A Final Report to the Townsville City Council

WETLANDS OF THE TOWNSVILLE AREA

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TABLE OF CONTENTS

1. INTRODUCTION

1.1 Wetlands and the Community

Lakes, swamps, marshes, ponded pastures and water storage dams; estuaries, rivers, streams and springs; intertidal sand flats, mud flats and mangroves, and shallow marine areas such as seagrass beds or fringing coral reefs - can all be regarded as "wetlands". They sustain commercial and recreational fisheries, provide flood mitigation, groundwater recharge, water supply for domestic, industrial and agricultural use, and through their natural habitat values, support a variety of wildlife. However, they have also been degraded through human modification (e.g. drained, filled-in, impounded) and catchment activities (e.g. pollution).

This paradox is being addressed through a renewed commitment by the community, industry and governments to better manage these vital natural resources, such that their use is "wise" and sustainable. For example, "Waterwatch" community groups are being established throughout Australia to monitor local water quality, eco-tourism has become a major industry (e.g. the Kakadu wetlands), and both state and federal governments are developing strategies to ensure the sustainable use of wetlands. In Queensland, the government has recently released a *Proposed Strategy for the Conservation and Management of Queensland's Wetlands* (QDoE 1996) that will commit the state to a strategy which will:

i) avoid the further loss or degradation of natural wetlands, including the biological diversity and abundance of wetland-dependent wildlife, unless overriding public interest, including necessary vector control, can be shown;

ii) ensure wetland management, including appropriate wetland creation, is undertaken within the context of Integrated Catchment Management, and that use of wetlands and their products by industry and the community is ecologically sustainable;

iii) develop the community awareness and appreciation of the values and benefits of wetlands, and encourage individuals to take personal responsibility for avoiding associated health risks from vectors with an aquatic stage in their lifecycle.

Together with such "wise use" policies, the efforts of local government will be crucial for improved wetland management. Through the facilitation of community initiatives and the development and implementation of regional wetland strategies which are consistent with those of natural resource management and conservation agencies, the sustainable use and conservation of wetlands will become achievable.

1.2 The Wetlands of the Townsville Region

The wetlands of the Townsville-Burdekin region are recognised as being of international significance, with the complex coastal aggregation between Alligator Creek and Cape Bowling Green being only the second site in Queensland to be listed under the "Ramsar Convention". The "Convention on Wetlands of International Importance" (or Ramsar Convention) predominantly recognises the importance of sites as waterfowl habitat; however, this generally necessitates them to also be in very good condition. Key components of the "Ramsar site" are found within the Townsville City Council (TCC) area, and this international acknowledgment of the tremendous value of this site should provide the basis on which to develop greater recognition of other wetlands within the Townsville region.

Although much of the area has become urbanised over time, the wetlands remain as valuable components of this unique environment, and form part of the most significant aggregation of wetlands on the north-east coast of Australia (Arthington and Hegerl, 1988). The Townsville Town Common is perhaps the best known of these wetland areas, attracting thousands of tourists and locals interested in wetlands and the wildlife they support. Bird observer clubs, ecological societies, and other community groups often visit the Common, and value its proximity and environmental qualities. Many other wetlands and waterways within the Townsville region are similarly utilised by the community. For example, the freshwater reaches of the Ross River and Alligator Creek are often used for swimming and recreation, and their estuaries for commercial and recreational fishing or aquaculture. Appreciation of the values and functions of the region's wetlands can be seen by the inclusion of key areas in National Parks (e.g. Bowling Green Bay National Park) or Conservation Parks (e.g. Townsville Town Common).

The community has also expressed its interest in the values of wetlands outside of the reserve system, with several other areas identified as "important wetlands in the Townsville area" (TCC 1990). Table 1 lists the sites identified as part of a community consultation program.

Table 1. Important wetlands, foreshore areas and drainage/waterways in the Townsville area (adapted from TCC 1990).

Wetlands	***Foreshore areas***	***Drainage/Waterways***
Blakey's Crossing-Mt St John sewerage works Mt Louisa ponds Sandy Crossing South of Ross River - Sandfly Ck Mt St John lagoons RAAF base - Town Common East Bohle River region Horseshoe Bay lagoons East End of Orpheus Island Anderson Park lakes Lakes development Stages I and II Oonoonba lagoons (DPI area) West coast freshwater areas of Magnetic Island Area east of Oonoonba Rd Stuart Ck lagoons including quarry area Palmetum lagoon Lavarack barracks region wetlands Idalia lagoon Cungulla area wetlands Bundock St (near airport) lagoons Goondi Ck mangrove area Forrest Garden Estate ponds (Bowen road)	Ross River south to Cleveland Bay Bohle River-Cape Pallarenda Cape Pallarenda-Kissing Point Magnetic Island beaches and rocky foreshores Kissing Point-Ross River (Strand, port area) West Point-Cockle Bay (Magnetic Island)	Ross River and tributaries Ross Ck Bohle River and tributaries Stuart Ck Sandfly Ck Gordon Ck (Cluden area) Mt St John area PeeWee Ck Vantassel's Ck lagoon Rowes Bay drain Mindham Ck drain system Duck Ck system (west coast of Magnetic Island) Campus Ck, Lavarack Ck Gustav Ck (Nelly Bay, Magnetic Island) Three Mile Ck Woolcock Canal Inlet drains to the Lakes development Belgian Gardens drainage area Mt Louisa Ck Endeavour Ck - Gorge Ck (Horseshoe Bay) Goondi Ck

This list is not comprehensive as it does not include the TCC area since the Local Government Area (LGA) boundary changes, nor does it adequately address the relative importance of one site over the other (e.g. South of Ross River vs Forest Garden ponds). However, it does illustrate the wide variety of wetlands in the TCC region and the importance the community places on adequate recognition and management of these areas.

1.3 Values and Functions of Wetlands

Intrinsic to achieving the wise use of wetlands is recognising the value such systems have to the community as well as the role they play in the natural environment. The value of wetlands can often be related to the functions which they may provide in the landscape (see Marble 1992). This may involve a variety of wetland types and mechanisms which are specific to each type. The following lists some of these functions and the mechanisms involved:

Nutrient removal/transformation: Wetlands can maintain water quality of receiving waters by removing nutrients - mechanisms involved include denitrification, nitrogen fixation, ammonium volatilisation, and absorption into sediments.

Sediment/toxicant retention: Wetlands can retain contaminants through deposition and burial, chemical breakdown, and/or assimilation into plant and animal tissues.

Shoreline stabilisation: Wetlands can stabilise shorelines through the establishment of wetland plants which bind soils and dissipate the erosive energy caused by waves, currents and tides. Stabilisation also protects adjacent upland lands from erosion.

Floodflow alteration: Wetlands can mitigate the peak flows from runoff, surface flow and precipitation such that they are delayed or stored. Even if there is little storage capacity, they can desynchronise flows by soil capillary storage and the frictional roughness of vegetation.

Groundwater recharge: Wetlands can recharge ground water by holding surface water long enough to allow the water to percolate into the underlying sediments and/or bedrock aquifers.

Provision of habitat: Wetlands can significantly add to regional biodiversity through the provision of a range of microhabitats (often along an ecotone) which are highly productive and support a variety of dependent biota.

2. METHODOLOGY

2.1 Scope

This report provides preliminary information on the wetland systems of the greater Townsville area, and as such, assists the Townsville City Council to produce a Natural Assets Register for the region. It was conducted in conjunction with a similar study by the ACTFR, which assessed the vegetation communities and their conservation priorities (ACTFR Report No. 96/26), and should be read with this in mind.

The mapping of the wetlands is the most crucial element in developing a framework for better understanding these systems, and this task formed the basis of this study. Dominant wetland vegetation communities for the entire Townsville area were mapped for this report, and presented in the context of the following seven regions:

i) Bohle River Catchment and Associated Wetlands (including the Town Common),
ii) South Bank Coast and Associated Wetlands (Ross River to Alligator Creek),
iii) Magnetic Island Coast and Associated Wetlands (Cockle Bay to West Point),
iv) Cape Cleveland Coast (including the Cungulla region),
v) Alligator Creek Catchment,
vi) Reid-Haughton River Catchment (including Majors Creek Catchment), and
vii) Ross Creek and Ross River Catchment.

The term "wetlands" is used in this report to describe a variety of aquatic habitats (swamps, lagoons, billabongs, rivers, saltmarshes, mangroves, etc) and is mostly consistent with the definition adopted by the Queensland Government for the state Wetlands Strategy (QDoE 1996); however, this report does not consider marine foreshores, coral reefs, seagrass communities or other "marine" communities. Access and time/budget constraints has also meant that freshwater wetlands were covered in more detail than intertidal areas.

2.2 Mapping

The mapping of the wetland communities used three sets of aerial photographs. Both 1:10,000 (TCC) and 1:25,000 (Townsville) colour aerial photographs were used, as well as 1:25,000 black and white photographs (Mingela). Data were then digitised through the use of the GIS system ARCcad. TIC control points are listed in Appendix 1 of the complementary vegetation report (ACTFR 96/26).

To verify the accuracy of the map, ground referencing with th use of a GPS was undertaken (sites listed in Section 3.0) in association with the use of a number of GIS layers obtained from the TCC. The accuracy of these layers had already been verified and included:

- property boundaries;
- roads;
- rivers and streams;
- topography.

Once the topology was geo-corrected and map accuracy refined to within a pre-defined limit of 20 metres, data including the type of wetland vegetation community and the dominant species were installed into the database of the GIS system.

2.3 Classification

The "Provisional Handbook for the Classification and Field Assessment of Queensland Wetlands and Deep Water Habitats" (Blackman *et al*, 1992) was used as the basis for describing the different wetland types which were sampled as part of this study (see Appendix 3). This hierarchical approach is based on defining systems, sub-systems, classes, sub-classes, dominant species, and modifiers (water regimes, water chemistry, soil type, special). It can be applied to both simple and complex (continuous and disjunct) wetland areas; however, the more complex an area, the more sampling sites are required to adequately define the wetland. Hence, it was not possible in the time allowed to fully utilise the classification system, as extensive field time is required to sample and record all attributes recommended. However, a subset of the classification criteria was used to adequately define and describe the wetlands within the TCC area. This compromise provides the TCC with detailed information of 46 sample sites based on the classification of Blackman *et al*. (1992), as well as the comprehensive mapping of wetlands based upon vegetation types. It remains possible to complete the field survey at the level recommended by the handbook; however, significant funds would be required to ground-truth the vegetation-type mapping such that it could be presented according to the classification suggested in the field handbook.

2.4 Sampling

Wetland aggregations were identified from aerial photos, topographical maps and past experience of the Townsville-Burdekin region. Vehicle access generally limited the extent which wetland communities could be sampled; however, a boat was also used to gain a better impression of mangrove and saltmarsh communities. Estuarine wetlands were the most poorly sampled, due to the access constraints and the large intertidal region they occupy. The saltmarsh communities could generally be accessed by vehicle or foot, but significant areas of mangrove could not be sampled. Riverine wetlands were sampled at several locations along their lengths, and mostly in relation to access points or the occurrence of significant features (e.g. weirs, billabongs). Palustrine (e.g swamps) and lacustrine wetlands (e.g. lakes) were sampled by transects across each site or by gaining access to different locations on their perimeter.

At each site, the dominant macrophyte community was recorded, together with the occurrence of any exotic species, the likely water regime and water chemistry, the soil type (mineral or organic), the wetland size (estimates of total area for distinct palustrine sites and widths for riverine or estuarine channels), and the significant management issues. Subsequent to the field survey, an assessment of the wetland's conservation value was made and weighted relative to the other sites.

3.0 DISCUSSION OF THE WETLANDS

In this section the wetlands of the Townsville region are briefly discussed in relation to seven "catchments". The somewhat artificial boundaries were primarily identified from topographical information and simply provide a useful framework on which to discuss issues surrounding wetlands and waterways. For example, the Alligator Creek "catchment" not only includes the drainage catchment of Alligator Creek, but also that of Whites Creek and Killymoon Creek. Sample sites were generally located both in the upper and lower parts of each catchment.

3.1 The Bohle River Catchment

(Sampling Sites 1.1-1.6, see Maps - Appendix 1)

Most of this catchment is located outside the TCC boundary, being within Thuringowa Shire Council, and this would make it necessary for joint approaches to most management issues. However, a significant section of the south bank of this system does occur within the TCC area and there is a need to address the poor condition of the river and its riparian zone. The only wetland reserve in the greater Townsville region recognised by the state government is located at the mouth of the Bohle River (see Appendix 4).

In the freshwater sections, weed invasion, particularly rubber vine and chinee apple, but also aquatic weeds such as *Pistia stratiodes* (pistia) and *Eichhornia crassipes* (water hyacinth), has degraded the aquatic habitat. Rubbish is extensive, soil erosion is prevalent, riparian vegetation has been cleared, and pollutants from upstream (e.g. a sewerage treatment plant) is resulting in the eutrophication of the river. A large wet season flush will improve the waterway, but ongoing pollution and degradation by weeds and erosion (riverbank, sheet and rill) will continue. In the tidal reaches, stormwater from industrial developments, the clearing of riparian zones, illegal boat access points, fishing pressures, weed invasion and soil erosion have similarly resulted in the degradation of the river.

Recent land subdivision in the catchment (e.g. "Willows") and future development (e.g. the Woolcock St extension) is likely to place further pressure on the river, with increased surface drainage and land clearing changing the catchment's characteristics (e.g. hydrology, water quality). However, given the current poor state of the river, there may be some benefit derived from catchment development. If the TCC and TSC can guide development with the goal of also improving the Bohle River (through implementing weed control and tree planting programs, providing adequate riparian buffers for the river, installing pollution mitigation devices such as litter traps and constructed wetlands, and developing a sense of community ownership of the resource), a net gain can be made from further development. Conversely, if development proceeds without such goals in mind, the risk of completely degrading the river's natural values is high.

The most significant wetland complex within the catchment is the Townsville Town Common. This large palustrine and estuarine complex is an extensive area of wetland habitat that can seasonally support thousands of waterfowl and is a feature of the Townsville environment. There already exists considerable information about the flora and fauna of this area, and in the past several management plans have been produced. There is likely to be little that this broad-scale assessment can add to this knowledge base; however, this assessment can place many of the values and issues surrounding the Town Common in the context of the greater Townsville region.

The size and nature of the wetland complex insulates it from many of the incremental impacts which can significantly degrade urban wetlands; however, the encroachment of land subdivision along Rowes Bay, together with the continued degradation of its ecological values, should be of some concern. The most

significant problem is *Urochloa mutica* (paragrass), which is widespread, and few pockets of native emergent macrophytes occur in the freshwater parts of the wetland. There would appear to be little point in continuing the current management strategy to deal with this problem and it is recommended that the TCC support strategic grazing trials. This view has been held by many in the past (e.g. G. Blackman, DoE) and it is time that such approaches be tested. Dr Bob Congdon (JCU) is actively involved with this type of research and should be consulted to initiate grazing trials which aim to increase macrophyte species diversity and the amount of available habitat for waterfowl. Without such intervention, the long-term accumulation of paragrass is likely to exhaust native macrophyte seedbanks, making the possibility of rehabilitation more unlikely.

3.2 South Bank Coast And Associated Wetlands

(Sampling Sites 2.1-2.6, see Maps - Appendix 1)

This mosaic of mangrove, saltmarsh and lowland habitat stretches from the Ross River past Cocoa Creek and is the most significant in the greater Townsville region, outside of conservation reserves. Historically, it has been the subject of considerable development pressure (e.g. shipping port, clearing and grazing, abattoir, aquaculture, dredge spoil dump, sand mine, rubbish tip, sewerage treatment and disposal, and more recently, land subdivision). It is also the designated area for the proposed zinc refinery and, possibly, a power generation plant. Much of the area has been the subject of several previous studies (e.g. TCC 1990; Wallace 1992; ACTFR 1995) or environmental impact assessments (e.g. the proposed rail-line deviation, the Korea Zinc refinery), and hence, there is considerable information on parts of the wetland complex (particularly between Ross River and Muntalunga Range).

The importance of this northern section of the southbank coast (i.e. Ross River to Muntalunga Range) for commercial and recreational fisheries, habitat for migratory birds, and local ibis, egrets and flying foxes, has been documented in many of these previous reports. However, the geomorphological significance of this relatively narrow and stunted strip of mangrove and saltmarsh has seldom been mentioned. It is regarded as crucial to stabilising the coast and preventing saltwater intrusion (G.Blackman, pers.comm.), and impacts which may reduce its capacity to buffer tidal movements place at risk infrastructure and valuable grazing lands. The nature of these impacts may be as subtle as progressive mangrove defoliation from airborne pollutants or the increased erosive force of sea currents due to breakwater construction. It is recommended that the TCC further investigate the geomorphological significance of this coastline.

The southern section of the southbank coast (i.e. Muntalunga Range to Alligator Creek) is less well documented, and there is insufficient information about the habitat value of the wetland complex. The area is composed of similar mangrove, samphire and saltmarsh species but is much more developed (in both the height of the mangrove strata and the areal extent of the intertidal zone). In general, there is a more intact continuum between the intertidal zone and the terrestrial lowlands, and through the Muntalunga Range, a link to upland areas also exists. The internationally recognised wetland area of Bowling Green Bay National Park is immediately to the south of this wetland complex; however, outside of such conservation reserves, such a mosaic of landform elements is unique in the greater Townsville region.

The level of disturbance of the Ross River to Muntalunga Range wetland mosaic also emphasises the importance on this southern section of the southbank coast. However, burgeoning rural-residential development on the seaward side of the Muntalunga Range, exotic species (chinee apple, para grass, rubber vine), and agricultural development on the Alligator Creek floodplain are placing at risk this important area. Further encroachment of development into the lowlands and greater access to the coast should be prevented. The "Phantom Retreat" boat ramp is restricted to those with access to this subdivision and has resulted in illegal boat ramps being constructed on Alligator Creek. With a larger population settling in this area, there

will be pressure to increase access to the coast, and the TCC need to develop a management strategy for this important area. It is recommended that the coastal wetland complex between Muntalaunga Range and Alligator Creek be protected through gazettal of some form of conservation tenure, and access points be rationalised.

3.3 Magnetic Island Coast And Associated Wetlands

(Sampling Sites 3.1-3.2, see Maps - Appendix 1)

The scarcity of freshwater wetlands on the island suggest that sites which do remain should be afforded significant protection. There is a small Conservation Park located at Horseshoe Bay, which conserves a *Melaleuca leucadendra* wetland; however, there is a significantly larger and more intact area of this type adjacent to the Park which is currently controlled by the TCC. This wetland complex is similarly dominated by *M. leucadendra* but with considerably fewer exotic species and its status should be increased to that of a conservation reserve. The TCC should also seek to restrict land uses and rationalise tenures in this area, such that further impact and/or development of the lowlands in this area is not possible. In particular, i) land disposal of wastewater from the overloaded and ageing sewerage treatment plant should cease (and be relocated away from wetland and foreshores areas), ii) the TCC, together with conservation agency support, should seek to acquire and reserve nearby parcels of land which contain intact lowland communities, and iii) pollution mitigation devices (e.g. litter traps) should be installed on the main drain which enters the wetland.

The Picnic Bay-West Point intertidal and lowland mosaic contains valuable mangroves and saltmarsh which provide the connectivity from the coast to the upland areas, and in turn support important migratory bird and fishery habitats. However, the construction of the coast road has caused changes to tidal hydrodynamics, and resulted in the death of some *Melaleuca* stands. This extent of tree death does not warrant rehabilitation in itself, but any proposal to seal and upgrade this road should ensure that no further damage to these habitats occurs, and if possible areas which have previously been affected, are restored. It is also recommended that the TCC consult the Department of Natural Resources and seek the reservation of this coastal zone as a Wetland Reserve.

Magnetic Island also contains a significant number of intermittent streams, which can often be disregarded by development proposals or planning controls. These seasonal creeks (e.g. Gustav Creek) and drainage lines not only produce more heterogenous vegetation assemblages and hence greater habitat diversity, but they are also important conduits of stormflows. Seasonal rainfall often forms ephemeral off-stream wetlands through overbank streamflow, and alterations to creek hydrology (e.g. for flood mitigation) can significantly reduce their viability.

3.4 Cape Cleveland Coast (Including The Cungulla Region)

(Sampling Sites 4.1-4.5, see Maps - Appendix 1)

The western side of Cape Cleveland contains few freshwater wetlands. There are several intermittent streams which flow toward Cleveland Bay and one small palustrine wetland behind dune ridges at the far end of Long Beach. The small swamp was dry at the time of sampling and there was extensive damage to the aquatic vegetation by both fire and feral pigs; however, some stands of *Phragmites australis* did remain and it appeared that groundwater was close to the surface. Given the long period of drought, this wetland would appear to be at least semi-permanent, and its relative isolation has meant that the surrounding vegetation has mostly remained intact.

The significant wetlands which occur on Cape Cleveland are mostly to the east and south of Cungulla, and at the footslopes of Mt Elliot. This region contains a variety of wetland types, including large estuarine systems, expansive saltmarsh and samphire communities, freshwater swamps and several intermittent riverine streams.

The estuarine wetlands which fringe the northern and southern coasts of the cape, and extend up the Haughton River and its tributaries (e.g. Burrumbush Ck, Doughboy Ck) support commercial and recreational fisheries and provide habitat for a variety of migratory birds, regionally significant populations of egrets, ibis, spoonbills and other waterfowl, and also saltwater crocodiles. The extensive saltmarsh and samphire communities which are associated with these waterways form part of a coastal complex which is largely intact and there are few immediate pressures on the integrity of these landforms. However, the freshwater wetlands which occur leeward to the intertidal zones, and are possibly of greater regional importance, are likely to come under considerably more pressure over time (particularly from land subdivision). The DoE has indicated that a number of areas are pending inclusion in Bowling Green Bay National Park and that they are keen to see as much as possible of this wetland type conserved (G. Blackman pers.comm.).

The majority of this wetland type is just outside of the TCC boundary (e.g. the "Cromarty wetlands"), and are the responsibility of the Burdekin Shire Council. However, there remains a considerable amount of freshwater wetland, that extends from near the base of the Mt Elliot complex to Feltham Cone, which is within the TCC boundary. The principal land holding in the area ("Eden" of the Chapman family) is a large grazing property which extends from the Cape Cleveland road to almost the township of Cungulla. However, the natural values of the holding have become progressively more degraded through grazing, pasture establishment and repeated fires. This has affected many of the freshwater wetlands on the property, as exotic species dominate and there is little recruitment of native riparian species. However, two of the important functions of these swamps are that they provide valuable habitat for waterfowl and fish (e.g. barramundi). Experience of many degraded Burdekin wetlands suggests that (under the correct management) these functions can still be supported by the wetlands.

Therefore, although some of the "Eden" wetlands may not be intact, they are comparably important in the TCC region and form part of a significant complex of coastal seasonal freshwater wetlands which extend from the Alligator Creek floodplain to the lower Burdekin (and are not well represented in conservation reserves). Unfortunately, a more comprehensive survey of the wetlands on this property could not be undertaken due to access restrictions imposed by the land manager, and there was insufficient time to organise approvals from the Chapman family, in Cairns. It is recommended that the TCC protect this area through its planning provisions, and negotiate with the DoE and landholders over reservation and management responsibilities.

3.5 Alligator Creek Catchment

(Sampling Sites 5.1-5.6, see Maps - Appendix 1)

With a significant proportion of its headwaters contained within Bowling Green Bay National Park, the water quality of the stream generally appears good above the Alligator Creek subdivision. However, a significant proportion of the creek is also fed by a tributary which passes through grazing lands, and there is a need to monitor water quality in the stream throughout the year. This is particularly important as the creek is heavily utilised for recreation (e.g. swimming) both within the National Park and downstream. The riparian vegetation is generally intact above the subdivision, but it rapidly degrades downstream. This decrease in stream habitat quality is mostly the result of clearing riparian zones, farming the levees, and the

invasion of weeds. Activities in this catchment have a direct influence on the wetland complex downstream (a Ramsar site), and this may become an even more important factor if further subdivision occurs and/or connections to "town water" are made, increasing water use and the need for wastewater disposal. Given the relatively large population of the area, community based stream rehabilitation and the introduction of water quality monitoring programs (e.g. Waterwatch) should be encouraged.

The slower movement of water in the lower reaches of Alligator Creek has caused the build up aquatic macrophytes in some areas during dry seasons, and this has probably been enhanced by nutrient rich runoff from adjacent fertilised croplands. This level of macrophyte growth is likely to cause oxygen depletion in the stream and the seasonal loss of fish habitat. Large lagoons impounded by a weir on the creek downstream of the highway are generally in good condition, with remnant riparian forest for much of the stream length. However, the (current) minor occurrence of water hyacinth, salvinia (*Salvinia molesta*) and pistia in the deepwater lagoons above the weir, should be of some concern. It is recommended that discussions with the Weed Research Centre at Charters Towers be made to facilitate the introduction of biological control agents.

Downstream of the weir on Alligator Creek, the stream is tidal and it again becomes part of Bowling Green Bay National Park. However, to the north of the creek it is not currently part of the Park, and it is strongly recommended that the TCC do not permit further development which will impinge on the creek or its associated saltmarshes (e.g. the Phantom Retreat subdivision, recent subdivision on the seaward side of Muntalunga Range). It also remains important that planning and/or development pressures do not result in greater access to either the foreshore or Alligator Creek itself. There are already significant management needs associated with Alligator Creek (e.g. illegal boat ramps, eroded riverbanks, illegal fish netting) and further development of this coastal area will worsen the situation. A management plan for the National Park is currently being developed by the Department of Environment which will consider issues relative to a Ramsar site (including catchment activities). It is recommended that the TCC develop a management strategy for the Alligator Creek catchment (including the coastal zone between the north bank of Alligator Creek and Muntalunga Range) which is consistent with the goals of the management plan for the "Ramsar" site.

Associated with Alligator Creek are several off-stream wetlands, the most significant of which occurs on Robyn Muller's property, downstream of the Bruce Highway. This brackish floodplain swamp has been confined by a levee which prevents saltwater intrusion and impounds freshwater runoff. The swamp is significant in the Townsville region because it is permanent, brackish, contains large stands of clubrush *(Schoenoplectus validus),* and provides habitat for a variety of waterfowl. In combination with the adjacent saltmarshes and freshwater reaches of Alligator creek, it forms part of a wetland continuum unique to the Townsville region; other similar coastal areas (e.g. the Town Common) are not permanently inundated or dominated by native emergent macrophytes. The TCC should consult the landholder in relation to facilitating the conservation management of wetlands on this property.

Although Whites Creek has the catchment of the Muntalunga Range, it can also usefully be considered as part of the Alligator Creek catchment, as it eventually joins Alligator Creek near its estuary. It is a particularly degraded creek, with riparian zones either being cleared (around the upstream areas where semi-rural subdivisions have occurred) or dominated by weeds (chinee apple on grazing lands). Extensive rehabilitation and TCC support is required to (even partially) restore the creek and this should be the focus of community groups in the area.

3.6 Reid-Haughton River Catchment (Including Majors Creek Catchment)

(Sampling Sites 6.1-6.5, see Maps - Appendix 1)

The Majors Creek catchment drains the south west corner of the Mt Elliot Range, and runs westerly before joining the Haughton River and flowing into the sea, near Cungulla. It is an important seasonal tributary of the Haughton River, and as such, is integral to sustaining irrigation development, a sugar mill, professional fishing operations, recreational fishing, and many of the environmental values of the region.

The headwaters of Majors Creek originate from within the Bowling Green Bay National Park before passing through intensive horticultural (e.g. fruit and vegetable), agricultural (e.g. sugar), and grazing lands. In many ways similar to Alligator Creek, it is likely that the aquatic habitat of the creek is more intact within the National Park (above the private landholdings); however, access and time constraints did not allow for a sampling site.

Downstream of the National Park, Majors Creek has becomes more influenced by farming operations, with the clearing of riparian zones, invasion of weeds (e.g. guinea grass, rubbervine), groundwater abstraction, and building of off-stream dams (e.g. mostly turkey nests) being the most obvious forms of impact. Harvesting of both groundwater and surface waters in this upper region of the catchment would appear to be significant, and the TCC should consult with the Department of Natural Resources (DNR) regarding sustainable harvest levels and the need for greater controls, including setting limits on groundwater abstraction, pending further investigation.

There was insufficient time to survey much of Majors Creek nearer the Haughton River; however, with sugarcane development underway or proposed in this region, there is a need for the TCC to ensure that land clearing and subsequent agriculture does not degrade aquatic habitats. The TCC should consult with the DNR to confirm that riparian buffer zones are left intact, irrigation drainage into coastal stream is minimised and is of sufficient quality (e.g. through the use of retention basins and constructed wetlands as part of irrigation schemes), and significant areas of habitat (and linking corridors) are retained.

The Haughton River is an intermittent stream for much of its length, but becomes much larger further downstream with over a hundred metres between the upper banks in some locations. Pioneer vegetation has become established in its bed with prolonged drought (*Callistemon, Melaleuca, Casuarina*); however, much of this would be flushed out with seasonal rains. Its banks (and similarly for the Reid River) are often characterised by woodland vegetation rather than gallery riparian forest (see vegetation report). Isolated pools are small (~50m) and generally turbid from cattle grazing and watering.

The Haughton River is the boundary between TCC and Burdekin Shire Council and joint approaches to management are likely to be necessary. The extent of weed invasion is more significant along its southern bank, with rubber vine dominating the riparian communities. The northern bank, which is within the TCC area, is more intact due to fencing by some landholders and the TCC should seek to maintain the quality of these riparian areas. The impact of overgrazing is also evident in the region with both sheet and rill erosion adjacent to the watercourse and severe undercutting of the riverbanks in some locations.

There are also several other significant wetlands within the Majors Creek catchment. The Serpentine Lagoon system is possibly the most valuable within the TCC area and should be afforded a very high conservation value. It provides habitat for a great variety of waterfowl (the Townsville Bird Observers Club has been using the site for many years and should be contacted for further information), has a floristically limited variety of aquatic macrophytes (but which are native and representative of a healthy wetland for the region), and it significantly contributes to the fish population of the catchment (L. Arratta pers.comm.). These attributes alone make the site particularly significant in the region, but when coupled with the outstanding opportunities for bird watching and possibly eco-tourism, it makes the site extremely important for the Townsville region.

However, the wetland does form a large part of an otherwise degraded grazing property (Arratta's). It has remained relatively free of impacts (most likely due to the wetland being ephemeral and the grazing intensity being sufficient to keep exotics from establishing as it drys out), but the surrounding area has been badly invaded by chinee apple, and there is little new recruitment of valuable riparian species. The invasion of chinee apple into the wetland is unlikely to occur: however, valuable nesting and roosting sites are being the lost from the wetland ecosystem. The TCC is urged to take preventative action by either securing the tenure for itself and rehabilitating the property as a local reserve (and possibly as an eco-tourism venture), or to consult the Department of Environment in relation to possible joint reservation and management, akin to that of the Townsville Town Common. Mr Arratta has indicated that he is interested in alternative management of the property and is willing to enter into negotiations with interested parties.

Near Serpentine Lagoon are also several significant artificial water bodies, and these shallow impoundments collect localised runoff for stock watering. They are generally less than 2m deep and have bund walls which may extend for up to 1 kilometre. Aquatic macrophytes readily establish themselves with seasonal rains and most of the dams contain a good diversity of native species (mostly *Eleocharis* and *Nymphaea*). Together with Serpentine Lagoon, the artificial wetlands established by the runoff from the western catchment of the Mt Elliot range produces a mosaic of water bodies suitable for waterfowl, and which are of some value as aquatic habitat.

3.7 Ross Creek And Ross River Catchment

(Sampling Sites 7.1-7.16, see Maps - Appendix 1)

i) Ross Creek

Ross Creek, an urban tidal waterway which extends almost 5km from near the Ross River to Cleveland Bay, has been the focus of much discussion in the past. The Townsville City Council has previously commissioned the Ross Creek Scoping Study (ACTFR 1994), and this report comprehensively reviews baseline information for the future management of the creek and recommends several actions for implementation. Unfortunately, few of the suggested management actions have been implemented and the main impacts on the creek remain. For example, pollution from urban stormwater remains unchecked and there is an immediate need for litter traps or other mitigation devices. Similarly, the rehabilitation and revegetation of degraded areas has not been attempted and many areas (e.g. Bicentennial Park) continue to erode and potentially contaminate adjacent watercourses.

Several recommendations from the Ross River Scoping Study which are pertinent to this report bear repeating:

- control access to the creek to prevent erosion of the creek banks and other associated impacts to the tidal environment, especially the deposition of refuse and litter;
- manage estuarine and non-estuarine vegetation along the banks of Ross Creek to increase the appeal of the creek; improve the habitat for marine intertidal fauna and birds by maintaining current mangrove stands and increasing their coverage; improve the planting strategies in non-estuarine areas to complement the creek surrounds and increase its resource potential; and control exotic weeds;
- enhance faunal diversity by ensuring adequate parkland and creek margin vegetation; and produce a current species list of fish and birds in Ross Creek and associated waterways, to foster public appreciation of the creek;

- clean up existing refuse and litter along the banks of Ross Creek, and formulate guidelines for water and sediment quality monitoring to facilitate regular assessments of the environmental status of Ross Creek.

ii) Ross River - below the dam

The Ross River is the main river which runs through the Townsville region, and as such, has been seen as both the vital resource and scourge of the Townsville community. Historically, the river provided potable water supply from wells and pumps (near the present day Aplins weir) and then eventually from weirs (Gleeson's in 1908, Aplin's in 1928 and Black's in 1934). The construction of the weirs provided valuable water supplies and lessened the flow in the river, but not sufficient to provide mitigation from the often devastating floods. It was only with the construction of the Ross River dam in 1973 that flooding was reduced, and most flood flows trapped behind the dam wall. The average annual water flow in the river to the sea was reduced by approximately 56% (QWISC 1974). However, given the large variability in annual rainfall for the Townsville district, this reduction in average annual flow more realistically equates to most wet season rain events not being sufficient to overtop the dam wall. The last time there was overflow from the dam was January 1991 and prior to this only sporadically. Scheduled releases from the Ross River dam for environmental or other purposes do not occur.

Thus, the construction of the Ross River dam has not allowed the river to maintain its natural seasonal flow regime. The downstream consequences of river regulation have often been the subject of limnological study, and common to most developments, including the Ross River, are i) the loss of seasonal habitat and dependent species, ii) inadequate flows for riparian vegetation, iii) restrictions to fish movement, iv) invasion of weeds due to the lack of flushing, and v) stagnation of waterbodies. The acute need for potable water supply, the development of the floodplain, and the recreational use of the weir impoundments rules out the possibility of environmental releases of water in this catchment; however, other strategies which can mitigate many of the problems associated with regulated streams can still be pursued. For example, weed control measures (preferably mechanical harvesting), rehabilitation of riverbanks for wading bird habitat, replanting of riparian species, and greater fluctuations of water levels will improve this aquatic environment.

A number of other issues unrelated to river regulation also require further attention. The impact of sand extraction activities on the river's water quality and ecology should be further investigated. Land subdivision (e.g. Douglas) may degrade the aquatic environment by increasing the volume of stormwater inputs and through clearing riparian and adjacent woodland habitat. This can accelerate the invasion of noxious weeds, deteriorate water quality for primary (e.g. swimming) and secondary (e.g. fishing) contact, and diminish the area's aesthetic values. The TCC should ensure that any further land development maintains the integrity of the riparian zone as habitat by setting appropriate buffers and restricting the use of these areas. Similarly, best practice management should be followed for stormwater management such that contaminants are minimised (e.g. through the use of litter traps, retention basins and constructed wetlands).

The tidal reaches of the Ross River provide the best opportunity for significant additional reservation and protection of wetlands through local government provisions. Downstream of Aplin's Weir, the saltmarsh communities within the river levees are extensive, and by their nature, not prone to significant weed invasion. Further development on the south bank of the river should not impact upon these areas, and significant setbacks should be put in place to allow for re-establishment of the riparian vegetation. The land tenures associated with the southern side of the river may allow for significant reservation of some areas, with the cooperation of landholders (e.g. Department of Primary Industry).

Other wetlands situated on the Ross River floodplain, such as the Idalia lagoons, have been disconnected from the river for decades and are reliant on surface runoff from their immediate catchments (and stormwater from developed areas). The drought conditions over the preceding six years has resulted in these wetlands drying out and losing their characteristic aquatic vegetation; however, these wetlands do provide valuable ephemeral habitat within a highly urban area (G. Blackman, pers.comm.). Development intended for this area should incorporate the wetlands within their plans, and not fill and level these sites.

iii) Ross River - the dam and its catchment

An Environmental Management Plan (EMP) for the Ross River Dam is currently being developed as part of the Townsville City Council's Integrated Environmental Management System (IEMS) to cover the Environmentally Relevant Activities it undertakes, such as water treatment. The EMP for activities associated with the Ross River dam will cover those issues which the TCC are responsible, and suggest;

- appropriate land uses within the vicinity of the dam,
- the formulation of guidelines for grazing leases (e.g. stocking rates),
- water quality monitoring, and
- further environmental information required for management.

(P.Ireland, pers.comm.)

These actions will improve the environmental management of the dam and the adjacent lands which the TCC own or control. Ideally, an integrated EMP should also lead to improved habitat values; however, future water management strategies may not necessarily be equitable with conservation priorities (e.g. motor boat activity and waterfowl roosting).

Although an artificial waterbody (constructed solely for potable supply purposes), it is important that water management strategies for the dam be sensitive to functions that such a permanent aquatic ecosystem serves in the local area. Blackman *et al*. (1992) listed the Ross River reservoir as an important wetland in Australia for the following reasons:

- it is a good example of a wetland type occurring in Australia,
- it is a type of wetland which is rare in Australia,
- it is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, and
- it provides a refuge when adverse conditions, such as drought, prevail.

Specifically, this relates to the fact that the reservoir is a large permanent freshwater body in a seasonally dry environment, low level recreational use is made of the surrounding area, and it is a dry season refuge for a range of water birds. A detailed assessment of the habitat values associated with the impoundment (and their management needs) should be made prior to any decision to either expand recreational activities or to renew grazing leases on lands controlled by the TCC.

Landholders in the catchment of the dam need to be consulted regarding grazing intensities and appropriate management of lands within a potable water supply catchment. Further study of the catchment is also needed to better define hydrology, yields and water quality, particularly in relation to proposed semi-rural subdivisions. For example, in some years, the Rocky Springs area and Antill Plains Creek may contribute the bulk of water supplied to the dam (P. Ireland, pers.comm.), and contamination of these supplies by inappropriate land development should be avoided..

3.8 General Issues

3.8.1 Contaminated Lands

The amount and extent of land contamination in the Townsville area is unknown. The history of development in Townsville suggests that there may be significant areas which are contaminated, both in the declared industrial areas (e.g. Bohle, Stuart, South Townsville) and the older or more established suburbs (e.g. Railway Estate, Hermit Park). However, it appears that it remains difficult to clearly identify and manage sites which may be "contaminated". For example, the reclamation of lands (often with mine spoil or waste material) in the Hermit Park, Railway Estate, and South Townsville areas (see ACTFR 1994) has resulted in a number of lots being listed on the Contaminated Sites Register. It is not known whether this should require further attention.

There are close to 400 sites registered with the Department of Environment (A. Robinson pers. comm.), and from casual observation, many of these are adjacent to wetlands. However, it is important to note that the registration of a contaminated site (either as "probable", "former", "released" or "deleted") does not automatically indicate a risk to the environment. Nevertheless, it can highlight the "hotspots" within catchments and near waterways which may require closer attention.

For example, the development of industrial areas on low-lying floodplains has potentially increased the risk of contamination of downstream environments. Many industries in these areas have been placed on the register of contaminated sites due to the nature of their activities, and in-practice, stormwater run-off from seasonal events should be treated as point-source pollution. This would require improved site drainage plans which aim to retain or recycle as much stormwater as possible on-site, and the utilisation of simple stormwater treatment devices (e.g. gross pollutant traps, constructed wetlands). The TCC can also contribute to improved wastewater management from industrial areas through constructing pollutant traps or building constructed wetlands as part of drainage schemes.

Unfortunately, it was not possible to undertake further assessment of contaminated sites in relation to wetlands because of the format in which the data were available (lot numbers were provided but not grid references). It is understood that the TCC is currently endeavouring to place the known information on contaminated sites on to a GIS. It is recommended that the TCC complete this GIS mapping as it would provide useful information for environmental management (e.g. spatial analysis to determine the number of sites located on shallow aquifers).

3.8.2 Flood Mitigation and Constructed Wetlands

The development of low-lying lands, together with the need to rapidly drain wet season rainfall, has resulted in major drainage works being carried out throughout the Townsville area (e.g. Annandale, Bohle, Mt Louisa). The drains are often designed with a high capacity for stormflows and ensure that as much as possible of the water is transferred to the downstream environment. The increase in impermeable surfaces associated with land development (e.g. more concrete, roads etc) often accentuates the runoff such that higher flood peaks now occur. Although necessary for flood mitigation, the construction of such drainage can have a variety of impacts on downstream wetlands.

Many of the impacts are associated with drain construction - as natural drainage lines are often used as the basis for developing a "formed" drain. This not only affects the hydrological regime of the watercourse but the also the biota dependent upon particular drying and wetting cycles. It results in more aggressive species (weeds) often becoming established, and together with the physical alterations, such as steeper channel sides and the importation of more impervious substrate, reduces the habitat value of the waterway (e.g. loss of

shallow wading zones for waterfowl). The concrete lining of channels destroys all the residual habitat value of watercourses.

The greater flows and contaminant loadings into downstream wetland areas can also result in habitat degradation. Increased sediment deposition, together with adsorped nutrients and pollutants, can result in the eutrophication of aquatic habitat and/or the deterioration of water quality. However, some natural watercourses, with lower gradients and instream vegetation can act as filters for contaminants and encourage the deposition of particulate material prior to discharge into downstream areas. This should be the model upon which the TCC develops further drainage works.

The use of retention basins in drainage schemes is well documented (see Marble 1992) and although less well known, the construction of artificial wetlands is similarly achievable. Planning for the use of constructed wetlands and retention basins within drains generally involves determining i) the wetland system to use, ii) outlet characteristics, iii) the land cover of the watershed, iv) watershed soils, v) wetland/watershed ratio, vi) water/vegetation proportions and interspersion, and vii) vegetation class (Marble 1992).

Benefits of the use of such systems include the reduction of peak flood flows to a pre-determined level (depending on outlet construction), a reduction in contaminant loading to downstream areas, and an increase in the area of aquatic habitat (if additionally designed for this purpose).

The creation of wetlands for the treatment of "multi-point source" contaminants has not been attempted in many situations (but see the "community wetland" of Hinchinbrook Shire Council); however, there may be sufficient scope in some areas (e.g. drainage into the Town Common) to construct a large artificial wetland upstream of the natural wetland complex. For example, stormwater from the Mt Louisa subdivision and nearby areas drains into land adjacent to the Town Common and the Mt St John sewerage treatment plant. It may be possible to construct a wetland in this area which can receive both wastewater and stormwater such that the combined effluent is sufficiently treated for disposal into the Town Common. This would create a permanent wetland habitat in a highly visible location, provide cost-effective polishing of the treatment plant's wastewater, and reduce the level of gross pollutants in the stormwater (through using a litter trap). Such an artificial wetland would also be consistent with the recommendations of Plante and Associates (1992) to create/improve wetland features along the north and south approaches to Townsville. It is recommended that the TCC determine the feasibility of such proposals for constructed wetlands.

3.8.3 Waterfowl Habitat

The use of the Brolga as the city's emblem, together with the declaration of Bowling Green Bay National Park as a "Ramsar Site", highlights the importance of the region's wetlands to waterfowl. Arthington and Hegerl (1988) have summarised much of the information that exists for the Townsville-Burdekin region: the swamps and lagoons of the area support 10 of the 15 species of waterfowl occurring in north Queensland and a variety of waterbird species from 15 families of birds use the coastal wetlands seasonally as habitat (Lavery 1971a). Populations of coastal breeding species (magpie goose, grass whistling-duck, water whistling-duck and brolga) use the seasonal swamps and permanent lagoons perennially (Lavery 1970; Lavery and Johnson 1974; Lavery and Seton 1974; Lavery and Blackman 1969; Blackman 1978). Deep water habitats also provide important refuge areas for waterbirds during severe drought (Blackman and Locke 1985).

Garnett and Cox (1983) have described the birds of the Townsville Town Common and a variety of JCU Zoology Department students and researchers have also undertaken studies of the wetlands and waterways of the region (e.g. J. Nolen on the waterfowl of the lower Burdekin, R. Harrington on bird use of riparian

corridors). The Townsville Bird Observers Club has also been active for a considerable period of time in the region and have records for a number of sites (e.g. Serpentine Lagoon).

However, detailed examination of waterfowl and other bird use of wetlands has not been carried out for much of the Townsville region. Little is known about the effects of cattle grazing, introduced pasture, or exotic fauna on maintaining wetlands as habitat for waterfowl. Drainage works and land development has also reduced areas of wetland within the immediate Townsville region. The successful management of wetlands for waterfowl in the region will require a better understanding of waterbird ecology and the pressures which are placed upon these populations. For example, little is known about waterbird feeding and necessary dietary intake (energy gained per unit time feeding) - and poorer quality feed (e.g. paragrass dominated wetlands) may reduce the viability of some populations to utilise local wetlands (e.g. magpie geese or brolga).

It is recommended that the TCC determine populations of waterbirds which use local wetlands, and better define the local/regional factors which influence their use of wetlands. For example, a management strategy which seeks to maximise waterbird use of the local area would need to regularly consider issues such as i) wetland types and areas, ii) land uses, iii) current condition of habitat, iii) the provision of drought refuge areas, iv) weeds, v) feral animals and vi) seasonal influences. Without such a strategy to better manage wetlands, it places at risk the continued waterbird use of the region, and it would be highly unfortunate if the community (and tourists) were deprived of regularly viewing these waterbirds.

4.0 WETLANDS SAMPLED AND SPECIFIC RECOMMENDATIONS

4.1 The Bohle River Catchment

	Wetland Habitat Pro-forma
Wetland Sample Site	***1.1 Mt Louisa Creek*** **-** Mt Louisa
Grid Reference No.	DU736676
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Intermittent
Class/Subclass	Emergent/Persistent
Dominance Type	*Urochloa mutica*
Water Regime	Intermittently flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	
Associated vegetation	*Panicum maximum*
Size	channel ~ <10m wide
Management Issues	Urban encroachment, exotics, stormwater contamination, improvement works
Conservation Value	Low
Recommended Action	1. Further rehabilitate the creek banks and bed (e.g. exotics control)
	2. Intensify replanting program of indigenous vegetation along creek and in adjacent reserves (e.g. Commonwealth lands)
	3. Investigate potential for further community involvement in management and education.

	Wetland Habitat Pro-forma
Wetland Sample Site	***1.2 Blakeys Crossing* -** Mt St John
Grid Reference No.	DU742702
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Palustrine
Class/Subclass	Emergent/Persistent
Dominance Type	*Urochloa mutica*
Water Regime	Semi-permanently flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	Excavated
Associated vegetation	*Typha domingensis*
Size	-
Management Issues	Weeds, litter, pollution
Conservation Value	Low
Recommended Action	1. Investigate possibility of rehabilitation (e.g. litter clean-up, weed control).
	2. Improve water quality through adequate wastewater treatment and stormwater management (e.g. litter traps).
	3. Investigate the possibility of selective grazing trials to control paragrass.
	4. Investigate potential as a high profile site for public information on wetland management.

	Wetland Habitat Pro-forma
Wetland Sample Site	***1.3 Townsville Town Common***
Grid Reference No.	DU720750
Wetland Type Classification (after Blackman *et al*., 1992)	Complex continuous wetland
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	1. Palustrine 2. Estuarine/Intertidal
Class/Subclass	1. Emergent/Persistent 2.Emergent/Persistent
Dominance Type	*1. Urochloa mutica* 2.*Halosarcia indica*
Water Regime	1. Seasonally flooded 2. Irregularly flooded
Water Chemistry	1. Fresh 2. Mixohaline
Soil	Organic
Special Modifiers	Dyked/Impounded
Associated vegetation	*Avicennia marina, Melaleuca viridiflora*
Size	-
Management Issues	Weeds, water quality, land reclamation and industrial development, tourism,
Conservation Value	High
Recommended Action	1. Investigate implementation of grazing trials to control paragrass.
	2. Improve water quality through adequate stormwater management (e.g. litter traps, constructed wetlands).
	3. Better define wetland boundary and establish buffer zones which i) prohibit land reclamation and development, and ii) are replanted with native species indigenous to the area.

	Wetland Habitat Pro-forma
Wetland Sample Site	***1.4 Bohle River*** - downstream of Bruce highway
Grid Reference No.	DU697718
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Estuarine/Intertidal
Class/Subclass	Streambed/Mud
Dominance Type	*Avicennia marina*
Water Regime	Regularly flooded
Water Chemistry	Mixohaline
Soil	Organic
Special Modifiers	
Associated vegetation	*Bruguiera* sp.,*Ceriops tagal*
Size	channel ~ <20m
Management Issues	Streambank erosion, fishing pressure, exotics, access tracks
Conservation Value	Low-Medium
Recommended Action	1. Implement water quality monitoring program.
	2. Investigate possibility of rehabilitation (e.g. litter clean-up, weed control)
	3. Establish management plan in conjunction with stakeholders (e.g. DoE, landholders)
	4. Conduct fish surveys to determine populations and sustainable harvest levels.

	Wetland Habitat Pro-forma
Wetland Sample Site	***1.5 Bohle River*** - near Woolcock St extension
Grid Reference No.	DU692684
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Lower perennial
Class/Subclass	Aquatic Bed/Floating vascular
Dominance Type	*Pistia stratiodes*
Water Regime	Intermittently exposed
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	
Associated vegetation	*Eichhornia crassipes, Salvinia molesta*
Size	channel ~ >10m
Management Issues	Exotics, eutrophication, fire, litter
Conservation Value	Low
Recommended Action	1. Investigate possibility of rehabilitation (e.g. litter clean-up, weed control)
	2. Seek advice on biological control of floating exotic species.
	3. Improve water quality through adequate wastewater treatment and stormwater management (e.g. litter traps).

	Wetland Habitat Pro-forma
Wetland Sample Site No.	***1.6 Rowes Bay drain*** - Rowes Bay
Grid Reference No.	DU775715
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Intertidal
Class/Subclass	Emergent/Persistent
Dominance Type	*Schoenoplectus validus*
Water Regime	Seasonally flooded
Water Chemistry	Mixohaline
Soil	Organic
Special Modifiers	Excavated
Associated vegetation	*Typha domingensis*
Size	channel ~ 5m wide
Management Issues	Water quality, aesthetics, habitat
Conservation Value	Low
Recommended Action	1. Investigate possibility of rehabilitation (e.g. litter clean-up, weed control)
	2. Improve water quality through adequate wastewater treatment and stormwater management (e.g. litter traps).
	3. Control access to adjacent reserve and hind dune system of Rowes Bay.
	4. Initiate replanting program of indigenous vegetation along creek and adjacent reserves.

4.2 South Bank Coast And Associated Wetlands

	Wetland Habitat Pro-forma
Wetland Sample Site	***2.1 Stuart Creek*** - Stuart
Grid Reference No.	DU829603
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Lower perennial
Class/Subclass	Emergent/Persistent
Dominance Type	*Urochloa mutica*
Water Regime	Permanently flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	
Associated vegetation	*Communis riccinus, Panicum maximum*
Size	channel ~ <20m
Management Issues	Exotics, stormwater contamination
Conservation Value	Low
Recommended Action	1. Investigate the potential for community involvement in rehabilitation.
	2. Improve water quality through adequate wastewater treatment and stormwater management (e.g. litter traps).
	3. Implement water quality monitoring program.

	Wetland Habitat Pro-forma
Wetland Sample Site	***2.2 Stuart Creek*** - below Bruce highway
Grid Reference No.	DU830640
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Intermittent
Class/Subclass	Unconsolidated Bottom/Mud
Dominance Type	*Myriophyllum verrucosum*
Water Regime	Seasonally flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	
Associated vegetation	*Urochloa mutica, Panicum maximum*
Size	channel ~ 10m wide
Management Issues	Catchment management, weeds
Conservation Value	Low-Med
Recommended Action	1. Prevent further impact to gallery riparian forest by adjacent land uses (existing and proposed).
	2. Support/facilitate community group rehabilitation initiatives.

	Wetland Habitat Pro-forma
Wetland Sample Site	***2.3 Stoney Creek*** - Roseneath
Grid Reference No.	DU825578
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Intermittent
Class/Subclass	Streambed/Sand
Dominance Type	*Melaleuca dealbata*
Water Regime	Intermittently flooded
Water Chemistry	Fresh
Soil	Mineral
Special Modifiers	
Associated vegetation	*Lophostemon grandiflorus, Pongamia pinnata, Panicum maximum*
Size	channel ~ <10m
Management Issues	Quarry, weeds
Conservation Value	Low-Med
Recommended Action	1. Ensure the creek and its riparian zone is not impacted by further land development.
	2. Investigate the potential for community involvement in rehabilitation.

	Wetland Habitat Pro-forma
Wetland Sample Site	***2.4 Ross River-Alligator Ck Mangroves***
Grid Reference No.	DU895640
Wetland Type Classification (after Blackman *et al.*, 1992)	Complex continuous wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	1. Marine/Intertidal 2. Estuarine/Intertidal
Class/Subclass	1. Scrub-shrub wetland/Evergreen 2. Emergent/Persistent
Dominance Type	1. *Avicennia marina* 2. *Halosarcia* sp.
Water Regime	Regularly flooded
Water Chemistry	1. Euhaline 2. Mixohaline
Soil	Organic
Special Modifiers	
Associated vegetation	1. *Rhizophora* sp. *Bruguiera* sp. 2. *Halosarcia indica, Sporobolous virginicus*
Size	up to ~ >100m from landward edge
Management Issues	Sewerage disposal, industrial development, land tenure, urban development.
Conservation Value	Very High
Recommended Action	1. Establish management plan in conjunction with stakeholders (e.g. DoE, landholders)
	2. Ensure any further industrial or rural-residential development does not impact on area (e.g. suitable buffer distances, adequate wastewater treatment, etc)
	3. Investigate reservation/conservation of area between Sandfly Creek and Alligator Creek.
	4. Seek information from DNR which determine fish populations and sustainable harvest levels - and promote sustainable fishing in the area.
	5. Establish water quality monitoring program for catchment and near shore areas.

	Wetland Habitat Pro-forma
Wetland Sample Site	***2.5 Sandfly Creek***
Grid Reference No.	DU856670
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Tidal
Class/Subclass	Streambed/Mud
Dominance Type	*Avicennia marina*
Water Regime	Regularly flooded
Water Chemistry	Mixohaline
Soil	Organic
Special Modifiers	
Associated vegetation	*Bruguiera* sp., *Rhizophera* sp.
Size	channel ~ 15m wide
Management Issues	Sewerage disposal
Conservation Value	High
Recommended Action	1. Implement water quality monitoring program for creek.
	2. Ensure adequate wastewater treatment prior to disposal from plant.
	3. Investigate reservation/conservation of remnant mangrove and saltmarsh areas, both upstream of creek mouth and for the Sandfly Ck - Alligator Ck foreshore (also see *Ross River-Alligator Ck*)

	Wetland Habitat Pro-forma
Wetland Sample Site	***2.6 Southbank freshwater swamps***
Grid Reference No.	DU828645
Wetland Type Classification (after Blackman *et al.*, 1992)	Complex continuous wetland
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Palustrine
Class/Subclass	1. Unconsolidated Bottom/Mud 2. Emergent/Persistent
Dominance Type	1. *Ludwigia peploides* 2. *Urochloa mutica*
Water Regime	1./2. Seasonally flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	
Associated vegetation	*Panicum maximum, Chloris* sp.
Size	lagoons up to ~ 100m x 10m
Management Issues	Grazing, weeds,
Conservation Value	Low
Recommended Action	1. Ensure the retention of wetlands, if subdivision is proposed.
	2. Consult landholders and investigate the potential for community involvement in wetland rehabilitation.

4.3 Magnetic Island Coast And Associated Wetlands

	Wetland Habitat Pro-forma
Wetland Sample Site	***3.1 Picnic Bay - West Point Mangroves***
Grid Reference No.	DU800810
Wetland Type Classification (after Blackman *et al*., 1992)	Complex continuous wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	1. Marine/Intertidal 2. Estuarine/Intertidal
Class/Subclass	1. Scrub-shrub wetland/Evergreen 2. Emergent/Persistent
Dominance Type	1. *Avicennia marina* 2. *Sporobolus virginicus*
Water Regime	Regularly flooded
Water Chemistry	1. Euhaline 2. Mixohaline
Soil	Organic
Special Modifiers	
Associated vegetation	1. *Rhizophora* sp. *Bruguiera* sp. 2. *Halosarcia indica, Sueda australis*
Size	~ >50m from landward edge
Management Issues	Altered hydrology from levees, roads etc
Conservation Value	High
Recommended Action	1. Ensure infrastructure does not further alter hydrology of area.
	2. Ensure any further rural-residential development does not impact on area (e.g. suitable buffer distances, adequate wastewater treatment, etc)

	Wetland Habitat Pro-forma
Wetland Sample Site	***3.2 Horseshoe Bay swamp***
Grid Reference No.	DU840860
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Palustrine
Class/Subclass	1. Forested/Evergreen 2. Emergent/Non-persistent
Dominance Type	1. *Melaleuca leucadendra* 2. *Eleocharis dulcis*
Water Regime	Seasonally flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	
Associated vegetation	*Urochloa mutica, Passiflora foetida*
Size	800m x 100m
Management Issues	Sewerage disposal, urban encroachment, exotics, fire.
Conservation Value	High
Recommended Action	1. Investigate with stakeholders the reservation/conservation of the entire swamp under the one conservation tenure.
	2. Seek improvement in sewerage disposal methods to avoid groundwater contamination of swamp.
	3. Investigate potential for eco-tourism.

	Wetland Habitat Pro-forma
Wetland Sample Site	**4.1 West Cape Cleveland swamp** - Long Beach
Grid Reference No.	EU024758
Wetland Type Classification (after Blackman *et al*., 1992)	Simple Wetland Aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Palustrine
Class/Subclass	1.Emergent/Persistent 2. Forest/Evergreen
Dominance Type	*1. Phragmites australis 2. Melaleuca leucadendra*
Water Regime	Intermittently exposed
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	
Associated vegetation	*Passiflora foetida, Eucalyptus clarksoniana*
Size	< 5ha
Management Issues	Fire, exotics
Conservation Value	Very High
Recommended Action	1. Investigate reservation/conservation of area.
	2. Implement fire and exotics management plan (if tenure is upgraded to a reserve)

4.4 Cape Cleveland Coast (Including The Cungulla Region)

	Wetland Habitat Pro-forma
Wetland Sample Site	***4.1 Cungulla "Town Common"*** - Cungulla
Grid Reference No.	EU114546
Wetland Type Classification (after Blackman *et al*., 1992)	Continuous wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	1. Palustrine 2. Estuarine/Intertidal
Class/Subclass	1. Emergent Persistent 2. Emergent/Persistent
Dominance Type	*1. Phragmites australis 2. Halosarcia indica*
Water Regime	1. Seasonally flooded 2. Seasonally flooded - tidal.
Water Chemistry	Mixohaline
Soil	Organic
Special Modifiers	
Associated vegetation	*Melaleuca viridiflora, Livistona* sp.
Size	
Management Issues	Encroachment of subdivision, litter, rubbish dump
Conservation Value	High
Recommended Action	1. Provide adequate buffers for wetland from residential subdivision.
	2. Monitor for groundwater contamination by rubbish tip - close, relocate and rehabilitate site if required.
	2. Ensure hydrology of wetland area remains unimpacted by development.
	3. Encourage community responsibility to control further impacts (e.g. rubbish dumping)

	Wetland Habitat Pro-forma
Wetland Sample Site	**4.3 Dune wetland** - Cungulla
Grid Reference No.	EU093523
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Palustrine
Class/Subclass	Emergent/Vegetated pioneer
Dominance Type	*Stachytarpheta jamaicensis*
Water Regime	Seasonally flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	
Associated vegetation	*Stylosanthes humilis, Sesbania cannabina*
Size	lagoon ~ 500m x 30m
Management Issues	Weeds, grazing, fire
Conservation Value	Med-High
Recommended Action	1. Ensure retention of lagoons and buffers as part of any proposed subdivision.
	2. Avoid overt modification to hydrology of lagoons (e.g. canalisation, dredging etc)
	3. Better determine the viability of such wetland systems to support waterfowl.
	4. Facilitate weed management plan and replanting program.

	Wetland Habitat Pro-forma
Wetland Sample Site	**4.4 Freshwater Dams** - adjacent to Mt Elliot
Grid Reference No.	EU045528
Wetland Type Classification (after Blackman *et al*., 1992)	Simple Wetland Aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Palustrine
Class/Subclass	Unconsolidated Bottom/Mud
Dominance Type	*Nymphaea gigantea*
Water Regime	Semipermanently flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	Impounded
Associated vegetation	*Ludwigia peploides, Paspalum distichum*
Size	<1 hectare
Management Issues	Grazing, weeds
Conservation Value	High
Recommended Action	1. Ensure the retention of area as drought refuge for waterfowl.
	2. Investigate protection of natural values with landholder.

	Wetland Habitat Pro-forma
Wetland Sample Site	**4.5 Freshwater swamps** - Cape Cleveland to Cungulla
Grid Reference No.	EU055520
Wetland Type Classification (after Blackman *et al*., 1992)	Complex continuous wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Palustrine
Class/Subclass	Emergent/Non-persistent
Dominance Type	*Eleocharis dulcis*
Water Regime	Seasonally flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	
Associated vegetation	*Nymphaea gigantea, Cyperus* spp.
Size	**-**
Management Issues	Grazing
Conservation Value	Very High
Recommended Action	1. Consult landholder and investigate reservation/conservation of area.
	2. Further investigate importance of site as fish, mammal and waterfowl habitat.
	3. Ensure infrastructure (e.g. roads) do not further alter hydrology of area.

4.5 Alligator Creek Catchment

	Wetland Habitat Pro-forma
Wetland Sample Site	***5.1 Whites Creek* -** Nome
Grid Reference No.	DU576932
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Intermittent
Class/Subclass	Streambed/Sand
Dominance Type	*Urochloa mutica*
Water Regime	Seasonally flooded
Water Chemistry	Fresh
Soil	Mineral
Special Modifiers	
Associated vegetation	*Ziziphus mauritiana*
Size	channel ~ 10m
Management Issues	Buffers to creek, weeds, subdivision
Conservation Value	Low-Med
Recommended Action	1. Establish riparian buffers to prevent further impact from land subdivision**.**
	2. Investigate the potential for community involvement in rehabilitation.
	3. Establish water quality monitoring program for catchment.

	Wetland Habitat Pro-forma
Wetland Sample Site	***5.2 Alligator Creek*** - above Bruce highway
Grid Reference No.	DU949535
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Lower Perennial
Class/Subclass	Unconsolidated Bottom/Sand
Dominance Type	*Urochloa mutica*
Water Regime	Intermittently exposed
Water Chemistry	Fresh
Soil	Mineral
Special Modifiers	
Associated vegetation	*Cyperus* sp., *Potamogeton crispus, Vallisneria spiralis*
Size	channel <5m
Management Issues	Agricultural runoff, recreational use, weeds
Conservation Value	High
Recommended Action	1. Establish water quality monitoring program for catchment.
	2. Investigate the potential for community involvement in rehabilitation.

	Wetland Habitat Pro-forma
Wetland Sample Site	***5.3 Muller's lagoon*** - Alligator Creek
Grid Reference No.	DU974590
Wetland Type Classification (after Blackman *et al*., 1992)	Simple Wetland Aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Palustrine
Class/Subclass	Emergent/Persistent
Dominance Type	*Schoenoplectus validus*
Water Regime	Unknown
Water Chemistry	Mixohaline (brackish)
Soil	Organic
Special Modifiers	Dyked
Associated vegetation	*Sporobolus virginicus, Pseudoraphis spinescens*
Size	> 10ha
Management Issues	Cattle grazing, control of noxious weeds, fish habitat connectivity
Conservation Value	High
Recommended Action	1. Investigate protection of natural values with landholder.
	2. Facilitate/assist landholder with noxious weed control.
	3. Further investigate importance of site as fish habitat.

	Wetland Habitat Pro-forma
Wetland Sample Site	***5.4 Alligator Creek*** - below highway to above weir
Grid Reference No.	DU965581
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Lower Perennial
Class/Subclass	Unconsolidated Bottom/Mud
Dominance Type	*Melaleuca leucadendra*
Water Regime	Permanently flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	Impounded
Associated vegetation	*Salvinia molesta, Pistia stratiodes, Ceratophyllum demersum*
Size	lagoon ~ 40m x >500m
Management Issues	Fish habitat, riparian vegetation, aquatic weeds
Conservation Value	High
Recommended Action	1. Consult weed research staff re: biological control agents.
	2. Investigate protection of natural values with landholder.
	3. Establish water quality monitoring program for catchment.

	Wetland Habitat Pro-forma
Wetland Sample Site	***5.5 Alligator Creek*** - below weir to mouth
Grid Reference No.	DU940623
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Estuarine/1.Intertidal 2. Subtidal
Class/Subclass	1. Streambed/Mud 2. Unconsolidated Bottom/Mud
Dominance Type	*Avicennia marina*
Water Regime	1. Irregularly flooded 2. Subtidal
Water Chemistry	1. Mixoohaline 2.Euhaline
Soil	Organic
Special Modifiers	
Associated vegetation	*Rhizophora* sp., *Ceriops tagal, Sporobolus virginicus*
Size	1. channel ~ 50m wide. 2. channel ~ >60m wide
Management Issues	Fishing pressure, boating activity, fish stocking, conservation management of adjacent areas.
Conservation Value	Very High
Recommended Action	1. Establish management plan in conjunction with stakeholders (e.g. DoE, landholders)
	2. Conduct fish surveys to determine populations and sustainable harvest levels.
	3. Establish water quality monitoring program for catchment.

	Wetland Habitat Pro-forma
Wetland Sample Site	***5.6 Killymoon Creek*** - above highway
Grid Reference No.	DU993556
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Intermittent
Class/Subclass	Streambed/Sand
Dominance Type	*Lomandra longifolia, Melaleuca leucadendra*
Water Regime	Seasonally flooded
Water Chemistry	Fresh
Soil	Mineral
Special Modifiers	
Associated vegetation	*Nauclea orientalis, Ficus* sp., *Terminalia melanocarpa, Pongamia pinnata*
Size	channel ~ 10m wide
Management Issues	Land tenure, weed invasion, further information required
Conservation Value	Very high
Recommended Action	1. Investigate protection/conservation of creek and riparian buffer areas with stakeholders.
	2. Implement/facilitate weed control program.
	3. Undertake further detailed survey of catchment, with view to reservation of area.

4.6 Reid-Haughton River Catchment (Including Majors Creek Catchment)

	Wetland Habitat Pro-forma
Wetland Sample Site	***6.1 Serpentine Lagoon*** **-** Majors Creek
Grid Reference No.	DU885354
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple Wetland Aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Palustrine
Class/Subclass	1.Emergent/Non-persistent 2. Forested/Evergreen
Dominance Type	*1. Eleocharis dulcis 2. Melaleuca dealbata*
Water Regime	Seasonally flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	
Associated vegetation	*Nymphaea gigantea, Ludwigia peploides, Azolla* sp., *Utricularia gibba?*
Size	
Management Issues	Protection of natural values, noxious weed control.
Conservation Value	Very High
Recommended Action	1. Consult landholder and investigate reservation/conservation of site
	2. Investigate potential for eco-tourism.
	3. Facilitate/assist landholder with noxious weed control

	Wetland Habitat Pro-forma
Wetland Sample Site	***6.2 Majors Creek*** - upper catchment
Grid Reference No.	DU931341
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Intermittent
Class/Subclass	Streambed/Sand
Dominance Type	*Melaleuca leucadendra*
Water Regime	Seasonally flooded
Water Chemistry	Fresh
Soil	Mineral
Special Modifiers	
Associated vegetation	*Nauclea orientalis, Corymbia tessellaris, Panicum maximum*
Size	channel ~ <15m
Management Issues	water harvesting,weeds, agricultural pollutants
Conservation Value	High
Recommended Action	1. Consult DNR re: sustainable harvest levels from creek and groundwater.
	2. Implement water quality monitoring program.
	3. Assist/facilitate riparian landholders with noxious weed control.

	Wetland Habitat Pro-forma
Wetland Sample Site	***6.3 Majors Creek*** - lower on floodplain
Grid Reference No.	DU936270
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Intermittent
Class/Subclass	Streambed/Sand
Dominance Type	*Panicum maximum*
Water Regime	Seasonally flooded
Water Chemistry	Fresh
Soil	Mineral
Special Modifiers	
Associated vegetation	*Chloris* sp., *Melaleuca dealbata, Corymbia tessellaris*
Size	channel ~<10m
Management Issues	Land clearing, agricultural runoff, weeds
Conservation Value	Med-High
Recommended Action	1. Implement water quality monitoring program.
	2. Ensure agricultural activities do not impact upon riparian zone of creek.

	Wetland Habitat Pro-forma
Wetland Sample Site	***6.4 Reid River***
Grid Reference No.	DU841153
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Intermittent
Class/Subclass	Streambed/Vegetated pioneer
Dominance Type	*Melaleuca leucadendra*
Water Regime	Seasonally flooded
Water Chemistry	Fresh
Soil	Mineral
Special Modifiers	
Associated vegetation	*Callistemon viminalis, Nymphaea gigantea*, *Casuarina littoralis?*
Size	channel ~ >100m
Management Issues	Weeds, grazing
Conservation Value	High
Recommended Action	1. Ensure land development does not impact upon riparian zone of river and sufficient habitat is retained.
	2. Assist/facilitate riparian landholders with noxious weed control.
	3. Undertake further conservation assessment of Reid-Haughton region.

	Wetland Habitat Pro-forma
Wetland Sample Site	***6.5 Reid/Haughton River confluence***
Grid Reference No.	DU913125
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Intermittent
Class/Subclass	Streambed/Vegetated pioneer
Dominance Type	*Melaleuca leucadendra*
Water Regime	Seasonally flooded
Water Chemistry	Fresh
Soil	Mineral
Special Modifiers	
Associated vegetation	*Callistemon viminalis, Casuarina littoralis?*
Size	channel width ~>200m
Management Issues	Weeds, grazing
Conservation Value	High
Recommended Action	1. Ensure land development does not impact upon riparian zone of river and sufficient habitat is retained.
	2. Assist/facilitate riparian landholders with noxious weed control.
	3. Undertake further conservation assessment of Reid/Haughton River region.

4.7 Ross Creek And Ross River Catchment

	Wetland Habitat Pro-forma
Wetland Sample Site	***7.1 Antill Plains Creek*** - Upper catchment
Grid Reference No.	DU902484
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Intermittent
Class/Subclass	Streambed/Rubble
Dominance Type	*Callistemon viminalis*
Water Regime	Temporarily flooded
Water Chemistry	Fresh
Soil	Mineral
Special Modifiers	
Associated vegetation	*Lophostemon grandiflorus, Melaleuca leucadendra*
Size	channel ~ >10m
Management Issues	Land tenure, water quality for potable supply
Conservation Value	Very High
Recommended Action	1. Investigate reservation/conservation of creek and upstream catchment.
	2. Undertake further biological survey of creek.
	3. Develop management policy for water supply creek.
	4. Implement water quality monitoring program.

	Wetland Habitat Pro-forma
Wetland Sample Site	***7.2 Antill Plains Creek*** - above Flinders highway
Grid Reference No.	DU870486
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Lower Perennial
Class/Subclass	Aquatic Bed/Rooted vascular
Dominance Type	*Potamogeton crispus*
Water Regime	Semipermanently flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	
Associated vegetation	*Lomandra longifolia, Vallisneria spiralis, Marsilea mutica*
Size	channel ~ >5m
Management Issues	Grazing, water quality for potable supply
Conservation Value	Medium - High
Recommended Action	1. Develop management policy for water supply creek.
	2. Implement water quality monitoring program
	3. Assist/facilitate landholder with noxious weed control.

	Wetland Habitat Pro-forma
Wetland Sample Site	***7.3 Slippery Rocks Creek*** - Rocky Springs
Grid Reference No.	DU892592
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Intermittent
Class/Subclass	Streambed/Rubble
Dominance Type	*Lophostemon grandiflorus*
Water Regime	Temporarily flooded
Water Chemistry	Fresh
Soil	Mineral
Special Modifiers	
Associated vegetation	*Melaleuca dealbata, Eucalyptus crebra*
Size	channel ~ 10m - 40m wide
Management Issues	Weed invasion, grazing, fire.
Conservation Value	High
Recommended Action	1. Implement/facilitate weed control program.
	2. Investigate habitat value for fauna.

	Wetland Habitat Pro-forma
Wetland Sample Site No.	***7.4 Sachs Creek*** - Oak Valley
Grid Reference No.	DU801557
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Intermittent
Class/Subclass	Aquatic Bed/Floating-leaved
Dominance Type	*Nymphaea gigantea*
Water Regime	Seasonally flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	
Associated vegetation	*Marsilea mutica, Ludwigia peploides, Vallisneria spiralis, Aponogeton queenslandica*
Size	channel ~ 10m
Management Issues	Potable water supply, semi-rural subdivision, recreational use
Conservation Value	High
Recommended Action	1. Implement water quality monitoring program
	2. Restrict further development which impinges on creek or its riparian zones.
	3. Develop management policy for water supply creek.
	4. Investigate the potential for community involvement in rehabilitation.

	Wetland Habitat Pro-forma
Wetland Sample Site	***7.5 Toonpan Lagoon*** - Toonpan
Grid Reference No.	DU828441
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Palustrine
Class/Subclass	Emergent/Persistent
Dominance Type	*Urochloa mutica*
Water Regime	Seasonally flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	
Associated vegetation	*Panicum maximum, Chloris* sp.
Size	
Management Issues	Grazing, weeds
Conservation Value	Low-Med
Recommended Action	1. Investigate grazing trials to control *Urochloa*.

	Wetland Habitat Pro-forma
Wetland Sample Site	***7.6 McDonald's dams* -** Barringha
Grid Reference No.	DU848387
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Palustrine
Class/Subclass	Emergent/Non-persistent
Dominance Type	*Eleocharis dulcis*
Water Regime	Semi-permanently flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	Dyked/Impounded
Associated vegetation	*Nymphaea gigantea, Paspalum distichum, Ottelia ovalifolia, Ludwigia peploides*
Size	largest dam ~ >1km x 500m, several smaller @ 500m x 500m
Management Issues	Grazing, weeds
Conservation Value	High
Recommended Action	1. Investigate protection of natural values with landholder.
	2. Assist landholder with noxious weed control.
	3. Undertake hydrological study of catchment to better determine yields and impact of levees and dams.

	Wetland Habitat Pro-forma
Wetland Sample Site	***7.7 Ross River*** - above the dam
Grid Reference No.	DU715378
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Intermittent
Class/Subclass	Streambed/Sand
Dominance Type	*Urochloa mutica*
Water Regime	Seasonally flooded
Water Chemistry	Fresh
Soil	Mineral
Special Modifiers	
Associated vegetation	*Cyperus* sp.
Size	channel ~ 20m
Management Issues	Potable water supply, grazing, weeds
Conservation Value	Very High
Recommended Action	1. Implement water quality monitoring program for the river.
	2. Develop management policy for water supply creek.

	Wetland Habitat Pro-forma
Wetland Sample Site	***7.8 Ross River Reservoir***
Grid Reference No.	DU740510
Wetland Type Classification (after Blackman *et al*., 1992)	Simple Wetland Aggregation
Biogeograhic Region	Brigalow Belt (north)
Land System	
Landform Pattern/Element	Dam
Ecological System/Subsystem	Lacustrine/Limnetic
Class/Subclass	Unconsolidated bottoms/shores/Mud
Dominance Type	*Urochloa mutica*
Water Regime	Intermittently exposed
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	Impounded
Associated vegetation	**-** (not surveyed)
Size	2781 ha
Management Issues	Water quality for potable supply. EMP currently being devised.
Conservation Value	High
Recommended Action	1. Implement water quality monitoring program for catchment.
	2. Determine habitat values prior to any approval for recreational use.

	Wetland Habitat Pro-forma
Wetland Sample Site	***7.9 Ross River*** - reservoir to Blacks weir
Grid Reference No.	DU719598
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Lower Perennial
Class/Subclass	Unconsolidated Bottom/Mud
Dominance Type	*Typha domingensis*
Water Regime	Permanently flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	Dyked/Impounded
Associated vegetation	*Nelumbo nucifera, Utricularia gibba?, Hydrilla verticillata, Nymphaea gigantea*
Size	channel ~ <40m
Management Issues	Urbanisation, weeds, stormwater
Conservation Value	Med-High
Recommended Action	1. Maintain riparian zones (i.e. do not allow further development to river edge)
	2. Implement rehabilitation programs (e.g. reinstatement of riparian vegetation) and support complimentary community initiatives.
	3. Implement water quality monitoring program for the river.
	4. Identify significant contaminant input sources and install pollution mitigation devices.
	5. Investigate need for environmental flows/releases.

	Wetland Habitat Pro-forma
Wetland Sample Site	***7.10 Ross River*** - Blacks Weir to Gleesons Weir
Grid Reference No.	DU725642
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Lower Perennial
Class/Subclass	Unconsolidated Bottom/Mud
Dominance Type	*Eichhornia crassipes*
Water Regime	Permanently flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	Dyked/Impounded
Associated vegetation	*Urochloa mutica, Utricularia gibba?, Hydrilla verticillata, Nymphaea gigantea*
Size	channel ~ <40m
Management Issues	Urbanisation, weeds, stormwater
Conservation Value	Med-High
Recommended Action	1. Maintain riparian zones (i.e. do not allow further development to river edge)
	2. Implement rehabilitation programs (e.g. reinstatement of riparian vegetation) and support complimentary community initiatives.
	3. Implement water quality monitoring program for the river.
	4. Identify significant contaminant input sources and install pollution mitigation devices.

	Wetland Habitat Pro-forma
Wetland Sample Site	***7.11 Ross River*** - Gleesons Weir to Aplins Weir
Grid Reference No.	DU741642
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Lower Perennial
Class/Subclass	Unconsolidated Bottom/Mud
Dominance Type	*Eichhornia crassipes*
Water Regime	Permanently flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	Dyked/Impounded
Associated vegetation	*Urochloa mutica, Utricularia gibba?, Hydrilla verticillata, Nymphaea gigantea*
Size	channel ~ <50m
Management Issues	Urbanisation, weeds, stormwater
Conservation Value	Med-High
Recommended Action	1. Maintain riparian zones (i.e. do not allow further development to river edge)
	2. Implement rehabilitation programs (e.g. reinstatement of riparian vegetation) and support complimentary community initiatives.
	3. Identify significant contaminant input sources and install pollution mitigation devices.
	4. Implement water quality monitoring program for the river.

	Wetland Habitat Pro-forma
Wetland Sample Site	***7.12 Ross River*** - Aplins Weir to Rooney's bridge
Grid Reference No.	DU788658
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Tidal
Class/Subclass	Unconsolidated Bottom/Mud
Dominance Type	*Sporobolus virginicus*
Water Regime	Regularly flooded
Water Chemistry	Mixohaline
Soil	Organic
Special Modifiers	
Associated vegetation	*Avicennia marina, Halosarcia indica, Pseudoraphis spinescens*
Size	channel ~ <40m; including levees ~ >100m
Management Issues	Pollution, urbanisation, riverbank stabilisation
Conservation Value	High
Recommended Action	1. Investigate reservation/conservation of remnant mangrove and saltmarsh areas.
	2. Conduct regular site assessments of the Bicentennial Park area to determine extent and impact of leachates and other pollution (e.g. exposed garbage) on the adjacent aquatic environment.
	3. Implement rehabilitation works (structural) for the Bicentennial Park area to reduce contaminant loadings, bank erosion and river siltation.
	4. Implement rehabilitation programs (e.g. reinstatement of riparian vegetation) and support complimentary community initiatives.
	5. Identify significant contaminant input sources and install pollution mitigation devices.
	6. Implement water quality monitoring program for the river.

	Wetland Habitat Pro-forma
Wetland Sample Site	**7.13 Ross River** - below Rooney's Bridge
Grid Reference No.	DU810672
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Riverine/Tidal
Class/Subclass	1. Streambed/Mud 2.Emergent/persistent
Dominance Type	*1. Avicennia marina 2. Sporobolus virginicus*
Water Regime	1. Regularly flooded 2. Temporarily flooded
Water Chemistry	Mixohaline
Soil	Organic
Special Modifiers	
Associated vegetation	1. *Bruguiera* sp. 2. *Halosarcia indica*
Size	channel up to ~ >80m
Management Issues	Urban/industrial encroachment, stormwater inputs and other contaminants, fishing pressure, unrestricted access, boat moorings.
Conservation Value	Medium-High
Recommended Action	1. Develop a management plan for tidal waters of the Ross River.
	2. Identify significant contaminant input sources and install pollution mitigation devices.
	3. Rehabilitate adjacent degraded areas to enhance community involvement in river management and to improve the aesthetics of the city s major waterway
	4. Investigate reservation/conservation of remnant mangrove and saltmarsh areas, particularly in relation to the south bank and associated areas.

	Wetland Habitat Pro-forma
Wetland Sample Site	***7.14 Idalia lagoons*** - Idalia
Grid Reference No.	DU801647
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Palustrine
Class/Subclass	Unconsolidated bottom/Mud
Dominance Type	*Azolla* sp.
Water Regime	Semi-permanently flooded
Water Chemistry	Fresh
Soil	Organic
Special Modifiers	
Associated vegetation	*Nymphaea gigantea, Urochloa mutica*
Size	largest ~30m x >200m
Management Issues	Urban subdivision, weed invasion
Conservation Value	Med - High
Recommended Action	1. Ensure retention of lagoons and buffers as part of proposed subdivision.
	2. Avoid overt modification to lagoons (e.g. canalisation, dredging etc)
	3. Implement weed management plan and replanting program.

	Wetland Habitat Pro-forma
Wetland Sample Site No.	***7.15 Ross Creek* -** Townsville
Grid Reference No.	DU805698
Wetland Type Classification (after Blackman *et al*., 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Estuarine/Subtidal
Class/Subclass	Unconsolidated Bottom/Mud
Dominance Type	*Avicennia marina*
Water Regime	Subtidal
Water Chemistry	Mixohaline
Soil	Organic
Special Modifiers	Impounded
Associated vegetation	*Sporobolus virginicus, Halosarcia indica*
Size	channel ~ 30m
Management Issues	Stormwater, litter, recreational use
Conservation Value	Med-High
Recommended Action	1. Control access to the creek to prevent erosion of banks and the deposition of refuse and litter.
	2. Replant estuarine and non-estuarine vegetation along the banks of Ross Creek to improve aesthetics and habitat values.
	3. Clean up existing refuse and litter along the banks of Ross Creek, and formulate guidelines for water and sediment quality monitoring to facilitate regular assessments of the environmental status of Ross Creek.

	Wetland Habitat Pro-forma
Wetland Sample Site	***7.16 The Lakes development* -** Townsville
Grid Reference No.	DU778693
Wetland Type Classification (after Blackman *et al.*, 1992)	Simple wetland aggregation
Biogeograhic Region	Brigalow Belt (North)
Land System	
Landform Pattern/Element	
Ecological System/Subsystem	Estuarine/Subtidal
Class/Subclass	Unconsolidated Bottom/Mud
Dominance Type	-
Water Regime	Artificially flooded
Water Chemistry	Mixohaline
Soil	Organic
Special Modifiers	Excavated
Associated vegetation	-
Size	-
Management Issues	Stormwater, litter, recreational use
Conservation Value	Low
Recommended Action	1. Replant estuarine and non-estuarine vegetation along the banks of lakes to improve aesthetics and habitat values.
	2. Formulate guidelines for water and sediment quality monitoring to facilitate regular assessments of its environmental status.
	3. Install stormwater pollution mitigation devices (e.g. litter traps).

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APPENDIX 1: MAPS OF WETLAND AREAS

APPENDIX 2: COMPOSITE SPECIES LIST

This list is comprised from published information (QDoE draft lists for the Town Common, QDoE KEYCONS database), previous studies conducted by the ACTFR, and the results of this broad survey.

N.B. Explanation of symbols: * - Species introduced from another country; R - Rare species.

FERNS

ADIANTACEAE
Cheilanthes sieberi

SALVINIACEAE
Salvinia molesta *

MARSILEACEAE
Marsilea hirsuta
Marsilea mutica

FLOWERING PLANTS

ACANTHACEAE
Acanthus ilicifolius
Hypoestes floribunda
Ruellia acaulis

APOCYNACEAE
Alyxia ruscifolia
Carissa ovata
Cartharanthus roseus *
Tabernaemontana orientalis

AIZOACEAE
Sesuvium portulacastrum
Trianthema portulacastrum *

ARACEAE
Pistia stratiodes

ARECACEAE
Livistona decipiens
Livistona drudei

ARALIACEAE
Schefflera actinophylla

AMARANTHACEAE
Achyranthes aspera
Alternanthera nana
Alternanthera nodiflora

Deeringia amaranthoides
Gomphrena celosioides *

ASCLEPIADACEAE
Asclepias curassavica *
Cryptostegia grandiflora *
Cynanchum carnosum
Gymnanthera oblonga
Hoya australia
Sarcostemma sp.

AMARYLLIDACEAE
Crinum angustifolium

ANACARDIACEAE
Euroschinus falcata
Mangifera indica *
Pleiogynium timoriense
Schinus terebinthifolia *

ANNONACEAE
Fittzalania heteropetala
Polyalthia nitidissima

APONAGETONACEAE
Aponogeton queenslandica R

ASTERACEAE
Acanthospermum hispidum *
Bidens pilosa *
Calyptocarpus vialis *
Centipeda minima
Conyza bonariensis *
Emilia sonchifolia
Epaltes australis
Helichrysum rupicola
Pterocaulon serrulatum
Pterocaulon sphacelatum
Sphaeranthus africanus
Tridax procumbens *
Wedelia spilanthoides
Xanthium pungens *

AVICENNIACEAE
Avicennia marina

BIGNONIACEAE
Pandorea panorana
Spathodea campanulata *
Tecoma stans *

BIXACEAE
Cochlospermum gillivraei

BORAGINACEAE
Ehretia membranifolia
*Heliotropium indicum **
Heliotropium ventricosum
Trichodesma zeylanicum

BURSERACEAE
Canarium australianum
Garuga floribunda

CAESALPINIACEAE
Chaemacrista mimosoides
Caesalpinia bonduc
*Cassia fistula **
*Parkinsonia aculeata **
Senna surattensis subsp. retusa
*Tamarindus indica **

CACTACEAE
*Opuntia inermis **
*Opuntia tomentosa **

CAPPARIDACEAE
Capparis canescens
Capparis sepiaria
Cleome viscosa

CASUARINACEAE
Casuarina equisetifolia

CELASTRACEAE
Cassine melanocarpa
Maytenus dispserma

CERATOPHYLLACEAE
Ceratophyllum demersum

CHENOPODIACEAE
Enchylaena tomentosa
Halosarcia indica
*Salsola kali **
Sueda australia

COMBRETACEAE
Lumniterzer racemosa
Terminalia melanocarpa
Terminalia muelleri

COMMELINACEAE
Commelina lanceolata
Murdannia graminea

CONVILULACEAE
Argyreia nervosa *
Cressa cretica
Evolvulus alsinoides
Ipomoea aquatica
Ipomoea graminea
Ipomoea pes-caprae
Ipomoea plebeia
Ipomoea quamoclit *

CYPERACEAE
Bulbostylis barbarta
Cyperus alopecuroides
Cyperus conicus
Cyperus difformis
Cyperus exaltatus
Cyperus iria
Cyperus polystachyos
Cyperus rotundus *
Cyperus scarious
Cyperus stoloniferus
Eleocharis dulcis
Eleocharis geniculata
Fimbristylis dichotoma
Fimbristylis ferruginea
Schoenoplectus validus
Scleria brownii

CUCURBITACEAE
Cucumis myricorpus

EUPHORBIACEAE
Acalypha eremorum
Alcornea ilicifolia
Antidesma parvifolium
Bridelia leichhardtii
Croton arnhemicus
Drypetes deplanchie
Euphorbia cyathophora *
Euphorbia hirta *
Euphorbia macgillivrayi
Euphorbia micradenia
Euphorbia tannensis
Excocaria agallocha
Fluggea virosa
Jatropha gossypiifolia *

Mallotus philippensis
Petalostigma pubescens
Phyllanthus novae-hollandiae
Phyllanthus similis
Poranthera microphylla
Ricinus communis *

FABACEAE
Abrus precatorius
Alysicarpus vaginalis
Canavalia rosea
Canjanus marmoratus
Cliteria ternate *
Crotaliaria calycina
Crotalaria goreensis *
Crotalaria laburnifolia *
Crotalaria medicaginea
Crotalaria montana
Crotalaria pallida *
Desmodium rhytidophyllum
Erythrina vespertilio
Flemingia parviflora
Glycine tabaccine
Indigofera hirsuta
Indigofera linifolia
Indigofera tinctoria *
Indigofera suffruticosa *
Macroptilium atropurpureum *
Macroptilium atropurpureum *
Macroptilium lathyroides *
Pongamia pinnata
Pycnospora lutescens
Sesbania cannabina
Stylosanthes humilus *
Tephrosia filipes
Tephrosia juncea
Zornia dyctiocarpa

GENTIANACEAE
Limnanthemum indicum

HALORACIDACEAE
Myriophyllum verrucosum

HAEMODORACEAE
Haemodorum coccineum

HERNANDIACEAE
Gyrocarpus americanus

HYDROCHARITACEAE

Hydrilla verticillata
Ottelia ovalifolia
Vallisneria spiralis

LAMIACEAE
Hyptis suaveolens *
Pleactranthus parviflorus

LAURACEAE
Cassytha filiformis
Cassytha pubescens
Litsea glutinosa

LECYTHIDACEAE
Planchonia careya

LENTIBULARIACEAE
Utricularia stellaris
Utricularia gibba

LOGANIACEAE
Strychnos lucida

LORANTHACEAE
Amyema bifurcatum
Dendrophthoe glabrescens
Lysiana maritima

LYTHRACEAE
Ammannia awiculata
Ammania multiflora

MALVACEAE
Hibiscus tiliaceous
Sida cordifolia
Sida rhomboides
Sida subspicata
Thespesia populnea
Urena lobata *

MELIACEAE
Terraea pubescens
Xylocarpus granatum
Xylocarpus australasicum

MELASTOMATACEAE
Memecylon pauciflorum

MEMISPERMACEAE
Stephania japonica
Tinospora smilacina

MENYANTHACEAE
Nymphoides indica
Nymphoides crenata

MIMOSACEAE
Acacia aulococarpa
Acacia crassicarpa
Acacia flavescens
Acacia holosericea
Acacia julifera
Acacianesophila
Acacia simsii
Acacia spirorbus
Albbizia canescens
*Albizia lebbeck **
Albizia procera
Paraserianthes toona
*Prosopis glandulosa **
*Tamarindus indicus **

MORACEAE
Ficus obliqua
Ficus opposita
Ficus platypoda
Ficus racemose
Ficus virens
Malaisia scandens

MYOPORACEAE
Myoportum acuminatum

MYRSINACEAE
Austromyrtus bidwillii
Callistemon viminalis
Eucalyptus clardsoniana
(= Corymbia clarksoniana)
Eucalyptus crebra
Eucalyptus platyphylla
Eucalyptus tereticornis
Eucalyptus tessellaris subsp. dallachyana
(was E. papuana; = Corymbia dallachyana)
Eucalyptus tessellaris subsp. tessellaris
(= Corymbia tessellaris)
Eugenia reinwardtiana
Homoranthus sp.
Lophostemon grandiflorus
Lophostemon suaveolens
Melaleuca dealbata
Melaleuca leucadendra
Melaleuca quinquenervia

Melaleuca viridiflora
Osbornia octodonta

NELUMBONACEAE
Nelumbo nucifera

NYCTAGINACEAE
Boerhavia sp.
Pisonia aculeata

NYMPHAEACEAE
Nymphaea gigantea

OLEACEAE
Jasminum didymum
Jasminum simplicifolium

ONAGRACEAE
Ludwigia peploides *
Ludwigia octovalvis

ORCHIDACEAE
Cymbidium madidum
Denbrobium sp.

OCALIDACEAE
Ocalis corniculata *

PANDANACEAE
Pandanus pedunculatus

PASSIFLORACEAE
Passiflora aurantia
Passsiflora foetida *

PEDALLIACEAS
Martynia diandra

PITTOSPORACEAE
Bursaria incana
Citriobatus spinescens

PLUMBAGINACEAE
Aegialitis annulata
Plumbago zeylanica

POACEAE
Aristida sp.
Bothriochloa decipiens
Cenchrus echinatus *
Chloris divaricata

*Chloris gayna **
Chloris virgata
Cymbopogon queenslandicus
Cynodon dactylon
*Dactyloctenium aegyptium **
Dicanthium sericeum
*Digitaria ciliaris **
*Echinochloa crus-galli **
*Eleusine indica **
Enneapogon pallidus
Entolasia stricta
Eragrostis interrupta
Eriachne Sp.
Heteropogon triticeus
*Melinus repens **
Mnesithea rottboelloides
Oryza australis
Panicum decompositum
*Panicum maximum **
Paspalum distichum
Paspalidium gracile
Pennisetum setaceum
Phragmites australis
Pseudoraphis spinescens
Setaria Sp.
Spinifex hirsutus
Sporobolus virginicus
Themeda triandra
*Urochloa mutica**

PROTEACEAE
Grevillea parallela
Grevillea striata
Persoonia falcata

POLYGONACEAE
Persicaria attenuatum
Persicaria lapathifolia

PONTEDERIACEAE
*Eichhornia crassipes **
Monochoria cyanea

PORTULACACEAE
Portulaca bicolor
Portulaca oleracea

POTAMOGETONACEAE
Potamogeton crispus

RHAMNACEAE

Alphitonia excelsa
Colubrina asiatica
Pomaderris canescens
Ziziphus mauritiana *

RHIZOPHORACEAE
Bruguiera exaristata
Bruguiera gymnorhiza
Ceriops tagal var. australia
Rhizophora apiculata
Rhizophora mucronata
Rhizophora stylosa

RUBIACEAE
Aidia racemosa
Canthium attenuatum
Canthium odoratum
Larsenaikia ochreata
Nauclea orientalis
Pavetta australiensis
Spermacoe brachystema
Timonius timon

RUTACEAE
Geijera salicifolia
Melicope erythrococca
Micromelum minutum
Murraya ovatifoliolata

SANTALACEAE
Exocarpus latifolia

SAPINDACEAE
Alectryon connatus
Alectryon tomentosus
Cupaniopsis anacardioides
Dodonaea lanceolata
Dodonaea viscosa
Jagera pseudorhus

SAPOTACEAE
Mimusops elengi
Planchonella pohlmaniana
Pouteria sericea

SCROPHULARIACEAE
Scoparia dulcis *

SOLANACEAE
Solanum sp.

SMILACEAE
Eustrephus latifolius
Smilax australis

SONNERATIACEAE
Sonneratia alba

SPARGANIACEAE
Sporganium stenphyllum

STERCULIACEAE
Brachychiton sp.
Melhania oblongifolia
Sterculia quadrifida

STYLIDIACEAE
Stylidium sp.

TACCACEAE
Tacca leontopetaloides

TILIACEAE
Corchorus aestuans
Greqia retusifolia
Triumfetta repens

THYMELEACEAE
Pimelea sericostachya

TYPHACEAE
Typha orientalis
Typha domingensis

ULMACEAE
Celtis paniculata
Trema tomentosa

URTICACEAE
Dendrocnide moroides

VERBENACEAE
Clerodendrum floribundum
Clerodendrum inerme
Glossyocarya hemimderma
Lantana camara *
Phyla nodiflora
Premna serratifolia
Stachytarpheta jamaicensis *
Vitex trifolia

VIOLACEAE
Hybanthus enneaspermus

VISCACEAE
Viscum articulatum

VITACEAE
Cayratia tricolia
Cissus reniformis

XANTHORRHOEACEAE
Lomandra longifolia

ZYGOPHYLLACEAE
Tribulus cistoides
Tribulus terrestris

APPENDIX 3: CLASSIFICATION SYSTEM UTILISED (Blackman *et al.* 1992)

APPENDIX 4: RECOGNISED WETLAND RESERVES IN THE TCC AREA