different approaches were considered for determining the biodiversity significance of Mission Beach that are based on systematic comparative evaluation. Three sets of criteria were initially considered as potential models against which significance could be assessed, including:

- Natural World Heritage Criteria;
- Natural Heritage Criteria (based on Mackey, Nix and Hitchcock, 2001); and
- National Heritage Criteria.

Following review of the criteria included within each of these models, it was determined that the approach adopted by Mackey, Nix and Hitchcock (2001) provided the most suitable approach for Mission Beach in that it included elements of the other models. The criteria, initially developed to assist in defining the Natural Heritage Significance of Cape York Peninsula, include:

1. **GEO EVOLUTION –** Outstanding examples representing major stages of Earth's evolutionary history, including significant geological processes which have contributed to the development of landforms, or significant geomorphic or physiographic features.
2. **GEODIVERSITY –** The most important and significant lands for *in situ* conservation of geodiversity, including those containing rare or threatened features of outstanding (universal/regional/continental/local) value from the point of view of science or conservation.
3. **BIO EVOLUTION –** Outstanding examples representing major stages of Earth's biological evolutionary history, including the record of life.
4. **BIODIVERSITY –** The most important and significant natural habitats for *in situ* conservation of biological diversity, including those containing rare or threatened species, communities or ecosystems of outstanding (universal/regional/continental/local) value from the point of view of science or conservation.
5. **NATURAL INTEGRITY –** Ecosystems and landscapes which exhibit outstanding ecological and geophysical integrity.
6. **ON GOING NATURAL PROCESSES –** Geophysical, evolutionary, and ecological processes, including local and global scaled life support systems fully functional.
7. **CONTRIBUTION TO KNOWLEDGE –** Examples of geomorphic or physiographic features, ecosystems, plant and animal communities or natural processes or phenomena, the study of which has, or is continuing to, contribute significantly to an understanding of natural history beyond that place.
8. **AESTHETICS –** Superlative natural phenomena or areas of exceptional natural beauty or aesthetic importance.

These criteria have been applied to the natural environment attributes of Mission Beach to determine the significance of the area within Cardwell and Johnstone Shires, Wet Tropics Bioregion, Far North Queensland Region, Queensland, Australia, and the world.

The 'Aesthetic/lifestyle significance' of Mission Beach will be considered in a separate report commissioned by Terrain Natural Resource Management.

3.0 THE NATURAL ENVIRONMENT ATTRIBUTES OF MISSION BEACH

3.1 GEO EVOLUTION

3.1.1 Criteria

Outstanding examples representing major stages of Earth's evolutionary history, including significant geological processes which have contributed to the development of landforms, or significant geomorphic or physiographic features.

SUB CRITERIA

(i) Geological features – outstanding or representative

(ii) Geomorphological and landform features – outstanding or representative

3.1.2 Geoevolution Discussion

There are four main topographic types in the Mission Beach area, the forms of which are directly related to the area's geology and climate. The geomorphic processes of weathering, erosion, transport and deposition play a dominant role in shaping the micro relief, as well as major features of the landscape. The four types are:

- Tidal Flats;
- Floodplains;
- Lowland Plain; and
- Coastal Ranges (Goosem, 1992).

The coastal ranges include part of the Water Hill Range, the Tam O'Shanter Range, Granadilla Ridge and the Mount Mackay area. The highest point of these ranges is Mt Mackay (725m) in the south of the area. The coastal section of the Walter Hill Range merges with the Central Highland (Great Divide) section of the Walter Hill Range to the west of the study area (Goosem, 1992).

The area is characterised by a sequence of Palaeozoic Hodgkinson Formation sediments and the Mission Beach Granite complex. Cainozoic basalts form Clump Point and the substrate for the adjoining submarine reefs. Extending southwards of Clump Point is a narrow strip of Quaternary dune deposits up to 0.5km wide that form part of Mission Beach (EPA, 2005d). Further to the south the Quaternary deposits form a well developed dune/swale sequence about 2km in width from Tam O'Shanter Point to near the Tully River. They feature broad, high quality sandy beaches. Associated with these dunes are extensive estuarine deposits associated with the Tully and Hull Rivers. (EPA, 2005b).

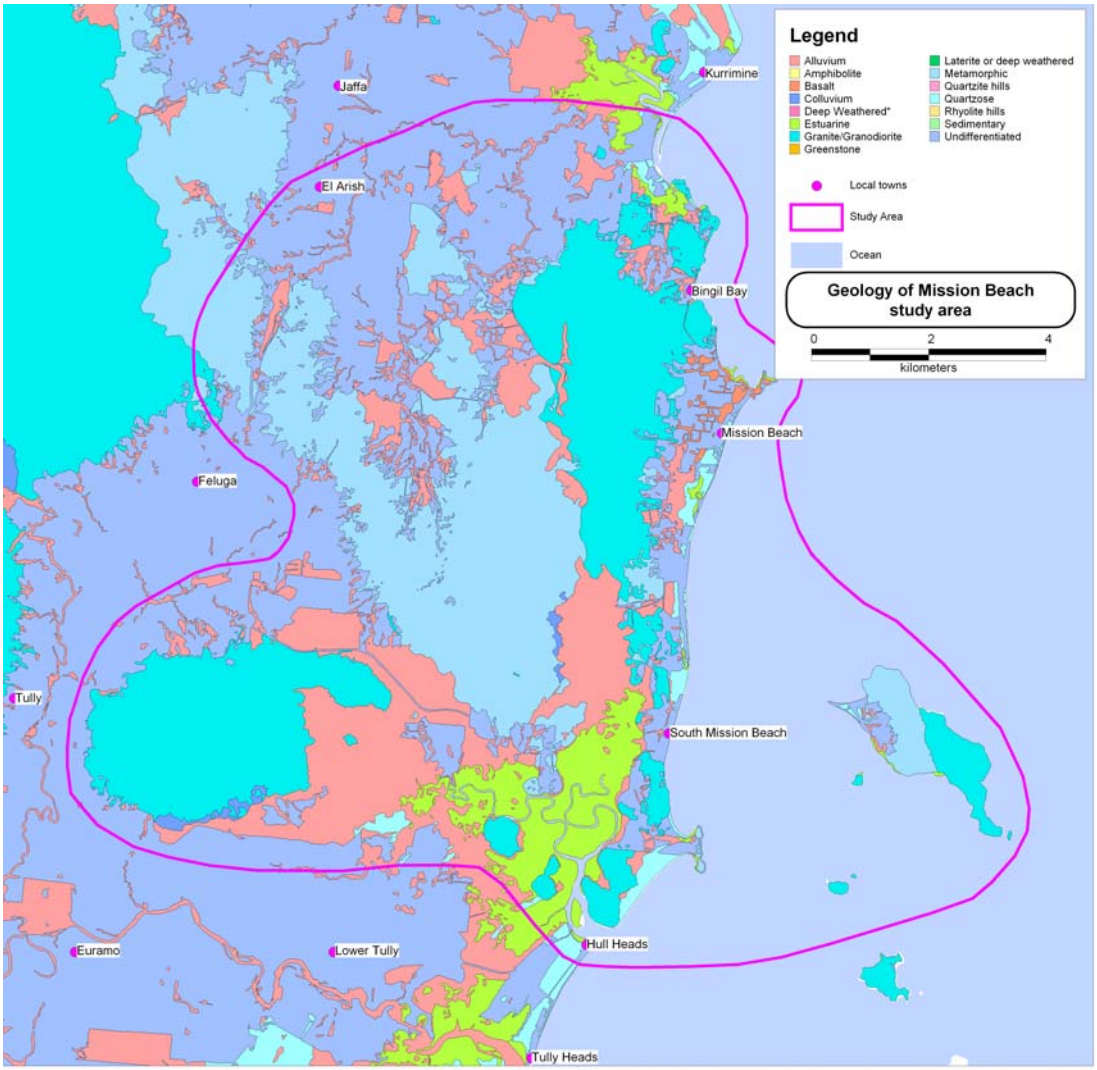


FIGURE 6 – Mission Beach Geology

Soil parent materials in the upland country include granite, low grade metamorphics and an area of basalt. The lowland country is largely riverine alluvium. Freshwater swamps, tidal estuaries and beach ridges also occupy large areas (Goosem, 1992). Less fertile soils are derived from metamorphic and granite rocks while more fertile ones are found on basalt and floodplains. The fertility of the soil governs the different vegetation associations in Mission Beach with more complex forests flourishing on the more fertile soils (EPA, 2007b). The combination of diverse geologies in conjunction with the drainage and hydrological properties of the soils derived from them has contributed to the development of the diverse vegetation assemblages found in the Mission Beach area (Small, 1995) (discussed further in Section 3.4.2.2).

What is now Tam O'Shanter Point was once an offshore island which was subsequently joined to the mainland by a tombolo[1]. This extensive dune deposit (EPA, 2005b) has formed since at least the mid Holocene and means there is little likelihood of any significant

[1] A spit that connects the mainland and an island.

longshore transport of sand around Tam O'Shanter Point. Therefore there is no significant modern day sand supply to the South Mission Beach area from the Hull or Tully Rivers, whereas, there has been deposition of sand to the south of Tam of O'Shanter Point in recent times (EPA, 2005a). Elsewhere along the Mission Beach coastline some beaches are prograding due to the proximity of Dunk Island (*pers comm.* Goosem).

PLATE 2 – Tam O'Shanter Point

3.2 GEODIVERSITY

3.2.1 Criteria

The most important and significant lands for *in situ* conservation of geodiversity, including those containing rare or threatened features of outstanding (universal/regional/continental/local) value from the point of view of science or conservation.

SUB CRITERIA

(i) Geological and geomorphological features or processes – outstanding or representative examples.

(ii) Geological and geomorphological features or processes – rare or threatened.

3.2.2 Geodiversity Discussion

The landscape configuration of Mission Beach is complex, including a number of major watercourses (e.g. Hull River and Maria Creek), mountainous landforms (e.g. Mount Mackay), foothills, dunes, swamps, reefs, islands and more. It is this diversity of land forms and

geologies contained within such a relatively small area that, in part, drives the diversity of life in Mission Beach.

As part of the regional ecosystem framework for Queensland there are twelve land zones defined which represent a simplified geology/substrate-landform classification (Sattler & Williams, 1999). The complexities of geologies means that 6 of the 7 land zones identified for the Wet Tropics occur in Mission Beach. By comparison, the whole Daintree National Park only contains 6 of the 7 land zones.

In terms of the geodiversity of Mission Beach, the following are of particular note:

- The area represents the overlap of rocky and sandy shores. To the south of Mission Beach there are virtually no mainland rocky shores until Thuringowa (a distance of approximately 150km). The rocky shoreline south of the Bingil Bay boat ramp is of particular significance as it is one of the few known sites in Queensland inhabited by the Asterinid sea star *Patriella pseudoexigua* (EPA, 2005d);

PLATE 3 – Overlap of rocky and sandy coasts

PLATE 4 – Clump Mountain

- The occurrence of basalt soils on Clump Point is also of conservation significance, as this type of soil does not occur anywhere else along the coast in the region (NRA, 2004;Stanton & Stanton, 2005;EPA, 2005d). This explains the rarity and disjunct nature of overlying vegetation communities, including the mostly intact complex mesophyll rainforest (RE 7.8.1) and native grassland. These communities are considered of high scientific and conservation value (NRA, 2004 and Goosem, 1992). Additionally, metamorphosed basalt (greenstone) occurs in the Bicton Hill area and supports rainforest as complex as that occurring on basalt. (Goosem, 1992);
- Tam O'Shanter Point is the only mainland headland in the Cardwell-Hinchinbrook Regional Coastal Management Plan (RCMP) region and supports the only occurrence of Ordovician Tam O'Shanter Granite (EPA, 2005b);
- As most areas above the 80m contour were not suitable for agricultural pursuits, they were not cleared and now much of this area has been incorporated in conservation estate. The converse is largely true for lowland areas where there was extensive clearing for agriculture. Therefore lowlands retaining native vegetation cover are regarded of significance. The diversity of soils of lowland areas, particularly those that are fertile, are under-represented in the protected area estate. Examples in the

Mission Beach area include humic gley soils of the Bulguru series and soils of the Bronson and Lugger series (Whiteley, unknown date); and

- The Walter Hill Colluvials is significant within the Tully-Murray area in that it is the only colluvium derived from metasediments in the region (Whiteley, unknown date).

3.2.3 Geoevolution and Geodiversity Significance

The geology of Mission Beach is pivotal to the diversity of ecosystems present. Table 2 summarises some of the attributes of Mission Beach's Geoevolution and Geodiversity that demonstrate how the significance criteria are met.

Table 2 – Relative Significance of Mission Beach Geoevolution and Geodiversity

Significance Context	Significance discussion
Cardwell and Johnstone Shires	Attributes of Mission Beach that demonstrate its significance within Cardwell and Johnstone Shires include: ▪ Tam O'Shanter Point is the only mainland headland in the Cardwell-Hinchinbrook RCMP region ▪ The Walter Hill Colluvials is the only colluvium derived from metasediments for the region ▪ The broad dune field south of Tam O'Shanter Point is an excellent example of its type ▪ The presence of geological features such as Mt Mackay and Dunk Island continue to shape the diversity of Mission Beach by effecting weather and ongoing geological processes
Wet Tropics Bioregion	Attributes of Mission Beach that demonstrate its significance within the Wet Tropics bioregion: ▪ The presence of 6 of the region's 7 land zones ▪ The occurrence of coastal basalt at Clump Point ▪ Humic gley soils of the Bulguru series which have not been impacted by agriculture
Far North Queensland Region	Attributes of Mission Beach that demonstrate its significance within the Far North Queensland Region: ▪ The interface of sandy and rocky shores
Queensland	Attributes of Mission Beach that demonstrate its significance within Queensland: ▪ Half of Queensland land zones are represented in a relatively small area
Australia & the world	Attributes of Mission Beach that demonstrate its significance in Australia and at a global scale: ▪ The diversity in geology in Mission Beach is one of the key drivers to the diversity in flora and fauna in one of the world's biodiverse 'hotspots'.

3.3 BIO EVOLUTION

3.3.1 Criteria

Outstanding examples representing major stages of Earth's biological evolutionary history, including the record of life.

SUB CRITERIA

(i) Palaeobotanical and palaezoological (fossil records) – outstanding or representative.

(ii) Plant and animal species or communities which are evidence of Earth's biological evolutionary history – outstanding or representative.

3.3.2 Bio Evolution Discussion

The Wet Tropics contains the most complete and diverse living record of the major stages in the evolutionary history of land plants and the most important 'living' record of the history of marsupials and the world's songbirds (Goosem, 2002). In fulfilling the criteria for World Heritage listing, the Wet Tropics is an area supporting "outstanding examples representing the major stages of the earth's evolutionary history". The Wet Tropics region conserves in its biota elements that relate to 8 major stages in the earth's evolutionary history:

1. The Age of the Pteridophytes;
2. The Age of the Conifers and Cycads;
3. The Age of the Angiosperms;
4. the final break-up of Gondwana;
5. the origins of the Australian sclerophyll flora and marsupial fauna;
6. the origin and radiation of the songbirds;
7. the mixing of the continental biota of the Australian and Asian continental plates; and
8. the extreme effects of the Pleistocene glacial periods on tropical rainforest vegetation.

The Mission Beach area supports many examples representing each of these stages as illustrated in Table 3 below.

Table 3 – Assessment of the Bio-evolution Attributes of Mission Beach

Major stages in the earth's evolutionary history	Examples in the Mission Beach area
1. The Age of the Pteridophytes	▪ Only 7 families of the 36 families of true ferns can be traced back to the earliest fossil record in the Early Carboniferous. The greatest evolutionary diversity of these 7 ancient families is found in the Wet Tropics. The 7 families represent 27 genera of which 18 are present in the Wet Tropics and 10 in the Mission Beach area (Goosem, 2002; CSIRO, 2007). ▪ The Wet Tropics has the highest diversity of ferns in Australia. Within the Mission Beach area alone, 22 of the world's 36 known families are present. 39 or approximately 11% of the 364 described genera of ferns occur in Mission Beach (Goosem, 2002; CSIRO, 2007).

PLATE 5 – ANCIENT CYCAD (*LEPIDOZAMIA HOPEI*) FOREST

2. The Age of the Conifers and Cycads	▪ *Bowenia spectabilis* is a common understorey element of the rainforests of Mission Beach. Fossil remains of a species (*Bowenia oecenica*) closely resembling *Bowenia spectabilis* have been found in Eocene deposits in Victoria (Goosem, 2002). Hope's cycad (*Lepidozamia hopei*) (Plate 5) are also found in forests of Mission Beach.
3. The Age of the Angiosperms	▪ Of the world's 19 most primitive or archaic families of flowering plants, 12 are known to occur in the Wet Tropics and 6 (or approx. 36%) within the Mission Beach area (Goosem, 2002; CSIRO, 2007). ▪ The orders Hamamelidales, Rosales, Euphorbiales, Dilleniales, Violales, Theales, Celastrales and Gentianales are considered to be particularly important groups in the evolution of flowering plants. As such, key families with relict distribution are regarded as of considerable importance. 10 out of the 15 genera represented in the Wet Tropics are found in Mission Beach (Goosem, 2002; CSIRO, 2007). ▪ Major extinctions of the flowering plants occurred at around the Cretaceous-Tertiary boundary. However, the eastern portion of Gondwana in the southern hemisphere was relatively unaffected and as such support the highest relict concentrations of Cretaceous families. The highest concentrations of relict flowering plant taxa from the Cretaceous are found in the Wet Tropics. Of the 16 families represented 8 are found in Mission Beach.
4. The final break-up of Gondwana	▪ The Wet Tropics is the only large part of the entire Australasian region where rainforests have persisted continuously since Gondwanan times and as such represents the closest modern counterpart of these ancient forests. It is accepted that the Southern Cassowary has a Gondwanan origin (Goosem, 2002) and its stronghold in Mission Beach is therefore regarded as significant.
5. The origins of the Australian sclerophyll flora and marsupial fauna	▪ The Wet Tropics region contains the highest concentration of the surviving remnants of the ancestral stock from which evolved the sclerophyll flora and marsupial fauna that now dominate the Australian landscape. Some of the Gondwanan relict species found in the Mission Beach area with affinities to sclerophyllous flora and fauna include the plants in the genera *Carnarvonia*, *Melicope* and *Medicosma* (Goosem, 2002; CSIRO, 2007) and the Musky Rat-kangaroo (*Hypsiprymnodon moschatus*) (Goosem, 2002;Keto & Scott, 1987).
6. The origin and radiation	▪ The Wet Tropics contains the highest numbers of bird species from which

of the songbirds	the nation's and possibly the world's songbirds evolved (Keto & Scott, 1987). These rainforest birds hold vital clues to the origin, evolution and biogeography of the songbirds. Numerous species from Primary Australian Stocks including the Australian robins (Eopsaltriidae), Acanthizid warblers (Acanthizidae), Honeyeaters (Meliphagidae) and Secondary Australian Stocks including the Bowerbirds and Bird of Paradise (Paradisaeidae), Australian magpies and butcherbirds (Cracticidae), Cuckoo-shrikes (Campephagidae), Monarch flycatchers (Myagridae) and Whistlers (Pachycephalidae) have been recorded in the broader Mission Beach area (Keto & Scott, 1987).
7. The mixing of the continental biota of the Australian and Asian continental plates	▪ About 15 million years ago the Australian and Asian continental plates collided. This event resulted in the mixing of two evolutionary streams that had been largely separated for at least 80 million years (Goosem, 2002). Of the 23 genera of Gondwanan or Laurasian decent, 10 have been recorded in Mission Beach (Goosem, 2002;Keto & Scott, 1987;CSIRO, 2007). ▪ Of Australia's mammals, the rodents and bats are considered to have entered since the collision of the plates (Goosem, 2002). In the broader Mission Beach area, five native rodents have been recorded including the Water-rat (*Hydromys chrysogaster*), Fawn footed Melomys (*Melomys cervinipes*), White-tailed Rat (*Uromys caudimaculatus*) (Keto & Scott, 1987), Bush rat (*Rattus fuscipes*) and Cape York Rat (*Rattus leucopus*) (Williams, 2006).
8. The extreme effects of the Pleistocene glacial periods on tropical rainforest vegetation	▪ Fossil pollen records from within the World Heritage area indicate that the rainforest underwent severe contractions during the Pleistocene glacial periods resulting in a number of extinctions and near extinctions (Goosem, 2002). An important example of ancient species that survived and persists in Mission Beach is *Podocarpus grayae* (Keto & Scott, 1987).

A large number of primitive angiosperms are known to occur in the Wet Tropics as identified in Table 3 above. A comparison of the numbers occurring in the world, the Wet Topics and in Mission Beach is presented below in Table 4.

Table 4 – Analysis of the primitive angiosperms of Mission Beach relative to the Wet Tropics and the World

		Number of Genera			Number of species		
ORDER	**FAMILY**	**Worldwide (Goosem, 2002)**	**Wet Tropics (Goosem, 2002)**	**Mission Beach (CSIRO, 2007)**	**Worldwide (Goosem, 2002)**	**Wet Tropics (Goosem, 2002)**	**Mission Beach (CSIRO, 2007)**
Magnoliales	Annonaceae	130	12	5	2,300	30	8
	Austrobaileyaceae	1	1	0	1	1	0
	Eupomatiaceae	1	1	1	3	2	2
	Himantandraceae	1	1	0	1	1	0
	Myristicaceae	15	1	1	300	2	2
	Winteraceae	9	2	0	100	7	0
Laurales	Hernandiaceae (incl. Gyrocarpaceae)	4	2	1	60	2	2
	Idiospermaceae	1	1	0	1	1	0
	Lauraceae	50	8	7	3,000	83	31
	Monimiaceae (incl. Atherospermataceae)	30	14	7	450	27	9
TOTAL		242	43	22	6,216	156	54

3.4 BIODIVERSITY

3.4.1 Criteria

The most important and significant natural habitats for in situ conservation of biological diversity, including those containing rare or threatened species, communities or ecosystems of outstanding (universal/regional/continental/local) value from the point of view of science or conservation.

SUB CRITERIA

(i) Species, populations or ecosystems – representative examples.
(ii) Species, populations or ecosystems – rare, threatened or endangered.
(iii) Species, populations or ecosystems – endemic.
(iv) Species, populations or ecosystems – other outstanding scientific or conservation value.

3.4.2 Biodiversity Discussion

The Wet Tropics is regarded on a global scale as a biological 'hotspot'. Mission Beach in its own right supports a high diversity of flora and fauna and has been referred to as a 'hotspot' within a 'hotspot'. There are many attributes that contribute to the flora and fauna diversity in Mission Beach including climate and diversity of ecosystems (both terrestrial and marine). These, along with species assemblages, are discussed in the following.

3.4.2.1 Climate

Mission Beach is located within the wettest region in Australia. The annual rainfall in the Mission Beach area varies from approximately 2,800 mm over the coastal lowlands to about 3,200–3,600 mm along the Walter Hill Range, rising to 4,000 mm a year in the area around Clump Mountain (Moore, 2007). This wide range of climates in close proximity (including very wet Mt Mackay and lower rainfall areas south from South Mission Beach) superimposed upon a complex landscape configuration assists in driving biological diversity.

Mission Beach receives approximately 54% of its annual rainfall in the wettest quarter of the year (Goosem, 1992). This is largely different from much of the Wet Tropics (including Daintree lowlands) which typically has a more distinct dry and wet season (i.e. a higher percentage of its rain falls in the wet season). This difference in rainfall patterns has a major effect on the ecology of Mission Beach. The regular moisture throughout the year, a relatively warm climate and the nutrient rich soils of Mission Beach provides for optimal tree growing conditions. Native vegetation associated with this climate type is poorly represented in the Wet Tropics World Heritage Area or other protected areas because it was historically favoured for agricultural pursuits.

3.4.2.2 Terrestrial Vegetation Communities

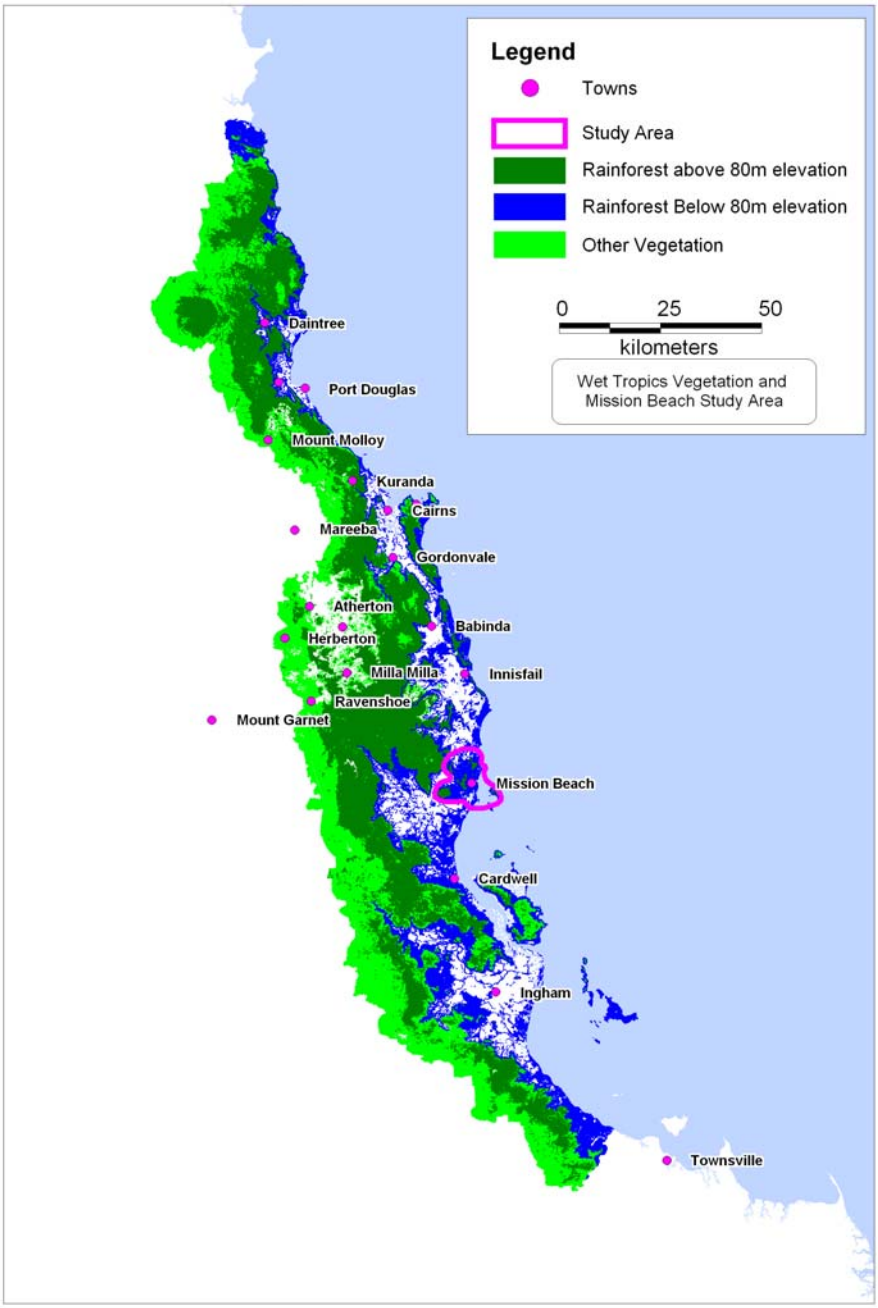
Mission Beach supports one of the most complex coastal vegetation mosaics within the Wet Tropics – only the Daintree lowlands have a greater complexity of community types and species associations. The Mission Beach area supports the greatest diversity of impeded drainage vegetation community types in North Queensland (Small, 1995) and has the highest diversity (per unit area) of broad habitat types in the Wet Tropics (C4, 2007). A feature of the areas between North and South Mission Beach are the extensive coastal forest dune swale systems dominated by Moreton Bay Ash (*Corymbia tessellaris*) and Blue-leaved Paperbark (*Melaleuca dealbata*) with an extensive vine scrub (littoral vine forest) understorey that are dissected by streams and water courses.

PLATE 6 – Paperbark Woodland

PLATE 7 – Vine thicket on sand

The rugged terrain, steep slopes and highly erodible escarpment of the Wet Tropics' coastal ranges are unsuitable for agriculture and have remained largely uncleared. However, areas below the 80m contour have been very significantly impacted by clearing for agriculture resulting in the loss of 81% of all Wet Tropics' lowland vegetation types by 1997 (WTMA, 2006). On this basis, remaining areas of lowland vegetation are regarded as being of high significance. Figure 7 illustrates the extent of vegetation below the 80m contour in the Wet Tropics region.

FIGURE 7 – Rainforest below 80m contour



Mission Beach supports 12.8% of all lowland rainforest in the Wet Tropics and 6% of all remaining lowland vegetation. The rainforests of Mission Beach represent the largest area of intact 'blocks' of lowland rainforest south of the Daintree River.

The diverse vegetation assemblage of Mission Beach has been mapped by Stanton and Stanton (2005) who have described 37 natural[2] vegetation communities. A tabulated list of all communities is included in Appendix A.

[2] Stanton and Stanton (2005) had mapped a total of 41 vegetation types, however for the purpose of this study, 4 were disregarded. These are also listed in Appendix A.

These assemblages represent the largest area of remaining lowland vegetation mosaics and complexes in the Wet Tropics, including a large number of rare and threatened vegetation communities (i.e. Types 3a, 3b, 1a, 18, 17 and others) (Weston & Goosem, 2004). Amongst the vegetation communities represented the following are of particular note:

- Although two thirds of the original fan palm forests that occur near Stony Creek, North Hull River and O'Donnell Creek have been cleared, one of the remaining patches is nonetheless the largest surviving remnant of mesophyll vine forest with dominant palms (Type 3b) in the Wet Tropics (Keto & Scott, 1987). The extent of Licuala Fan Palm forests within Mission Beach represents 50% of all remaining stands (C4, 2007).

PLATE 8 – Fan Palm Forest

PLATE 9 – Coastal rainforest on basalt

- The Clump Point area is the only occurrence within the Wet Tropics of complex mesophyll rainforest (Type 1a) occurring on basalt in a coastal situation. Although the patches are small, they have been described by Stanton and Stanton (2005) as a "resource of exceptional scientific interest".
- A small patch of native grassland (Type 59) occurs at Clump Point (Stanton & Stanton, 2005;NRA, 2004). Grasslands are rare in the Wet Tropics region and very few occur on basalt. The patch at Clump Point is unique within the Wet Tropics in that it represents the only headland occurrence of grassland on basalt and hence its occurrence has been described by Stanton and Stanton (2005) as of "outstanding significance".
- Prior to European settlement *Melaleuca viridiflora* woodland (Type 78) was a common vegetation type in the valley of the Tully River and in coastal areas from the Mission Beach area to Cardwell, but since settlement has undergone extensive clearing. Although remnants of this community in Mission Beach represent just over 1% of its total extent in the Wet Tropics, it is regarded of "considerable conservation significance" by Stanton and Stanton (2005) within the context of the Clump Point map sheet.
- Mesophyll Vine Forest on sand would not have been abundant even prior to settlement. It is a rare and fragile vegetation type of very high conservation significance (Goosem, 1995). Its occurrence at Mission Beach, although only accounting for approximately 2% of its extent in the Wet Tropics, is regarded as important.
- A large diversity of wet tropical lowland vegetation types is found within a small and complex area of the Mt Mackay section of the Hull River National Park (Stanton and Stanton, 2005).

- The dunal habitat of Kennedy Bay represents the most intact example of this ecosystem type within the Clump Point map sheet (Stanton and Stanton, 2005).

PLATE 10 – Clump Point's grassland looking toward Dunk Island

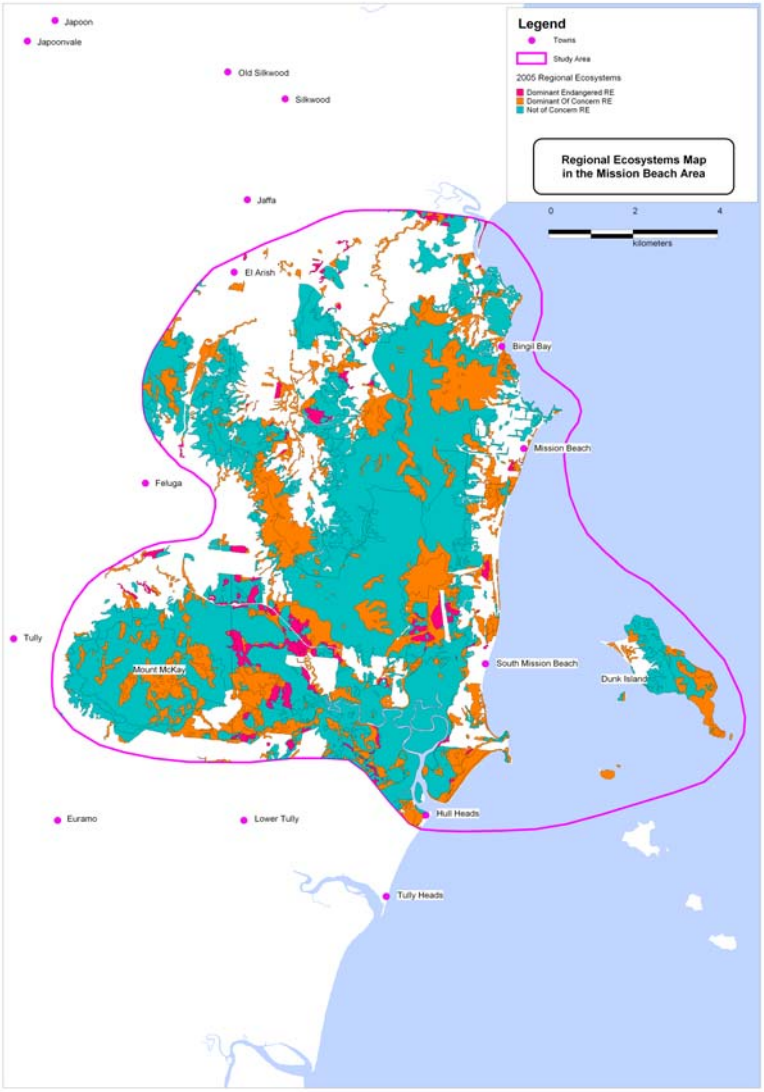
PLATE 11 – Coastal lowland rainforests

The area has also been mapped by the Queensland Herbarium through application of the Regional Ecosystems framework (EPA, 2007a;EPA, 2005c). Regional Ecosystems are ascribed a status under the *Vegetation Management Act 1999* (VMA) most often based on the percentage of the regional ecosystem remaining following European settlement. Where <10% of a regional ecosystem remains it is regarded as 'Endangered' and where 10-30% remains it is regarded as 'Of Concern'. Generally where >30% remains it is regarded as 'Not of Concern'. Table 5 below provides a comparison of the number of Endangered and Of Concern regional ecosystems occurring in Mission Beach with the Wet Tropics Bioregion and the State. The distribution of regional ecosystems for Mission Beach and their status is illustrated in Figure 8.

Table 5 – Number of Endangered and Of Concern Regional Ecosystems in Mission Beach

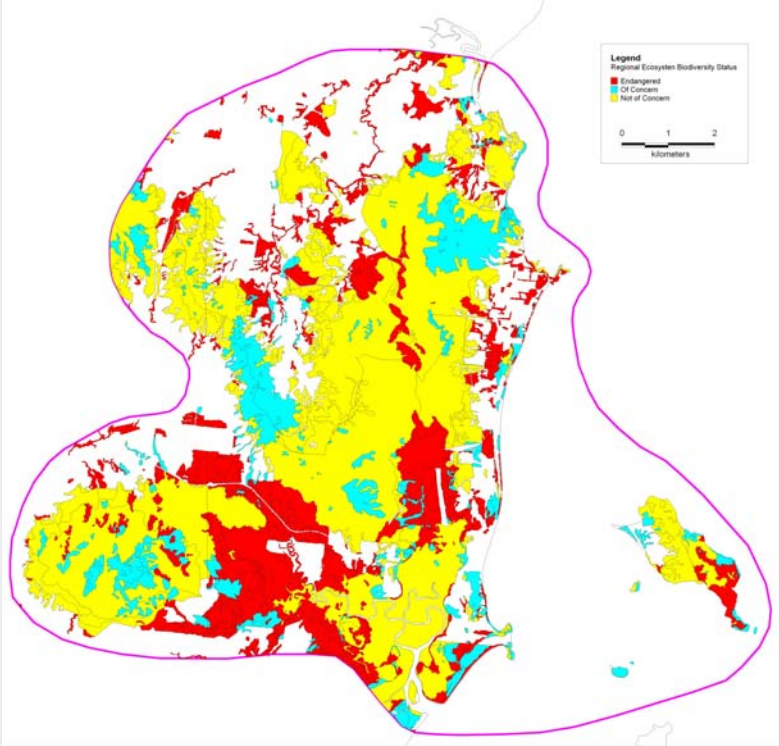
Location	Total Regional Ecosystems	Total Endangered under VMA	Total Of Concern under VMA
Queensland	1,351	92	516
Wet Tropics Bioregion	185	18	134
Mission Beach	47	8	31

FIGURE 8 – Regional Ecosystems of Mission Beach



The Environmental Protection Agency also identifies a 'Biodiversity Status' of regional ecosystems based on an assessment of the condition of, and threats to, remnant vegetation in addition to the pre-clearing and remnant extent of a regional ecosystem. Within the Mission Beach area, 23 are regarded as 'Endangered' and 19 are regarded as 'Of Concern' representing almost 90% of all regional ecosystems in the area as illustrated in Figure 9.

FIGURE 9 – Regional Ecosystems of Mission Beach and their Biodiversity Status



3.4.2.3 Terrestrial Flora diversity

In terms of the diversity of terrestrial flora, the Wet Tropics is regarded as a 'hotspot' of global significance. It possesses 26% of Australia's vascular plant diversity and 41% of all of the species in Queensland within an area accounting for slightly more than 1% of the State (Weston & Goosem, 2004). Table 6 below provides a comparison of vascular plants within Mission Beach to that in Queensland and the Wet Tropics. The known floral diversity of Mission Beach represents 5% of all recorded vascular plant species in Australia (CSIRO, 2007;ANPG, 2007) in approximately 0.005% of the continental area.

Table 6 – Diversity of native vascular plants in Mission Beach, the Wet Tropics and Queensland

Vascular Plants	Queensland	Wet Tropics	Mission Beach
Angiosperms	7,901	2,555	692
Gymnosperms	62	23	3[3]
Pteridophytes	381	267	58
TOTAL	8,344 (Bostock & Holland, 2007)	2,845 (Goosem, 2002)	752 (CSIRO, 2007)

Another significant attribute of the diversity of flora in the Wet Tropics is the degree of endemicity, that is, the number of species that do not occur anywhere else. There are over 700 species endemic to the Wet Tropics (Weston & Goosem, 2004) in an area that accounts for 0.26% of the Australian continent (Goosem, 2002). Mission Beach supports approximately 13% of the species that are found nowhere else but the Wet Tropics. An analysis of flora endemicity in Mission Beach is presented in Table 7.

[3] Based on CSIRO, 2007, plus local evidence of the presence of *Lepidozamia hopei*

Table 7 – Analysis of flora endemicity in Mission Beach

(CSIRO, 2007;Weston & Goosem, 2004)

Vascular Plants	Mission Beach total species recorded	Number of species in Mission Beach that are endemic to Australia	Number of species in Mission Beach that are endemic to Australia and New Guinea	Number of species in Mission Beach that are endemic to the Wet Tropics	Number of species in Mission Beach that are endemic to Mission Beach
Angiosperms	692	271	376	87	1[4]
Gymnosperms	3	3	3	0	0
Pteridophytes	58	9	13	2	0
TOTAL	752	282	391	89	1

The Wet Tropics supports an amazing diversity of Mangroves with 39 species representing all of Australia's species in the one region (Johnstone Shire Council, 2005) corresponding with 54% of the world's mangrove diversity (CSIRO, 2001). Within the Mission Beach area, there have been 25 species of mangrove recorded (Lovelock, 1993; CSIRO, 2007). At Clump Point, Mission Beach supports the only mangroves on basalt in the Wet Tropics bioregion.

PLATE 12 – Mangroves

[4] The orchid *Habenaria divaricata* is regarded as endemic to Dunk Island.

3.4.2.4 Threatened Terrestrial Flora

The diverse and relatively intact forests of the Mission Beach area support a high diversity of threatened plant species. The known listed plant species recorded to date in the Mission Beach area are listed in Table 8 and comparison of the numbers occurring in the area with those in the Wet Tropics and the State is presented in Table 9.

Table 8 – Rare & threatened plant species listed in the *Nature Conservation (Wildlife) Regulation 2006* that have been collected in Mission Beach to date

COMMON NAME	SPECIES	FAMILY	*Nature Conservation Act 1992* Status
-	*Carronia pedicellata*	Menispermaceae	Endangered
Showy Costus	*Costus potierae*	Zingiberaceae	Endangered
-	*Hedyotis novoguineensis*	Rubiaceae	Endangered
-	*Amomum dallachyi*	Zingiberaceae	Rare
-	*Aphyllorchis queenslandica*	Orchidaceae	Rare
-	*Cleistanthus discolor*	Euphorbiaceae	Rare
-	*Gouania australiana*	Rhamnaceae	Rare
-	*Ilex* sp. (Gadgarra B.P.Hyland RFK211)	Aquifoliaceae	Rare
-	*Macaranga polyadenia*	Euphorbiaceae	Rare
-	*Polyalthia patinata*	Annonaceae	Rare
-	*Rourea brachyandra*	Connaraceae	Rare
Arenga Palm	*Arenga australasica*	Arecaceae	Vulnerable
Ant Plant	*Myrmecodia beccarii*	Rubiaceae	Vulnerable

PLATE 13 – Midstorey of the 'Vulnerable' Arenga Palm

Table 9 – Number of rare & threatened plant species listed in the *Nature Conservation (Wildlife) Regulation 1994* occurring in Mission Beach, the Wet Tropics and Queensland

	Endangered			Vulnerable			Rare		
Vascular Plants	**QLD**	**WT**	**MB**	**QLD**	**WT**	**MB**	**QLD**	**WT**	**MB**
Angiosperms	131	38	3	247	41	2	649	207	8
Gymnosperms	8	0	0	12	1	0	9	3	0
Ferns + Fern Allies	12	7	0	14	12	0	40	28	0
TOTAL	151	42	3	273	54	2	698	238	8

QLD = Queensland (Goosem, 2002); WT = Wet Tropics (Goosem, 2002); MB = Mission Beach (CSIRO, 2007)

Case Example:

Ant Plant (*Myrmecodia beccarii*)

The Ant Plant (*Myrmecodia beccarii*) is regarded as 'Vulnerable' under both Queensland's *Nature Conservation Act 1992* and the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*. It is an unusual epiphytic species growing on the trunks of coastal trees including mangroves and paperbarks, the latter primarily occurring in vegetation communities that have been subject to extensive clearing. Present in the Mission Beach area, it represents an excellent example of the interdependency of species and complexities of ecological functions.

As the plant grows, tissue within the tuber dies forming a series of hollow chambers or 'galleries'. These galleries are inhabited by colonies of a small golden ant (*Iridomyrmex cordatus*). A symbiotic relationship exists between the Ant Plant and the ants; the plant provides a protective shelter for the ants, in turn the aggressive ants provide additional nutrients to the plant through its waste and protects the plant from insect attack (Johnstone Shire Council, 2005).

In a three-way symbiotic relationship the 'Vulnerable' Apollo Jewel Butterfly (*Hypochrysops apollo apollo*) lay eggs on the Ant Plants, and after hatching the ants carry the larvae into their nests and protect them in exchange for a sugary secretion exuded from glands on the larvae's back. The larvae of the butterfly graze on the inside walls of the Ant plant's galleries and sometimes on the leaves at night (Qld Museum, 2007). The larvae then pupate, hatch normally and fly away.

The seeds of the Ant Plant are spread by the Mistletoe Bird (*Dicaeum hirundinaceum*). The sticky flesh on the seeds glues the seed onto the bark of its host tree, making life for the Apollo Jewel Butterfly dependent on birds, ants, trees and epiphytes.

3.4.2.5 Terrestrial Fauna Diversity

The Wet Tropics supports a high diversity of the Australian continent's faunal diversity including (Weston & Goosem, 2004):

- 35% of Australia's mammal species;
- 29% of Australia's frogs;
- 20% of Australia's reptiles;
- 42% of Australia's freshwater fish; and

- 58% of Australia's butterflies.

The richness of land types, vegetation communities and floristic assemblages means that Mission Beach supports a diversity of terrestrial habitats and consequently a high diversity of terrestrial fauna. Of the available datasets, a comparison of the area's diversity to the remainder of the Wet Tropics and Australia could only be made for the mammals and birds (see table 10)

Table 10 – Diversity of mammals and birds occurring in Mission Beach compared with the Wet Tropics and Australia

Class	Australia (Weston & Goosem, 2004)	Wet Tropics (Weston & Goosem, 2004)	Mission Beach
Mammals	315	110	52 (C4, 2007)
Birds	777	314	277 (Walker, 2007)

Existing information indicates that almost half of all mammal species occurring in the Wet Tropics occur in Mission Beach, which also equates to 17% of the mammals on the continent.

The diversity of birds is also significant. By way of comparison, the UK has 280 regularly occurring bird species and New Zealand has only 97 native species (Weston & Goosem, 2004) while Mission Beach has 277 (Walker, 2007). Mission Beach provides habitat for approximately 36% of Australia's bird species.

The Wet Tropics supports more rainforest dependant vertebrates than any other area in Australia (Goosem, 2002). Most of these are confined to the cooler, upland rainforests and therefore do not occur in Mission Beach. However, there are a number of Wet Tropic endemic species that have been recorded in the broader Mission Beach area that are not restricted by altitude (Goosem, 2002, Keto & Scott, 1987, Keto & Scott, 1987) including:

- Musky Rat-Kangaroo (*Hypsiprymnodon moschatus*);
- The limbless snake-tooth skink (*Coeranoscincus frontalis*);
- Prickly Forest Skink (*Gnypetoscincus queenslandiae*);
- Boyd's Forest Dragon (*Hypsilurus boydii*);
- Ornate Frog (*Cophixalus ornatus*);
- Pied Monarch (*Arses kaupi*);
- Victoria's Riflebird (*Ptiloris victoriae*);
- Lesser Sooty Owl (*Tyto multipunctata*); and
- Macleay's Honeyeater (*Xanthotis macleayana*).

The diversity of fauna also includes some of the more spectacular creatures of the Wet Tropics such as the Stripped Possum (*Dactylopsila trivirgata*) and one of the largest populations of the White Lipped Tree Frog (*Litoria infrafrenata*) – one of the world's largest frogs. Although there is no comprehensive list of the frogs of Mission Beach available, local naturalists have recorded up to 27 different species including the significant species Common Mist Frog (*Litoria rheocola*), Green-eyed Treefrog (*Litoria genimaculata*), Waterfall Frog (*Litoria nannotis*) and Lace-eyed Tree Frog (*Nyctimystes dayi*) (pers comm. Walker, 2007)

Photo on left courtesy of Phil Bender and photo on right courtesy of Michael Anthony

PLATE 14 – The Lace-eyed Tree Frog (*Nyctimystes dayi*) is listed as 'Endangered' under both State and Federal legislation.

Mission Beach provides habitat for a diversity of insects including the iconic Ulysses Butterfly (*Papilio ulysses*) and the 'Vulnerable' Apollo Jewel Butterfly (*Hypochrysops apollo apollo*). There still remains much to learn about the insect diversity of Mission Beach (Johnstone Shire Council, 2005).

3.4.2.6 Threatened Terrestrial Fauna

The extent of clearing of lowland vegetation in the Wet Tropics has significantly reduced the available habitat for a range of fauna species. Consequently a number are now listed as threatened under State and/or Federal legislation. The diverse vegetated areas of Mission Beach provide habitat for many threatened fauna including two of the Wet Tropics icon species – the Southern Cassowary (*Casuarius casuarius johnsonii*) and the Mahogany Glider (*Petaurus gracilis*).

Areas below the 80m contour are regarded as particularly important habitat for Cassowaries with the highest densities of the species concentrated on the lowland plain (WTMA, 2006). The extensive clearing of these areas has meant that only approximately 19% of all vegetation types of the lowland plain remain. As Mission Beach supports 12.8% of the Wet Tropics lowland rainforests, it is regarded as highly significant for the conservation of this Endangered species. Large portions of the Mission Beach area have been identified as either 'Critical Habitat', 'Important Cassowary Habitat' or 'Potentially Critical/Important' Cassowary Habitat (Goosem, 1992). Significant areas of Cassowary Habitat at Mission Beach are within the protected area estate but also significant areas of Cassowary Habitat at Mission Beach are outside the protected area estate, particularly corridors connecting protected areas of habitat.

Case Example:

The Southern Cassowary (*Casuarius casuarius johnsonii*)

The most widely recognised and documented significant species of the Mission Beach area is the Southern Cassowary (Biotropica Australia, 2005;NRA Environmental Consultants, 2006). It is estimated that there are between 900 (C4, 2007) and 1,500 (Weston & Goosem, 2004) individual cassowaries remaining in the Wet Tropics with the highest densities of the species found in the lowland plain below the 80m contour (WTMA, 2006). The Mission Beach population represents the highest concentration of the species in Australia (Weston, 2006) and is estimated to include approximately 110 individuals (Moore, 2007).

PLATE 15 – The Southern Cassowary

At the National level, the Southern Cassowary is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999*. At the State level, the northern (Cape York) and southern (Wet Tropics) populations are listed separately under the Queensland *Nature Conservation Act 1992* as:

- Northern (Cape York) population listed as Vulnerable; and
- Southern (Wet Tropics) population listed as Endangered.

The clearing of lowland cassowary habitat has been, and continues to be, a major problem. The loss of connectivity segregates the feeding and breeding sections of an individual's habitat and increases its vulnerability to threatening processes such as dog predation and roadkill.

The Southern Cassowary plays an important role in the dispersal of a number of rainforest plants with over 230 native Wet Tropics plant species recorded in their diet (WTMA, 2006). They have the capacity to disperse large rainforest seeds, often too large for other animals (Weston, 2006) for distances exceeding 5km (WTMA, 2006). It has been estimated that 70 to 100 species of plant depend almost entirely on the cassowary to disperse their seeds (C4, 2007).

The importance of the Mission Beach population extends beyond to adjoining areas of World Heritage as the Mission Beach population is likely to be a vital source for the dispersal of the overall Cassowary population (Biotropica Australia, 2005).

The Mission Beach area represents the northern extent for the 'Endangered' Mahogany Glider (*Petaurus gracilis*) with the Hull Heads/Mission Beach area being recognised as an important isolated metapopulation (QPWS, 2001). Areas of Swamp Paper Bark (*Melaleuca*

quinquenervia), Broad-leaved Teatree (*M. viridiflora*), Red Teatree (*M. dealbata*) and Forest Red Gum (*Eucalyptus tereticornis*) woodlands within and surrounding the Tam O'Shanter, Mount Mackay and the Hull River National Parks are regarded as significant for the species (DNRME, 2004).

Other listed species that have been recorded utilising the diverse terrestrial and estuarine habitats of Mission Beach are tabulated below:

Table 11 – Threatened Fauna species recorded in the terrestrial portions of the Mission Beach study area

(NRA, 2004;EPA, 2005b;EPA, 2005d)

Class	Common Name	Species	Status
Mammals	Mahogany Glider	*Petaurus gracilis*	E
	Spectacled Flying Fox	*Pteropus conspicillatus*	V*
Birds	Southern Cassowary	*Casuarius casuarius johnsonii*	E
	Little Tern	*Sterna albifrons*	E
	Beach Stone Curlew	*Esacus neglectus*	V
	Macleay's fig-parrot	*Cyclopsitta diophthalma macleayana*	V
	Eastern Curlew	*Numenius madagascariensis*	R
	Sooty Oystercatcher	*Haematopus fuliginosus*	R
	White-rumped Swiftlet	*Collocalia spodiopygius*	R
Reptiles	Estuarine Crocodile	*Crocodylus porosus*	V

With the exception of the Spectacled Flying Fox, which is regarded as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*, the status listed is that applied under the *Nature Conservation Act 1992*.

The Family Islands provide regionally significant bird sites supporting several seabird nesting colonies including (EPA, 2005b):

- Dunk Island Spit for the Little Tern and other ground-nesting species;
- Mound (Purtaboi) Island for the Beach Stone Curlew, Sooty Oyster Catcher and ground nesting seabirds;
- Battleship Rock (Pee Rahm Ah) Island for the White-rumped Swiftlet and ground nesting seabirds; and
- Woln Garin Island for various ground nesting seabirds.

The *Environment Protection and Biodiversity Conservation Act 1999* also lists migratory species. A number of migratory species have been recorded in the Mission Beach area including the Caspian Tern (*Sterna caspia*), Little Tern (*S. albifrons*), Lesser Crested Tern (*S. bengalensis*), Common Tern (*S. hirundo*), Eastern Curlew, Whimbrel (*Numenius phaeopus*) and Greenshank (*Tringa nebularia*) (NRA, 2004).

3.4.2.7 Wetlands

The wetlands of the Wet Tropics have experienced considerable pressure from both direct clearing and from man-made changes to their natural hydrology, such that only 14% of their pre-clearing extent remains (Weston & Goosem, 2004).

Significantly, 51% of the Regional Ecosystems mapped in Mission Beach are regarded to be, or contain, wetlands (EPA, 2007a;EPA, 2005c). These are tabulated below.

Table 12 – Wetland Regional Ecosystems mapped in Mission Beach

Wetland	Regional Ecosystem Code
Contains palustrine wetland (e.g. in swales)	7.2.1
	7.3.7
	7.3.10
	7.8.7
	7.11.1
	7.12.1
	7.12.37
Estuarine wetlands (e.g. mangroves)	7.1.1
	7.1.2
	7.1.3
Floodplain (other than floodplain wetlands)	7.2.4
	7.3.8
	7.3.12
	7.3.46
	7.12.60
Palustrine wetland (e.g. vegetated swamp)	7.2.8
	7.2.9
	7.3.1
	7.3.3
	7.3.4
	7.3.5
	7.11.2
	7.12.2
Riverine wetland or fringing riverine wetland	7.3.25

The Wet Tropics region has about one-fifth of Queensland's Wetlands of National and State Significance (Weston & Goosem, 2004). Of the 181 Nationally Important Wetlands recorded in Queensland, the Wet Tropics includes 32 of which 3 are located, in part, within Mission Beach (Weston & Goosem, 2004). Although some of these wetlands are not entirely contained within the Mission Beach area they are integral to the biological value of the area. The wetlands include (DEWR, 2007b):

- The **Great Barrier Reef Marine Park**;
- Located in the north of the Mission Beach area the **Kurrimine Wetlands** includes the estuary of Maria Creek, the sand spit to the south of Kurrimine township, Garners Beach and the wetlands associated with Muff and Cedar creeks. Habitats present on the site include open estuarine water, the sandy spit, closed mangrove forest,

saline/freshwater ecotonal communities, open sclerophyll woodland, open sclerophyll forest, vine thicket and closed forest. Mangroves occupy about half of the site. The largest area (c. 350 ha) is located on the tidal reaches of Maria Creek;

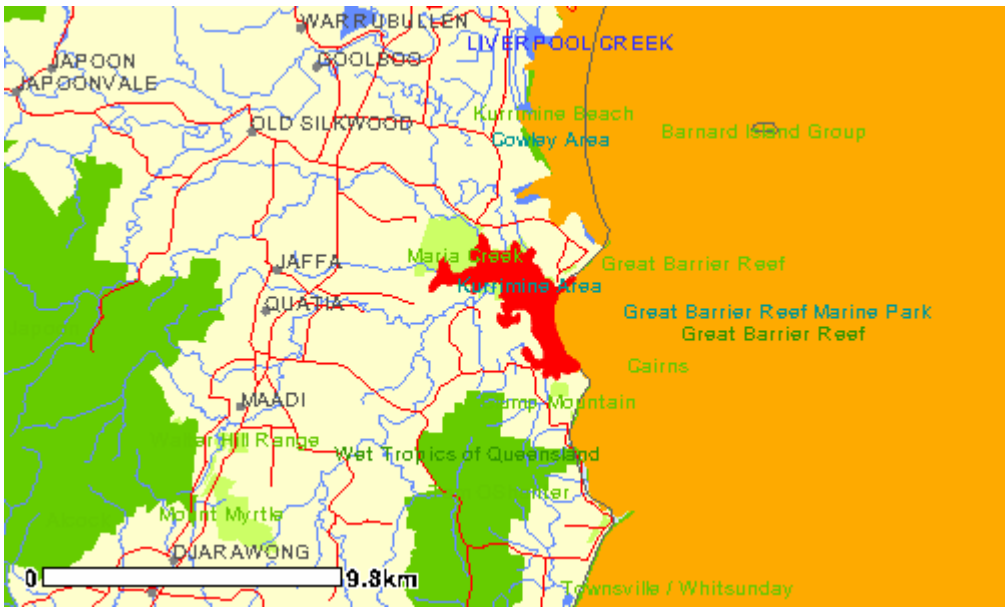


Image sourced from DEWR, 2007b. Red areas define the extent of the listed wetland.

FIGURE 10 – Kurrimine Wetlands

- **Licuala Palm Forest** is centred west of Wongaling Beach. The site is an area of lowland forest traversed by several small streams, with associated depressions which have impeded drainage. The catchment is that of a number of small streams which drain out of the forested low hills of the adjacent Tam O'Shanter and Walter Hill Ranges and into the North Hull River.

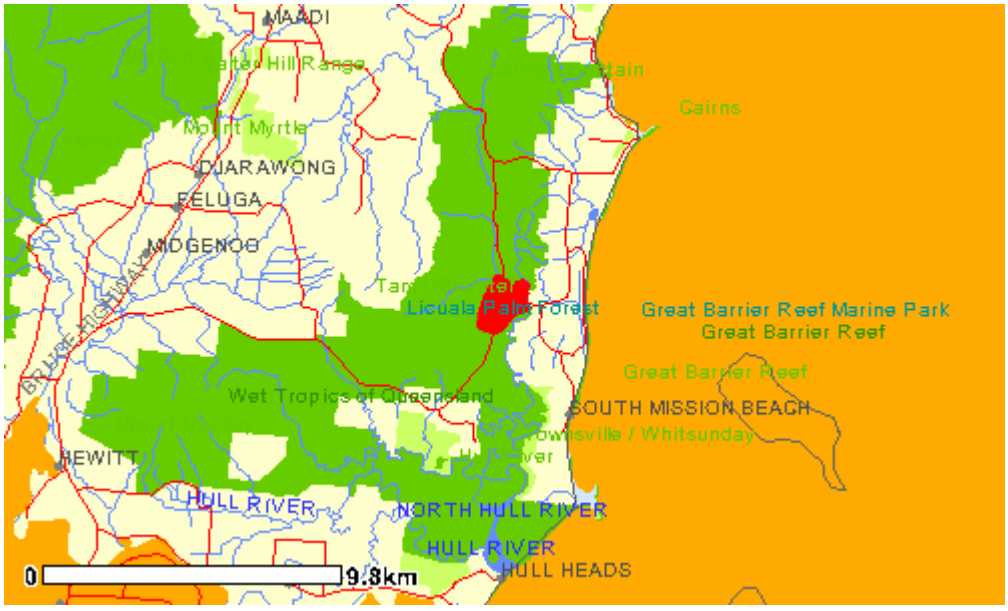
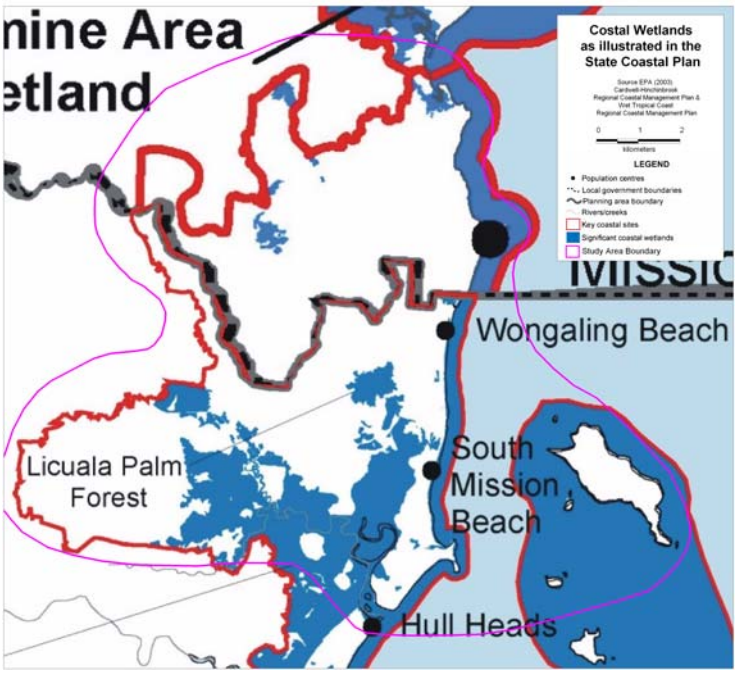


Image sourced from DEWR, 2007b. Red areas define the extent of the listed wetland.

FIGURE 11 – Licuala Palm Forest Wetlands

Much of the Mission Beach area has also been mapped as Wetlands of State Significance under the Regional Coastal Management Plans (see Figure 12). and as Estuarine System, Riverine System and Palustrine System as part of the Queensland Wetlands Programme (EPA, 2006)

FIGURE 12 – Significant Wetlands



The wetland complex in the south of the Mission Beach area is significant in that it has high natural integrity as it is fed from reasonably intact catchments arising from the largely natural Mount Mackay and Walter Hill Range (EPA, 2005b). Hull River represents the northern extent of one of the largest mangrove system in the Wet Tropics (Small, 1995). As discussed in Section 3.4.2.3, the area supports 64% of Australia's mangrove species and the only occurrence of mangroves on basalt in the Wet Tropics bioregion.

3.4.2.8 Marine Ecosystems

The marine areas of Mission Beach form part of the Great Barrier Reef Marine Park regarded as a wetland of National Significance (DEWR, 2007b) and as a World Heritage Area. The Marine Park zonings within the Mission Beach area include Habitat Protection, Conservation Park and Marine National Park (including Kennedy Bay, Garners Beach and areas to the south of Dunk Island incorporating the Stingaree Reefs) (MBMAC, 2005).

The marine areas support habitat for a large diversity of flora and fauna including rare and threatened species such as Irrawaddy and Indo-Pacific humpback dolphins, dugong and turtles (EPA, 2005d). Intertidal reef platforms of high natural integrity occur around some of the Family Islands (EPA, 2005b). The rocky shoreline south of the Bingil Bay boat ramp is of particular scientific significance as it is one of the few known sites in Queensland inhabited by the Asterinid Sea Star (*Patriella pseudoexiqua*) (EPA, 2005d). Mainland fringing reefs occur at Garners Beach, Bingil Bay, Clump Point and Tam O'Shanter Point. Together with King Reef at Kurrimine Beach, the Mission Beach reefs represent the largest suite of mainland fringing reefs between Cairns and Bowen (GBRMPA, 2004) and therefore are regionally significant.

Dunk Island has been identified as supporting important Seagrass beds (MBMAC, 2005) including 12 different species (Weston & Goosem, 2004) equating with 57% of Australia's (Earth Trends, 2007) and about 20% of the world's species (EOEarth, 2007).

3.4.3 Biodiversity Significance

Mission Beach supports a high diversity of flora and fauna and many of the elements that make the Wet Tropics the most complete and diverse living record of the major stages in the evolutionary history of land plants and the most important 'living' record of the history of marsupials and the world's songbirds. Table 13 summarises the Bioevolution and Biodiversity values of Mission Beach

Table 13 – Relative Significance of Mission Beach in terms of Bio evolution and Biodiversity

Significance Context	Significance discussion
Cardwell and Johnstone Shires	Attributes of Mission Beach that demonstrate its significance within Cardwell and Johnstone Shires include: ▪ The largest 'block' of intact lowland rainforest remaining in the local government area ▪ Relatively large areas of intact *Melaleuca viridiflora* woodlands ▪ 90% of all regional ecosystems in the area have an 'Endangered' or 'Of Concern' Biodiversity Status
Wet Tropics Bioregion	Attributes of Mission Beach that demonstrate its significance within the Wet Tropics bioregion: ▪ One of the most complex coastal vegetation mosaics in the Wet Tropics ▪ The only location where rainforest occurs on basalts in a coastal situation ▪ The only headland occurrence of a native grassland community on basalt ▪ Contains habitat for a diversity of threatened flora and fauna ▪ Largest suite of mainland fringing reefs between Cairns and Bowen
Far North Queensland Region	Attributes of Mission Beach that demonstrate its significance within the Far North Queensland Region: ▪ Represents the northern extent of habitat for the Mahogany Glider ▪ Virtually the entire rocky foreshore of Mission Beach is significant due to its unique landforms (Tam O'Shanter Point Ordovician granite and Clump Point basalt headland), unique flora (mangroves on basalt), unique fauna (Asterinid sea star) and extensive fringing reefs associated with the rocky shores
Queensland	Attributes of Mission Beach that demonstrate its significance within Queensland: ▪ The largest remaining patch of Licuala Fan Palm forests
Australia	Attributes of Mission Beach that demonstrate its significance in Australia: ▪ Supports 5% of all recorded vascular plant species in Australia in approximately 0.005% of the continent ▪ The area provides habitat for 17% of all species of mammal recorded in Australia and approximately 36% of the native bird species ▪ The highest concentration of Cassowary in Australia ▪ Includes (in part) 3 Nationally Important Wetlands
World	Attributes of Mission Beach that demonstrate its significance on a global scale: ▪ Approximately 10% of the world genera of primitive angiosperms are represented in Mission Beach ▪ 13% of the flora of Mission Beach are found nowhere else but the Wet Tropics ▪ 20% of the world's seagrass and about 35% of the world's mangrove species occur in the marine areas of Mission Beach

3.5 NATURAL INTEGRITY

3.5.1 Criteria

Ecosystems and landscapes which exhibit outstanding ecological and geophysical integrity.

SUB CRITERIA

(i) Terrestrial ecosystems – high degree of natural integrity.
(ii) River corridor ecosystems – high degree of natural integrity.
(iii) Wetland ecosystems – high degree of natural integrity.
(iv) Coastal and marine ecosystems – high degree of natural integrity.

3.5.2 Natural Integrity Discussion

In considering this criterion, the integrity of terrestrial, riverine, wetland, coastal and marine ecosystems must be taken into consideration.

The Integrity of terrestrial ecosystems can be considered by assessing the 'quality' of mapped vegetation. Despite considerable clearing of lowland environments in the Wet Tropics, Mission Beach still supports broad areas of vegetation including over 12% of the Wet Tropics lowland rainforests. However, many of these areas have been logged such as almost all of the accessible rainforest in the Tam O'Shanter National Park (Keto & Scott, 1987). The drier ridges supporting Vine Forests characterised by Acacia species (Type 12c) was however excluded including:

- areas along the southeast alignment of the Tam O'Shanter Range where Bovril, Stony, Limbo and O'Donnell Creeks arise;
- a small western ridgeline spur of the Tam O'Shanter Range being the watershed for Jurs Creek; and
- The watershed for Limbo and Laceys Creeks on a lateral spur of the Walter Hill Range.

Virtually all of the valley floor and midslopes were selectively logged in the past affecting the Type 2a 'mesophyll vine forest' with exception being a narrow "Visual Resource Protection Area" either side of the El-Arish – Mission Beach Road. Figure 13 illustrates the 'integrity' of vegetation based on the Stanton and Stanton (2005) mapping.

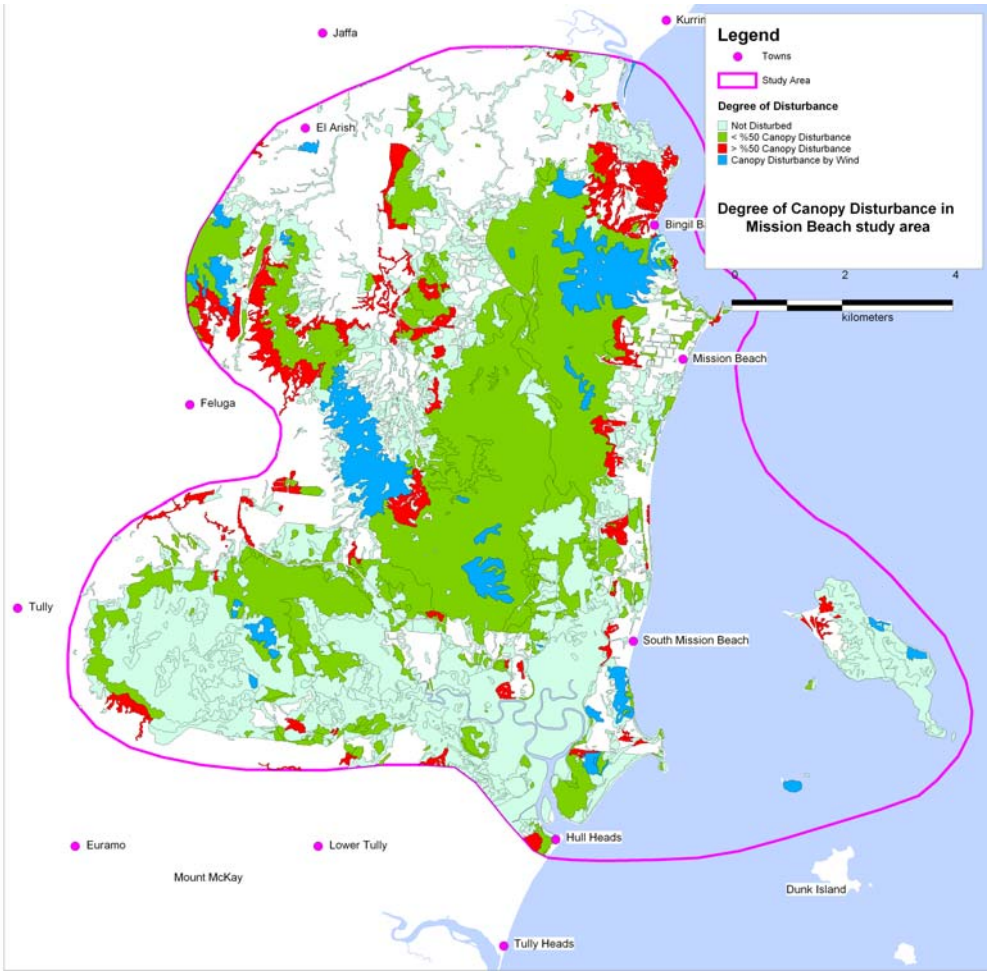


FIGURE 13 – Vegetation Integrity

Although portions of the vegetation assemblages of Mission Beach have been historically disturbed, it should be noted that logging involving clear felling was not practiced, logging ceased in the area many decades ago and the vegetation presently forms part of a significant contiguous 'block' of natural wildlife habitat. The rainforests of Mission Beach represent 12.8% of all lowland rainforests in the Wet Tropics. The vegetation of the area forms part of the only lowland to highland forested link in the Wet Tropics that supports an altitudinal gradation of rainforest types and provides the best wildlife corridor between the coast and the highlands, south of Daintree. The link is continuous from the coast to the Walter Hill Range to the Mount Fisher block to the Hugh Nelson Range and on to Wongabel to the west of Atherton.

Despite extensive logging disturbance of the Walter Hill Range through central portions of the Mission Beach study area, there remains a large band of relatively undisturbed vegetation extending from Mt Mackay through to the low lying areas associated with the Hull River and in the north associated with the Maria Creek wetland complex (see Figure 13). Similarly Dunk Island remains largely undisturbed and is therefore regarded as having a high natural integrity. Although two thirds of the original Fan Palm forests that occur near Stony Creek, North Hull River and O'Donnell Creek have been cleared, one of the remaining patches is

nonetheless the largest surviving remnant of Mesophyll Vine Forest with Dominant Palms (Type 3b) in the Wet Tropics (Keto & Scott, 1987).

PLATE 16 – Diverse, extensive and connected habitat

Importantly, it should be noted that although 'disturbed', much of this area supports vegetation, which for the purposes of the *Vegetation Management Act 1999*, is regarded as 'remnant' (see Figure 8). Although some of the vegetation has been historically disturbed and still includes evidence of this disturbance, it has nonetheless achieved remnant status since the disturbance had occurred.

The Mission Beach area contributes to the catchments of the Hull River, North Hull River, Tully River, Riverine, Maria Creek and several coastal creeks. The Hull and North Hull Rivers are virtually entirely contained within the study area. The integrity of vegetation in their catchments is outstanding, with 90% of the North Hull River catchment and 68% of the Hull River catchment being mapped as remnant regional ecosystem (EPA, 2005c).

The wetlands of Mission Beach are also considered to be of high natural integrity given the area contributes to 4 wetlands that have been mapped as of National significance (DEWR, 2007b) which includes the marine environment of the Great Barrier Reef National Park.

An ecological system exhibits integrity if, when subjected to disturbance, it has the ability to recover toward a state that is normal for that system. A state other than 'pristine' may be accepted as normal for Wet Tropics coastal ecosystems subject to regular natural disturbances such as destructive cyclones.

Ecosystems can be considered to have regained their integrity when they have restored their naturalness including:

- abiotic components (e.g. soil, water, rocks);
- biodiversity (the typical composition and abundance of species and communities); and
- ecosystem processes (e.g. the water cycle, the mineral cycle, energy flow and ecological successions).

It is possible for a highly disturbed system to regenerate itself over a period of time and reinstate and progressively increase its ecological integrity – integrity is not a characteristic exclusively applied to pristine or undisturbed ecosystems.

Therefore, an area with low ecological integrity has:

- low resilience;
- ecological processes disrupted;
- not able to recover; and
- lacking natural species compliments

Although there is currently no official definition of ecological integrity, the following definition reflects the ideas described above:

> "*integrity is a condition wherein a forest has the capacity across the landscape for renewal, for recovery from a wide range of disturbances, and for retention of its ecological resiliency.*"

On this basis, even though much of the area was subject to varying degrees of logging impact in the past and is subject to frequent natural disturbances such as cyclones, the environment in the Mission Beach area is a very resilient one, and is generally able to maintain its integrity or to restore its integrity rapidly following low to medium intensity natural and/or human disturbances.

Additional strategic protection and restoration of Mission Beach forests will enhance both the resilience and integrity of mission Beach ecosystems and landscapes.

3.6 ON GOING NATURAL PROCESSES

3.6.1 Criteria

Geophysical, evolutionary, and ecological processes, including local and global scaled life support systems fully functional.

SUB CRITERIA

(i) Areas of sufficient size, natural integrity and other essential elements to allow or maintain significant on-going ecological, life support, and evolutionary processes.

(ii) Areas of sufficient size, natural integrity and other essential elements to allow or maintain significant on-going geophysical evolutionary processes.

3.6.2 On Going Natural Processes Discussion

In terms of achieving the criterion, we must consider the capacity of the area to allow or maintain ecological, life support and biological and geophysical evolutional processes through its size and natural integrity.

The area retains large tracts of remnant regional ecosystems, accounting for 6% of all remnant in the Cardwell and Johnstone Shires (EPA, 2005c) and supports the largest block of lowland rainforest south of the Daintree River. It contains catchments that retain a relatively high percentage of native vegetation and the northern extent of the one of the largest mangrove system in the Wet Tropics (Small, 1995). Significantly, it is not the extent of vegetation within the Mission Beach area that dictates its contribution to ongoing processes, but the degree to which it is connected to the broader areas of vegetation in the Wet Tropics. The vegetation of the area forms part of the only lowland to highland forested link in the Wet Tropics that supports an altitudinal gradation of rainforest types. The link is continuous from the coast, through the Walter Hill Range to the Mount Fisher block to the Hugh Nelson Range and on to Wongabel to the west of Atherton. The continuity of rainforest and habitat through an altitudinal gradient is highly significant from an evolutionary context. Although east-west vegetation continuity occurs to the north of the Mission Beach area in the vicinity of Eubenangee Swamp (Biotropica Australia, 2005), the Mission Beach Link differs in that it represents a continuity of rainforest habitats while the Eubenangee link consists of a wide range of habitat types (e.g rainforests, melaleuca swamps, open forests and woodlands etc) and is more fragmented. The 3.9km wide link along the Walter Hill Range within the Mission Beach area has previously been referred to as the Smith's Gap – Big Maria and Little Banyan Creeks linkage (Biotropica Australia, 2005;WTMA, 2006) and is regarded as vital for a diversity of fauna, particularly the Southern Cassowary (EPA, 2005d). It is the widest and most intact coast to highlands wildlife corridor between Cairns and Cardwell (Biotropica Australia, 2005). This connectivity is not only vital for Mission Beach but the bioregion.

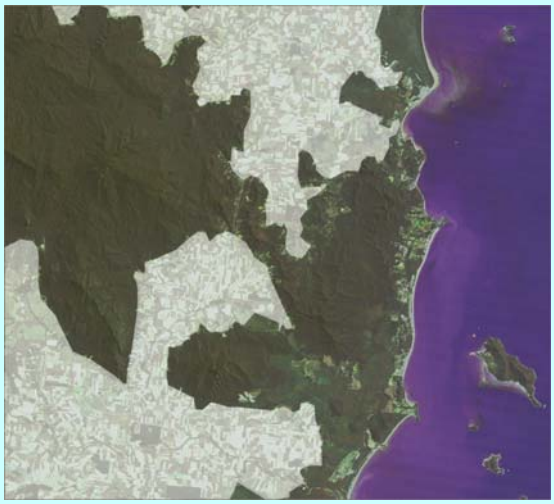
Case Example:

Mission Beach-Tablelands Rainforest Corridor

Clearing patterns along the Wet Tropics coastal plain have almost completely severed coast to highlands wildlife corridors. On the Cassowary Coast between Cairns and Cardwell, adequate connections now only exist at Eubenangee Swamp National Park north of Innisfail, and at Mission Beach through the Walter Hill Ranges.

The Eubenangee corridor is tenuous in some locations whereas the Mission Beach/Walter Hill Ranges corridor is virtually intact and is much wider, being up to 3.9km wide at the Bruce Highway (Smith's Gap). The corridor provides population connectivity from Mission Beach all the way to Ravenshoe, allowing the movement of pollen, seeds, genes and individuals across this zone.

FIGURE 14 – Mission Beach-Tablelands Rainforest Corridor



The corridor is potentially the most critical east-west linkage for the Southern Cassowary south of Cairns because of its continuous rainforest vegetation, the cassowary source population at Mission Beach, and the need to maintain connectivity with the cassowary population to the west.

The most widely recognised and documented significant species of the Mission Beach area is the Southern Cassowary (Biotropica Australia, 2005;NRA Environmental Consultants, 2006). Mission Beach supports a number of species that provide evidence of ongoing evolutionary processes. In the context of geological time, ecological, biological and geological processes of the Wet Tropics have occurred at a rapid pace. As a consequence, many species are restricted to upland areas and are divided by altitudinal barriers into two or more disjunct populations (Goosem, 2002). This isolation can result in geographic or 'allopatric' speciation, whereby disjunct populations can no longer interbreed. Examples of plant genera occurring within the Mission Beach area displaying allopatric speciation include *Buckinghamia*, *Elaeocarpus*, *Endiandra*, *Pilidiostigma*, *Polyosma*, *Pouteria*, *Sarcotoechia* and *Symplocos* (Goosem, 2002;CSIRO, 2007). Examples of two plant species found in the Mission Beach area known to occur in disjunct populations outside of the Wet Tropics and therefore with the potential for allopatric speciation include the grass *Lophatherum gracile* and tree *Toechima daemelianum* (Keto & Scott, 1987;CSIRO, 2007).

3.6.3 Natural Integrity and On Going Natural Processes Significance

Although in part impacted by past logging, the forests of Mission Beach still display many attributes indicating significant natural integrity and on going natural processes as outlined below.

Table 14 – Relative Significance of Mission Beach in terms of Natural Integrity and On Going Natural Processes

Significance Context	Significance discussion
Cardwell and Johnstone Shires	Attributes of Mission Beach that demonstrate its significance within Cardwell and Johnstone Shires include: ▪ The area supports 6% of all remnant vegetation in Cardwell and Johnstone Shires (EPA, 2005c)
Wet Tropics Bioregion and Far North Queensland	Attributes of Mission Beach that demonstrate its significance within the Wet Tropics bioregion and Far North Queensland: ▪ The rainforests of Mission Beach represents the largest area of intact contiguous 'blocks' of Lowland Rainforest south of the Daintree River ▪ The vegetation forms part of the only continuous corridor of rainforest from the coast to Atherton. This is significant not only for the immediate conservation of species such as the Southern Cassowary, but also to enable on going biological and evolutionary processes ▪ Includes rivers of high natural integrity including the Hull and North Hull ▪ Supports examples of species that demonstrate evolutionary processes
Queensland	Attributes of Mission Beach that demonstrate its significance within Queensland: ▪ Much of the vegetation remaining in Mission Beach is regarded as 'remnant' for the purposes of the *Vegetation Management Act 1999*
Australia and World	Attributes of Mission Beach that demonstrate its significance on an Australian and global scale: ▪ Supports habitats of sufficient integrity to provide habitat for a high diversity of native flora and fauna including threatened species and high levels of endemicity ▪ Represents a rare example of lowland to highland rainforest connectivity in the Wet Tropics World Heritage Area ▪ Supports wetlands of National and, in the case of the Great Barrier Reef, international significance

3.7 CONTRIBUTION TO KNOWLEDGE

3.7.1 Criteria

Examples of geomorphic or physiographic features, ecosystems, plant and animal communities or natural processes or phenomena, the study of which has, or is continuing to, contribute significantly to an understanding of natural history beyond that place.

SUB CRITERIA

(i) Geomorphic or physiographic features, ecosystems, plant and animal communities or natural processes or phenomena – significant contribution to understanding of natural history.

(ii) Geomorphic or physiographic features, ecosystems, plant and animal communities or natural processes – significant contribution to direct educational value.

3.7.2 Contribution to Knowledge Discussion

The core attribute to achieving this criterion is whether study of the area, has or will, contribute significantly to knowledge and understanding of natural history of not only the area but beyond. That is, there are features present that are important for the teaching of natural history.

Assessment of the previous criteria has identified a number of unique attributes of the Mission Beach area important to the contribution of knowledge including:

- The Mission Beach Southern Cassowary population is subject to numerous ongoing studies regarding the biology of the species and is therefore highly significant in understanding the mechanisms of its conservation;
- The northern most extent of the Mahogany Glider found in an important isolated metapopulation (QPWS, 2001);
- 5% of Australia's vascular plant species (CSIRO, 2007;ANPG, 2007) many of which are endemic to the Wet Tropics or represent species that chart the history of vascular plants from Gondwana to the modern day (CSIRO, 2007;Weston & Goosem, 2004);
- The Mission Beach area has the greatest diversity of broad habitat types (per unit area) in the Wet Tropics (C4, 2007);
- The best coast to highland habitat continuity south of Daintree and the best coast to highland rainforest continuity in the Wet Tropics;
- The only occurrence of rainforest on basalt occurring in a coastal situation is regarded by Stanton and Stanton (1995) as a "resource of exceptional scientific interest"; and
- The largest patch of Licuala Fan Palm Forest (Keto & Scott, 1987) and 50% of all Licuala Fan Palm Forests in the Wet Tropics (C4, 2007).

As one of the most intact and accessible lowland remnant rainforests remaining in the Wet Tropics and as an area regarded of international importance as a biodiversity hotspot, the Mission Beach area should be regarded of exceptional educational value.

This is still much to be learnt from the ecosystems of Mission Beach. Testimony to the degree to which the area will provide for on going research activities is that the first comprehensive vegetation mapping of the Wet Tropics was not completed until 2006. It is likely that this mapping will continue to be refined in much the same way regional ecosystems have been. By way of example, since 1999 when Sattler and Williams had identified 105 regional ecosystems for the Wet Tropics, on-going refinement has resulted in 185 regional ecosystems now being recorded for the bioregion (EPA, 2007a).

As much of the lowland vegetation of the Wet Tropics has been cleared, it is likely that a high diversity of species associated with these lowland ecosystems has also been lost. Given Mission Beach supports over 12% of the lowland rainforest of the Wet Tropics, it represents an important area for future study. It is likely that the current list of Mission Beach's flora (CSIRO, 2007) is not exhaustive and that many more species are yet to be recorded for the area. It is not unreasonable to expect that new species await discovery in the area given there has been an 8% increase in the number of flora species recorded in Queensland (Bostock & Holland, 2007) since 2002 through discoveries or formal recognitions.

Although much research has been undertaken on the Southern Cassowary in Mission Beach, there have been very few other detailed studies of other fauna. C4 (C4, 2007) note that two species of mammal have only recently been recorded for the area. Similarly, although the butterflies of Mission Beach have been well documented, little is known of the diversity of other insect/invertebrate groups.

3.7.3 Contribution to Knowledge Significance

The significance of Mission Beach to the contribution of knowledge is considered of universal importance. Many attributes of the area are unique and/or play a role in charting the history of the earth from Gondwanan times to the modern day. Although some research has been undertaken of the natural history of Mission Beach, which has significantly contributed to the basis of this report, there remains much to be learnt from the area.

PLATE 17 – Still much is to be learned from the ecosystems of Mission Beach (photo of Bingil Bay)

4.0 SUMMARY AND RECOMMENDATIONS

Mission Beach has been described as a "special place". Assessment of the natural environment attributes of Mission Beach against a set of criteria has confirmed that the area is significant at the local, regional, state-wide, national and global scale.

To summarise, the following lists some of the key findings for each of the seven criteria assessed:

(1) GEO EVOLUTION and **(2) GEODIVERSITY**

- Geological types largely under cultivation elsewhere in the Wet Tropics are protected under native vegetation cover.
- Geological features such as the basaltic headland at Clump Point and Ordovician Tam O'Shanter Granite at Tam O'Shanter Point are unique in the region.
- The interface of rocky and sandy coasts is of regional significance.
- There is a high diversity of land zones in the area (6 of the 7 recorded in the Wet Tropics). The diversity in land zones and landscapes helps drive the high biological diversity of the area.

(3) BIO EVOLUTION and **(4) BIODIVERSITY**

- The 'voyage' of vascular plants from Gondwanan times through to the modern day is recorded in the living flora of Mission Beach. This includes a high number of genera of the world's primitive flowering plants.
- 12.8% of all remaining lowland rainforest in the Wet Tropics is present in Mission Beach, representing the largest contiguous 'block' of lowland rainforest south of the Daintree River.
- The largest diversity of broad habitat types for the Wet Tropics (per unit area) is found in Mission Beach.
- 50% of Queensland's remaining Licuala Fan Palm Forests, incorporating the largest single stand, are retained in Mission Beach.
- At least 5% of all Australian vascular plant species, 17% of all Australian mammal species and about 36% of all Australian bird species occur in Mission Beach in an area approximating 0.005% of the continent.
- 13% of the recorded plant species of Mission Beach occur nowhere else but the Wet Tropics. One species of orchid occurs nowhere else but Dunk Island.
- Supports habitat for many threatened species of flora and fauna, including two of the region's iconic species – the Southern Cassowary and the Mahogany Glider.
- Australia's highest concentration of Cassowaries occurs at Mission Beach.
- 3 of Australia's wetlands of National Significance are directly linked to the Mission Beach area.
- 20% of the world's seagrass species and close to 35% of the world's mangrove species occur in the marine areas of Mission Beach.
- The largest suite of mainland fringing reefs between Cairns and Bowen.

(5) NATURAL INTEGRITY and **(6) ON GOING NATURAL PROCESSES**

- Although much of the area has been logged, many areas are now mapped as remnant regional ecosystems.
- Some of the catchments of Mission Beach retain a high percentage of native vegetation cover. The North Hull River remains 90% forested.
- The forests of Mission Beach form part of the only continuous rainforested link between lowlands and highlands as far as Atherton. It is one of only two areas in the Wet Tropics where east-west connectivity has been retained from lowland to highland environments. The link is of vital importance to a number of species including the Southern Cassowary.
- Supports wetlands of National and, in the case of the Great Barrier Reef, international significance.

(7) CONTRIBUTION TO KNOWLEDGE

- The Mission Beach Southern Cassowary population is subject to numerous ongoing studies regarding the biology of the species and is therefore highly significant in understanding the mechanisms of its conservation.
- The northern most extent of the Mahogany Glider found in an important isolated metapopulation.
- As Mission Beach supports over 12% of the lowland rainforest of the Wet Tropics, it represents an important area for future study. With a high diversity of lowland ecosystems and consequently flora and fauna diversity in one location, the importance of this area to contributing to knowledge can't be understated.

This study did not consider aesthetics in determining the biodiversity significance of Mission beach. However it is likely that Mission Beach contains superlative natural phenomena or areas of exceptional natural beauty or aesthetic importance.

Despite these examples that demonstrate the area's significance, there still remains much to be researched about the biodiversity values of Mission Beach. In the course of this study it was found that there are information gaps that require further attention including:

- There is no thorough study of the mammals, reptiles or amphibians of Mission Beach;
- As it is with many areas of the world, little is known about the insect/invertebrate diversity;
- Additional work on the area's flora is certainly warranted. Surprisingly there are very few individual plant collection records for Mission Beach given the diversity of its landscapes; and
- There needs to be a greater understanding of fauna movement in the Walter Hill ranges and Smith's Gap in order to enhance the functionality of the highly significant lowland to highland ecological corridor.

Consistent with the Strategies of the FNQ Regional Plan (FNQRPAC, 2000), additional further detailed studies and audits of areas of outstanding biodiversity value should be undertaken, particularly for remnant vegetation of the coastal lowlands such as Mission Beach.

Mission Beach has many significant environmental attributes. Some of these individual attributes alone, such as the highest cassowary concentration in Australia, justify that Mission Beach has high biodiversity significance. What is outstanding is that these attributes are all contained within a small area representing only around 0.005% of the continental area of Australia or about one third the area of mainland Brisbane City.

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APPENDIX A

Vegetation communities recorded in
Mission Beach by Stanton and Stanton (2005)

Natural associations

VEGTYPE CODE	DESCRIPTION
1a	Medium to tall closed forest Complex mesophyll vine forest on very wet and wet lowlands and foothills.
2a	Medium to tall closed forest Mesophyll vine forest. Very wet and wet lowlands and foothills.
2b	Medium to tall closed forest Mesophyll vine forest. Very wet and wet lowlands on beach sands.
3a	Medium closed forest Mesophyll vine forest with dominant palms. Very wet lowlands, feather-leaf (Archontophoenix) palm swamps.
3b	Medium closed forest Mesophyll vine forest with dominant palms. Very wet lowlands and lower foothills, fan-leaf (Licuala) palm swamps on seasonally impeded drainage
8	Medium to tall closed forest Simple notophyll vine forest. Moist to very wet uplands and highlands.
12a	Closed forest Dominated by Acacia celsa. Very wet and wet foothills and uplands.
12c	Closed forest Dominated by Acacia mangium and Acacia celsa. Very wet and wet lowlands and foothills.
13a	Medium open forest Eucalyptus pellita dominant closed forest Very wet and wet lowlands and foothills.
13e	Medium open forest. Forest with Syncarpia glomulifera, Corymbia intermedia, Eucalyptus pellita, Eucalyptus tereticornis, Acacia celsa and Acacia mangium. Very wet and wet lowlands and foothills.
16e	Low to medium woodland with Corymbia clarksoniana, C. intermedia, E. tereticornis, E. drepanophylla, Allocasuarina torulosa, Allocasuarina littoralis, Lophostemon suaveolens, A. cincinnata, A. flavescens, Banksia aquilonia, Xanthorrhoea johnsonii.
16g	Low to medium woodland with Eucalyptus tereticornis, Corymbia tessellaris, E. pellita, C. intermedia, Melaleuca dealbata, Lophostemon suaveolens, Acacia mangium and A. crassicarpa. Coastal footslopes and lowlands.
21	Complex of open to closed shrubland, low to medium woodlands and forests and grasslands. Mountain Rock Pavements. Main component: scrub (Allocasuarina littoralis, Syncarpia glomulifera, Lophostemon confertus), shrubland (Banksia aquilonia, Leptospermum sp.) and heath (Xanthorrhoea johnsonii, Gahnia spp., Dicranopteris linearis). Minor components: 13f and 16f. (Webb and Tracey) Mountainous eastern fall.
22a	Medium closed forest Mangrove Forest. Main components: medium closed mangrove forest (Rhizophora spp., Bruguiera spp., etc) and scrub (Avicennia eucalyptifolia, Ceriops spp.)
22b	Herbland Samphire flats with Halosarcia indica subsp. Leiostachya and Suaeda australis. Includes bare salt pans.
31	Low closed forest Low notophyll vine forest of ridge crests, very steep slopes, and areas of shallow soil. Wind-shearing is often evident. A community of simple structure, with species composition determined by exposure, shallow soils, and severe drainage.
32	Medium to tall open forest and woodland dominated by Eucalyptus tereticornis. Other species commonly present are Corymbia intermedia, Lophostemon suaveolens and Allocasuarina torulosa.
33	Low to medium woodland and forest and minor shrubland dominated by Melaleuca quinquenervia. Includes transitional saline areas, and areas of recent invasion of former grasslands.
38	Medium to tall woodland and forest with Melaleuca leucadendra. Coastal lowlands. Can include low woodland and forest in areas of recent invasion.
44	Complex of open to closed shrublands, grasslands and low to medium woodlands and forests. Includes pure stands of Casuarina equisetifolia, and open to closed woodlands dominated by Acacia crassicarpa. Other species commonly present include Syzygium forte subsp. forte, Calophyllum inophyllum and Pandanus sp. On aeolian dunes on Hinchinbrook Island (associated with types 206 and 208).
59	Grassland dominated by Themeda triandra.
66	Closed vineland Open areas in vine forests. Dominated by vines with isolated emergent vine-draped trees or clumps of trees. Generally foothills of coastal ranges below 400 metres.
72	Mesophyll vine forest with palms mesophyll vine forest with abundant feather palms. (A. alexandrae). Seasonally inundated lowland areas.
73	Medium to tall open forest dominated by Corymbia intermedia.
74	Medium to tall woodland with Corymbia tessellaris and/or Corymbia intermedia. Coastal lowland and adjacent foothills.

75	Simple mesophyll/notophyll vine forest with Syzygium forte subsp. forte, Buchanania arborescens, Pleiogynium timorense, Dillenia alata, Litsea fawcettiana, and Chionanthus ramiflora.
78	Low woodland with Melaleuca viridiflora. Includes areas of natural invasion onto former grasslands.
80	Medium open forest and woodland with Eucalyptus pellita and Corymbia intermedia. Poorly drained alluvium, including seasonal swamps.
91	Low to medium, rarely tall, woodland and forest dominated by Lophostemon suaveolens. May be pure Lophostemon suaveolens, or on alluvium may include species such as Corymbia tessellaris, Melaleuca sp. aff. viridiflora, M. dealbata and Eucalyptus platyphylla.
92	Mixed shrubland-sedgeland complex with Melaleuca quinquenervia. Perennially inundated areas of peat soils.
104	Low woodland, low forest and shrubland Low woodland and forest with Lophostemon suaveolens, Corymbia tessellaris, Corymbia intermedia, Acacia flavescens, Acacia crassicarpa, Acacia celsa , Acacia polystachya, Eucalyptus platyphylla, Melaleuca viridiflora, Dillenia alata, Randia sessilis, Canthium coprosmoides. Steep exposed coastal headlands and hillslopes.
105	Medium to tall woodland with Melaleuca dealbata. Melaleuca leucadendra is a common associated species. This unit includes two areas of 105 on north-eastern edge of Wharps Holding which are young dense recruiting stands of Melaleuca dealbata which have taken over naturally op en areas. The reason for this recruitment is unclear.
117	Medium open forest and Medium woodland with Corymbia tessellaris, Corymbia intermedia, Melaleuca dealbata, Lophostemon suaveolens, Acacia mangium, Acacia crassicarpa, Canarium australianum, Deplanchea tetraphylla. Unweathered low prograding beach dunes.
145	Low woodland and open forest dominated by Allocasuarina littoralis. Steep rocky mountain slopes, and ridge tops.
162	Fernland-sedgeland complexes with or without shrubs. Shrubs, when present, occur as emergents or form open to very open woodlands. Dominant ground cover species include Dicranopteris linearis, Gleichenia dicarpa, Gahnia sieberiana and Schoenus melanostachys. Shrubs include Melaleuca quinquenervia, Allocasuarina littoralis, Banksia aquilonia, Banksia plagiocarpa, Syncarpia glomulifera, Rhodomyrtus sericea, Melastoma affine. Wet to very wet uplands. Dominant ground cover species include Dicranopteris linearis, Gleichenia dicarpa, Gahnia sieberiana and Schoenus melanostachys. Shrubs include Melaleuca quinquenervia, Allocasuarina littoralis, Banksia aquilonia, Banksia plagiocarpa, Syncarpia glomulifera, Rhodomyrtus sericea, Melastoma affine. Wet to very wet uplands.
260a	Rock, largely unvegetated
268	Sedgeland Swamp of permanent open water which fluctuates seasonally between freshwater and estuarine. Dominated by clumps of Schoenoplectus littoralis and/or Eleocharis dulcis. Swamp of permanent open water which fluctuates seasonally between freshwater and estuarine. Dominated by clumps of Schoenoplectus littoralis and/or Eleocharis dulcis. May include scattered Melaleuca quinquenervia and/or mangrove species.

Anthropogenic vegetation

VEGTYPE CODE	DESCRIPTION
24c	Disturbed areas Tree plantation. This may include plantings of native species for the purpose of rehabilitation.
24e	Disturbed areas Quarry, or bare areas resulting from mining activity
28	Vegetation complexes and mosaics Extremely disturbed areas that originally supported rainforest vegetation. The original canopy has been entirely removed and the original vegetation type cannot be determined from the present species composition. It is 50% crown cover and less than 70% of the original canopy height.
29	Vegetation complexes and mosaics Extremely disturbed areas that originally supported sclerophyll vegetation, and including areas that have regrown from complete clearing. The original canopy has been entirely removed and the original vegetation type cannot be determined from the present species composition. It is 50% crown cover and less than 70% of the original canopy height.

APPENDIX B

Regional Ecosystems of Mission Beach

(EPA, 2005c)

Regional Ecosystem Code	Subtypes	Biodiversity Status	Vegetation Management Act 1999 Status	Short Description
7.1.1		NC	N	Mangrove closed forest to open shrubland of areas subject to regular tidal inundation
7.1.2	a	OC	O	Sporobolus virginicus grassland, samphire open forbland to sparse forbland, and bare saltpans, on plains adjacent to mangroves
7.1.3	a,b	E	O	Schoenoplectus litoralis and/or Eleocharis dulcis sparse sedgeland, or Melaleuca quinquenervia shrubland to open forest, in swamps which fluctuate periodically between freshwater and estuarine
7.2.1	a,i	E	E	Mesophyll vine forest on beach ridges and sand plains of beach origin
7.2.3	a,b,c,d,e	OC	O	Corymbia tessellaris and/or Acacia crassicarpa and/or C. intermedia and/or C. clarksoniana closed forest to woodland, of beach ridges, predominantly of Holocene age
7.2.4	d,e,f,g	OC	O	Eucalyptus spp. (often E. pellita or Corymbia intermedia) open forest and/or Lophostemon suaveolens open forest on swampy sand plains of beach origin, and Pleistocene beach ridges
7.2.5	a	OC	O	Mesophyll/notophyll vine forest of Syzygium forte subsp. forte on beach ridges and sand plains of beach origin
7.2.7	a	E	O	Casuarina equisetifolia ± Corymbia tessellaris open forest ± groved vine forest shrublands of the beach strand and foredune
7.2.8		E	O	Melaleuca leucadendra open forest to woodland on sands of beach origin
7.2.9	a	E	O	Melaleuca quinquenervia shrubland to closed forest, or Lepironia articulata open to closed sedgeland on dune swales and swampy sand plains of beach origin
7.3.1	a	E	E	Hemarthria uncinata and/or Ischaemum australe and/or Cynodon dactylon grassland, and/or ephemeral sedgelands, on seasonally inundated alluvial plains
7.3.3	a,b	E	O	Mesophyll vine forest with Archontophoenix alexandrae on poorly drained alluvial plains
7.3.4		E	O	Mesophyll vine forest with Licuala ramsayi on poorly drained alluvial plains and alluvial areas of uplands
7.3.5	a,b	E	N	Melaleuca quinquenervia and/or Melaleuca cajuputi closed forest to shrubland on poorly drained alluvial plains
7.3.7	a,b	E	E	Eucalyptus pellita and Corymbia intermedia open forest to woodland (or vine forest with emergent E. pellita and C. intermedia), on poorly drained alluvial plains
7.3.8	a,b	E	N	Melaleuca viridiflora ± Eucalyptus spp. ± Lophostemon suaveolens open forest to open woodland on alluvial plains
7.3.10	a,b,c	E	O	Simple to complex mesophyll to notophyll vine forest on moderate to poorly drained alluvial plains of moderate fertility

7.3.19	a,b,c,e	OC	O	Corymbia intermedia or C. tessellaris ± Eucalyptus tereticornis open forest (or vine forest with these species as emergents), on well drained alluvium
7.3.12	a,b	E	E	Mixed eucalypt open forest to woodland, dominated by Eucalyptus tereticornis and Corymbia tessellaris ± Melaleuca dealbata, (or vine forest with these species as emergents), on alluvial plains of lowlands
7.3.17		E	E	Complex mesophyll vine forest on well drained alluvium of high fertility
7.3.20	a,b,c	OC	O	Corymbia intermedia and Syncarpia glomulifera, or C. intermedia and Eucalyptus pellita, or Syncarpia glomulifera and Allocasuarina spp., or E. cloeziana, or C. torelliana open forests (or vine forests with these species as emergents), on alluvial fans at
7.3.25	a	OC	O	Melaleuca leucadendra ± vine forest species, open to closed forest, on alluvium fringing streams
7.3.35	a	E	E	Acacia mangium and/or A. celsa and/or A. polystachya closed forest on alluvial plains
7.3.40		E	E	Eucalyptus tereticornis medium to tall open forest on well drained alluvial plains of lowlands
7.3.46		E	E	Lophostemon suaveolens open forest to woodland on alluvial plains
7.8.1	a	E	N	Complex mesophyll vine forest on well drained basalt lowlands and foothills
7.8.7	b	E	O	Eucalyptus tereticornis open forest, and associated grasslands, predominantly on basalt uplands
7.11.1	a,b	NC	N	Simple to complex mesophyll to notophyll vine forest on moderately to poorly drained metamorphics (excluding amphibolites) of moderate fertility of the moist and wet lowlands, foothills and uplands
7.11.2	a	OC	O	Notophyll or mesophyll vine forest with Archontophoenix alexandrae or Licuala ramsayi, on metamorphics
7.11.5	a,b,e	NC	N	Eucalyptus pellita ± Corymbia intermedia open forest (or vine forest with E. pellita and C. intermedia emergents), on metamorphics
7.11.10	a	OC	O	Acacia celsa open to closed forest on metamorphics
7.11.18	a,b,e,f	OC	O	Corymbia intermedia and/or C. tessellaris ± Eucalyptus tereticornis medium to tall open forest to woodland (or vine forest with these species as emergents), on coastal metamorphic headlands and near-coastal foothills
7.11.24	a,c	OC	O	Closed vineland of wind disturbed vine forest, on metamorphics
7.11.34	a	OC	O	Complex of shrublands, low heathy or shrubby woodlands and low forests, with Corymbia tessellaris and C. intermedia or Melaleuca viridiflora, Allocasuarina spp. and Acacia spp. on metamorphic coastal headlands and islands
7.12.1	a,b,d	NC	N	Simple to complex mesophyll to notophyll vine forest on moderately to poorly drained granites and rhyolites of moderate fertility of the moist and wet lowlands, foothills and uplands

7.12.2	b	OC	O	Notophyll or mesophyll vine forest with Archontophoenix alexandrae or Licuala ramsayi, on granites and rhyolites
7.12.4		E	O	Syncarpia glomulifera ± Eucalyptus pellita open forest of granites and rhyolites, on deep soils
7.12.5	a,b,g	E	O	Eucalyptus pellita ± Corymbia intermedia open forest, or Acacia mangium and Lophostemon suaveolens open forest (or vine forest with these species as emergents), on granites and rhyolites
7.12.9		OC	O	Acacia celsa open to closed forest on granites and rhyolites
7.12.12	a	OC	O	Acacia mangium and A. celsa open to closed forest, or A. polystachya woodland to closed forest on granites and rhyolites
7.12.16	a	NC	N	Simple to complex notophyll vine forest of cloudy wet and moist uplands and highlands on granites and rhyolites, including small areas of Araucaria bidwillii
7.12.23	a,b,d	E	O	Corymbia intermedia and/or C. tessellaris ± Eucalyptus tereticornis medium to tall open forest to woodland (or vine forest with these species as emergents), on coastal granite and rhyolite headlands and near-coastal foothills
7.12.37	a,b,g,i	OC	O	Rock pavements and seepage areas of wet lowlands, uplands and highlands of the eastern escarpment and central range (excluding high granite areas of Hinchinbrook Island and Bishops Peak) on granite and rhyolite, with Allocasuarina spp. shrublands and/or
7.12.40	a,b	OC	O	Closed vineland of wind disturbed vine forest, on granites and rhyolites
7.12.48		OC	O	Wind-sheared notophyll vine forest of exposed granite and rhyolite ridge-crests and steep slopes
7.12.54	a,g	OC	O	Complex of shrublands and low open forests on wind-exposed granite and rhyolite coastal headlands and islands, on skeletal soils
7.12.60	a	E	O	Melaleuca viridiflora ± Corymbia clarksoniana ± Eucalyptus platyphylla woodland to open forest, on granite and rhyolite