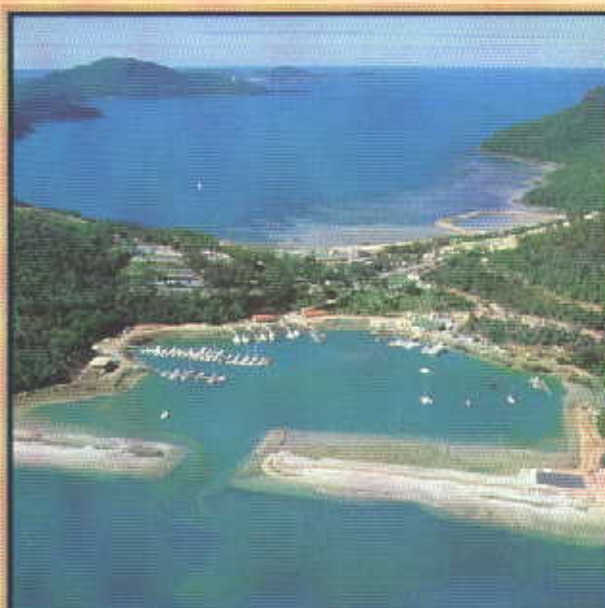
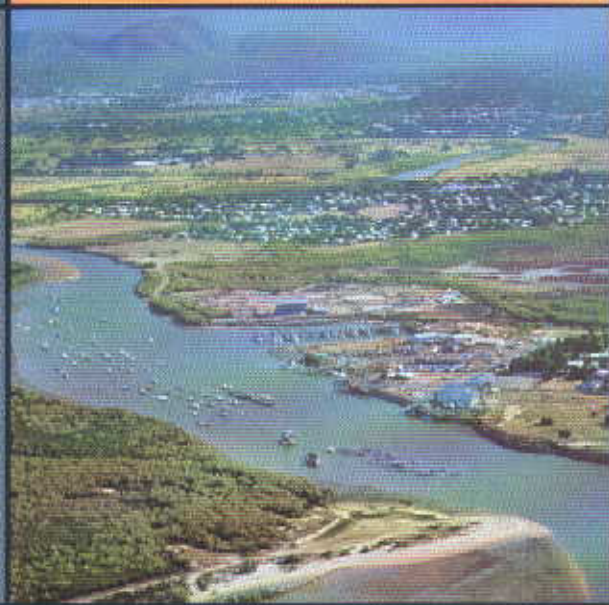


**Preliminary Study of
Potential
Impacts
on the**

**Great Barrier
Reef World
Heritage Area
from
Coastal Urban
Development**



**A scoping
study
to identify
projects
suitable
for future
funding
proposals**



Preliminary Study of Potential Impacts on the Great Barrier Reef World Heritage Area from Coastal Urban Development

**A scoping study to
identify projects
suitable for future
funding proposals**

Prepared for:
Great Barrier Reef Marine Park Authority
in association with

North Queensland Local Government Association
Represented by Townsville City Council

Central Queensland Local Government Association
Represented by Livingstone Shire Council
Queensland Department of Environment



GREAT BARRIER REEF
MARINE PARK AUTHORITY



Department of the Environment



Livingstone
Shire Council



Published by the Great Barrier Reef Marine Park Authority 1998

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Cover photograph:

Top left - Hamilton Island Marina taken during the mid 80's
Bottom right - Ross River, Townsville.

National Library of Australia Cataloguing-in Publication data:

Preliminary study of potential impacts on the Great Barrier Reef
World Heritage Area from coastal urban development: a scoping
study to identify projects suitable for future funding proposals.

Bibliography.
ISBN 0 642 23052 8.

1. Urbanization - Environmental aspects - Queensland - Great
Barrier Reef. I. Great Barrier Reef Marine Park Authority (Australia).

307.141609943

This report is based primarily on a report prepared for the Steering Committee by
David Pitts, Environment Science and Services.

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Introduction

1.1 Background

This report was initiated under the Commonwealth Coastal Policy, the aim of which is 'to promote ecologically sustainable use of Australia's coastal zone'.

The Policy recognises that integrated strategic coastal planning is a critical tool for achieving sustainable use of Australia's coastal zone. It also recognises the need for all spheres of government, industry and the community to work in partnership to develop a vision for the sustainable use of the coastal zone, and then work together to develop a strategic plan to implement that vision.

This study was funded by the Commonwealth under that policy, with in-kind support from the Queensland Government and coastal local governments in Queensland. It is a preliminary study to identify potential impacts of local government activity on the coastline through current planning regimes and service provision. One of the key expected outputs was the identification of projects that would address impacts on the Great Barrier Reef from coastal urban development, and which were therefore suitable for further funding. These projects were generally expected to involve more than one local government area and involve partnership approaches between different spheres of government, industry and the community.

The project has been managed by the Great Barrier Reef Marine Park Authority in association with the Townsville City Council.

1.2 Study Area

The boundary of the Great Barrier Reef World Heritage Area is shown in figure 1.1. It covers an area of 351 400 km². Its western edge coincides with Queensland's coast at low water. Although this coastline is approximately 3400 km in length, the maximum extent of the World Heritage Area is 1955 km between its north-west and south-east extremities.

Twenty-one Queensland local governments about the boundary of the World Heritage Area. These local government areas are listed in table 1.1 and their boundaries are shown in figure 1.2.

1.3 Terms of Reference

The terms of reference as specified in the project contract were:

- (i) Purpose of the Study:
To study the potential impacts on the social, natural, cultural and world heritage values of the Great Barrier Reef World Heritage Area associated with development in the adjacent coastal areas.
- (ii) Focus of the Study:
The study is to focus upon the impacts associated with urban development, in particular those arising from tourist activity, industrial development, and services associated with the fishing industry, and impacts from increasing residential development and thus with activities resulting from increased population such as recreational boating and fishing activity adjacent to, and within, the World Heritage Area. Impacts can relate to three tiers, those associated with regional planning, assessment of specific coastal developments and urban development in general.
- (iii) Outputs of the Study:
Outputs of the preliminary study will be the identification of projects suitable for funding under various programs, and working with identified Aboriginal communities, local government authorities and the State and Commonwealth agencies in the adjacent coastal areas of the Great Barrier Reef to identify:
 - (a) and summarise the known potential impacts associated with coastal development in the immediate adjacent coastal areas on the Great Barrier Reef World Heritage Area;
 - (b) the potential management needs of the World Heritage Area arising from the impacts associated with urban development, focusing on the associated implications for adjacent coastal development;

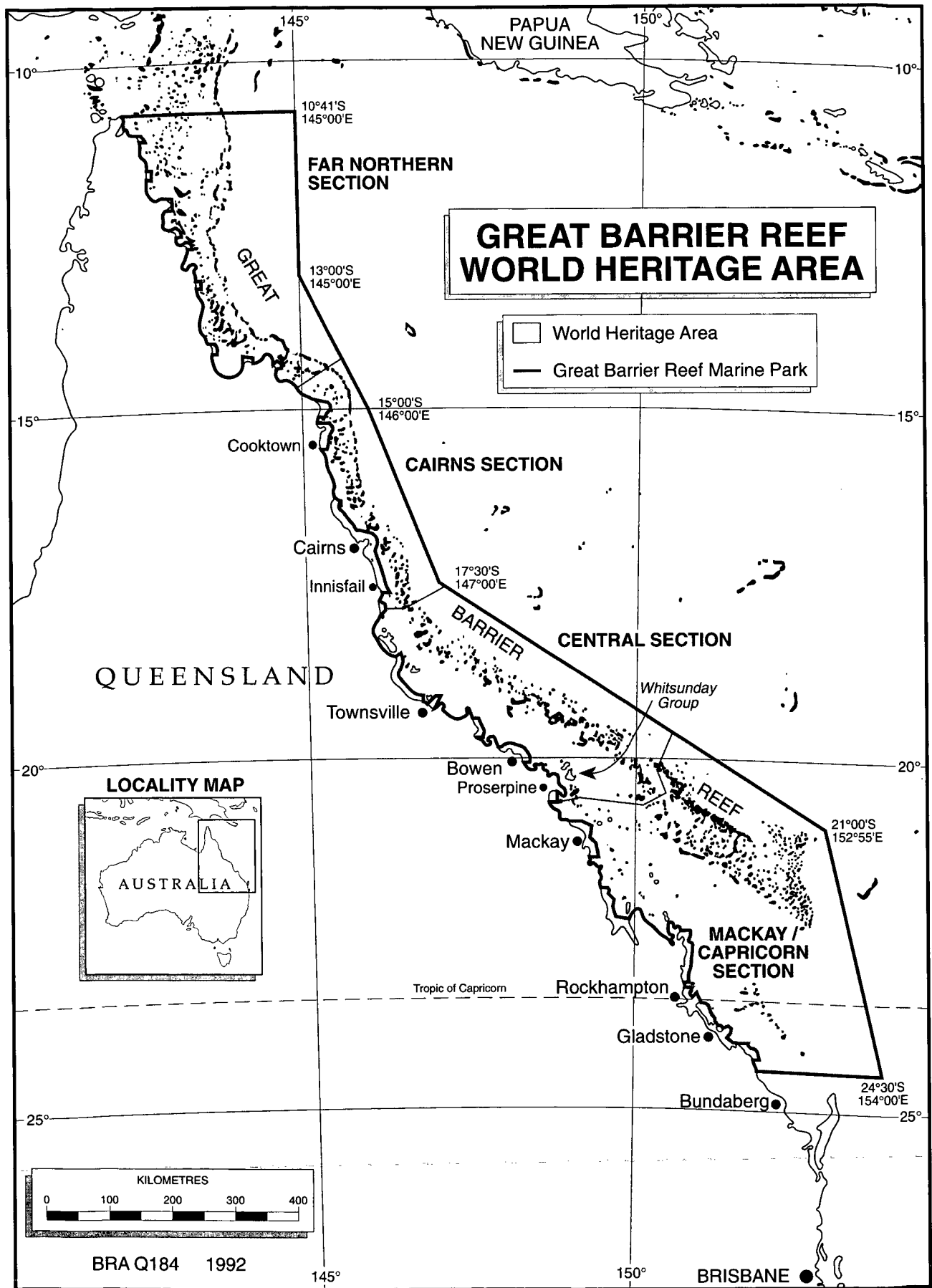


Figure 1.1 Great Barrier Reef World Heritage Area

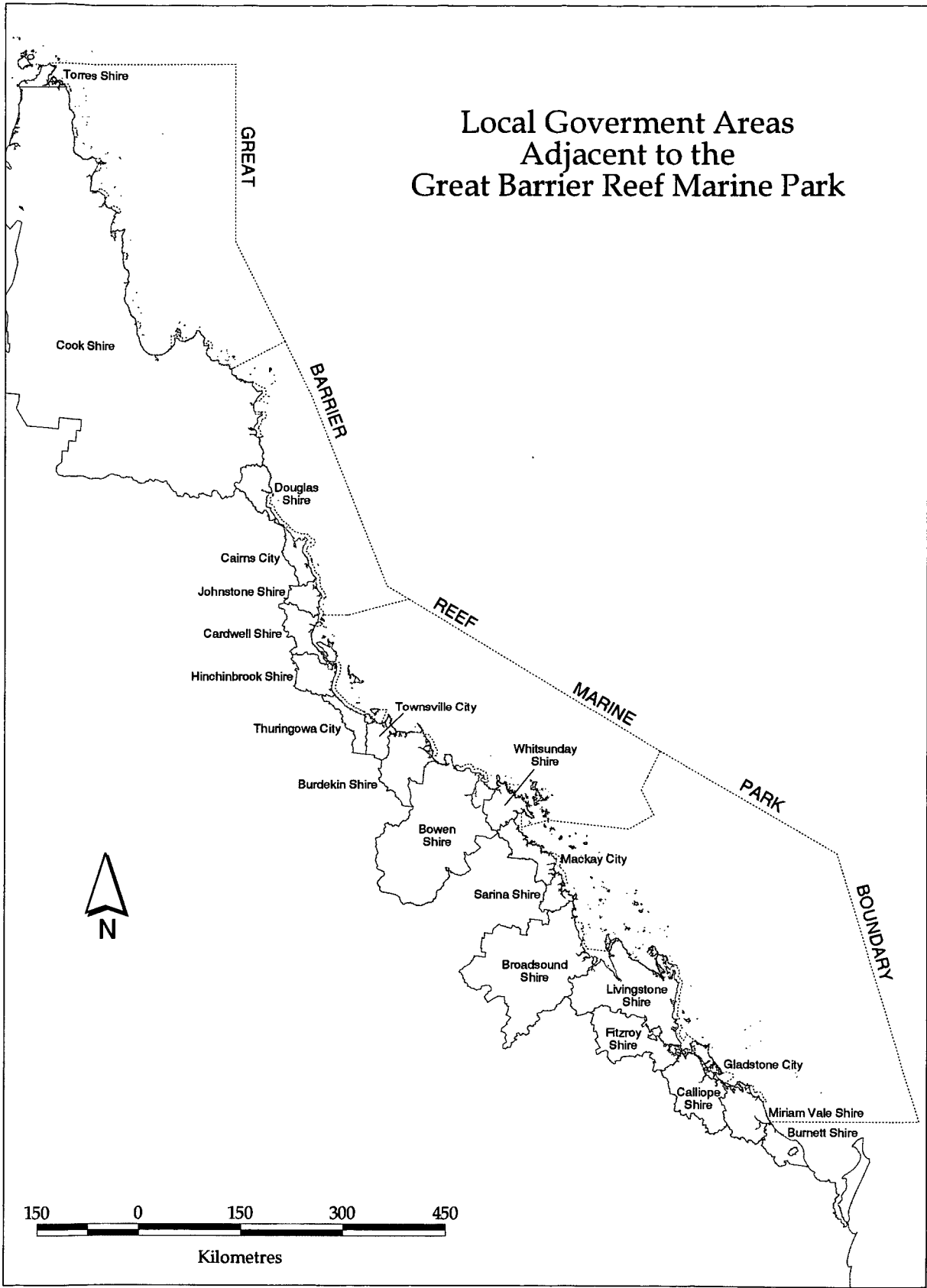


Figure 1.2 Local Government Areas

Table 1.1 Local Governments abutting the World Heritage Area

Local Government Assn of Qld District	Local Government (1995)	Resident population	Approx. length of coastline (km)
Northern District	Torres	8 640	120
	Cook	7 630	900
	Douglas	8 880	114
	Cairns	107 460	129
	Johnstone	19 230	62
	Cardwell	8 850	84
	Hinchinbrook	15 390	69
	Thuringowa	44 420	53
	Townsville	89 730	83
	Burdekin	19 250	132
	Bowen	13 420	156
	Whitsunday	12 840	219
	Mackay	70 470	177
	Sarina	9 020	114
Central District	Broadsound	8 290	155
	Livingstone	22 210	587
	Fitzroy	10 050	20
	Gladstone	26 960	20
	Calliope	12 620	96
	Miriam Vale	3 530	193
	Burnett	19 870	93
TOTAL		538 760	3 576

- (c) Commonwealth, State and local government activities (legislation, policy and management practices) that exist to meet identified needs and the agencies responsible for the identified activities;
- (d) the manner in which the activities of the different agencies relate to each other and the gaps and overlaps that exist and undertake an audit of these to determine associated management issues;
- (e) specific funding proposals that could be developed by one or more levels of government to develop a range of actions that should be undertaken in order to minimise identified impacts.

Given the breadth of the terms of reference and the limited resources available for this project, the Steering Committee provided directions to the consultant concerning the range of issues to be addressed and the emphasis that was to be given to the various outputs.

Firstly, the Steering Committee directed that the study was to focus on planning and management interactions arising from:

- residential development, including rural residential development,
- tourist activity, including the construction and operation of accommodation and boating facilities and associated day-trip activities, and industrial development,
- ports and harbours, including services associated with the fishing industry, and
- activities such as recreational boating and fishing associated with increased population in coastal areas.

The project is therefore not concerned with the impacts of agriculture, pastoral activities, aquaculture or mining.

Secondly, the Steering Committee directed that the primary focus of the investigations was to be directed towards output (e), that is, the identification of specific future projects and funding proposals that are practical and workable.

It is important that this project be seen in the broader context of:

- implementing the National Strategy for Ecologically Sustainable Development,
- fulfilling commitments made by Australia as a signatory to the United Nations' Agenda 21 and the United Nations' Environment and Development Declaration,
- meeting Australia's obligations under the World Heritage Convention, and
- the Commonwealth Government's marine and coastal activities.

The output from this study should not just be seen as a collection of individual projects that would benefit from financial assistance. More importantly, they should be seen as a 'package' of projects that would collectively involve coastal communities and all three spheres of government in helping to meet Australia's commitments in the areas of ecologically sustainable development and World Heritage Area management.

This preliminary study includes relevant material from local, State and Commonwealth government agencies with responsibilities within the World Heritage Area and adjacent coastal areas. Although local governments and relevant regional offices of the State agencies concerned have been visited, the study is largely a desk top analysis of the material available.

The project has been directed by a Steering Committee consisting of the following representatives:

- Great Barrier Reef Marine Park Authority – Prue Keen, Dominique Benzaken and Karen Robinson
- North Queensland Local Government Association – Councillor Ann Bunnell (Chair)
- Central Queensland Local Government Association – Councillor Michael Prior
- Townsville City Council – Deborah Szekely (until October 1996), Karen Robinson (until March 1997) and Greg Bruce (after October 1996)
- Queensland Department of Environment – David Briggs

- Queensland Department of Primary Industries – Ed Donohue and Lyn McTaggart
- Queensland Department of Local Government and Planning – Peter Lindwall
- Commonwealth Department of Housing and Regional Development – Alex Appleman (until September 1996)
- Reef Tourism 2005 – Ed Green (observer).

The report draws upon and documents work undertaken between June 1996 and March 1997.

1.4 Sources of Information

The main sources of information used in the preparation of this report have been:

- published reports and papers relevant to coastal urban development and the value of the Great Barrier Reef World Heritage Area,
- local government planning schemes and policies,
- discussions with representatives from government agencies and other interest groups (see section 1.5),
- file information held by government agencies, and
- the consultants' knowledge of coastal planning issues in Queensland.

The report includes selected bibliography of references used in its preparation.

1.5 Consultation

During the preparation of this report discussions have been held with:

- officers from coastal local governments adjacent to the Great Barrier Reef World Heritage Area,
- representatives from State and Commonwealth government agencies,
- representatives from some Port Authorities, and
- representatives from other stakeholder groups including commercial and recreational fishermen, local coastal communities, traditional owners, the tourist industry and conservation groups.

Details of individuals who have been consulted are contained in appendix 1.

The Great Barrier Reef World Heritage Area and its Value

2.1 Location and Description

The boundaries of the Great Barrier Reef World Heritage Area are shown in figure 1.1. It extends from the tip of Cape York to just north of Fraser Island and from low water mark on the Queensland coast to beyond the edge of the continental shelf. It is 351 400 km² in area and includes all islands within its boundaries. The Great Barrier Reef Marine Park covers 98% of the World Heritage Area.

The main physical and biological characteristics of the World Heritage Area are summarised in table 2.1.

The Great Barrier Reef has developed over the past 8000 years on a limestone foundation. The reef in its present form is largely a result of limestone accretion of minute skeletons of

single-celled animals called polyps and a cementation process associated with coralline algae. There are about 2900 individual reefs in the World Heritage Area as well as many small bare sand cays, vegetated cays and continental islands. There are 300 reef islands including 213 unvegetated cays and 83 permanently vegetated sand cays.

The reef and surrounding waters support a rich diversity of plants and animals. The myriad of interdependent plants and animals are specially adapted to their complex physical environment. The species composition varies across the reef shelf because of microclimates created by the interaction of siltation, availability of nutrients, light intensity, ocean currents, and many other factors (Gilmore 1988). Living on the limestone foundations are 400 species of hard and soft corals as well as numerous other animals, including sponges, sea urchins, fish, birds and turtles. Whales are also frequent visitors to the marine park.

The Great Barrier Reef is a source of many highly valued goods and amenity services. The reef environment supports many organisms exploited by humans. Commercial and recreational fishers harvest a range of fish and shellfish. However, non-extractive uses of the reef are becoming the most highly valued. The aesthetic appeal of the reef and its diverse and

Table 2.1 Great Barrier Reef World Heritage Area

Characteristic	Number or size
Area of the Great Barrier Reef World Heritage Area	351 400 km ²
Approximate length of Queensland coast at low water	3 400 km
Number of reefs	2 900
– fringing reefs	760
– continental reefs	618
Number of reef islands	318
Number of cays and wooded systems	300
Number of fish species	1 500
Number of hard and soft coral species	400
Number of molluscs	4 000
Number of bird species	240
Number of turtle species	6

Source: Geen and Lal (1991)

abundant animal species and corals attract many tourists. Popular recreational activities include diving, snorkelling and viewing the corals from glass-bottomed or semi-submersible vessels (Geen and Lal 1991).

The Great Barrier Reef is the largest coral reef system in the world and one of the richest in biological diversity. It was inscribed on the World Heritage List on 26 October 1981. Under Article 4 of the Convention for the Protection of World Cultural and Natural Heritages (UNESCO 1972), the listing of the Great Barrier Reef Region and its associated islands as a World Heritage Property means that Australia accepts an obligation to 'do all it can to identify, protect, conserve, present and transmit to future generations the natural and cultural heritage situated on its territory'.

2.2 Biogeographic Regionalisation of the World Heritage Area

Commonwealth and State governments have been working together to develop a marine and coastal regionalisation for Australia. In 1996, an interim system of marine and coastal regionalisation was released (Thackway and Cresswell 1996). It is an ecosystem-based hierarchical classification that includes:

- 11 different broad marine provinces, and
- a system of 58 different inshore regions.

Under the Interim Marine and Coastal Regionalisation for Australia, the Great Barrier Reef World Heritage Area is almost entirely included within the North East Province. In terms of inshore regions, it embraces all or part of:

- the Ribbons region,
- the East Cape York region,
- the Wet Tropic Coast region,
- the Central Reef region,
- the Lucinda-Mackay Coast region,
- the Pompey-Swains region,
- the Mackay-Capricorn region, and
- the Shoalwater Coast region.

The Coastal Management Branch of the Department of Environment has used coastal and marine regionalisation data to help

develop a system of coastal regions for practical coastal and management purposes in Queensland. The coastal regions are:

- primarily based on a combination of biogeographic considerations such as catchment boundaries, terrestrial biogeographic regions and marine habitats, but
- also adjusted to coincide with local government boundaries which dictate the boundaries of terrestrial planning regions in Queensland.

The end result has been the delineation of 10 different coastal management regions along the eastern Queensland coastline. These regions are shown in figure 2.1. They will form the basis for regional coastal management plans being prepared under the Coastal Protection and Management Act.

There are 9 coastal management regions that include local government areas adjacent to the Great Barrier Reef World Heritage Area. The local government areas within each of these regions and the major river systems which drain into them are shown in table 2.2.

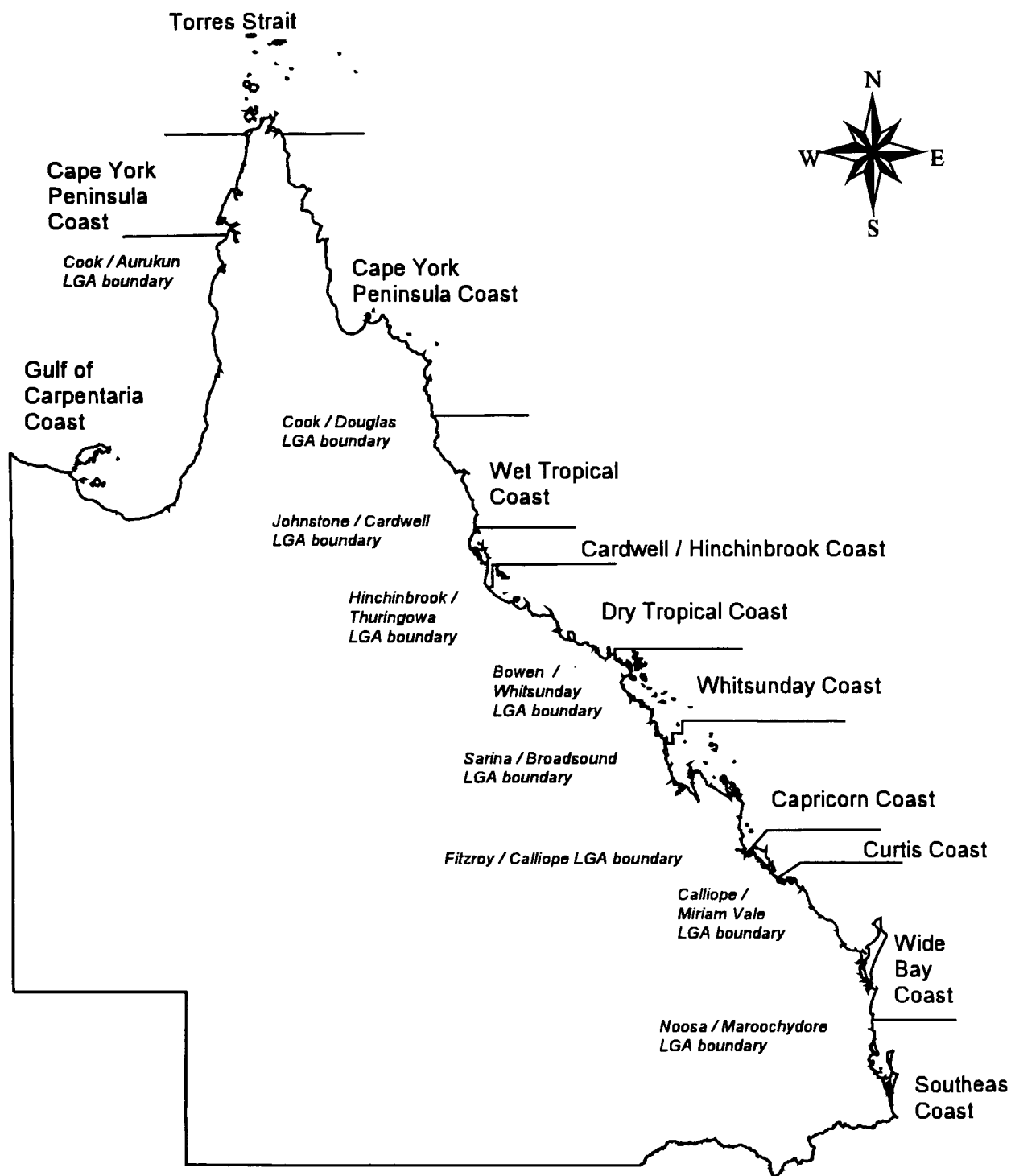
These coastal regions are used as the basis for defining coastal development regions in the balance of this report.

2.3 Value of the World Heritage Area

The nomination for World Heritage listing of the Great Barrier Reef states that (Great Barrier Reef Marine Park Authority 1981):

The Great Barrier Reef is by far the largest single collection of coral reefs in the world. Biologically the Great Barrier Reef supports the most diverse ecosystem known to man. Its enormous diversity is thought to reflect the maturity of an ecosystem which has evolved over millions of years on the north-east continental shelf of Australia.

The Great Barrier Reef provides some of the most spectacular scenery on earth and is of exceptional natural beauty. The Great Barrier Reef provides major feeding grounds for large populations of the endangered species, *Dugong dugon*, and contains nesting grounds of world significance for the endangered turtle species, green turtle (*Chelonia mydas*) and loggerhead turtle (*Caretta caretta*).



**Department
of Environment**

(as of May 1998)

Figure 2.1 Coastal Regions

Table 2.2 Coastal Management Regions adjacent to the Great Barrier Reef Marine Park

Coastal Region	Local Government Areas included in this Study	Major Drainage Basins
Torres Strait	Torres Shire (part)	Jackey Jackey Creek
Cape York Peninsula Coast	Cook Shire	Olive River Pascoe River Stewart River Kennedy River Normanby River Endeavour River Annan River
Wet Tropical Coast	Douglas Shire Cairns City Johnstone Shire	Daintree River Mossman River Barron River Mulgrave River Johnstone River
Cardwell–Hinchinbrook Coast	Cardwell Shire Hinchinbrook Shire	Tully River Herbert River
Dry Tropical Coast	Thuringowa City Townsville City Burdekin Shire Bowen Shire	Ross River Haughton River Burdekin River Don River
Whitsunday Coast	Whitsunday Shire Mackay City Sarina Shire Broadsound Shire	O’Connell River Pioneer River
Capricorn Coast	Livingstone Shire Fitzroy Shire	Fitzroy River
Curtis Coast	Gladstone City Calliope Shire	Boyne River Calliope River
Wide Bay Coast (northern section)	Miriam Vale Shire Burnett Shire	Kolan River Burnett River

The nomination also notes that:

The area of this nomination contains many middens and other archaeological sites of Aboriginal or Torres Strait Islander origin. There are over 30 historic shipwrecks in the area, and on the islands there are ruins and operating lighthouses which are of cultural and historical significance.

The Great Barrier Reef was inscribed on the World Heritage List on the basis of its outstanding natural, cultural and historical features and its integrity as a self-perpetuating ecological system (Great Barrier Reef Marine Park Authority 1994). It satisfied all four of the natural heritage criteria, viz:

- an example of a major stage in the earth's evolutionary history,
- an outstanding example of geological processes, biological evolution and people's interaction with their natural environment,
- a place with unique, rare and superlative natural phenomena, and
- a place which provides habitats for rare and endangered species of plants and animals.

The inscription also recognises the area's cultural and historical significance, including the long-term presence of Aboriginal and Torres Strait Islander peoples and the presence of many archaeological sites and shipwrecks.

As management regimes for the World Heritage Area have progressively been put into place, the need for an increased understanding of and knowledge about the attributes and the outstanding universal value of the World Heritage property has become apparent. This has resulted in a number of recent investigations to document attributes and value. Key findings are presented below under the following headings:

- biophysical attributes,
- economic and financial values,
- cultural attributes,
- landscape and aesthetic attributes, and
- residential amenity attributes.

(i) Biophysical Attributes

The biophysical attributes of the Great Barrier Reef World Heritage Area have recently been assessed by Lucas et al. (1997). As part of this process, summary reports were prepared on the following natural heritage attributes of the World Heritage Area:

- algae,
- ascidians,
- birds,
- bryozoans,
- butterflies,
- crocodiles and terrestrial reptiles,
- crustaceans,
- echinoderms,
- fishes,
- flatworms,
- fringing reefs,
- geology and geomorphological aspects,
- geological aspects of continental islands,
- *Halimeda* banks,
- hard corals,
- mangroves,
- marine mammals,
- marine turtles,
- molluscs,
- octocorals,
- phytoplankton,
- polychaete worms,
- the Proserpine rock-wallaby,
- seagrasses,
- sea snakes,
- soft-bottom habitats,
- sponges, and
- terrestrial flora.

A summary of specific attributes under each of the above headings is provided in appendix 2. Collectively, the assessment draws the following conclusions about the biophysical attributes of the Great Barrier Reef World Heritage Area.

In so far as geological processes are concerned:

The Great Barrier Reef is the largest reef system the world has known, with 2904 coral reefs covering 20 055 km². Within this reef system are more than 300 coral islands and 600 continental islands, the latter comprised of mostly massive granites or silicic volcanics. The processes of geological evolution in this system are uniquely represented, linking islands, cays, reefs and changing sea levels, together with sand barriers, deltaic and associated dune systems. It is this interplay of all the coastal and marine geomorphological elements which give outstanding value to the Great Barrier Reef. The extraordinary size of the Great Barrier Reef and its morphological diversity capture a comprehensive record of past and ongoing processes in the development of coral reef and associated geomorphological systems. Major changes in sea level are recorded in the reef's structure and a total history of the reef's evolution is available. There are examples within the Great Barrier Reef of nearly all stages of reef development. Novel techniques have now yielded information about environmental conditions and processes extending back over many hundreds of years. There are also many less common formations including serpentine rocks of South Percy Island, intact and active dune systems, undisturbed tidal sediments providing an excellent record of Holocene sea level and vegetation changes and the exceptional examples of 'blue holes'. Great Barrier Reef *Halimeda* banks have been actively accumulating for up to 10 000 years. The extraordinary elevation range extends from sea level (sea-bed) to 1142 metres (Mt Bowen) and in addition to this elevation range for the terrestrial components, the cross-shelf extent provides the fullest possible representation of marine environmental processes within the reef system.

In so far as ecological and biological processes are concerned:

Within the reef system there is an extensive diversity of reef morphologies including deltaic, detached and dissected reefs. The high heterogeneity at a range of spatial scales gives rise to high habitat diversity with 359 species of hard corals recorded. Fringing reefs cover some 667 km² with most of this area adjacent to continental islands. The reefs contain some of the largest and oldest coral colonies with the genotype of some colonies suspected of being present on the reef for several thousand years. Inshore coral communities in southern regions may offer new insights into coral reef formation. The reef includes the most extensive actively accumulating *Halimeda* beds in the world.

Coastal seagrasses within the Great Barrier Reef occupy some 3000 km² and at least 2000 km² of deepwater seagrasses have recently been found. These seagrass beds provide outstanding examples of the ecological interaction between plants and animals including communities with numerous fish species, prawns and other animals including green turtles and dugongs.

Heterogeneity of the reef at various spatial scales provides an extensive range of habitats for the estimated 1500 species of fish found within the Great Barrier Reef. The Lizard Island region and Ribbon Reef shelf-break contain the major spawning ground in the world for the black marlin. Life histories of some species of fish demonstrate the connectivity of Great Barrier Reef habitats.

The Great Barrier Reef contains representatives from all marine phyla, for example algae, sponges, ascidians, echinoderms, fishes, polychaete worms, flatworms, corals, molluscs, crustaceans, marine mammals and bryozoans. It is clear that the combination of extensive latitudinal range and complete cross-shelf transect provides an outstanding example of ongoing ecological and evolutionary processes. Although much of the marine flora and fauna are shared within the Indo-Pacific Region, the state of preservation and prospects of survival, together with the scale, make the Great Barrier Reef unique.

There are some 2069 km² of mangroves in or directly adjacent to the Great Barrier Reef World Heritage Area and the presence of important trends at a range of spatial scales makes the Great Barrier Reef a prime location for research into mangrove ecology and evolution. Furthermore, mangrove habitats provide crucial nursery habitat for many fishes and crustaceans. The extraordinary richness of terrestrial flora within the Great Barrier Reef World Heritage Area and its distribution amongst a vast number of variable islands provides an outstanding example of the processes of dispersal, colonisation and establishment of plant communities within the context of island biogeography. So far, 2195 species of plants, some 25% of the total flora for Queensland, have been recorded from the continental islands. Many species occur at their latitudinal limits within the Great Barrier Reef and there are distinct latitudinal variations which display examples of evolutionary biogeography.

Terrestrial fauna also demonstrate ongoing ecological and biological processes including globally important breeding grounds for seabirds

as well as a rich but sparsely known fauna on continental islands. Important feeding grounds for international migratory species occur within or adjacent to the Great Barrier Reef World Heritage Area including extensive communities of shorebirds and breeding areas for the Torresian imperial pigeon. The role of this pigeon, and other birds, is crucial in the dispersal and establishment of much of the coral cay and continental island floras. The insect fauna is poorly known but despite limited studies, 30% of the Australian butterfly fauna has been recorded within the Great Barrier Reef (118 species) including some exceptional examples of overwintering aggregations by populations of *Tirumala hamata*. Island subpopulations appear to be showing evidence of recent speciation and there have been two endemic subspecies described.

In so far as natural habitats and biological diversity are concerned:

The Great Barrier Reef contains many outstanding examples of important and significant natural habitats for in situ conservation of biological diversity. Examples include fringing reefs which exhibit high species diversity and often high coral cover; fish species numbering around 1500 species in more than 130 families; 359 species of hard coral; 1500 species of sponges; 800 species of echinoderms; at least 5000 species of molluscs; at least 330 species of ascidian; between 300 and 500 species of bryozoans; an estimated 80 genera of octocorals; and high diversity in flatworms, crustaceans, polychaetes and algae. It is largely the extraordinary diversity of habitats, the product of latitudinal extent and cross-shelf completeness, which provides the Great Barrier Reef with the capacity to conserve such richness. The benthic flora is not constant across the soft-bottom areas of the Great Barrier Reef World Heritage Area, rather distinct zonation occurs, with a considerable increase in diversity occurring in mid-shelf regions due to the presence of 'natural isolates'.

The Great Barrier Reef is also a significant refuge for cetacean biodiversity with the Irrawaddy dolphin and the Indo-Pacific hump-backed dolphin unlikely to survive outside Australia. Apart from regionally important habitat for the dwarf minke whale, the Great Barrier Reef provides a breeding ground for the humpback whale and Longman's beaked whale, the rarest whale in the world, has also been recorded. Extensive seagrass beds provide important food resources for threatened dugongs, supporting 15% of the dugongs recorded within Australian waters. This species is classified as vulnerable

with poor long-term survival prospects outside Australia. The green turtle is also dependent on the seagrass beds. Six of the world's seven species of turtle are found in the Great Barrier Reef which contains globally important nesting and feeding grounds for the loggerhead, green, hawksbill and flatback turtles including one of the last significant breeding populations of the hawksbill turtle in the world, the largest green turtle breeding population in the world and 70% of the southern Pacific population of the loggerhead turtle.

Mangrove communities are amongst the richest in the world with 37 species recorded being 54% of the world diversity. Given this richness and combined with their protected status, the Great Barrier Reef mangroves are of exceptional value. The island vegetation communities include 79 rare or threatened species of plants and the least threatened remaining habitat of the endangered Proserpine rock-wallaby. Amongst the extensive breeding colonies of seabirds the Great Barrier Reef also contains populations of threatened species of birds including the roseate tern, the little tern and the vulnerable beach thick-knee. The internationally important Torresian imperial pigeon breeds in extensive colonies on Great Barrier Reef islands during its annual migration from Papua New Guinea.

Although the extensive biodiversity of the Great Barrier Reef marine and terrestrial flora and fauna contains few endemics, for many of the species there are few other locations in the world which provide secure in situ conservation.

The assessment also draws two other important conclusions. Firstly, the Great Barrier Reef World Heritage Area is in a relatively pristine state compared with other tropical coral reef ecosystems. Secondly, the size of the area means that a highly diverse suite of habitats and environmental regimes at a range of spatial scales are represented in the one World Heritage Area. The size and diversity of the Great Barrier Reef World Heritage Area underlies its 'outstanding universal value' – this value is a consequence of many attributes combining to produce a whole that cannot be reduced, without loss, to disconnected components.

(ii) Economic and Financial Values

Some of the economic and financial values of the Great Barrier Reef World Heritage Area have been assessed by Driml (1994). In this assessment, financial values are measures of the flows of dollars generated by human use of

resources through industries such as tourism and commercial fishing and expenditure on private recreation and research. Economic values generally include net financial values of commercial activities plus valued attributes of the natural environment which are not normally exchanged in the market place. They also recognise the costs of environmental damage often not accounted for in financial values.

A summary of the gross financial values generated by the World Heritage Area is provided in table 2.3.

In contrast to the biophysical attributes, it is possible to trace financial values back to particular parts of the World Heritage Area. For example, 95% of all current tourism use which operates under a permit occurs within 5% of the World Heritage Area in the offshore Cairns and Whitsunday areas (Vanderzee 1996).

It should also be noted that there are important flow-on multiplier effects of this expenditure. Driml (1994) has estimated that multipliers for the various sectors are:

- tourism – 1.7
- commercial fishing – 2.0
- recreational fishing and boating – 1.7

A recent study of the structure and economics of the marine tourism industry in the Cairns

Section of the Great Barrier Reef (Coopers and Lybrand 1996) has found that:

- total expenditure (direct plus indirect) is approaching \$650 million per annum, and
- marine tourism leads to an extensive amount of related expenditure in the areas of accommodation, shopping and travel – this is in the order of 1.75 times the amount spent on marine tourism specific activities.

Less work has been undertaken on determining economic values associated with uses and activities within the World Heritage Area. Most of the available measures are based upon estimates of consumers' surplus, i.e. the difference between what a person is willing to pay for a good or service, rather than go without it, and the lesser amount they usually have to pay.

Estimates of economic value provided in Driml (1994) are summarised in table 2.4.

The financial and economic values reported in Driml (1994) are primarily for 'direct compatible uses'. They do not include the financial and economic values associated with the development and operation of ports and harbours along the western boundary of the World Heritage Area. These include the major export ports at Gladstone, Hay Point, Mackay, Abbot Point, Townsville, Lucinda, Mourilyan, Cairns and Cape Flattery.

Table 2.3 Financial Values 1991–92

Direct Use	Description (for 1991–92)	Financial value \$ million
Tourism	2.2 million visitors	681
Commercial Fishing	Around 16 000 tonnes catch	128
Recreational fishing and boating	24 300 private boats	94
Research	Great Barrier Reef Marine Park Authority and AIMS	19
Total		923

Table 2.4 Economic Values

Use	Economic Value	Method of Calculation	Source
Tourism	\$23 million to \$357 million	Consumers' surplus	Hundloe et al. (1987)
Commercial Fishing	approx. \$31 million	Gross revenue minus costs of production	Driml (1994)
Recreational Fishing and Boating	\$52 million to \$124 million	Consumers' surplus	Blamey (1991)

An excellent overview of tourism use and visitation to the Great Barrier Reef World Heritage Area has recently been published as part of the Review of the Marine Tourism Industry (Tourism Review Steering Committee, 1997).

(iii) Cultural Attributes

It is only in relatively recent times that the cultural attributes associated with the Great Barrier Reef World Heritage Area have begun to be assessed. Smyth (1993a) points out that Aboriginal occupation of Australia predates the last substantial sea level rise which commenced about 20 000 years ago. Aboriginal people were therefore an integral part of the ecosystems which adapted to become the present coastal zone when sea levels stabilised at approximately their current levels about 6000 years ago.

There are parts of the Queensland coastline where distinctive Aboriginal coastal communities existed and depended almost entirely upon marine, island and coastal resources. Some of these communities engaged in extensive sea journeys between islands, between the mainland and islands and in pursuit of dugong, turtle and other marine resources. Even today, on Cape York Peninsula for example, Aboriginal and Torres Strait Islander people comprise the majority of the population and traditional subsistence uses of coastal resources are still practised.

However, as Smyth (1993a) points out:

Aboriginal and Torres Strait Islander utilisation of the coastal zone has always had more than an economic/subsistence value. Although there is considerable regional variation in Aboriginal social structure, language and mythological constructs across Australia, there are some important elements of the relationship between Aboriginal people and the coastal zone which are common to all regions.

Coastal landscapes and seascapes ('coastscares') are part of integrated cultural domains comprising defined, owned country (clan estates) to which small (usually patrilineal) descent groups belong, and from which they get their identity and customary right to exploit subsistence and other resources. The estates are integrated geographically in that boundaries embrace land, river, estuary, beach, reef, seabed and sea property. They are integrated sectorally in that traditional owners (descent group members) are responsible for the control of access to, and exploitation and allocation of, resources within those boundaries.

For Australia's indigenous coastal and island peoples, the relationship and sense of belonging to 'sea country' is as elemental as their affiliations with the land. Knowledge, use and occupation of 'sea countries', whether they are identified as 'home reefs and islands', or shoreline, nearshore or extended regional estate can be subtle and often elusive and enigmatic to outside observers.

The World Heritage Area is also of more recent cultural significance to non-indigenous Australians. The Great Barrier Reef has an

important place in the early discovery and exploration of Australia's east coast and there are about 30 shipwrecks of historic importance known to exist within the World Heritage Area. There are also a number of lighthouses of historical value, with their significance derived from circumstances associated with the people involved in their construction, their architecture and/or their particular methods of construction.

(iv) Landscape and Aesthetic Attributes

Landscape and aesthetic attributes of the World Heritage Area have been assessed in Lucas et al. (1997). This assessment is based largely on the following work commissioned by the Queensland Department of Environment:

- a visual landscape evaluation procedure and a trial of this procedure in the Whitsunday Region (Catherine Brouwer Landscape Architects and Chenoweth & Associates 1994b), and
- an overview of scenic resources of the Queensland coast (EDAW 1996).

In terms of landscape and aesthetic attributes:

The Great Barrier Reef provides some of the most spectacular scenery on earth and is of exceptional natural beauty. The vast extent of reef and island systems produces an unparalleled aerial vista. Individual islands range from towering forested continental islands of immense size and exceptional beauty (such as Hinchinbrook Island rising steeply from sandy beaches to 1000 metre peaks), to small coral cays clad in rainforest and peripatetic (mobile) unvegetated sand cays.

Fringing reefs have very high aesthetic values also. Within the marine fauna there is a huge diversity in fishes size, shape and colour which provides very special experiences for visitors to the underwater environments. The great diversity of marine life includes numerous conspicuous and colourful animals which collectively produce an extraordinary spectacle. There are many species and groups of organisms involved, including the polyclad turbellarians, the echinoderms, in particular the feather stars, fishes, hard corals, octocorals and bryozoans, particularly the lace corals.

Within the Great Barrier Reef the presence of humpback whales and other marine mammals provides an additional superlative natural phenomenon which is highly valued by people.

Concentrations of large fish such as the potato cod near Lizard Island and the megafauna at sites like the *Yongala* wreck, have demonstrated their singular value through the attraction of numerous international tourists as divers and snorkellers.

Significant aesthetic value is also derived from large breeding colonies of birds and great concentrations of overwintering butterflies. The variety of environments represented by the latitudinal and cross-shelf dimensions of the Great Barrier Reef ensures extraordinary variety in aesthetic appeal. There are many examples of rich variety in landscapes and seascapes within a small area, such as the Whitsunday Islands, which includes sweeping beaches and rugged mountains with dense and diverse vegetation and adjacent pristine fringing reefs. Extensive mangrove communities provide another example of exceptional natural beauty including the outstanding mangrove channels of Hinchinbrook Island. The vast and relatively unpopulated extent of the northern section of the Great Barrier Reef may be seen as the marine equivalent of the Serengeti Plains. Within this region there are also occurrences of spectacular wildlife including immense whale sharks.

The evaluation work undertaken in the Whitsunday Region by Catherine Brouwer Landscape Architects and Chenoweth & Associates (1994b) has for the first time provided a systematic and relatively detailed assessment of scenic quality within a regional context. An interesting CRC research project by Birtles and Valentine is exploring the underwater landscape elements which are valued by snorkellers and the Great Barrier Reef.

The Department of Environment has also recently commissioned a consultancy to assess all of the landscape values (including cultural values) for the coastal regions for which regional coastal management plans are currently being prepared.

(v) Residential Amenity Attributes

The residential amenity of the Australian coastline is a real, but relatively unexplored attribute. As the Resource Assessment Commission's Coastal Zone Inquiry found (Resource Assessment Commission 1993c):

The coastal zone has a special place in the lives of Australians. Most Australians want to live there and if they can't they want to take their holidays there. It contains diverse ecosystems

and a high proportion of Australia's industrial activity occurs in the zone. It is a priceless national resource.

The coastline of Queensland which abuts the World Heritage Area has a number of important attributes which give it special value for residential purposes. These attributes include:

- areas of high scenic quality,
- safe and sheltered beaches despite the hazards of marine stingers and estuarine crocodiles in northern areas,
- easy access to excellent diving and fishing sites,
- opportunities for interesting and relatively safe boating, and
- a more 'agreeable' climate than many inland areas.

Coastal Development Adjacent to the World Heritage Area

3.1 Introduction

The purpose of this chapter is to provide a brief overview of:

- current patterns of coastal urban development, and
- development trends and pressures.

This is achieved by way of regional overviews for each coastal management region which lead to a series of conclusions about the nature and location of urban use pressures which could potentially have impacts on the values of the Great Barrier Reef World Heritage Area.

3.2 Regional Overview

The coastal local governments adjacent to the World Heritage Areas contain:

- an estimated 1995 population of 538 760 (15% of the Queensland population),
- all but two of Queensland's major ports,
- the major areas of heavy industry in Queensland,
- approximately 16 000 hotel/motel rooms (some 37% of the Queensland total), and
- approximately 39 000 registered vessels (some 32% of the Queensland total).

Coastal centres adjacent to the World Heritage Area are amongst the fastest growing areas in Queensland. As a recent report on population and housing trends in Queensland notes (Queensland Department of Local Government and Planning 1996b):

One of the factors contributing to the State's growth pattern has been the rapid development of coastal centres associated with perceived

attractive lifestyles (e.g. the Gold and Sunshine Coasts and coastal areas in the Wide Bay-Burnett region), and the growth of areas focusing on tourism and recreation (e.g. Far North Queensland). It is believed that environmental and/or lifestyle factors are potentially as important as economic considerations in any decision to move into non-metropolitan regional centres.

An overview of the scale and character of existing urban development, together with notes on development trends and pressures, is presented in the balance of this section for each of the coastal management regions relevant to this project. This information is presented under the following headings:

- local government areas included,
- extent of region,
- population of local government areas,
- major population centres,
- smaller coastal settlements,
- extent of rural residential development,
- extent of industrial development,
- extent of port and harbour development,
- extent of tourist development, and development trends and pressures.

Maps of the coastline for each coastal region are located in appendix 4. These maps show local government boundaries and the principal areas of coastal urban development.

3.3 Conclusions

The analysis of coastal development trends and pressures is summarised in table 3.1. On a regional basis, taking all pressures into account, it is the Capricorn, Wide Bay and Wet Tropical Coast Management Regions which appear likely to come under the greatest urban development pressure over the next 10 years or so.

It has also been possible to identify geographical 'hot spots' where there are particular existing or emerging coastal management issues associated with coastal urban development. These areas and the nature of the issues are summarised in table 3.2.

Wide Bay Coast Overview (northern section only)

Local Government Areas	Burnett Shire and Miriam Vale Shire
Extent of Region (northern section)	From Woodgate in the south to Rodds Bay in the north – a distance of approximately 290 km
Population of Local Government Areas	1986: 14 488 1991: 17 480 1996: 23 939 % change 1986–1996 = 65% est. 2011: 41 410 % change 1996–2011 = 73%
Major Population Centres	Bargara
Smaller Coastal Settlements	Elliott Heads, Innes Park, Burnett Heads, Moore Park, Agnes Water, Seventeen Seventy and Turkey Beach
Rural Residential Development	Extensive areas of unoccupied rural residential development in Miriam Vale Shire
Industrial Development	There is no major industrial development along this section of coastline. There is a sugar mill at Bundaberg, with associated sugar refining and alcohol distilling industries.
Port and Harbour Development	The port of Bundaberg is located near the mouth of the Burnett River (but south of the World Heritage area). The principal commodities handled are raw sugar and petroleum products.
Tourist Development	The main tourist accommodation facilities are located in the Bargara area and at Seventeen Seventy/ Agnes Water. There are no major resort complexes, although there is a small tourist resort on Lady Elliot Island. Charter boats operate from Seventeen Seventy.
Development Trends and Pressures	• An area where rapid population growth is expected over the next decade. • Possible marina and associated tourist development at Burnett Heads. • Continued urban expansion along the coast between Burnett Heads and Elliott Heads. • Urban expansion at Moore Park. • Settlement of large numbers of vacant allotments around Seventeen Seventy/ Agnes Water and gradual 'urbanisation' of this area. • Some expansion of facilities at the port of Bundaberg.

Curtis Coast Overview

Local Government Areas	Calliope Shire and Gladstone City
Extent of Region	From Rodds Bay in the south to the mouth of the Fitzroy River in the north – a distance of approximately 120 km
Population of Local Government Areas	1986: 33 293 1991: 36 116 1996: 40 189 % change 1986–1996 = 20.7% est. 2011: 49 740 % change 1996–2011 = 23.8%
Major Population Centres	Gladstone and Tannum Sands
Smaller Coastal Settlements	–
Rural Residential Development	Relatively limited in coastal areas
Industrial Development	Major industries in Gladstone area between Yarwun and Boyne Island. These industries include an alumina refinery, an aluminium smelter, chemical plants, a cement clinker plant and a major coal fired power station.
Port and Harbour Development	Gladstone is one of Queensland’s major ports – the principal commodities handled are bauxite, alumina, coal, caustic soda and petroleum products. Associated with the port is a large marina and a range of marine service industries.
Tourist Development	The major tourist accommodation centre is Gladstone. There is a resort on Heron Island and there are several camping grounds on national park islands of the Capricorn–Bunker groups. Charter boats operate from Gladstone to the Capricorn–Bunker groups and the Swain Reefs.
Development Trends and Pressures	• Proposals for major industrial growth at Gladstone – possible oil shale mining processing plant, steel works, expansion of chemical plants, additional alumina refinery and nickel ore processing plant. • Plans for major port expansion. • Proposals for resort development on Curtis Island.

Capricorn Coast Overview

Local Government Areas	Fitzroy Shire, Livingstone Shire and Broadsound Shire
Extent of Region	From the mouth of the Fitzroy River in the south to Cape Palmerston National Park in the north – a distance of approximately 760 km.
Population of Local Government Areas	1986: 30 453 1991: 34 894 1996: 40 508 % change 1986–1996 = 33% est. 2011: 57 060 % change 1996–2011 = 40.9%
Major Population Centres	Emu Park and Yeppoon
Smaller Coastal Settlements	Broadmount, Keppel Sands, Byfield, St Lawrence, Carmila Beach and Clairview
Rural Residential Development	Relatively limited in coastal areas
Industrial Development	Mainly limited to marine service industries at locations such as Rosslyn Bay.
Port and Harbour Development	There is a small port at Port Alma at the mouth of the Fitzroy River. The principal commodities handled here are salt, petroleum products and fertiliser.
Tourist Development	The major tourist accommodation centres are located at Yeppoon and Emu Park. There are resorts on the coast north of Yeppoon and on Great Keppel Island. Charter boats operate from Rosslyn Bay to the Capricorn–Bunker groups and the Swain Reefs.
Development trends and Pressures	• Major coastal population growth is expected to continue in the Yeppoon–Emu Park area in Livingstone Shire. • There are proposals for development at Clairview.

Whitsunday Coast Overview

Local Government Areas	Sarina Shire, Mackay City and Whitsunday Shire
Extent of Region	From Cape Palmerston National Park in the south to Edgumbe Bay in the north – a distance of approximately 510 km
Population of Local Government Areas	1986: 76 128 1991: 83 131 1996: 94 658 % change 1986–1996 = 24.3% est. 2011: 116 360 % change 1996–2011 = 22.9%
Major Population Centres	Mackay, Sarina, Cannonvale and Airlie Beach
Smaller Coastal Settlements	Armstrong Beach, Sarina Beach, Grasstree, Half Tide, Shoal Point, Seaforth, Midge Point, Shute Harbour and Earlando
Rural Residential Development	Main areas are around Midge Point.
Industrial Development	Several sugar mills. Ethanol distillery at Sarina. Marine service industries at Airlie Beach and Shute Harbour.
Port and Harbour Development	Coal export port at Hay Point. Port facility at Mackay – principal commodities handled are raw sugar, refined sugar, fertiliser and petroleum products. A new small boat harbour is under construction at the port. Marinas/boat harbours for small craft are provided at Mackay, Shute Harbour, Airlie Beach, Hamilton Island.
Tourist Development	The islands of the Whitsunday, Lindeman and Cumberland groups are one of Queensland’s premier tourist destinations. The island resorts, camping areas and reefs are serviced mainly from Shute Harbour, Airlie Beach and Mackay. The Whitsunday Islands are a focal point for charter boats, pleasure cruises and ‘bare-boating’. Mainland accommodation is concentrated at Airlie Beach, Laguna Quays, Seaforth and Mackay.
Development trends are and Pressures	• An area where high levels of coastal development pressure expected over the next decade. • Expansion of port and coal loading facilities at Hay Point. • Major residential expansion at Midge Point. • Continued urban expansion and tourist development at Airlie Beach and Cannonvale. • Expansion of beach front settlements around Sarina. • Resort proposals at Woodwark Bay, Keswick Island and St Bees Island. • Proposed residential/resort development at Clarks Cove.

Dry Tropical Coast Overview

Local Government Areas	Bowen Shire, Burdekin Shire, Townsville City and Thuringowa City
Extent of Region	From Edgumbe Bay in the south to Crystal Creek in the north – a distance of approximately 420 km
Population of Local Government Areas	1986: 143 894 1991: 154 316 1996: 164 404 % change 1986–1996 = 14.2% est. 2011: 209 510 % change 1996–2011 = 27.4%
Major Population Centres	Bowen, Townsville, Ayr and Home Hill
Smaller Coastal Settlements	Alva Beach, Magnetic Island, Saunders Beach, Bushland Beach, Balgal, Cungulla
Rural Residential Development	Extensive areas of rural residential development occur in Thuringowa City along the coast north of Townsville.
Industrial Development	Development of major new zinc refinery south of Townsville. Nickel refinery at Yabulu. Extensive marine service industries. Sugar mills. Peak load power station.
Port and Harbour Development	Townsville is one of Queensland's major ports – principal commodities handled are sugar, molasses, nickel ore, lead products, other mineral concentrates, petroleum products and general cargo. The port includes a marina, small craft facilities and a full range of marine service industries. There is a small port and marina facilities at Bowen. A coal export port is located at Abbot Point.
Tourist Development	Tourist facilities in this region are mainly found at Townsville. It is a centre of tourist accommodation and an important embarkation point to offshore reefs and Magnetic Island. Bowen is a tourist destination with a more localised catchment.
Development trends and Pressures	• New port access and possible port-related future industrial development. • Urban development along the coastline north of Townsville. • Port expansion and reclamation at Townsville. • Continued development of smaller coastal communities. • Possible base load power station. • Major industrial site (3000 ha) has been designated at Woodstock, south-west of Townsville.

Cardwell–Hinchinbrook Coast Overview

Local Government Areas	Hinchinbrook Shire and Cardwell Shire
Extent of Region	From Crystal Creek in the south to the mouth of Wongaling Creek in the north – a distance of approximately 150 km
Population of Local Government Areas	1986: 23 362 1991: 23 853 1996: 24 610 % change 1986–1996 = 5.3% est. 2011: 25 690 % change 1996–2011 = 4.3%
Major Population Centres	–
Smaller Coastal Settlements	Forrest Beach, Halifax, Lucinda, Cardwell, Tully Heads, Hull Heads, Palm Island, Mission Beach (part)
Rural Residential Development	Minor amounts
Industrial Development	Sugar mills.
Port and Harbour Development	Bulk sugar terminal and loading facility at Lucinda.
Tourist Development	The major focus of mainland tourist accommodation and facilities is at Mission Beach. Other tourist facilities are located at Cardwell, Hull Heads and Halifax. Access to Hinchinbrook Island and the Hinchinbrook Channel is available at Cardwell. There are resorts on Dunk Island, Bedarra Island and Orpheus Island.
Development trends and Pressures	• Proposal for development of tourist accommodation and marina at Dungeness. • Development of integrated resort at Oyster Point (Cardwell). • Increased residential and tourist development at Forrest Beach. • Continued urban expansion and tourist development at Mission Beach.

Wet Tropical Coast Overview

Local Government Areas	Johnstone Shire, Cairns City and Douglas Shire
Extent of Region	From the mouth of Wongaling Creek in the south to the mouth of the Bloomfield River in the north – a distance of approximately 300 km
Population of Local Government Areas	1986: 103 171 1991: 118 542 1996: 142 867 % change 1986–1996 = 38.4% est. 2011: 192 220 % change 1996–2011 = 34.5%
Major Population Centres	Cairns, Innisfail, Mossman, Port Douglas, Mission Beach (part)
Smaller Coastal Settlements	Bingil Bay, Kurrimine Beach, Flying Fish Point, Bramston Beach, Yarrabah, Ellis Beach, Oak Beach, Cooya Beach, Wonga, Daintree, Cow Bay, Cape Tribulation, Ayton
Rural Residential Development	There are extensive areas of vacant subdivided land north of the Daintree River.
Industrial Development	Sugar Mills. Ship Building and repair services at Cairns. A full range of marine service industries at Cairns.
Port and Harbour Development	Cairns is one of Queensland's major ports – principal commodities handled are sugar, molasses, fertiliser and petroleum products. There is a naval base at Cairns. It is a major trawler base and a major base for tourist and charter vessels. There is a bulk sugar port at Mourilyan and mooring facilities for fishing and tourist vessels at Port Douglas and Innisfail.
Tourist Development	This section of the coastline adjacent to the World Heritage Area has the greatest concentration of tourist facilities. Key areas of tourist accommodation/facilities are found at Cairns, Mission Beach, Palm Cove and Port Douglas. There are resorts on Fitzroy and Green Islands. This region is a major embarkation point for trips to reefs and islands and fishing charters.
Development trends and Pressures	• Continued residential and tourism development along beaches north of Cairns. • Resort proposals at Cape Tribulation, Ella Bay and Garners Beach. • Major residential/resort development proposal at East Trinity at Cairns. • Cairns Port Authority City Port proposal. • Proposal for extension of electricity services north of the Daintree River. • Continued urban expansion and tourist development at Mission Beach and other smaller coastal settlements.

Cape York Peninsula Coast Overview

Local Government Areas	Cook Shire
Extent of Region	From the mouth of the Bloomfield River in the south to Cape York in the north – a distance of approximately 900 km
Population of Local Government Areas	1986: 6 996 1991: 7 489 1996: 8 020 % change 1986–1996 = 14.6% est. 2011: 8 090 % change 1996–2011 = 0.9%
Major Population Centres	Cooktown
Smaller Coastal Settlements	Hope Vale, Port Stewart, Lockhart River, Portland Roads and Captain Billy Landing
Rural Residential Development	None of any significance
Industrial Development	No major coastal industries.
Port and Harbour Development	Silica sand export facility at Cape Flattery. Community port at Quintell Beach. Small craft facilities in the Endeavour River at Cooktown. Trawler anchorage at Portland Roads.
Tourist Development	Main centre of tourist activity and accommodation is at Cooktown. Resorts at Lizard Island and at Cape York.
Development trends and Pressures	• Sealing of road to Cooktown – will lead to increased tourist activity. • Dredging of the mouth of the Endeavour River – will make Cooktown more accessible for tourist and charter vessels. • The Torres Strait Region does not have any urban development on the coastline adjacent to the Great Barrier Reef World Heritage Area.

Table 3.1 Overview of Development Pressures

Relative Magnitude of Pressures in Each Coastal Management Region								
Source of Urban Development Pressure	Wide Bay	Curtis	Capricorn	Whitsunday	Dry Tropical	Cardwell-Hinchinbrook	Wet Tropical	Cape York Peninsula
Expansion of major residential nodes	Moderate-High	Moderate	High	Moderate	Moderate	Low	High	Moderate
Expansion of smaller coastal communities	High	Low	Moderate-High	Moderate	Moderate-High	Moderate	High	Low-Moderate
Rural residential development and/or population growth	High	Low-Moderate	Low	High	Moderate	Low	Moderate	Low
Development of major industries	Low	High	Low	Low	High	Low	Low	Low
Port and harbour expansion	Low-Moderate	High	Low	Moderate	High	Low	Moderate-High	Low-Moderate
Growth and development of tourist facilities	Moderate	Moderate	Moderate-High	High	Moderate	Moderate-High	High	Moderate

Table 3.2 Geographical 'Hots Spots'

Location	Nature of Issues
Cooktown	• increased accessibility arising from sealing of road from Cairns • improvement of harbour due to dredging of river mouth
North of the Daintree River	• increased occupancy of vacant allotments, particularly if power supply provided
Port Douglas	• continued tourist development and increased pressures on adjacent reefs • proposed airstrip
Beaches north of Cairns	• continued residential and tourist development and effects on wetlands, visual amenity, water quality and quality of life • beach erosion
East Trinity	• environmental and visual effects of proposed major residential and tourist development • effects on Yarrabah community
Cairns	• increased tourist traffic to reefs and islands due to increased tourist development – environmental and social effects • latent capacity of commercial tourism operations based at Cairns • urban stormwater management and sewage plant outfalls
Mission Beach	• continued residential and tourist development and effects on visual amenity, water quality and quality of life • provision of sewerage treatment works • increased pressure on the Family Islands and displacement of traditional users
Cardwell	• managing impacts and flow-on effects of resort development • increasing visitor use pressures on Hinchinbrook Island, Goold Island and Hinchinbrook Channel
Beaches north of Townsville	• continued residential and rural residential development • effects on water quality, visual amenity and quality of life • provision of services
Townsville	• environmental management of heavy industries • port and industrial area expansion • extent of development and services on Magnetic Island • beach erosion • urban stormwater management and sewage treatment plant outfalls
South of Townsville	• management of coastal settlements at Phantom Springs and Cungulla
Whitsunday area	• continued residential and rural residential development • resort proposals at Woodwark Bay and Clarks Cove • sewage treatment plant outfalls • increasing visitor use pressures on Whitsunday Islands and fringing reefs • latent capacity of commercial tourism operators based in the Whitsunday area

Midge Point	• servicing of rural residential allotments • management of future population growth
Sarina area	• management of coastal State lands • moorings for fishing and other vessels • residential and tourist development of small coastal communities and effects on wetlands, visual amenity, water quality and quality of life
Yeppoon/Emu Park	• provision of services in coastal communities • continued residential and tourist development and effects on wetlands, visual amenity, water quality and quality of life • increasing visitor use pressures on Keppel Islands and Swain Reefs • provision of services
Gladstone	• environmental management of heavy industries • port and industrial area expansion • urban stormwater management • increasing visitor use pressures on islands and reefs of the Capricorn-Bunker groups
Seventeen Seventy/Agnes Water	• increased accessibility arising from sealing of access road • population growth on existing vacant allotments • provision of services • change of character as population grows

Activity – Impact Linkages

4.1 Introduction

There is evidence that coral reefs are under global threat and it has been estimated that around 70% of all the world's coral reefs are degraded in some way (Zann 1995). Given that the Great Barrier Reef is the largest coral reef complex in the world, it is not surprising that there is general community concern about the possible impacts of coastal urban development adjacent to the Great Barrier Reef World Heritage Area. This is reinforced by evidence of urban run-off and wastes leading to destruction of reefs in other parts of the world (see for example, Ferguson Wood and Johannes 1975; Kinsey 1987).

The potential impacts of urban development on coastal values has emerged in recent years as an important planning issue. This is evidenced by:

- the terms of reference of the 1993 Resource Assessment Commission Coastal Zone Inquiry,
- the findings of the State of the Marine Environment Report for Australia (Zann 1995),
- the findings of the 1996 Australian Bureau of Statistics Report on 'Australians and the Environment',
- the findings of the 1996 State of the Environment Report for Australia, and
- the findings of the recent Review of the Marine Tourism Industry in the Great Barrier Reef World Heritage Area (Tourism Review Steering Committee 1997).

The purpose of this chapter is to address potential impacts associated with coastal urban development and the associated management needs of the adjacent World Heritage Area. It does this by discussing:

- the full range of impacts that need to be considered,
- available evidence of impacts, and

- implications for decision-making processes connected with coastal urban development.

In view of the relative weights that were assigned to the study outputs by the Steering Committee, this chapter does not attempt to present a detailed analysis of potential impacts arising from coastal urban development. Its primary purpose is to provide, particularly for local government, an awareness of the full range of potential impacts that need to be considered in making decisions about coastal urban development.

4.2 Impacts that need to be Considered

In a nutshell, the coastal planning and management process is all about the allocation of scarce coastal resources amongst different, and sometimes competing interest groups. Urban development encompasses a broad 'church' of interest groups and is a legitimate use of the coastal zone.

However, in areas adjacent to the Great Barrier Reef World Heritage Area, decisions to allocate coastal resources for urban purposes should only be made in the light of relevant international obligations and intergovernmental agreements. Of particular note is:

- the need to protect World Heritage values – this requires knowledge of those values and the likely effects of urban development,
- the need for sustainability, taking into account all of its ecological, economic, social and cultural dimensions, and
- the need to apply the precautionary principle which involves:
 - dealing cautiously with uncertainty,
 - shifting the burden of proof onto development proponents,
 - ensuring that environmental wellbeing is given legitimate status, and
 - developing best practice techniques in the pursuit of management excellence.

The 'correct' allocation of coastal resources requires informed and prudent decision making. In the case of coastal urban development, this implies a need to take into account:

- both the positive and negative effects of development proposals,

- all of the various biological, physical, economic, cultural, social and amenity implications over both the short and the long term, and
- all of the secondary, indirect or downstream effects of planning and development decisions.

While there is a requirement under the World Heritage Convention that 'outstanding universal values' be protected, the way in which these values are often expressed makes it difficult for them to be adequately incorporated into local government planning schemes and development control processes. For example, the assessment of the outstanding universal value of the Great Barrier Reef World Heritage Area prepared by Lucas et al. (1997) classifies values on the basis of either:

- attributes which include a mixture of organisms and features,
- processes, or
- whole of system characteristics.

These are often difficult concepts to incorporate into traditional planning and decision-making processes. From the point of view of local government planning, there may be advantages in focusing on ecosystems as the mechanism for incorporating values and management needs into local government decision making. Ecosystems include consideration of ecological communities, physical environments, biological and physical processes and they can be mapped.

The Queensland Department of Environment has already prepared a draft report on coastal ecosystems of Queensland, their values and management needs (Saenger and Pitts 1997). Extracts from this draft report are included in appendix 3. Links between urban development activities and coastal ecosystems are illustrated in table 4.1. The information contained in table 4.1 is intended to be illustrative rather than definitive. Its main purpose is to show the diverse and sometimes complex interactions between coastal urban development and coastal ecosystems.

Recreational and commercial fishers are two stakeholder groups that have played a significant role in raising awareness of the potential impacts of coastal urban development on marine and estuarine habitats. These groups

have long argued that environmental degradation of fish habitats in Queensland has resulted from:

- fragmented responsibility for management of coastal resources, and
- the lack of overall strategic plans for natural resource conservation and management (Queensland Fisheries Management Authority 1996).

The 1993 State Government Inquiry into Recreational Fishing identified a number of key environmental issues that require attention. These include the following issues which are of direct relevance to coastal urban development:

- sewage discharge into aquatic environments,
- industrial and domestic run-off,
- loss of fishing amenity caused by jet skis, hovercraft and 4WD vehicles,
- loss of access to foreshores and waterways resulting from coastal development,
- siting of rubbish tips, and
- dredging and extraction of sand and gravel resources.

4.3 Evidence of Impacts

There has been no attempt to address the impacts of coastal urban development on the values of the World Heritage Area in any comprehensive or systematic manner. What does exist are:

- broad-scale assessments of total nutrient loadings over the Great Barrier Reef lagoon, and
- smaller, localised assessments of the impacts of some aspects of coastal urban development.

In so far as nutrient and sediment discharges into the Great Barrier Reef lagoon as a whole are concerned, Brodie (1995a) provides a summary of the latest findings. These show that:

- approximately 15 million tonnes of sediment, 77 thousand tonnes of nitrogen and 11 thousand tonnes of phosphorus are discharged by coastal rivers,
- the major sources of nutrients are grazing lands (80%) and areas under sugar cane (15%) – sewage discharges contribute approximately 1% of the overall flux,

Table 4.1 Changes to Coastal Ecosystems Arising from Urban Development

Nature of Change	Ecosystems Potentially Affected	Examples of Sources of Change
Changes in local drainage patterns and watershed levels	• Freshwater Streams and Stream Banks • Swamp Forests and Woodlands • Mangroves • Seagrass Beds • Shallow Channels • Saltmarshes • Ephemeral Lakes	• Dams, weirs or other structures which modify flow regimes of rivers and creeks • Modification of natural drainage channels (e.g. channelisation) • Filling of flood plains or wetlands • Gravel extraction • Piped drainage schemes • Vegetation removal which alters run-off rates
Changes in groundwater levels or quality	• Freshwater Streams and Stream Banks • Swamp Forests and Woodlands • Mangroves • Saltmarshes • Cays • Ephemeral and Dune Lakes	• Modification of natural drainage channels (e.g. channelisation) • Filling of flood plains or wetlands • Septic tank seepage • Piped drainage schemes • Vegetation removal which alters groundwater levels • Groundwater extraction for domestic purposes • Intrusion of saltwater
Changes in sediment deposition patterns or rates	• Freshwater Streams and Stream Banks • Mangroves • Saltmarshes • Seagrass Beds • Sandy Coasts • Fringing Reefs	• Construction of dams, weirs or other structures which modify sediment regimes • Foreshore development • Dredging and extractive operations • Clearing of stream banks
Changes in light levels due to increases in suspended solids or turbidity	• Seagrass Beds • Mangroves • Fringing Reefs • Freshwater Streams and Stream Banks	• Dredging and extraction operations • Roads, bridges and dams • Wastewater disposal • Foreshore development • Stormwater run-off
Changes to temperature regimes (thermal pollution)	• Soft Bottoms • Mudflats, Sandflats and Sandbars • Seagrass Beds • Rocky Foreshores • Mangroves • Freshwater Streams and Stream Banks • Fringing Reefs	• Power stations • Industrial cooling • Loss of Stream Bank vegetation

Changes to water quality, including nutrient and organic enrichment	• Soft Bottoms • Seagrass Beds • Rocky Foreshores • Mangroves • Freshwater Streams and Stream Banks • Fringing Reefs • Ephemeral and Dune Lakes	• Disposal of sewage and industrial effluent • Marine and recreational facilities • Disturbance of sediments • (e.g. dredging and extractive operations) • Stormwater run-off • Solid waste disposal sites • Roads, bridges and dams
Changes to salinity regimes	• Mangroves • Saltmarshes • Freshwater Streams and Stream Banks • Swamp Forests and Woodlands • Ephemeral Lakes and Dune Lakes • Rocky Foreshores	• Construction of dams, weirs and other structures which interfere with tidal levels, flood behaviour, flushing or mixing • Dredging and extractive operations • Foreshore developments • River improvement works • Stormwater run-off
Changes to tidal regimes/tidal drainage patterns	• Freshwater Streams and Stream Banks • Mangroves • Saltmarshes • Swamp Forests and Woodlands • Sandy Coasts • Mudflats, Sandflats and Sandbars • Shallow Channels • Rocky Foreshores	• Construction of dams, weirs, spits, retention walls and other structures which will influence/change natural tidal limits • Dredging and Extractive operations • Foreshore developments and reclamation • River improvement works • Clearing of intertidal vegetation
Changes in wave regimes	• Rocky Coasts • Mudflats, Sandflats and Sandbars • Sandy Coasts	• Breakwater construction • Seawalls
Changes in sand mobility	• Sandy Coasts • Seagrass Beds • Sandy Bottoms • Mudflats, Sandflats and Sandbars	• Vegetation clearance • Offroad vehicles • Recreational activities • Bait digging
Erosion due to increased currents and wave action	• Sandy Foreshores	• Breakwater construction • Channel re-alignment
Erosion due to increased rates of surface run-off	• Swamp Forests and Woodlands	• Catchment vegetation removal • Channelisation/piped drainage schemes
Wind erosion	• Sandy Coasts • Dune Lakes	• Foreshore development • Offroad vehicles • Access tracks

Physical disturbance of substrates or shorelines	• Mudflats, Sandflats and Sandbars • Seagrass Beds • Mangroves • Sandy Bottoms • Soft Bottoms • Rocky Foreshores • Fringing Reefs	• Offroad vehicles • Bait digging • Foreshore development • Recreational usage/access • Boat landing facilities • Dredging and extraction
Changes in vegetation cover	• Sandy Coasts • Non-tidal Wetlands • Tidal Wetlands • Headland/Bluffs	• Timber removal • Frequent firing • Foreshore development • Recreational usage/access • Filling of flood plains or wetlands
Changes in species composition and biodiversity	• Sandy Coasts • Non-tidal Wetlands • Tidal Wetlands • Headland/Bluffs • Fringing Reefs • Rocky Foreshores • Soft Bottoms • Sandy Bottoms	• Weed and pest introductions • Selective removal of target organisms • Timber removal • Frequent firing • Nutrient enrichment • Ballast water discharge
Changes to fire frequency and intensity	• Swamp Forest and Woodlands • Sandy Coasts • Headland/Bluffs • Mangroves	• Visitor access • Vegetation clearance

- urban lands contribute a small but significant proportion of sediment,
- discharge of sewage effluent associated with increasing coastal population is a significant local problem in some areas, and
- urban diffuse run-off from major coastal cities is a significant, but very localised problem.

In so far as localised assessments of impacts are concerned, there are a number of reasonably well documented case studies of both positive and negative impacts available. A cross-section of these case studies is provided below. It should be noted that there is a dearth of information on social and cultural impacts of coastal urban development. These case studies deal with:

- specific examples of actual and potential impacts resulting from specific residential/resort/marina projects,

- the construction of transport infrastructure across tidal wetlands,
- the effects of urban drainage works,
- the effects of reef blasting to allow small boat access to a coral cay,
- the cumulative water quality effects of urban development around an estuarine inlet, and
- the flow on effects of coastal tourism development which leads to increased visitor pressure on offshore reefs and islands.

Case Study 1: Assessment of Likely Effects of a Proposed Resort, Residential and Marina Development

Nature of Project: Proposed mixed resort, residential and marina proposal at Rainbow Harbour, Cairns

Source of Information: Queensland Department of Environment and Heritage (1992)

The Queensland Department of Environment and Heritage prepared an assessment of the likely positive and negative impacts of this proposed major development on the coastline north of Cairns.

Positive impacts include:

- the production of high quality residential land from generally poor quality cane land and the consequent reduction in farm impacts such as pesticide spraying, the harbouring of vermin and weeds, fertiliser run-off and cane burning;
- increased housing availability for local residents and an increase in the range of available residential lifestyles;
- increased availability of water-based recreational facilities and moorings which would be a safe haven for boats;
- improved beach access for residents of the district and visitors;
- improved availability of services and possibility of increased land value for nearby communities;
- possible replenishment of local beaches at no cost to the Council;
- the prospect of increased foreign exchange from tourists attracted by the development;
- stimulation of the local economy and creation of jobs;
- possible reduction in insect problems for Yorkeys Knob residents;
- possible reduced flooding in the immediate vicinity of the development due to improved drainage although regional flooding should be unaffected;
- stabilisation of the Richters Creek/Barron River system;
- replenishment of mangroves in the Yorkeys Creek system as a result of removal of existing tide gates;
- landscaping with native species may attract native fauna displaced by farming; and
- the development would be aesthetically pleasing to some individuals.

Negative impacts include:

- some marine habitat loss, including approximately 2 ha of mangroves, mainly at the mouth of Richters Creek;
- aesthetic loss to Holloways Beach users caused by construction of Richters Creek training walls on an unspoilt beachfront;
- beach replenishment and increased coastal sand transport may increase dredging requirements at other marinas in the short term, although the long-term average will be unaffected;
- loss of some terrestrial habitat including melaleuca wetlands, mainly at the harbour entrance;
- increased boating and road traffic at the mouth of Richters Creek;
- the location of another community near the approaches to Cairns Airport could increase pressures to modify flight operations;
- possible turbidity problems during maintenance and capital dredging operations;
- possible pollution from the marina; and
- loss of productive though fairly low quality cane land.

Case Study 2: Tidal Wetland at Eimeo, Pioneer Shire

Nature of Project: Construction of
causeway across a tidal
wetland

Source of Information: Tidal Wetlands
Information
System

The tidal inundation into the upper part of the wetland has been severely impeded by the construction of a large causeway across the wetland. In addition there has been quarrying of areas that formerly would have supported tidal marsh and some mangroves at both the northern and south-eastern ends of the wetland. The site at the northern end appears to have been turned into a lake for a hotel or tourist facility. In 1991 airphotos, about 20% of the remaining mangrove forests of the wetland appear to be dead from the alterations in tidal and freshwater inputs caused by these activities (E. Hegerl, airphoto interp.).

Human-induced alterations to drainage are on a sufficiently large scale that changes to soil chemistry could be expected to adversely impact on the entire wetlands system.

Case Study 3: Magazine Creek at Bowen

Nature of Project: Marina construction

Source of Information: Tidal Wetlands
Information
System

In recent years there have been major alterations to the mouth of the estuary due to the construction of a marina, a causeway and pipeline across the wetland, as well as from dredging a channel through the tidal flats into the marina. A channel also has been dredged along the south-east side of the wetland. A substantial mangrove area at the mouth of the estuary has been cleared, and patchy regrowth seems to be occurring. Upstream of the causeway, the limitation on tidal inundation caused by the construction of the causeway appears to have resulted in substantial

mangrove mortality in the higher (less frequently inundated) areas of mangrove forest.

While originally formed as part of the delta of the Don, human activities have drastically altered the drainage into and through this wetland.

Case Study 4: Drainage Waterways at Cairns

Nature of Project: Assessment of water
quality and fisheries
habitat values of urban
drainage channels

Source of Information: Queensland
Department of
Primary
Industries (1996)

Cairns is built on coastal lowlands that flood during heavy rainfall, particularly when flood rain coincides with high tides. A complex network of both natural and artificial waterways service the Cairns region.

Whilst drainage waterways are essential to prevent flooding of coastal development, fish and other aquatic life utilise the drainage waterways to disperse and as nursery and feeding habitat in the same manner as they would a creek.

Thirty species of fish and crustacea were collected and identified from the Cairns drainage waterways – seven commercial target species, nine recreational target species, eight bait species and three target aquarium species. Twenty different aquatic and riparian species, including thirteen of Queensland's 34 mangrove species, were identified.

Drainage waterways may be designed and maintained in a way that takes into account fisheries values as well as the need to reduce flooding, minimise mosquito breeding and retain water quality.

Mosquito control is a major issue that concerns the community. Potential disease carrying insects require some form of control. Many freshwater fish species actually prey on mosquito larvae and so act as a natural form of mosquito control.

Best Practice Guidelines for the maintenance of the Cairns drainage waterways have been formulated by researching existing clearing practices and technical and ecological assessment of the Cairns drainage waterways. Best practice recommendations include:

- the protection and creation of vegetated waterway buffer zones
- drainage waterway maintenance timing and techniques that are mindful of the fisheries values of the waterways
- design and layout of drainage waterways and surrounding development to decrease dredging requirements
- the rehabilitation and careful monitoring of drainage waterways.

Case Study 5:

Beach Erosion on Heron Island

Nature of Project: Construction of boat harbour at Heron Island

Source of Information: Jell and Flood (1978)

The initial blasting (ca. 1945) of a gap in the reef rim to allow small boats access to the island during low tide periods. This gap was adjacent to the wreck which was positioned at this time. The gap allowed ebbing tidal currents passing around the island to be channelled in the direction of the gap rather than radially out over the reef rim. The increased velocity of the redirected tidal currents, which now moved across the area of the sand spit adjacent to the western beach, produced erosion on the spit and beach.

The management of the tourist resort attempted to protect their buildings by constructing a vertical faced retaining wall along the eroding sector of the beach. The alignment of the wall reflects waves approaching the island from the northwest or northeast and enhances the erosive capacity of such waves. This promotes erosion in the areas adjacent to the end of the wall. When erosion continued, extensions were made to the wall

during 1964–65. These extensions caused further realignment of the beach.

In 1966 a channel was dredged into the reef rim and reef flat to provide boat harbour facilities for the island. During the dredging the reef was subjected to severe cyclonic activity (cyclone Dinah, February 1967) which caused infilling of the dredged area and other undocumented readjustments to the beach and sediment distribution patterns on the adjacent reef flat. Redredging of the silted harbour occurred in 1967, and the spoil was placed within the beach zone on the southwestern corner of the island forming a base for the helipad, which was built in 1968.

Sediment was prevented from entering the harbour by walls which were constructed around it approximately one metre above the level of the reef flat, nevertheless, erosion and readjustment of the beach continued, and the helipad was endangered. More retaining walls were constructed.

The harbour walls were breached and flattened during the cyclone season of 1971. Tidal currents and cyclone Emily (April 1972) produced marked changes to the beaches by infilling the boat harbour through these breaches with sediment derived from the reef flat and beach.

The boat harbour was redredged in 1972 and the spoil (approximately 20 000 m³) placed near the northwestern beach, the area that had suffered erosion since the early 1950s. This artificially formed beach and spit experienced reorientation and migration by westward movement of sand along the beach. This sediment was able to re-enter the boat harbour through the gaps in the walls, which had not been fixed after the dredging operation. During the cyclone season of 1976 (cyclone David, January 1976) the harbour became once again sediment filled. The mound of spoil from the 1972 dredging had been totally removed by this time. Recently attempts have been made to block the gaps in the harbour walls.

Case Study 6:

Water Quality Trinity Inlet, Cairns

Nature of Project: Monitoring of water quality

Source of Information: Trinity Inlet Management Program (1996)

Over the past two and a half years, Trinity Inlet has been the subject of one of the most intensive investigations of inshore water quality and tidal movements undertaken for any regional centre in Australia.

Sewage effluent discharge is a major nutrient source for Trinity Inlet as it flows regardless of river flows or the state of the tide, and is the major source of both nitrogen and phosphorus in a dry year. The discharge of sewage effluent accounts for 50 to 78 per cent of the total phosphorus load in any year and from 26 to 58 per cent of the nitrogen load in wet and dry years respectively.

Information was also obtained on licensed point-source discharges to Trinity Inlet from industrial premises. The composition of these discharges was found to be similar to that of stormwater draining from streets and other hard surfaces in industrial areas. Hence, the addition of nutrients from industrial sources is considered minor when compared to that from sewage treatment plants.

The treatment plant outfalls are in a poorly flushed section of the Inlet and monitoring has now revealed the symptoms of a classic eutrophic system. Chlorophyll measurements show phytoplankton concentrations to be continuously high, nutrient concentrations are very high, while dissolved oxygen concentrations are low near the bottom of the Inlet and the benthic communities are reduced in diversity.

The Woree plant has recently been upgraded and the Edmonton plant is currently being upgraded to improve the quality of the effluent and to enable better control of effluent standards.

Case Study 7:

Impact of Tourist Pontoons on Fish Assemblages

Nature of Project: Assessment of impacts of pontoons on Agincourt and Kelso Reefs

Source of Information: Sweatman (1996)

For many tourists, observing schools of fish is an important part of the day's visit, whether it be watching the fish naturally in the water while snorkelling or diving or controlled feeding activity from the boat or pontoon. Many Reef managers have been concerned about the impacts this feeding might have on the natural regime of reefs. Concerns include possible depletion of aggregating species from other sections of the Reef and a concentration of feeding activity (and thus impact on other species) around tourist pontoons. Monitoring programs for tourist pontoons have been put in place by Reef managers based on the assumption that one or both of these impacts were occurring. For example, monitoring programs often require that fish census be taken at pontoon sites with aggregations and at control sites without aggregations.

The project has shown however, that such a monitoring system based on 'presumed change' may be inappropriate. Both these species, and many others that are found in aggregations around pontoons, naturally form aggregations at particular sites on reefs or at least spend the day time within a restricted area.

Regarding the second assumed impact of increased predatory effort around the tourist pontoons, the project has, through observation of fish behaviour and analysis of densities of likely prey, determined that this impact is minimal, probably of no consequence. Certainly for red bass, predation on natural prey is very limited. A comparatively significant but still very small subset of the spangled emperor aggregations did feed on their natural prey. The impacts of this predation are not readily detectable within the bounds of the methods available.

4.4 Implications for Coastal Urban Development

The investigation of activity–impact linkages has revealed a number of implications for the way in which information on potential impacts is incorporated into decision-making processes that affect coastal urban development. It is suggested that:

- there should be a greater awareness of coastal values and management needs on the basis of different ecosystem types,
- management needs for different ecosystem types be incorporated into planning schemes and decision-making processes,
- greater attention be given to the social, cultural and amenity implications of coastal urban development,
- greater emphasis be placed on identifying and documenting the secondary, indirect

and downstream effects of coastal urban development,

- greater resources be allocated to the monitoring of impacts resulting from coastal urban development – the important point is made by Lucas et al. (1997) that the concept of monitoring lies at the very root of the World Heritage Convention, and
- greater emphasis be placed on the assessment and documentation of cumulative impacts associated with coastal urban development.

It is also important to recognise that actions aimed at protecting the World Heritage Area must be incorporated into both planning and management. Ecologically sustainable outcomes will only be achieved if appropriate management systems and ‘good’ planning decisions co-exist across all spheres of government.

Mechanisms for Avoiding or Managing Impacts on the World Heritage Area

5.1 Introduction

Protection of values associated with the Great Barrier Reef World Heritage Area is primarily a function of sound planning and management that is able:

- to tackle the sources as well as the symptoms of pressures arising from coastal urban development,
- to consider ecosystems, processes and inter-relationships, and cumulative effects
- to cross jurisdictional boundaries, and
- to integrate the various natural, cultural, social and economic dimensions of coastal zone management.

The purpose of this chapter is to provide a concise overview of government and non-government roles and activities as they relate to the planning and management of coastal urban development in Queensland. It does this by considering:

- the roles and activities of government agencies,
- the roles and activities of non-government organisations, and
- integrated approaches to management.

5.2 Roles and Activities of Government Agencies

(i) Commonwealth Government

Since this study was initiated there have been a number of changes to the Commonwealth's coastal program. *Coasts and Clean Seas*, a major component of the Natural Heritage

Trust, sets the direction for Commonwealth activities in the coastal and marine environment. *Coasts and Clean Seas* is designed to help tackle coastal and marine pollution problems, threats to marine biodiversity and habitat degradation, and to promote sustainable use of Australia's coastal and marine areas, including estuarine areas.

Funding of \$125 million will be contributed over five years commencing in 1996–97.

Programs supported through *Coasts and Clean Seas* include:

- Coastal and Marine Planning Program – a grants program targeted at Local and State Government to increase the coverage of and support for quality coastal and marine planning. Through quality planning CMPP aims to improve the management of potential and/or existing pressures causing negative environmental impacts, and reduce conflict between uses of coastal and marine resources.
- Clean Seas Program – this grants program aims to reduce pollution from and the impact of waste water, including stormwater, from coastal cities and towns, and to reduce pollution of coastal and marine environments from other sources such as maritime and industrial activities.
- Coastcare – this program will continue to provide resources to the community to deal with local coastal problems.
- *Coasts and Clean Seas* is complemented by other Natural Heritage Trust programs, particularly the National Rivercare Program, the National Landcare Program, the national Vegetation Initiative and the National Wetlands Program.

The Commonwealth Government's activities and responsibilities relevant to coastal urban development are summarised in table 5.1 below under the headings of international treaties and conventions, legislation, programs and activities, and direct management involvement.

The Commonwealth Government, through the Great Barrier Reef Marine Park Authority, is involved in a number of activities to address the impacts of coastal urban development on the values of the Great Barrier Reef World Heritage Area.

These activities include:

- the documentation of the values of the Great Barrier Reef World Heritage Area,
- the management of tourist activity within the Great Barrier Reef Marine Park,
- the funding of research by agencies such as GBRMPA, AIMS and the CRC Reef Research Centre,
- the monitoring of impacts,
- the preparation of guidelines (e.g. for marinas, moorings, use of wastewater, coastal tourism development, etc.),
- the provision of information to local government and other organisations,
- helping to achieve a more integrated approach to coastal zone management.

(ii) Queensland Government

The main Queensland government agencies with interests in coastal urban development are listed in table 5.2, together with an overview of principal legislation and main areas of responsibility.

Until recently, there has been no single Queensland government agency with an overall responsibility for coastal management. With the passing of the Coastal Protection and Management Act in 1995, this responsibility now rests with the Department of Environment. The Department is currently preparing a State coastal management plan and in the Great Barrier Reef World Heritage Area has commenced work on regional coastal management plans for:

- the Cardwell–Hinchinbrook Coast,
- the Wide Bay Coast,
- the Wet Tropical Coast, and
- the Curtis Coast.

Preparation of these plans is involving consultation with all key stakeholders and in particular local government. When completed, they will become subordinate legislation and there is a requirement under section 46 of the Act that local government planning schemes are to be consistent with regional coastal plans.

The regional coastal planning process is acting as an important catalyst to bring together State government agencies and local governments to discuss and resolve coastal management issues.

However, the consultation undertaken as part of this current project has revealed a lack of knowledge and understanding of individual State Government agency policies and practices that affect coastal planning and management. This was particularly evident at the Local Government level.

Collectively, Queensland government agencies are involved in a wide range of activities which are addressing the impacts of coastal urban development. These activities include:

- the preparation of State and regional coastal management plans,
- the preparation of regional plans for areas such as Cape York Peninsula, Far North Queensland and the Wide Bay Region,
- the approval of local government planning schemes,
- the licensing of environmentally relevant activities involving discharges to rivers and coastal waters,
- the general protection of environmental quality,
- the preparation of an Environmental Protection Policy for water quality,
- developing terms of reference for and overseeing impact assessment studies,
- developing environmental policies and guidelines (e.g. for ports, re-use of wastewaters, acid sulphate soils and stormwater management),
- coordinating and facilitating Landcare and Coastcare programs,
- undertaking State of Environment reporting (including State of the Coastal Zone) at a State-wide scale,
- the preparation of industrial land studies (e.g. at Gladstone and Townsville),
- the management of tourism in Queensland marine parks,
- the management of works below high water mark,
- monitoring population growth and trends in growth,
- monitoring water quality and other impacts, and
- assisting local governments in areas such as wastewater treatment.

Table 5.1 Summary of Commonwealth Government Interests Relevant to Coastal Urban Development

Role	Specific Responsibilities
International Treaties and Conventions	• Convention on Wetlands of International Importance (Ramsar Convention) • Convention for the Protection of the World Cultural and Natural Heritage • Japan–Australia Migratory Birds Agreement (JAMBA) • China–Australia Migratory Birds Agreement (CAMBA) • USSR–Australia Migratory Birds Agreement
Legislation	• <i>Australian Heritage Commission Act 1975</i> • <i>Endangered Species Protection Act 1992</i> • <i>Environment Protection (Impact of Proposals) Act 1974</i> • <i>Great Barrier Reef Marine Park Act 1975</i> • <i>Native Title Act 1993</i> • <i>World Heritage Properties Conservation Act 1983</i> • <i>Aboriginal and Torres Strait Islander Heritage Protection Act 1984</i>
Programs and Activities	• <i>Coasts and Clean Seas</i> –Coastal and Marine Planning Program –Clean Seas Program –Coastcare –Marine Species Protection Program –Introduced Marine Pests Program –Coastal Resource Atlas (for combating oil spills) –Fisheries Action Program –Oceans Policy development –Marine Protected Areas Program –Capacity Building –Monitoring Program –Australian Coastal Atlas (electronic interactive atlas) • Other Natural Heritage Trust programs –Bushcare: the National Vegetation Initiative –National Landcare Program –National Rivercare Program –Endangered Species Program –National Wetlands Program –Waterwatch Australia • Commonwealth Greenhouse Measures –Australian Greenhouse Office –Cities For Climate Protection –Commonwealth Greenhouse Challenge –Household Greenhouse Action Program –Energy Performance Codes and Standards for Housing and Commercial Buildings • Environmental Impact Assessment • State of the Marine Environment and State of the Environment Reporting • Collaborative Australian Protected Areas Dataset (CAPAD) • Environmental Resources Information Network (ERIN) • National Marine Information System • GBRMPA Research and Monitoring Program • CRC Reef Research

Strategies	• Cape York Peninsula Land Use Strategy (jointly with Queensland Government) • National Water Quality Management Strategy • Strategic Plan for the Great Barrier Reef World Heritage Area
Direct Management Involvement	• Great Barrier Reef Region • Great Barrier Reef World Heritage Area • Commonwealth properties (e.g. Military Reserves and facilities)

(iii) Local Governments

Local governments in Queensland are responsible for:

- the planning and management of urban development on freehold and leasehold lands,
- the provision and operation of infrastructure for the collection, treatment and disposal of wastewaters from urban areas,
- the disposal of solid wastes,
- recreational use of foreshores, and
- elements of water quality management and beach protection by way of delegated powers under the Environmental Protection Act and the Beach Protection Act.

Local governments therefore have a crucial role to play in ensuring that coastal urban development does not place the values of the Great Barrier Reef World Heritage Area at risk. As part of this project, special attention has been given to activities being undertaken by local government in relation to planning, management and impact minimisation. A summary of some of these key activities is provided below.

In so far as planning is concerned, most of the local governments adjacent to the World Heritage Area are in the process of preparing new planning schemes. Typically, these new planning schemes:

- have a greater environmental focus than earlier schemes and are based much more on the performance-based approach to planning,

- aim to consolidate existing areas of coastal urban development rather than open up new areas of the coast,
- generally aim to limit and better manage rural residential development in coastal areas,
- contain references to ESD and the protection of coastal values in strategic plan aims and objectives,
- incorporate provisions for beach protection and coastal buffer zones, and
- are tending to use Development Control Plans in innovative ways to address issues associated with coastal urban development.

Some typical examples of ways in which planning schemes are being used to address the impacts of coastal urban development are provided in table 5.3.

While there are some obvious advances in the way that planning schemes are addressing potential impacts on coastal resource values, there is also evidence that planning studies being undertaken as part of planning scheme reviews are not considering coastal values and issues in as much depth as they probably should. It is common for planning studies to focus considerable attention on terrestrial resources and values without attempting to document the values of estuarine and marine resources that could potentially be affected by coastal urban development.

The investigation of local government planning schemes and their implementation has also revealed that the ESD principles embodied in planning scheme aims and objectives are rarely

translated into plan implementation in any structured or systematic way. This is not meant to be a criticism of local government. It merely reflects the difficulty of delivering ESD principles at the local level and identifies an area where local government would benefit from support and assistance.

In so far as the collection, treatment and disposal of wastewaters from urban areas is concerned, the investigations undertaken as part of this project have revealed an awareness across local government of the need to improve the standards of sewage treatment, to look at alternative methods of waste disposal and to address issues of stormwater.

A number of local governments are upgrading sewerage treatment works, others are investigating options for land-based disposal of effluent and some are preparing and implementing broad wastewater management strategies. The main issues raised by local government during the course of this study were:

- the need for more information on alternative methods of treated wastewater disposal,
- the need for more information on the use of artificial wetlands for removing nutrients from stormwater run-off,
- the need for guidelines which have been specifically developed for climatic conditions found in north and far north Queensland, and
- the need for financial assistance to upgrade wastewater treatment systems to a standard that is compatible with the World Heritage status of the receiving waters.

There is also evidence of local governments taking a more pro-active approach to the management of foreshore reserves under their control. This is largely being done by way of management plans which are being prepared in consultation with local communities. Examples include:

- the Management Plan for the Nelly Bay Habitat Reserve and Foreshore Management Plans prepared by the Townsville City Council, and
- the Esplanade management plan prepared by the Cairns City Council.

While there are quite a few examples of excellent initiatives by individual local governments, there is little evidence of any consistent or coordinated approach across coastal local governments as a whole. It is evident from discussions held during the course of this project that:

- by and large, local governments do not perceive coastal management as being a core business function,
- planners and engineers in coastal local governments are under heavy workloads and unable to devote the time that they would like to coastal planning issues,
- most local governments do not have access to specialist professional advice on coastal matters,
- there are few opportunities for local government staff to meet together and with Queensland government agencies to discuss coastal planning issues and experiences, and
- most local governments are unclear about the various legislations, jurisdictions, responsibilities and policies which currently apply to coastal planning and management in Queensland.

(iv) Government-owned Corporations

The major government-owned corporations which are of relevance to this study are the Ports Corporation of Queensland and the Port Authorities at Cairns, Townsville, Mackay and Gladstone. They all operate major port facilities.

Over the past decade, there has been a major shift in environmental awareness amongst Port Authorities and major commitments of resources towards best practice environmental management. This is reflected in:

- the environmental inputs that are being integrated into the preparation of development strategies and land use plans,
- greatly increased levels of baseline environmental monitoring,
- participation in the development of the Environmental Policy for Queensland Ports, and
- the preparation of environmental management systems.

Table 5.2 Summary of Queensland Government Agencies and Responsibilities

Agency	Principal Legislation	Key Responsibilities
Dept of Local Government and Planning	• Local Government Act • Local Government (Planning and Environment) Act • Integrated Resort Development Act • Integrated Planning Act	• State Planning Policies • Regional Planning • Approval of Town Planning Schemes • Assistance with water supply and sewerage services
Dept of Environment	• Coastal Protection and Management Act • Environmental Protection Act • Nature Conservation Act • Marine Parks Act • Beach Protection Act • State Development and Public Works Organization Act (s. 29)	• Protection and management of the coast • Protection of water quality • Licensing of environmentally relevant activities • Protection of native flora and fauna • Management of protected areas • Planning and management of Queensland marine parks • Management of erosion prone areas • Approval of structures below high water mark • Impact assessment • Preparation of Environmental Protection Policies • Education and interpretation
Dept of Natural Resources	• Land Act • Water Resources Act	• Land and seabed tenures • Integrated catchment management • Landcare • River management
Dept of Transport and Main Roads	• Transport Infrastructure Act • Transport Operations (Marine Pollution) Act • Transport Planning and Co-ordination Act	• Government-owned ports and boat harbours • Integrated transport planning • Operation of vessels
Dept of Primary Industries, Fisheries and Forestry	• Fisheries Act	• Protection of fisheries habitat • Protection of marine plants
Dept of Economic Development and Trade		• Regional industrial development • Planning for and facilitation of major projects
Dept of Premier and Cabinet	• Aboriginal Land Act	• Native Title
Dept of Tourism, Small Business and Industry		• State Tourism Strategy • State Ecotourism Strategy • Regional tourism development

Increasingly, Port Authorities are working together with local governments and Queensland government agencies to address issues associated with coastal urban development. Examples include:

- the involvement of the Cairns Port Authority in the Trinity Inlet Management Program,
- the involvement of the Townsville Port Authority in a stormwater discharge study,
- the involvement of the Mackay Port Authority in the preparation of a management plan for conservation areas adjacent to the port, and
- the involvement of the Gladstone Port Authority in the Curtis Coast Resources Study.

Similar changes can also be observed in the operations of providers (both public and private) of utilities such as electricity, telecommunications and gas.

5.3 Roles and Activities of Non-government Organisations

There are several non-government organisations which are increasingly becoming more involved in managing the impacts of coastal urban development of the values of the Great Barrier Reef World Heritage Area. These organisations include:

- urban Landcare groups which are active in Cairns and Townsville,
- the marine tourism industry which has an active involvement in:
 - the Reef Tourism 2005 project,
 - the monitoring of impacts on reefs,
 - the direct management of areas such as the Low Isles,
 - industry training, and
 - local conservation groups which play an important role in raising community awareness.

There is welcome evidence of a trend towards the development of partnerships between government and non-government agencies. This is having the effect of raising community awareness and providing greater resources for activities such as monitoring.

5.4 Integrated Approaches to Management

The Commonwealth Coastal Zone Inquiry Final Report states that the two major problems inhibiting sustainable use of the coastal zone are:

- fragmented management arrangements based on single issues or sectors, and
- the tyranny of small decisions, whereby over time a number of decisions that in themselves are not significant accumulate and interact to result in a significant impact on the coastal zone.

While the investigations undertaken as part of this study generally confirm this view, they have also shown that there are some good examples of integrated coastal planning in operation along the Queensland coastline adjacent to the Great Barrier Reef World Heritage Area. Several of these examples are listed in table 5.4

There is certainly a case to suggest that greater levels of integration across sectors and agencies is required. What this preliminary study has shown, is that such integration is feasible and achievable provided that:

- the will exists,
- there is a likelihood of improved outcomes,
- resources are provided, and
- there are people to drive the process.

Of particular interest to local government is the expected passage through Parliament of the Integrated Planning Act in early 1998. The purpose of this new planning legislation is to achieve ecological sustainability in the following three ways:

- coordinating and integrating local, regional and State level planning;
- managing the process by which development occurs; and
- managing the effects of development on the environment (including the use of premises).

Amongst other things, the new legislation is intended:

- to provide a more efficient and accountable integrated development assessment system (IDAS),

- to provide greater flexibility in the preparation of planning schemes, and
- to improve opportunities for public consultation.

The new legislation appears to offer important opportunities for local governments to better plan and manage coastal urban development. There is, however, a major learning process required to determine how the new legislation and its associated planning instruments can best be utilised.

5.5 Conclusions

The major conclusions that can be drawn from this overview of governance and management are that:

- despite some excellent initiatives, there is no overall, consistent and coordinated approach to the management of impacts arising from coastal urban development adjacent to the Great Barrier Reef World Heritage Area,
- local governments do not perceive coastal management as being a core business function,
- planning studies that are undertaken as part of planning scheme reviews do not consider coastal values and issues in as much depth as they probably should,
- nearly all coastal local governments adjacent to the World Heritage Area are in various stages of planning scheme reviews,
- the new generation of planning schemes that are emerging have a much greater environmental focus (albeit mainly land-based) and much more of a performance-based approach to planning,
- references to ESD and the protection of coastal values are relatively common in planning scheme aims and objectives, but are rarely translated into plan implementation in any structured or systematic way,
- there is a need for environmental management guidelines (e.g. for treated wastewater disposal and stormwater management) which are specifically tailored for local climatic and environmental conditions,
- there are some good examples of the use of Development Control Plans to address coastal management issues,
- planners in coastal local governments are under heavy workloads and unable to devote the time that they would like to coastal planning issues,
- most local governments do not have access to specialist professional advice on coastal matters,
- most local governments are unclear about the various legislations, jurisdictions, responsibilities and policies which currently apply to coastal planning and management in Queensland,
- there are few opportunities for local government staff to meet together and with Commonwealth and State agency staff to discuss common issues and experiences,
- it is possible to develop successful integrated and partnership approaches to issues arising from coastal urban development provided that the will exists, there is a likelihood of improved outcomes, resources are provided and there are people to drive the process, and
- the issue of coastal urban development and the value of the Great Barrier Reef World Heritage Area is an area of considerable Commonwealth government interest and responsibility – this includes the responsibility that the Commonwealth has to monitor the condition of the World Heritage property as required under the World Heritage Convention.

Table 5.3 Examples of Planning Scheme Initiatives

Component of Planning Scheme	Examples of Approaches to Address Impacts of Urban Development on Coastal Resources and Values	Local Government
Planning Scheme Aims and Objectives	'To provide for and facilitate the protection, management and rehabilitation of the coast, its ecosystems, land forms, natural processes and intrinsic and heritage values.'	Cook Shire
	'To ensure the protection and proper management of the Shire's coastline and encourage environmental responsibility in the use of the coastal area.'	Burnett Shire
General Scheme Provisions	'In particular, Council shall seek to ensure that draining, filling or excavation does not cause changes to groundwater and surface water regimes which may impact on wetland habitats, waters of the Great Barrier Reef, riverine systems and World Heritage Areas'.	Cook Shire
	'The preferred use of lands in Erosion Prone Areas is that it will be left in a natural state or used for low intensity activity...the only uses permissible will be in accordance with the Beach Protection Authority requirements for the protection of coastal areas.'	Thuringowa City
Development Control Plans	The Mission Beach Coastal Area Development Control Plan	Johnstone Shire and Cardwell Shire
	The Development Control Plan for the Cairns Central Swamp Area	Cairns City
	The Development Control Plan for the Mon Repos Beach Area	Burnett Shire
Local Planning Policies	Local Planning Policy for the Provision of Foreshore Parks and Esplanades	Burnett Shire
	Local Planning Policy for Beachfront and Hinterland Development – Coastal Land Use Study	Thuringowa City
Performance Criteria	'Development on coastal headlands and foreshores should not be apparent from beaches, offshore islands or at any point along the coast at the water's edge.'	Johnstone Shire and Cardwell Shire
	'In areas of potentially acid sulphate soils, proponents of development will be required to document the extent and severity of the problem and develop a strategy for either management or treatment or both'.	Cardwell Shire

Table 5.4 Examples of Integrated Approaches

Scale	Nature of Management Instrument	Principal Partners
State-wide	Coastal Memorandum of Understanding (Coastal MOU)	Commonwealth Government Queensland Government Local Government Association
	Integration of ICM initiatives into local government planning schemes	Dept of Local Government and Planning Local Government Association Dept of Natural Resources
	State Coastal Management Plan	Dept of Environment Coastal local governments Community groups Industry Other Queensland government departments GBRMPA
Regional	25 Year Strategic Plan for the Great Barrier Reef World Heritage Area	Commonwealth Government Queensland Government Coastal local governments Industry
	Joint preparation of the Wide Bay Coast Regional Management Plan and the Wide Bay 2020 Regional Planning Study	Dept of Local Government and Planning Dept of Environment Community groups Industry Other Queensland government agencies
	Curtis Coast Resources Study	Dept of Environment Gladstone Port Authority Gladstone City Council Calliope Shire Council
	Reef Tourism 2005 – A Strategy for the Sustainable Development of the Far North Queensland Marine Tourism Industry	Marine Tourism Industry GBRMPA Dept of Environment\Local Governments CRC Reef Research Centre FNQ Regional Development Network
	Regional Coastal Management Plans	Dept of Environment Other State government agencies GBRMPA Community groups Industry Port Authorities

Local	Trinity Inlet Management Program	Cairns City Council Cairns Port Authority Dept of Environment Dept of Primary Industries Dept of Transport
	Development Control Plan for the Mission Beach Coastal Area	Johnstone Shire Cardwell Shire Community groups
	Management Plan for Conservation Areas at the Port of Mackay	Mackay Port Authority Mackay City Council Dept of Natural Resources Dept of Environment Local conservation groups
	Broadsound and Sarina Coastal and State Lands Management Strategy	Dept of Natural Resources Dept of Environment Sarina Shire Broadsound Shire Traditional owners Local community groups

Findings and Recommendations

6.1 Introduction

The purpose of this chapter is to put forward a range of specific funding proposals that would materially help in reducing and managing the impacts of coastal urban development on the Great Barrier Reef World Heritage Area. It does this by:

- identifying priority issue areas that have emerged from this investigation, and
- recommending specific projects that are aimed at addressing these priority areas.

In the recommendation of specific projects, the consultants have been mindful of:

- the need to identify projects that will have application across more than one local government area,
- the desirability of projects that are interdisciplinary in nature and/or cross traditional jurisdictional boundaries,
- the need for projects to provide tangible outcomes that will be of practical benefit, particularly to local governments, and
- the desirability of projects that build upon areas of local enthusiasm and interest and/or value-add to work already done.

The consultants have also attempted to identify projects that are consistent with the goals and objectives of Commonwealth environment policies.

6.2 Priority Issues

The following 12 issue areas have emerged as being of high priority:

- Greater awareness and integration of coastal values in the preparation and review of planning schemes.
- A greater emphasis on urban catchment management.
- Delivery of ESD principles at the local level via town planning schemes and development control processes.
- Improved information for local government on values, issues, policies and legislation.

- Improved procedures and mechanisms for the systematic and objective monitoring and assessment of the impacts of coastal urban development.
- Improved management of coastal State lands.
- The availability of specialised coastal planning and management expertise and training for local government
- Improved networking and communication between Commonwealth government, State government, local government, industry and community groups involved in issues of coastal planning and management.
- Mechanisms for the involvement of traditional owners.
- Development of best practice guidelines for use by local government and the development industry.
- Upgrading of levels of wastewater treatment.
- A review of issues associated with small boat harbours.

Specific projects which are recommended within each of these issue areas are listed in table 6.1. In identifying specific projects, preference has been given to projects for which there is already local enthusiasm and interest and where there is the capacity to build upon, and add value to, work which is already under way. There is also an emphasis on projects which provide information to and raise awareness amongst coastal local governments. Most importantly, all the projects are practical, workable and aimed at achieving improved outcomes across jurisdictional boundaries.

It should be noted that several other important issues were raised during the course of this project. However, they have not been included as 'priority issues' in this report because they are already receiving considerable attention under existing programs. Such issues include:

- acid sulphate soils,
- matters relating to the storage of hazardous substances which are being addressed under the Environmental Protection Act,
- the impacts of boat moorings,
- the environmental management of ports, and
- Environmental Management Systems in general.

Table 6.1 Recommended Projects

Issue Area	Comments and Criteria for Project Selection	Recommended Projects
1 Awareness and integration of coastal values	There is evidence that coastal values are not adequately addressed in local government planning studies which provide the basis for the development of local government planning schemes. A suitable project would involve: • one or more local governments who are about to review their planning schemes, and • a section of coastline where there is good knowledge of coastal resources and values.	1.1 Expansion of planning studies for the review of the Gladstone City and Calliope Shire Planning Schemes
2 Urban catchment management	Issues of urban catchment management are poorly researched and funded in comparison to rural catchment management. A suitable project would involve: • a major urban area where there is already interest in urban catchment management, • local interest and resources that could drive the project, • a catchment of rapid residential and/or industrial development.	2.1 Development of an Integrated Catchment Management Strategy for the Cleveland Bay catchment at Townsville which is a designated dugong sanctuary
3 Local delivery of ESD principles via local government planning schemes	Planning schemes typically talk of ESD principles and the protection of coastal values, but do not translate these aims into consistent and implementable performance standards and criteria. A suitable project would involve the taking of existing guidelines and developing them into model provisions that could be incorporated into planning schemes.	3.1 Opportunities under new Integrated Planning Act 3.2 Preparation of model planning scheme provisions for: • the protection of valued coastal ecosystems, • the protection of coastal landscapes and visual amenity, and • achieving sustainable coastal tourism • protection of the adjacent GBRWHA
4 Improved information	The Resource and Assessment Commission found that coastal managers were suffering from a lack of core information at the local scale (Brown and Burke 1995). Similar conclusions have been drawn in this preliminary study. A suitable project would involve: • collating management-related information from different sources, • presenting it to coastal managers in a readily usable and accessible format.	4.1 Development of the point source discharge database 4.2 Development of a coastal planners governance manual 4.3 Further development and distribution of the Tidal Wetlands Information System
5 Monitoring and assessment of impacts	While State-of-Environment reporting is proceeding at a regional scale, there are few systematic mechanisms in place to monitor the condition of environmental and social conditions at the local level. A suitable project would involve: • an area where there is good background information and known pressures on local environments,	5.1 Community-based monitoring of performance indicators

	• an area where there are established response mechanisms that are able to take necessary management actions. Monitoring the condition of the World Heritage Property is an obligation under the World Heritage Convention.	5.2 Local State of Environment reporting
6 Coastal State land management	Coastal State lands are a valuable community resource. The management of these lands has arisen as an issue during this study. A suitable project would involve: • a section of the coastline with State lands that are under pressure, • local governments and communities that are keen to address and resolve management issues.	6.1 Implementation of the Broadsound and Sarina Coastal and Islands State Lands Management Strategy
7 Specialised resourcing and training	Local governments are suffering from a lack of specialised expertise in coastal planning and management. A suitable project would involve: • the availability of specialist coastal planning and management expertise to assist with real-world planning involving more than one local government, • the development of a broadly based training tool to raise awareness and understanding of issues across all levels of local government.	7.1 Provision of coastal planning resource officer to work within the study team for the Wide Bay 2020 Regional Planning Study 7.2 Modification of the International Year of the Reef Internet education program to provide a learning and training package for local government
8 Networking	Communication and networking amongst coastal planners and managers was seen as a major need across Australia by Brown and Burke (1995). A similar situation was observed in Queensland during this study. A suitable project would involve: • improved communications channels, • better exchange of ideas and information.	8.1 Development of a coastal 'planners' network
9 Involvement of traditional owners	There are no mechanisms in place to ensure that the views of traditional owners are adequately integrated into decision making regarding coastal urban development. A suitable project would involve: • the identification of key interest groups, • the investigation of ways in which views can best be obtained and taken into account, • determining how the process could be best managed.	9.1 Processes for involving traditional owners in decision making about coastal urban development
10 Best Practice Guidelines	There are numerous guidelines being produced which address issues associated with coastal urban development. This study has found a need to modify generic guidelines for application in tropical and subtropical Queensland and to look at ways of ensuring that existing guidelines are implemented. A suitable project would involve:	10.1 Erosion and sediment control guidelines 10.2 Stormwater management guidelines 10.3 Guidelines for irrigation with treated sewage effluent

	• the development of guidelines which address key issues in the local context, • taking actions to ensure that existing guidelines are implemented.	10.4 Implementation of Marine Tourism Industry Code of Practice
11 Upgrading of wastewater sewage treatment processes	While local governments are aware of the need to upgrade sewage treatment plants, they are subject to severe financial constraints. There is a need for additional information on the most cost-effective means of upgrading existing plants and potential methods of financing. A suitable project would involve the preparation of a summary information package.	11.1 Information package on options for upgrading treatment plants
12 Provision and management of small boat harbours	This preliminary study has identified a number of issues associated with the supply and management of small boat harbours along the coastline adjacent to the Great Barrier Reef World Heritage Area. A suitable project would involve: • an assessment of demand and supply factors, • the incidence of illegal moorings, • the identification of major management issues.	12.1 Review of issues associated with the provision of small boat harbours

6.3 Recommended Projects

In total, 20 specific projects are recommended. Some of these have separate component parts. Collectively they embrace:

- issues in particular geographical areas,
- issues which are common across a number of local government areas,
- issues of governance and coordination,
- issues of capacity building and networking, and
- issues associated with the problems of cumulative impacts of urban development.

Information on each of the recommended projects is presented on the following pages under the headings of:

- issue area,
- project title,
- brief description,
- justification,

- outline scope of work,
- partners and beneficiaries,
- method of implementation,
- approximate cost (indicative only at this stage), and
- relevance to Commonwealth coastal objectives

It is important to appreciate that while the nominated projects are quite specific in nature, they also represent important types of projects. It is therefore quite reasonable and foreseeable that other specific projects of a similar type, perhaps in different geographical areas, could also legitimately be nominated for funding in addition to or in place of the projects recommended in this report. In many respects, the recommended projects can legitimately be regarded as demonstration projects that have the potential for broader application. This also highlights the need for projects to be evaluated.

Issue 1

Awareness and Integration of Coastal Values

Project 1.1

Expansion of Planning Studies for Gladstone City and Calliope Shire Planning Scheme Reviews

Project: The purpose of this project is to provide a model of how local government should include consideration of coastal values as part of planning studies leading to the review of their planning schemes.

Justification:

- the planning study is a key input into the development and review of planning schemes
- coastal values should be given due weight in this process
- Gladstone City and Calliope Shire are about to embark on reviews of their planning schemes
- a joint planning study would be desirable
- the Curtis Coast Resources Study provides an excellent body of background information

Outline Scope of Work:

- agreement between Gladstone City and Calliope Shire to prepare a joint planning study that is expanded in scope to include consideration of coastal values
- review of available information with limited additional fieldwork where necessary
- documentation of coastal values and management needs
- incorporation of this information into joint planning study
- derive implications for coastal urban development

Note: The outputs from this project should also feed into the strategic and land use planning for the Gladstone Port Authority.

Partners and Beneficiaries (*lead agency or agencies in bold*):

Gladstone City, Calliope Shire, Gladstone Port Authority, Great Barrier Reef Marine Park Authority

Method of Implementation:

Probably via consultants

Approximate Costs:

\$30 000 to be added to the base cost of the planning studies

Relevance to Commonwealth Coastal Objectives:

- promotion of an ecosystem and integrated approach to management
- conservation of natural and cultural values
- policy and program coordination
- promotion of world heritage management approaches

Issue 2

Urban Catchment Management

Project 2.1

ICM Strategy for the Cleveland Bay Catchment

Project: The purpose of this project is to work towards the preparation of an integrated catchment management strategy for the Cleveland Bay catchment at Townsville.

Justification:

- in terms of funding and resources, urban catchment management has traditionally been a 'poor cousin' to rural catchment management
- there are issues of urban development, water quality and land management in the Townsville area and development pressures are increasing
- there is already work under way but in a relatively uncoordinated fashion
- there is considerable interest and professional expertise available
- adjacency of recently declared dugong sanctuary

Outline Scope of Work:

Stage 1

- review existing projects under way by government, industry, research and community groups
- identify the values of Cleveland Bay and drainage elements, including World Heritage values
- identify key issues
- develop program objectives
- prepare a coordinated action plan

Stage 2

- implementation and evaluation

Partners and Beneficiaries (*lead agency or agencies in bold*):

DoE, DNR, TPA, DoT, Townsville City, Thuringowa City, GBRMPA, Landcare and ICM groups, Users of Cleveland Bay, other local governments with regional coastal centres

Method of Implementation:

Stage 1: Consultant or contract staff for 3–4 months

Stage 2: To be determined

Approximate Costs:

Stage 1: \$40 000

Stage 2: To be determined

Relevance to Commonwealth Coastal Objectives:

- promotion of an ecosystem and integrated approach to management
- pollution avoidance and control
- encouraging community understanding and awareness
- policy and program coordination
- addresses relationship between land-based activities and dugong protection area

Issue 3

Local Delivery of ESD Principles via Local Government Planning Schemes

Project 3.1

Opportunities under the New Integrated Planning Act

Project: New planning legislation is to come into effect in Queensland in early 1998. The purpose of this project is to explore opportunities under the Integrated Planning Act for the delivery of sustainable coastal outcomes associated with coastal urban development.

Justification:

- current planning legislation and planning schemes in Queensland have not made it easy for local governments to specifically address many of the issues associated with coastal urban development
- the new Integrated Planning Act does not specify the structure or contents of local government Planning Schemes and therefore may provide some flexibility for new and innovative approaches based on performance-based plans
- the new Integrated Development Approvals System (IDAS) may also provide opportunities for more integrated and performance-based approaches to coastal urban development

Outline Scope of Work:

- identify key planning and management issues associated with coastal urban development and sustainability
- identify which of these issues are able to be addressed under the Integrated Planning Act
- identify and evaluate possible planning instruments and mechanisms that could potentially be used to address these issues
- prepare a draft and final strategy on how issues of coastal urban development and sustainability might be addressed under planning schemes, integrated development approval or other provisions of the Integrated Planning Act

Partners and Beneficiaries (*lead agency or agencies in bold*):

Local Government Association, all coastal local governments, Dept of Local Government and Planning, Great Barrier Reef Marine Park Authority

Method of Implementation:

Contract staff or consultant

Approximate Costs:

\$35 000

Relevance to Commonwealth Coastal Objectives:

- conservation of natural and cultural coastal values
- implementation of the National Strategy for Ecologically Sustainable Development
- policy and program coordination

Issue 3

Local Delivery of ESD Principles via Local Government Planning Schemes

Project 3.2

Preparation of Model Planning Scheme Provisions

Project: The purpose of this project is to prepare model provisions which will allow various coastal management guidelines for ecosystem protection, landscape and visual amenity protection, and sustainable tourism development to be incorporated into planning schemes. Specific guidelines to be targeted are:

- protection of coastal ecosystems (Dept of Environment),
- protection of landscape and visual amenity (Dept of Environment),
- sustainable tourism development (Dept of the Environment, Sport and Territories).

Justification:

- planning schemes typically refer to ESD principles in protection of coastal values in a general sense in their aims and objectives
- these aims and objectives are rarely translated into implementable performance standards/criteria or linked to management needs
- there are some good guidelines available which address issues of ecosystem protection, landscape and visual amenity protection, and sustainable tourism development
- there is a need for these guidelines to be incorporated into statutory planning instruments

Outline Scope of Work:

For each selected guideline:

- review guidelines
- assess options for incorporating them into statutory planning and management instruments
- undertake consultation with local government and the development industry
- select preferred option and develop model provisions
- seek comment on model provisions
- circulate model provisions and explanatory documentation to local governments

Partners and Beneficiaries (*lead agency or agencies in bold*):

Department of Local Government and Planning, all coastal local governments, Dept of Environment, development industry, Great Barrier Reef Marine Park Authority

Method of Implementation:

Contract staff or consultant

Approximate Costs:

\$40 000 for each guideline plus additional costs for consultation

Relevance to Commonwealth Coastal Objectives:

- Conservation of natural and cultural coastal values
- implementation of the National Strategy for Ecologically Sustainable Development
- policy and program coordination

Issue 4

Improved Information

Project 4.1

Development of Point Source Discharge Database

Project: Point source discharges need to be licensed under the Environmental Protection Act. There is a requirement under section 213 of this Act that a register of licences be kept. The purpose of this project is to develop that register as an easily accessible information system.

Justification:

- point source discharges may have important impacts on coastal resources and values
- although these discharges are licensed and a register is kept, it is difficult to extract information for particular catchments, local government areas, sections of coastline or types of industries/discharges
- this type of information is necessary for good coastal planning and the assessment of cumulative impacts

Outline Scope of Work:

- review types and amount of information to be included in database
- investigate likely information requests and consult with end users
- consider database options and design of information system
- design information system
- acquire software and hardware
- set up and test database
- undertake operator training
- plan for ongoing evaluation and maintenance

Partners and Beneficiaries (*lead agency or agencies in bold*):

Dept of Environment, all coastal local governments, community groups, Great Barrier Reef Marine Park Authority

Method of Implementation:

Contract staff or consultant

Approximate Costs:

\$120 000

Relevance to Commonwealth Coastal Objectives:

- pollution avoidance and control
- information base to support decision making
- encouraging community understanding and awareness

Issue 4

Improved Information

Project 4.2

Development of Coastal Planners Governance Manual

Project: The purpose of this project is to develop a concise manual of legislation, jurisdictions, policies, obligations, guidelines, responsibilities and contacts relating to coastal planning and management in Queensland.

Justification:

- coastal zone governance is a complex and dynamic business
- local government in particular is of the view that they are unable to keep abreast of the situation
- there is a need for a single source book which can act as an easy reference manual to local government councillors and staff

Outline Scope of Work:

- discuss format and contents with local government and other interested groups
- agree on manual structure and contents
- assemble background material
- prepare initial draft
- circulate for comment and discussion, including workshops
- prepare final manual
- publish and circulate
- make arrangements for updating

Partners and Beneficiaries (*lead agency or agencies in bold*):

Queensland Local Government Association, all coastal local governments and commonwealth government agencies, community groups, industry, Great Barrier Reef Marine Park Authority

Method of Implementation:

Contract staff or consultant

Approximate Costs:

\$60 000

Relevance to Commonwealth Coastal Objectives:

- information base to support decision making
- encouraging community understanding and awareness
- policy and program coordination

Issue 4

Improved Information

Project 4.3

Further Development and Distribution of Tidal Wetlands Information System

Project: The purpose of this project is to make the contents of the Tidal Wetlands Information System (TWIS) available to local government and other interested parties. TWIS is a joint initiative of the Department of Environment and the Australian Marine Conservation Society (AMCS).

Justification:

- TWIS is a comprehensive management information system which is being developed jointly by the Department of Environment and the Australian Marine Conservation Society
- Data input is nearly complete, but the information is not generally available to local governments

Outline Scope of Work:

- Review format and contents of existing system
- complete data entry and validation
- copy database and query system to CD-ROM
- produce operating manual
- distribute (sell?) CD-ROM to local governments and other interested parties
- provide backup technical support

Partners and Beneficiaries (*lead agency or agencies in bold*):

Dept of Environment, AMCS, all coastal local governments, port authorities, community groups, industry, Great Barrier Reef Marine Park Authority

Method of Implementation:

Contract staff

Approximate Costs:

\$120 000 (excluding backup technical support)

Relevance to Commonwealth Coastal Objectives:

- conservation of natural and cultural values
- information base to support decision making
- encouraging community understanding and awareness

Issue 5

Monitoring and Assessment of Impacts

Project 5.1

Community-based Monitoring of Performance Indicators

Project: The purpose of this project is to develop and trial a community-based program for the monitoring of sustainability performance indicators at Trinity Inlet near Cairns.

Justification:

- the Trinity Inlet Management Program has been in operation for approximately 5½ years – it has been documented as an important case study in integrated coastal planning at the local level
- the Management Plan which underpins the Program is currently the subject of a major review as provided for under the Trinity Inlet Management Agreement. As part of this review, a State of Trinity Inlet report has been produced
- one of the tasks being undertaken during the review, is the development of specific performance indicators to help measure the extent to which the Plans Over-riding Principle of Management is being achieved – the over-riding principle is 'the maintenance of Trinity Inlet as an ecologically viable and sustainable ecosystem'
- following the Plan review, a monitoring program will need to be undertaken to measure the performance indicators
- in keeping with the consultative nature of the Trinity Inlet Management Program, there is an excellent case for involving the local community in this monitoring program

Outline Scope of Work:

Stage 1 – Design community-based monitoring program

- identify indicators which could feasibly be monitored by community groups
- identify community groups willing and able to participate
- develop monitoring strategies
- develop monitoring programs (to include sites, sampling strategies, measurement techniques, quality control, analysis, data management and reporting)
- identify agency support roles, costs and protocols

Stage 2 – Monitoring trial

- enter into agreements/protocols
- provide resource materials, training and equipment
- undertake trial program for 6 months
- evaluate results

Partners and Beneficiaries (*lead agency or agencies in bold*):

Trinity Inlet management agencies via the **Technical Committee**, community groups, GBRMPA, other local and State government agencies

Method of Implementation:

Consultant or contract staff

Community groups

Approximate Costs:

Stage 1: \$30 000

Stage 2: say \$50 000, but could vary depending on equipment and other costs

Relevance to Commonwealth Coastal Objectives:

- promoting an ecosystem and integrated approach to management
- conservation of natural and cultural values
- information base to support decision making
- encouraging community understanding and awareness
- implementation of the National Strategy for Ecologically Sustainable Development

Issue 5

Monitoring and Assessment of Impacts

Project 5.2

Local State-of-Environment Reporting

Project: To provide basic baseline environmental information for local coastal areas which are undergoing, or are about to undergo, rapid urban development. This will provide an extremely useful database for the assessment of development projects and for the assessment of cumulative impacts. Potential sites for local State-of-Environment reporting include both major urban areas such as the Cairns region and smaller settlements such as Cooktown, Yeppoon/Emu Park and Seventeen Seventy/Agnes Water.

Justification:

- there is often little baseline marine and coastal information for coastal settlements which are the subject of urban development pressures
- there is a tendency of development to be assessed on a project-by-project basis, often with little knowledge and understanding of existing environmental conditions and capacities
- local State-of-Environment reporting can provide essential background information and provide a benchmark for ongoing monitoring and cumulative impact assessment

Outline Scope of Work:

- identify development pressures
- review and document existing information
- establish objectives
- determine variables to be measured and evaluation criteria
- prepare program (e.g. sampling sites, sampling strategy, variables to be measured, methods of analysis, data management, quality control, reporting)
- allocate responsibilities and arrange measuring equipment
- implement program
- evaluation

Partners and Beneficiaries (*lead agency or agencies in bold*):

Local governments, Dept of Environment, Great Barrier Reef Marine Park Authority, local communities

Method of Implementation:

Consultant or contract staff, volunteers, local government staff

Approximate Costs:

\$100 000 per local area

Relevance to Commonwealth Coastal Objectives:

- promoting an ecosystem and integrated approach to management
- conservation of natural and cultural values
- information base to support decision making
- encouraging community understanding and awareness

Issue 6

Coastal State Land Management

Project 6.1

Implementation of the Broadsound and Sarina Coastal and Islands State Lands Management Strategy

Project: The purpose of this project is to assist with the implementation of the Broadsound and Sarina Coastal and Islands State Lands Management Strategy. The Strategy has been prepared as a cooperative endeavour by State government agencies, local governments and key stakeholder groups.

Justification:

- residential development, public access and boating access have generated a range of resource management issues on a range of State coastal lands under a variety of tenures
- State government agencies, local government and interest groups have jointly prepared a broad land use strategy
- there is an urgent need for more detailed planning to progress the implementation of the strategy
- the issues here are typical of those found in other coastal areas of Queensland

Outline Scope of Work:

- review strategy
- identify additional planning needs and priorities
- proceed with key planning tasks in consultation with all government and non-government stakeholders
- undertake consultation
- prepare specific action programs

Partners and Beneficiaries(lead agency or agencies in bold):

Dept of Natural Resources, Broadsound Shire, Sarina Shire, traditional owners, community groups, other coastal local governments, Great Barrier Reef Marine Park Authority

Method of Implementation:

Consultants or contract staff

Approximate Costs:

\$75 000

Relevance to Commonwealth Coastal Objectives:

- promoting an ecosystem and integrated approach to management
- conservation of natural and cultural values
- encouraging community understanding and awareness
- policy and program coordination
- involvement of traditional owners

Issue 7

Specialised Resourcing and Training

Project 7.1

Wide Bay 2020 Regional Planning Study

Project: The purpose of this project is to ensure that coastal values and issues are integrated into the local government planning arena via the Wide Bay 2020 Regional Planning Study.

Justification:

- the regional planning study is now under way
- it will provide the blueprint for local government strategic planning in the region
- preparation of the regional coastal management plan is occurring in parallel
- there is a need for coastal planning expertise on the regional planning team to ensure that information from the regional coastal plan is properly integrated and able to flow through to implementation by local government

Outline Scope of Work:

- act as a liaison person between the regional coastal study, the regional planning study and individual local governments
- provide a source of coastal planning expertise to local governments and the regional planning team during the course of the study
- help raise the awareness of local government to coastal values and issues associated with urban development

Partners and Beneficiaries (*lead agency or agencies in bold*):

Local Government Association, Dept of Local Government and Planning, coastal local governments within the Region, Great Barrier Reef Marine Park Authority

Method of Implementation:

Contract staff

Approximate Costs:

\$100 000 over 18 months

Relevance to Commonwealth Coastal Objectives:

- promoting an ecosystem and integrated approach to management
- conservation of natural and cultural values
- encouraging community understanding and awareness
- policy and program coordination

Issue 7

Specialised Resourcing and Training

Project 7.2

International Year of the Reef Training Package

Project: To provide an interactive, computer-based training package based on the Reef educational program being developed as part of the International Year of the Reef by the Coral Reef Research Institute (CRRI).

Justification:

- an Internet-based educational program based on catchment management is currently operating successfully
- a reef-based version of the same program is currently under development
- there is potential for adapting the package to provide an interactive coastal training package for local government, universities, industry, etc.

Outline Scope of Work:

- establish objectives for package in consultation with end users
- develop specifications
- develop software and supporting documentation
- market and distribute
- provide technical support
- conduct workshops utilising training package

Partners and Beneficiaries (*lead agency or agencies in bold*):

Local Government Association, CRRI, Great Barrier Reef Marine Park Authority, coastal local governments, community groups, schools

Method of Implementation:

CRRI with assistance from training specialists

Approximate Costs:

\$100 000 (for development of package)

Relevance to Commonwealth Coastal Objectives:

- promoting an ecosystem and integrated approach to management
- information base to support decision making
- encouraging community understanding and awareness

Issue 8

Networking

Project 8.1

Development of Coastal Planners Network

Project: The purpose of this project is to promote greater levels of communication and information sharing amongst coastal planning and management professionals in Queensland.

Justification:

- coastal planning and management professionals are scattered amongst head offices, regional offices and local governments along the entire length of the Queensland coastline
- there are relatively few opportunities to share ideas, knowledge and experiences

Outline Scope of Work:

- prepare and distribute a regular (say quarterly) coastal management newsletter targeted mainly at local governments
- establish an electronic coastal managers newsgroup – this could operate along the lines of the successful international COASTNET discussion group
- organise periodic coastal management workshops for local government councillors and officers

Partners and Beneficiaries (*lead agency or agencies in bold*):

Queensland Local Government Association, coastal local governments, Dept of Environment, Great Barrier Reef Marine Park Authority

Method of Implementation:

Consultants or contract staff

Approximate Costs:

\$60 000 to consult and establish network

\$20 000 per annum to run project

Relevance to Commonwealth Coastal Objectives:

- promoting an ecosystem and integrated approach to management
- information base to support decision making
- policy and program coordination

Issue 9

Involvement of Traditional Owners

Project 9.1

Processes for Involving Traditional Owners in Decision Making

Project: The purpose of this project is to investigate ways in which traditional owners might meaningfully participate in decision making about coastal urban development.

Justification:

- Aboriginal and Torres Strait Islander peoples have particular attachments to and associations with coastal resources
- there are no structured processes which provide traditional owners with opportunities to have their views incorporated into decision making about coastal urban development
- there is often difficulty in making contact with and consulting traditional owners in coastal areas subject to urban development pressures

Outline Scope of Work:

- identify key interest groups
- discuss project with these interest groups
- investigate ways in which views of traditional owners can be obtained and integrated into decision-making processes
- investigate ways in which process can be resourced and managed
- prepare recommendations

Partners and Beneficiaries (*lead agency or agencies in bold*):

Land Councils, Community councils, coastal local governments, traditional owners, Great Barrier Reef Marine Park Authority

Method of Implementation:

Consultant

Approximate Costs:

\$50 000

Relevance to Commonwealth Coastal Objectives:

- information base to support decision making
- encouraging community understanding and awareness
- involvement of traditional owners

Issue 10

Best Practice Guidelines

Project 10.1

Best Practice Guidelines for Erosion and Sediment Control

Project: The purpose of this project is to develop a set of simple and easy to read best practice guidelines that specifically meet the needs of local government in tropical and subtropical Queensland. They are to be based upon existing guidelines which are available.

Justification:

- the proposed guidelines address an immediate need of local government
- although various guidelines are available, they do not necessarily relate to specific biophysical characteristics of the Queensland coastline and the intensity of tropical rainfall events
- there is a need for more simple and easy to read guidelines
- Townsville City and James Cook University are working together on such a set of guidelines

Outline Scope of Work:

- review existing guidelines
- consult with local governments over needs and how guidelines are proposed to be used
- develop draft specific guidelines based on currently available information as far as possible
- distribute draft guidelines for comment
- prepare final guidelines and distribute

Partners and Beneficiaries (*lead agency or agencies in bold*):

Townsville City, James Cook University, Thuringowa City, other coastal local governments, Dept of Environment, Great Barrier Reef Marine Park Authority

Method of Implementation:

James Cook University in association with Townsville City Council

Approximate Costs:

\$30 000

Relevance to Commonwealth Coastal Objectives:

- conservation of natural and cultural values
- pollution avoidance and control
- information base to support decision making

Issue 10

Best Practice Guidelines

Project 10.2

Best Practice Guidelines for Stormwater Management

Project: The purpose of this project is to develop a set of simple and easy to read best practice guidelines that specifically meet the needs of local government in tropical and subtropical Queensland. They are to be based upon existing guidelines which are available.

Justification:

- the proposed guidelines address an immediate need of local government
- although various guidelines are available, they do not necessarily relate to specific biophysical characteristics of the Queensland coastline and the intensity of tropical rainfall events
- there is a need for more simple and easy to read guidelines
- there is a requirement for local governments to prepare urban stormwater quality managements plans
- Townsville City and James Cook University are working together on such a set of guidelines

Outline Scope of Work:

- review existing guidelines
- consult with local governments over needs and how guidelines are proposed to be used
- develop draft specific guidelines based on currently available information as far as possible
- distribute draft guidelines for comment
- prepare final guidelines and distribute

Partners and Beneficiaries (*lead agency or agencies in bold*):

Townsville City, James Cook University, Thuringowa City, other coastal local governments, Dept of Environment, Great Barrier Reef Marine Park Authority

Method of Implementation:

James Cook University in association with Townsville City Council

Approximate Costs:

\$30 000

Relevance to Commonwealth Coastal Objectives:

- conservation of natural and cultural values
- pollution avoidance and control
- information base to support decision making

Issue 10:

Best Practice Guidelines

Project 10.3

Best Practice Guidelines for Irrigation with Treated Sewage Effluent

Project: The purpose of this task is to provide information to local governments in tropical areas on how to best achieve beneficial reuse of effluent through irrigation. It is based on field experiments currently under way in south-east Queensland.

Justification:

- coastal local governments need information on how to best use treated sewage effluent for irrigation purposes
- research is being undertaken in south-east Queensland by the Centre for Integrated Resource Management at the University of Queensland in conjunction with Redland Shire council
- there is a need to establish similar trials in tropical north Queensland

Outline Scope of Work:

- establish partnership arrangements with local governments
- find site for field trials
- undertake trials using different nutrient concentrations and plant species
- monitor biomass production and nutrient stripping under different conditions
- report results and implications for local governments

Partners and Beneficiaries (*lead agency or agencies in bold*):

Centre for Integrated Resource Management, coastal local governments in tropical north Queensland, Dept of Environment, Great Barrier Reef Marine Park Authority

Method of Implementation:

Contract arrangement with the Centre for Integrated Resource Management

Approximate Costs:

Establishment: \$100 000

Running costs: \$50 000 per annum

Relevance to Commonwealth Coastal Objectives:

- conservation of natural and cultural values
- pollution avoidance and control
- information base to support decision making

Issue 10

Best Practice Guidelines

Project 10.4

Implementation of Marine Tourism Industry Code of Practice

Project: One of the outputs from the Reef Tourism 2005 project is a Code of Practice for the Marine Tourism Industry. The purpose of this project is to facilitate the implementation of the Code of Practice.

Justification:

- the Code of Practice has been developed and adopted
- it will only lead to better outcomes if it is embraced and implemented by industry
- processes need to be set in place to enable feedback to be obtained
- the Code needs to be reviewed and updated in the light of learned experience

Outline Scope of Work:

- promote awareness of the Code
- undertake training programs for industry
- obtain feedback from operators
- review and amend Code as necessary

Partners and Beneficiaries (*lead agency or agencies in bold*):

Reef Tourism 2005, Marine Tourism Industry, Great Barrier Reef Marine Park Authority,
Dept of Environment

Method of Implementation:

Consultants via the Reef Tourism 2005 project

Approximate Costs:

\$40 000

Relevance to Commonwealth Coastal Objectives:

- conservation of natural and cultural values
- encouraging community understanding and awareness
- information base to support decision making

Issue 11

Upgrading of Wastewater Treatment Plants

Project 11.1

Information Package on Options for Upgrading Sewage Treatment Plants

Project: Coastal local governments are aware of the need to upgrade sewage treatment plants. The purpose of this project is to scope cost-effective means of upgrading sewage treatment plants and potential methods of financing. It is particularly aimed at providing summary information in an easily readable form for local governments.

Justification:

- coastal local governments will progressively be required to upgrade existing sewage treatment plants
- local governments are also subject to severe financial constraints
- there is a need for basic information on the most cost-effective means of upgrading and the financing options that might be available
- local governments have a need for easily readable summary information

Outline Scope of Work:

- summarise current state-of-the-art with respect to sewage treatment
- review options for upgrading (including costs, effectiveness and operational factors)
- summarise cost-effectiveness of options
- investigate financing options

Partners and Beneficiaries (*lead agency or agencies in bold*):

Local Government Association, coastal local governments, Dept of Environment, Dept of Local Government and Planning, Great Barrier Reef Marine Park Authority

Method of Implementation:

Consultants

Approximate Costs:

\$30 000

Relevance to Commonwealth Coastal Objectives:

- pollution avoidance and control
- information base to support decision making

Issue 12

Provision and Management of Small Boat Harbours

Project 12.1

Review of Issues Associated with the Provision of Small Boat Harbours

Project: The purpose of this project is to review the demand for, supply of and issues associated with the provision (or non-provision) of small boat harbours along the coastline adjacent to the World Heritage Area.

Justification:

- commercial and recreational craft have the potential to impact on coastal values at their moorings, in transit or at their destinations
- there is evidence of private and commercial craft moored illegally in inlets along the coast
- the location of boat harbours can have important local effects as well as influencing the distribution of users at reefs and islands
- there does not appear to be any overall strategy for the future provision of boat harbours
- there are jurisdictional issues associated with the management of small craft harbours

Outline Scope of Work:

- review use and capacity of existing small boat harbours
- collate information on the extent of private and commercial vessels moored at sites outside of boat harbours
- identify management issues, including water quality issues
- assess likely future demands for private and commercial moorings
- report on the extent and magnitude of any management problems and the nature of any further investigations that may be required

Partners and Beneficiaries (*lead agency or agencies in bold*):

Dept of Transport, coastal local governments, Dept of Environment, marine industry, boat harbour users, Great Barrier Reef Marine Park Authority

Method of Implementation:

Consultants

Approximate Costs:

\$60 000

Relevance to Commonwealth Coastal Objectives:

- pollution avoidance and control
- information base to support decision making
- policy and program coordination

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Appendixes

Appendix 1

Details of Consultation

This appendix contains a list of individuals contacted during the preparation of this report. The information is presented under the following headings:

- local government,
- State government,
- Commonwealth government,
- Port Authorities, and
- other contacts.

Unless otherwise indicated, consultation was undertaken by way of face-to-face interviews during October and November 1996.

Local Government

- 1.1 Bowen Shire Council
Mr Barry Menzies – Town Planner
- 1.2 Broadsound Shire Council
Mr Peter Stenhouse – Ulman & Nolan,
Mackay: Consultant Town Planner
- 1.3 Burdekin Shire Council
Mr Ian Stewart – Planner
- 1.4 Burnett Shire Council
Mr Martin Hunt – Manager, Planning
and Development
Mr Graham Harvey – Senior Planning
Officer, Planning and Development
- 1.5 Cairns City Council
Mr Paul Kearsley – Supervising Senior
Planner
- 1.6 Calliope Shire Council
Ms Kristina Butler – Planning Officer
Mr Nick Alderson – Landscape Architect
- 1.7 Cardwell Shire Council
Mr Rod Milne – Planning Officer
- 1.8 Cook Shire Council
Mr John Harrison – Town Planning
Technical Officer

Ms Kim Campbell – Consultant Town
Planner (telephone contact only)

- 1.9 Douglas Shire Council
Ms Nicole Huddy – Manager Planning
Services
- 1.10 Gladstone City Council
Mr Geoff McColl – Manager, City
Planning
- 1.11 Hinchinbrook Shire Council
Mr Ross Hogan – Shire Engineer
- 1.12 Johnstone Shire Council
Mr Matthew Coleman – Planning Officer
- 1.13 Livingstone Shire Council
Mr Michael Paine – Director of
Environmental Services
Ms Maaret Sinkko, Planning Officer
- 1.14 Mackay City Council
Mr John Caldwell – Senior Development
Officer
- 1.15 Miriam Vale Shire Council
Mr John Beevors – Shire Planner
- 1.16 Sarina Shire Council
Ms Veronica Schilling – Manager,
Planning & Development
- 1.17 Thuringowa City Council
Mr Martin Clarke – Planning Officer
- 1.18 Townsville City Council
Ms Karen Robinson – Manager, Strategic
Planning
Mr Peter Rollston – Project Officer,
Strategic Planning
- 1.19 Whitsunday Shire Council
Mr David Young – Manager Planning,
Development & Environment
Mr Paul Lucy – Town Planner

State Government

- 2.1 Department of Environment,
Rockhampton
Ms Angelina Bismarck – Senior
Environmental Officer
Mr Colin Reynolds

- 2.2 Department of Environment, Townsville
 - Ms Heather Lloyd – Senior Conservation Officer (Planning)
 - Ms Deborah Szekely
 - Mr Maurice Matthews
 - Mr Troy Collie
- 2.3 Department of Environment, Cairns
 - Mr Lyndsay Delzoppo, Acting Regional Director
 - Mr Max Chappel
- 2.4 Department of Natural Resources, Mackay
 - Mr Harry Usher – Regional Planning Officer
- 2.5 Department of Natural Resources, Townsville
 - Ms Lyn McTaggart
 - Mr Gary Rogers
- 2.6 Department of Local Government and Planning, Brisbane
 - Mr Mike Bradbury (telephone contact only)

Commonwealth Government

- 3.1 Great Barrier Reef Marine Park Authority
 - Mr John Brodie – Director, Research and Monitoring
 - Mr Martin Robinson – Project Manager, Impact Assessment Unit
 - Mr Michael Vanderzee – Manager, Marine Use Management
 - Ms Carol Honchin – Planning Officer
- 3.2 Department of the Environment, Sport and Territories
 - Mr Gerry Morvel (telephone contact only)

Port Authorities

- 4.1 Townsville Port Authority
 - Ms Caryn Anderson – Project Officer, Environment
- 4.2 Gladstone Port Authority
 - Mr Noel Bowley, Planning and Environment Manager

Other Contacts

- 5.1 Trinity Inlet Management Program
 - Ms Kris Kristensen
- 5.2 North Queensland Conservation Council
 - Mr Jeremy Tager
- 5.3 Australian Marine Conservation Society
 - Mr Eddie Hegerl
- 5.4 Reef Tourism 2005
 - Mr Ed Green – Chief Executive Officer
- 5.5 Reference Group for the Broadsound and Sarina Coastal and Islands Land Use Study of State Lands:
 - A group of approximately 25 people representing commercial fishing, recreational fishing, conservation, local government, rate payer, boating and traditional owner interests in the Broadsound/Sarina area.

Appendix 2

Summary of Natural Heritage Attributes of the Great Barrier Reef World Heritage Area

Source: Lucas P.H.C., Webb T., Valentine P.S. and Marsh H. 1997, The Outstanding Universal Value of The Great Barrier Reef World Heritage Area, Great Barrier Reef Marine Park Authority, Townsville.

Attribute 1: Algae

- Great Barrier Reef World Heritage Area benthic macroalgae are typical of the Indo-West Pacific region, with moderately high diversity but relatively low endemism;
- approximately 400–500 species of macroalgae occur in the Great Barrier Reef World Heritage Area;
- importance of the Great Barrier Reef World Heritage Area is by virtue of its latitudinal and cross-shelf extent giving rise to a huge variety of habitats;
- algae are important in cementing reef structures;
- algae are significant contributors to reefal and inter-reefal sediments;
- algae are the primary producers of reefal systems as zooxanthellae, macroalgae (including seaweed and turf algae) and phytoplankton;
- important food resource for numerous animals, especially fishes.

Attribute 2: Ascidians (sea-squirts)

- at least 330 species of ascidians are likely to occur in the Great Barrier Reef World Heritage Area; and a further 100 or more indigenous Australian temperate species appear to have been derived from the tropical fauna that flourishes in the reefal habitats of the Great Barrier Reef World Heritage Area;

- most species occurring in the Great Barrier Reef World Heritage Area occupy a vast geographic range covering its latitudinal length;
- the Great Barrier Reef World Heritage Area acts as a bridge for ascidians between tropical and temperate waters, providing the reefal habitats that accommodate the extension of the range of tropical species to the south, at least to the Tropic of Capricorn, and by providing candidates for speciation in the temperate waters of Australia, contributes to the species diversity of the continent;
- The Great Barrier Reef World Heritage Area, is an avenue for gene flow which contributes to the genetic diversity of the Indo-West Pacific tropical fauna by accommodating populations of tropical species well to the south of their usual range.

Attribute 3: Birds

- Great Barrier Reef World Heritage Area contains globally important areas for seabirds, including breeding colonies for 22 species;
- Great Barrier Reef World Heritage Area is at the extremity of distribution for some species;
- areas that are of international importance to migratory shorebirds are adjacent to or included within the Great Barrier Reef World Heritage Area;
- Great Barrier Reef World Heritage Area contains populations of threatened species;
- birds play important roles in nutrient addition to cays, and the establishment of terrestrial flora;
- significant aesthetic value derived from large breeding colonies.

Attribute 4: Bryozoans

- Indo-West Pacific region contains the highest diversity of bryozoans;
- Great Barrier Reef World Heritage Area contains an estimated 300–500 species of bryozoans (8–12% of world fauna);

- bryozoans along with sponges and ascidians form 'natural isolates' that provide important structure and habitats for other invertebrate species in areas of soft sediments;
- likely that the bryozoan fauna of reefal and shelf environments are distinct;
- some species particularly noted for their beauty.

Attribute 5: Butterflies

- 118 species have been identified within the Great Barrier Reef World Heritage Area, representing 30% of all known Australian butterflies;
- two endemic subspecies have been described;
- limited study of the Great Barrier Reef World Heritage Area butterflies has taken place;
- rapid speciation processes may be at work on some of the islands following the post-glacial sea-level rise, however studies are required;
- several rare and little-known species occur within the Great Barrier Reef World Heritage Area;
- remarkable migratory and aggregation records occur for some Great Barrier Reef World Heritage Area butterflies;
- the butterfly fauna have strong links with the coastal fauna and islands may provide relatively secure populations in the face of coastal development pressures;
- the addition of the Torres Strait area to the Great Barrier Reef World Heritage Area would add greatly to the butterfly richness and significance.

Attribute 6: Crocodiles and Terrestrial Reptiles

- estuarine crocodiles occur in the Great Barrier Reef World Heritage Area, but these individuals are marginal to the mainland population;
- reefal island crocodiles are unlikely to have any significant contribution back to the main populations, however they form part of the reefal ecosystem;

- at least 9 snakes and 31 lizards occur on the islands of the Great Barrier Reef World Heritage Area;
- one threatened lizard occurs on Magnetic Island.

Attribute 7: Crustaceans

- many of the groups have been poorly studied;
- the Great Barrier Reef World Heritage Area is likely to be highly diverse for most groups with a cosmopolitan Indo-West Pacific fauna;
- endemism of reef fauna is low, but other habitats may have greater endemism;
- the extensive range of habitats in the Great Barrier Reef World Heritage Area is important for crustacean diversity.

Attribute 8: Echinoderms

- an estimated 800 extant species of echinoderms occur in the Great Barrier Reef World Heritage Area, representing about 13% of the world's taxa;
- many rare taxa occur in the Great Barrier Reef World Heritage Area;
- higher phylogenetic diversity of echinoderms is well expressed in the Great Barrier Reef World Heritage Area;
- Great Barrier Reef World Heritage Area is likely to have the greatest species diversity of echinoderms for any marine protected area in the world;
- distinct reefal and non-reefal suites of species exist with very strong zonation observable in both assemblages.

Attribute 9: Fishes

- species diversity of Great Barrier Reef World Heritage Area is high but is less diverse than for the Indo-West Pacific centre;
- endemism is low as most fish are distributed through the Indo-West Pacific;
- heterogeneity of the Great Barrier Reef World Heritage Area at a range of spatial scales offers an extensive range of habitats for fish;
- life histories of some species demonstrate the connectivity of the range of nearshore and offshore habitats within the Great Barrier Reef World Heritage Area;

- abundance and diversity of fishes changes over a range of spatial and temporal scales;
- abundance and huge diversity in fishes shape, size and colour contributes to the aesthetic value of the Great Barrier Reef World Heritage Area.

Attribute 10: Flatworms

- platyhelminth fauna of the Great Barrier Reef World Heritage Area is largely Indo-West Pacific in distribution with correspondingly low levels of endemism;
- flatworm fauna exhibits high diversity in free-living macro and meiofaunal forms, and very high diversity in parasitic forms;
- the polyclad turbellarians are a conspicuous animal on the reef with vivid colours and patterns contributing to the aesthetic value of the Great Barrier Reef World Heritage Area.

Attribute 11: Fringing Reefs

- fringing reefs cover 667 km² of the Great Barrier Reef World Heritage Area with the majority being adjacent to continental islands;
- they can exhibit high species diversity, and often high coral cover;
- Great Barrier Reef World Heritage Area contains some of the largest and oldest coral colonies;
- the genotype of some colonies may have been present on the reef for several thousand years;
- inshore coral communities in the southern regions of the Great Barrier Reef World Heritage Area may offer new insights into coral reef formation and evolution;
- fringing reefs can exhibit very high aesthetic value.

Attribute 12: Geological and Geomorphological Aspects

- Great Barrier Reef World Heritage Area contains the largest reef system the world has ever known;
- the size and morphological diversity of the Great Barrier Reef makes the Great Barrier Reef World Heritage Area unique;

- Great Barrier Reef World Heritage Area contains 2904 coral reefs covering 20 055 km²;
- geological evolution of continental islands, reefs and cays is intimately connected with sea-level change;
- major changes in sea-level are recorded in the reef's structure;
- cross-shelf gradients in many parameters are particularly evident in the Great Barrier Reef World Heritage Area;
- as a consequence of its young age, the total history of the reef's evolution is available, offering a unique opportunity for greater understanding of coral reef evolution;
- Great Barrier Reef World Heritage Area contains examples covering nearly all stages of reef development;
- Great Barrier Reef World Heritage Area contains exceptional examples of blue holes;
- the Great Barrier Reef World Heritage Area contains more than 300 coral islands displaying a range of morphologies;
- coastal attributes of world importance include rock types and morphologies, sand barriers, deltas, and dune systems.

Attribute 13: Geological Aspects of Continental Islands

- a majority of the 600 continental (high) islands are composed of massive granites or silicic volcanics with two significant age groups, Late Palaeozoic (330–270 Ma) and Cretaceous (120–100 Ma);
- the Great Barrier Reef World Heritage Area contains some exceptional sites for studying particular geological assemblages;
- the Great Barrier Reef World Heritage Area contains some assemblages, including the serpentinite rocks of South Percy Island, not commonly found elsewhere.

Attribute 14: *Halimeda* Banks (calcareous green algae)

- 20 species of *Halimeda* occur in the Great Barrier Reef World Heritage Area;
- significant sediment contributors to reefal and inter-reefal environments;
- the Great Barrier Reef World Heritage Area contains the most extensive, actively accumulating *Halimeda* beds in the world;
- actively accumulating for up to 10 000 years;
- primarily located in the northern region with unique deepwater *Halimeda* beds in the central region of the Great Barrier Reef World Heritage Area;
- may provide important nursery habitat for a range of taxa.

Attribute 15: Hard Corals

- the Great Barrier Reef World Heritage Area contains the largest coral reef system in the world;
- 2904 coral reefs cover 5.6% of the Great Barrier Reef World Heritage Area;
- the Great Barrier Reef World Heritage Area contains an extensive diversity of reef morphologies, including deltaic, dissected and detached reefs;
- high heterogeneity at a range of spatial scales gives rise to high habitat diversity;
- 359 species of hard corals recorded from the Great Barrier Reef World Heritage Area;
- Great Barrier Reef World Heritage Area exhibits low endemism, with most species distributed through the Indo-West Pacific;
- long lived massive corals can provide historical information regarding environmental conditions over several hundreds of years;
- Great Barrier Reef World Heritage Area occurs within a jurisdiction that has a higher potential for effective conservation management than other reefal areas of the Indo-West Pacific region.

Attribute 16: Mangroves

- 2069 km² of mangroves occur in or directly adjacent to Great Barrier Reef World Heritage Area;

- 37 species recorded in the Great Barrier Reef World Heritage Area, being 54% of world flora;
- Great Barrier Reef World Heritage Area has a comparable and complimentary diversity to other areas of high diversity;
- important trends at a range of spatial scales makes the Great Barrier Reef World Heritage Area the prime location for research into mangrove ecology and evolution;
- habitat for a range of taxa, in particular the juveniles of some species;
- important contributors to ecological processes.

Attribute 17: Marine Mammals

- The Great Barrier Reef World Heritage Area is a significant refuge for cetacean biodiversity in the tropical Indo-Pacific as coastal species such as the Irrawaddy dolphin and the Indo-West Pacific humpback dolphin are unlikely to survive outside Australia. It is also a breeding ground for the threatened humpback whale.
- The Great Barrier Reef World Heritage Area supports an estimated 15% of the dugongs that have been recorded in Australian waters to date. The dugong is the only extant species of the family *Dugongidae* and one of only four species in the mammalian order *Sirenia*. The dugong is classified as vulnerable to extinction by the IUCN with poor long-term survival prospects outside Australia.

Attribute 18: Marine Turtles

- Great Barrier Reef World Heritage Area contains globally important nesting and feeding grounds for loggerhead, green, hawksbill and flatback turtles;
- southern Great Barrier Reef World Heritage Area loggerhead turtle breeding population is approximately 70% of the southern Pacific population;
- Raine Island accommodates the largest green turtle breeding population in the world;
- Great Barrier Reef World Heritage Area contains one of the last significant breeding population of the hawksbill turtle in the world;

- approximately 10% of the endemic flatback turtles breed on a few islands in the southern region of the Great Barrier Reef World Heritage Area;
- olive ridley and leatherback turtles also utilise the resources of the Great Barrier Reef World Heritage Area.

Attribute 19: Molluscs

- the number of mollusc species occurring in the Great Barrier Reef World Heritage Area is estimated to range from a minimum of 5000, to possibly as many as 8000;
- Great Barrier Reef World Heritage Area molluscan fauna represents a significant proportion of world molluscan diversity;
- there are four main components to the Great Barrier Reef World Heritage Area molluscan fauna, with the most speciose being the shallow reefal fauna, with tropical Indo–West Pacific affinities and very low levels of endemism;
- the other three main components are the shallow coastal molluscan fauna and the shelf fauna both of which are shared with southern Queensland and New South Wales, and a tropical coastal component that is shared, in large part, with northern Australia;
- endemism is highest in the components that are shared with southern Queensland and New South Wales;
- the gastropod family Volutidae exhibits the highest degree of endemism in the Great Barrier Reef World Area;
- many species have large colourful shells prized by shell collectors, and adding to the aesthetic qualities of the Great Barrier Reef World Heritage Area;
- some species of bivalves are important in bioerosion of coral substrates;
- larval molluscs and other planktonic molluscs are important components of the Great Barrier Reef plankton;
- much of the molluscan fauna of the Great Barrier Reef World Heritage Area is poorly known, in particular the smaller sized taxa.

Attribute 20: Octocorals

- from 270 genera of octocorals worldwide, an estimated 80 genera are likely to occur in the Great Barrier Reef World Heritage Area;
- octocorals occur in all habitats, across all shelf positions and throughout the latitudinal extent of the Great Barrier Reef World Heritage Area;
- soft corals are a major component of the sessile benthic reef fauna of the Great Barrier Reef World Heritage Area;
- form and colour of octocorals contribute to the aesthetic value of the Great Barrier Reef World Heritage Area.

Attribute 21: Phytoplankton (microscopic algae)

- phytoplankton are the principal primary producers in the open shelf waters of the Great Barrier Reef World Heritage Area (approximately 95% of the World Heritage Area);
- includes a diverse group of algae ranging in size from 0.5 microns to 200+ microns;
- two broad communities exist: an offshore oceanic community and a lagoonal community;
- phytoplankton biomass is highest in shallow nearshore waters;
- upwelling of nutrients along the shelf break, cyclonic disturbances of shelf sediments and flood waters may locally increase phytoplankton biomass;
- *Trichodesmium* is a significant contributor of nitrogen to the Great Barrier Reef World Heritage Area.

Attribute 22: Polychaete Worms

- polychaetes are an old group extending back to Cambrian times (500 Ma);
- dominant macrofauna (in numbers of species and individuals) in reefal sediments and coral substrates;
- currently 80 species are recorded for the reefs of the Great Barrier Reef World Heritage Area, however total species diversity could exceed 500;

- diversity is a product of latitudinal extent, habitat diversity and good condition of the Great Barrier Reef;
- polychaetes play important roles in ecosystems;
- the tropical polychaete fauna is very poorly known.

Attribute 23: The Proserpine Rock-wallaby

- Proserpine rock-wallaby is classified internationally as endangered;
- restricted to a very small range, including one continental island in the Great Barrier Reef World Heritage Area.

Attribute 24: Seagrasses

- 15 species of seagrass are recorded from the Great Barrier Reef World Heritage Area and other species may yet be described;
- Great Barrier Reef World Heritage Area flora is typical of the Indo-West Pacific flora;
- several species reach latitudinal limits in the Great Barrier Reef World Heritage Area, and at least two species appear endemic;
- more than 3000 km² of seagrass habitat within the Great Barrier Reef World Heritage Area;
- extensive meadows of deepwater seagrass recently found;
- important nursery for many fishes and penaeid prawns;
- important food resource for threatened dugong and green turtle;
- important roles in sediment stabilisation and nutrient capture.

Attribute 25: Sea Snakes

- 17 species of sea snakes occur in the Great Barrier Reef World Heritage Area;
- distinct reefal and soft bottom assemblages are apparent;
- patterns of abundance and distribution poorly known;
- trawling is the major anthropogenic impact on sea snakes in the Great Barrier Reef World Heritage Area.

Attribute 26: Soft Bottom Habitats

- soft bottom habitats occupy the majority (approx. 94%) of the Great Barrier Reef World Heritage Area;
- species diversity of soft bottom habitats is high, but poorly documented;
- strong cross-shelf zonation is apparent, with four discernible zones;
- lagoonal and inter-reefal diversity is associated with the presence of 'natural isolates' that create small areas of hard substrate in the soft bottom environment;
- 'natural isolates' are particularly vulnerable to periodic disturbance such as trawling.

Attribute 27: Sponges

- 1500 species estimated to occur in the Great Barrier Reef World Heritage Area, being equivalent to approximately 30% of the extant Australian sponge fauna;
- sponge fauna tends to be Indo-West Pacific in distribution;
- endemism likely to be low but lack of taxonomic studies limits quantification;
- relicts of reef-building sponges prominent during the Ordovician Period have been recorded in the Great Barrier Reef World Heritage Area;
- cross-shelf trends in sponge abundance and diversity exhibited;
- play significant roles in ecosystem processes.

Attribute 28: Terrestrial Flora

- over 2100 plant species occur on the Great Barrier Reef World Heritage Area islands, representing about 25% of Queensland's floral diversity in just 0.1% of its area;
- over 75 species are rare or threatened, with a number of endemic species;
- the southern limits of world distribution for a number of pantropic plants are reached in the Great Barrier Reef World Heritage Area;
- the Great Barrier Reef World Heritage Area provides a unique opportunity to investigate theories of island biogeography through the continuing processes of rainforest species invasion;

-
- birds are important for the dispersal, colonisation and establishment of some plants;
 - 5 floristic regions on continental islands can be delineated, and an additional 2 for coral cays;
 - distinct latitudinal trends in community composition are expressed.

Appendix 3

Ecosystem Values and Management Needs

Sandy Coasts

Rocky Coasts (Headlands and Bluffs)

Non-tidal Wetlands

Tidal Wetlands

Fringing Reefs

Rocky Foreshores

Sandy Bottoms

Soft Bottoms

Source: Saenger and Pitts (1997)

Values and Management Needs: Sandy Coasts

Biological Values

- important habitat including habitat for rare or threatened species

Functional Values

- dissipative barrier to erosive on-shore wave action
- stabilisation of windblown sand
- high scenic amenity
- high recreational amenity
- regionally important for groundwater recharge

Management Considerations

Sandy Coasts are sensitive to:

- changes in sediment deposition patterns or rates
- changes to tidal regimes/tidal drainage patterns
- erosion due to increased currents and wave action
- physical disturbance of substrates or shorelines
- removal of vegetative cover (wind erosion)
- nutrient enrichment
- changes in groundwater levels
- fire

Values and Management Needs: Rocky Coasts (Headlands and Bluffs)

Biological Values

- important habitat including habitat for rare or threatened species

Functional Values

- dissipative barrier to erosive on-shore wave action
- stabilisation of windblown sand
- high scenic amenity
- high recreational amenity

Management Considerations

Rocky Coasts are sensitive to:

- physical disturbance of substrates or shorelines
- removal of vegetative cover (wind erosion)
- nutrient enrichment
- changes in groundwater levels
- fire
- changes to tidal regimes/tidal drainage patterns
- introduced species

Values and Management Needs: Non-tidal Wetlands

Biological Values

- important habitat including habitat for rare or threatened species
- provision of drought refuges for waterbirds
- provision of summer feeding areas for migratory waders

Functional Values

- store and regulate terrestrial flood run-off
- filter sediment from terrestrial run-off
- provide biological uptake of excessive nutrients and other pollutants
- high scenic amenity
- important habitat and migratory pathway for fisheries resources
- high recreational value
- high educational value (nature study)

Management Considerations

Non-tidal Wetlands are sensitive to:

- changes in sediment deposition and erosion patterns or rates
- changes to water quality, particularly nutrients, organic loading and turbidity
- changes in drainage patterns or flow rates
- physical disturbance of substrates or shorelines
- groundwater extraction and drawdown
- erosion due to increased currents, wave action or surface run-off
- clearing of catchments
- changes in adjacent land use

Values and Management Needs: Tidal Wetlands

Biological Values

- important habitat including habitat for rare or threatened species
- important habitat for waders and other migratory birds
- high biological productivity
- generally high biological diversity

Functional Values

- physical barrier to erosive wave or current action and tidal and storm inundation
- prevention of salt intrusion
- shoreline and tidal channel bank stabilisation
- stabilisation of sediment deposits
- important habitat for commercial and recreational fisheries resources
- important nursery or breeding habitat for important commercial and recreational offshore fisheries resources
- silt trapping (maintain marine water quality and reduce in-channel sedimentation)

Management Considerations

Tidal Wetlands are sensitive to :

- physical disturbance of substrates or shorelines
- changes in sediment deposition patterns or rates

- changes to water quality, including nutrient loadings
- changes in local drainage patterns
- changes to salinity regimes
- changes to turbidity levels
- changes to tidal regimes/tidal drainage patterns
- substrate erosion due to increased currents, wave action or surface run-off
- changes to temperature regimes (thermal pollution)

Values and Management Needs: Fringing Reefs

Biological Values

- high biological diversity
- important habitat including habitat for rare or threatened species
- high biological standing stock with low productivity

Functional Values

- important habitat for commercial and recreational fisheries resources
- physical/dissipative barrier to erosive wave action
- high scenic/visitor value
- high education value (nature study)

Management Considerations

Fringing Reefs are sensitive to:

- changes in sediment deposition patterns or rates
- changes to water quality particularly nutrients and salinity
- changes to turbidity levels
- trampling and overharvesting
- changes to tidal regimes/tidal drainage patterns
- physical disturbance of substrates or shorelines (e.g. anchor damage)
- changes in wave regimes
- changes to temperature regimes (thermal pollution)

Values and Management Needs: Rocky Foreshore

Biological Values

- high biological diversity
- important habitat including habitat for rare or threatened species
- high biological standing stock with low productivity

Functional Values

- important habitat for commercial and recreational fisheries resources
- physical/dissipative barrier to erosive wave action
- generally high recreational value (bait collecting, rock fishing)
- high educational value (nature study)

Management Considerations

Rocky Foreshores are sensitive to:

- changes in sediment deposition patterns or rates
- changes to water quality, including nutrient and salinity levels
- changes to turbidity levels
- changes to tidal regimes/tidal drainage patterns
- physical disturbance of substrates or shorelines
- trampling and overharvesting
- changes in wave regimes
- changes to temperature regimes (thermal pollution)

Values and Management Needs: Sandy Bottoms

Biological Values

- high biological diversity
- important habitat including habitat for rare or threatened species
- biological productivity variable

Functional Values

- important habitat for commercial and recreational fisheries resources

Management Considerations

Sandy Bottoms are sensitive to:

- changes in sediment deposition patterns or rates
- changes to water quality, including nutrient and organic loadings
- changes in wave regimes
- changes to temperature regimes (thermal pollution)
- disturbance of substrates

Values and Management Needs: Soft Bottoms

Biological Values

- high biological diversity
- important habitat including habitat for rare or threatened species

Functional Values

- important habitat for commercial and recreational fisheries resources
- important role in recycling organic matter
- important trophic linkage between seabottom communities and organisms swimming actively in the water
- important role in adsorption of pollutants

Management Considerations

Soft Bottoms are sensitive to:

- changes in sediment deposition patterns or rates
- physical disturbance of substrates
- changes to temperature regimes (thermal pollution)

Appendix 4

Maps of Coastal Regions

Wide Bay Coast

Curtis Coast

Capricorn Coast

Whitsunday Coast

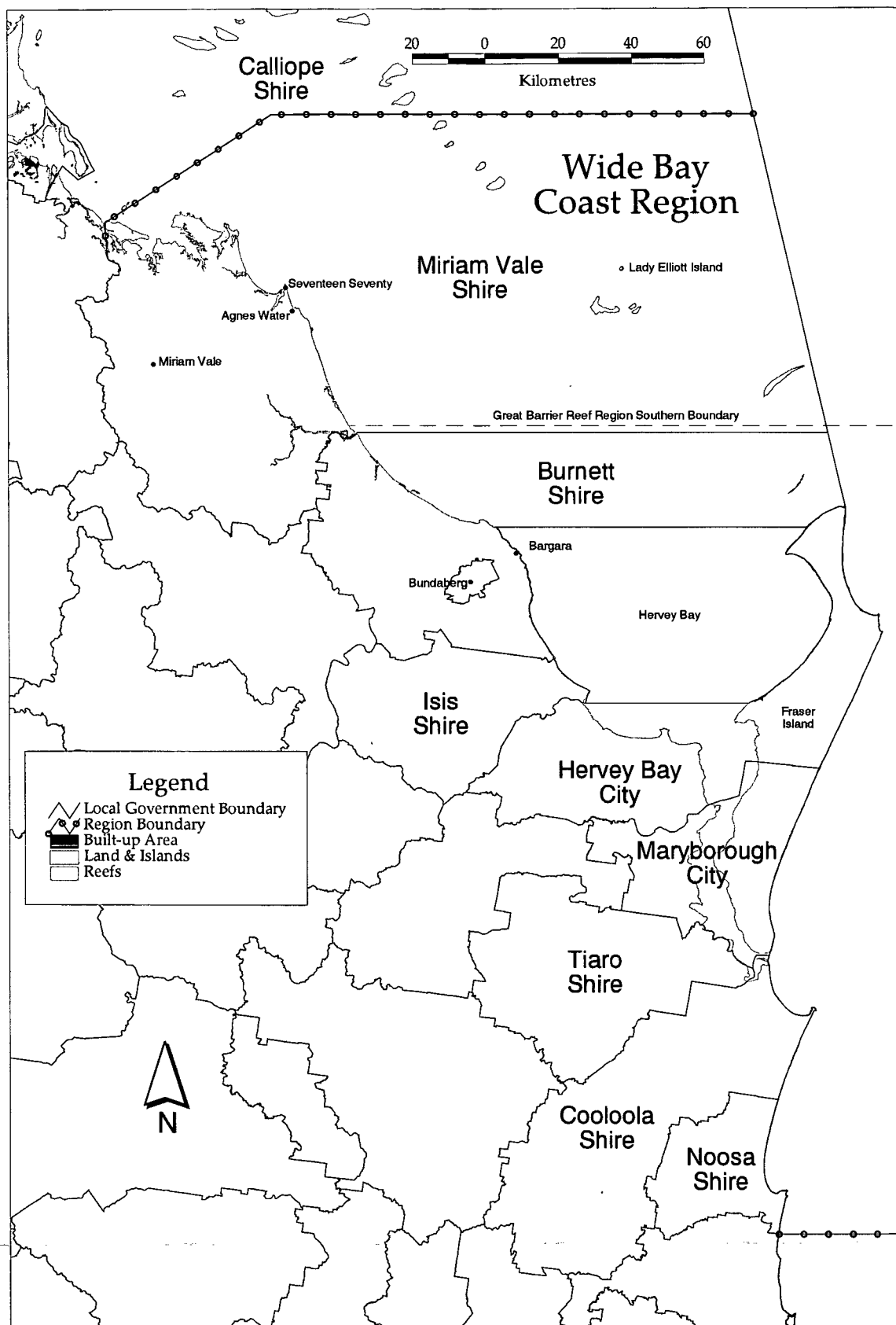
Dry Tropical Coast

Cardwell–Hinchinbrook Coast

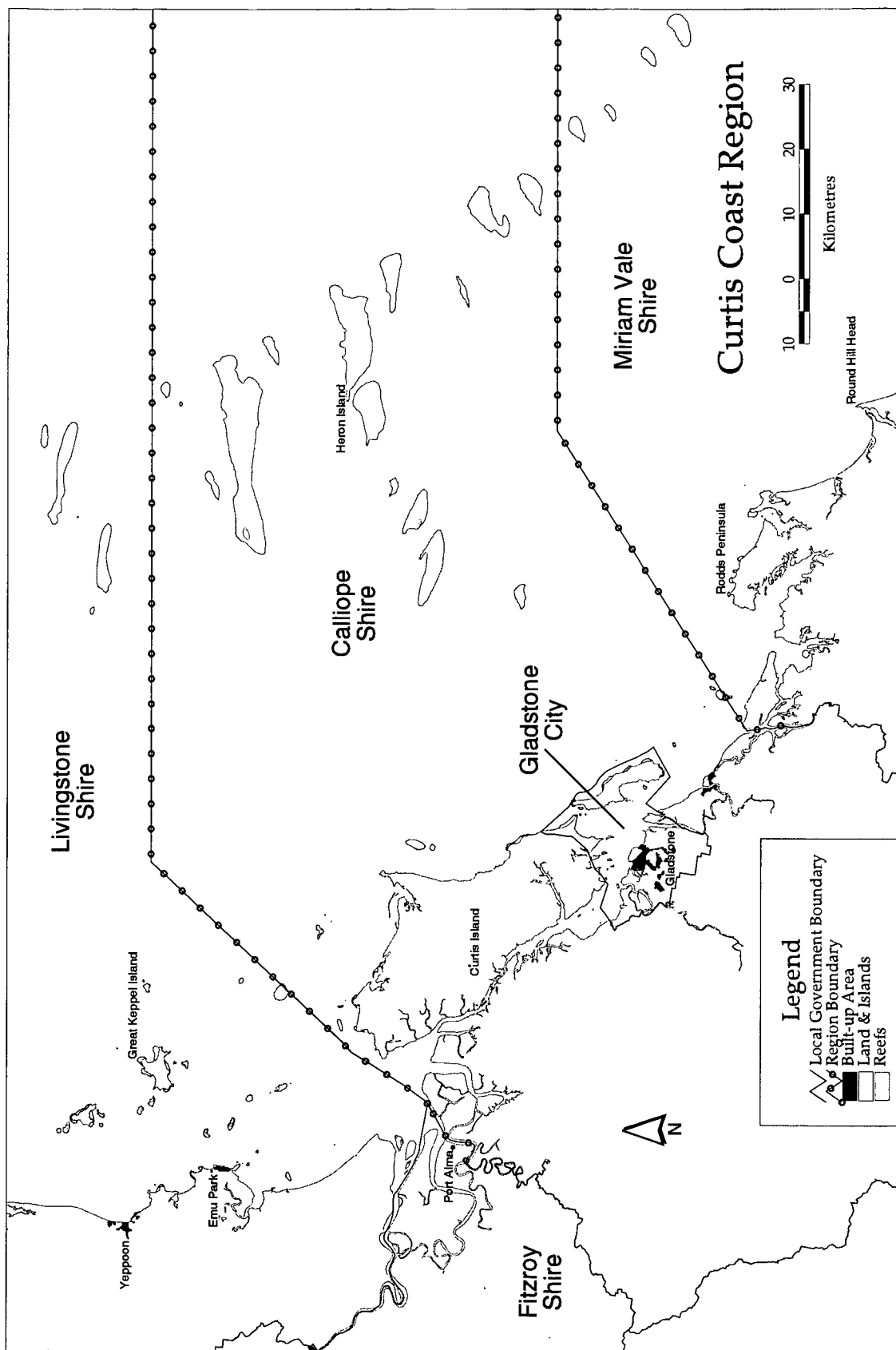
Wet Tropical Coast

Torres Strait and Cape York Peninsula Coast

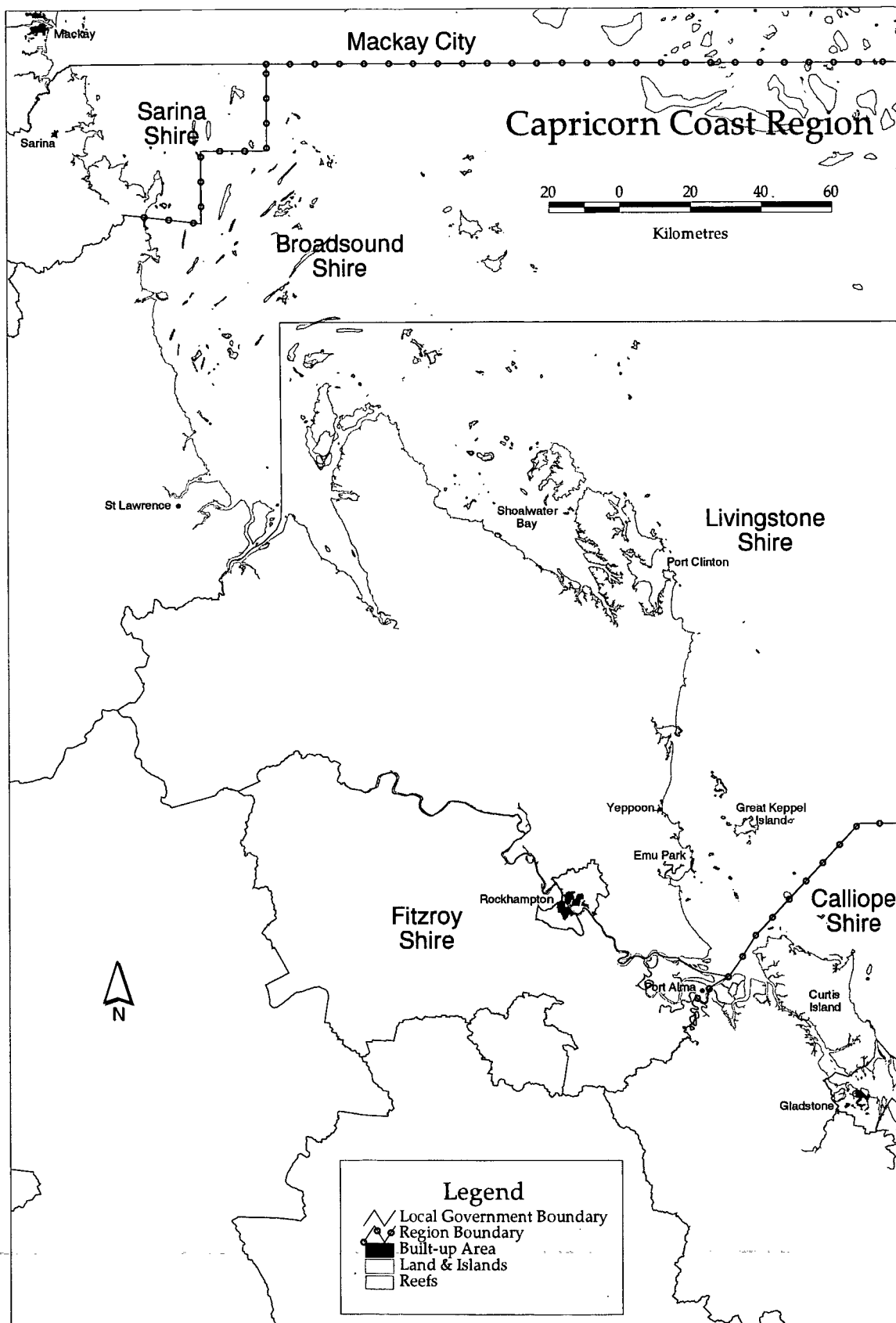
Maps supplied by the Great Barrier
Reef Marine Park Authority.



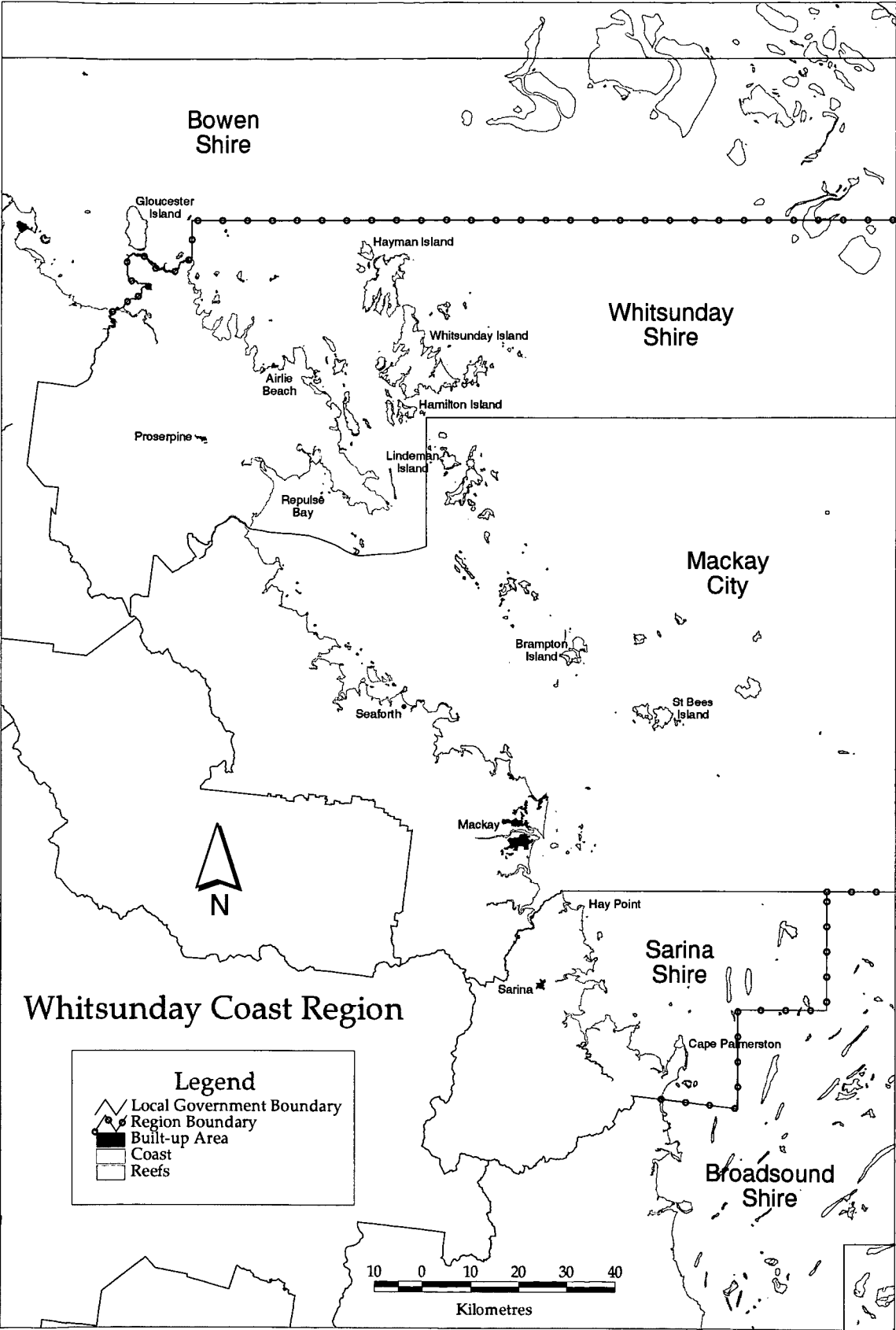
Wide Bay Coast



Curtis Coast

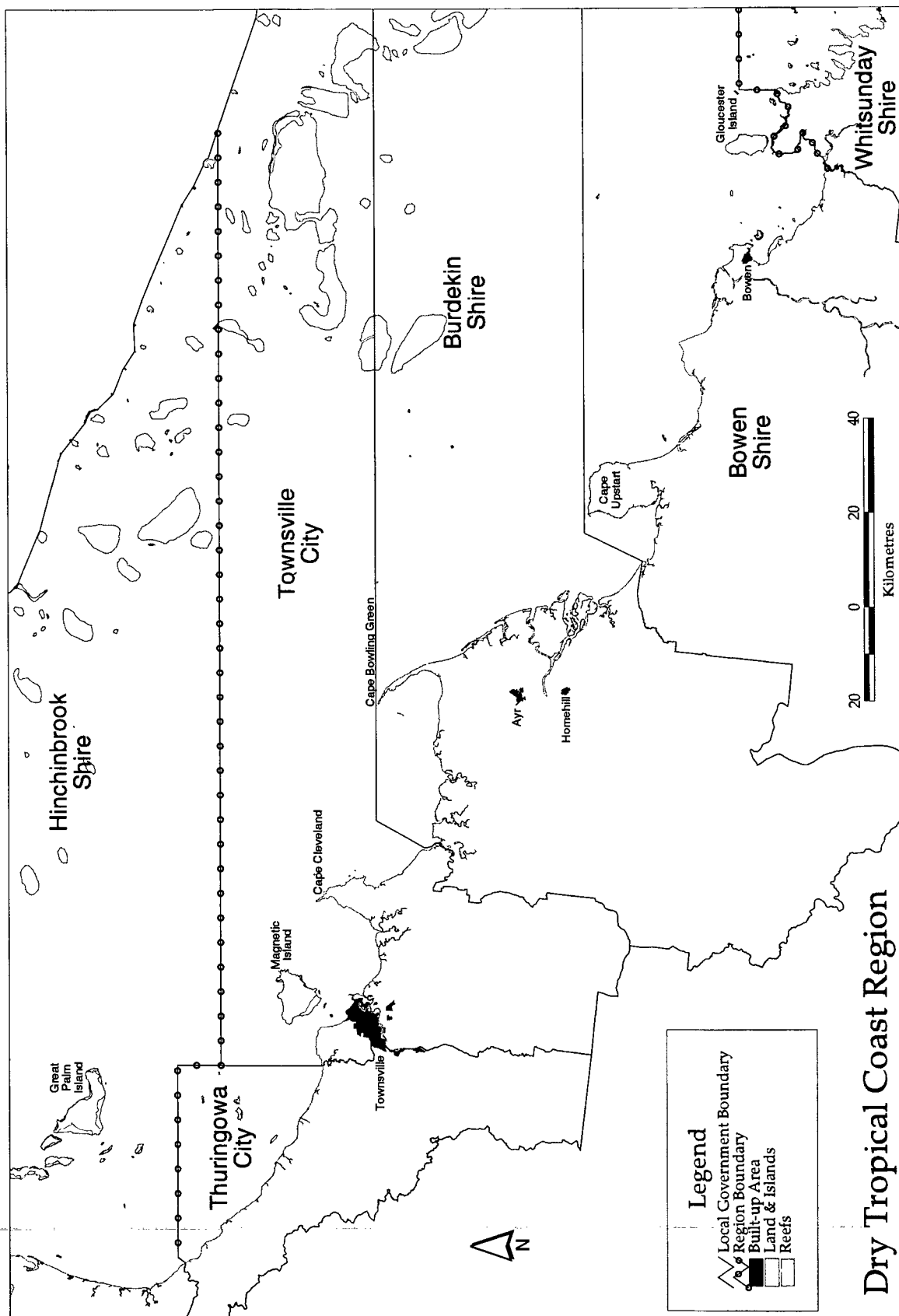


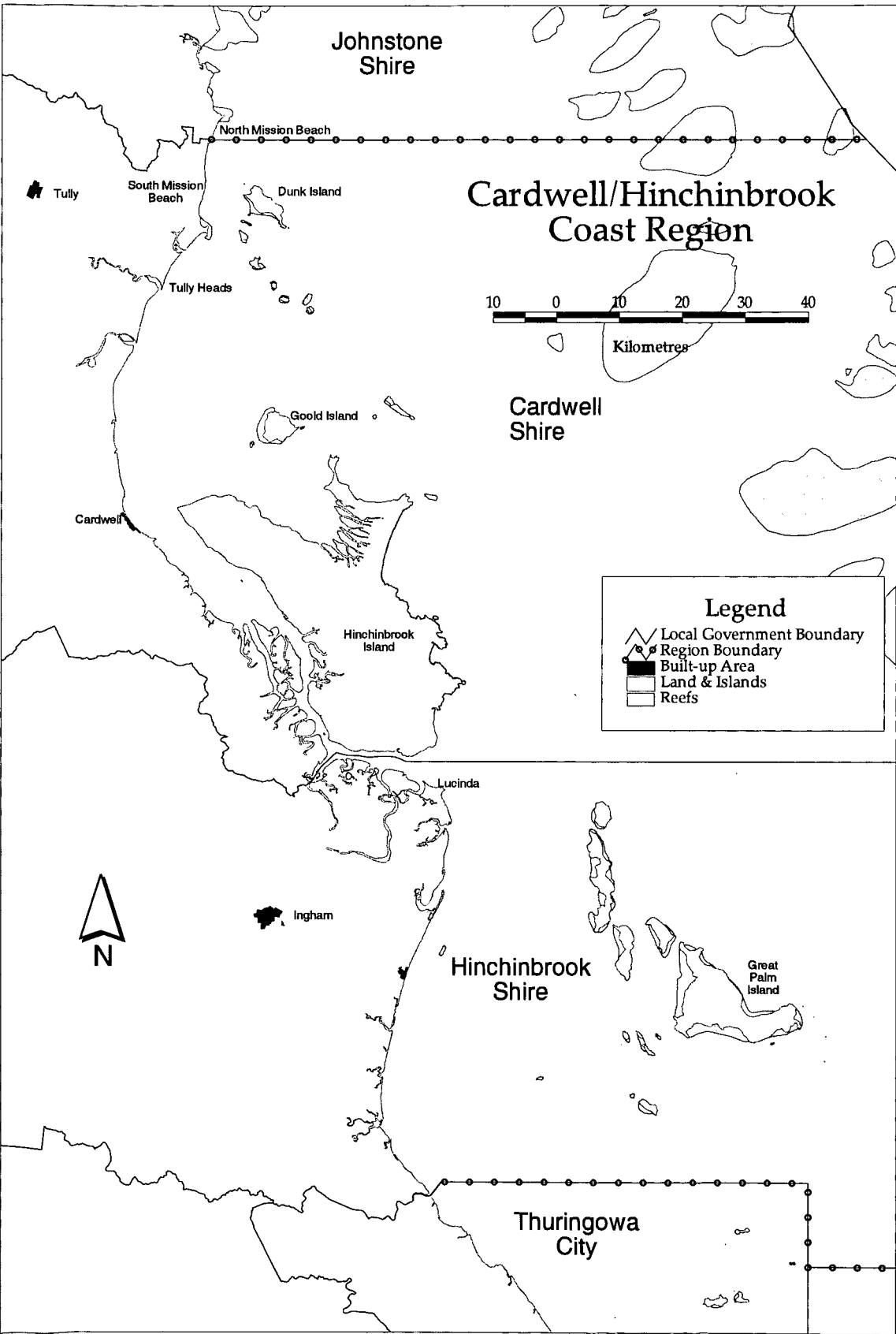
Capricorn Coast



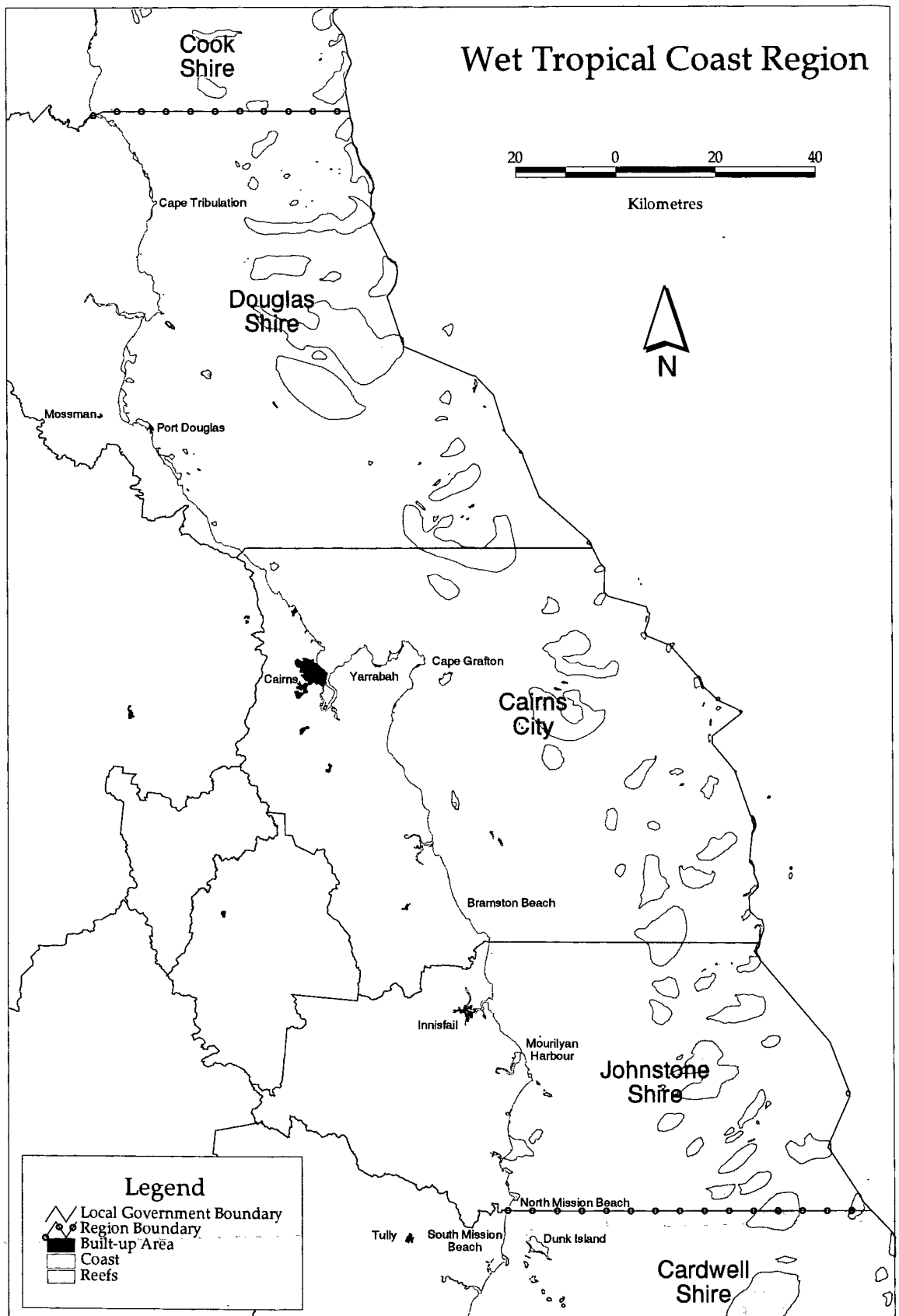
Whitsunday Coast

Dry Tropical Coast

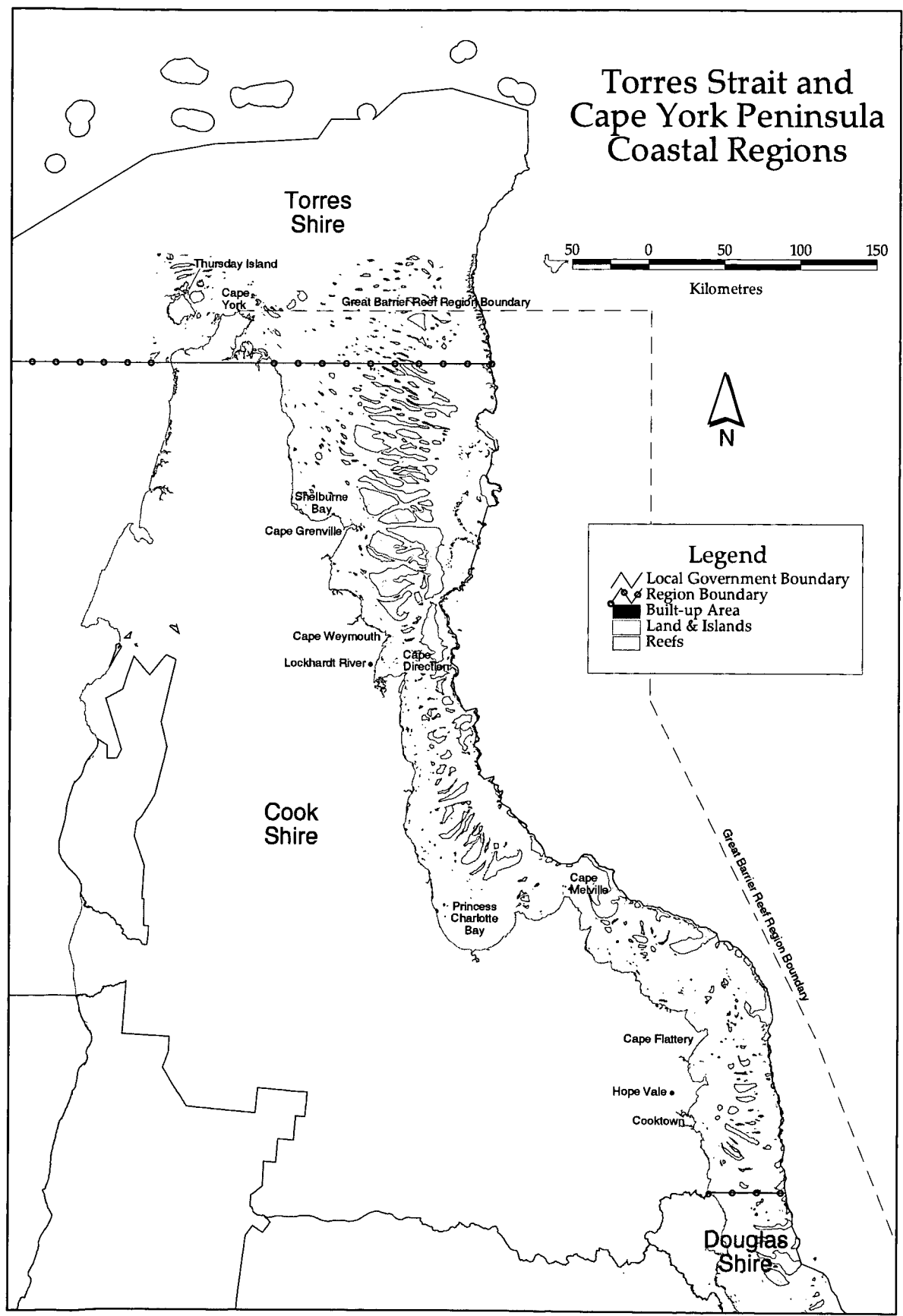




Cardwell/Hinchinbrook Coast



Wet Tropical Coast



Torres Strait and Cape York Peninsula Coast

