

Mackay Coasts and Communities

Sandfly Creek Environmental Reserve

Management Plan

December 2010



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Executive Summary

The Management Plan for Sandfly Creek Environmental Reserve is the first fine-scale plan completed under the umbrella of recently adopted Coastal Management Guidelines for the Mackay Regional Council jurisdiction.

This Management Plan outlines aspirations for future management and preservation of the Reserve. The intent of this plan is to provide cost-effective management options that will maintain the Reserve's significant environmental values into the future whilst providing for nature-based recreational and educational opportunities.

The management options provided do not include expensive infrastructure development, nor do they require significant levels of maintenance once established. Instead, natural patterns of topography, geomorphology and vegetation are used to provide key management functions such as wind breaks, screening of sensitive areas such as shorebird roosts, provision of wildlife viewing opportunities, weed control measures and storm-water quality improvements.

Development and maintenance of the 'natural infrastructure' described above not only provides for cost-effective management functions. Combined with appropriate interpretive signs, this management design provides for educational opportunities particularly related to 'Ecosystem Services'. This is perhaps an apt theme for Sandfly Creek Environmental Reserve; a small part of the original natural environment of Mackay City, which continues to support and enhance the lives of its residents.

1 Introduction

The purpose of this management plan is to provide pragmatic and cost-effective strategies to ensure the long-term protection of the natural environment within Sandfly Creek Environmental Reserve and the ecosystem services that it provides. These strategies will also ensure that the area can support sustainable, low impact, nature-based recreation that compliments the opportunities provided by adjacent areas of Council controlled and other land.

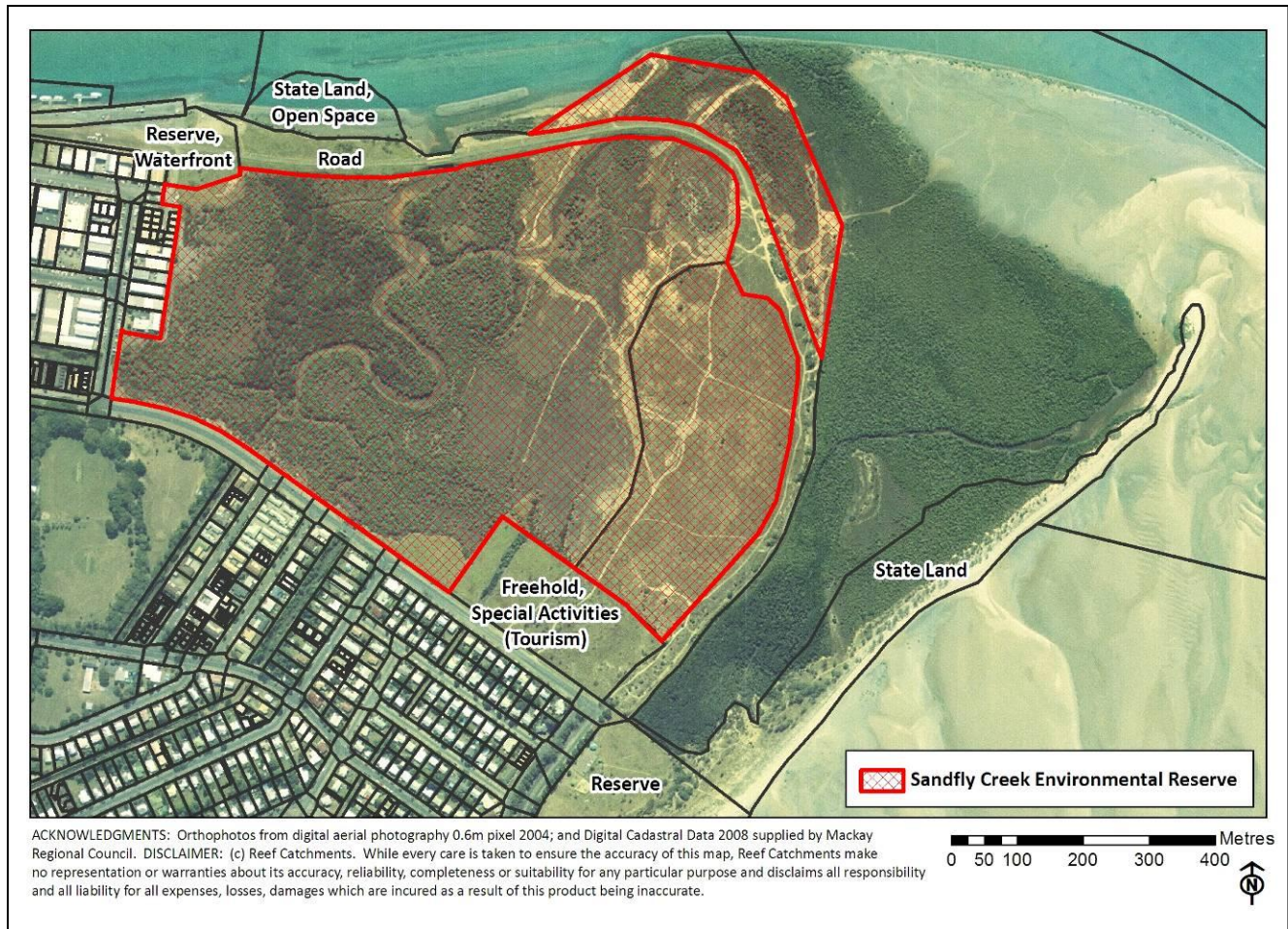
It is worthy of note that a plethora of information relating to the Reserve has been collected and collated during various land use studies and management planning processes. Links to these sources are provided in Appendix 1. This management plan seeks to provide concise descriptions of the natural assets present, the management issues and relevant strategies to maintain the value of these assets.

1.1 Description of the Reserve

Sandfly Creek Environmental Reserve contains small remnants of the original coastal vegetation and habitats that once typified the coastal zone adjacent to Mackay City. The Reserve is made possible by its designation under the *Land Act* 1994 with Mackay Regional Council as trustee. Under this designation the Reserve is to be managed “for the protection of natural environment values while allowing low impact public use”. The Reserve was designated following a comprehensive ‘Most Appropriate Land Use Study’ completed by the Department of Natural Resources and Mines in 2005 (Department of Natural Resources and Mines, 2005).

The Reserve and its environs (Map 1) have been extensively modified although this does not preclude it from making a significant contribution to nature conservation and low impact nature-based recreation. The Reserve is bounded largely by a slightly elevated and undulating sand ridge which has been structurally modified to form a levee. Contained within this ridge is the estuarine system of Sandfly Creek which opens into the Pioneer River by a system of floodgates that control the movement of tidal and storm surges into residential areas and the urban centre of Mackay City. Some of this estuarine vegetation has been cleared and is currently regenerating. Upstream areas outside of the Reserve have been modified into channels that drain residential areas. Western and southern boundaries are adjacent to built infrastructure, including industrial and residential developments.

Map 1: Sandfly Creek Environmental Reserve and surrounds



1.2 Site History

It is appropriate to recognise the Yuibera people as Traditional Owners of the land that forms the Reserve. Natural resources contained by the Reserve were used extensively by the Yuibera people and much of the knowledge relating to the use of plants, animals and physical resources is retained. Mangrove and salt marsh plants, resident fish, crustaceans and shellfish formed a large part of the Yuibera diet. Areas of littoral rainforest ('beach scrubs') supplied ample and diverse plant foods and medicines. Tools were constructed from acacia and eucalypt timbers, and fibres were sourced from a variety of plants including native hibiscus, pandanus and sedges. All these resources remain on the Reserve to some degree, although some such as beach scrub plants have been largely removed by vegetation clearing and other activities.

The Reserve and its immediate environs have had a long and diverse history of more recent human use. This history is chronologically summarised by the Most Appropriate Land Use study (Department of Natural Resources and Mines, 2005) with more recent use and management being guided by recent management and master planning works. The history of use of the Reserve clearly influences its current condition and subsequent management challenges and opportunities. This history is not repeated here, but links to information sources can be found in Appendix 1.

The most important historical actions and/or uses that have, and may continue to influence natural resources within the Reserve are:

- Historical restriction of tidal flows by construction of the levy bank along the Pioneer River, and subsequent restoration of these flows through controlled flood gate apparatus.
- Construction of vehicle tracks through the Reserve.
- Structural modification and clearing of native vegetation across the top and slopes of the sand ridge and in estuarine areas.
- Construction of the concrete pathway and associated viewing platforms and seating.
- Designation of the area as an Environment Reserve pursuant to the *Land Act* 1994.

1.3 Statutory Obligations

There are a range of statutes at both State and Commonwealth level that are relevant to, and may guide management of resources contained by the Reserve:

- The *Land Act* 1994 provides for the designation of the Reserve and its Trustee, and makes the requirement that its management is “for the protection of natural environment values while allowing low impact public use”.
- The *Coastal Protection and Management Act* 1995 provides for the preparation of a Regional Coastal Management Plan to guide coastal development. The Act also provides for designation of Coastal Management Districts.
- The *Nature Conservation Regulation* 1994 provides management principles for wildlife within Queensland.
- The *Native Title (Queensland) Act* 1993 identifies the presence of Native Title over land.
- *Land Protection (Pest and Stock Route Management) Act* 2002 provides the regulatory basis for control of pest species. In particular the Act classifies pest species and provides obligations for landholders.
- The *Fisheries Act* 1994 provides protection for marine plants including mangroves and saltmarshes, and provides the regulatory environment for control of recreational fishing activities.
- The *Environmental Protection and Biodiversity Conservation Act* 2000 provides a high level of protection for matters of National environmental significance. In particular it provides protection for important populations of migratory species such as shorebirds present within the Reserve.
- The *Integrated Planning Act* 1997 guides the planning, assessment and regulation of development, which includes the operation of existing floodgates adjacent to the Sandfly Creek Environmental Reserve.

- International Agreements: The China and Australia Migratory Bird Agreement, the Japan and Australia Migratory Bird Agreement, and the Republic of Korea-Australia Migratory Bird Agreement provide for conservation of shorebirds (waders) across the migratory flyway for these species.

2 Conservation and Management Issues

Sandfly Creek Environmental Reserve provides numerous nature-based services for the Mackay community:

- The sand ridge that begins adjacent to Gordon Street and extends to the Pioneer River acts as a buffer against coastal processes, and as a levee, protecting the adjacent section of Mackay City.
- Sandfly Creek itself is a major drainage outlet that discharges stormwater from adjacent residential areas.
- The Reserve supports a diverse assemblage of fauna notably birds and this provides important opportunities for nature-based recreation within close proximity to Mackay City and residential areas.
- Estuarine wetlands are an important fish nursery habitat area.
- Despite the Reserve's small size it supports conservation values of International and National significance. These are notably migratory shorebird populations that occur in Internationally significant numbers. In addition suitable habitat area exists for the Nationally threatened mangrove mouse.
- Excellent opportunities exist for science education at all levels particularly in relation to coastal processes, estuarine biodiversity, and ecosystem services.
- The Reserve is a popular recreational area enabling opportunities for residents to retreat and enjoy natural surroundings very close to the heart of Mackay City.

Given the Reserve's relatively small size, history and proximity to a major residential and urban area, there are predictably, numerous management issues. These notably include:

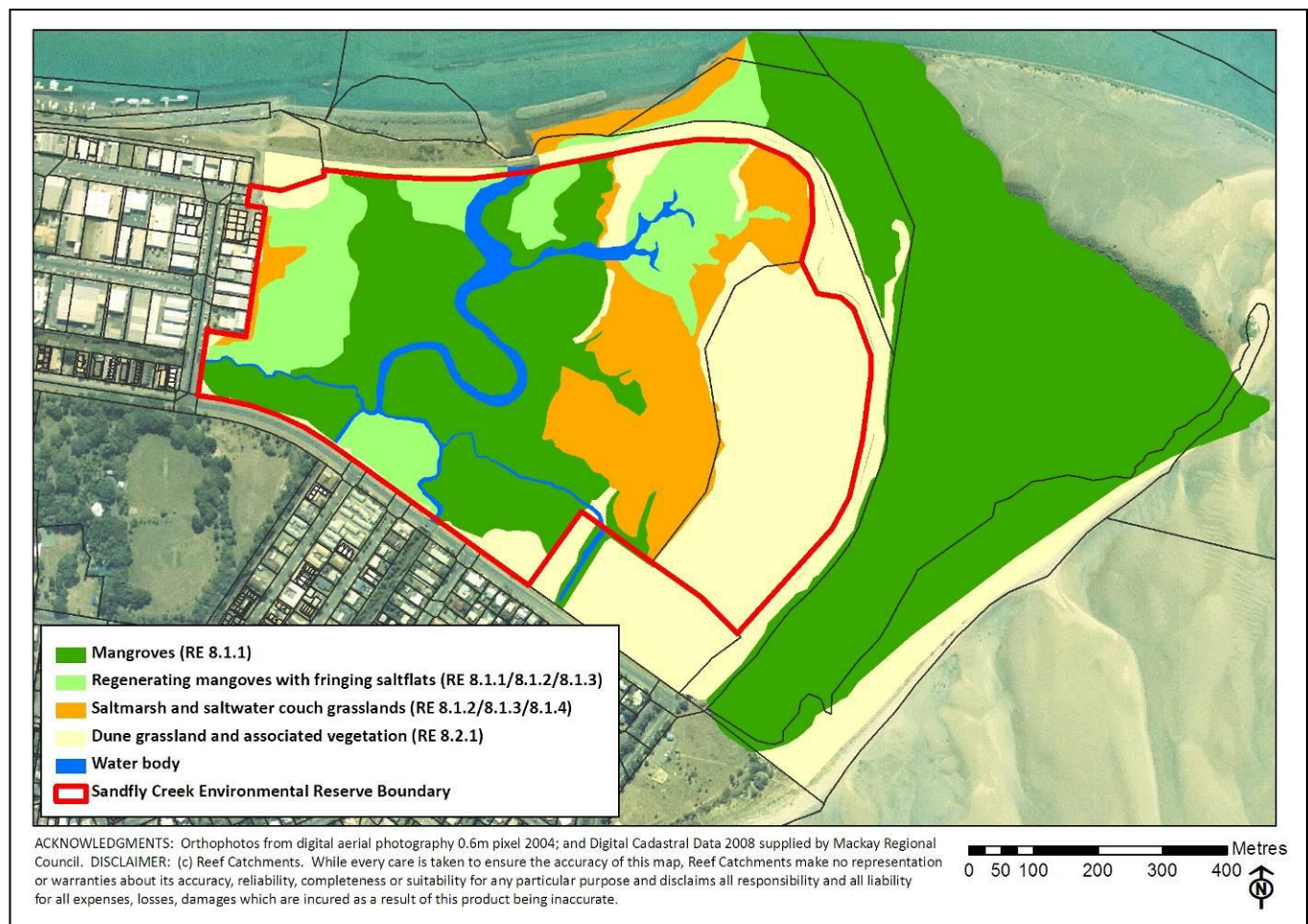
- Maintenance and where appropriate and feasible, re-establishment of the Reserve's natural values so that the services they provide can be sustained in the long term.
- Protection of the Reserve's high level biodiversity values in the face of multiple threats at local, State, National and global levels.
- Resolution of user conflicts; determining the appropriate places and times for multiple activities so that their impacts are minimized and made sustainable. In this regard management recommendations are made within the broader context of public land available in the vicinity, for various uses.

2.1 Vegetation

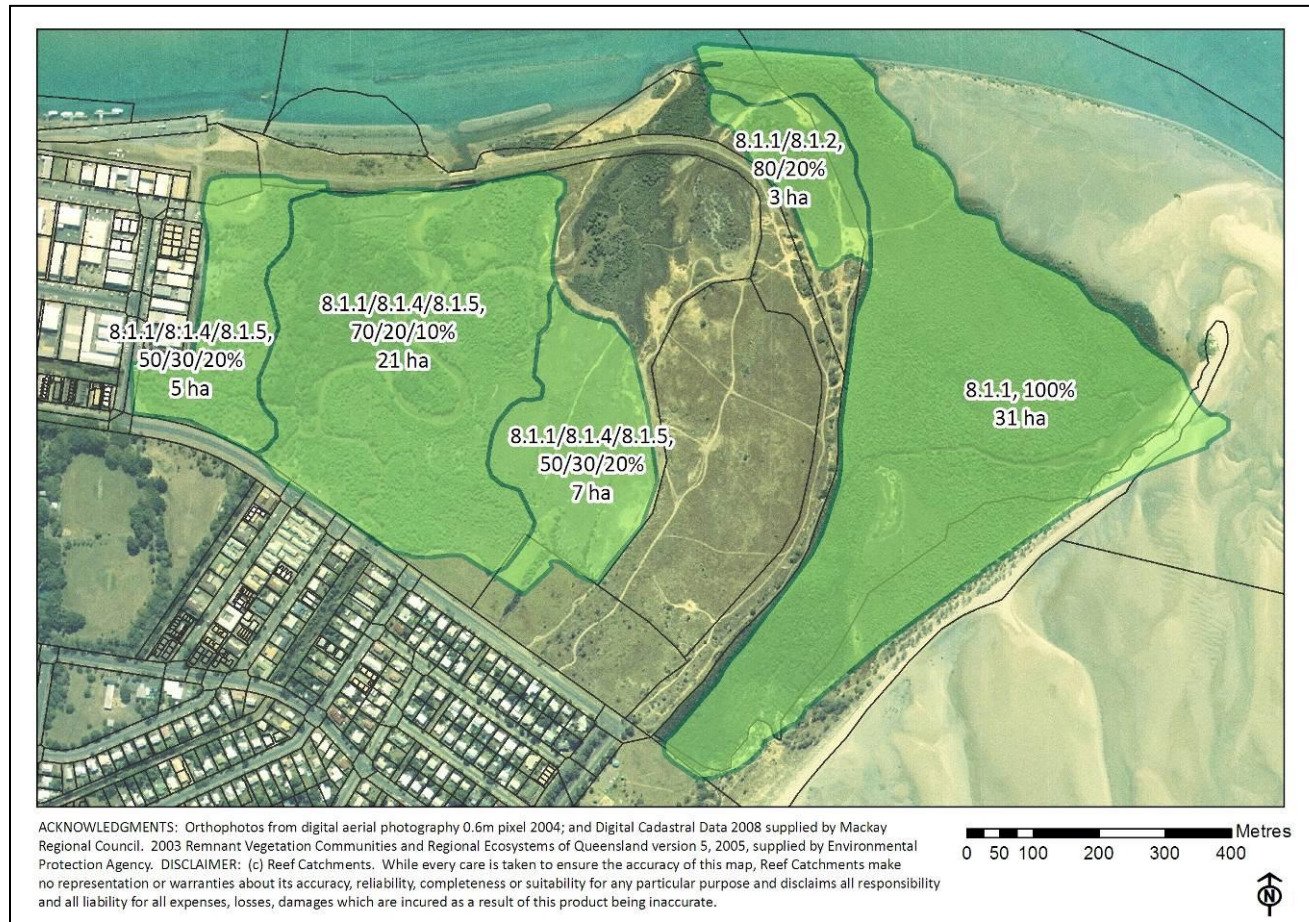
2.1.1 Remnant Vegetation

Current vegetation communities within the Reserve (Map 2) consist of estuarine and beach dune vegetation and the ecotone that lies between these. Dune vegetation has been historically cleared (Map 3) and thus does not continue to provide the level of ecosystem services that it once did. The estuarine vegetation (mangrove, saltmarsh and saline grassland) has been relatively undisturbed although some areas have suffered from the downstream impact of activities within adjacent residential areas, in addition to some clearing and a level of physical disturbance by vehicles. A flora species list for the Reserve and surrounds is included in Appendix 2.

Map 2: Current Vegetation Communities Sandfly Creek Environmental Reserve and surrounds



Map 3: Remnant Vegetation Sandfly Creek Environmental Reserve and surrounds



2.1.1.1 Dune Vegetation

Approximately 20ha of the Reserve is currently semi-native and/or exotic grassland on a slightly undulating and elevated sand ridge (Map 2, dune grassland and associated vegetation). Pre-clearing regional ecosystem mapping illustrates this area as originally composed of Moreton Bay ash (*Corymbia tessellaris*), +/- *Acacia leptocarpa* +/- *Banksia integrifolia* +/- *Melaleuca dealbata*, +/- beach scrub species open-forest on coastal parallel dunes (Regional Ecosystem 8.2.6a; Environmental Protection Agency, 2009). Current regional ecosystem mapping illustrates this area as largely non-remnant (Map 3). Small remnant areas of regional ecosystem 8.2.1 (*Casuarina equisetifolia* open forest to woodland with *Ipomea pes-caprae* and *Spinifex sericeus* dominated ground layer on foredunes) also occur (but are too small to be mapped). All these areas suffer variously from invasion of pest plants and these management issues will be discussed in section 2.1.2 below.

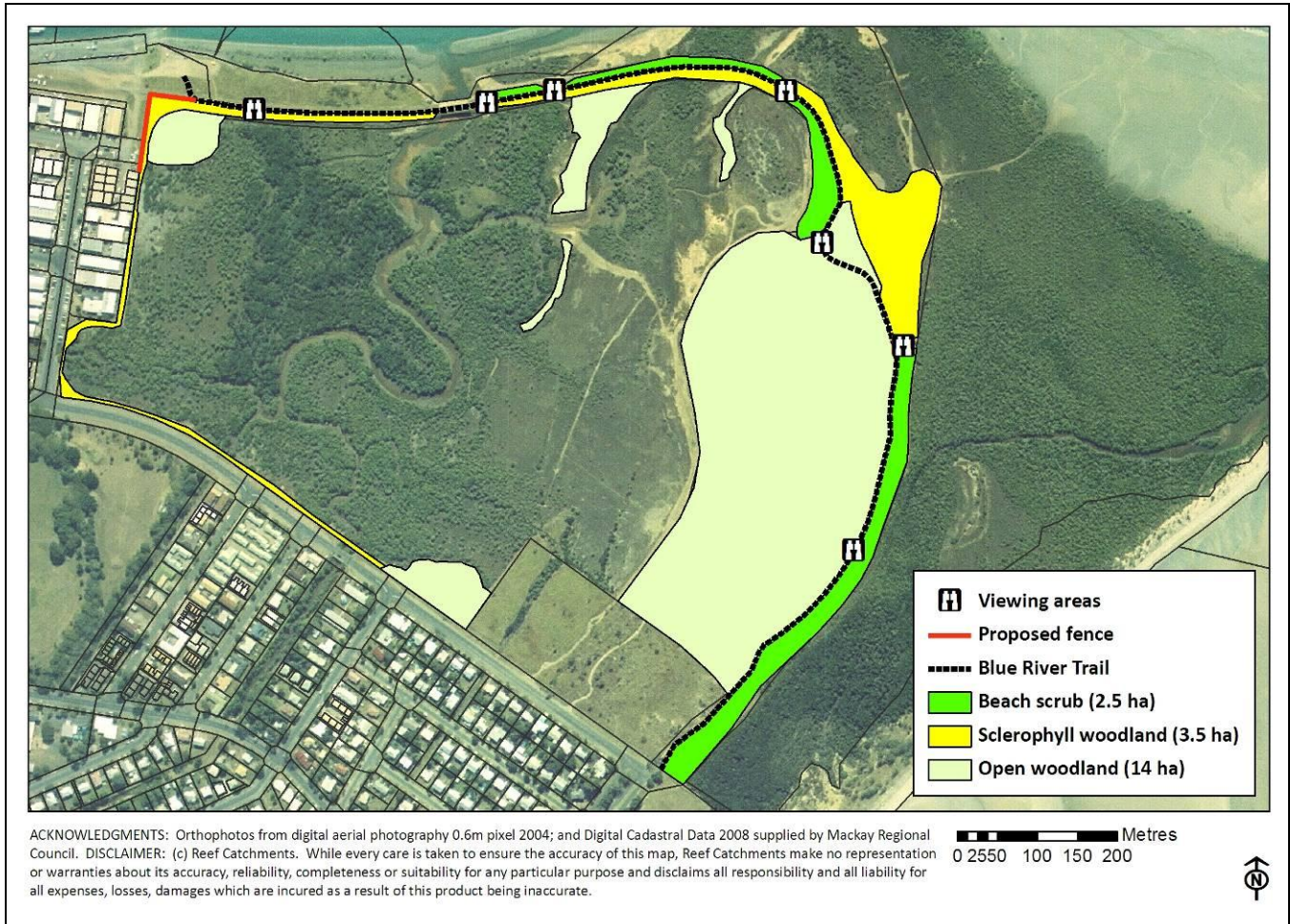
Although the sand ridge is structurally modified to form a levee, there is an important opportunity to restore much of its natural value through rehabilitation works to mirror as close as possible its previous natural condition, and its contribution to ecosystem services. At the time of writing the grassy layer was well developed, contained some areas of native pastures, and probably contributes to effective stabilisation of the sand ridge/ levee. However, in very dry periods, after fire, or in extreme weather events, this situation may be

compromised. Rehabilitation of the area to a more natural condition (including re-establishment of beach scrub in more protected areas) would provide the following:

- a) More effective stabilisation of the levee.
- b) Competition against some weed species principally in areas restored to beach scrub.
- c) Creation of wind breaks (including along pedestrian areas).
- d) Screening of sensitive areas including shorebird roosts and foraging areas, minimising potential for human disturbance.
- e) Enhanced habitat for fauna that utilise woodland and open woodland areas.

Principal Recommendation 1: The area currently represented as grassland should be progressively restored to regional ecosystem 8.2.6 including patches of beach scrub in appropriate areas as illustrated on (Map 4). The proposed locations of beach scrub restoration mirror the areas in which this system likely developed originally e.g. in swales and other areas of higher soil moisture and protection from prevailing winds. Beach scrub will provide a screening function along much of the junction between the northern pathway and the key shorebird roost. However, this can be achieved without unduly compromising the river views available to users of the walkway. Concerns have been raised that screening vegetation would obstruct the flight path of shorebirds attempting to enter the wetland area to roost and/ or forage. However it would be difficult to contend that birds capable of global migration would be unduly hindered by low patchy vegetation restored in a discontinuous band along the northern side of the pathway, adjacent to the primary roost area. Appendix 3 provides details of proposed revegetation work including recommended species and planting densities for beach scrub, sclerophyll woodland and open woodland communities.

Map 4: Revegetation Areas for Sandfly Creek Environmental Reserve



2.1.1.2 Estuarine Vegetation

Sandfly Creek Reserve contains the remnants of a small estuarine system (Map 2; mangrove, saltmarsh and saline grassland). The upper reaches of the estuary have been largely modified to facilitate drainage of adjacent residential areas. However, the estuary still contains contiguous areas of:

- Saltmarsh and saltwater couch grasslands,
- Forest of small stilted mangrove (*Rhizophora stilosa*) and grey mangrove *Avicennia marina*,
- Fringing areas of orange (*Bruguiera* spp.) and yellow (*Ceriops tagal*) mangroves,
- Fringing forest to shrubland of blind-your-eye mangrove (*Excoecaria agallocha*), club mangrove (*Aegialitis annulata*), myrtle mangrove (*Osbornia octodonta*) and river mangrove (*Aegiceras corniculatum*).

Regional ecosystem mapping prepared by the Environmental Protection Agency is based on a scale of 1:100,000 (Map 3) and thus these data may not best illustrate Sandfly Creek at the scale being considered by this management plan. Site inspection detects the following estuarine regional ecosystems (as illustrated on Map 2).

8.1.1 Mangrove vegetation of marine clay plains and estuaries (no concern at present).

8.1.2 Samphire to open forbland to isolated clumps of forbs on saltpans and plains adjacent to mangroves (of concern).

8.1.3 *Sporobolus virginicus* (saltwater couch) on marine sediments (of concern).

8.1.4 Estuarine wetland dominated by *Schoenoplectus littoralis* (clubrush), *Eleocharis dulcis* (bulkuru) or *Paspalum vaginatum* (endangered).

(Note: The conservation status of these ecosystems is the Biodiversity Status as given by the EPA's Regional Ecosystem Description Database, 2009).

Management issues within the estuarine vegetation areas are primarily twofold:

1. Physical degradation of the soil surface and alteration of soil hydrology as a result of numerous vehicle tracks: Soil salinity is a principal driver of zonation within estuarine systems. Within the Mackay locality maximum soil salinity within mangrove forests reaches approximately 60 ‰ (parts per thousand) whilst in salt marsh this figure can rise to more than 120 ‰ (Ball, unpublished data). However even salt marsh is not resistant to highly elevated levels of soil salinity. On spring high tide events estuarine water pools in vehicle tracks and ruts, subsequently evaporates, leading to increased soil salinity. This process of continued build-up of evaporates can lead to scalding from high soil salinities and this discourages re-establishment of salt marsh plants.
2. Water quality and litter from upstream residential areas: The catchment of the Sandfly Creek estuary is primarily residential. Drewry, Higham and Mitchell (2008) provide a comprehensive analysis of the water quality issues within the Mackay City area, including a synopsis of pollutants, fresh and estuarine habitat condition and current and desired management practices. Recommendations provided notably include the following (for existing urban management):
 - a. Water sensitive urban design to be incorporated into any redevelopment.
 - b. A reduction in nutrient and pesticide inflows.
 - c. A reduction in directly connected impervious surfaces.

In addition to the above, previous master planning for the Reserve incorporated a number of gross pollutant traps at points where urban drains enter the Reserve. This would likely reduce the amount of litter entering the Reserve and being transferred through the estuary into the Pioneer River.

Principal Recommendation 2: That an Urban Stormwater Quality Management Plan be developed and implemented for the Catchment area of the Reserve. The implementation of this plan should include installation of gross pollutant traps as indicated by the Sandfly Creek Wetlands Masterplan (2003).

Principal Recommendation 3: That all vehicle tracks within the Reserve be closed with exception of the concrete pathway. This later route should be used for all management access with the exception of that required for access to conduct mosquito and pest plant control. Protocols for the later management access should include; restriction of access to low impact quad motorbikes, to the minimum required for effective and efficient application of chemical control, and wherever possible in dry conditions so as to avoid further damage to vegetation and the soil surface. Interpretive and information signage, approximately 150 metres of post and rail fencing on the western margin (Map 4), and screen plantings should be used to encourage compliance.

2.1.2 Non-native Vegetation

Non-native vegetation has been recorded throughout Sandfly Creek Environmental Reserve and surrounds (see Appendix 2, for flora species list). The vast majority of these species were recorded on the western and southern road margins of the Reserve, and on the constructed levee banks; reflecting the effects of dumped garden waste and past vegetation disturbance (Map 5).

Non-native grasses such as Guinea grass (*Megathyrsis maximus*) and para grass (*Urochloa mutica*) comprise the greatest percentage of weed cover throughout the Reserve, and dominate road embankments, levee banks, and internal sand ridges above the high water mark. These species out compete native vegetation, pose a fire risk to adjacent fire-sensitive vegetation by increasing fuel loads, and may alter the flow regimes of wetland systems. These species should be progressively removed using a combination of mechanical, chemical and revegetation techniques to establish a canopy layer to shade out exotic species.

Several Declared species including mother of millions (*Bryophyllum delagoense*), prickly pear (*Opuntia sp.*), lantana (*Lantana camara*), and singapore daisy (*Sphagneticola trilobata*) were recorded in the Reserve and surrounds and require timely action for control under the *Land Protection (Pest and Stock Route Management) Act 2002*. A combination of mechanical and chemical removal, with suitable replacement by native species, is recommended for their control.

Large woody weeds including leucaena (*Leucaena leucocephala*) and yellow poinciana (*Peltophorum pterocarpum*) are present on the boundary of mangrove communities, particularly along the Reserve's southern East Gordon Street margin. Such species should undergo a staged removal and be replaced with local native vegetation to ensure the maintenance of habitat values and continued protection against erosion.

A multitude of other non-native, herbaceous, garden escapees are also present with the Reserve (Appendix 2), however priority and resources should first be directed to the forementioned priority species capable of significantly altering habitats of ecosystem functions such as hydrology and fire, and Declared species. Appendix 4 provides details of weed management techniques for use in the Reserve.

Map 5: Location of High Incidence of Non-native Vegetation



Principal Recommendation 4: That non-native vegetation is systematically removed from the Sandfly Creek Environmental Reserve. The presence of Declared, invasive, or environmental weeds on adjacent land parcels should also be included in weed management activities given the obvious implications of seed or vegetative spread from nearby sources. Weed management should be carried out over a suitable time period, as maintenance can be kept up, and coupled with the revegetation schedule. Weed control priorities include Declared species, and those capable of altering habitats of ecosystem function. Appendix 4 provides detail of weed control techniques to be used within Sandfly Creek Environmental Reserve and surrounds.

2.1.3 Waste Dumping

Given the downstream location, and the Reserve's proximity to residential and urban areas, the notable presence of waste is not unexpected. Waste dumping results in a number of management issues including; enhanced weed infestation from dumping of garden waste e.g. 'garden escapees', and introduction of plastic materials and pollutants (e.g. vehicle oils and fluids) which impact on natural systems and species. In addition, waste dumping is unsightly and detracts from the natural values of the Reserve. It should be kept in mind that

this issue is common to public land throughout the Mackay area and presents a significant, ongoing management issue in the broader landscape.

Site inspections suggest that idle littering by Reserve users is unlikely to be contributing significantly to accumulations of waste present within the reserve. Much of the material present appears to be derived from upstream areas through stormwater drainage and in this respect; much progress could be made by installation and management of gross pollutant traps as outlined by the Master Plan for the area (Figure 1).

Additional waste materials are almost certainly a result of illegal and informal ‘camps’ within the Reserve (Figure 2). Other waste accumulations may have been present for significant periods of time and do little to encourage improved behaviours. It is very unlikely that there is any panacea to this situation short of making investments in removing existing accumulations of waste to enable improved presentation of the Reserve, in the expectation that this will at least assist in influencing behaviours. The ongoing development of ‘camps’ in the Reserve has its roots in complex social issues that are well outside the scope of this plan. It seems reasonable to suggest that in absence of solutions to these issues, the problem of ‘camp’ development will only be influenced by appropriate and sensitive compliance activities.

Dumping of garden waste has the potential to cause significant environmental harm to the natural resources of the Reserve through introduction of pest plants. Some of this potential is already realised. For example the plant, mother of millions has almost certainly been introduced by this means. One of the preferred habitats of this species includes the sandy soils associated within the sand ridge and it has the potential to continue its spread through this part of the reserve. The presence of mother of millions places statutory obligations (and thus financial burden) on the Reserve Trustee in terms of control actions required by the *Land Protection (Pest and Stock Route Management) Act 2002*. As noted above, the issue of garden waste dumping is not restricted to the Reserve but is common on many areas of public land. One management strategy that has met with some (but limited) success elsewhere has been ‘letterbox’ drops to adjacent residents warning of the environmental impact (and legal consequences) of dumping garden waste. In addition, information signs could be erected to remove the argument of ignorance. However, the only pragmatic and immediately effective management strategy is likely to be regular vigilance by Council staff, and subsequent chemical control of high risk pest plants in the problem areas of the Reserve boundaries (see section 2.1.2 above).



Figure 1: Waste products are being brought into the Reserve from storm water drainage.



Figure 2: Several informal ‘camps’ were recorded within the Reserve, with associated environmental and social impacts.

Principal Recommendation 2 (from section 2.1.1.2 above). That an Urban Stormwater Quality Management Plan be developed and implemented for the Catchment area of the Reserve. The implementation of this plan should include installation of gross pollutant traps as indicated by the Reserve Master Plan (Mackay City Council, 2003).

Principal Recommendation 5. That investments be made to remove accumulated waste within the Reserve with the focus on non-biodegradable materials, including plastics, any evidence of vehicle oils, fluids and similar substances.

Principal Recommendation 6. That a public education and awareness program be instigated, focusing on areas directly adjacent to the Reserve boundary. Material previously prepared for the Slade Point Reserve for Natural Resource Management may be useful for this task. This should include appropriate signs on the Reserve boundaries and 'letterbox' drops to adjacent residents. This should be complimented by biannual inspections of the Reserve boundary by suitably qualified Council staff or contractors, to identify and control high risk pest plants along the Reserve boundary.

2.2 Public Access and Facilities

Council has invested heavily in provision of public access and facilities within both the Reserve and adjacent areas (e.g. Pioneer River boat ramp and associated facilities, Iluka Park and Binnington Esplanade). Notably, a concrete pathway designed to also carry heavy vehicles, traverses the top of the sand ridge/ levee from the boat ramp precinct, over the flood gate structures, along the Reserve margin to east Gordon Street. In the northern area, viewing and shelter facilities are provided immediately to the west of the shorebird roost, and a small seating area is provided immediately east of this roost (Map 6). The location and construction of these facilities has not been without debate particularly in relation to concerns of potential impacts on roosting shorebirds through disturbance. These concerns are not restricted to Sandfly Creek Environmental Reserve and indeed such debates are common globally. Specific recommendations designed to reduce the impact of public access on shorebirds and other fauna, are provided in section 2.3 below.

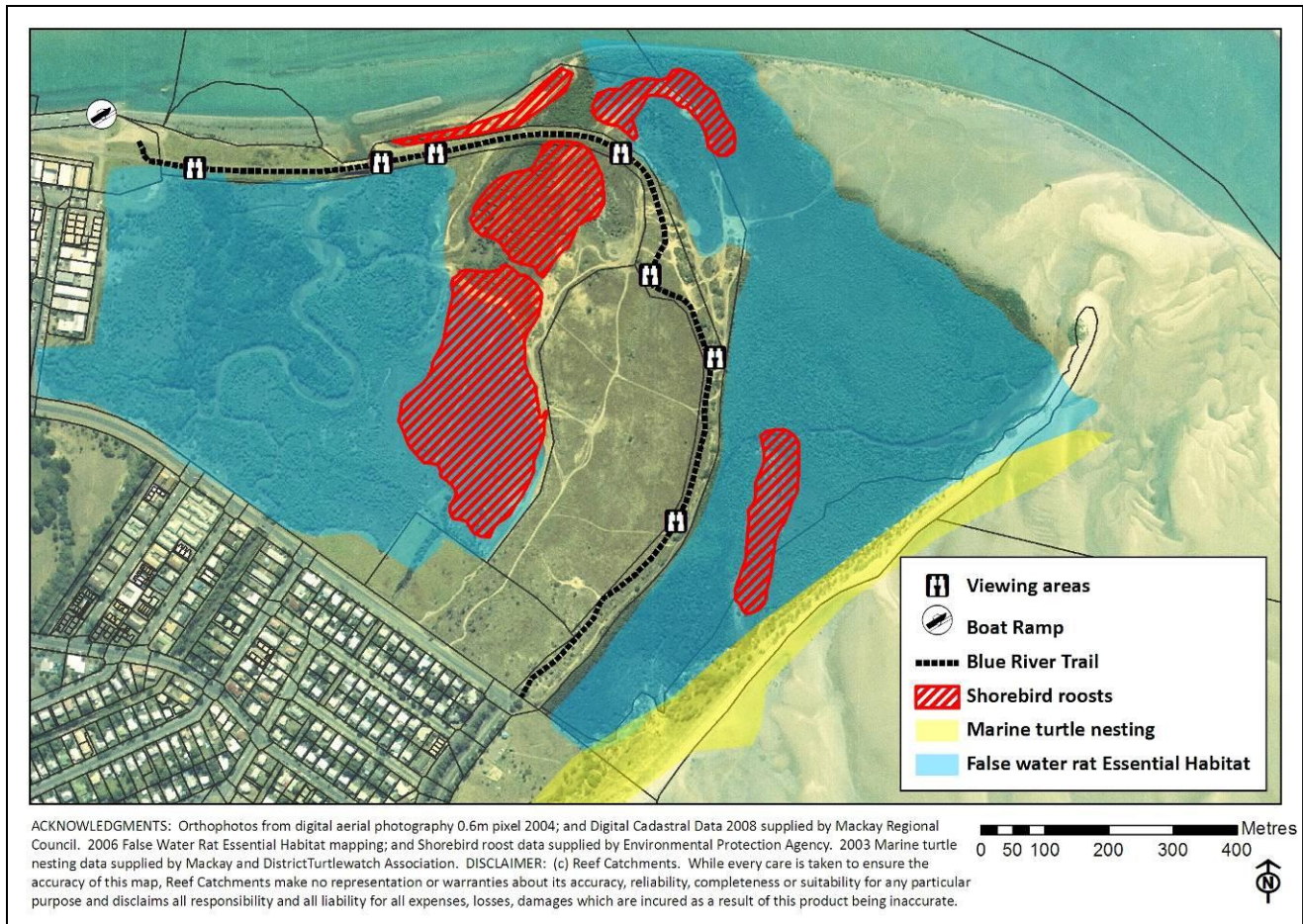
The Reserve area has been used on an ad hoc basis by the community for many years; public access and facilities have only recently been developed in their current form. In addition, the population and demographics of Mackay City are generally accepted as changing rapidly. Given this, it is difficult to predict the demand for additional access and facilities in the future, and whether further development would compromise the sustainability of natural values contained by the Reserve. However, overarching management principles for the Reserve are clear in that use should be low impact.

Extensive areas of adjoining land are available for public use and enjoyment including a large section of Pioneer River frontage to the west (that has and is currently being further developed for the public amenity), and largely developed beach frontage to the south which includes other recreational facilities. Relative to these and other similar areas close to Mackay City; the Reserve represents an extremely small proportion of the overall public land available for use. Given the highly significant natural values of the Reserve, (particularly in relation to migratory shorebirds) it is proposed that further provision of public access and facilities are located outside the Reserve, in areas that are more resilient to visitation and recreational activities. This recommendation

extends to any proposal for bird hides, fishing platforms, additional shelters, seating and paths and similar facilities.

Principal Recommendation 7: No further facilities or structures, with the exception of signage and fencing, are provided within the Reserve.

Map 6: Recreational and Wildlife Values of Sandfly Creek Environmental Reserve



2.3 Wildlife

The most effective management strategy to conserve and enhance fauna biodiversity within the Reserve is through a habitat management approach as opposed to species specific actions. This approach centres on maintaining the broad distribution of vegetation types (habitats) that currently exist within the Reserve by eliminating further vegetation clearing, and restoration of areas that have been previously cleared. This combined with effective pest plant management (see section 2.1.2 above) will provide ample management input to sustain fauna diversity into the future. A fauna species list for the Reserve is provided in Appendix 5.

The outstanding and often controversial management issue is that relating to fire. Significant progress has been made recently in collecting, collating and debating the role of fire within the region's landscape. Contributors to this exercise have been fire management agencies, Queensland Parks and Wildlife Service, Volunteer Rural Fire Brigades, numerous landholders, fire ecologists and conservation biologists. This exercise has seen the development of fire management prescriptions for landscapes within the region that provide acceptable outcomes in terms of conservation, wildfire hazard reduction, and where applicable production outcomes (Appendix 6).

From a conservation perspective, there is no ecological requirement for fire within estuarine landscapes (including saltwater couch grasslands) and indeed, such fire could result in damage to these areas, and/or at least a temporary loss of resources required for key species such as foraging areas for the mangrove mouse and shorebirds. Similarly, there is little evidence to suggest that fire within habitats based on coastal sand dunes, contribute to their ecological integrity or functioning. Indeed, fire within this landscape may contribute to increased infestation from pest plants such as guinea grass, grader grass and thatch grass. From a wildfire hazard reduction perspective, the Reserve may (and has previously) be subjected to unplanned burning/wildfire. However, adjacent infrastructure is separated from the primary area of flammable fuels (the grassy sand ridge) by estuarine wetlands, or by Gordon Street. These are effectively, large, wide, and permanently maintained fire breaks that have successfully isolated fire to within the Reserve on previous occasions, and could be reasonably expected to do so again in the future.

Notwithstanding the above, it is clear that specific management actions will be required to sustain shorebird populations within the Reserve, given the myriad pressures acting on these species across the range of their habitat and migratory paths. Shorebirds are present in large, Internationally significant numbers during the summer residential period in the southern hemisphere. During this period they need to feed prodigiously in order to return to their northern hemisphere breeding grounds. Some individuals, in addition to resident shorebirds, are also expected to utilize the Reserve year round. The principal threat to shorebirds in the Reserve is disturbance which interrupts feeding and thus may impact on their ability to undertake their breeding migration successfully. Within the Reserve such disturbance may occur as a result of pedestrian activity along the primary pathway, but also more importantly through direct disturbance on roost sites by vehicles, fishers and domestic animals (Anon, 2009; Banks and Bryant, 2007) (Figures 3, 4). It will be critical to the conservation of shorebird populations that this disturbance is eliminated or reduced as much as is possible.



Figure 3: Inappropriate vehicle access through the Reserve destroys marine vegetation and disturbs wildlife.



Figure 4: Direct disturbance on roost sites by vehicles, fishers and domestic animals disturbs shorebird populations.

A number of fauna surveys have been conducted within the Reserve although no definitive audit of all groups has taken place. Representative fauna that may be contained by the Reserve at any point include:

8.1.1 Mangrove vegetation of marine clay plains and estuaries.

Although terrestrial vertebrate diversity is relatively low in mangrove vegetation, this ecosystem nevertheless represents important habitat for key species. The vulnerable mangrove mouse (*Xeromys myoides*) is known from some mangrove communities within the northern section of the bioregion; mature animals appear to utilise taller communities dominated by yellow mangrove (*Ceriops tagal*) and orange mangrove (*Bruguiera* spp), however juveniles are sometimes located in low forests of yellow mangrove. Although not restricted to this ecosystem, common brush-tail possums (*Trichosurus vulpecular*) are often observed nesting and feeding within mangrove trees. Flying foxes (*Pteropus* spp) form large 'camps' within mangroves at several locations such as the Proserpine River, and at Eimeo and may use other areas from time to time. The rare rusty monitor (*Varanus semiremex*) has been located within mangrove vegetation behind Smalley's Beach (Cape Hillsborough area) and is likely to be present at other locations. Mangrove vegetation within the bioregion supports a diverse assemblage of avifauna. Some waders such as whimbrel and tattlers roost in mangrove vegetation when high tides inundate their foraging grounds. The little kingfisher reaches the southern extremity of its range within the bioregion. Although never common, this species can be observed within estuarine systems and associated riparian vegetation in upstream areas. Great-billed heron are quite rare, although records are consistently received from areas such as Sandfly Creek.

8.1.2 Samphire to open forbland to isolated clumps of forbs on saltpans and plains adjacent to mangroves.

Samphire flats provide important roosting sites for wader birds, particularly during spring tides when sand-flats and sandy foreshores become inundated. Notable species include the rare eastern curlew, whimbrel, bar-tailed godwit, red-necked stint, and red-capped plover. The rare Burdekin duck forages amongst the samphire although sightings mostly consist of only a few birds. The vulnerable beach stone-curlew feeds within this ecosystem and along its margins, particularly when it lies in close association with sandy foreshores. Mammals do not appear to heavily utilise this ecosystem, although some macropods such as agile wallabies (*Macropus agilis*), are sometimes observed browsing on samphire. Common planigale (*Planigale maculata*) are sometimes found nesting under driftwood, and near urban centres, under rubbish such as roofing iron. Flats of samphire and associated vegetation, lying close to estuarine waterways, can provide suitable nesting areas for estuarine crocodiles (*Crocodylus porosus*). The littoral skink (*Cryptoblepharus littoralis*) is a common inhabitant of this ecosystem, often found foraging amongst driftwood and larger clumps of samphire.

8.1.3 *Sporobolus virginicus* (saltwater couch) on marine sediments.

False water rats (*Xeromys myoides*) are occasionally trapped within this ecosystem but never far from adjacent mangrove forests. This species nest within similar habitats in south-eastern Queensland (Van Dyck, 1997) however, within the central Queensland coast bioregion, this activity appears to take place in adjacent mangrove communities. Other mammals such as agile wallabies (*Macropus agilis*) and eastern grey kangaroo

(*Macropus giganteus*) readily graze on the saltwater couch that distinguishes this ecosystem. Wader birds use this ecosystem both as a roosting area and also for feeding. Notable species include the rare eastern curlew, whimbrel, red-capped plover, red-necked avocet, and marsh sandpiper (*Tringa stagnatilis*).

8.1.4 Estuarine wetland dominated by *Schoenoplectus littoralis* (clubrush), *Eleocharis dulcis* (bulkuru) or *Paspalum vaginatum*.

This regional ecosystem provides habitat of importance to many birds including migratory waders such as sharp-tailed sandpiper; marsh sandpiper, black-winged stilt, and black-fronted dotterel. A diverse suite of other birds utilise this habitat including; grey teal, Pacific black duck, wandering whistling-duck, plumed whistling-duck, the rare Burdekin duck, great egret, cattle egret, intermediate egret, royal spoonbill, Australian white ibis, straw-necked ibis, dusky moorhen, and purple swamphen. Frogs are present within this ecosystem during seasonally wet periods. Recorded species include the; marbled frog (*Limnodynastes convexiusculus*), eastern sedgefrog (*Litoria fallax*), broad palmed rocketfrog (*Litoria latopalmata*), striped rocketfrog (*Litoria nasuta*), northern laughing tree-frog (*Litoria rothii*) and the ruddy tree-frog (*Litoria rubella*).

8.2.1 *Casuarina equisetifolia* open forest to woodland with *Ipomea per-caprae* and *Spinifex sericeus* dominated ground layer on foredunes.

Ground litter layers within this foreshore ecosystem provide habitat for burrowing skinks; eastern stripe-skink *Ctenotus robustus* and *Ctenotus taeniolatus*, the litter dweller, *Lygisaurus foliorum* and the arboreal skink *Cryptoblepharus virgatus*. Other reptiles encountered include the dtella (*Gehyra dubia*), Bynoe's gecko (*Heteronotia binoei*), the vulnerable stripe-tailed delma (*Delma labialis*), *Carlia schmeltzii*, *Cryptoblepharus littoralis*, eastern striped skink (*Ctenotus robustus*), major skink (*Egernia frerei*), mulch skink (*Glaphyromorphus punctulatus*). Both flatback turtles (*Natator depressus*) and green turtles (*Chelonia mydas*) nest in sand dunes seaward of this forest, although at times nests are constructed well into wooded areas. Beach stone-curlew nest and raise chicks within this regional ecosystem, although foraging tends to be within intertidal areas of sand and mud flat, fringing reef or samphire flat. Raptors, notably the white-bellied sea eagle and osprey roost in casuarinas and often consume their prey from these vantage points. Based on available data it would appear that mammals do not make significant use of this ecosystem. The exception is the short-beaked echidna (*Tachyglossus aculeatus*) which is at times observed feeding amongst driftwood in areas more removed from marine influences.

8.2.6 *Corymbia tessellaris* + *Acacia leptocarpa* + *Banksia integrifolia* + *Melaleuca dealbata* + beach scrub species open forest on coastal parallel dunes

Reptiles recorded in this ecosystem include the geckoes; *Gehyra dubia*, southern spotted velvet gecko (*Oedura tryoni*), the dragon (*Diporiphora australis*), bearded dragon (*Pogona barbata*), the sand monitor (*Varanus gouldii*), lace monitor (*Varanus varius*), reduced limb skink (*Anomalopus verreauxii*), rainbow skink (*Carlia pectoralis*), skinks *Cryptoblepharus virgatus* and *Eulamprus brachysoma*, *Lygisaurus foliorum* and copper-tailed skink *Ctenotus taeniolatus*. Also present are the blind snake (*Ramphotyphlops polygrammicus*) and common

tree snake (*Dendrelaphis punctulata*). A relatively rich mammalian assemblage is present including common brush-tail possums (*Trichosurus vulpecular*) which utilise arboreal habitats, as do black flying foxes (*Pteropus alecto*) and little red flying foxes (*Pteropus scapulatus*). Smaller ground dwelling mammals include the common planigale (*Planigale maculata*), fawn-footed melomys (*Melomys cervinipes*), grassland melomys (*Melomys burtoni*) and eastern chestnut mouse (*Pseudomys gracilicaudatus*). Larger grazing and browsing mammals include rufous bettong (*Aepyprymnus rufescens*) and agile wallabies (*Macropus agilis*). During the wet season, this ecosystem supports a diverse assemblage of frogs including; marbled frog (*Limnodynastes convexiusculus*), ornate burrowing frog (*Limnodynastes ornatus*), striped marsh frog (*Limnodynastes peronii*), spotted grass frog (*Limnodynastes tasmaniensis*), scarlet-sided pobblebonk (*Limnodynastes terraereginae*), striped marsh frog (*Litoria peronii*) and the ruddy tree-frog (*Litoria rubella*). 49 bird species have been recorded from this ecosystem including the bar-breasted honey-eater (*Ramsayornis fasciatus*) which is generally uncommon in the bioregion.

Principal Recommendation 1 (from section 2.1.1.1 above): The area currently represented as grassland should be progressively restored to regional ecosystem 8.2.6 including patches of beach scrub in appropriate areas as illustrated on (Map 4). This will assist in screening pedestrian activity from the primary roost sites. However revegetation will be designed in such a way that it does not create a barrier to flight paths and in particular, a gap will be made available directly between the foraging area in Basset Basin and the interior roosting area.

Principal Recommendation 3 (from section 2.1.1.2): That all vehicle tracks within the Reserve be closed with exception of the concrete pathway.

Principal Recommendation 8: Planned burning will not be conducted within the Reserve.

Principal Recommendation 9: The roost area adjacent to the Pioneer River should be closed to all access including fishing. This area represents a tiny fraction of the available river bank available for fishing activity.

Principal Recommendation 10: Domestic animals should be excluded from the Reserve on a seasonal basis between October and April annually. The Reserve area represents a very small proportion of the area of public land available for exercising domestic animals and this recommendation should not unduly impact on such activities.

2.4 Cultural Heritage

Site visits and discussions with Traditional Owners have emphasized that the Reserve overlies a very dynamic part of the coastal zone and indeed there is a strong recognition that the mouth of the Pioneer River has changed location dramatically over time. Traditional Owners have suggested that this theme of dynamic coastal change would represent a suitable interpretive theme for the Reserve.

Other views reflect or are consistent with the recommendations given above:

- There should be suitable revegetation works undertaken to restore the areas adjacent to the current pathway area.
- Pest plants should be controlled and there should be a strong emphasis on controlling the movements of domestic animals within the Reserve.
- Vehicle access should be restricted.

2.5 Erosion

The primary concern raised through community consultation and field inspection in relation to erosion within the Reserve has been the imperative to maintain stabilization of the sand ridge/ levee. This can be achieved by revegetation works and restricting fire within the Reserve to protect the grassy ground layer.

Principal Recommendation 1 (from section 2.1.1.1): The area currently represented as grassland should be progressively restored to regional ecosystem 8.2.6 including patches of beach scrub in appropriate areas as illustrated on (Map 4).

Principal Recommendation 8 (from section 2.3): Planned burning will not be conducted within the Reserve.

3 Recommended Activities

Recommendations	Management Activities		Implementation priority	Estimated cost
	#	Description		
Principal Recommendation 1: The area currently represented as grassland should be progressively restored to Regional Ecosystem 8.2.6 including patches of beach scrub in appropriate areas.	1	Progressive rehabilitation/ re-vegetation of Beach scrub zones (Map 4, Appendix 3).	URGENT	\$25,000 (2.5ha @ \$10,000/ha)
	2	Rehabilitation/ re-vegetation of Sclerophyll woodland zones (Map 4, Appendix 3).	HIGH	\$30,000 (3 ha @ \$10,000/ha)
	3	Rehabilitation/ re-vegetation of Open woodland zones (Map 4, Appendix 3).	MEDIUM	\$30,000 (3 ha @ \$10,000/ha)
Principal Recommendation 2: That an Urban Stormwater Quality Management Plan be developed and implemented for the Catchment area of the Reserve.	4	Development (and subsequent implementation) of an Urban Stormwater Quality Management plan. The stormwater pipe network in the Sandfly Creek catchment needs to be surveyed prior to preparation of catchment management plan.	LOW	Site specific quotes required to estimate pipe network mapping and catchment management plan preparation.
	5	Installation of gross pollutant traps at points defined by the Sandfly Creek Master Plan.	MEDIUM	Site specific design required to estimate GPT costs.
Principal Recommendation 3: That all vehicle tracks within the Reserve be closed with exception of the concrete pathway.	6	Regulatory signage at both entry points, stipulating by-laws and other regulation relevant to the Reserve including a request to e.g. <i>"Stay on cement path provided"</i>	URGENT	\$2,000 (2 signs @ \$1,000 each)
	7	Installation of interpretive signage highlighting the values of vegetation communities within the Reserve in terms of coastal processes and protection.	HIGH	\$12,000 (4 signs @ \$3,000 each)
	8	Construction of post and rail fencing on north western margin to define Reserve boundary and prevent vehicle access (approx 150 metres, Map 4).	HIGH	\$8,250 (150 metres @ \$55/metre)
	9	Negotiate construction of fencing around the freehold parcel in the south-east to manage incoming vehicle traffic.	URGENT	
	1,2,3	Revegetation activities and the use of plants for screening will assist in closing of current tracks.		
Principal recommendation 4: That non-native vegetation be systematically removed from the Sandfly Creek Environmental Reserve.	10	Control of legislatively Declared weeds (in combination with activities 1, 2). (Appendix 2, 3, 4).	HIGH	\$17,250 (11.5 ha @ \$1,500/ha)
	1,2,3	Control of environmental weeds; guinea grass etc, site preparation for reveg will address this in 1, 2, 3. (Appendix 2, 3, 4).		Including in costings for #1, 2, 3, 10.

	11	Removal of common woody weeds such as Leucaena and Yellow Poincianas, particularly along the Reserve's southern margin; and associated revegetation, activity 2. (Appendix 2, 3, 4).	MEDIUM	Included in costings for #10.
	1,2,3	All revegetation activities will progressively address other herbaceous, garden escapees. (Appendix 3, 4).		
Principal Recommendation 5: That investments be made to remove accumulated waste within the Reserve.	12	Removal of accumulated waste in the Reserve; focus on non-biodegradable materials, plastics, vehicle oils, temporary camps.	MEDIUM	\$2,000 (4 days/year @ \$500/day for 2 people)
	5	Installation of gross pollutant traps at points defined by the Sandfly Creek Wetlands Masterplan.		
Principal Recommendation 6: That a public education and awareness program be instigated, focusing on areas directly adjacent to the Reserve boundary.	6	Regulatory signage at both entry points, stipulating by-laws and other regulation relevant to the Reserve including a request to e.g. <i>"No waste dumping"</i>		
	13	Education campaign for local residents on the requirement to dispose of garden waste and other debris at designated Council refuse sites.	MEDIUM	\$1,000 (2 letterbox drops/year @ \$500 each)
Principal Recommendation 7: No further facilities are provided within the Reserve.		No activity required		
Principal Recommendation 8: Planned burning will not be conducted within the Reserve.		No activity required		
Principal Recommendation 9: The roost area adjacent to the Pioneer River should be closed to all access including fishing.	6	Regulatory signage at both entry points, stipulating by-laws and other regulation relevant to the Reserve including a request to e.g. <i>"Stay on cement path provided"</i>		
	7	Installation of interpretive signage highlighting the significance and location of shorebird roosts within the Reserve.		
	2	Screen planting as per activity 1 (rehabilitation/ revegetation of beach scrub zones) (Map 4, Appendix 3).		
Principal Recommendation 10: Domestic animals should be excluded from the Reserve on a seasonal basis between October and April annually.	6	Signage at both entry points, stipulating by-laws and other regulations relevant to the Reserve including a request for <i>"No domestic animals in the Reserve between October and April"</i> .		

4 Implementation and Review

The implementation of the Sandfly Creek Management Plan will occur on a prioritised basis as resources become available. The relative priority of recommended activities and associated costs is recorded in the previous section.

In addition to Mackay Regional Council's Natural Environmental Program staff and funding, multiple external opportunities for funding and resources to assist in the implementation of the Sandfly Creek Environmental Reserve Management Plan exist. These include:

- Federal Government grant opportunities;
- State Government grant opportunities;
- Corporate grant opportunities;
- Regional natural resource management group (Reef Catchments Mackay Whitsundays Inc);
- Specialist organisations with interest in the Reserve (such as the Queensland Wader Study Group);
- Local community groups; and
- Local community volunteers.

Ongoing monitoring will be required to ensure that, as trustees of the Reserve, Mackay Regional Council are upholding their legislative requirements to protect the environmental values of the Reserve, specifically with regard to the management of shorebirds populations.

A formal review of the Sandfly Creek Environmental Reserve Management Plan should take place every five years. However, Mackay Regional Council may seek to update the Management Plan at any stage based on the results of monitoring programs, and in line with further protecting the natural environment values of the Sandfly Creek Environmental Reserve.

5 References

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Van Dyck, S. (1997) 'Xeromys myoides Thomas, 1889 (Rodentia: Muridae) in mangrove communities of North Stradbroke Island, south-east Queensland', *Memoirs of the Queensland Museum*, 42: 337-366.

Appendix 1: Background Information on Sandfly Creek

Department of Natural Resources and Water (2001) *Sandfly Creek Proposed Reserve for Environmental Purposes Draft Management Plan*.

Department of Natural Resources and Mines (2005) *Sandfly Creek Wetland Area Determining the Most Appropriate Use (MAU)*.

Mackay City Council (2003) *Sandfly Creek Wetlands Masterplan*.

Appendix 2: Flora Species List Sandfly Creek Environmental Reserve and Surrounds

* non-native species

+ introduced native species

Growth form: (T) tree; (S) shrub; (H) non-woody plant; (V) creeper

Genus species	Common Name	Growth Form	Non-native species status (Land Protection (Pest and Stock Route Management) Act 2002)
<i>Abildgaardia ovata</i>	A fine sedge	H	
<i>Abrus precatorius</i>	Giddy Giddy	V	
<i>Acacia leptocarpa</i>	Northern Wattle	T	
<i>Acacia holosericea</i> (planted)	Silver-leaved Wattle	T	
<i>Acanthus ilicifolius</i>	Holly mangrove	S	
<i>Aegialitis annulata</i>	Club mangrove	T	
<i>Aegiceras corniculatum</i>	River mangrove	S	
* <i>Agave sp.</i>	Agave	H	
* <i>Ageratum conyzoides</i>	Billy-goat weed	H	
+ <i>Albizia lebbek</i>	Siris Tree	T	
* <i>Aloe ?vera var. officinalis</i>	Aloe vera	H	
<i>Alphitonia excelsa</i>	Soapy ash	T	
<i>Avicennia marina</i>	Grey mangrove	T	
* <i>Bidens pilosa</i>	Cobblers pegs	H	
<i>Bruguiera exaristata</i>	Rib-fruited Orange Mangrove	T	
<i>Bruguiera gymnorhiza</i>	Large-fruited Orange Mangrove	T	
<i>Bruguiera parviflora</i>	Small-flowered Orange Mangrove	T	
* <i>Bryophyllum pinnatum</i>	Live leaf	H	
* <i>Bryophyllum delagoense</i>	Mother-of-millions	H	Declared Class 2
<i>Bulbostylis barbata</i>	A fine sedge	H	
<i>Canavalia rosea</i>	Beach Bean	H	
<i>Casuarina equisetifolia</i>	Beach she-oak	T	
* <i>Catharanthus roseus</i>	Pink Periwinkle	H	
* <i>Cenchrus echinatus</i>	Seaforth Burr	H	
<i>Ceriops tagal</i>	Spurred Mangrove	T	
* <i>Chamaesyce hirta</i>	Asthma Plant	H	
* <i>Chloris inflata</i>	Purpletop Chloris	H	
* <i>Chloris virgata</i>	Feathertop Rhodes Grass	H	
<i>Clerodendrum floribundum</i>	Lolly Bush	T	
<i>Clerodendrum inerme</i>	Sorcerer's Flower	S	
* <i>Clitoria ternatea</i>	Butterfly Pea	H	
* <i>Crotalaria juncea</i>	Sun Hemp	H	
* <i>Crotalaria lanceolata</i>	A rattle pod	H	
<i>Cupaniopsis anacardioides</i>	Tuckeroo	T	

<i>Cynanchum carnosum</i>	Mangrove Milk-pod	H	
<i>Cynodon dactylon</i>	Green Couch	H	
<i>Cyperus javanicus</i>	A tall sedge	H	
<i>Cyperus pedunculatus</i>	Pineapple Sedge	H	
* <i>Dactyloctenium aegyptium</i>	Coast Button Grass	H	
* <i>Desmodium tortuosum</i>	Florida Beggar Weed	HS	
* <i>Digitaria eriantha</i> subsp. <i>pentzii</i>	Pangola Grass	H	
* <i>Emilia sonchifolia</i>	Emilia	H	
<i>Enchylaena tomentosa</i>	Ruby Saltbush	H	
<i>Exoecaria agallocha</i>	Milky mangrove/ Blind your eye	T	
<i>Fimbristylis dichotoma</i>	Common Fridge-rush	H	
<i>Fimbristylis ferruginea</i>	Rusty Fringe-rush	H	
<i>Glycine</i> sp.	Glycine	H	
<i>Halosarcia</i> sp.	Samphire	H	
<i>Heteropogon contortus</i>	Black speargrass	H	
<i>Hibiscus tiliaceus</i>	Cotton tree	T	
* <i>Hyparrhenia rufa</i>	Thatch grass	H	
<i>Indigofera hirsuta</i>	Hairy Indigo	S	
* <i>Indigofera tinctoria</i>	Indigo	S	
* <i>Ipomea cairica</i>	Mile-a-minute	H	
<i>Ipomea pes-caprae</i>	Goats Foot	H	
<i>Jagera pseudorhus</i>	Foambark Tree	T	
* <i>Lantana camara</i>	Lantana	S	Declared Class 3
* <i>Leucaena leucocephala</i>	Leucaena	T	
<i>Limonium solanderi</i>	Sea statice	H	
<i>Lomandra</i> sp (planted)	Mat-rush		
<i>Lumnitzera racemosa</i>	White-flowered Black Mangrove	T	
<i>Macaranga tanarius</i>	Macaranga	T	
* <i>Macroptilium atropurpureum</i>	Siratro	HV	
* <i>Macroptilium lathyroides</i>	Phasey Bean	H	
* <i>Megathyrsis maximus</i>	Guinea grass	H	
* <i>Melinis repens</i>	Red natal grass	H	
<i>Millettia pinnata</i>	Pongamia	T	
* <i>Mimosa pudica</i>	Sensitive weed	H	
<i>Myoporum acuminatum</i>	Boobiella	T	
* <i>Opuntia</i> sp.	Prickly pear	H	Declared Class 2
<i>Osbornia octodonta</i>	Myrtle mangrove	S	
<i>Pandanus</i> sp.	Screw Palm	T	
<i>Paspalum distichum</i> or <i>vaginatatum</i>	Water Couch	H	
* <i>Peltophorum pterocarpum</i>	Yellow Poinciana	T	
<i>Pittosporum ferrugineum</i>	Rusty Pittosporum	T	
<i>Rhizophora stylosa</i>	Small Stilted Mangrove	T	

<i>*Sansevieria trifasciata</i>	Mother in laws tongue	H	
<i>Sersalisia sericea</i>	Mongo	T	
<i>Sesbania cannabina</i>	Sesbania Pea	HS	
<i>Sesuvium portulacastrum</i>	Sea Purslane	H	
<i>*Sphagneticola trilobata</i>	Singapore Daisy	H	Declared Class 3
<i>*Sida cordifolia</i>	Flannel Weed	H	
<i>*Sida rhombifolia</i>	Sida Retusa	H	
<i>*Sonchus oleraceus</i>	Milk Thistle	H	
<i>Sporobolus virginicus</i>	Marine Couch	H	
<i>*Stachytarpheta jamaicensis</i>	Blue SnakeWeed	H	
<i>*Stylosanthes humilis</i>	Townsville Stylo	H	
<i>*Stylosanthes scabra</i>	Shrubby Stylo	H	
<i>Suaeda australis</i>	Austral Seablite	H	
<i>*Themeda quadrivalvis</i>	Grader Grass	H	
<i>*Tridax procumbens</i>	Tridax Daisy	H	
<i>*Urochloa mutica</i>	Para grass	H	
<i>+Wodyetia bifurcata</i> (planted)	Fox-tail Palm	T	

List compiled from: Irene Champion and Kylie Dodds (*Sandfly Creek Draft Management Plan June 2001*), Irene Champion (*Sandfly Creek Vascular Plants Compiled for Landcare Conference Walk 2007*), and field assessments by Eddie Adams, Derek Ball, and Kerri Woodcock (2009).

Appendix 3: Sandfly Creek Environmental Reserve Proposed Revegetation Activities

Three 'zones' are proposed for revegetation activities (Map 4):

Beach Scrub areas (approx 2.5 ha)

Revegetation of patches of beach scrub vegetation is proposed to mirror the areas in which this system was likely to develop naturally; in swales and other areas of higher soil moisture and protection from prevailing winds. The beach scrub revegetation is intended to provide a screening function along much of the junction between the northern pathway and the key shorebird roost, without unduly compromising the views currently available to users of the walkway nor creating any substantial barrier to shorebird flight paths. This can be achieved by using a combination of various shrub and tree heights and revegetation patterns on the northern bank of the Reserve. In addition to the above, re-establishment of beach scrub will assist in the ongoing management of pest plants by 'shading out' key species such as exotic grasses. The northern and eastern seaward margins off the 'beach scrub' revegetation zones may require the inclusion of more salt tolerant, wind resistant or shrub species (representing Regional Ecosystem 8.2.1).

Sclerophyll woodland (approx 3.5 ha)

The revegetation of sclerophyll woodland intends to progressively restore vegetation (nominally to that resembling Regional Ecosystem 8.2.6 and 8.2.1) along the south of the pathway along the Pioneer River and to the East of the sand ridge as it traverses to Gordon Street. This revegetation will serve the purposes of habitat restoration, erosion control, and it will act as a wind break, assisting in re-establishment of beach scrub vegetation.

Open woodland (approx 14 ha)

Revegetation of open woodland intends to progressively restore the dune system to Regional Ecosystem 8.2.6. However, given that there are expanses of well-established native grasses which contribute to the effective stabilization of the sand ridge/ levee, revegetation is proposed to occur at a much lower density, in selected patches of the landscape which are currently infested by exotic grasses. The result should be a combination of open woodland and native grassland, providing maximum habitat values across the landscape.

Table 1: Species lists and planting densities for revegetation zones

Growth form: (T) tree; (S) shrub

Beach Scrub zone RE 8.2.2/ 8.2.1 (approx 2.5 ha)	Sclerophyll Woodland zone RE 8.2.1/ 8.2.6 (approx 3.5 ha)	Open Woodland zone RE 8.2.6 (approx 14 ha)
Planting density		
1000 plants per hectare	500 plants per hectare	500 plants per hectare (in patchy areas only, where exotic grasses dominate)
Dominant species for revegetation		
<i>Alphitonia excelsa</i> (T) <i>Casuarina equisetifolia</i> (T) (seaward margin only) <i>Cupaniopsis anacardioides</i> (T) <i>Euroschinus falcatus</i> (T) <i>Hibiscus tiliaceus</i> (T) <i>Jagera psuedorhus</i> (T) <i>Mallotus philippensis</i> (T) <i>Pittosporum ferrugineum</i> (T) <i>Planchonia careya</i> (T)	<i>Acacia leptocarpa</i> (T) <i>Alphitonia excelsa</i> (T) <i>Argusia argentea</i> (S) <i>Casuarina equisetifolia</i> (T) <i>Clerodendron inerme</i> (S) <i>Hibiscus tiliaceus</i> (T) <i>Vitex trifolia</i> (S)	<i>Corymbia tessellaris</i> (T)
Subdominant species for revegetation		
<i>Clerodendrum floribundum</i> (S) <i>Clerodendrum inerme</i> (S) <i>Drypetes deplanchei</i> (T) <i>Eugenia reinwardtiana</i> (S) <i>Vitex trifolia</i> (S)	<i>Banksia integrifolia</i> subsp. <i>compare</i> (T) <i>Chionanthus ramiflora</i> (T) <i>Euroschinus falcatus</i> (T) <i>Jagera psuedorhus</i> (T)	<i>Acacia leptocarpa</i> (T) <i>Alphitonia excelsa</i> (T) <i>Banksia integrifolia</i> (T) <i>Chionanthus ramiflora</i> (T) <i>Euroschinus falcatus</i> (T) <i>Jagera psuedorhus</i> (T)

From “Sustainable Landscape Program Revegetation Species List” (Regional Ecosystems 8.2.1, 8.2.2, 8.2.6); and “Species for consideration for the Sandfly Creek Barrier” (compiled by Irene Champion, 2000).

Appendix 4: Weed Management techniques for Sandfly Creek Environmental Reserve

Techniques	Comment
Natural regeneration	Encouraging the natural regeneration of native species is the best method for restoration of an area. For this to occur a viable seed bank must be present, and re-growth must include all native plant species from each stratum level. In areas where natural regeneration is to occur, the area should be clearly marked for exclusion from pedestrians and public. In these areas, ongoing maintenance is required to minimise re-growth of weed species.
Revegetation	Where planting, local native vegetation is required due to insufficient cover or re-growth of native species. Local native species should be sourced and replanted within an area as per revegetation guide. Correct soil and bed preparation techniques should be carried out prior to planting and ongoing maintenance of the site is required.
Staged weed removal	Weed removal should be carried out in a staged approach. Particularly useful in removal of non-native vegetation along the dune scarp. Large woody weeds should be removed slowly to ensure the replaced native vegetation provides sufficient habitat value and protection against erosion before more removal of woody species.
Physical weed removal	Physical weed removal, including hand pulling, chipping or cutting weeds is effective in small infestations in environmentally sensitive areas.
Mechanical weed removal	Mowing or brush cutting will suppress weed growth, discourage seeding and spread. This method should be used particularly in areas bordering large infestations. Care should be taken to reduce potential disturbance as excessive mowing and brush cutting can facilitate further weed growth and reduce regeneration of native vegetation.
Herbicide weed removal	The application of herbicides includes foliage or basal spraying, cut/ paste and stem injection where applicable. Spraying may be carried out on large or robust weed infestation, particularly to gain initial control of an infestation. However the majority of spraying is likely to be small scale 'spot spray' applications to minimise non-target impacts. Roundup Bi-active [®] is recommended due to its low toxicity to wildlife and humans.

Extract from *Sarina Coastal Sustainable Landscapes Project (2007)*.

Appendix 5: Fauna Species List Sandfly Creek Environmental Reserve

* Bird records provided by the Mackay and Whitsunday Branch of Bird Observation and Conservation Australia (MACBOCA), compiled by Marj Andrews (2009).

+ Records from Sandfly Creek Proposed Reserve for Environmental Purposes Draft Management Plan (2001)

All other records are species which are potentially in the Reserve based in Regional Ecosystem data.

NCA – *Nature Conservation Act 1992* (E – endangered, V – vulnerable, R – rare)

EPBC – *Environment Protection and Biodiversity Conservation Act 1999* (V – vulnerable, M – migratory, m – marine)

Family	Genus species	Common name	NCA Status	EPBC Status
BIRDS				
Acanthizidae	<i>Gerygone levigaster</i>	Mangrove Gerygone*		
Accipitridae	<i>Accipiter fasciatus</i>	Brown Goshawk*		M, m
	<i>Elanus axillaris</i>	Black-shouldered Kite*		M
	<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle*		M, m
	<i>Haliastur indus</i>	Brahminy Kite*		M, m
	<i>Haliastur sphenurus</i>	Whistling Kite*		M, m
	<i>Milvus migrans</i>	Black Kite*		M
	<i>Pandion haliaetus</i>	Osprey*		M, m
Alaudidae	<i>Mirafra javanica</i>	Horsfield's Bushlark*		
Anatidae	<i>Anas superciliosa</i>	Pacific Black Duck*		M
	<i>Cygnus atratus</i>	Black Swan*		M
	<i>Dendrocygna eytoni</i>	Plumed Whistling Duck*		M
	<i>Tadorna radjah</i>	Radjah Shelduck	R	M, m
Anhingidae	<i>Anhinga melanogaster</i>	Australasian Darter*		
Anseranatidae	<i>Anseranas semipalmata</i>	Magpie Goose*		
Apodidae	<i>Hirundapus caudacutus</i>	White-throated Needletail*		M, m
Ardeidae	<i>Ardea alba</i>	Eastern Great Egret*		m
	<i>Ardea intermedia</i>	Intermediate Egret*		m
	<i>Butorides striatus</i>	Striated Heron*		
	<i>Egretta garzetta</i>	Little Egret*		m
	<i>Egretta novaehollandiae</i>	White-faced Heron*		
Artamidae	<i>Artamus leucorhynchus</i>	White-breasted Woodswallow*		
	<i>Cracticus nigrogularis</i>	Pied Butcherbird*		
	<i>Cracticus quoyi</i>	Black Butcherbird*		
	<i>Cracticus tibicen</i>	Australian Magpie*		
Burhinidae	<i>Burhinus grallarius</i>	Bush Stone-curlew*		
	<i>Esacus neglectus</i>	Beach Stone-curlew*	V	m
Cacatuidae	<i>Cacatua roseicapilla</i>	Galah*		
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike*		m
Centropodidae	<i>Centropus phasianinus</i>	Pheasant Coucal*		
Charadriidae	<i>Charadrius bicinctus</i>	Double-banded Plover*		M, m
	<i>Charadrius leschenaultii</i>	Greater Sand Plover*		M, m

	<i>Charadrius mongolus</i>	Lesser Sand Plover*		M, m
	<i>Charadrius ruficapillus</i>	Red-capped Plover*		M, m
	<i>Euseyornis melanops</i>	Black-fronted Dotterel*		M
	<i>Pluvialis fulva</i>	Pacific Golden Plover*		M, m
	<i>Pluvialis squatarola</i>	Grey Plover*		M, m
	<i>Vanellus miles</i>	Masked Lapwing*		M
Ciconiidae	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork*	R	
Columbidae	<i>Columba livia</i>	Rock Dove*		
	<i>Ducula bicolor</i>	Pied Imperial Pigeon*		m
	<i>Geopelia humeralis</i>	Bar-shouldered Dove*		
	<i>Geopelia striata</i>	Peaceful Dove*		
	<i>Ocyphaps lophotes</i>	Crested Pigeon*		
	<i>Streptopelia chinensis</i>	Spotted Dove*		
Coraciidae	<i>Eurystomus orientalis</i>	Dollarbird*		m
Corvidae	<i>Corvus orru</i>	Torresian Crow*		
Cuculidae	<i>Cacomantis variolosus</i>	Brush Cuckoo*		
	<i>Chrysococcyx minutillus</i>	Little Bronze-cuckoo*		m
	<i>Chrysococcyx russatus</i>	Gould's Bronze-cuckoo*		m
	<i>Eudynamis scolopacea</i>	Eastern Koel*		m
	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo*		m
Dicruridae	<i>Dicrurus bracteatus</i>	Spangled Drongo*		m
	<i>Grallina cyanoleuca</i>	Magpie Lark*		m
	<i>Myiagra rubecula</i>	Leaden Flycatcher*		
	<i>Rhipidura leucophrys</i>	Willie Wagtail*		
Estrildidae	<i>Taeniopygia bichenovii</i>	Double-barred Finch*		
Falconidae	<i>Falco berigora</i>	Brown Falcon*		M
	<i>Falco cenchroides</i>	Nankeen Kestrel*		M, m
Haematopodidae	<i>Haematopus fuliginosus</i>	Sooty Oystercatcher*	R	
	<i>Haematopus longirostris</i>	Pied Oystercatcher*		
Halcyonidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra*		
	<i>Todiramphus macleayii</i>	Forest Kingfisher*		m
	<i>Todiramphus sanctus</i>	Sacred Kingfisher*		m
Hirundinidae	<i>Hirundo ariel</i>	Fairy Martin*		
	<i>Hirundo neoxena</i>	Welcome Swallow*		m
	<i>Hirundo nigricans</i>	Tree Martin*		m
Laridae	<i>Chlidonias leucopterus</i>	White-winged Black Tern*		M, m
	<i>Larus novaehollandiae</i>	Silver Gull*		m
	<i>Sterna albifrons</i>	Little Tern*	E	M, m
	<i>Sterna bengalensis</i>	Lesser Crested Tern*		m
	<i>Sterna bergii</i>	Crested Tern*		m
	<i>Sterna caspia</i>	Caspian Tern*		m
	<i>Sterna nilotica</i>	Gull-billed Tern*		m

Maluridae	<i>Malurus melanocephalus</i>	Red-backed Fairy-wren*		
Meliphagidae	<i>Entomyzon cyanotis</i>	Blue-faced Honeyeater*		
	<i>Lichenostomus fasciogularis</i>	Mangrove Honeyeater*		
	<i>Lichenostomus virescens</i>	Singing Honeyeater*		
	<i>Lichmera indistincta</i>	Brown Honeyeater*		
	<i>Myzomela obscura</i>	Dusky Honeyeater*		
	<i>Philemon buceroides</i>	Helmeted Friarbird*		
	<i>Philemon citreogularis</i>	Little Friarbird*		
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater*		M, m
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit*		m
Nectariniidae	<i>Nectarinia jugularis</i>	Olive-backed Sunbird*		
Oriolidae	<i>Oriolus sagittatus</i>	Olive-backed Oriole*		
	<i>Sphecotheres viridis</i>	Australasian Figbird*		
Pardalotidae	<i>Pardalotus striatus</i>	Striated Pardalote*		
Passeridae	<i>Lonchura castaneothorax</i>	Chestnut-breasted Manikin*		
	<i>Lonchura punctulata</i>	Nutmeg Mannikin*		
	<i>Passer domesticus</i>	House Sparrow*		
Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian Pelican*		m
Phalacrocoracidae	<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant*		
	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant*		
	<i>Phalacrocorax varius</i>	Pied Cormorant*		
Phasianidae	<i>Coturnix ypsilophora</i>	Brown Quail*		
Psittacidae	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet*		
Recurvirostridae	<i>Himantopus himantopus</i>	Black-winged Stilt*		M, m
	<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet*		M, m
Scolopacidae	<i>Actitis hypoleucos</i>	Common Sandpiper*		M, m
	<i>Arenaria interpres</i>	Ruddy Turnstone*		M, m
	<i>Calidris acuminata</i>	Sharp-tailed Sandpiper*		M, m
	<i>Calidris canutus</i>	Red Knot*		M, m
	<i>Calidris ferruginea</i>	Curlew Sandpiper*		M, m
	<i>Calidris ruficollis</i>	Red-necked Stint*		M, m
	<i>Calidris tenuirostris</i>	Great Knot*		M, m
	<i>Heteroscelus brevipes</i>	Grey-tailed Tattler*		M, m
	<i>Limicola falcinellus</i>	Broad-billed Sandpiper*		M, m
	<i>Limosa lapponica</i>	Bar-tailed Godwit*		M, m
	<i>Limosa limosa</i>	Black-tailed Godwit*		M, m
	<i>Numenius madagascariensis</i>	Eastern Curlew*	R	M, m
	<i>Numenius phaeopus</i>	Whimbrel*		M, m
	<i>Tringa nebularia</i>	Common Greenshank*		M, m
	<i>Tringa stagnatilis</i>	Marsh Sandpiper*		M, m
<i>Xenus cinereus</i>	Terek Sandpiper*		M, m	
Strigidae	<i>Ninox novaeseelandiae</i>	Southern Boobook*		m

Sylviidae	<i>Cisticola exilis</i>	Golden-headed Cisticola*		M
	<i>Megalurus timoriensis</i>	Tawny Grassbird*		M
Threskiornithidae	<i>Platalea regia</i>	Royal Spoonbill*		
	<i>Threskiornis molucca</i>	Australian White Ibis*		m
	<i>Threskiornis spinicollis</i>	Straw-necked Ibis*		m
Zosteropidae	<i>Zosterops lateralis</i>	Silvereve*		m
MAMMALS				
Dasyuridae	<i>Planigale maculata</i>	Common planigale		
Macropodidae	<i>Aepyprymnus rufescens</i>	Rufous bettong		
	<i>Macropus agilis</i>	Agile wallaby		
	<i>Macropus giganteus</i>	Eastern grey kangaroo		
Muridae	<i>Melomys burtoni</i>	Grassland melomys		
	<i>Melomys cervinipes</i>	Fawn-footed melomys		
	<i>Pseudomys gracilicaudatus</i>	Eastern chestnut mouse		
	<i>Xeromys myoides</i>	False water rat	V	V
Phalangeridae	<i>Trichosurus vulpecular</i>	Common brush-tail possum		
Pteropodidae	<i>Pteropus alecto</i>	Black flying fox		
	<i>Pteropus scapulatus</i>	Little red flying fox		
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked echidna		
REPTILES				
Agamidae	<i>Diporiphora australis</i>	Dragon		
	<i>Pogona barbata</i>	Bearded dragon		
Cheloniidae	<i>Natator depressus</i>	Flatback turtle	V	V, M, m
	<i>Chelonia mydas</i>	Green turtle	V	V, M, m
Colubridae	<i>Dendrelaphis punctulata</i>	Common tree snake		
Crocodylidae	<i>Crocodylus porosus</i>	Crocodile	V	M, m
Gekkonidae	<i>Gehyra dubia</i>	Dtella		
	<i>Heteronotia binoei</i>	Bynoe's gecko		
	<i>Oedura tryoni</i>	Southern spotted velvet gecko		
Pygopodidae	<i>Delma labialis</i>	Strip-tailed delma	V	V
Scinidae	<i>Anomalopus verreauxii</i>	Reduced limb skink		
	<i>Carlia schmeltzii</i>	Schmeltz's skink		
	<i>Carlia pectoralis</i>	Rainbow skink		
	<i>Cryptoblepharus littoralis</i>	Littoral skink		
	<i>Cryptoblepharus virgatus</i>	Arboreal skink		
	<i>Ctenotus robustus</i>	Eastern striped skink		
	<i>Ctenotus taeniolatus</i>	Copper-tailed skink		
	<i>Egernia frerei</i>	Major skink		
	<i>Eulamprus brachysoma</i>	Skink		
	<i>Glaphyromorphus punctulatus</i>	Mulch skink		
	<i>Lygisaurus foliorum</i>	Tree-base litter-skink		
Typhlopidae	<i>Ramphotyphlops</i>	Blink snake		


	<i>polygrammicus</i>			
Varanidae	<i>Varanus semiremex</i>	Rusty monitor	R	
	<i>Varanus goldii</i>	Sand monitor		
	<i>Varanus varius</i>	Lace monitor		
FISH				
Ariidae	<i>Arius graffei</i>	Blue catfish ⁺		
Centropomidae	<i>Lates calcarifer</i>	Barramundi ⁺		
Lutjanidae	<i>Lutjanus argentimaculatus</i>	Mangrove jack ⁺		
Scatophagidae	<i>Selenotoca multifasciata</i>	John dory/ striped butterfish ⁺		
Tetraodontidae		Toadfish ⁺		
AMPHIBIANS				
Hylidae	<i>Litoria fallax</i>	Eastern sedgefrog		
	<i>Litoria latopalmata</i>	Broad palmed rocketfrog		
	<i>Litoria nasuta</i>	Striped rocketfrog		
	<i>Litoria rothii</i>	Northern laughing tree-frog		
	<i>Litoria rubella</i>	Ruddy tree-frog		
Myobatrachidae	<i>Limnodynastes convexiusculus</i>	Marbled frog		
	<i>Limnodynastes ornatus</i>	Ornate burrowing frog		
	<i>Limnodynastes peronii</i>	Striped marsh frog		
	<i>Limnodynastes tasmaniensis</i>	Spotted grass frog		
	<i>Limnodynastes terraereginae</i>	Scarlet-sided pobblebonk		


Appendix 6: Fire Management Guidelines for landscapes within the Reserve

Mangroves and Estuarine Wetlands

Fire Management Guidelines for Central Queensland Coast

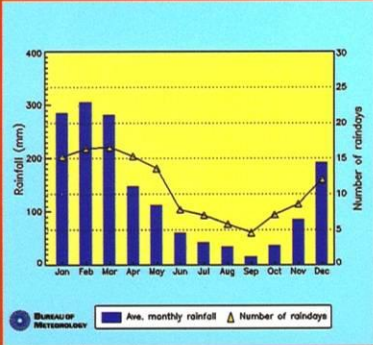
Landscape 1






BURNING IS GENERALLY NOT RECOMMENDED IN THIS LANDSCAPE


Mangroves, saltmarsh, saltwater couch, areas of saltpan and fringing melaleuca forests and pandanus.



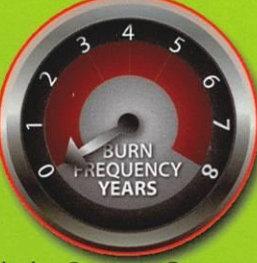
Month	Ave. monthly rainfall (mm)	Number of raindays
Jan	300	20
Feb	280	20
Mar	250	20
Apr	180	15
May	120	10
Jun	80	8
Jul	60	7
Aug	50	6
Sep	40	5
Oct	50	6
Nov	80	8
Dec	150	15




BURNING MOSAIC - UNBURNT 100%



SEASON MONTHS



BURN FREQUENCY YEARS



LOW MODERATE HIGH

FIRE INTENSITY - °C

The Clarke Connors Range
bushfire consortium

1

Hazard Reduction

Saltmarsh and saltwater couch grasslands are regularly inundated by high tides which maintain high soil moisture and ensure continual green growth throughout the year. Because of this these areas rarely represent a fire hazard risk. Risk is further minimised by the fact that the grasslands rarely accumulate large amounts of fuels and tend to be broken up by patches of saline clay and sparse saltmarsh.

The native ground cover within fringing melaleuca woodland and forests is also saltwater couch and this does not represent a high fire hazard. However, in many areas Guinea grass and other exotic grasses have invaded and these can accumulate high fuel loads that pose a fire risk in the dry season. Guinea grass and many other exotic grasses tend to quickly increase their biomass after fire, often reaching a similar fuel load in as little as one season. The most effective long-term fire hazard reduction strategy is to remove these grasses using herbicide such as glyphosate.

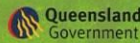
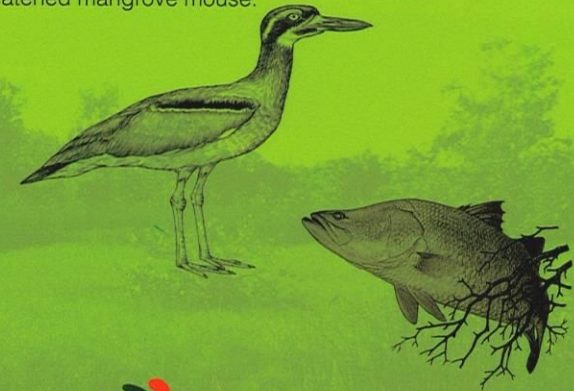
Production

Because of high salt levels in the soil, weed infestations are rarely a problem in saltwater couch grasslands and burning for weed control does not need to be undertaken. Saltwater couch is a perennial grass and pasture condition is strongly dependant on normal tidal cycles. Fire does

not improve productivity and indeed, fire can lead to loss of important nutrients. Saltmarsh and saltwater couch grasslands are an important food source, and refuge for juvenile fish. There is strong evidence that juvenile fish feed heavily in these areas on high tides. A decrease in biomass through removal by fire, or overgrazing, may have a significant impact on coastal fisheries production.

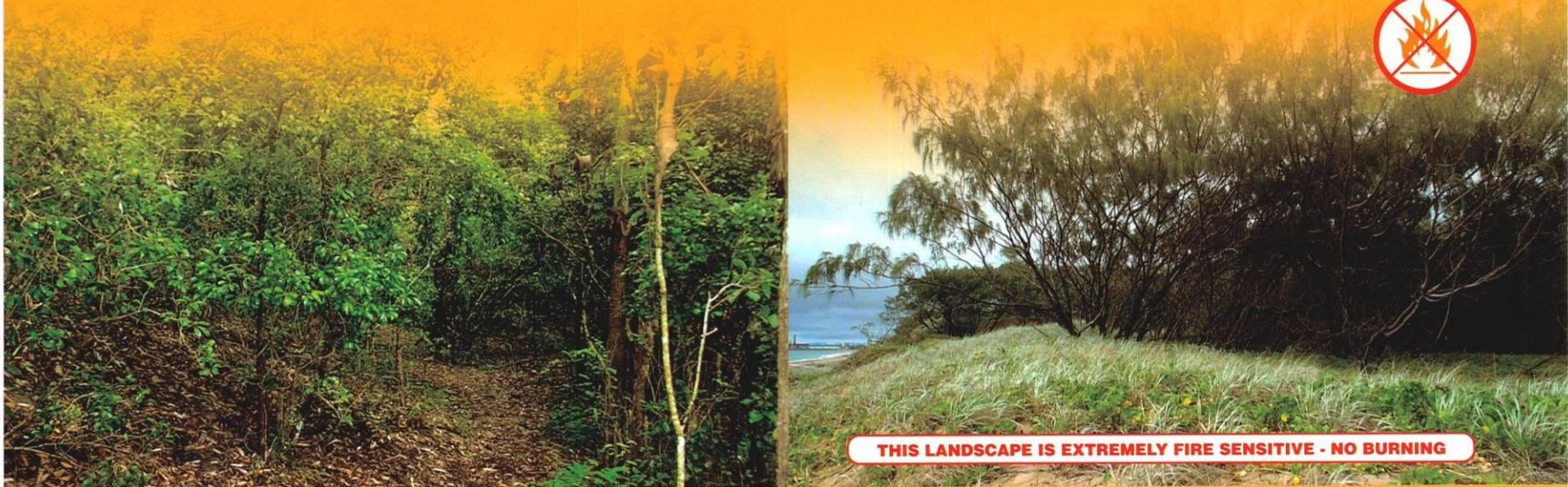
Conservation

Apart from their values to coastal fisheries, mangroves, saltmarsh and saltwater couch grasslands provide essential habitat for a range of conservation dependant species. Minimising fire and other disturbance within these areas provides significant positive benefits for migratory and resident shorebirds, seabirds and the threatened mangrove mouse.



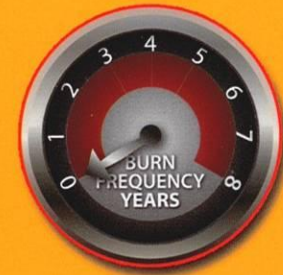
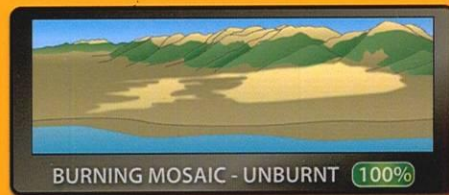
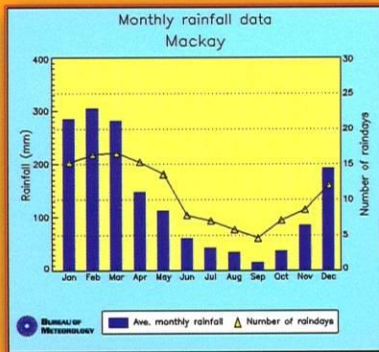
Beaches and foreshores

Landscape 2



THIS LANDSCAPE IS EXTREMELY FIRE SENSITIVE - NO BURNING

Coastal she-oak & beach scrub (rainforest) in protected areas.



The Clarke Connors Range bushfire consortium

Hazard Reduction

Coastal she-oak and beach scrub habitats are fire sensitive and will be killed or severely degraded by even low intensity fire.

The native ground cover within beach scrubs and coastal foreshores does not accumulate large amounts of fuel and does not represent a high fire hazard. However, infestations of exotic grasses and weeds can significantly increase hazardous fuels, especially along disturbed edges of this landscape.

Hazard reduction burning is generally not suitable in coastal areas as Guinea grass and other fire loving grasses quickly increase their biomass after fire, often reaching a similar fuel load in as little as one season.

An effective long-term strategy is the use of registered herbicide to reduce fuel hazards where required. Apply when grasses are actively growing, preferably prior to dry season.

Production

Many remaining areas of beach scrub are islands in a sea of cleared land, and much remaining foreshore vegetation is the only buffer between the land and the sea.

Undisturbed foreshores and beach scrubs are fairly resistant to weed invasions, however smaller patches and disturbed areas are more prone to weed invasions and associated fire risk.

Disturbance caused by stock trampling and the presence of

feral pigs can encourage spread of lantana and other

weeds into otherwise intact areas. Management of stock access and provision of shade and watering points away from beach scrub and foreshores will reduce the impacts of disturbance in the long term.

Reducing weed impacts by means other than fire around buffers and in degraded areas will protect, and facilitate recovery of, these sensitive coastal areas.

Conservation

Fire is a key threat to remaining areas of beach scrub (rainforest on sand dunes) - a critically endangered ecological community under the National Environment Protection and Biodiversity Conservation Act (1999). Beach scrubs and foreshores are key habitats for many rare and threatened plants and animals and migratory birds. Foreshores are breeding sites for marine turtles and shorebirds such as the beach stone-curlew (pictured above).

Disturbance of these habitats, commonly due to arson; clearing/mowing of undergrowth; stock trampling; 4WD and pedestrian tracks, leads to weed invasions and increased fire risk. Weed management, rather than fire management, should be used to protect and rehabilitate remaining areas.

Very careful use of fire in adjacent fire prone landscapes is required; check that there is little to no scorch into beach scrubs and foreshores as an indicator of successful fire management.

