LAURA-NORMANBY CATCHMENT MANAGEMENT STRATEGY

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ACKNOWLEDGEMENTS

Many people have been involved in the production of this report. Thank you first of all to the members of the community who have completed surveys and discussed local issues with the Project Officers (Cathy Waldron and Ian Adcock). The local knowledge and concerns of the community have provided the content and direction for this report and the strategies to address local issues have been directly chosen by the community members. The final report producers, Christina Howley and Kim Stephan, would also like to thank the following persons: Jamie Molyneuax (CYWAFAP); Graeme Elmes; Sam Dibella, Andrew Hartwig and Barry Lyons (QPWS); Geoff Mills, Graeme Herbert, Anthony McLoughlin and Stephen Parker (DNR&M); Miles Furnas (AIMS); Stuart Hyland and John Russell (DPI Fisheries); Peter Thompson (CYPDA); Victor Stephanson (Traditional Knowledge Recording Project) and John Farrington (Quinkan & Regional Cultural Centre); all of whom been extremely helpful in providing information regarding resources and concerns within the Catchment. Thank you also to Michael Stephan for his generous assistance with technical matters and to Jean Stephan for editing.

Finally, thank you to the members of the Laura-Normanby Catchment Management Group.

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LIST OF ACRONYMS

AIMS	Australian Institute of Marine Science
ANZECC	Australia New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia New Zealand
CRC	Cooperative Research Centre
CSC	Cook Shire Council
CYP	Cape York Peninsula
CYPDA	Cape York Peninsula Development Association
CYPLUS	Cape York Peninsula Land Use Strategy
CYPNRM	Cape York Peninsula Natural Resource Management
CYRAG	Cape York
CYWAFAP	Cape York Weeds and Feral Animals Program
DNR&M	Qld Department of Natural Resources & Mines
DOGIT	Deed of Grant in Trust
DOCS	QLD Department of Communities
DPI&F	QLD Department of Primary Industries & Fisheries
EPA	Environmental Protection Agency
EPBC	
LNCMG	Laura Normanby Catchment Management Group
mg/L	milligrams/Litre
NFACP	National Feral Animal Control Program
NHT	Natural Heritage Trust
NRM	Natural Resource Management
PCB	Princess Charlotte Bay
Pers.comm.	personal communication
QPWS	QLD Parks and Wildlife Service
RFS	Rural Fire Service
TKRP	Traditional Knowledge Recording Project
µS/cm	microSiemen/centimetre

EXECUTIVE SUMMARY

The Catchment of the Laura and Normanby Rivers covers approximately 1,517,300 hectares or 586,080 km^2, spanning the central base of Cape York Peninsula. The Laura-Normanby Catchment area covers a vast and relatively undeveloped area encompassing extensive riverine and wetland systems, one of Queenland's largest conservation areas (Lakefield National Park), numerous sacred aboriginal sites, good cattle country, and productive agricultural lands. The Laura-Normanby Catchment Management Strategy was initiated by the Laura-Normanby Catchment Management Group in 2002 utilising funding from the Department of the Environment, Natural Heritage Trust (NHT1). This Strategy documents the knowledge and concerns of the local landholders, resource managers and traditional owners who are most affected by Cape York management decisions. Stakeholder surveys were conducted to identify and prioritise issues and management actions required to address natural resource management in the Catchment. The top priority issues, according to the majority of surveyed stakeholders, are: water quality and quantity, weeds, conservation of biodiversity, grazing impacts and feral animals. Other priority issues identified included fire management, the preservation of Cultural Heritage, management of commercial and recreational fishing and the increasing tourist and recreational use of the Catchment.

Most members of the community would like to see more funding go towards the on-ground works that are needed for natural resource management. Support (financial and other) is needed to control weed infestations, to provide and maintain fencing along stream banks to keep out cattle and feral animals, to identify and protect critical habitat for the diverse range of aquatic and terrestrial fauna of the catchment area, to map groundwater resources for irrigation and stockwatering, and to coordinate burning regimes across the Catchment. Additional infrastructure is required to support the growing tourism and recreation industry and the use of proper engineering design and sediment controls must be enforced during any earthworks conducted in the highly erodible soils within the Catchment. The Laura-Normanby Catchment Management Strategy has identified these and other priority actions to which natural resource funding should now be directed.

Implementation of the Strategies identified in this Plan will require cooperation among the various segments of the Catchment community, including QPWS, traditional owners, graziers, the agricultural industry, and the Cook Shire Council. The knowledge of the local community will be critical to the identification of specific locations requiring action and government support and coordination will be necessary to see these actions through. By working together, members of the community can significantly contribute towards improving the productivity and sustainability of the various industries within the Catchment AND towards ensuring the protection of local natural resources.

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF THE PLAN

The Laura-Normanby Catchment Area covers a vast and relatively undeveloped area with extensive riverine and wetland systems, one of Queenland's largest conservation areas (Lakefield National Park), numerous sacred aboriginal sites, good cattle country and rich agricultural lands. The majority of residents and landholders in the Catchment recognise the unique attributes of the area and the need to protect and preserve these attributes for the future. Most are working hard to develop the land in a sustainable manner. Yet as many people in the wider community are placing a greater emphasis on retaining wilderness in undeveloped areas, the decisions regarding land use and management are being increasingly made with little input from those who are impacted by the decisions. This plan having taken into account the extensive community consultations that have been conducted, documents the knowledge and concerns of the local landholders, resource managers, and traditional owners who are most affected by Cape York management decisions. It is intended to provide direction for the prioritisation of resource management issues and the specific actions needed to address these issues.

1.2 LAURA-NORMANBY CATCHMENT AREA

The Catchment of the Laura and Normanby Rivers covers approximately 1,517,300 hectares or 586,080 km^2, spanning the central base of Cape York Peninsula (Figure 1). The Laura-Normanby Catchment lies between Latitude 14º 15` to the north and 16º 15` in the south, and Longitude 143º 45` to the west and 145º 20` to the east. The East and West Normanby, Kennedy, and the Deighton River systems all join the Laura River. Together, these Catchments form the Laura-Normanby Catchment. From its beginnings in the Windsor Tableland, the water flow in the basin is generally north through grazing, farming and DOGIT land and Lakefield National Park, into the Coral Sea at Princess Charlotte Bay.

CATCHMENT DEFINED

A Catchment is the whole of a land surface area that discharges run off to a common drainage point. A Catchment (or watershed) provides a robust unit for natural resource management. Water movement across the total Catchment area of a river system affects ecological systems. As well as causing the land forming processes of erosion and deposition, the movement of water through a Catchment is often the prime mode of pollution transportation.

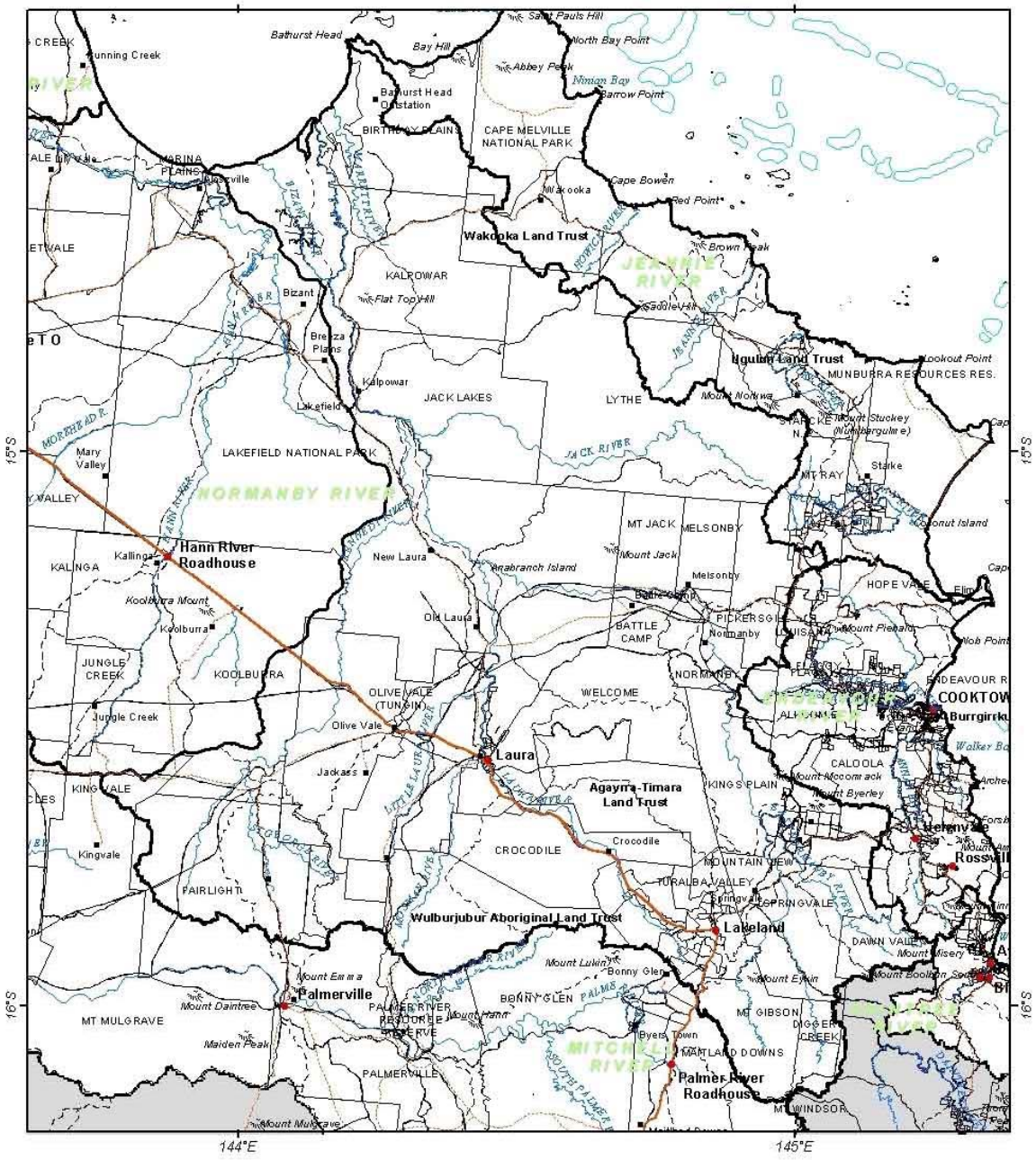


Figure 1: Laura-Normanby Catchment Map

1.3 IDENTIFIED ATTRIBUTES OF THE CATCHMENT

Numerous natural attributes have been identified for the region, which is classed as a large, dry catchment that is closest to pre-1850 condition in Queensland. There is a good supply of underground water and extensive wetlands and marine plains in the north. Upland areas contain escarpment country of sandstone, basalt and granite that rival those found in the Kimberley region of Western Australia. The rich basalt soils of the Lakeland Downs area in the south east of the Catchment provide good agricultural land. There are significant cultural heritage sites, including a vast network of indigenous rock art sites. The region also contains non-indigenous cultural heritage sites, such as remains of the railway infrastructure and the Old Laura Homestead. The Catchment is classed as good cattle country away from the hills and escarpments.

Due to its lack of development and industry, the Catchment has retained a feeling of remote wilderness. Many areas are valued for their recreational fishing and camping spots, both within and outside of, Lakefield National Park. Endemic species in the Catchment area include the Foxtail Palm, Gibson's Rock Wallaby, Golden Shouldered Parrot and the Star and Crimson Finches. Princess Charlotte Bay, where the Normanby River discharges, contains one of the largest tidal wetlands systems on Cape York Peninsula, with meandering rivers cutting through extensive salt pans and major mangrove communities (Danaher, 1995). Extensive seagrass meadows fringe the southeastern shore at Princess Charlotte Bay. Dolphins, turtles, and dugongs are common in the Bay. Fish, crabs, and prawns abound in the estuary regions.

All of these aspects of the Catchment contribute to the necessity for a plan to protect and manage the unique natural heritage of the area.

1.4 LAURA-NORMANBY CATCHMENT MANAGEMENT GROUP

In 1998 a steering committee was formed with the vision of a cooperative approach for the sustainable management of natural resources and maintenance of biodiversity in the Catchment. The primary interest of the group has been to create a balanced approach to the use of Catchment resources. The membership of the Group reflects the diverse interests of the community. Cook Shire Council as the local government body, grazing, grain growing, horticulture, tourism, small mining and an embryonic aquaculture industry are represented.

The LNCMG provides a round-table forum to discuss and exchange ideas and information. Early discussions within the LNCMG developed 4 specific objectives. These are:

- Fostering coordination and corporation between landholders, community action groups and Government Agencies in the management of water, land, vegetation and related biological resources.
- Identifying and prioritising interrelated land and water resource issues in the Catchment. Identifying solutions and agreeing on actions through public and Government participation.
- Promoting the planned and sustainable economic growth of catchment areas in the Laura-Normanby river system.
- Establish balanced ecosystems within our Catchment, to maintain the productivity and diversity of the natural resources upon which we all depend.

1.5 LAURA-NORMANBY CATCHMENT MANAGEMENT STRATEGY

The Laura-Normanby Catchment Management Strategy was initiated by the LNCMG in 2002 with funding from the Department of the Environment, Natural Heritage Trust (NHT1). A Project Officer (Cathy Waldron) was appointed by the LNCMG to conduct community consultations. A survey was sent to all the known stakeholders within the Catchment area, including private landholders, traditional owners and land managers. The Project Officer then spent six months meeting with the stakeholders and discussing the Catchment issues. The general topics that were identified as priority issues (as ranked by the community) are:

Priority Catchment Issues Identified During Community Consultations

Rank:	Issue:
1	Water quality and quantity [surface and groundwater]
2	Weeds
3	Nature Conservation / Biodiversity
3	Grazing
4	Feral Animals [inc, cattle, horses]
4	Use of fire
4	Fishing [commercial / recreation]
4	Tourism and recreation [camp sites / rubbish]
5	Cultural Heritage
5	Land degradation [erosion / salinity susceptibility]
6	Clearing
6	Aquatic habitat
7	Agriculture / horticulture
8	Mining
9	Aquaculture

In March 2003, discussion papers and surveys on each of the topics were sent out to the members of the community in order to further define the issues and to identify the most appropriate objectives and strategies to manage these issues. The Objectives and Strategies included in each section of this report were chosen by those who responded to the survey, and were compiled by the LNCMG Project Officer (Ian Adcock). Mr. Adcock was also responsible for beginning the writing of this report, including the History of the Catchment (Section 1.7) and the Climate and Rainfall Section.

In the final stages of the Strategy's production (June/July 2005), local consultants (Kim Stephan and Christina Howley) were contracted to complete the final report. Their contributions included conducting an in-depth assessment of the priority issues identified by the community and compiling additional information relating to the major industries within the Catchment. The Cultural Heritage section was written by John Farrington of the Quinkan & Regional Cultural Centre.

Implementation of the strategies outlined in this plan will require significant cooperation among government agencies and local landowners, as well as communication and coordination across the Catchment. The landholders' knowledge and assistance is critical to the identification of problem spots and to the implementation of the actions required to address these issues. Government support will be necessary for activities such as property planning, fencing and maintenance, burning and feral weed and animal control. Some sources of financial support and landcare advice for landholders and community groups are listed in Appendix A.

1.6 HISTORY OF THE CATCHMENT

PRE-EUROPEAN HISTORY

The Laura-Normanby river system, like the rest of Australia, has a long history of human settlement. For many thousands of years, Aboriginal peoples have relied on the resources of the Catchment for food, shelter and medicines. Aboriginal inhabitation of the region has been dated back at least 15,000 years (based on the rock art found) but this habitation has not always been passive and without influence. Fire and other management tools have actively shaped the surrounding landscape and influenced the resource base on which the indigenous population depended. Available resources influenced local cultures and continue to do so today.

EUROPEAN HISTORY

Grazing and mining activities dominated the early European history of the Catchment, with agriculture rising in prominence since about the 1970's. This was followed by small acreage farming with horticulture including coffee, bananas and sugar cane on a trial basis. Tourism is also becoming increasingly important economically.

GOLD RUSH

Massive changes for Aborigines began with the discovery of gold along the Palmer River in the 1870's. Lured by the promise of rich rewards, in the first three years, 15,000 Europeans and 20,000 Chinese chased the alluvial and reef gold found in the Palmer, the upper reaches of the Normanby and the Hodgkinson Gold Fields. Soon other entrepreneurs realised there were profits to be made in servicing the mining industry and cattle were brought in to supply meat for a high price in the goldfields. These new activities began the displacement of the earlier inhabitants. Fighting and strife often followed and a poor relationship developed between the communities. While the Palmer River gold lasted more than a decade, much of the wealth generated was spirited away from the region.

The Queensland Government attempted to service the Palmer region by building a railway line from Cooktown to Maytown. The first sod was turned on the 4th April 1884. The Laura section was completed in October 1888 and so the town of Laura came into being. A bridge was built over the Laura River, tested by a steam loco and approved. The estimate to complete the line to Maytown was £609,000. It was there at Laura that the Government decided to terminate the line due to financial difficulties. Steam locomotives ceased to use the line in 1930 and were replaced by Railmotors. The line was eventually closed down in 1962.

GRAZING

The birth of the grazing industry began with the Palmer River gold rush. Meat was required to feed the miners and the early properties taken up include "Butcher's Hill" in 1877, and "Olive Vale" and "Laura" in 1881. As these were closest to the route taken by the miners from Cooktown to the Palmer River gold fields and much of the land is classed as good grazing country, they quickly became viable enterprises. Until 1970 when the roads south had improved and cattle could be transported by truck, the majority of stock was driven south to Mareeba via Laura and the Byerstown Range or east to Cooktown to be shipped to the port of

Cairns. Even though the gold rush was in decline by 1883, the grazing industry was well established throughout the Catchment and with approximately one million hectares of leasehold land for 'grazing purposes' in the Catchment, has remained the dominant land use.

AGRICULTURE

The village of Lakeland Downs came into being at the beginning of the 1970's, based on a dream by Mr. Clive Foyster. With the establishment of large-scale agriculture following the clearing of trees from the basalt soils, crops were exported from a deep-water, man-made port at Archer Point. However, the enterprise was under-resourced and failed. With a change of ownership and the introduction of finance and a land buy scheme, today, Lakeland's farming, grazing and horticulture enterprises all prosper around a well-established town. A diversity of crops such as sorghum, maize, coffee, hay, navy beans, bananas, sugar cane, pawpaws, some organics, and peanuts have all been tried and tested over the years.

TOURISM AND FISHING

More recent forms of resource use and economic activity have come from the seasonal tourist trade. Holidaymakers driving 4x4 vehicles, make their way up the Peninsula to enjoy the experience of our remote area. They are invited to visit the National Park, fish, take in the Indigenous Rock Art, sample the fresh fruit and locally grown coffee. With the development of tourism, there is increasing pressure being placed on those areas of the Catchment that offer remote camping and fishing sites. As the numbers increase, there will be added pressure to find more and new areas to satisfy this latest industry.

RECENT LAND TENURE/ POPULATION

Data provided by the Queensland Department of Natural Resources & Mines (DNR&M) indicates that current land tenure in the Catchment area is primarily Leasehold Land administered by the DNR&M (approximately 987,225 hectares, or 66%), and National Park, which covers approximately 18% of the Catchment. Freehold Land (including Native Title) covers 169,562 hectares (11%), while 51,022 hectares (3%) is Unallocated State Land and 17,693 hectares (1%) is Reserve. An additional 1,583 hectares is held by the DNR&M as timber reserve and 225 hectares is forest reserve managed by the EPA (QLD DNR&M). Of the leasehold lands, 54% is held by the Pastoral Holding, 35% is Permit to Occupy, 6% is Grazing Permit Perpetual Lease, 5% is Occupational Lease and less than 1% each is Freeholding Lease, Special Lease and Special Lease Freehold Purchase. Figure 2 shows land tenure within the Catchment as of 2003.

The major population centres within the Laura-Normanby Catchment area are Lakeland Downs and Laura, both of which have less than 100 residents (Hans Looser, pers. comm., 2005). The current resident population for the entire Catchment area is less than 500.

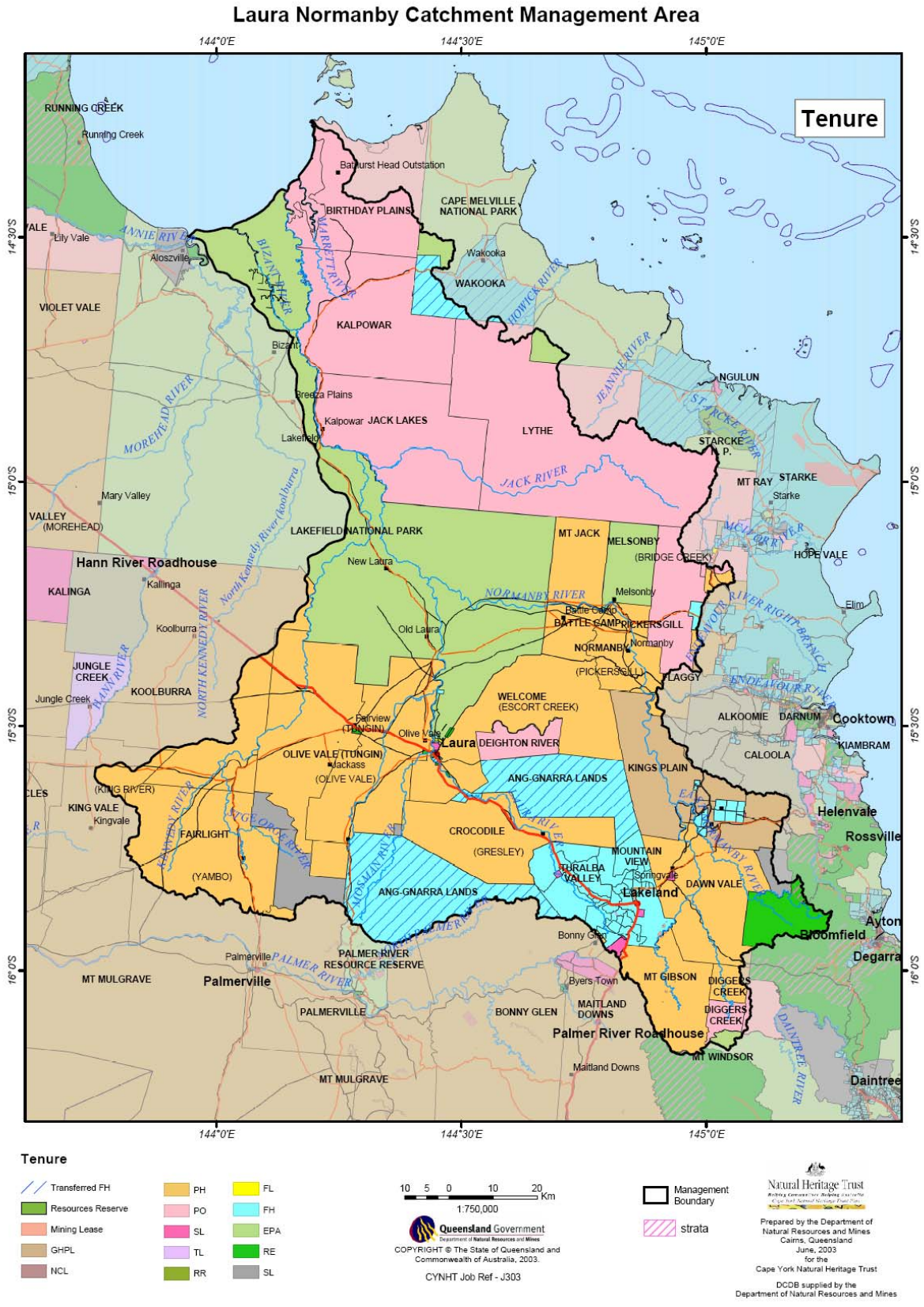


Figure 2: Land Tenure Map

1.7 BIOPHYSICAL ENVIRONMENT

CLIMATE AND RAINFALL

The Catchment has a defined 'wet' and 'dry' season with 95% of its annual rainfall occurring between the months of November and April. Mean annual rainfall varies from 600mm to 1400 mm across the Catchment with the higher falls occurring in the east and south. Rainfall is typically cyclonic or from thunderstorms during the wet season with any dry season rainfall usually of orographic (mountain) origin. Cyclones can be experienced during the wet season. The northern and central area of the Catchment experience drought during the dry season and this is reflected in the vegetation of the region.

Temperatures vary little over the Catchment during the year. Maximum temperatures of around 36° C are found in the wet season months of October through to April with the minimum being, on average, about 19° C. During the dry season, the temperatures range from 30° C in June to a minimum of 14° C in July. Humidity is around 80% during the wet season months and can drop down to as low as 56% for the remainder of the year. Evaporation rates will exceed rainfall between April and September, with rainfall exceeding evaporation only during the months of January and February.

TOPOGRAPHY and HYDROLOGY

The majority of the Laura-Normanby Catchment area is of relatively low relief and gently slopes towards Princess Charlotte Bay. Topography in the upland areas ranges from undulating rises to steep hills, with deeply dissected sandstone plateaus and intervening plains, and steep mountain ranges composed of metamorphic rocks to the south. The lowlands of the Basin include large alluvial plains and extensive areas of residual sands derived from the sandstones.

The Laura and Normanby Rivers originate in the mountains in the east and south of the Catchment area and flow to the northwest and north, discharging into the Coral Sea at Princess Charlotte Bay. Major tributaries to these rivers include the East and West Normanby Rivers and the Jack River to the southeast and east, and the Mosman, George and Kennedy Rivers in the south and southwest. Drainage from the mountain ranges across the southern Catchment is rapid, causing wide-spread flooding at the river's mouth. Annual flood waters feed extensive lagoon and wetlands systems in the lower Catchment area. Severe storm activity in the south causes surface water run off and high turbidity during the summer months. From June to November many sections of the Catchment's streams are dry and small water holes from springs represent most of the permanent water.

Figure 3: Catchment Relief Map

GEOLOGY

The central and northern plains of the Catchment area are underlain by a layer up to 70 metres thick of Cainozoic era deposits, including Tertiary period sediments (clayey silty sandstones and claystones, with some rounded quartz gravels) and Quaternary period alluvial deposits (grey silty clay, sand and gravel, and orange and white residual sands). Surface sands and gravels associated with the river systems are usually less than 10 m thick and are generally fairly coarse in the south, becoming siltier towards the northern onshore margins (Horn et al, 1995). The coastal plains at Princess Charlotte Bay are comprised of Quaternary period marine deposits including limestone, salt pans, beach sands and pumice (The 1:250,000 Cape Melville Geological Series, Sheet SD/55-9 (Geological Survey of QLD, Second Edition, 1983) and 1:250,000 Cooktown Geological Series, Sheet SD 55-9 (Geological Survey of QLD, First Edition, 1966).

Underlying these Cainozoic era alluvial and marine deposits are the Mesozoic era sedimentary rocks of the Rolling Downs Group, Gilbert River Formation (formerly named the Battlecamp Formation), and the Dalrymple Sandstone. These primarily sandstone formations are exposed across the hills and mountain ranges in the eastern and southerly regions of the Catchment area. Underlying the Mesozoic sedimentary rocks, and exposed in the mountains of the southern Catchment area, are the Paleozoic era Hodgkinson Formation metamorphic rocks (greywacke, slate, some conglomerate and metavolcanics), and intrusive Permian period granites. During the Tertiary period, volcanic basalt flowed to the surface from vents in the Hodgkinson Formation rocks. The McLean basalt, located in the Lakeland Downs area, covers approximately 300 km^2 and is composed of olivine basalt and gravels (Horn et al, 1995).

The geological maps indicate that there are a number of faults located within the Catchment area. The major fault in the region is the north-south orientated Palmerville fault located along the western margin of the Catchment area (Bain and Draper, 1997).

HYDROGEOLOGY

The Laura-Normanby Catchment area overlies two regional groundwater basins: The Laura Basin, which underlies the majority of the Catchment area, and the Hodgkinson Basin. The Laura Basin is an artesian basin (where groundwater is under pressure, and flows upwards in bores) comprised primarily of Mesozoic era sandstone formations. The Basin extends from the southern margin of the Catchment area to the edge of the continental shelf north of Princess Charlotte Bay and has a thickness of up to 1 kilometre (Bain and Draper, 1997). The Laura Basin overlies and is bounded to the south and east by the Paleozoic era Hodgkinson Basin (Passmore, 1978).

The principal groundwater aquifers in the Laura Basin are the Gilbert River Formation and Dalrymple Sandstone. There are also water resources in the overlying Cainozoic sediments. Groundwater in the Laura Basin flows generally to the north. Recharge by infiltration of rainfall into the outcropping sandstone aquifers occurs mainly along the elevated southern and eastern margins of the Basin (Bain and Draper, 1997). Natural discharge occurs at permanent and semi-permanent springs. Numerous springs have been identified in the Quinkan region (surrounding Laura) and at Lakefield National Park. Spring flow also maintains perennial or near continuous flow to the little Laura and the Normanby Rivers.

The fractured rock aquifers of the Hodgkinson Basin underly the southern portion of the Laura-Normanby Catchment area and include the McLean basalt that occurs in the Lakeland region. These fractured rock aquifers of the Hodgkinson formation and McLean basalt provide an important supply of groundwater for domestic and stockwatering purposes, through a number of low yielding bores. The fractured rock aquifers of the Hodgkinson Basin principally recharge vertically and therefore the groundwater supplies are closely dependent on rainfall (Horn et al, 1995).

Figure 4 shows the general geology of the Catchment.

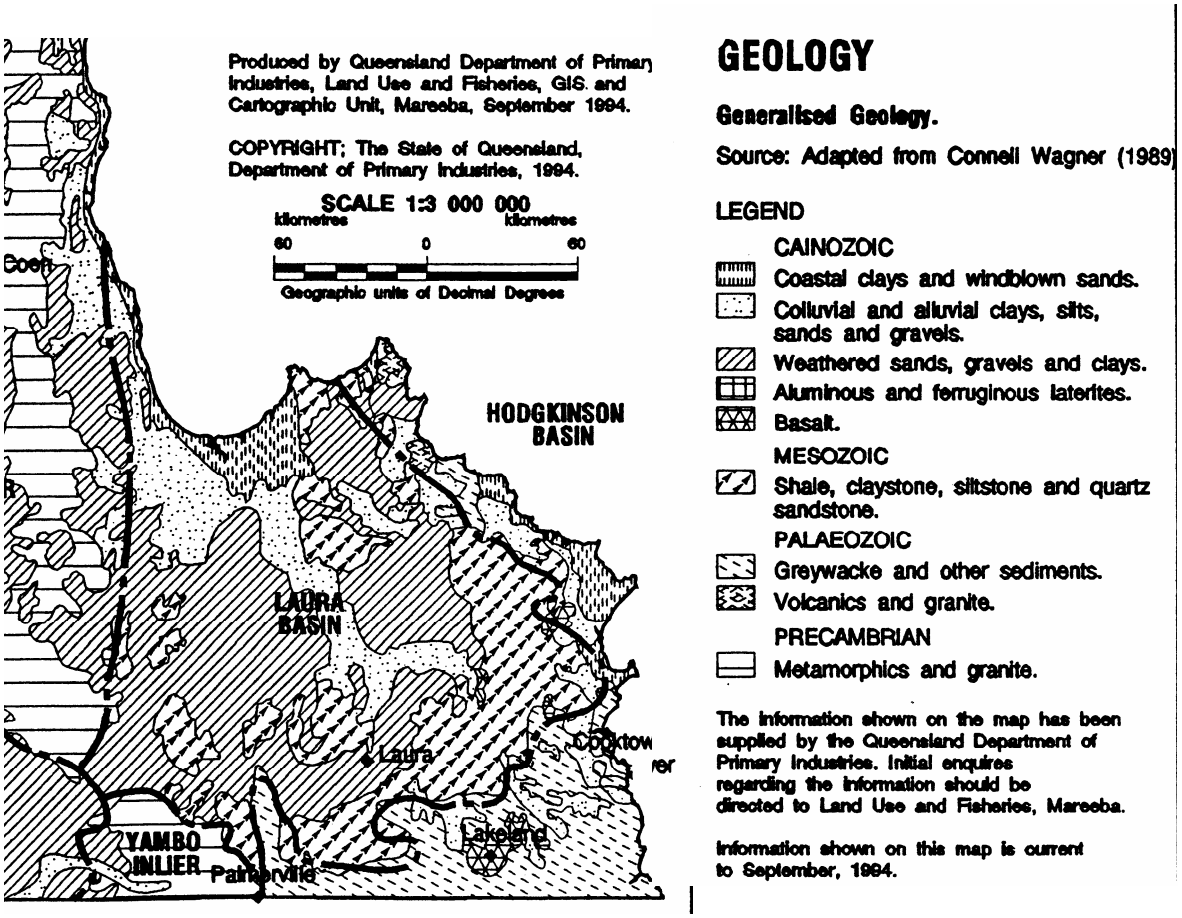


Figure 4: Catchment Geology (adapted from Biggs et al, 1994).

SOILS

A wide variety of soil types occur within the Catchment. Along the coast and inland from Princess Charlotte Bay, soils are dominated by moderately deep (0.5 m - 1.0 m) and farther inland, very deep (1.5 m - 5.0 m) saline clays. The Laura basin generally consists of shallow (0.25 m - 0.5 m) rocky sandy soils derived from sandstone and red and yellow silty soils and massive sands (1.0 m - 1.5 m deep) in the lower plains. Soils in the Hodgkinson Basin region (southern Catchment area) are comprised primarily of sodic and non sodic yellow and grey soils, and red and brown structured clay soils derived from volcanic basalt in the Lakeland Downs area. The basaltic soils support a wide range of agricultural enterprises (Horn et al, 1995).

Pockets of sodic yellow or grey soils (Gibson) occur along the Laura River between Lakeland and Laura and in the vicinty of the Normanby River near Battlecamp. Red soils (Victor) found in the vicinity of the town of Laura and along the Laura River are generally 1 m to 3 m deep and overlie significant salt depositions. Deep acid to alkaline yellow soils (Greenant) occur along the alluvial plains of the East and West Normanby Rivers, along the Laura River north of Laura, and along the Normanby River to the north and west of Battlecamp.

Soils in the Catchment area are generally associated with high levels of natural erosion and low nutrient levels. Significantly accelerated rates of erosion have been observed in association with roads constructed through Victor, Greenant, and Gibson soils. A moderate risk of development of secondary salinity is associated with Gibson and Victor soils. Low nutrient levels in sandy soils are a major restriction to grazing and agriculture (Biggs and Philip, 1995).

2.0 CULTURAL HERITAGE (by Ian Adcock, unedited)

*****This section has not been updated and needs revising.**

The Laura-Normanby Catchment is rich in Aboriginal and European cultural sites. Ancient Rock Art that adorns the caves and escarpment face along the Laura River Valley is world renown. Areas along the Deighton River and upper reaches of the Little Laura River record a culture of the inhabitants of long ago.
Some of the art depicts the coming of the white man and Chinese miners on their way to the diggings on the Palmer River Gold Fields.

Rock Art means different things to different people. The images may be an integral part of Aboriginal belief systems. Some represent spirits of the creation period and contain the essence of Ancestral Beings who created the environments, the peoples and their laws. Others represent the signatures or daily activities of the people who's country it was.
Non-Aboriginal people may perceive the images as personal creative expressions which have certain aesthetic qualities. Archaeologist record rock art and attempt to date the images, determine changes in style, and relate them to changes in society and the environment. Despite the different values placed on rock art, there is a universal belief that it is part of Australia's unique cultural heritage and that it should be protected for future generations.
The Laura-Normanby Catchment has a great richness and diversity in its rock art heritage and sites are distributed through the area where there are suitable rock surfaces. Around the town of Laura, human and animal figures, birds and reptiles are painted in bright colours, with complex decorative details.

Rock Art sites are among the many physical traces of Aboriginal occupation to have survived over the eons of time.

Story places' are areas of landscape or specific natural features which are of spiritual or historical significance. They do not necessarily contain physical evidence and may be linked to other story places.
The links between Aboriginal people and their country continues and provisions in future land management needs to be made, such as allowing for burial sites on home land.

In 1885 the Cooktown to Laura Railway commenced construction and terminated at the newly built bridge across the Laura River. The village of Laura came with the railway in 1888.

The line was demolished in 1962 and very little remains to show for a superhuman effort. The line embankment, an occasional sleeper, dog spike, the goods shed steps in Laura and the remains of the bridge over the Laura River. Some stone work is still visible along the line rout. The bridge across the Deighton River a trestle construction solely of timber, built by hand, was a feat of human endurance and ingenuity.
Principal tools used would have been, cross cut saw, axe, adze, auger, wedges, and hand forged bolts fabricated on the job. It's a shame that some sort of preservation was never carried out to document and preserve these relicts.
Remains of the old Laura Police Camp and coach exchange depots are still visible through the district.

TABLE 1: LAURA-NORMANBY CATCHMENT AREA
CULTURAL HERITAGE STRATEGIES & RECOMMENDED ACTIONS
GOAL: To preserve past cultural sites and history, and maintain present living cultures for the future.

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
CH1	Prepare educational material and programs on the history and heritage sites of the Laura-Normanby Catchment.	**** Table Not Completed**	
CH2	Develop and maintain a register of all the cultural heritage sites within the Laura-Normanby Catchment.		
CH3	Develop and implement management plans for protecting significant cultural heritage sites within the Catchment.		
CH4	Develop and implement protocols on consultation practices and participation with Aboriginal communities regarding any Aboriginal cultural sites.		
CH5	Encourage the maintenance of appropriate traditional practices and their incorporation into the broad scale resource management programs.		
CH6	Resource a systematic program of data collection, analysis and communication of the cultural heritage in the Laura-Normanby Catchment.		
CH7	Involve all land managers in the management of sites of cultural significance.		

3.0 MAJOR INDUSTRIES WITHIN THE CATCHMENT

3.1 AGRICULTURE

Banana Farm in the Lakeland Region

Agriculture and horticulture within the Catchment are mainly limited to the upper reaches of the Laura River and to a lesser extent the Normanby. This is due to the geographical distribution of soil types and the reliability of the water supply. The rich basaltic soils in the Lakeland area support a wide range of crops, including:

Peanuts	Navy Beans	Maize
Sorghum	Bananas	Mangoes
Coffee	Paw-paws	Farm forestry

Top quality crops of sugar cane and hemp were grown on a trial basis. However, the transport costs to the closest mill and the price of sugar, and similar issues with hemp, made these crops economically unviable.

The reliable water supply to farms in the Lakeland Downs area comes from large private dams, replenished during the wet season, which allow irrigation to be carried out during the dry part of the year. Groundwater is becoming increasingly relied upon for irrigation as greater areas of land are going into production. One resident estimates that there is enough suitable land available to double the amount of agricultural industry in the Lakeland region (Graeme Elmes, pers. comm., 2005). The expansion of the industry is made possible due to the improvement of the road to Lakeland and the upgrading of irrigation systems allowing for more efficient use of water. The crops that are likely to expand include bananas, watermelon, and seed crops such as sorghum and corn. The seed crops have a high market value and may provide an important source of income to local farmers. They also have high water requirements and depend upon adequate surface water and groundwater supplies through the dry season.

Intensive cropping can impact the surrounding environment and downstream waterways in several ways. Land clearing for agriculture can increase erosion and reduce wildlife habitat.

It can cause changes to catchment hydrology through water extraction, changes in vegetation cover and the addition of irrigation water. Potential exists for serious impact upon water quality in local streams from poor management of farm chemicals and fertilisers.

Loss of topsoil and soil nutrient declines have not been identified as major concerns associated with agriculture in the Catchment area. These issues have been managed in the Lakeland area through the use of contoured paddocks and efficient irrigation systems. The contoured paddocks reduce surface water runoff, which results in minimal loss of soil and more efficient use of water and fertilisers. Overhead irrigation with centre pivot has replaced traveling irrigators and lateral irrigation. Previously large volumes of water were wasted due to drift caused by the prevailing southeast tradewinds. The spray nozzle on the centre pivot system can be lowered to avoid loss of water to drift. The current centre pivot irrigation system has reduced the volume of water required for irrigation by half (Elmes, pers. comm., 2005). This system is in use at most farms throughout Lakeland. Banana farms are irrigated using efficient computer controlled trickle irrigation systems. These systems monitor the exact volumes of irrigation water and fertilisers supplied to the plants.

Some concern has been expressed by resource managers and Lakeland landowners over the increasing reliance on groundwater for irrigation. The fractured rock aquifers of the region are dependent on rainfall to be replenished and the total available groundwater resources are unknown. Over-extraction and/or lack of rainfall could result in the depletion of groundwater resources, leaving inadequate supplies to support the planted crops or for domestic use.

Because agriculture occurs across the headwaters of the Laura River, impacts in that region have the potential to affect the whole Catchment. Fertilisers, pesticides and herbicides can be transported via groundwater and surface water runoff into local streams, where they may impact upon aquatic habitats downstream. Aerial applications of chemicals can also result in contamination of water supplies and soils outside the intended spray area. There is no evidence of agricultural chemicals impacting surface water or groundwater quality in the region but there is also no known monitoring for agricultural chemicals in groundwater or surface water in the Lakeland region. Previous monitoring projects have detected high nutrients in the Laura River, although it is unclear whether this data is reliable. High nutrient levels could be associated with the use of fertilisers, cattle, town septic systems, or natural seasonal fluctuations.

The use of efficient irrigation systems and contouring in Lakeland will reduce surface water and sediment runoff and potential impacts upon water quality. However, careful monitoring of chemical use and water quality are recommended, particularly as the agricultural industry expands. The property planning process should aim to avoid or minimize impacts on neighbouring lands and natural resources and endeavour to develop sustainable production methods. Decision-making on issues affecting land use within the Catchment needs to be based on adequate mapping of water resources and assessment of land capability. In particular, future subdivision of land must ensure that the land resource is not diminished by the creation of unviable holdings that may impact on the future productivity of good quality agricultural land.

TABLE 2: LAURA-NORMANBY CATCHMENT AREA
AGRICULTURE and HORTICULTURE STRATEGIES & RECOMMENDED ACTIONS
Goal: A sustainable and economically viable agriculture industry

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
AHA1	Encourage and support training in Agriculture and Horticulture skills.		
AHA2	Promote the sustainable and efficient use of natural resources within the Agriculture and Horticultural industries.		"Support cropping and horticulture industry to continue and improve ecologically sustainable practices."
AHA3	Involve the community in natural resource monitoring programs.	Monitoring of water quality downstream from Lakeland should be conducted to ensure that agricultural chemicals are used efficiently and sustainably.	
AHA4	Compile agriculture and horticulture suitability information for landholders in the Laura-Normanby Catchment Area.	Land use within the Catchment needs to be based on adequate mapping of water resources and assessment of land capability.	
AHA5	Provide links and support to land holders with agriculture, horticulture development projects.		
AHA6	Support and encourage Property Management Plans within the industries.		
AHA7	Develop links with Landcare Groups and the Annan-Endeavour Catchment Group.		

3.2 GRAZING

Cattle Station Outside of Lakeland

Grazing is the most extensive land use in the Catchment. Properties tend to be large (grazing leases average around 600 square miles in size), with low intensity management applied. Cattle density is estimated to be approximately 1 per square kilometer across the Catchment (Ian Adcock, pers. comm., 2005). The major issues faced by the local cattle industry include transport and infrastructure limitations and distance to major markets. The construction of the Byerstown Range Road and further development of the Cooktown Development Road to bitumen standard is helping to provide year round access. However, until the Peninsula Development Road standard is improved upon, movement of stock to the exporting port of Weipa from the Southern Peninsula area will not be an option.

The environmental impacts of grazing in the Laura-Normanby Catchment are considered to be minimal in comparison to other grazing regions due to the relatively low cattle numbers. However, degradation of water quality around waterholes frequented by cattle has been identified by stakeholders as a significant issue of concern. Although the numbers of cattle across the Catchment are low, the congregation of cattle around waterholes leads to high impacts in these areas. Cattle are attracted to virtually all permanent waters in the Catchment, even within the Lakefield National Park. Loss of riparian vegetation and erosion of stream banks occur in areas where cattle have access to the stream. A decline in ground cover due to grazing and soil compaction from hooves can also lead to accelerated erosion. Road and track networks to service the industry can also lead to erosion problems. Fencing off rivers and supplying an alternative source of stockwater may be necessary in some areas.

Due to the low nutrient levels in soils in the Laura-Normanby Catchment, the land will only sustain low density grazing. This means that income per hectare is comparatively low. In many cases the landholders have at least 100 years of data on their properties and can see what management practices need to be changed but cannot afford to implement changes. Landholders and industry groups are now looking for incentives and discounts from the Government and supply companies to enable them to become more economically viable, to compete with landholders in areas of higher yield and to make the changes to farming practices that will make properties more environmentally sustainable.

A group of producers in the Georgetown district has begun processes to improve cattle management and property planning. With the assistance of Beef Production staff from the Queensland Department Primary Industries, they are documenting land types, management requirements, cattle management regimes and issues affecting their property management. Known as a Local Consensus Data Group, this is an excellent vehicle to pool insight and understanding for those producers who are thoughtfully planning their property management. This interaction and group planning could also provide a strong basis for integrated catchment planning in the Laura-Normanby.

TABLE 3: LAURA-NORMANBY CATCHMENT AREA
GRAZING STRATEGIES & RECOMMENDED ACTIONS

GOAL: A sustainable grazing industry integrating environmental, economic and cultural values

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
GM1	Promote a greater understanding of pasture and rangeland ecology.		
GM2	Identify indicators of sustainability and develop monitoring programs.		
GM3	Identify and promote best management practices.	-Provide information about grazing impacts and their causes to graziers. -Government and community support for the development of Property Management Plans for grazing properties.	-"Native pastures maintained by appropriate combinations of moderate stocking rates, fire and spell grazing." -"Emphasis on improved liveweight gain over increased stocking rates." -"Promote new technologies deemed to be both ecologically sustainable and economically viable."
GM4	Encourage and promote the Local Consensus Data group process and "Future Profit" as management planning tools.		
GM5	Assess land suitability for grazing in the Laura-Normanby Catchment.		"Seasonal stocking rates are consistent with land condition and long-term carrying capacity of each land title."
GM6	Develop improved systems for sharing resources and information between stakeholders groups.		

3.3 TOURISM AND RECREATION

Many areas of the Laura-Normanby Catchment are used for Tourism and Recreation. The Laura-Normanby River system provides a wide range of camping and fishing locations for both visitors and local residents. All overland travellers to Cape York must cross the Catchment boundary at some point. Popular tourist destinations include Lakefield National Park and the aboriginal rock art, found in the vicinity of Laura. Many graziers and other landholders are also gaining income diversification from tourism services such as Farm Stay or Tour Guiding. As the road from Mareeba to Cooktown improves, visitors to local destinations will continue to increase and additional infrastructure will be required to support the tourist industry. Consideration must be given to the way tourism and recreational use of the Catchment will develop.

From the mouth of the Normanby River in Princess Charlotte Bay to the ranges of the Great Divide, the Catchment is already under increasing pressure from recreational activities. The attraction to remote wilderness means that tourists and recreationalists will consistently extend the boundaries of their activities, opening new areas to impacts and management needs. With GPS and modern four-wheel drives, the only restriction to access is often weather. Camping and other recreational activities often occur on land that is not designated or supported for tourism and recreational use. Where the appropriate infrastructure is not in place, such as effluent free toilets, rubbish bins, and fire pits, the impact to the environment is increased. New tracks can lead to erosion issues and weeds can be spread into new areas.

One of the major issues regarding tourism in the area is the minimal economic benefit that is gained from much of the four-wheel drive traffic. Many campers bring their own supplies with them and put little back into the local economy. Infrastructure must be provided to support this traffic, despite the lack of economic returns from this investment in infrastructure.

Lakefield National Park, which occupies 18% of the Catchment area, is a popular camping destination for both tourists and locals. The park was established in 1979 and had previously been utilized for cattle grazing. Numbers of visitors to the Lakefield region have significantly increased since the establishment of the park (Barry Lyons, pers.comm., 2005). In 2004, there

were 2,343 camping registrations, with each registration generally representing between one to six persons and some registrations representing up to 28 (QPWS, IA Parks Self Registration Report). The Cook Shire Council traffic counter located at New Laura registered approximately 9,700 vehicles for the year of 2004. (The traffic counter registers vehicles passing in both directions, so it does not represent the total number of cars visiting the park.) The number of QPWS camping registrations prior to 2004 was not available, however traffic counter data indicates that vehicle numbers did not significantly increase between 1994 and 2004 (CSC Traffic Figures, provided by Graeme Burton).

Rock art and cultural heritage in the Catchment, and particularly within the Laura or Quinkan region, offers a unique tourism product and important employment opportunity for the Laura region's indigenous population. The rock art of the Quinkan region is of equal significance to that found in the Kimberley or Kakadu regions. There are currently several rock art tours available. The art at Split Rock can be visited as a self-guided tour or with a tour guide. Other sites, such as Mushroom Rock and Giant Horse, are only available to visitors with a local indigenous guide. In 2004, the Quinkan & Regional Cultural Centre at Laura was opened in order to enhance the value of the rock art visitor's experience and provide long-term tourism opportunities for the community. Through the Centre, members of the local community are working to expand the number of sites and tours available. However, a number of issues, including land tenure and the delivery of appropriate training must be addressed. (John Farrington, pers.comm., 2005).

According to the manager of the Quinkan Centre, a crucial factor for the development of sustainable tourism in the Laura area will be the completion and implementation of a Cultural Heritage Management Plan. A Draft Plan has been released, but due to the large number of stakeholders, final production and implementation of the Plan is likely to take a considerable amount of time and will require further government assistance. The Cultural Heritage Management Plan will need to have workable links with the Cape York Natural Resource Management Plan and the Cape York Tourism Development Plan (John Farrington, pers.comm., 2005).

MANAGEMENT ISSUES

Not everyone who lives and works in the Laura-Normanby Catchment wants the area thought of as wilderness. New legislation, such as the Vegetation Management and Other Legislation Amendment Bill 2004 (Qld), will seriously limit the opportunities for some landowners to expand existing industries such as agriculture and grazing. It is therefore likely that landowners will be increasingly looking towards tourism for business opportunities. This expansion of the tourism industry could also impact upon natural resources, particularly if the appropriate infrastructure does not exist.

In May, 2005, the Queensland government announced that it has allocated $500,000 in new initiative funding for a Cape York Tourism Development Action Plan. So far, little information is available about the production of the Plan. For the plan to be relevant or successfully implemented, it is imperative that all sectors of the community be involved with the planning process. The Plan will need to address the growing infrastructure requirements in the Catchment area, as well as the necessity for appropriate training and assistance with business planning and management.

TABLE 4: LAURA-NORMANBY CATCHMENT AREA
TOURISM AND RECREATION STRATEGIES & RECOMMENDED ACTIONS

Goal: To develop a sustainable tourism and recreation industry, whilst maintaining the natural integrity of the Catchment.

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
TR1	Tourism and recreational fishing is maintained at an ecologically sustainable level within the Catchment.	Recreational resources are identified and mapped and a management plan is developed for each area.	"Promote ecologically sustainable and culturally appropriate tourism that benefits local communities."
TR2	Encourage low impact recreational activities in the Catchment.		"Develop protocols for tourist operators (local community work together with tourist operators)."
TR3	Improve tourist information services through the Catchment.		"Develop orientation and interpretation materials for self-drive tourists."
TR4	Provide suitable facilities at established Recreational sites to meet visitors needs yet protect the sites.	Identify roads and other areas where infrastructure needs do not meet the growing tourism industry.	-"Identify for treatment high risk sites where tourist/camping facilities are impacting on water quality." -"Support improvements to visitor facilities that reduce environmental impacts (e.g. toilets and waste facilities)."
TR5	Implement a Catchment wide management plan for problems specific to recreational areas	Determine where infrastructure needs to be improved or access to critical areas should be limited via camping permits or road closures.	"Develop stronger permitting and compliance systems for when other methods don't work."

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
TR6	Encourage the development of a stakeholder advisory committee to steer future direction for tourism and recreation within the Catchment.	The Cape York Tourism Development Action Plan must be produced with full participation by all relevant sectors of the Catchment.	"Work with local community to develop a comprehensive and well-promoted natural and cultural tourism strategy."
TR7	Provide training and support for the development of appropriate tourism related businesses.	-Provide financial assistance for the development of tourism related businesses, particularly where landholders are financially impacted by the Vegetation Management Amendment Bill (Qld Bills, 2005). -Ensure that the appropriate training and business planning advice is available for members of the Catchment involved in tourism related businesses.	"The Catchment to be marketed and recognised as a desirable visitor destination."
TR8	Liaise and support Queensland Fisheries Service and Sunfish who manage recreational fishing.		

3.4 FISHERIES

Recreational Fishers on the Normanby River (Source: B. Lyons, QPWS)

The Laura-Normanby River system is a haven for recreational fisherman and the estuary supports a small commercial fishing industry. The aquatic habitats of the rivers support a diverse range of fish and crustaceans. There is a variety of wetlands associated with the Normanby River and these include mangroves, saltmarsh and claypans as well as seasonally inundated brackish-water wetlands. These wetlands form important fisheries' nursery areas. Target fisheries species include barramundi, grunter, mangrove jack, salmon, shark and mud crab. There is a commercial net fishery and a recreational line fishery for barramundi in the estuary of the Normanby River. The freshwater habitats of the Normanby River also support an important recreational line fishery.

In the past, Princess Charlotte Bay, where the Normanby discharges, has supported a prolific commercial fishing industry, with up to 50 prawn trawlers and 20 to 30 net fishers operating within the Bay in the 1970's and 80's. Princess Charlotte Bay is now zoned as a Special Management Area under the Great Barrier Reef Marine Park zoning regulations. No trawling is allowed within the bay and only a limited number (4) of net fishing permits have been issued. The Special Management Area does not include the river itself and there are no special restrictions on commercial fishing within the tidal reaches of the Normanby. There are currently 6 net fishers and 3 - 4 commercial mud crabbers working within the estuary (Ian McCollum, pers. comm., 2005).

There are no restrictions on the number of recreational fishers in the Normanby and there is no reliable catch data available for the recreational harvest from the River system. The only survey of recreational catch was conducted from 1986 - 1991 by Qld DPI&F. Anglers in the national park were asked by park rangers to fill out a voluntary catch card prior to departing. The results of the survey indicated that the recreational barramundi catch in the park ranged from 4.4 to 9.4 tonnes per annum and the average angler caught 1.26 barramundi per visit. The catch rate for anglers participating in the study steadily increased between 1986 - 1991 (Russell and Hales, 1993).

Apart from the harvest by local residents, increasing numbers of Queensland and interstate travellers visit Lakefield National Park each year. A trip into the National Park usually involves some recreational fishing. Although many visit during the winter months to catch barramundi, this is not the optimum time to catch this species.

QPWS rangers have seen no evidence of reduced fish populations in Lakefield National Park, despite the increase in visitor numbers. In fact, they believe that barramundi numbers have increased significantly since the national park was established in 1979. At that time, barramundi fishing usually resulted in a high catch of catfish- often 15 to 20 catfish per barramundi. Crocodile hunting ceased around 1974 and since then estuarine crocodile numbers in the Normanby have notably increased. It is believed that the increase of crocodiles feeding in the area has decreased the catfish population, which has allowed the barramundi population to thrive, bringing the ecosystem back into a more natural balance (Barry Lyons, pers.comm., 2005).

In order to protect this natural balance, there are some who would like to see the bag limit for barramundi in Princess Charlotte Bay and all of the streams of the Laura Basin, including the National Park, reduced from 5 to 2. In their submission for the Draft Rezoning and Management Proposals for Princess Charlotte Bay, the Endeavour Sportfishing Association states that; "We are particularly concerned with the "fill the freezer" mentality of many visiting anglers… The ongoing and increasing effect of this pressure is likely to be detrimental to both the local ecosystems and the future condition of the fishery. A possession limit of 2 would see a significant drop in overall numbers, but still allow visitors to keep a reasonable feed of fish."

The Endeavour Sportfishing Association has also proposed banning the use of set lines and stainless steel hooks in Lakefield National Park. The use of set lines is believed to cause significant mortality to non-target species such as freshwater turtles, waterbirds, and crocodiles. Stainless steel hooks, due to their long life span, do not disintegrate but are left dangling in the mouths of fish and can seriously harm the fish.

TABLE 5: LAURA-NORMANBY CATCHMENT AREA
FISHERIES STRATEGIES & RECOMMENDED ACTIONS

Goal: The continuation of a productive fisheries industry maintained through educated management decisions and a healthy catchment.

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
F1	Promote education on aquatic and marine ecosystems and species breeding requirements.		
F2	Improve our knowledge base of the fishery's capabilities and potentials.	-Identify important breeding habitats in fisheries' resources. -Identify potential threats to fisheries' resources in the Catchment.	"Systematically survey fish and macroinvertebrate diversity and community structure throughout all major systems which were not adequately covered in CYPLUS."
F3	Collate and utilise information on Aboriginal traditional use and knowledge of fisheries.		
F4	Develop and implement a standard riparian zone protection and management plan.		-"Provide support (including through grants) to landholders to undertake measures to reduce impacts on and threats to riparian and aquatic habitats." -"Include management goals and monitoring methods specific to wetland and riparian management in Property Management Plans."

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
F5	Encourage links between recreational fishers and scientific research.	-Monitor recreational fish catch within the national park. Repeat the 1993 QDPI voluntary catch card survey for anglers visiting the park. -Determine if the bag limit for barramundi should be reduced based on a thorough evaluation of recreational fish catch data. -Ban the use of set lines and stainless steel hooks within Lakefield National Park and potentially the entire Catchment area.	

3.5 MINING

Historically, most mining ventures in the Laura-Normanby Catchment have focused on gold. Alluvial gold was discovered in the West Normanby River around 1876 (Denaro and Ewers, 1995). The Brothers deposit on the West Normanby River has been a major contributor for the approximately 18kg of gold recorded for the West Normanby River Area.

Mining is not currently a major industry in the Laura-Normanby Catchment. There are noticeably very few mines present in the Laura-Normanby Catchment compared with surrounding areas on Cape York (see Figure 5). Most of those recorded with the Department of Natural Resources and Mines are abandoned gold mines. Other abandoned mines include arsenic, sapphire, copper and gemstone mines (DNR& M website, 2005). The principal areas of operation are the upper reaches of the Normanby and Laura Rivers.

A large part of the catchment is classified as 'sterile'. This means that mining tenure over the land is excluded under the Mineral Resources Act, 1989 (Paul O' Sullivan, pers.comm, 2005). The majority of sterile land in the Catchment is within Lakefield National Park. All National Parks are excluded from mining unless a mining lease was present before the National Park was gazetted.

Reconnaissance sampling in the 1980's indicated that high grades of alluvial gold and significant platinum and palladium contents occur in the Laura River (Denaro and Ewers, 1995). An underground coking coal resource exists at Bathurst Range. A feasibility study has been undertaken to produce a mine plan for the production and export of this high grade coking coal (Denaro and Ewers, 1995).

There are at least two gold mines in the catchment that have been actively operating for the last 15-20 years (Graeme Elmes, pers. comm., 2005). Like all mining leases these mines must have an Environmental Management Plan (EMOS) before a mining lease is issued. This plan outlines a set of conditions regarding the impact, limitations and rehabilitation of the mining venture. Once a lease is issued and the mine is actively operating, inspectors from the EPA inspect the mine a few times a year to check that it meets the water quality, tailings and quarry guidelines.

As regulations tighten on other aspects of land use (such as agriculture), mining may become more of an economical option for some landholders.

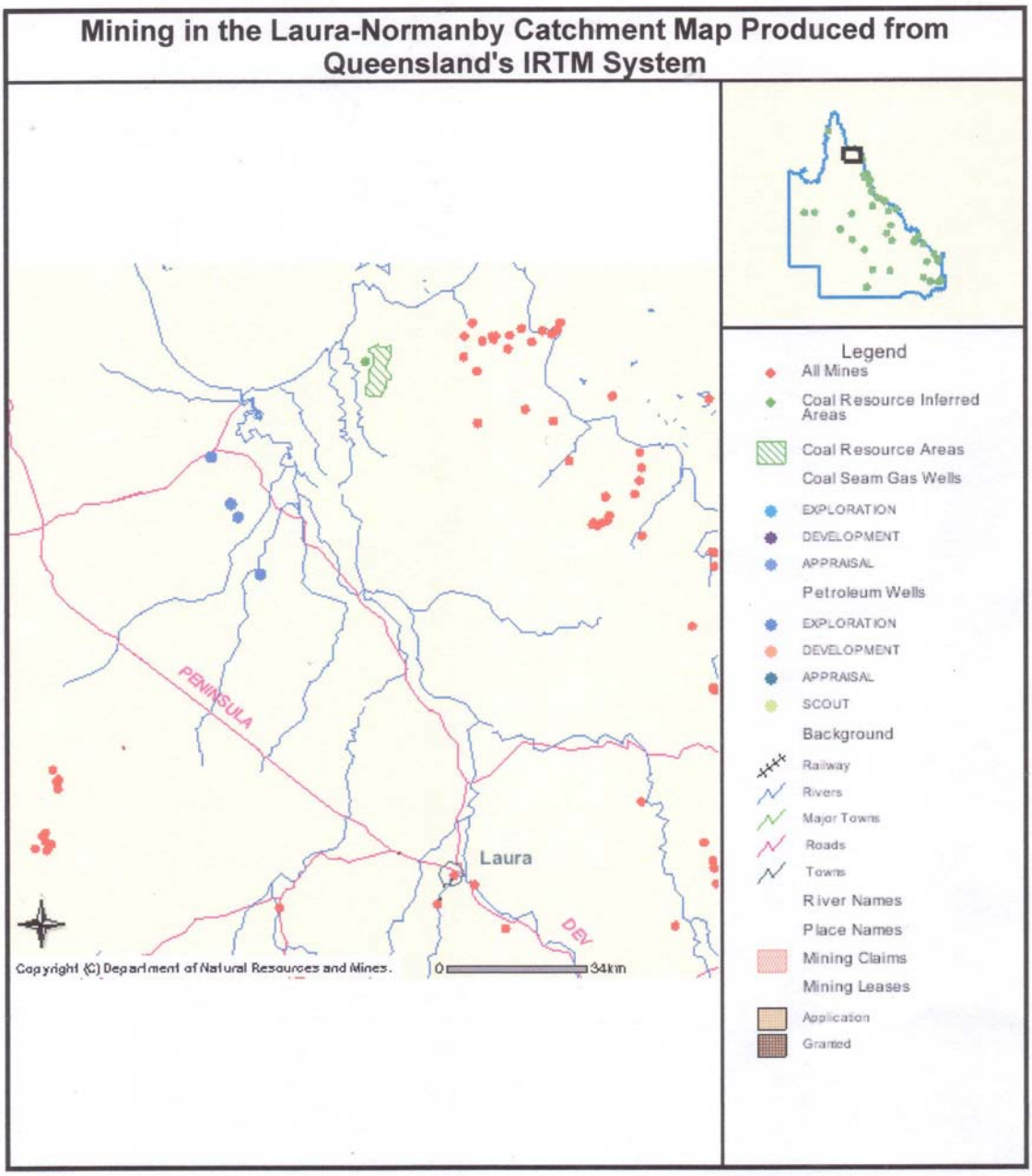


Figure 5: Catchment Mining Lease Locations
(Source: www.webgis.nrm.qld.gov.au/servlet/com.esri.esrimap 12/10/2005)

TABLE 6: LAURA-NORMANBY CATCHMENT AREA
MINING STRATEGIES & RECOMMENDED ACTIONS

Goal: To implement current best management practices and to ensure the effective rehabilitation and maintenance of past mine sites

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
M1	Encourage a greater awareness of mine rehabilitation procedures and benefits within the whole Catchment.	Develop extension material on mine rehabilitation and current mining practices.	-"Commence audit of abandoned mine sites." -"When closing mine sites, ensure papulations of threatened bat species are not threatened."
M2	Integrate local mining issues in any sub-regional management planning.		"Negotiate CYP specific mining guidelines with stakeholders."
M3	Identify and map all past and current mining sites for monitoring of contaminated sites.		"Link with the DNR&M abandoned mine land program (AMLP). This program addresses issues relating to abandoned mine sites on a state-wide risk-based priority basis."
M4	Increase the understanding of water quality in the Catchment in relation to downstream effects from mining operations.	Include monitoring of mining impacts in community water quality monitoring projects.	
M5	Support the development of best practice mining procedures.		"Collate relevant information about the existing statutory requirements and processes and local knowledge, relating to environmental management of mining."

4.0 PRIORITY CATCHMENT ISSUES AND RECOMMENDATIONS

4.1 WATER QUALITY AND QUANTITY

The Normanby River (Photo Source: Barry Lyons, QPWS)

Protection of water quality and quantity was rated as the number one priority in a survey of stakeholders in the Catchment area. A number of specific concerns were raised, including the following:

- Surface water impoundments and large scale groundwater extraction may alter the duration of streamflow on the Laura River and the supply of water to springs that are relied upon for stockwater and aquatic habitat during the dry season*;*
- Increasing turbidity at watering holes and the destruction of stream banks frequented by cattle;
- Poor road construction resulting in accelerated erosion and increased turbidity in streams;
- Potential contamination of groundwater and surface water by septic systems; and
- The increased dependence on groundwater for irrigation in the Lakeland Downs area, despite unknown groundwater availability.

The following is a detailed assessment of the issues relating to surface water and groundwater quality and quantity and recommended actions to address these issues.

SURFACE WATER RESOURCES

The Laura-Normanby Catchment is greatly affected by the monsoonal wet and dry seasons. During the summer, monsoon flooding is common and overland transport is restricted. The Catchment has one of the largest annual run-off rates in Queensland. Drainage from the Windsor Tableland is relatively rapid, creating extensive flooding in the lower flood plains along the coast of Princess Charlotte Bay. In the dry season many tributaries cease flowing which greatly reduces the flow of the Laura-Normanby. This highlights the importance of access to and management of perennial creeks and waterholes in the Catchment.

In general, the flow regimes for these rivers are largely unmodified. There are, however, numerous small dams in the watershed, mostly associated with stock water and irrigation, as well as small mining operations. There are approximately 10 dams in the Lakeland Downs area; most located on gully systems, with the larger Honey and Cattle Dams located on the major watercourse. Impoundments and offstream storages in the Lakeland Downs area may be altering the duration of stream flow on the Laura River. One report suggests that the duration of stream flow in the Lakeland area had been reduced due to impoundments (Horn, 1995). Residents speculate that leaks in the dams may be providing year round flow to local streams (Graeme Elmes, pers. comm., 2005).

Large scale groundwater extraction also has the potential to reduce streamflow. The relationship between groundwater and surface water in the region is not well understood, however, groundwater is considered to be critical for maintaining dry season surface water flows. Subsurface river channel flow fed by groundwater is also critical for maintaining riparian zones and billabongs during the dry season (Horn, 1995).

Surface Water Quality

Water quality in the Catchment area streams is generally considered to be good. However, localised issues do exist and long-term water quality data is sparse and irregular. Significant issues relating to water quality in the Laura-Normanby Catchment area include;

- increasing levels of turbidity from accelerated erosion, primarily associated with roadworks and other earthworks;
- increasing levels of turbidity from cattle and feral pigs in the vicinity of streams and lakes;
- increasing nutrient and bacteria levels from septic system leakage, stock, feral animals, and people camping close to watercourses;
- potential surface water or groundwater contamination by fertilisers, herbicides and pesticides used for agriculture; and
- the reduction of riparian zones by cattle, pigs, fire, or clearing.

Cattle Hooves at Carol's Crossing on Laura River

Feral pigs present a major threat to water quality in the area. Evidence of pig activity is extensive around waterholes in the Lakefield National Park and the Quinkan region surrounding Laura. By wallowing and digging in and around these waterholes, pigs trample riparian zone plants (plants along the banks of a watercourse) and aquatic vegetation, reduce stream bank stability and increase turbidity. Cattle and horses can have similar impacts. Grazing by cattle, compaction of soil and destruction of soil structure by hooves can lead to increased erosion and surface water turbidity. Water quality problems can also occur from nutrient additions in and around watercourses frequented by cattle and pigs.

Fencing around waterholes and rivers is critical for the protection of riparian zones and water quality. One example of a successful fencing project is that of Red Lily Lagoon at Lakefield, where a pig and cattle proof fence has drastically improved riparian vegetation and water quality (Andrew Hartwig, pers. comm., 2005). However, fencing requires regular maintenance in order to be successful. In July 2005, numerous cattle were observed in the Laura River at Carol's Crossing, despite the presence of fencing on either side of the river.

Soils in the Catchment area are generally associated with high levels of natural erosion. Significantly accelerated rates of erosion have been observed in association with roads constructed through highly erodible soils. These erosion prone soil types (Victor, Greenant, and Gibson) occur intermittently along the upper reaches of the Laura and Normanby Rivers (Biggs and Philip, 1995). Increasing levels of turbidity can impact aquatic ecosystems and reduce the suitability of surface water for some uses. Increased levels of sedimentation at the mouth of the river could potentially smother seagrasses or corals growing in Princess Charlotte Bay.

Agricultural enterprises in the Catchment area are primarily limited to the Lakeland Downs area, where rich basaltic soils support a variety of crops. The agricultural industry in this area is expanding, including some crops that are dependent on ample water supplies in the dry season. Contoured paddocks at Lakeland reduce the amount of run off and thus reduce soil loss and the potential for fertilisers and other agricultural chemicals to reach streams via surface water. Although local streams and dams have not been monitored for nutrients, pesticides, or herbicides, locals see no evidence of poor water quality. They state that fish in the streams are more abundant than ever, possibly due to the leaking of dams providing year round water in local creeks (Graeme Elmes, pers. comm., 2005). Nevertheless, unless carefully managed and monitored, increasing areas of land going into production will have the potential to reduce water supplies and water quality.

Septic systems in the towns of Laura and Lakeland may contribute nutrients and bacteria to local streams. Shallow groundwater in the vicinity of Laura has been contaminated by septic systems, and it is possible that nutrients and bacteria may have also entered the Laura River. There is also some speculation that septic systems in the town of Lakeland may have impacted water quality in the creek at Perfume Gully. A salivinia weed outbreak at Perfume Gully may be correlated with increased nutrient levels from nearby septic systems.

Fires (especially wild fires) can also have a significant effect on surface water and groundwater. By removing ground cover and reducing soil moisture content, fire can lead to increased runoff rates and increased erosion. Intense wild fires can destroy watercourse riparian zones, which directly affect stream bank stability and may allow for different species to establish, with an unknown effect on aquatic habitat (Horn, 1995). An integrated fire management strategy that transcends property boundaries is required to protect water quality and other natural resources.

Riparian zones are critical for maintaining water quality and aquatic ecosystems. The riparian zones along the Laura and Normanby Rivers are mostly intact; however, some areas have been impacted by fires, land clearing and trampling by cattle and wild pigs. It is recommended that these areas be identified and measures such as the fencing off of cattle and creation of off-stream watering holes be undertaken to improve the condition of the riparian zone at critical locations.

Water Quality Monitoring

Monitoring of water quality has been conducted at several locations in the Catchment; however, a more thorough monitoring program is required. Regular monitoring will provide baseline surface water quality data so that future changes in water quality can be documented.

Water quality monitoring has been conducted along the Laura and Normanby Rivers by the Qld DNR&M and the Australian Institute of Marine Science (AIMS). AIMS scientists have conducted water quality monitoring at the Normanby River near the Lakefield Ranger Station during flood events since the late 1990's. Turbidity levels have been measured continuously by dataloggers and nutrient and sediment loads have been measured during flood events. Further monitoring at this location is planned as part of the Great Barrier Reef Water Quality Protection Plan (2004). Nutrient and sediment loads will continue to be monitored at the site. Due to the limited duration of monitoring at this location, no detailed assessment of the water quality has been conducted to date (Miles Furnas, pers. comm., 2005).

The DNR&M currently has three operational gauging stations within the Catchment, located on the Laura River at Coalseam Creek (Station No. 105102A), the East Normanby River at Development Road (Station No. 105102A), and the Normanby River at Battlecamp Road (105101A). These stations (and several others previously monitored) have been monitored since the late 1960's. Extensive monitoring of water quality was conducted until approximately 1988. The parameters monitored on a regular basis at the three remaining stations are now limited to river height and rainfall. Measurements of water quality parameters such as turbidity, nutrients and metals are collected on an irregular basis. The data collected from these sites is available to the public on the DNR&M website (www.nrm.QLD.gov.au/watershed/html/wshed.html), and is presented in Appendix B.

A review of the water quality data published on the DNR&M web page has been conducted and is presented in Table 7. Mean concentrations for water quality indicators such as turbidity, nutrients, and some metals are compared against the relevant water quality quidelines. Generally, high turbidity levels were recorded at the Laura River at Coalseam Ck (2 NTU - 585 NTU) and Normanby River at Battlecreek Road (3 - 353 NTU). The high turbidity is likely to be associated with flood conditions. Nitrate concentrations exceeded the recommended water quality guidelines at Laura River and the Normanby River at Development Rd. Total phosphorous concentrations exceeded the guidelines at the Laura River. Potential sources of these nutrients include the use of fertilisers and/or leaching from septic systems in the Lakeland area and the defecation of stock up-gradient of the sample location. Aluminium, copper and zinc concentrations at the Laura River exceeded the ANZECC trigger values for toxicants for the protection of aquatic ecosystems; however, zinc concentrations were high across the sites and may represent normal background levels for this region. Concentrations for these water quality indicators were generally within the guidelines at the Normanby River gauging station located at the Lakefield Ranger Station (Kalpowar Station).

The quality of the DNR&M data is unknown. The data has been collected on an irregular basis during both the wet and dry season, and the number of samples collected varies widely for each location and each analysis. Therefore, the mean concentrations are not necessarily representative concentrations for either base flow conditions (dry weather) or flood conditions. Additionally, recent data is sparse and the mean concentrations do not necessarily reflect current conditions. A more thorough examination of the available data is necessary to assess the seasonal and long-term trends and for many of the analyses there is not enough data to assess the current conditions. In addition, the water quality guidelines (ANZECC 2000 and the Draft Qld Water Quality Guidelines, 2005) are not specific to Cape York and may not be applicable to the local conditions.

TABLE 7: MEAN CONCENTRATIONS FOR WATER QUALITY INDICATORS IN THE LAURA-NORMANBY RIVERS
Data from DNRM Water Monitoring and Guaging Stations

	ANZECC Trigger Values, Tropical Australian Freshwater[1]		**ANZECC Trigger Values[2], Toxicants, 95% Protection**	**QLD Guidelines for Rivers of the Wet Tropics[3]**		**Laura River, Coalseam Crk, 1980-1996** (2004 Turb[4]) (n^5 = 4 - 28)	**East Normanby, Development Rd, 1981-2001** (2004 Turb[4]) (n = 4 - 38)	**Normanby River, Mt Selheim 1981-1998** (2001 Turb[4]) (n = 2 - 16)	**Normanby, BattleCreek, 1971-2004** (n= 5 - 34)	**Normanby, Kalpowar Crossing, 1994-1997** (n = 6)
Analyte (mg/L)	**Upland**	**Lowland**		**Upland**	**Lowland**					
Turbidity (pre 98) (NTU)	2-15	2-15		6	15	46.068	28.232	36.513	33.266	2.067
Turbidity (post 98) (NTU)	2-15	2-15		6	15	41.107	14.176	11.667	29.529	5.697
Total N	0.15	0.2-0.3		0.15	0.24	NA	0.185	0.465	0.345	NA
Nitrate	0.03	0.01	0.7	0.03	0.03	1.404	1.047	0.786	0.450	0.445
Total P	0.01	0.01		0.01	0.01	0.090	0.016	0.061	0.034	0.010
Aluminium			0.055			2.786	0.078	0.060	0.089	0.057
Boron			0.37			0.032	0.015	0.043	0.026	0.050
Copper			0.014			0.033	0.015	0.010	0.019	0.030
Manganese			1.9			0.008	0.009	0.022	0.025	0.010
Zinc			0.008			0.013	0.013	0.013	0.019	0.012

1. Australia New Zealand Environment and Conservation Council (ANZECC 2000). Trigger Values for the Protection of Aquatic Ecosystems, Tropical Australia, Physical and Chemical Stressors
2. ANZECC (2000). Guidelines for the Protection of Aquatic Ecosystems, Freshwater, 95% Protection Level, Toxicants
3. Draft QLD Water Quality Guidelines (2005). Regional Guideline Values for Physio-Chemical Indicators, Wet Tropics
4. Turbidity samples were collected after other sampling had ceased
5. n = number of samples (the number of samples collected at each location varies for some analytes)

0.013 Highlighted numbers indicate that the mean value exceeds one or all of the relevent guidelines

GROUNDWATER RESOURCES

The Laura-Normanby Catchment overlies two regional groundwater basins, the Laura Basin and the Hodgkinson Basin. The Laura Basin is an extensive artesian groundwater basin that underlies the Laura-Normanby Catchment area and extends to the north of Princess Charlotte Bay. The Laura Basin overlies and is bounded to the south and east by the Hodgkinson Basin (Passmore, 1978). The Laura Basin is composed of sedimentary rocks deposited in the Mesozoic era, while the Hodgkinson Basin is a fractured rock aquifer composed of the Paleozoic era Hodgkinson Formation metamorphic rocks (greywacke, slate, some conglomerate and metavolcanics) and Tertiary period volcanic basalt.

The principal groundwater aquifers in the Laura Basin are the sandstone dominated Gilbert River Formation and Dalrymple Sandstone Formation. These aquifers have a combined thickness of up to 700 metres in the central basin area and are overlain by the relatively impermeable mudstone of the Rolling Downs Group, which ranges from 40 metres to over 200 metres thick. The overlying Cainozoic era deposits can also provide small quantities of water (less than 2.0 L/sec); however, large fluctuations are expected in the groundwater levels in these surface deposits and no water may be present during drought conditions (Horn et al, 1995).

Groundwater in the Laura Basin flows generally to the north. Recharge by infiltration of rainfall occurs mainly along the elevated sandstone outcrop areas in the southern and eastern margins of the Basin (Bain and Draper, 1997). Much of the stored water in these aquifers may be ancient water derived from wetter periods of recharge during the Quaternary period (Horn et al, 1995). Natural discharge of groundwater occurs at numerous permanent and semi-permanent springs throughout the Catchment area. Spring flow also maintains perennial or near continuous flow to the Little Laura River and the Normanby River.

The total available water quantity in the Laura Basin aquifers is unknown. Abundant supplies are expected for most of the region, except at outcrop margins, where insufficient formation thickness exists and beds drain soon after recharge events. The only other constraints to availability are the increasing depth to intersection and decreasing water quality towards the centre of the basin (Horn et al, 1995). This central region is primarily National Park, where large supplies of groundwater are not expected to be required.

The fractured rock aquifers of the Hodgkinson Basin underlie the southern portion of the Laura-Normanby Catchment area and include the McLean basalt that occurs in the Lakeland region. These fractured rock aquifers of the Hodgkinson formation and McLean basalt provide an important supply of groundwater for domestic and stock-watering purposes and will be increasingly relied upon for irrigation. Flow rates within the basalt are generally low (Morgan, 1984). The amount of groundwater available within the Hodgkinson Basin is unknown; however, the fractured rock aquifers recharge vertically and therefore the groundwater supplies are closely dependent on rainfall.

Groundwater Use

Groundwater is the primary source of water supplies for 95% of the population in the Catchment area, including the towns of Laura and Lakeland Downs. The domestic water

supply for Lakeland Downs is from bores in the McLean basalt fractured rock aquifer. The town supply for Laura is obtained from bores in the Dalrymple Sandstone and Gilbert River formations of the Laura Basin. Throughout the Catchment numerous artesian and sub artesian bores are used for stock and domestic supplies.

According to the Qld DNR&M database of registered groundwater bores, there are approximately 180 registered bores within the Laura-Normanby River Catchment area. The current condition and use of these bores is not reported and many of the bores are likely to be exploratory and/or have been abandoned. The majority of bores was listed as being screened within the McLean Basalt formation located in the Lakeland Downs area. Other bores were extracting groundwater from the Dalrymple Sandstone, Cainozoic undifferentiated, Hodgkinson formation and the Gilbert River formation. The amount of groundwater extracted is largely unknown.

Groundwater Quality

The groundwater quality in the Catchment is generally considered to be good and suitable for most purposes but can be relatively more saline in alluvial areas (Morgan, 1984). On one property an Artesian bore emits a small quantity of gas and the groundwater used for stock has a mild sulphur taste (Ian Adcock, from landholder surveys, 2003). Local occurrences of high manganese, iron and fluoride concentrations exceeding the recommended levels for human consumption have also been documented.

Horn et al, (1995) reported on groundwater quality for the Gilbert River Formation and Dalrymple Sandstones of the Laura Basin and the basalt aquifer of the Hodgkinson Province (Lakeland area). The bores tested from the sandstone formations of the Laura Basin had an average conductivity (a measurement of salt ions) of 900 μS/cm, which is sufficiently low for human consumption. Some alkaline groundwater was encountered in the sandstone formations, primarily in the northern portion of the Catchment area. Alkalinity in several wells exceeded 500 mg/L, which is the maximum concentration recommended for human consumption. Fluoride concentrations in some bores also exceeded the recommended levels for both human and stock consumption.

Small quantities of water may be obtained from sandy lenses within the Rolling Downs Group mudstone. Water quality in the Rolling Downs Group is generally poor (conductivity ranges from 1400 μS/cm to over 7000 μS/cm), but suitable for stock watering (Horn et al, 1995).

Water quality in Cainozoic sediments overlying the Laura Basin sandstones and mudstone was generally good; however manganese and iron concentrations were high in some areas and may be of some concern for human consumption (Horn et al, 1995).

Generally the fractured rock aquifers of the Hodgkinson Basin in the southern Catchment area contain good quality groundwater. Groundwater in the McLean basalt is of low salinity and is considered suitable for all purposes (Horn et al, 1995).

The only documented occurrence of groundwater contamination within the Catchment area occurred within the shallow groundwater underlying the Laura township. Laura previously obtained all its town water supply from a shallow aquifer comprised of Cainozoic sediments. Bacterial contamination from septic systems rendered groundwater in some of the shallow bores in the Laura region unsuitable for human consumption. Town water supplies for Laura

are now sourced from deeper bores in the Laura Basin sandstone formations (Graeme Herbert, pers.comm., 2005).

The results of water quality testing in registered bores are recorded and stored as part of the Qld DNR&M database of registered groundwater bores. A review of these groundwater quality analytical results was beyond the scope of this report.

Groundwater Management Issues

Adequate groundwater supplies seem to meet the current demand in the Laura-Normanby Catchment area. However, some of the resources are not available during the dry, when they are most needed. Although over-exploitation has not been identified as a problem at present, demand for groundwater is increasing, particularly in the Lakeland area where groundwater is being increasingly relied upon for irrigation. There is some concern regarding the increasing use of groundwater for irrigation since the total available groundwater quantities are unknown and the aquifers in the Lakeland region are dependent on rainfall. The amount of groundwater extracted must be properly managed to ensure that adequate water supplies are available for all users.

Consideration must also be given to the extraction of groundwater and its potential impact upon natural discharge sites. Overuse of groundwater in some areas could reduce the outflow at springs, which are often relied upon for stockwater in dry periods and provide valuable aquatic habitats. The contribution of groundwater to streams and wetlands is also important for the protection of aquatic ecosystems during the dry season. A thorough investigation of available groundwater supplies and the connections between groundwater and surface water, is needed to support sustainable groundwater allocation in the Lakeland area.

Groundwater pollution has not been identified as a major issue, with the exception of bacteria in shallow groundwater at Laura. However, septic systems and the use of agricultural chemicals in the Lakeland Downs area pose a potential risk to both groundwater and surface water supplies and should be monitored.

Long term management of water resources in the Catchment should also consider the potential impacts of climate change, such as more frequent drought conditions.

TABLE 8: LAURA-NORMANBY CATCHMENT AREA
WATER QUALITY AND QUANTITY STRATEGIES & RECOMMENDED ACTIONS
GOAL: To maintain a standard of water quality and quantity acceptable to human, stock, agricultural and ecological health.

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
WQ1	Raise community awareness of water quality and quantity management issues.	Provide regular reports on water quality in the Catchment and wise water use practices for the community.	- "Develop education and awareness programs regarding wise water management practices and use." - "Improve community knowledge of aquatic and riparian management issues and management options."
WQ2	Develop a better understanding of the hydrology of the Laura-Normanby Catchment.	Map ground and surface water resources.	- "Map ground and surface water resources." - "Document all relevant groundwater resources, including contaminants and capacity." - "Identify rates of extraction and recharge"
WQ3	Establish a comprehensive and coordinated approach to water quality and quantity monitoring in the Catchment.	- Review historic water quality and quantity data for trends and potential changes over time, identify areas of potential impacts. - Establish regular water quality monitoring projects within the Catchment, in addition to the AIMS monitoring project at Lakefield. Potential locations include DNR&M gauging stations and specific locations where current or potential water quality or quantity issues have been identified. - Develop regionally relevant water quality targets based on data from local rivers. - Provide regular reports on water quality and quantity for LNCMG and other stakeholders.	- "Document water usage at relevant sites." - "Undertake a full analysis of existing water quality data and develop and implement recommendations." - "Based on water quality data, identify priorities for improvements to water quality." - "Design and begin a program to develop regionally relevant water quality targets consistent with the Reef Water Quality Protection Plan."

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
WO4	Encourage and support the development of Water Allocation Management Plans for high water use areas.	Produce a groundwater and surface water allocation plan based on the sustainable yield (after mapping of resources) so that no decline in water quality or quantity is observed downgradient.	- "Identify rates of extraction and recharge" - "Establish sustainable yield and 'permissible annual volumes' for groundwater resources." - "At community level develop water allocation plans for surface and groundwater resources that will allow for maintenance of ongoing hydrological processes."
WQ5	Management strategies are developed to improve the quality of ground water and surface water and allowances are made for the preservation of aquatic ecosystems within the Catchment.	Where potential impacts have been identified through review of water quality data or visual assessment, determine sources and coordinated approaches to improve water quality. For example: - Identify priority creeks and rivers for fencing, provide financial support for fencing, and the establishment of off-stream watering points. - Identify camping or tourist areas with potential to impact on water quality. Improve infrastructure such as providing compost toilets. - Identify erosion problem spots and management options including engineering works, limiting vehicle access. - Ensure that the appropriate surface water runoff and sediment controls are in place for all roadworks and other earthworks with potential to impact on water quality.	- "Identify surface springs requiring protection and identify priorities for protection." - "Identify for treatment high risk sites where tourist/camping facilities are impacting on water quality." - "Priority creeks and rivers identified for fencing." - "Adequate incentives provided for fencing." - "Extension program established to encourage the establishment of appropriate off-stream watering points."
WQ6	Improve agricultural, domestic and stock water use efficiency.	Monitor use of water to identify areas where improvements in efficiency may be made.	
WQ7	Develop and maintain a data base of the Laura- Normanby Catchment water reserves.	Identify rates of groundwater extraction and recharge.	- "Map ground and surface water resources." - "Document all relevant groundwater resources, including contaminants and capacity."

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
WQ8	Encourage the involvement of the community in the development and implementation of strategies.	- Encourage sharing of information between traditional owners and other landowners and land managers regarding water quality protection and traditional values. - Community involvement in the identification of specific sites requiring actions to protect or improve water quality or quantity.	- "Include community involvement in all water quality monitoring programs." - "Communities and relevant agencies to liase and develop management actions to address priority water quality issues." - "Provide support including through grants) to landholders to undertake measures to reduce impacts on and threats to riparian and aquatic habitats."

4.2 WEEDS AND FERAL ANIMALS

Weeds have been identified by the Laura-Normanby Catchment Management Group as the second most important land use issue in the region (Stakeholder survey, 2001). The impacts of feral animals, particularly pigs were also considered to be a priority issue for management. The Cape York Peninsula Natural Resource Management Plan (Final Draft), 2005 also identifies pest species as the number one priority threat to the assets of Cape York (Appendix C).

Weeds and feral animals are often referred to as pests. The Cook Shire Pest Management Strategy (2004) defines a pest as: ***"A plant or animal that has, or has the potential to have, a detrimental effect on economic, social or conservation values"***.
Declared weeds and feral animals under the Qld Land Protection (Pest and Stock Route Management) Act 2002 are targeted for control because they have, or could have, serious economic, environmental or social impacts (Department of Natural Resources and Mines, 2005). Declaration under state legislation imposes various legal responsibilities for control by landowners on land under their management, including all landowning state agencies (Department of Natural Resources and Mines, 2005). Large landowning state agencies are also required to develop and implement pest management strategies (Department of Natural Resources and Mines, 2004).

WEEDS

Of the many weeds identified in the Catchment only a few could be regarded as significant pests. The following are arguably the worst weeds in the Catchment:

- Rubbervine (*Cryptostegia grandiflora*)
- Sicklepod (*Senna obtusifolia*)
- Salvinia (*Salvinia molesta*)
- Lion's Tail (*Leonotis nepetifolia*)

Some of the impacts in the Laura-Normanby Catchment caused by weeds include:

- Diminished land values e.g., rubber vine, *Leucaena*
- Invasion of grain and horticultural crops e.g., sicklepod
- Reduced water quality e.g., Salvinia, rubber vine
- Damage to conservation areas e.g., lion's tail, sicklepod
- Harmful to stock and wildlife e.g., rubber vine, *Parthenium*
- Health problems e.g., *Parthenium* has allergenic properties

Rubber vine, sicklepod and Salvinia are declared plants under the Qld Land Protection (Pest and Stock Route Management) Act 2002. Lion's tail is declared under the Local Government Act in Cook Shire. Salvinia and rubber vine are listed as two of the twenty Weeds of National Significance (WONS) (Thorp and Lynch, 2000; CYWAFAP, 2001).

Other weed species in the Catchment with the potential to become a priority are gamba grass (*Andropogon gayanus*), Leucaena (*Leucaena leucocephala*), grader grass (*Themeda*

quadrivalvis), castor oil plant (*Ricinus communis*), navua sedge (*Cyperus aromaticus*) and *Parthenium* (*Parthenium hysterophorus*).

Gamba grass is a difficult weed to control and is gaining momentum on Cape York. Gamba grass was recommended and introduced into the Northern Territory 50 years ago to replace native pasture and to fatten up cattle in the wet season. It serves this purpose when well managed. Elsewhere on roadsides and increasingly in National Parks it is a weed that can reach 4 metres in height and produce huge amounts of fuel. In October it dries out and can cause intensely hot, late season fires. Currently under review, gamba grass may become a declared weed in the near future. Presently around the Lakeland Downs area it has the potential to become one of the Catchments' worst weeds (Russel Graham, *pers. comm.* July, 2005).

Another potentially serious environmental weed within the catchment is Leucaena (*Leucaena leucocephala*) (*pers.comm.*, Russell Graham., July 2005). A weed of roadsides, riversides and other disturbed areas, Leucaena forms dense stands and inhibits the growth of other species. It continues to be recommended by the Department of Primary Industries as a fodder crop. Landholders are encouraged to use a less invasive species of Leucaena (*Leucaena glabrata*) and remove any Leucaena that is not being managed according to the Mandatory Code of Practice (Cook Shire Council, 2003). Leucaena is continuing to be removed on council land.

Grader grass is very widespread across the catchment, particularly in disturbed areas such as pastures and roadside edges. This species is not identified as a priority species in this report as it is not currently declared and it is so widespread that it would not be cost effective to control (Jamie Molyneaux, *pers.comm*., June 2005).

Castor oil plant thrives on disturbed or cleared land especially river banks. The seeds of the castor oil plant are highly toxic. It is present in Lakeland Downs and along the Normanby River, including the West Normanby River. The goal of the Cook Shire Council 'Pest Management Plan (2003) is to eradicate castor oil plant from around towns and homesteads. Elsewhere on the Cape it is considered a low priority (Cook Shire Council, 2003).

Also present in Lakeland Downs is navua sedge. This sedge is a problem in wet areas but can also be found in drier soils. It is problem to cattle growers as it is extremely aggressive and unpalatable (Cook Shire Council, 2003). It smothers pastures and native vegetation in wet areas and produces large quantities of seed (Cook Shire Council, 2003). The goal of the Cook Shire Council Pest Management Strategy (2003) is to eradicate the plant from the shire.

Mapping Weeds

A comprehensive database of weeds on Cape York is currently being compiled by the Cape York Weeds and Feral Animals Project. The location of all known weeds is being mapped using a Global Positioning System (GPS) for future identification, research purposes and to determine the effectiveness of control programs in the short and long term.

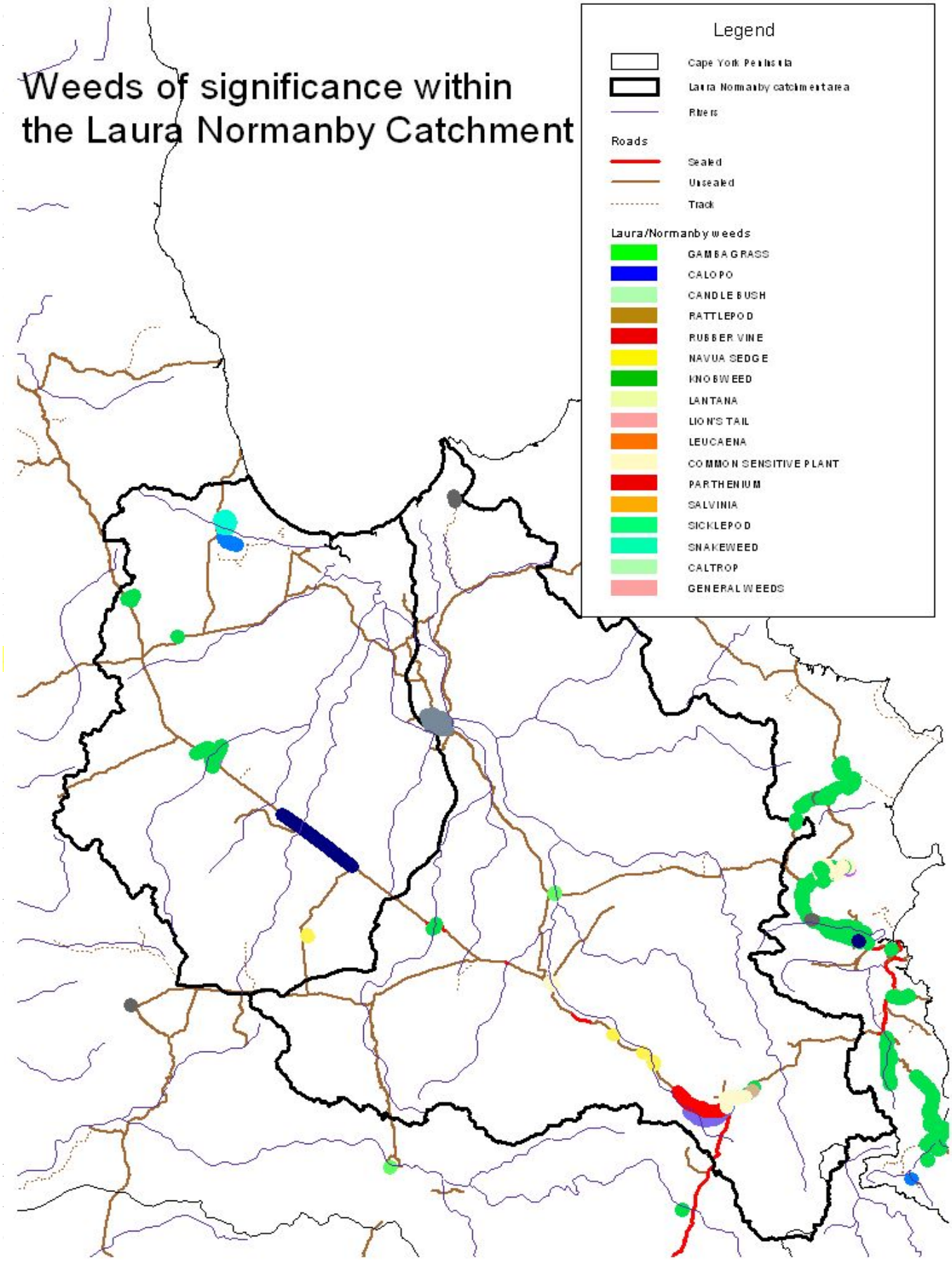


Figure 6: The Current Documented Occurrence of Weeds in the Catchment

At present weeds have been recorded opportunistically along roadsides and when undertaking control. Weeds will be actively surveyed by Cape York Weeds and Feral Animals Project when more staff is available. The above map (Figure 6) shows the current recorded occurrence of weeds in the Laura-Normanby Catchment.

PRIORITY SPECIES

Species become a priority for control when:

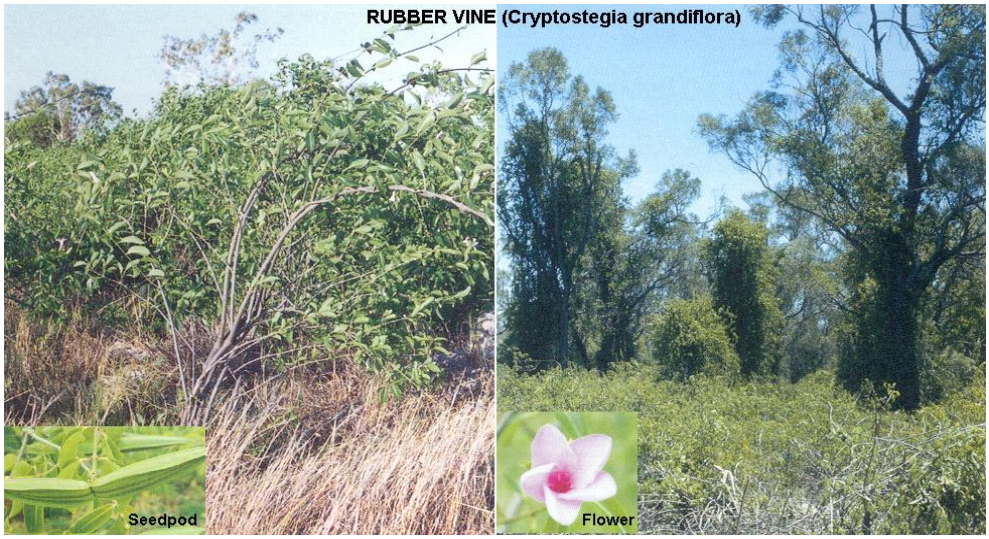
- The species is officially declared a noxious weed;
- The population is in isolated pockets and has not yet become widespread;
- Chances of eradication are high;
- Cost effective if treated soon; and
- The species is seriously causing lowered productivity or health problems.

The priority of weed control in a catchment may change over time as species are controlled or eradicated. Eradication is possible. Parthenium, once a priority for control in some urban areas of the Laura-Normanby Catchment has now been eradicated. Parthenium is declared a Weed of National Significance due to the allergenic properties of the plant and its toxicity to stock. Introduced in chicken food, small, isolated clumps appeared in Bonnyglen, Old Laura Station and Lakeland Downs. After treatment with 'Grazon' by CYWAFAP there have been no recent sightings.

Parthenium found at Old Laura Station. Photo courtesy CYWAFAP

The following species are considered to be a priority for control.

Rubber vine (*Cryptostegia grandiflora*)



Rubber vine in flower and seed

Rubber vine has been described as the most potentially devastating weed on Cape York (Mitchell and Hardwick, 1995). It has the ability to invade the whole of the Cape especially along the river systems.

Native to Madagascar, rubber vine is a robust woody, perennial climbing shrub that grows to 2 metres unsupported (CYWAFAP, 2001) or up to 30 metres in trees (NRM 'Rubber vine' factsheet, 2004). The stems, leaves and unripe pods exude a white, milky sap when broken or cut (NRM 'Rubber vine' factsheet, 2004).

Rubber vine is toxic to stock (Mitchell and Hardwick, 1995) and can leach toxic compound into streams (Ryan et.al., 2002). It can also smother the canopy and eventually kill trees and shrubs. This decreases biodiversity, prevents stock and native animals from accessing water, and harbours feral animals (NRM 'Rubber vine' factsheet, 2004). Lakefield National Park has infestations along the rivers running through the park, including the Normanby, Laura and Kennedy Rivers (Mitchell and Hardwick, 1995). It is also widespread along the Little Laura River, and 'Crocodile', 'Olive Vale' and 'Fairview' Stations. Infestations spread out from waterways resulting in loss of grazing and accessibility for mustering. Tourism is also affected as access to camping sites and fishing holes is obstructed (Mitchell and Hardwick, 1995).

The seed is spread by many mechanisms e.g., wind, water, vehicles and animals. Depending on the level of infestation, effective control of rubber vine can be achieved through biological control, fire, insect, chemical and mechanical methods.

Control methods of rubber vine: rust, aerial spraying, *Euclasta* moth, burning, mechanical, and spraying.

An integrated pest management approach is reported to be the most effective control for rubber vine over a large scale (Russel Graham, pers. comm., 2005). Firstly biological control agents such as rust fungus and a leaf eating moth reduce the leaf mass on the plant. The extra sunlight allows for the build up of grasses underneath to provide sufficient fuel for fire management (Ryan et.al., 2002). Once burnt any remaining or new growth can be basal bark sprayed with 'Arsenol' or 'Grazon'. Follow up sprays may be required until the rubber vine is eradicated.

Rubber vine along the Peninsula Developmental Road South of Laura

Small, isolated infestations should be controlled first as dense infestations are difficult and costly to treat (NRM 'Rubber vine' Factsheet, 2004). In 1984 rubber vine was reported to be "largely restricted to the fringing communities of the Laura River" (Morgan, 1984). Twenty years later the plant has spread further into the Catchment and is reaching infestation levels.

Sicklepod (*Senna obtusifolia*)

Sicklepod (*Senna obtusifolia*) in flower and seed. Photo courtesy CYWAFAP, 2000

Sicklepod is a vigorously growing, very competitive woody shrub of pastures and crops, especially on high nutrient soils. The shrub grows to 1.5 metres to 2 metres tall (NRM 'Sicklepod' Fact Sheet, 2004). It invades remnant areas only after significant disturbance. A native of the Caribbean (Mitchell and Hardwick, 1995) it is believed to have been accidentally introduced from America. The seed is commonly spread by cattle and horses eating and transporting mature seed. It is also suspected that Sicklepod seed may be spread in hay (Annette Marriott, pers. comm., 2005). The seeds can remain viable in the soil for ten years.

Sicklepod seedling emerging from cow pad. Photo courtesy CYWAFAP, 2000

Sicklepod can invade and completely dominate pastures within two to three growing seasons (Mitchell and Hardwick, 1995). Slashing will reduce mature plants to a manageable size but will not kill sicklepod. Blunt blades must be used to shatter the stems of the plant before flowering (March-May), well before the seed sets. If slashed too early sicklepod can flower and set seed. Once eradicated sicklepod should be replaced with a competitive pasture species such as *Brachiaria decumbens* or native vegetation. Any emerging seedlings should be spot sprayed. In conservation areas tree planting programs may be an option to control sicklepod by shading (Mitchell and Hardwick, 1995). CYWAFAP recommends using 'Grazon DS' at the ratio of 1:500 water and wetting agent ('Agral'). CYWAFAP newsletter 2003). Herbicide spraying is recommended from early seedling stage until well before flowering stage. Follow up maintenance is required for up to ten years while seed is viable in the soil.

In 2003, sicklepod was approved for biological control by the Natural Resource Management Standing Committee or under the Biocontrols Act (1985). The fungus ***Myrothecium verrucaria*** has been patented for sicklepod biocontrol (Van Driesche, *et al.*, 2002).

Sicklepod is continuing to spread even though landholders have commenced control programs. Problem areas include Lakeland Downs, King Plains Station and the East Normanby and Laura Rivers. The goal of the Pest Management Strategy is to prevent any further spread of this weed and reduce areas of current outbreaks (Cook Shire Council, 2003).

Salvinia (*Salvinia molesta*)

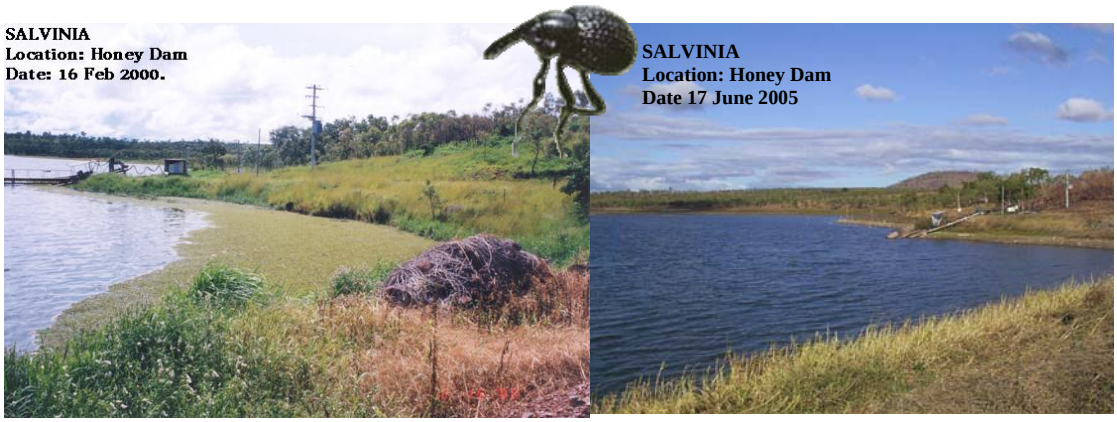
Salvinia molesta

Primarily restricted to a few locations in the Catchment the extent of Salvinia has been greatly reduced in recent years. It remains a potentially serious threat because it can severely impact freshwater ecosystems (ARMCANZ, 2000). It is also a declared Weed of National Significance. It has often been described as one of the world's worst weeds (Holm et al., 1977).

A free-floating aquatic fern with no flowers or true roots Salvinia invades slow moving fresh and brackish streams or still water ponds and dams (CYWAFAP, 2001). Originally from South America, many infestations in Australia can be traced to plants discarded by aquarium fanciers (ARMCANZ, 2000). The impacts of Salvinia include the reduction of aquatic biodiversity by reducing light entering the water body and killing submerged plants and associated fauna (ARMCANZ, 2000). The decomposing plant material also degrades water quality and leads to a reduction in water oxygen levels.

Salvinia in Perfume Gully. CYWAFAP

Lakeland's Perfume Gully bears the infamous claim to be the first known area of Salvinia on the Cape (Cook Shire Council, 2003). It is believed that Salvinia fragments were dumped in this gully. High nutrient conditions from nearby septic systems leaking into the gully may have contributed to the Salvinia outbreak (Graeme Elmes, pers.comm., 2005). From here Salvinia appears to have spread further into the Catchment resulting in the outbreaks at Honey Dam and the Laura River. The infestation at Honey Dam has been successfully controlled in recent years with the introduction of the biological control agent – *Cyrtobagus* weevil. However, Salvinia remains present in the dam, downstream of Honey Dam and has been recorded as far downstream as 'Carole's Crossing at 'Crocodile Station' (Russell Graham, pers.comm., 2005).



Salvinia in Honey Dam BEFORE and AFTER the introduction of the weevil. CYWAFAP (2001)

A number of methods have been used to control Salvinia. Mechanical removal of Salvinia is usually carried out to alleviate water blockage, rather than as part of a long term control program (ARMCANZ, 2000). Herbicide usage around and within any water body in Australia is strictly regulated and should be seen as a last resort. Complete drainage of the water body may be an option in dry years, especially when the dam is naturally almost dry. As with many methods of control for weeds and feral animals, this species responds best to an integrated management approach with consistent follow up. Salvinia thrives in high nutrient levels and therefore run off into Perfume Gully and Honey Dam from other nutrient sources should be minimised. Efforts made to eradicate Salvinia should commence at the top of the Catchment and then work down to prevent the plant constantly establishing downstream.

Lion's Tail (*Leonotis nepetifolia*)

Lion's Tail. Photo courtesy CYWAFAP

An established weed of Lakefield National Park, lion's tail is reported to cover approximately 10,000 hectares of the 537 000 hectare National Park (Andrew Hartwig, pers. comm., 2005). Native to South America, lion's tail is a garden escapee that colonises disturbed areas, roadsides, native vegetation, overgrazed sites and levee banks of creeks (CYWAFAP, 2001). It invades bushland along floodplains, eventually replacing native vegetation (Cook Shire Council, 2003).

In previous years the control of lion's tail has been a joint effort by Cape York Weeds and Feral Animals and Queensland National Parks and Wildlife Service. Various forms of control are still being trialled to work out the most effective approach. The best results have come from a combination of 'storm burning' and aerial spraying. A 'storm burn' is a burn during the wet season (between Christmas and New Year) that is expected to be extinguished by wet season rain. After the burn the rain germinates seedlings of the lion's tail. At about 2 inches high the seedlings are sprayed, long before the plant has a chance to flower and form a seed head. Surviving seedlings are continued to be sprayed up to three times. Seeds are reported to live in the seedbank for up to 8 years. The broadleaf spray 'Grazon' has been used previously but trials are currently under way to see if using a residual herbicide on the third spray (e.g., 'Brushkiller') may also kill seeds in the ground.

One of the features of successful weeds is the ability to disperse seed effectively. Lion's tail has the assistance of one of Lakefield's other most notorious pest – feral pigs. Feral pigs carry the seed on their hair and in their hooves and transport it elsewhere and in some cases bury it when digging for food (Andrew Hartwig, pers.comm., 2005). A further way to control the spread of Lion's tail is to control the spread of feral pigs.

It is believed Lion's tail may also be spread via vehicles. The lion's tail seed can be picked up and caught in the mud or tread of tyres and spread elsewhere, especially at river crossings (Sam Dibella, pers.comm., 2005). Suggested ways to prevent this is to install causeways at heavily used river crossings to keep vehicles out of the water or vehicle/wheel spray stations.

Lion's tail in Lakefield National Park after treatment. Photo courtesy CYWAFAP

For the past three years the infestation has been recorded and mapped by the Cape York Weeds and Feral Animal Project. QPWS staff are currently monitoring the existing invasion. Aerial surveys show the infestation to be contained.

The Strategies and Recommendations for Weed Management are located at the end of the Feral Animals section

FERAL ANIMALS

A feral or pest animal can be described as 'an animal causing detrimental impacts on the environment, industry or community activities' (Cook Shire Council, 2004). Pest animals can be native (e.g., dingoes, cockatoos, wallabies) or introduced from other countries (e.g., pigs, cane toads, cats). In many cases feral animal populations in Australia have resulted from the 'deliberate or accidental release of domesticated animals' (Cook Shire Council, 2003).

In 1984, Morgan described feral animals, along with fire, as the major destructive influence on the natural environment of the Quinkan area. Other previous surveys have identified "the Cape York peninsular region as having the highest feral pig population and highest density concentrations in Queensland (Mitchel et. al., *unpublished* 2005).

Eleven animals have been listed as pest or problem animals on Cape York Peninsula (Cook Shire Council, 2004) (see Appendix D). Cane toads (*Bufo marinus*) and Tilapia (*Oreochromis mossambicus*) fish could also be added to this list.

Some of the impacts in the Laura-Normanby Catchment caused by feral animals include:

- Damage and invasion of grain and horticultural crops e.g., cockatoos, pigs
- Damage to conservation areas e.g., pig diggings,
- Predation on stock and wildlife e.g., wild dogs, feral cats
- Soil disturbance and general land degradation e.g., wild cattle, feral horses
- Competition with livestock and wildlife for resources ie., food, water, shelter, breeding sites e.g., pigs, wild cattle
- Damage to fences and water sources e.g., wild cattle
- Disease threat e.g., foot and mouth in pigs

The main vertebrate pest species identified for Cape York during the CYPLUS study were feral pigs, feral cattle, feral horses, wild dogs/dingoes, feral cats, cane toads and feral fish (CYRAG, 1997). Feral pigs, wild dogs/dingoes and feral cats are Declared Animals of Queensland (Land Protection Act, 2003). The stakeholder survey conducted for the Laura-Normanby Catchment Management Group also included wild cattle and wild horses as problem animals in the Catchment. No pest fish species have been observed in the Catchment.

FERAL PIGS (*Sus scrofa*)

Trapped feral piglets. Photo courtesy CYWAFAP

Feral pigs are considered to be one of the most prolific, widespread and damaging pest animals of Queensland (Mitchel et. al., *unpublished* 2005). Feral pigs damage crops, degrade habitat, compete with stock for resources and spread weed seed and dangerous diseases such as Leptospirosis. They also dig up large areas of native vegetation, foul water and accelerate the rate of evaporation of water bodies (NRM 'Feral Pigs in Queensland' fact Sheet, 2003). Feral pigs have been listed as a Threatening Process of Endangered species and Ecological Communities (Pest Animal Control CRC 'Fact Sheet- Integrated Pest Management, 2004'), due to predation, competition with native animals and the spread of weeds.

In the Laura-Normanby Catchment pigs are known to damage corn, banana and peanut crops. They spread weed seed (e.g., lion's tail) in their hooves, fur and droppings. Pigs have been reported to damage the spring communities in the Quinkan Reserves (Morgan, 1984). Pigs cause considerable damage to aquatic systems, particularly to the banks of streams and lagoons (Ryan et. al., 2002). By wallowing and rooting around the edges of watercourses, they destroy the vegetation that prevents erosion and provides food and nesting for native wildlife (Department of the Environment and Heritage, 2004). Along with pig droppings this can result in the release of additional nutrients and sediment into the water system. This inturn can affect the growth of macrophytes (plants) and could result in eutrophication (Ryan et.al., 2002).

Feral Pig Damage

Aerial surveys in Cape York have shown the highest feral pig density to be in grasslands during both the dry and wet seasons (Mitchel et. al., *unpublished* 2005). This habitat type is reported to have an abundant and persistent water supply from creeks and very high vegetative biomass of sedges and grasses to supply abundant food and cover (Mitchel et. al., *unpublished* 2005). The forest and heath habitats had the lowest populations of pigs during both the wet and dry seasons. This is reportedly due to insufficient water sources during the dry season. This is illustrated in the grassland areas of Lakefield National Park which contain the highest recorded density of feral pigs in the Laura-Normanby Catchment (Figure 7).

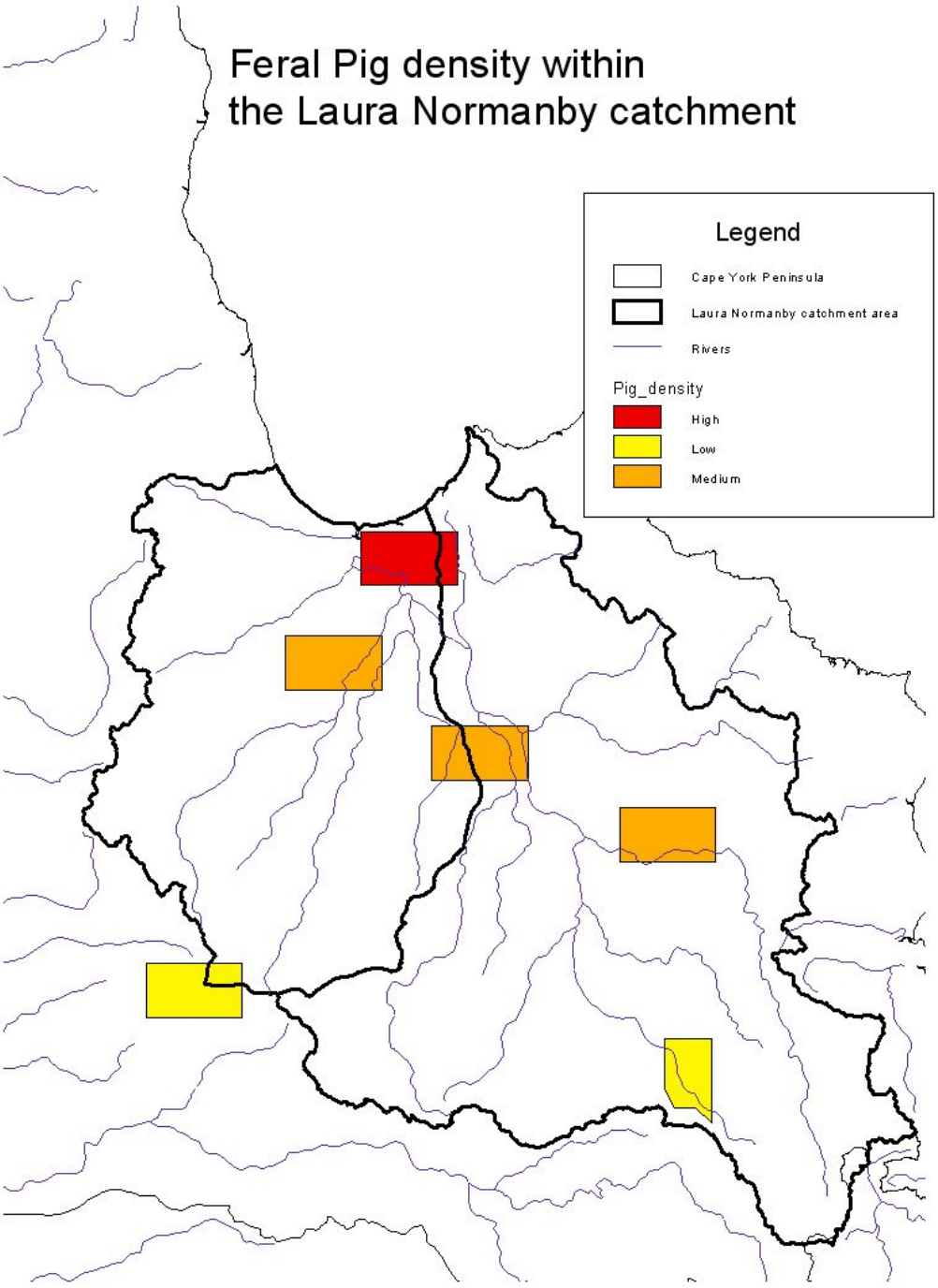


Figure 7: Feral pig density in the Laura-Normanby Catchment July 2005.
(Map courtesy CYWAFAP.)

Due to the high density of pigs in this region and the frequent visitation to Princess Charlotte Bay by fishermen and tourists, Lakefield National Park is considered a high risk zone for exotic disease outbreaks such as Foot and Mouth (Jamie Molyneaux, pers.comm., 2005).

Pigs are difficult to control. Total eradication is unlikely and not a preferred option for those who rely upon pigs as a food source. Management is aimed at minimising the damage. Integrated pest management by using a combination of aerial shooting and 1080 baiting and trapping, in that order, is the best method. The best time to commence control is during dry conditions when pigs are concentrating around waterholes (CYWAFAP Newsletter, 2003). Exclusion fencing with sheep mesh (dug into the ground) or electric fencing can also be used to keep pigs out of crops and small areas of high conservation priority (NRM 'Feral Pigs in

Queensland' Fact Sheet, 2003). Shooting or dogging often displaces pigs from a property, but generally has little impact on total numbers (NRM 'Control of Feral Pigs' Fact Sheet, 2004).

Recent studies concluded that "aerial baiting is by far the most cost-effective method of control, especially for large-scale pig management like in an exotic disease outbreak" (Mitchell, 2005). The Pest Animal Control CRC is working closely with Animal Control Technologies Australia to develop manufactured feral pig bait. The bait will specifically target pigs when undertaking either aerial or ground based baiting campaigns in a wide variety of habitats. The bait is also being adapted to carry disease vaccines and contraceptives (Pest Animal Control CRC 'Fact Sheet- Integrated Pest Management').

The Cape York Weeds and Feral Animals Project have proven that with the right combination of control techniques pig numbers can be reduced. On Rutland Plains station in 2002 CYWAFAP staff, assisted by the Australian Quarantine Service, shot 3700 pigs in three days. The overall population of pig numbers in the target area on the marine plain was reduced by 68%. The shoot was followed up with a successful 1080 baiting campaign. The landholder has since observed increases in productivity such as greener lagoon areas and less stress in cattle. The reduction in pig numbers is maintained by the landholder with a twice yearly baiting campaign and aerial shooting when necessary (Jamie Molyneaux, pers.comm., 2005).

Pig control programs have been operating in Lakefield National Park since 1999 in an attempt to reduce the spread of weeds and impacts on native species. CYWAFAP have had success in reducing and keeping numbers low. 'Red Lily Lagoon' has also been fenced off to exclude pigs. Queensland Parks and Wildlife Service have now taken over the control program and wait for further funding to prevent numbers from rising.

The goal for pig control in the Cape York Pest Management Strategy (2003) is "to reduce numbers in priority areas in all land uses and prevent an increase in numbers elsewhere".

WILD DOGS/ DINGOES (*Canis familiaris/ Canis familiaris dingo*)

Dingo (*Canis familiaris dingo*). Photo courtesy of Queensland Government, Department of Natural Resources and Mines, 2001

The term wild dog refers collectively to purebred dingoes, dingo hybrids and domestic dogs that have escaped or been deliberately released (NRM 'Wild dog control' fact Sheet, 2004).

Under current legislation, dingoes and wild dogs are declared species (Cook Shire Council, 2004) and it is the responsibility of landholders to reduce the number of dingoes/wild dogs on their property (DNR Fact sheet, 2003).

The dingo has been regarded as a serious predator of domestic stock since early European settlement in Australia (Twyford, 1991). On grazing country, wild dogs can harass, injure or kill calves. Dingoes and wild dogs are also vectors of diseases such as distemper and parvo-virus, and parasites (Cook Shire Council, 2003). The goal of the Cape York Pest Management Strategy (2003) is to prevent a rapid increase in numbers. This will be measured by a decrease in dingo or dog attacks in cattle areas.

The most effective control method is 1080 baiting in cattle areas. Poison baits are the most economic, efficient, humane and effective method of controlling wild dogs, especially in inaccessible or extensive areas (NRM 'Wild dog control' fact Sheet, 2004). Cook Shire Council offers a bounty system of $10 per scalp (Cook Shire Council, 2003). Shooting is an opportunistic method mostly used to control small populations or individual problem animals (NRM 'Wild dog control' fact Sheet, 2004).

Some conservationist groups disagree with the control of dingoes (Cook Shire Council, 2003). The Australian government protects dingoes in national parks and reserves only. In many public areas, dingoes are considered pests and are subject to control measures. Although the dingo is not considered threatened or endangered, pure populations in Australia and Asia are at risk of complete hybridization due to interbreeding with domestic dogs. Interbreeding often results in offspring that pose a greater threat to the sheep industry since they breed twice as often as pure dingoes (Hintze and Biardi, 2002).

Wild dogs and dingoes were not listed as a priority for control by stakeholders of the Laura-Normanby. Mangy dog numbers in towns are controlled by the Cook Shire Council Animal Control Officer.

FERAL CATS (*Felis catus*)

Feral Cat. (*Felis catus*). Photo courtesy of CYWAFAP

Cats kill many different species of wildlife in large numbers (Cook Shire Council, 2003). In Cape York, where the rabbit does not occur, feral cats prey heavily on native species. Predation by feral cats is listed as a key threatening process under the *Commonwealth*

Environment Protection and Biodiversity Conservation Act 1999 (the EPBC Act). Under the EPBC Act, the Australian Government in consultation with the states and territories has developed the *Threat Abatement Plan for Predation by Feral Cats*. Feral cats have been suggested as a potential threat to the endangered golden-shouldered parrot. However cat numbers are low in golden-shouldered parrot habitat and are not currently considered a significant threat (Crowley et.al., 2004).

Feral cats can also spread diseases such as Toxoplasmosis, ringworm and Sarcosporidiosis (Mitchell and Hardwick, 1995).

The domestic cat population continually replenishes and increases the feral cat population (Cook Shire Council, 2003). Roaming pet cats also prey on wildlife especially birds and ground dwelling mammals and reptiles.

The goal of the Cape York Pest Management Strategy (2003) is to reduce the number of stray/feral cats.

Cats are notoriously hard to control. Baiting is the primary control techniques for broad scale cat population control. Cats are also killed incidentally to dingoes in 1080 poisoning campaigns (Mitchell and Hardwick, 1995). Feral cat control programs need to be coordinated with other activities such as on ground protection of threatened plants and animals and control of other invasive species such as pigs and wild dogs.

FERAL CATTLE (*Bos spp.*)

Feral cattle (*Boss pp.*). Photo courtesy CYWAFAP

It is difficult to define feral cattle. Most properties in Cape York are inadequately fenced. Cattle that miss out on mustering could be considered feral. Feral cattle were identified during the CYPLUS study as one of the main vertebrate pest species on Cape York. The Laura-Normanby Catchment Management Group stakeholder survey also identified feral cattle to be an issue in the Catchment.

Feral cattle spread weeds, trample water courses, mate with breeding stock, invade National Parks and have the potential for the transmission of endemic and exotic diseases (e.g., Foot and Mouth and Screw worm fly).

Cattle have become established in Lakefield National Park over the years. Approximately 3,000 head of cattle are removed every year (Andrew Hartwig, pers.comm., 2005). Some of these belong to neighbouring properties and therefore are not considered feral.

Moderate grazing by cattle has been found to reduce the seed production in cockatoo grass which is a preferred food of the endangered golden-shouldered parrot. Lack of fencing has made the control of grazing pressure difficult (Crowley, 2004).

Aerial shooting and mustering are possibly the most effective way of controlling wild cattle.

FERAL HORSES (*Equus caballus*)

Feral horse. (*Equus caballus*). Photo courtesy CYWAFAP.

Also know as brumbies or wandering domestic horses, horses can be serious environmental pests (Department of the Environment and Heritage, 2004). The Laura-Normanby Catchment group and CYPLUS have also identified feral horses to be a problem in the Catchment.

Horses cause erosion, damage and foul waterholes, spread weeds and compete with stock and wildlife for water and food. They also compact soil, eat pasture grasses, obstruct mustering, damage fences and can carry exotic diseases such as equine influenza (Department of the Environment and Heritage, 2004). The greater mobility of horses allows them to graze further away from water than cattle (Mitchell and Hardwick, 1995).

There are an estimated 20,000 brumbies in the Peninsula (Cook Shire Council, 2003). Horses breed up more when cattle are cleaned out. Much effort has been directed at their control in National Parks (Cook Shire Council, 2003).

The goal of the Cape York Pest Management Strategy (2003) is to significantly reduce the number of feral horses. Aerial culling is the best method for control, especially during the Dry when horses gather around water holes (Department of the Environment and Heritage, 2004).

CANE TOAD (*Bufo marinus*)

Cane toad (*Bufo marinus*)

Although not a declared pest under the Rural Lands Protection Act, the cane toad is still considered a pest in Queensland. 'The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Bufo marinus*)' are listed as key threatening processes under the EPBC Act.

Since its introduction, the cane toad has had a negative impact on native fauna as its range has rapidly expanded. The biggest threat is to animals who eat the toad. From egg to adult, the cane toad is dangerously toxic and ingestion can cause death (from heart failure) within 15 minutes. Adult cane toads exude venom when provoked. Studies have shown that where toad populations have been established, numbers of goannas and northern quolls have been devastated. The northern quoll is present in the Laura-Normanby Catchment (see Appendix E, species list). It is estimated 95 percent of the northern quoll population will disappear by 2010. Some birds and native predators have learnt to avoid the poison glands.

In the aquatic environment the impacts are likely to be widespread from large freshwater predators such as the freshwater crocodile and barramundi to turtles, fish and crustacea (Ryan et. al., 2002). In the freshwater environment the cane toad may potentially compete for resources and directly prey on the eggs and hatchlings of native frog and fish species (Ryan et. al., 2002).

Cane toads are widespread throughout the Catchment and their tadpoles remain in pools in the Laura River during the dry season.

The most humane method of disposing of toads is to place them double-bagged in the freezer overnight. However, this method is unlikely to make a difference to overall population numbers, the most effective method maybe biological control.

PEST MANAGEMENT

The National Feral Animal Control Program (NFACP) recommends that a feral animal control program is impact based not pest based. The focus of the NFACP is not on killing pest animals but reducing their impact. The relationship between pest density and resultant damage is not well known, so reducing pest animals down to a target density may not achieve an expected or proportional reduction in damage. In other situations, pest animals are not causing major damage, or there are more significant causes of damage. The NFACP offers funding once a year to landholders for feral animal control. Incentives offered by Cape York Weeds and Feral Animals project include $1,000 for herbicides, $500 for ammunition for feral

animal control, seventeen portable pig traps and five spray units that are available for loan to landholders. Funding is also available from the Envirofund.

By 2015 the Cape York Peninsula Natural Resource Management Plan aims to reduce the adverse effects of weeds and feral animals on Cape York Peninsula natural and cultural heritage values (including ecosystems and biodiversity) from the levels found in 2004. The development of pest management plans for properties and state managed areas is listed as a management action for achieving this target. Ideally pest management plans should recognise that land systems should be managed as a whole as many land management issues are interrelated e.g., nutrients in applied fertilisers supporting the growth of Salvinia or feral pigs spreading lion's tail seed. Factors that could be considered in a pest property management plan could include methods to reduce soil disturbance, techniques for quarantine control, prioritisation of issues, coordination with neighbouring properties and options for successful weed management.

TABLE 9: LAURA-NORMANBY CATCHMENT AREA
WEED AND FERAL ANIMAL CONTROL STRATEGIES & RECOMMENDED ACTIONS
GOAL: To significantly decrease and manage weed and feral animal infestations in the Laura-Normanby Catchment

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
WF1	Improve ability of landholders and primary producers to identify and manage weeds and feral animals.	Undertake weed identification, weed control and feral animal control courses in conjunction with CYWAFAP. Recognise declining primary producer income which makes cost-effective reduction in pest animal impact more critical. Funding for qualified weed controllers to control weeds and feral animals on private land.	-"Support on-ground weed and feral animal control works in accordance with strategic plans and identified high priorities."
WF2	Develop and maintain a "whole of catchment" pest monitoring program and database.	CYWAFAP continues to collect data to develop weed maps for the Catchment. Landowners inform CYWAFAP of weeds on properties. DOCS/NHT consistently fund CYWAFAP for the longterm.	-"Continue to gather the information needed for strategic planning and management of weeds and feral animals." - "Continue funding and support for the CYWAFAP and the CYP Pest Advisory Committee." -"Carry out and support strategic management of weeds and feral animals, in accordance with relevant Federal, State, regional, local and property pest management plans and other relevant plans."
WF3	Encourage all landholders to develop Pest Management Plans for their properties.	Landholders work with CYWAFAP for advice on undertaking Pest Management Plans. Continue incentives for landholders who have pest property plans. Secure further funding for Pest Management Plans.	-"Complete pest management plans for all local government and indigenous community areas." -"Support the development of pest management plans for properties and state-managed areas." -"Ensure that plans are developed in collaboration with all relevant stakeholders."

4.3 BIODIVERSITY

The term biodiversity refers to all the components of biological life, its diversity and interactions. It includes plants, animals, fungi, bacteria and other microorganisms as well as the ecosystems and processes of which they are a part (ANZECC, 2001).

The Laura-Normanby Catchment supports a high diversity of habitats including eucalypt forest, woodland, savannah, wetlands, plateau springs, rock outcrops, sandstone gorges, marine plains, salt marsh, dunes and mangroves. The Laura basin is considered important in terms of fauna habitat and conservation significance but it requires further assessment, especially the sandstone ranges of the upper Normanby, Deighton and Laura Rivers and the Quinkan Country south of Laura (Stanton, 1976 and Lesslie, 1992) (Winter and Lethbridge (1995). The Quinkan landscape near Laura has been described as an area of natural beauty and aesthetic importance with natural heritage significance (Mackey et. al., 2001). The Laura sandstone and marine plains are considered nationally important wetlands in Australia (Environment Australia (2001). Relict Gondwanic plant species exist in the semi deciduous mesophyll vine forest of the lowlands along the Normanby River. This globally significant group of plant species played an important part in the nomination of the Wet Tropics Bioregion for World Heritage Listing (Mackey et. al., 2001).

VEGETATION

Vegetation types are largely related to geological types and rainfall (Morgan, 1984).
Five general categories of vegetation types have been classified. Seventy four percent of the Catchment is classified as eucalyptus forest and woodland, 11% is Melaleuca forest and approximately 5% is grassland. The remainder includes mangroves, coastal sand dunes, and closed forest. Tree height rarely exceeds 20 metres (Morgan, 1984). A map of the basic vegetation communities in the Catchment is shown in Figure 8.

Dense vegetation exists in the higher rainfall areas of the east (e.g., upper reaches of the East Normanby River) and on sandstone plateaus.

The vicinity of Laura is a known location of particularly rare and threatened plants. Some of these include an endangered grass *(Coix gasteenii*), two rare Acacias (*Acacia albizioides* and *Acacia armiti*) and a shrub (*Teucrium ajugaceum*) that was previously thought to be extinct (see Appendix F) (John Clarkson, pers.comm., 2005).

The semi-deciduous mesophyll vine forest along the Normanby Rivers supports a particularly large number of rare and threatened species.

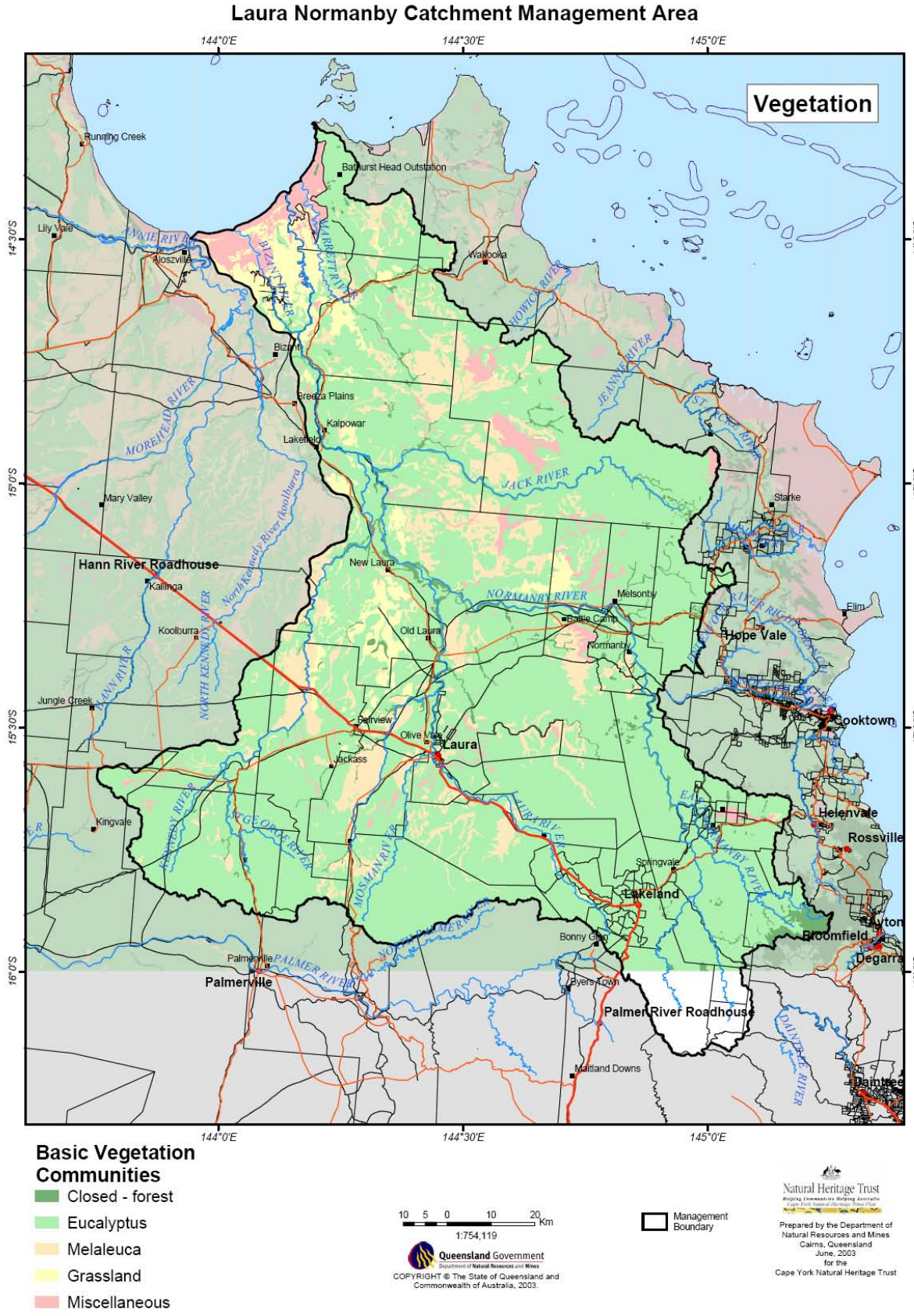


Figure 8: Map of Basic Vegetation Communities for the Catchment

FAUNA

In 1995 the records for vertebrate fauna across Cape York Peninsula were lower in the Laura-Normanby Catchment compared with the rest of the Cape (Figure 9). This could be due to less research conducted in this area compared with the rest of the Peninsula, rather than the Catchment being less abundant in species. Comprehensive surveys conducted within the Catchment, such as the marine plains in the vicinity of Princess Charlotte Bay, have revealed areas of high fauna richness (Abrahams et. al, 1995).

Like vegetation, major faunal habitats are defined by major geologies e.g., sandstone plateaus and gorges (Morgan, 1984). The faunal communities of the Laura Basin are typical of those found in monsoonal woodland, which is understood to have a low diversity of fauna (Winter and Lethbridge, 1995). Vertebrate fauna populations on the Peninsula in general are characteristically low, possibly as a reflection of low soil fertility; they are therefore susceptible to disturbances (e.g., weed invasion, fire) (Winter and Lethbridge, 1995). Mammals have been identified with contracting ranges or declining populations, but no known extinctions have been documented in recent times (Winter and Lethbridge, 1995).

Figure 9: Terrestrial Vertebrate Records on Cape York Peninsula
Illustrating relatively low vertebrate numbers in the Laura-Normanby catchment area. Map courtesy CYPLUS and Abrahams et.al., 1995.

THREATENED SPECIES

There is a number of rare, vulnerable and endangered animal species recorded in the Laura-Normanby Catchment. Those under the *Nature Conservation Act 1992*, (*Commonwealth Endangered Species Protection Act* 1992) include the endangered golden-shouldered parrot (*Psephotus chrysopterygius*), red goshawk *(Erythrotriorchis radiatus*) and star finch (*Neochmia ruficauda clarescens*). Vulnerable species include the saltwater crocodile (*Crocodylus porosus),* beach stone-curlew (*Burhinus giganteus*), southern cassowary (*Casuarius casuarius johnsonii)* and crimson finch *(Neochmia phaeton evagelinae).* The cotton pygmy-goose *(Nettapus coromandelianus)* is rare and the Quinkan skink (*Ctenotus quinkan*) is endemic to the Quinkan area (Abrahams et.al.,1995). Figure 10 shows the known locations of rare and threatened terrestrial species.

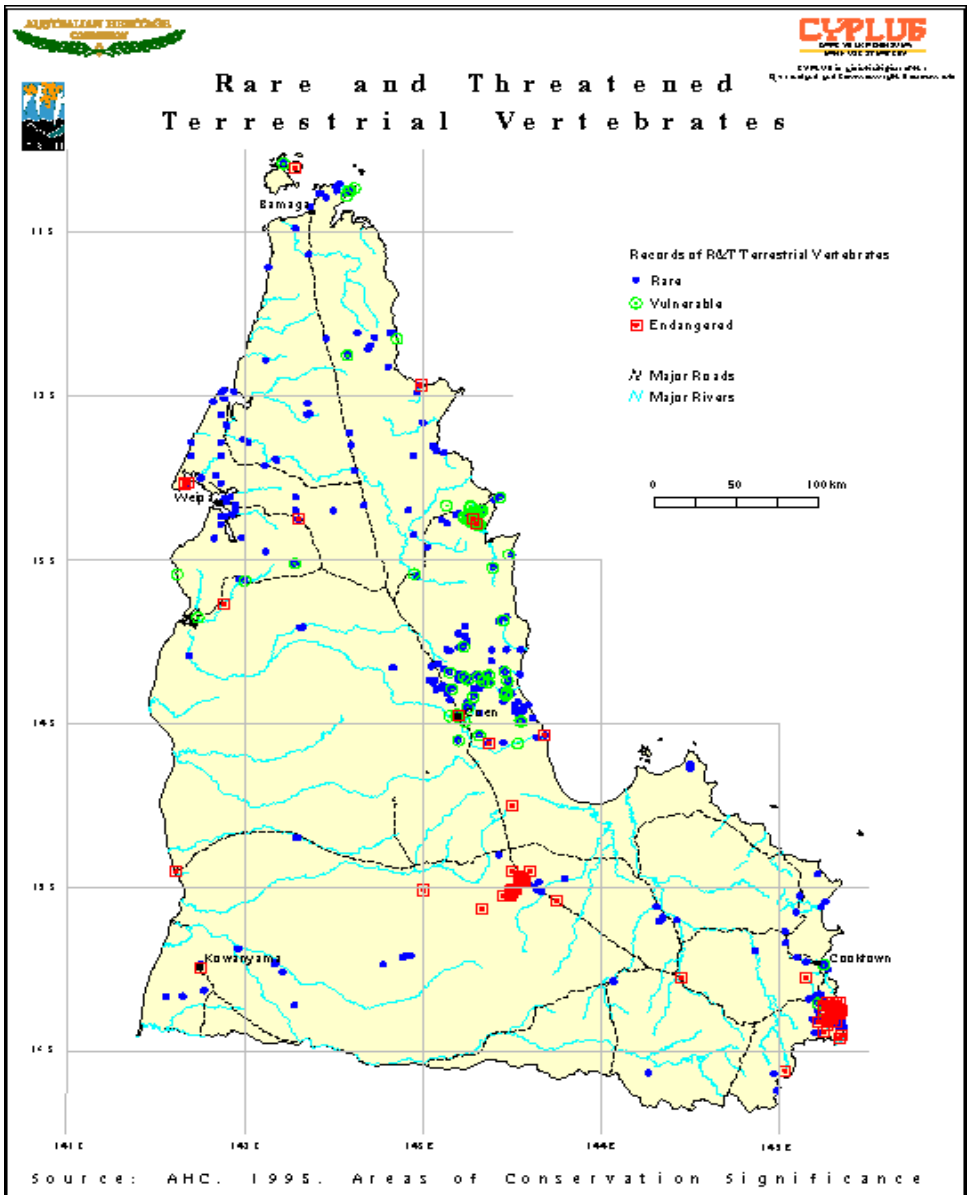


Figure 10: Rare and Threatened Terrestrial Vertebrates on Cape York

Further studies may reveal a high diversity of invertebrate species. The sandstone ranges in the Laura area, including west of Fairview, south of Laura, Henderson Range and Battle Camp Range are noted as nationally significant habitat for butterflies. There has been an

unconfirmed sighting of a *Nesolycaena* species of butterfly in this area which is almost certainly an undescribed species (Abrahams et. al, 1995).

Birds

Golden-shouldered Parrot

The golden-shouldered parrot (*Psephotus chrysopterygius*) once occurred over much of the central Cape York Peninsula but is now only known from two populations. One is centered around Artemis station, north of Laura and the other bordering on Staaten River National Park, near Chillagoe (Crowley et. al, 2004). It is considered to be endangered and at risk of extinction. Experts suggest that there are only about 3,900 of these birds left in two populations (Crowley et. al, 2004) and Cape York is the only known habitat in the world (NHT, 1999). This species requires relatively open grassy woodland terrain. Its breeding habits include tunneling into termite mounds and laying its eggs well inside the mound, safe from predators and fires. It feeds on grass seeds, particularly cockatoo grass. It is thought that the disappearance of the parrot over much of its former range may be caused by a decline in wet season burns and a lack of naturally rocky or open areas. Current grazing levels are not considered to threaten the parrot populations but higher stocking rates may reduce food availability. A recovery plan has been prepared for the species (Crowley et. al, 2004).

Red Goshawk
(Photo by 'Home Valley Station')

Golden Shouldered Parrot,
(Photo by Cindy Jackson)

Red goshawk

The red goshawk (*Erythrotriorchis radiatus*) is one of the world's rarest birds of prey. The genus *Erythrotriorchis* is endemic to Australia and monospecific (contains only one species). This bird occupies a range of habitats in northern and eastern Australia.

In 1995 the CYPLUS data-base contained two records of the red goshawk from across the Cape. It has also been observed in Lakefield National Park (Andrew Hartwig, pers.comm., 2005). It is a woodland bird with extremely sparse populations that nests in trees greater than 20 metres in height and within 1kilometre of a watercourse or wetland. It is estimated that there are about 350 pairs of red goshawk remaining in Australia, compared to a historical population of about 440 pairs. *Australian Heritage Commission, March 1995* (Abrahams et.al., 1995).

Most of the range contraction in this species has occurred in New South Wales and southern Queensland, where suitable habitat has been cleared. In northern Queensland, clearing of coastal vegetation for sugar cane is likely to cause further declines. According to the Action Plan for Australian Birds 2000, the red goshawk is vulnerable.

The woodlands, tall open forest and riverine forests on Cape York Peninsula are amongst the least disturbed in Australia and those catchments on the west of the Peninsula together with the Lakefield area are likely to be important for the conservation of this endangered species, (David Baker-Gabb RAOU pers. comm., 1994) (Abrahams et.al.,1995).

Star finch

There are two records of the northern sub-species of the star finch (*Neochmia ruficauda clarescens)* in the CYPLUS fauna data-base (Glasco *et al* 1995). The central eastern (Lakefield) and western coasts of Cape York Peninsula are some of the few areas in Queensland where the Finch has been recently sighted (Blakkers *et al* 1984). The population of this species is thought to contain fewer than fifty individuals. The Finch's preferred habitat is dense grass and rushes growing beside freshwater. It is considered that the most likely reason for the decline in the Queensland population is degradation of habitat by weeds, stock and feral animals, particularly during the dry season. Wilderness or little disturbed wetland areas in the Lakefield area and on the central west coast of the Peninsula are likely to be important to the continued survival of this sub-species in Queensland (Abrahams et.al., 1995).

Male Red-headed Star Finch
(photo by Harry Bryant)

Crimson Finch
(Photo by Cindy Jackson)

Crimson finch

The northern or white-bellied crimson finch *(Neochmia phaeton evangelinae*) has only been recently recorded on the western coast of Cape York Peninsula. It has been recorded in long perennial grass beside watercourses and has been observed in Lakefield National Park (M. Todd in Garnett and Crowley, 2000). A history of decline suggests the quality of habitat has deteriorated (Garnett and Crowley, 2000). Their habitat is regularly burnt, but the finches persist in nearby shrubs and unburnt remnants. Smothering of native vegetation by rubber vine may have also caused the disappearance of this species along the Laura River (Garnett and Crowley, 2000).

Cotton pygmy goose

(Photo by E.J. Peiker)

The cotton pygmy-goose *(Nettapus coromandelianus)* reaches its northern distribution limit in the Lakefield area and these wetlands are the only important habitat of the species on Cape York Peninsula (Driscoll 1994b). Habitat loss through wetland drainage, river diversion, salinisation and predation are the main causes for species losses (Garnett & Crowley 2000).

Fish

The aquatic habitats of the Normanby River support a diverse range of fish and crustaceans. Fishing is a major attraction of the Lakefield National Park, which attracts anglers from around Australia and from overseas. There is also a variety of wetlands associated with the Normanby River and these include mangroves, saltmarsh and claypans as well as seasonally inundated brackish water wetlands. These wetlands form important fisheries nursery areas (Stuart Hyland, pers.comm., 2005).

Surveys of sharks, barramundi and mud crab have been undertaken in the Normanby River estuary as part of the monitoring of coastal fisheries resources by the Reef Research Centre and the Queensland Department of Primary Industry and Fisheries (QDPI&F). A report will be available later this year (2005). A list of finfish species from netting surveys in the Normanby River estuary is presented in Appendix G.

Speartooth shark


*S*peartooth shark. (Species C).Photo courtesy Sarah Fowler, Darwin Project and IUCN Shark Specialist Group.

Only two freshwater spear toothed sharks (*Glyphis* sp A.) have been observed in Qld., and these were found in the Bizant River in the 1980's (Barry Lyons, pers.comm., 2005). This species is listed as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999.* The small eyes and slender teeth of the *Glyphis* sharks suggest that they are primarily fish-eaters that have adapted to hunting in cloudy estuarine and river waters. The maximum size of these species is unknown but they may grow to a length of 2-3 metres (Last and Stevens, 1994). Within the Bizant this species is known to occur in relatively shallow, upper freshwater and possibly brackish, reaches of the river and associated floodplains. It is thought that *Glyphis* sp. are naturally rare with specific habitat preferences and low reproductive rates, which makes populations vulnerable to any form of exploitation. Threats to the survival of *Glyphis* sp. include recreational line fishing, gill netting and habitat degradation.

Reptiles

Based on the limited survey data that is currently available, the Lakefield area supports a modest number of adult saltwater crocodiles (*Crocodylus porosus).* The estuarine or saltwater crocodile is declared nationally vulnerable under the *Nature Conservation Act 1992*. This species is found in coastal brackish water habitats and the tidal sections of river. However, the saltwater crocodile is also well known from the freshwater sections of river, and also frequents inland lakes, swamps and marshes (Webb *et al.* 1987, Messel and Vorlicek 1989). Habitat loss associated with coastal development and intensive hide-hunting (from the late 1940s through the 1970s) has depleted populations throughout much of the species' range. Habitat loss continues to be a major problem and illegal hunting also persists in some areas. According to QPWS Ranger Barry Lyons, both the number and population structure of estuarine crocodiles in Lakefield National park has significantly increased since the hunting of crocodiles was banned in 1979 (Barry Lyons, pers.comm., 2005).

CONSERVATION AREAS/IMPORTANT HABITAT AREAS

Riparian Forest

The major river systems on the Peninsula tend to run from east to west. The Normanby is an exception to this, mainly running from south to north. The rivers are usually fringed by a strip of forest, which is much lusher than the dry woodlands found away from the water courses. The forests act as corridors for dispersal for many species, including the spotted cuscus *(Spilocuscus maculatus),* white-tailed rat (*Uromys caudimaculatus),* fruit eating birds and palm cockatoo (*Probosciger aterrimus)*(Winter and Lethbridge 1994).

The Normanby River corridor also provides a substantial corridor that links the Wet Tropical Rainforests to the south of the study area with the coast to the south of the Central Peninsula Rainforest areas. This is an important linking corridor for many species that migrate north-south along the Peninsula and to the forests to the south (Abrahams et.al., 1995).

The riparian corridors are also important dry season refuge areas for woodland species whose populations may be decimated through a combination of heat and drought. The riparian vegetation may also be the highest feature on a floodplain and of importance as a refuge habitat during times of flooding (Winter and Lethbridge 1994).

It was noted by Ryan et al (2002) that degraded riverine environments generally benefit exotic species at the expense of native species. Therefore, the preservation of this environment is necessary not only for the survival of existing species but also to maintain future biodiversity.

Lakefield Region

Due to the size of the Lakefield National Park (537 000 ha), and the presence of extensive riparian thickets along most of the waterways, this area is considered to have a high conservation value in terms of protection of the habitat and feeding grounds of the adult estuarine crocodile. The national park contains a high diversity and richness of wetland types, including representative perennial water bodies and ephemeral (or non-permanent) lakes. It is considered to be of natural conservation significance because it contains rare semi-deciduous vine thickets, an extensive Chenier ridge system which has been unusually influenced by a major fault structure in its development, unique butterfly habitat, corridor link to the north of the Peninsula and the most extensive examples of saline flats on Cape York Peninsula (Abrahams et.al., 1995).

Three major river systems pass through the Lakefield National Park area – the Normanby, Kennedy and Morehead Rivers. Extensive wetlands occur throughout the Park including riparian thickets along the riverine systems, permanent swamps and lagoons. The coastal areas are low-lying and subject to flooding and some of the riverine stretches become hypersaline during the dry season. The extensive mangrove communities of the Normanby River may provide good opportunities for adult crocodile feeding grounds. The freshwater crocodile (*C. johnstoni*), occurs in permanent waterbodies of the inland sections of the Park.

The Park is in generally good to excellent condition. However, human population pressures from tourism are increasing and some freshwater lagoons have been degraded from feral pig and cattle disturbance.

Quinkan Area

The Quinkan area has national conservation significance because it supports regionally rare vegetation classes including semi notophyll/microphyll vine thicket and woodlands and open forests. It has very high wilderness quality. The boulder/cliff habitat found on the Laura sandstone is one of the most important habitats for endemic vertebrate species including the skink *Ctenotus quinkan* which is endemic to the Laura (Quinkan) Sandstone Plateau area.

Princess Charlotte Bay

Australia has the highest number of seagrass species of any continent in the world with particular communities being amongst the most diverse in the world (Larkum and den Hartog 1989). Seagrass meadows fringe the southeastern shore at Princess Charlotte Bay and nine species of seagrass have been identified. The Bay also has extensive and representative saline flats and an important shorebird area.

Princess Charlotte Bay is likely to support large populations of foraging Green Turtles *(Chelonia mydas*) which are considered to be nationally vulnerable under the *Endangered Species Protection Act 1992.* Surveys over a ten year period indicate that up to 56% up the Dugongs in the northern Barrier Reef region reside in Princess Charlotte Bay for long periods (CRC, 2002).

MANAGEMENT ISSUES

By 2010 the Cape York Peninsula Natural Resource Management Plan aims to maintain natural heritage values by incorporating natural integrity, ongoing natural processes, biodiversity, bioevolution, geodiversity, aesthetics and contribution to knowledge, through a coordinated approach that is supported across all land tenures.

There is a need to manage biodiversity and land degradation issues at the regional or catchment scale. The reliance of many native plant and animal communities on fragmented habitat remnants make them more vulnerable to a range of impacts e.g., pest animals. Conservation of much of Australia's biodiversity now depends on the management of wildlife outside reserves, often on private land. Effective pest management in these areas is necessary to meet both agricultural production and environmental objectives.

TABLE 10: LAURA-NORMANBY CATCHMENT AREA
BIODIVERSITY CONSERVATION STRATEGIES & RECOMMENDATIONS
GOAL: To manage, maintain, and conserve the biological and ecological diversity in the Laura-Normanby Catchment

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
BC1	Educate the community in its role in nature conservation.	Respect that the community has much to contribute to conservation programs.	- "Promote the adoption of biodiversity conservation principles across all land tenures." - "Develop an education program for reporting sightings."
BC2	Conduct an environmental audit of the Laura-Normanby Catchment. Develop and support a monitoring program for all areas with significant conservation values.	Conduct fauna/flora surveys along the rivers in the Catchment. Conduct ecological studies into the spring communities, rock outcrops and other specialised habitats.	- "Design and implement systematic field surveys to assess the conservation status of threatened species and threatened communities." - "Develop and implement a monitoring and evaluation program and collate information from all sources." - "Map the distribution of threatened species and threatened communities." - "Assess how well the existing protected area system protects terrestrial vertebrates."
BC3	Identify and ensure protection of critical dry season wildlife refuges.	Identify and protect permanent water bodies not already protected. Protect riparian forests because of their role as wildlife corridors and dry season refuges.	- "Identify regional ecosystems of concern including consideration of extensive processes that are causing changes in ecosystem structure."

TABLE 10 (Cont.)

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
	Develop and maintain a conservation corridor network to maintain viability of habitat.	Map corridor network. Use existing natural corridors along streams. Join up with conservation reserves and other large tracts of land. Link up fragmented areas through consultation with landholder by regeneration. Prioritise threatened species.	- "Map the distribution of threatened species and threatened communities." - **"**By 2010 all lands are being managed so that the natural integrity of ecological and hydrological connections is maintained."
BC5	Nature conservation is integrated with land management practices between shires, regions and catchments to maintain the catchments biodiversity.	Identify priority areas for conservation. Consult with neighbouring landholders for co-management. Continue/congratulate cooperative arrangements between conservation reserves and private landholders.	- "Promote and support cooperative management between all stakeholders." - "Work with landholders across all tenures to identify appropriate management interventions for addressing threatening processes."

4.4 LAND DEGRADATION

Gully erosion on the road from Lakeland to Laura

LAND DEGRADATION OVERVIEW

Land degradation encompasses a number of issues, including accelerated erosion, weed invasions and other less obvious forms of degradation such as soil compaction, fertility decline and soil salinity. The causes of land degradation include poor road design and construction, inappropriate land use practices, poor management of water resources, vegetation loss due to fires and feral animal impacts. Land degradation can result in reduced productivity of agricultural and grazing lands and can affect water quality and aquatic and terrestrial habitats.

The costs of land degradation can be enormous, including the cost of maintaining infrastructure, and the loss of productivity. The un-quantified costs such as the impact on water quality and aquatic habitats, fisheries, biodiversity and tourism must also be considered, particularly in the Laura-Normanby Catchment area, where the natural environments and plentiful resources of Princess Charlotte Bay and Lakefield National Park are an important attraction to both tourists and residents.

Many of the issues related to land degradation (e.g., weeds and feral animals, fire management) are discussed in detail in separate sections of this plan. This section will focus primarily on the causes of accelerated erosion and the potential for secondary salinisation to occur within the Laura-Normanby Catchment area.

EROSION

The most common form of land degradation in the Laura-Normanby Catchment area is soil erosion. Wind and water erosion are inherent features of the landscape and the area contains a number of naturally very erosion prone soil types. Human activities in these naturally erosion prone soils has accelerated erosion. Activities that can increase the susceptibility of land to erosion include the construction of roads and other infrastructure, removal of plant cover

(through clearing or fires), the effect of animal hooves on the soil surface and tillage. Tillage associated with cropping is only a factor in the Lakeland area, and land clearing within the Catchment has not been significant. Accelerated gully erosion and slumping of banks along the Laura and Normanby Rivers has primarily been attributed to the disturbance of river banks by stock and feral animals and the incorrect construction of roads.

Significantly accelerated rates of erosion have been observed in association with road construction activities in some areas of the Catchment. Biggs and Philip (1995) found that *"The very large gullies on the Lakeland to Cooktown road are clear evidence of road construction that has not taken the unstable nature of the soils into account"*. Gullying caused by poor roadway drainage is common in Gibson soils (a yellow sodosol). Areas with Gibson soils include the Laura River between Lakeland and Laura, and in the vicinty of the Normanby River near Battlecamp. The alluvial soils derived from the Hodgkinson formation rocks (in the southern and eastern margins of the Catchment) are also highly erodible. Red chromosol soils (Victor) are found in the vicinity of the town of Laura and along the Laura River. "Greenant" yellow sodosol soils occur along the alluvial plains of the East and West Normanby Rivers, along the Laura River north of Laura and along the Normanby River to the north and west of Battlecamp. The surface layers of Greenant and Victor soils are relatively stable but the soils at lower depths are increasingly unstable. If the surface is removed, the underlying soils disperse and erode rapidly (Biggs, 1995).

Regular road maintenance, as well as proper road construction, are necessary to reduce road related erosion. Grading dirt roads and clearing of drains before the wet season can minimise or avoid gully formation (Symons, pers.comm, 2005). Road construction should include proper cross or side drainage structures that do not allow for the concentration of large volumes of water into a few vulnerable points. Rock mulching should be used to reduce erosion in drainage areas. Causeways across rivers can also significantly reduce erosion. The main roads through the Catchment, including the Cooktown Development Road and the Peninsula Development Road, are currently being converted to bitumen. This should help to significantly reduce erosion in these locations.

Grazing pressure and its effect on plant cover and soil disturbance is also considered to be a significant factor in accelerated erosion within the Catchment. Cattle and horse hooves exert four to five times more pressure than a kangaroo (Biggs, 1995). This pressure can break down the structure of the soil. Sandy soils are particularly prone to structural damage, which increases runoff and erosion by reducing infiltration. Stock tracks down to river beds have induced accelerated gully formation and increased loss of material from the river banks. Erosion and accelerated sedimentation is also associated with the loss of vegetation due to trampling by cattle, feral pigs and horses. Property management must take into account the effects of stock along river banks and where possible, river frontages should be fenced and alternate water sources provided for cattle. Envirofund and Landcare Grants may be available to undertake such projects (Appendix A).

Figure 11 shows the areas of existing and potential soil erosion (as of 1994). More recent maps identifying areas of erosion have not been compiled.

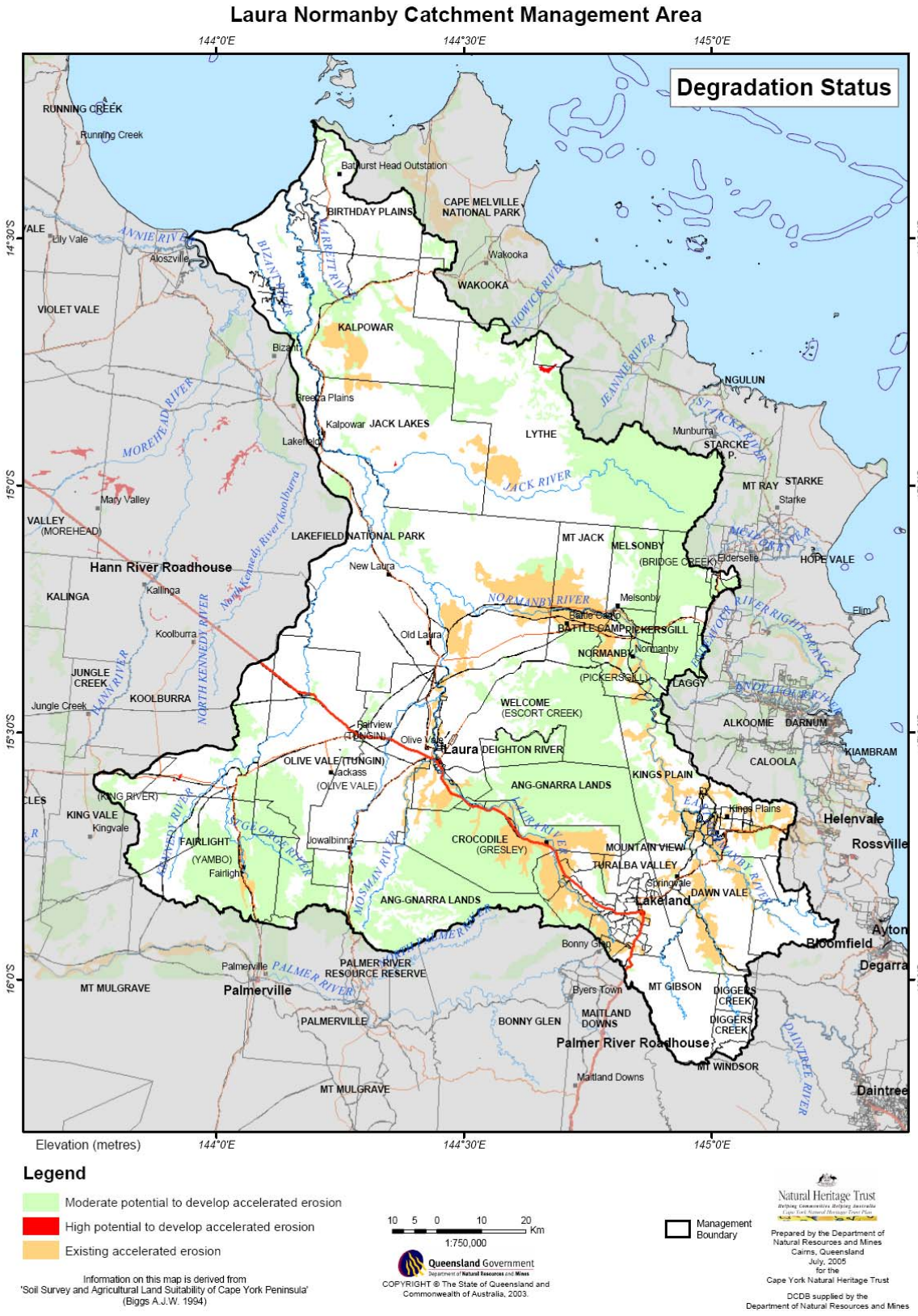


Figure 11: Existing and Potential Erosion Areas

SALINITY

The Laura-Normanby Catchment area has both naturally saline soils and landscapes that are susceptible to secondary salinisation. Secondary salinisation refers to soil salinity caused by human activities such as tree clearing or excessive irrigation. Tree clearing, or the flooding of soils with irrigation waters, can cause groundwater levels to rise, carrying salts from saline groundwater or subsurface soils to the surface. Salinity in soils can impede plant growth and can reduce the stability and permeability of soils, leading to increased erosion.

Naturally saline soils and sediments occur in the coastal plains of Princess Charlotte Bay and soils associated with the Rolling Downs Group and Hodgkinson Formation in the southern and eastern margins of the Catchment area. Naturally saline soils associated with these formations include the Victor and Gibson soil types, which are found intermittently along the Laura and Normanby Rivers. There is a moderate potential for secondary salinity issues to occur in regions where Victor and Gibson soils are found (Biggs and Philip, 1995).

The link between the soils of the Hodgkinson formation and secondary salinity has been seen at the Mareeba Dimbulah Irrigation Area, where highly saline groundwater is rising rapidly as a result of excessive irrigation (Biggs, 1995). Rising salinity can render soils unsuitable for agricultural and other uses. Irrigation within the Laura-Normanby Catchment area is primarily limited to the Lakeland Downs region, where the rapidly draining basaltic soils are not considered to be susceptible to secondary salinity. Salinisation is unlikely to be an issue so long as agricultural activities are limited to these soils. Any future expansion of agriculture into the surrounding Hodgkinson formation soils would increase the potential for secondary salinity issues to develop.

Figure 12 shows the areas with naturally saline soils and potential secondary salinisation issues.

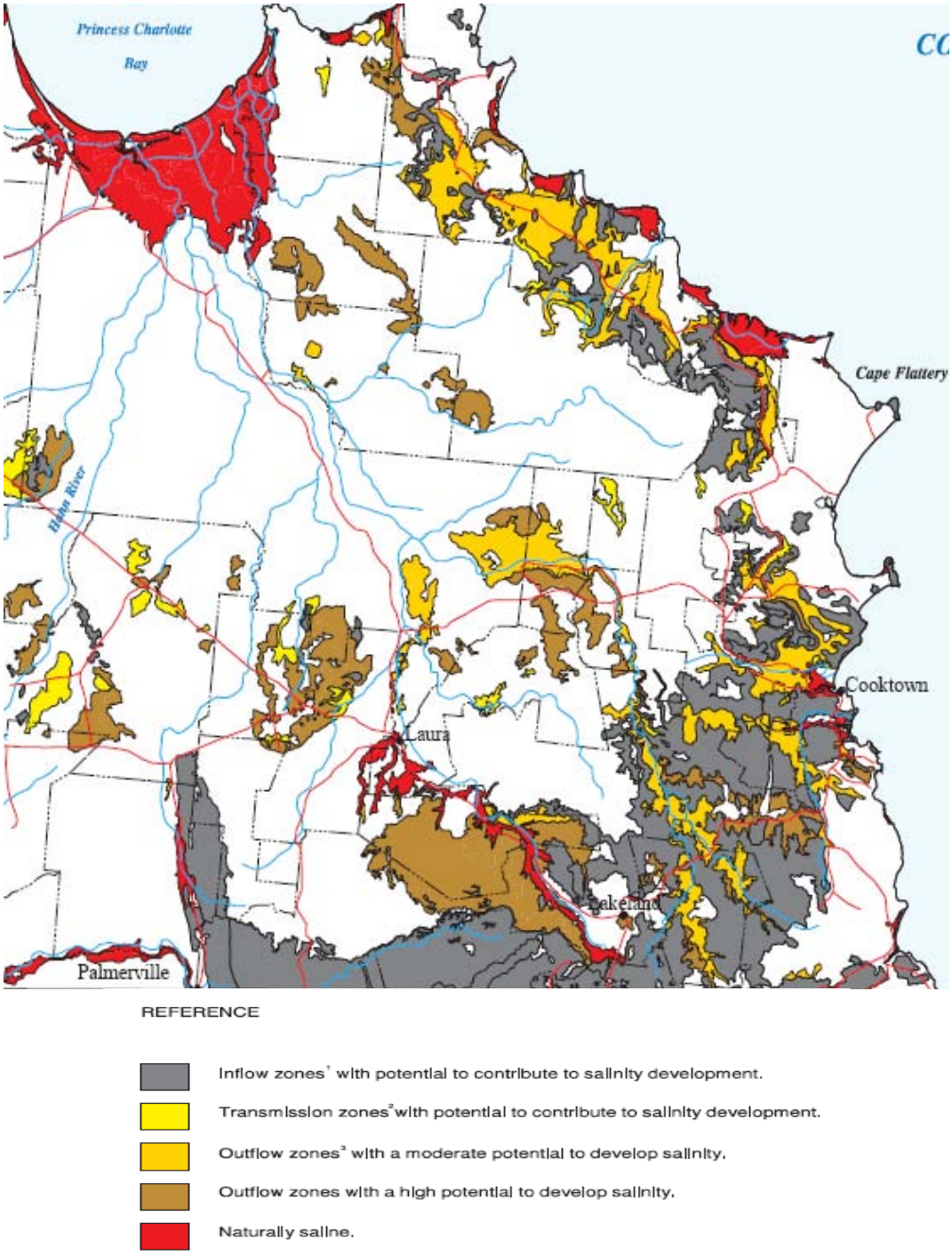


Figure 12: Laura- Normanby Catchment Salinity Hazard Map

Source:

Soil Survey and Agricultural Land Suitability Assessment

A.J.W. Biggs & S.R. Philip, 1994

Queensland Department of Primary Industries

This map was compiled using information sourced from NR02, and additional data gathered by C.M. Hill, P.R. Wilson and A.D. Stallman (QDPI). It is not a comprehensive statement on salinity hazard, being based on reconnaissance survey information only, involving air photo interpretation and ground observations of the order of one observation per 82 km^2. The map does not indicate that salinity will definitely occur in these areas, but rather that a potential exists, and further investigation is required.

MANAGEMENT RECOMMENDATIONS

Any earthworks conducted within the Catchment need to take into account the local soil type and the inherent erodibility of some soils. Road construction should include proper cross or side drainage structures that do not allow for the concentration of large volumes of water into a few vulnerable points. Surface water and sediment runoff should be managed both during and after construction works. Significant erosion areas should be identified and addressed through engineering controls.

Drainage control improvements on the Lakeland - Laura Road

The primary recommendations for salinity management in relation to the Laura-Normanby Catchment are the utilisation of tree clearing regulations and proper management of irrigation, including the removal of excess water (Biggs, 1995). Tree clearing is not considered to have been a major issue in the Catchment previously and the Vegetation Management and Other Legislation Amendment Bill (Qld, 2005) will prevent broadscale clearing of remnant vegetation in the future. Although this legislation has been opposed by many Cape York landholders, the clearing of any vegetation does need to be carefully managed, particularly in erosion prone or saline soils and on hillslopes. Future agricultural expansion and irrigation practices must also consider the soil salinity potential of the Hodgkinson formation.

TABLE 11: LAURA-NORMANBY CATCHMENT AREA
LAND DEGRADATION STRATEGIES & RECOMMENDED ACTIONS

GOAL: To arrest land degradation in the Catchment area through the improvement of land use planning and management practices

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
LD1	Prepare educational material highlighting the causes and consequences of land degradation.		"By 2006, assess the impacts to human health and environmental impacts (including downstream effects) of unsealed roads on the Peninsula."
LD2	Identify and promote best management practices in catchment resource management.	Significant erosion areas should be identified and addressed through engineering controls. Future earthworks conducted within the Catchment need to take into account the local soil type and the inherent erodibility of some soils.	"Compare current and historical evidence of erosion, identify priority problem sites and develop a management and remediation strategy."
LD3	Encourage land managers to monitor newly cleared land and earthworks.	Land managers should monitor earthworks conducted in the Catchment to ensure that best management practices are implemented to minimise soil erosion during and after earthworks.	
LD4	Develop the ability to make land management planning decisions based on assessment of land suitability and capability.	Future agricultural expansion and irrigation practices must consider the soil salinity potential of the Hodgkinson formation.	"Restrict vehicle access in some areas, and rationalise track numbers in priority areas."
LD5	Support and encourage land managers to increase their skills and share their knowledge of natural resource management.		
LD6	Support management practices, training and information that addresses land degradation and sustainable production.		

4.5 FIRE MANAGEMENT

Fire in the Laura-Normanby Catchment has been a significant part of the Catchment's history and will continue to occur whether lit naturally, accidentally or deliberately. The vegetation patterns of eucalyptus forest and woodland vegetation types are susceptible and adapted to fire and some flora depend on fire for germination. Fire also plays a vital role in land management within the Catchment, although there are contradictory opinions on the best methods of fire management.

The deliberate or accidental starting of wildfires is a common problem in the Laura-Normanby Catchment. This issue must be addressed by raising the awareness of all stakeholders and visitors of fire prevention methods, the danger of wildfires, and the impact of wildfires on the environment. Ensuring that firebreaks are in place across the Catchment is the best protection against the spread of wildfires. Due to the prevalence of accidental or deliberately lit fires, QPWS rangers state that they have no choice but to do proactive burning to reduce the threat of wildfires (Andrew Hartwig, pers. comm., 2005).

Fire is considered by many to be a valuable tool for resource management. Burning is used by QPWS rangers as a means of maintaining the balance between grasslands and woodlands and is considered to be the most effective method of controlling weeds such as rubber vine. Pastoralists utilise fire to promote productive pasture growth. Traditional indigenous burning is also conducted as a means of managing resources. Controlled burning can be used to reduce fuel loads and to create fire breaks, thus reducing the intensity and potential damage done by wild fires. Landholders can also use fire to encourage better pasture growth or to remove rank grass. Some grasses, such as bladey grass, have to be burnt on a regular basis to be useful for cattle grazing. Other grasses should not be burnt on a regular basis, or not at all, provided that, with local experience, a stocking rate can be maintained so as to achieve the correct balance between feed volume and stock numbers.

The frequency and timing of controlled burning are two of the most important factors to be considered in fire management. Some fire research indicates that it is not the intensity but the

frequency of fires that is most likely to impact wildlife. According to some resource managers, burning every two to five years is necessary to avoid the intense wild fires that can be destructive to vegetation and wildlife. Burning early in the year, after the first wet season rains, is used by some graziers to promote pasture growth, and has been used traditionally to attract wildlife for hunting purposes. "Storm" or wet season burning is used in the National Park to create firebreaks for controlled burning later in the year. However, there is some belief that continued early burning and overstocking in some areas, has lead to sucker growth and a thickening of vegetation in the Catchment area. Regrowth from early burning can also attract cattle and feral animals into the national park (Andrew Hartwig, pers. comm., 2005).

Different ecosystems require different fire management regimes. In general, small burns conducted year round on a rotational basis, so that the same area is not burnt each year, are considered to be the best management practice (Andrew Hartwig, pers. comm., 2005). This type of burning can help to maintain the age class structure for flora and fauna and one year's burning can create a firebreak for burning in adjacent areas the next year. Unfortunately, this method of burning is not always possible due to the time and costs of conducting controlled burning.

Aerial ignition is a valuable tool in preventative burning strategies. This low intensity burning is normally carried out during the day to self extinguish during the night, leaving burnt strips for firebreaks. Major roadways are targeted to lessen the possibility of tourists' visits causing wild fires. Aerial burning can be carried out very economically covering extensive distances in a short time. For example, three hours aerial burning would take five days of ground burning and at a much cheaper cost (based on aircraft costs $360 per hour approx). Property owners are subsidised if they are members of a registered Rural Fire Brigade.

One of the most useful advances in fire management is fire mapping via satellite, such as that conducted by the CRC Tropical Savannahs. The website, www.firenorth.com.au, presents satellite imagery showing where any fires are burning in Qld, Northern Territory, and Western Australia. By viewing the fire maps at this site, land managers can see where current fires are burning on their own land and surrounding areas, as well as what areas have been burnt in previous years. This information can be used to coordinate burning over large areas and across boundaries, to ensure the same lands are not burnt consecutively and to assess the success of firebreaks and other fire management practices.

The Cape York Peninsula Development Association (CYPDA) has previously organised annual fire management meetings for the Laura-Normanby Catchment area in order to coordinate burning within the Catchment. Coordination of burning among neighbouring properties is necessary to create firebreaks to stop the spread of wildfires across the Catchment area. However, the choice of when and if to burn is up to each property owner. In some cases, graziers choose not to burn at all during dry years in order to save what little grass exists. This increases the risk of wild fire and can also lead to cattle moving onto adjacent properties (such as Lakefield National Park) where early burns have been conducted.

Under the *Queensland Fire and Rescue Authority Act 1990*, fire on a property is deemed the owner's responsibility to control, contain and extinguish. The Rural Fire Service (RFS), formed under the *Queensland Fire and Rescue Authority Act 1990*, provides volunteers with equipment, training, research and fire safety programs. Permits for controlled burning must be obtained from the regional Fire Warden, appointed by the RFS.

Research into both the traditional use of fire by indigenous Australians and the best fire management practices for current land use is ongoing. Traditional burning practices are being

documented and demonstrated as part of the Traditional Knowledge Recording Project (TKRP). The northwestern corner of the National Park, an area under Native Title claim, is one of the traditional burning demonstration areas. Aboriginal elders from this area are monitoring the effects of traditional burning in comparison to the methods used on neighbouring lands. They believe that there is a lack of understanding of the complexity of traditional burning methods in the area and that their knowledge and experience in the use of burning for resource management has largely been ignored (Victor Stephenson, pers. comm., 2005). As part of the TKRP, a massive database of traditional burning methods is being developed, and much of the information will be available by the end of 2005 at www.TKRP.com.

Communication between the various landholders within the Catchment is critical for successful land management. Through a cooperative approach to developing and implementing burning regimes, fire can be used for conservation, hazard reduction and to maximise pasture productivity. These differing values and land uses do not have to be mutually exclusive. A sharing of knowledge between all landowners, including graziers, QPWS and traditional owners is necessary for the best management practices to be identified and implemented across the Catchment.

Coordination of burning practices needs to be conducted by landowners and/or the Rural Fire Service members. Most landowners do not have the time to set aside for meetings and planning; however, management of burning on a catchment scale does need to occur. Landowners should plan a schedule for coordinated burning. The joint planning should include a local schedule for proactive controlled burning, as well as a plan for how to react to uncontrolled wild fires. Training and resources need to be available to all landowners so that landowners can identify and implement the most effective burning practices for their properties.

TABLE 12: LAURA-NORMANBY CATCHMENT AREA
FIRE MANAGEMENT STRATEGIES & RECOMMENDED ACTIONS
Goal: A cooperative and educated approach to best fire management practices.

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
FM1	Promote education of community and visitors in fire prevention methods and the danger of wild fires.		
FM2	Promote landholder awareness and implementation of best management practices for burning.	Support the maintenance of grassland communities through best practice fire management.	-"Prepare a Cape York Peninsula Fire Management Strategy, consistent with the Northern Australia Fire Management Strategy." -"Provide input on fire regime requirements into the development of recovery plans for threatened species and communities." -"Support the implementation of appropriate fire regimes for the maintenance of regional ecosystems (including riparian vegetation)."
FM3	Investigate the impacts of fire in land degradation issues.		

	STRATEGY Determined By Stakeholder Survey	Recommended Actions For Implementation of Strategy	Cape York Regional Plan Management Actions Proposed By The Community
FM4	Continue to compile information on best management practices specific to the varying vegetation types and landuses within the Catchment.		-"Collate information on the fire regimes and broad management requirements for the maintenance of regional ecosystems." -"Collect information on indigenous burning and incorporate into management plans as appropriate." -"Continue funding and support for Cape York Peninsula Sustainable Fire Management Project."
FM5	Provide support for vegetation mapping and controlled burning as part of property management planning.		-"Promote the use of fire as a property management tool, e.g. for control of woody weeds." -"Support all stakeholders with the development of management plans by providing input on fire regime requirements for the maintenance of regional ecosystems."
FM6	Encourage further liaison between the Rural Fire Service, landmanagers, property owners and the indigenous community.	-Encourage better communication, a sharing of knowledge, and coordination of burning techniques across the Catchment. -Engage a local coordinator to set up a local burning schedule and organise training and access to other resources for landowners.	

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APPENDIX A

LANDCARE GRANTS AND OTHER SUPPORT FOR LANDHOLDERS

Landcare Grants and other support for landholders

Compiled by the Peninsula Pastoralist Landcare Committee

Introduction

This information has been collated by the Peninsula Pastoralist Landcare Committee (PPLC) for land managers on Cape York Peninsula. The information presented is as provided by the grant organization and in providing this information the PPLC is not necessarily promoting any scheme, just making the information available for the consideration of individual landholders. This information sheet will be regularly updated by the PPLC. Please contact the Landcare Facilitator (Wendy Seabrook) for more information on these and other grants (40695046 or wendy.seabrook@bigpond.com)

Grants landholders can apply for themselves

Australian Government Envirofund

The Australian Government Envirofund is the local action component of the Australian Government's $3 billion Natural Heritage Trust. It helps communities undertake local projects aimed at conserving biodiversity and promoting sustainable resource use.

Community groups and individuals can apply for grants of up to $30,000 (GST inclusive) to carry out on-ground and other actions to target local problems. Grants of up to $50,000 (GST inclusive) will be considered where the magnitude, complexity or public benefit of the project is such that additional funding would be beneficial.

Exact timing of the Envirofund Round, which will have $20 million on offer, has to be decided but it is likely to be in the September/October 2005 with a closing date in February 2006.

Envirofund Hotline on 1800 303 863. www.nht.gov.au/envirofund

Cultural Heritage Projects Program

Organisation: ENVIRONMENT AUSTRALIA
Program: CULTURAL HERITAGE PROJECTS PROGRAM (CHPP)
Address: Heritage Assistance and Projects Section, Australian and World Heritage Group
PO Box 787, Canberra, ACT 2601
Telephone: 1800 653 004 or (02) 6274 1111
Email: chpp@ea.gov.au or haps@ea.gov.au
Internet Address: http://www.environment.gov.au/heritage/general/grants.html

The program supports the conservation of places of cultural significance – built and indigenous heritage. Funding will predominantly be for on-ground works. Available: $10 000 to $250000
Open to private owners, not-for-profit organisations and local government authorities
Deadline: April each year.

Other Incentives/Assistance available to landholders

Green Reserve

Organisation: AUSTRALIAN CONSERVATION VOLUNTEERS
Program: GREEN RESERVE
Contact: Kay Sheehan or Mark Dwyer
Telephone: 40320844
Internet Address: www.conservationvolunteers.com.au

This program, and 'Better Earth' below, is run by Conservation Volunteers Australia, Australia's largest practical conservation organisation managing more than 2000 conservation projects across Australia each year. Green Reserve is a conservation program for volunteers over the age of 35 years, who are in receipt of the full Newstart allowance. The commitment is for 30 hours per fortnight (two days per week). Project has to have a community benefit, however this does not exclude work on private property if it is a landcare approved project. Participants may receive training in first aid, OH&S and project related technical skills.

Better Earth

Organisation: AUSTRALIAN CONSERVATION VOLUNTEERS
Program: GREEN RESERVE
Contact: Kay Sheehan or Mark Dwyer
Telephone: 40320844
Internet Address: www.conservationvolunteers.com.au

Conservation Volunteers Australia can assist your landcare project by involving the community in managed teams of volunteers. Better Earth projects usually run for five days Monday to Friday, and also on weekends. A program can be developed to achieve your landcare priorities.

Conservation Volunteers Australia provides:	Project Partner provides:
Team Leader to manage the volunteers	Project planning and preparation
Recruitment of volunteers	Materials required
Conservation Volunteers Australia vehicle	All specialised tools and safety equipment
Administrative support and insurance coverage	Accommodation
Hand tools and First Aid equipment	
Food for the volunteers	

Conservation Volunteers Australia is a not-for-profit organisation. This is not a free program but the volunteers pay to take part and CVA can access corporate funding to help cover costs for the teams.

Environmental Management Systems Incentives Program

The EMS Incentives Program encourages the adoption of sustainable management practices through a cash reimbursement for activities associated with the development and implementation of an Environmental Management System (EMS). The program provides a cash reimbursement of 50% of costs up to $3,000 to eligible primary producers. Therefore if you spend $5,000 you will get $2,500 back or if you spend $6,000 you will get $3,000. However, if you spend $10,000 you will only get $3,000 back!

Who is eligible for the EMS Incentives Program?

- **The applicant must be an Australian resident, or be a business registered in Australia;**
- **The applicant must be a primary producer as defined by the Australian Taxation Office;**
- **The applicant must have the authority to represent the primary production enterprise;**
- **The primary production enterprise must have a taxable income of less than $45 000; and**
- **There must be a plan in place for the primary production enterprise that documents essential EMS elements and is consistent with existing Catchment/Regional plans. It is not necessary to have a certified EMS in place.**

While this scheme is primarily for EMS, advice to PPLC from the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF) has indicated that there is flexibility in what Centrelink see as 'environmental plans'. We have been told that properties with Property Plans, Weed and Pest Plans, undertaking the $avannah Plan (GLM+ program), or similar planning programs can apply for funding through this incentive scheme. However the landholder will be still required to show that the planning work is consistent with existing Natural Resource Regional Plans, catchment plans and local council plans. Landcare staff can help you with this section of your application.

Here's some examples of the activities the Incentives Program will pay for:

- **obtaining professional advice to help develop an EMS, including assessment of environmental impacts and biodiversity, mapping of salinity, environmental monitoring, assessment of water quality, surface and groundwater flow;**
- **establishing trees and shrubs for salinity control, to stabilize or prevent erosion and as windbreaks;**
- **fencing to exclude stock or vermin; establish or protect native vegetation and wildlife habitat; protect remnant vegetation; or to separate land classes; and**
- **eradication/extermination of weeds or pests that are detrimental to the land.**

For further information www.daff.gov.au and www.centrelink.gov.au. Both sites use the search option to find -EMS Incentives Program. Phone free call: 1800 050 585

Wildlife Refuges

A nature refuge is a voluntary conservation agreement between a landholder and the Queensland Government that leads to the establishment of a nature refuge. A nature refuge is a category of protected area under the Nature Conservation Act 1992.

Each agreement is tailored to suit the management needs of the particular area and the needs of the landholder. In most cases, the agreement allows for the ecologically sustainable use of natural resources to continue. A nature refuge can cover part or all of a property protecting wildlife and wildlife habitat and emphasising the conservation of biodiversity as an important part of property management.

More than 95 landholders across Queensland manage nature refuges on their properties, protecting rare and threatened ecosystems, plants and animals, while maintaining and enhancing property enterprises as diverse as grazing, cropping, horticulture and ecotourism. If you think your property has outstanding value for native plants and animals, you might consider negotiating a conservation agreement to create a nature refuge and further contribute to the conservation and protection of Queensland's biodiversity.

For more information: www.epa.qld.gov.au/nature_conservation/nature_refuges

Financial incentives for nature refuges

1. **Transfer duty reimbursement**

Purchasers of land who enter into a Conservation Agreement with the Environmental Protection Agency (EPA) to protect its conservation values are eligible for a reimbursement of the transfer duty paid on the purchase of the land.

Eligibility:

- **Land must be purchased on or after 1 July 2003;**
- **The land must include vegetation, plants or animals that are considered by the EPA to be of a high conservation value. Potential buyers are urged to consult with their local EPA office for advice on the conservation values of the land;**
- **The landholder must enter into negotiations with the EPA to establish a Conservation Agreement with the EPA to create a Nature Refuge over part of or all of the land within 12 months of the purchase;**

Once the Conservation Agreement is finalised, the EPA will reimburse the landholder for the transfer duty paid on the purchase, or on a pro rata basis if the Conservation Agreement is over part of the land.

Contact: Nature Refuge Project Officer Environmental Protection Agency Ph. (07) 3225 1740 Office of State Revenue http://www.osr.qld.gov.au/taxes/duties/transfer.htm

2. **Land tax reimbursement**

Landholders who are liable too pay land tax on properties who enter into Conservation Agreements with the Environmental Protection Agency (EPA) are eligible for a reimbursement of land tax payable on land subject to the agreements.

Eligibility:

- **Landholder must fulfil the criteria to pay land tax;**
- **The land must include vegetation, plants or animals that are considered by the EPA to be of a high conservation value. Landholders are urged to consult with their local EPA office for advice on the conservation values of the land;**
- **The landholder must enter into a Conservation Agreement with the EPA to create a Nature Refuge over part of or all of the land.**

Once the Conservation Agreement is finalised, the EPA will reimburse the landholder for the land tax payable on the property, or on a pro rata basis if the Conservation Agreement is over part of the land. Also, if after the 30 June, a landholder enters into a Conservation Agreement in respect of land on which land tax has been paid for that year, the landowner will be eligible for a reimbursement of land tax on a pro rata basis for the period from the date the Conservation Agreement is finalised to the end of that financial year. Contact: Nature Refuge Project Officer Environmental Protection Agency Ph. (07) 3225 1740 Kevin Vinter - Land Tax Branch Office of State Revenue Ph. (07) 3227 6014
http://www.osr.qld.gov.au/taxes/land/index.htm

Conservation Covenants

What is a conservation covenant?

A conservation covenant is a voluntary agreement between a landowner and an authorised body to help the landowner protect and manage the environment on their property. It is usually registered on the title of the land and can apply to all or part of a property. Although there are exceptions, it is usually permanent. The terms of the agreement are negotiated between the landowner and the covenant provider and may only be changed with the agreement of both parties.

Protecting natural and cultural values

Conservation covenants are designed to protect the natural values of an area such as its native vegetation, wetlands, wildlife and related habitat, and areas of cultural significance. They can also include areas that have been rehabilitated. Covenants are not about stopping the use of an area, but ensuring that any use is compatible with the natural values to be looked after. A management plan would typically be prepared by, or in consultation with, the landowner, setting out practical strategies to make sure the natural values are protected. For example, the plan may include details of how weeds and pest animals are to be managed, or how and when controlled burning may occur.

Assistance

In entering into a conservation covenant, landowners may be able to access assistance such as:

- **specialist technical advice, e.g. mapping vegetation and**
- **fauna surveys;**
- **assistance with management costs;**
- **tax deductions;**
- **rate relief; and**
- **reimbursement for establishment costs.**

Technical Advice

The amount of technical advice and assistance available to landowners varies between covenanting scheme providers. Please contact the provider in your State for details (see the organisations listed at the back). Some schemes have budgets to assist with management costs (such as fencing), while others may have arrangements with volunteer and other groups to assist with on-ground works such as revegetation or pest control. Some State and local governments offer rebates on council rates to landowners who enter into conservation covenants. Other forms of financial assistance, such as those provided by the Queensland Vegetation Incentives Program, can include payments for entering into a conservation covenant and/or payments to cover management costs.

Tax arrangements

In some cases, tax concessions may be available to landowners entering into a perpetual conservation covenant. These concessions include:

1. An income tax deduction for any decrease in land value as a result of entering into a conservation covenant,

providing that:

- **the covenant is entered into on or after 1 July 2002;**
- **the land is owned (not leased);**
- **no money, property or other material benefit is received**
- **for entering into the covenant;**
- **the decrease in the market value of the land is over**
- **$5,000, or the land was acquired not more than**
- **12 months before entering into the covenant; and**
- **the covenanting organisation is eligible*.**

2. Special treatment of capital gains tax where a conservation covenant is entered into, and the landowner receives money or property for doing so. This treatment ensures a comparable treatment with landowners who sell part of their land.

A factsheet on tax arrangements for conservation can be found on the Australian Government Department of the Environment and Heritage website at http://www.deh.gov.au/land/publications/covenants/index.html or obtained by phoning the Community Information Unit on 1800 803 722.

The Australian Taxation Office also has information on conservation covenant concessions on their website at http://ato.gov.au/nonprofit/content/19507.htm. For information on Conservation Covenants in Queensland contact either your local DNRM or EPA office for more information.

Land for Wildlife

Land for Wildlife is a voluntary, non-binding program which encourages and supports landholders to provide habitat for native plants and animals on their property. It is a free, voluntary program, and landholders can leave at any time. The program offers landholders a variety of benefits which include: free advice and assistance on managing wildlife habitat with other land uses , recognition and support for your contribution to nature conservation in Queensland , opportunities to share ideas and experiences through the Land for Wildlife network and publications.

The program is designed for any landholder who has natural areas of vegetation like rangelands, vegetation along watercourses, or shelter belts. All types of small and large properties are eligible for Land for Wildlife status, such as farms, bush blocks, parks, school grounds – even golf courses and cemeteries. Land can be government owned or owned by individuals, organisations, and community groups.

Landholders can also get together with a group of neighbours and join Land for Wildlife to conserve habitat for a particular species of native animal, or to manage natural vegetation across properties or catchments.

How to apply

Once your property is registered with Land for Wildlife, you will receive an attractive sign and certificate to recognise your efforts. You will also receive professional information, support and advice on conserving native plants and animals, as well as solutions to environmental and wildlife management problems.

For more information, contact: Katherine Sinclair-Smith, Land for Wildlife Coordinator, (07) 4921 4820, email: ksinclairsmith@qld.greeningaustralia.org.au

Loans for Landcare

Concessional loans for landcare activities are available through the Primary Industries Productivity Enhancement Scheme (PIPES). QRAA administers the scheme with the assistance of the Department of Natural Resources and Mines (NR&M) and the Department of Primary Industries and Fisheries (DPI&F).

Activities eligible for loans

- Reclaimation of degraded areas
- Water supplies and irrigation
- Pest, plant and animal control
- Vegetation management
- Machinery that is to be used exclusively for landcare purposes
- Soil erosion control
- Salinity prevention and control
- Effluent management

Eligibility criteria

The approval of a PIPES loan for landcare is not subject to a means test. Applicants must have sound prospects for commercial viability in the long term and normally derive their major source of income from the enterprise. They should be in full-time working occupation of the enterprise as owner operator or as part of a small family company or partnership.

Terms and conditions

Landcare Loans are provided at concessional rates of interest with no additional fees or charges associated with the loan. Current interest rates can be obtained by phoning QRAA on Freecall 1800 623 946 or by visiting their website www.qraa.qld.gov.au.

Loans are provided for the total cost of a project (less labour provided by the property owner). The maximum loan available is $100 000 per annum, up to a cumulative total of $300 000. Loans are available for a maximum of 20 years. For further information contact the local office of the Department of Natural Resources and Mines or QRAA on Freecall 1800 623 946. Information is also available on the QRAA website at www.qraa.qld.gov.au.

Grants for community groups and landholders

While individual landholders can not apply for these funds directly, the PPLC can put applications in on behalf of landholders. Joint applications which involve neighbouring properties are likely to be more successful and projects which can demonstrate benefits to the community as a whole in relation to environmental improvements.

Community Natural Resource Awareness Activity Grants

The Community Natural Resource Awareness Activity Grants are offered to Landcare, and other community natural resource management (NRM) groups to develop small, innovative and creative promotional projects in partnership with community, school, youth or business groups, and / or local government.

These grants are intended to take an entertainment, educational or cultural approach to strengthening the community's awareness and involvement in sustainable NRM in Queensland.

In 2005 grants were up to $2,500. Next round late 2005. For more information phone 07 3239 3860 or www.nrm.qld.gov.au/community

Australian Water Fund Communities Program

$200 million will be available over the next 5 years for Community Water Grants funding of up to $50,000 to save and protect water resources through practical on-the-ground work.

What sorts of projects will Community Water Grants fund?
It will be important that projects: are community orientated and have public benefits; involve practical on-ground works to save or protect water resources; and comply with relevant planning, health and environmental regulations and or guidelines. In relation to landcare there will be funds for Surface and Groundwater Health. These are projects that improve surface or groundwater health, such as erosion control, creek and riverbank repair, or cleaning up a local creek or wetland, and projects that reduce pollution in rivers, groundwater or coastal areas.
Grant recipients may include community groups, schools, local government, Catchment Management Authorities and non-government organisations.

The first open call for grant applications is expected in June 2005. Grants will be assessed on a nationally competitive basis.

Further information will be made available on the Australian Government Natural Resource Management web site (www.nrm.gov.au) as it becomes available. Further queries can be directed to cwg@deh.gov.au or free call 1800 780 730.

Communityhelp Grants

These grants, provided by NRMA support community organisations that help reduce risk in the areas of crime and injury prevention, emergency rescue services, and the environment, Community and not-for-profit organizations can apply for grants of up to $5,000. For more information email Daniel.Musson@iag.com.au

Gambling Community Benefit Fund

Gambling Community Benefit Fund aims to develop, strengthen and enhance the capacity of community organisations to provide community services and activities through one-off grants. A maximum of $30,000 usually applies. Applications close 30 June 2005. For more information Ph 1800 633 619 or 3247 4284 or email gcbf@treasury.qld.gov.au

Junior Landcare Grants Program

These small grants offered by Landcare Australia and Mitre 10 aim to provide funds for schools and youth groups across Australia wishing to participate in environmental projects that encourage ownership through involvement. Applications close around May and further information is available from www.landcareaustralia.com.au or 1800 151 105.

Threatened Species Network Community Grants

The TSN Community Grants have been established to support and inspire community work to recover threatened species and ecological communities. The grants aim to provide seed funding to assist community groups to take on long term responsibility for conservation and recovery of populations of nationally threatened species and ecological communities. Applications are invited from incorporated community groups for funding of up to $50,000 for projects to conserve nationally threatened species and ecological communities. Further information is available by phoning 1800 032 551, email tsngrants@wwf.org.au or online at www.wwf.org.au. Applications close midyear.

Bundaberg Rum Bush Fund

Landcare and other community groups, tackling water quality projects, are invited to apply for a Bundaberg Rum Bush Fund grant (between $1,000 - $5,000). Landcare Australia and Bundaberg Rum will assess proposals, based on environmental and community merits, and allocate grants each year.

Funding timetable 2004 - 05:

- 31 October 2004 - Applications for Murray Catchment grants close;
- 31 March 2005 - Applications for national small grants close.

Grant applications must address water quality issues within the local area. This may be within a river, lake, stream, creek, or as part of the wider catchment. (Please see Grant Guidelines for further information on how to apply for a Bundaberg Rum Bush Fund grant.)

For more information www.landcareaustralia.com.au

BHPBilliton Community Support Program

Contact: Community Programs Co-ordinator, BHP Billiton Community Trust, GPO Box 86A
MELBOURNE VIC 3001, Telephone: (03) 9609 3770, Fax: (03) 9609 3244, Email: Melinda.buckland@BHPBilliton.com, Internet Address: www.bhpbilliton.com

Funding for a wide cross-section of community organisations conducting programs and providing services including environmental programs directed towards sustainable development and the conservation of native flora and fauna. $20 000 - $150 000
Eligibility: See website
Deadline: 1 March, 1 August, 1 November

Myer Foundation

Contact: Executive Officer
Address: 44th Floor 55 Collins St, Melbourne, VIC 3000, Telephone: (03) 9207 3040, Fax: (03) 9207 3070, Email: enquiries@myerfoundation.org.au,
Internet Address: www.myerfoundation.org.au

To fund initiatives in community welfare, environment (see below) and the arts etc. with an emphasis on innovation and social development
$ Available: No upper limit
Eligibility: Incorporated/non-profit and indigenous organisations
Deadline: 14 July
Must show:

- Evidence of Incorporation as a not-for-profit body
- Income Tax Exempt Charity ("ITEC")- please supply copy of the ATO notification letter
- Evidence of Deductible Gift Recipient (if applicable) - please supply copy of the ATO notification letter

Natural Environment

The Myer Foundation will support work that provides solutions to **environmental problems in Northern Australia.** This region includes **Cape York Peninsula**. Priority will be given to projects that include cultural, social and economic links that provide long term solutions

G4 Fund

The G4 Fund supports dynamic community-based projects in the priority areas of **Environmental education**. Please note that "youth" is defined as those in the 12 to 25 year age bracket. The G4 Fund makes grants of up to $25,000

Need Further information?

This fact sheet will be updated regularly when more incentives become available. If you want any advice or assistance with applying for these grants contact:

Wendy Seabrook
Landcare Facilitator
PO Box 3 Cooktown
Q 4895
Ph 07 40695046
Fax 07 40696997
Mobile 0428 695957
Email wendy.seabrook@bigpond.com

APPENDIX B

QLD DEPT OF NATURAL RESOURCES & MINES
SURFACE WATER QUALITY DATA
FOR LAURA-NORMANBY CATCHMENT AREA

Water Quality Summary by Site

***** ** STATION: 105102A Laura_R Coalseam Ck**

Variable	Count	Minimum	10 Percent	Median	90 Percent	Maximum	Mean	Std Dev	Start date	End date
100.00 Stream Water Level (m)	35	1.08	1.574	1.97	3.312	999.99	87.52	283.46	05/12/1971	06/06/1996
140.00 Stream Discharge (Cumecs)	31	0	0	0.118	3.83	42.4	2.397	7.71096	05/12/1971	06/06/1996
630.00 Dist. below Water Surface	64	0.1	0.1	0.1	0.285	0.3	0.159	0.06932	05/12/1971	12/05/2004
2010.00 Conductivity @ 25C (uS/cm)	34	68	99.4	233	847	930	371.73	294.267	05/12/1971	06/06/1996
2010.50 Conductivity @ 25C (uS/cm)	48	63	115.3	441	948	1188	488.1875	329.99862	20/08/1981	12/05/2004
2030.00 Turbidity (NTU)	19	1	1	10	76	514	46.06842	116.74712	09/03/1981	06/06/1996
2030.50 Turbidity (NTU)	28	2	2.7	5	43.2	585	41.10714	119.91242	31/05/1995	12/05/2004
2051.00 Colour True (Hazen units)	27	5	5	15	34	70	18.22222	14.74484	09/03/1981	06/06/1996
2065.50 Air Temperature ()	22	21.1	25.42	30.4	35.95	38.7	30.45909	4.55335	14/10/1994	12/05/2004
2080.50 Water Temperature	63	19	23.34	27.8	32.9	36	27.96984	3.55013	05/12/1971	12/05/2004
2100.00 pH (pH units)	34	6.7	7.1	7.775	8.2	8.65	7.68088	0.48218	05/12/1971	06/06/1996
2100.50 pH (pH units)	30	6.7	7.1	8.05	8.3	8.5	7.84333	0.49178	19/02/1993	12/05/2004
2113.00 Total Alkalinity as CaCO3 (mg/L)	34	12	26.6	65.295	278.8	314	119.71765	103.74814	05/12/1971	06/06/1996
2123.00 Hydroxide as OH (mg/L)	14	0	0	0.01	0.047	0.1	0.01929	0.02814	05/12/1971	06/06/1996
2124.00 Carbonate as CO3 (mg/L)	27	0	0.006	0.3	2.86	9.9	1.36963	2.20419	12/08/1975	06/06/1996
2125.00 Bicarbonate as HCO3 (mg/L)	34	14.5	32.61	79.22	334.9	379	144.16618	124.07868	05/12/1971	06/06/1996
2132.00 Hardness as CaCO3 (mg/L)	34	13	25.2	57.895	269.4	321	110.18735	97.30414	05/12/1971	06/06/1996
2141.00 Hydrogen as H (mg/L)	16	0	0	0	0	0	0	0	05/12/1971	06/06/1996
2169.00 Total Diss. Solids (mg/L)	34	36	56.6	127.485	457	510	203.01	158.54949	05/12/1971	06/06/1996
2170.00 Total Diss. Ions (mg/L)	34	34.9	63.42	149.215	614.03	670	264.76412	218.26461	05/12/1971	06/06/1996
2172.00 Total Suspended Solids	33	1	4	10	110.6	505	44.66667	101.17796	17/06/1973	06/06/1996
2302.00 Calcium as Ca soluble (mg/L)	34	1.7	3.55	8.75	26.45	35.5	12.86176	9.5055	05/12/1971	06/06/1996
2311.00 Chloride as Cl (mg/L)	34	5.1	11.44	28.985	110	140	47.81706	40.37788	05/12/1971	06/06/1996
2322.00 Magnesium as Mg soluble (mg/L)	34	1.9	3.22	9.1	51.7	56.6	19.00882	18.22335	05/12/1971	06/06/1996
2331.00 Nitrate as NO3(mg/L)	15	0.1	0.206	0.8	3.28	3.82	1.404	1.29589	26/05/1980	06/06/1996
2336.00 Kjeldahl Nitrogen (mg/L)	4	0.333	-	-	-	2.591	1.05888	1.05177	14/10/1994	06/06/1996
2351.50 Oxygen (Dissolved) (mg/L)	25	2.1	4	6.8	7.76	9	6.404	1.67593	31/05/1995	12/05/2004
2363.00 Total Phosphorus as P (mg/L)	4	0.0041	-	-	-	0.3187	0.08988	0.15299	14/10/1994	06/06/1996
2381.00 Potassium as K (mg/L)	33	0.5	1.42	2.6	4.48	9.8	2.92121	1.67365	17/06/1973	06/06/1996
2391.00 Sodium as Na (mg/L)	34	5.1	10.65	22.75	74.7	145	34.91471	30.50092	05/12/1971	06/06/1996
2401.00 Sulphate as SO4 (mg/L)	17	0.2	0.636	2	6.28	9.98	2.78647	2.60213	26/05/1980	06/06/1996
2502.00 Aluminium as Al soluble (mg/L)	8	0	-	-	-	0.31	0.07125	0.09848	01/06/1990	06/06/1996
2524.00 Arsenic as As - total (µg/L)	1	0	-	-	-	0	0	0	20/08/1980	20/08/1980
2551.00 Boron as B (mg/L)	18	0	0	0.03	0.072	0.1	0.03167	0.02936	17/06/1973	06/06/1996
2622.00 Copper as Cu soluble mg/L	11	0.01	0.01	0.03	0.06	0.07	0.03273	0.02149	08/02/1990	06/06/1996
2641.00 Fluoride as F (mg/L)	22	0	0.03	0.12	0.435	0.63	0.17955	0.16238	05/12/1971	06/06/1996
2682.00 Iron as Fe soluble (mg/L)	19	0	0.02	0.1	0.672	4.1	0.36474	0.92971	17/06/1973	06/06/1996
2712.00 Manganese as Mn soluble (mg/L)	5	0	-	-	-	0.02	0.008	0.01095	23/08/1993	06/06/1996
2762.00 Silica as SiO2 soluble (mg/L)	31	1	5	11.8	27	29	13.17419	7.38205	17/06/1973	06/06/1996
2822.00 Zinc as Zn soluble (mg/L)	10	0	0.009	0.01	0.02	0.02	0.013	0.00675	08/02/1990	06/06/1996

***** ** STATION: 105101A Battle Camp**

Variable	Count	Minimum	10 Percent	Median	90 Percent	Maximum	Mean	Std Dev	Sdate	Edate
100.00 Stream Water Level (m)	60	0.73	1.943	2.23	4.33	7.4	2.67777	1.24311	06/11/1971	28/04/2004
140.00 Stream Discharge (Cumecs)	53	0	0.0162	0.585	14.3896	198	9.95083	31.44643	06/11/1971	05/06/1996
630.00 Dist. below Water Surface	98	0	0.1	0.1	0.3	0.3	0.15255	0.07611	06/11/1971	28/04/2004
2010.00 Conductivity @ 25C (uS/cm)	56	58	75.6	142.5	242	335	153.78571	65.93778	06/11/1971	28/04/2004
2010.50 Conductivity @ 25C (uS/cm)	51	63.1	90	159	245	409	168.28235	66.89437	26/08/1981	28/04/2004
2030.00 Turbidity (NTU)	32	0.9	2	7.35	80	257	33.26563	53.16813	14/12/1984	28/04/2004
2030.50 Turbidity (NTU)	34	3	6	10	69.9	253	29.52941	47.96036	31/05/1995	28/04/2004
2051.00 Colour True (Hazen units)	33	5	5	16	40	77	20.78788	18.46408	01/09/1983	28/04/2004
2065.50 Air Temperature ()	25	22.8	25.72	28.5	33.36	34.4	28.704	2.88422	03/10/1995	28/04/2004
2080.50 Water Temperature	84	16	23	26.4	30.41	34	26.63333	3.22376	26/08/1972	28/04/2004
2100.00 pH (pH units)	56	6.52	6.85	7.4	7.85	8.7	7.37018	0.39752	06/11/1971	28/04/2004
2100.50 pH (pH units)	36	6.5	6.9	7.2	7.55	7.9	7.24083	0.27552	17/02/1993	28/04/2004
2113.00 Total Alkalinity as CaCO3 (mg/L)	55	8	15.124	33.6	66.012	116	38.56382	22.86934	06/11/1971	28/04/2004
2123.00 Hydroxide as OH (mg/L)	34	0	0	0	0.01	0.09	0.00382	0.01557	06/11/1971	28/04/2004
2124.00 Carbonate as CO3 (mg/L)	43	0	0	0.04	0.2	0.8	0.09116	0.14838	06/11/1971	28/04/2004
2125.00 Bicarbonate as HCO3 (mg/L)	55	9.7	18.638	40.9	80.162	140	46.97527	27.75065	06/11/1971	28/04/2004
2132.00 Hardness as CaCO3 (mg/L)	55	8.82	13.4	32	61.074	109	34.74945	20.42494	06/11/1971	28/04/2004
2141.00 Hydrogen as H (mg/L)	34	0	0	0	0	0.2	0.00588	0.0343	06/11/1971	28/04/2004
2169.00 Total Diss. Solids (mg/L)	55	39	49.2	84	134.8	190	92.198	35.96197	06/11/1971	28/04/2004
2170.00 Total Diss. Ions (mg/L)	55	36.5	49.86	89.7	163.364	243.9	101.65345	47.77473	06/11/1971	28/04/2004
2172.00 Total Suspended Solids	52	2	5	10	84	316	37.39231	61.54134	10/10/1973	28/04/2004
2302.00 Calcium as Ca soluble (mg/L)	55	1.16	2	5.2	12	32	6.39691	5.17069	06/11/1971	28/04/2004
2311.00 Chloride as Cl (mg/L)	55	8.5	13.604	22.3	36.698	50	24.37509	9.84	06/11/1971	28/04/2004
2322.00 Magnesium as Mg soluble (mg/L)	55	1.4	1.94	4.5	7.12	10.9	4.56255	2.12506	06/11/1971	28/04/2004
2331.00 Nitrate as NO3(mg/L)	21	0	0	0.5	0.9	1.24	0.45	0.36007	17/12/1976	28/04/2004
2336.00 Kjeldahl Nitrogen (mg/L)	3	0.1289	-	-	-	0.325	0.23397	0.0988	31/05/1995	05/06/1996
2337.00 Total Nitrogen (mg/L)	5	0.1306	-	-	-	0.4796	0.3453	0.13698	19/07/1998	28/04/2004
2351.50 Oxygen (Dissolved) (mg/L)	30	0.5	3.06	6.5	8.21	8.5	6.16167	2.0139	31/05/1995	28/04/2004
2363.00 Total Phosphorus as P (mg/L)	8	0.0079	-	-	-	0.0765	0.03406	0.02381	31/05/1995	28/04/2004
2381.00 Potassium as K (mg/L)	52	0.3	1	1.4	2.3	2.9	1.52519	0.56847	10/10/1973	28/04/2004
2391.00 Sodium as Na (mg/L)	55	7.4	9.91	15.8	26.2	32	16.83018	6.41779	06/11/1971	28/04/2004
2401.00 Sulphate as SO4 (mg/L)	26	0	0.25	1.135	5	5.8	1.75885	1.68424	24/05/1975	28/04/2004
2502.00 Aluminium as Al soluble (mg/L)	18	0	0	0.025	0.203	0.57	0.08944	0.15543	04/08/1986	28/04/2004
2551.00 Boron as B (mg/L)	23	0	0	0.02	0.072	0.11	0.02609	0.0313	14/12/1984	28/04/2004
2622.00 Copper as Cu soluble mg/L	17	0	0.006	0.01	0.044	0.06	0.01882	0.01691	04/08/1986	28/04/2004
2641.00 Fluoride as F (mg/L)	40	0.01	0.03	0.1	0.196	0.6	0.11975	0.12559	06/11/1971	28/04/2004
2682.00 Iron as Fe soluble (mg/L)	31	0	0.01	0.11	0.49	1.42	0.25226	0.32855	10/10/1973	28/04/2004
2712.00 Manganese as Mn soluble (mg/L)	13	0	0	0	0.018	0.28	0.02538	0.07677	14/12/1984	28/04/2004
2762.00 Silica as SiO2 soluble (mg/L)	52	5.8	10.91	15	21.9	55	16.53942	8.1105	10/10/1973	28/04/2004
2822.00 Zinc as Zn soluble (mg/L)	16	0	0	0.01	0.055	0.07	0.01938	0.02144	04/08/1986	28/04/2004

***** ** STATION: 105105A E Normanby_R Dev Rd**

Variable	Count	Minimum	10 Percent	Median	90 Percent	Maximum	Mean	Std Dev	Sdate	Edate
100.00 Stream Water Level (m)	63	0.29	1.28	1.42	2.73	5.2	1.68857	0.84861	22/08/1972	17/10/2001
140.00 Stream Discharge (Cumecs)	57	0	0.0496	0.443	26.5444	135.368	9.25898	24.43012	22/08/1972	04/06/1996
630.00 Dist. below Water Surface	98	0.1	0.1	0.1	0.3	0.3	0.15051	0.07269	22/08/1972	27/04/2004
2010.00 Conductivity @ 25C (uS/cm)	61	46	60	85	130	225	91.23934	30.61478	22/08/1972	17/10/2001
2010.50 Conductivity @ 25C (uS/cm)	47	32	77	93	175.2	305	111.2	51.90238	25/05/1981	27/04/2004
2030.00 Turbidity (NTU)	38	0.5	1	5.7	100	100	28.23158	39.48658	03/03/1981	17/10/20
2030.50 Turbidity (NTU)	34	2	3	5	13.8	148	14.17647	33.30708	13/10/1994	27/04/2004
2051.00 Colour True (Hazen units)	32	0	5	20	49	70	24.53125	19.02797	03/03/1981	17/10/2001
2065.50 Air Temperature ()	26	23.9	27.25	29.95	34.55	37	30.46923	2.98138	13/10/1994	27/04/2004
2080.50 Water Temperature	78	17	21.35	24	30	32.3	24.94615	3.4773	22/08/1972	27/04/2004
2100.00 pH (pH units)	61	5.7	6.7	7.1	7.7	8.1	7.12115	0.50483	22/08/1972	17/10/2001
2100.50 pH (pH units)	34	6.6	6.73	7.015	7.47	7.6	7.06441	0.25969	31/05/1993	27/04/2004
2113.00 Total Alkalinity as CaCO3 (mg/L)	59	6	8.8	16	30.4	46.11	18.3861	9.05326	22/08/1972	17/10/2001
2123.00 Hydroxide as OH (mg/L)	26	0	0	0	0	0.01	0.00077	0.00272	22/08/1972	17/10/2001
2124.00 Carbonate as CO3 (mg/L)	31	0	0	0	0.1	0.3	0.03677	0.0667	08/10/1973	17/10/2001
2125.00 Bicarbonate as HCO3 (mg/L)	59	7.9	11.32	19.5	36.6	56.17	22.43441	10.90015	22/08/1972	17/10/2001
2132.00 Hardness as CaCO3 (mg/L)	59	4	6.8	13.3	26.4	47.22	15.31949	8.42749	22/08/1972	17/10/2001
2141.00 Hydrogen as H (mg/L)	28	0	0	0	0	0.1	0.00357	0.0189	22/08/1972	17/10/2001
2169.00 Total Diss. Solids (mg/L)	59	28	33	57	79	129.73	59.27508	20.01401	22/08/1972	17/10/2001
2170.00 Total Diss. Ions (mg/L)	59	26.4	31.2	50.8	77.7	138.18	55.97593	21.74933	22/08/1972	17/10/2001
2172.00 Total Suspended Solids	56	0	2.5	10	235	700	73.975	157.39229	13/06/1973	17/10/2001
2302.00 Calcium as Ca soluble (mg/L)	59	0.6	0.98	1.8	4	6.4	2.17288	1.29386	22/08/1972	17/10/2001
2311.00 Chloride as Cl (mg/L)	59	6	9.48	14.69	22	40.68	15.3639	5.63046	22/08/1972	17/10/2001
2322.00 Magnesium as Mg soluble (mg/L)	59	0.5	0.98	2.2	4	7.6	2.42034	1.31671	22/08/1972	17/10/2001
2331.00 Nitrate as NO3(mg/L)	23	0	0	0.5	1.8	9	1.04696	2.02662	01/04/1977	17/10/2001
2336.00 Kjeldahl Nitrogen (mg/L)	4	0.2387	-	-	-	0.4006	0.32108	0.08607	13/10/1994	04/06/1996
2337.00 Total Nitrogen (mg/L)	4	0.0851	-	-	-	0.3474	0.18485	0.11747	20/07/1998	17/10/2001
2351.50 Oxygen (Dissolved) (mg/L)	31	0.1	4.1	6.6	8.4	8.6	6.15645	2.14929	13/10/1994	27/04/2004
2363.00 Total Phosphorus as P (mg/L)	8	0.0049	-	-	-	0.0297	0.01565	0.00825	13/10/1994	17/10/2001
2381.00 Potassium as K (mg/L)	57	0.5	1	1.2	2.1	3.7	1.45439	0.60091	13/06/1973	17/10/2001
2391.00 Sodium as Na (mg/L)	59	5.6	6.68	10.5	15.4	25.2	11.14068	3.62245	22/08/1972	17/10/2001
2401.00 Sulphate as SO4 (mg/L)	21	0.4	0.4	1	3	5	1.59429	1.40244	01/04/1977	17/10/2001
2502.00 Aluminium as Al soluble (mg/L)	15	0	0	0.01	0.166	0.62	0.078	0.16081	05/08/1986	17/10/2001
2524.00 Arsenic as As - total (Micrograms/Litre)	1	0	-	-	-	0	0	0	20/01/1989	20/01/1989
2551.00 Boron as B (mg/L)	24	0	0	0.02	0.03	0.04	0.01542	0.01179	13/06/1973	17/10/2001
2622.00 Copper as Cu soluble mg/L	15	0	0	0.01	0.03	0.04	0.01533	0.01187	05/08/1986	17/10/2001
2641.00 Fluoride as F (mg/L)	35	0.01	0.02	0.1	0.142	0.57	0.09943	0.10743	22/08/1972	17/10/2001
2682.00 Iron as Fe soluble (mg/L)	44	0.01	0.073	0.265	0.814	1.9	0.36682	0.35867	13/06/1973	17/10/2001
2712.00 Manganese as Mn soluble (mg/L)	14	0	0	0.01	0.017	0.04	0.00857	0.01099	03/03/1986	17/10/2001
2762.00 Silica as SiO2 soluble (mg/L)	58	0	7	16	21	44	15.82586	7.09115	13/06/1973	17/10/2001
2822.00 Zinc as Zn soluble (mg/L)	14	0	0	0.01	0.027	0.04	0.01286	0.01139	05/08/1986	17/10/2001

***** ** STATION: 105106A Mt Sellheim**

Variable	Count	Minimum	10 Percent	Median	90 Percent	Maximum	Mean	Std Dev	Sdate	Edate
100.00 Stream Water Level (m)	30	1.05	1.433	1.64	2.528	999.99	68.24633	253.27626	13/06/1973	27/11/1998
140.00 Stream Discharge (Cumecs)	30	0	0	0.3055	3.0088	19.577	1.6379	3.91355	13/06/1973	04/09/2001
630.00 Dist. below Water Surface	39	0.1	0.1	0.1	0.3	0.3	0.14103	0.07152	13/06/1973	04/09/2001
2010.00 Conductivity @ 25C (uS/cm)	30	74	85.9	142.5	250	293	160.1	62.75972	13/06/1973	27/11/1998
2010.50 Conductivity @ 25C (uS/cm)	14	66	82.1	139.5	210.8	265	142.42857	57.2279	25/05/1981	04/09/2001
2030.00 Turbidity (NTU)	16	2	2	13.5	100	100	36.5125	41.8988	03/03/1981	27/11/1998
2030.50 Turbidity (NTU)	3	4	-	-	-	27	11.66667	13.27906	16/07/1998	04/09/2001
2051.00 Colour True (Hazen units)	12	5	5	9.5	55.4	70	22.5	23.485	03/03/1981	27/11/1998
2065.50 Air Temperature ()	3	26	-	-	-	37.9	32.73333	6.10273	16/07/1998	04/09/2001
2080.50 Water Temperature	30	20	22.96	28	31.1	32	27.10667	3.45652	13/06/1973	04/09/2001
2100.00 pH (pH units)	30	6.5	7.09	7.4	7.91	8.7	7.47767	0.43203	13/06/1973	27/11/1998
2100.50 pH (pH units)	2	7.1	-	-	-	7.7	7.4	0.42426	27/11/1998	04/09/2001
2113.00 Total Alkalinity as CaCO3 (mg/L)	30	11	22	43	68.546	94	44.87267	19.52516	13/06/1973	27/11/1998
2123.00 Hydroxide as OH (mg/L)	15	0	0	0	0	0.01	0.00067	0.00258	13/06/1973	27/11/1998
2124.00 Carbonate as CO3 (mg/L)	20	0	0	0.1	0.43	1.1	0.1905	0.26996	08/10/1973	27/11/1998
2125.00 Bicarbonate as HCO3 (mg/L)	30	14	27	52.35	83.6	114	54.46733	23.6171	13/06/1973	27/11/1998
2132.00 Hardness as CaCO3 (mg/L)	30	9	19.6	34	59.342	71	36.131	16.2784	13/06/1973	27/11/1998
2141.00 Hydrogen as H (mg/L)	16	0	0	0	0.05	0.2	0.01875	0.05439	13/06/1973	27/11/1998
2169.00 Total Diss. Solids (mg/L)	30	51	57.8	95	141.7	171	98.41667	33.51169	13/06/1973	27/11/1998
2170.00 Total Diss. Ions (mg/L)	30	41.8	58.65	100.25	169.01	209	108.91833	44.06378	13/06/1973	27/11/1998
2172.00 Total Suspended Solids	26	3	5	10	156.5	775	80.34615	193.22669	13/06/1973	27/11/1998
2302.00 Calcium as Ca soluble (mg/L)	30	1.2	3.27	5.35	10.2	12	6.30667	2.97761	13/06/1973	27/11/1998
2311.00 Chloride as Cl (mg/L)	30	8.6	10.84	19	35	46	21.84767	9.7358	13/06/1973	27/11/1998
2322.00 Magnesium as Mg soluble (mg/L)	30	1.4	2.64	4.8	7.91	10	4.93667	2.22036	13/06/1973	27/11/1998
2331.00 Nitrate as NO3(mg/L)	8	0.1	-	-	-	1.9	0.78625	0.59375	16/12/1976	27/11/1998
2337.00 Total Nitrogen (mg/L)	2	0.283	-	-	-	0.647	0.465	0.25739	16/07/1998	27/11/1998
2351.50 Oxygen (Dissolved) (mg/L)	3	6.8	-	-	-	7.4	7.2	0.34641	16/07/1998	04/09/2001
2363.00 Total Phosphorus as P (mg/L)	2	0.025	-	-	-	0.0967	0.06085	0.0507	16/07/1998	27/11/1998
2381.00 Potassium as K (mg/L)	30	0.9	1	1.35	3.2	4.2	1.74333	0.86967	13/06/1973	27/11/1998
2391.00 Sodium as Na (mg/L)	30	7.6	9.88	15.75	27.1	33	17.81	7.25118	13/06/1973	27/11/1998
2401.00 Sulphate as SO4 (mg/L)	10	1	1.828	3	5.3	8	3.502	2.02913	07/04/1976	27/11/1998
2502.00 Aluminium as Al soluble (mg/L)	3	0	-	-	-	0.13	0.06	0.06557	06/12/1983	27/11/1998
2551.00 Boron as B (mg/L)	8	0.01	-	-	-	0.1	0.0425	0.03655	13/06/1973	27/11/1998
2622.00 Copper as Cu soluble mg/L	2	0.01	-	-	-	0.01	0.01	0	16/07/1998	27/11/1998
2641.00 Fluoride as F (mg/L)	25	0.05	0.1	0.1	0.188	0.4	0.1244	0.0664	13/06/1973	27/11/1998
2682.00 Iron as Fe soluble (mg/L)	16	0.01	0.025	0.21	2.15	3	0.62	0.99335	13/06/1973	27/11/1998
2712.00 Manganese as Mn soluble (mg/L)	5	0.01	-	-	-	0.05	0.022	0.01643	31/08/1983	27/11/1998
2762.00 Silica as SiO2 soluble (mg/L)	30	6	11.63	16.8	26	30	17.57667	5.41159	13/06/1973	27/11/1998
2822.00 Zinc as Zn soluble (mg/L)	3	0	-	-	-	0.02	0.01333	0.01155	06/12/1983	27/11/1998

***** ** STATION: 1051010 KALPOWER CROSSING**

	Count	Minimum	10 Percent	Median	90 Percent	Maximum	Mean	Std Dev	Sdate	Edate
100.00 Stream Water Level (m)	3	999.99	-	-	-	999.99	999.99	0	05/10/1995	17/12/1997
140.00 Stream Discharge (Cumecs)	11	0	0	1.228	2.5	2.504	0.96064	1.01053	15/10/1994	17/12/1997
630.00 Dist. below Water Surface	11	0.15	0.15	0.2	0.3	0.3	0.23636	0.0636	15/10/1994	17/12/1997
2010.00 Conductivity @ 25C (uS/cm)	6	120	-	-	-	165	137.83333	16.11728	15/10/1994	17/12/1997
2010.50 Conductivity @ 25C (uS/cm)	6	121	-	-	-	162.4	140.23333	15.07603	15/10/1994	17/12/1997
2030.00 Turbidity (NTU)	6	0.7	-	-	-	4	2.06667	1.37937	15/10/1994	17/12/199
2030.50 Turbidity (NTU)	6	2	-	-	-	10	5.69667	3.41761	15/10/1994	17/12/1997
2051.00 Colour True (Hazen units)	6	5	-	-	-	47	28.16667	19.13548	15/10/1994	17/12/1997
2065.50 Air Temperature ()	5	22.1	-	-	-	27	24.84	1.94499	15/10/1994	26/06/1997
2080.00 Water Temperature	1	26	-	-	-	26	26	0	15/10/1994	15/10/1994
2080.50 Water Temperature	5	24.9	-	-	-	31	27.34	2.386	02/06/1995	17/12/1997
2100.00 pH (pH units)	6	6.96	-	-	-	7.45	7.19333	0.1919	15/10/1994	17/12/1997
2100.50 pH (pH units)	6	6.8	-	-	-	7.8	7.23333	0.36148	15/10/1994	17/12/1997
2113.00 Total Alkalinity as CaCO3 (mg/L)	6	14	-	-	-	30.5	22.705	7.31022	15/10/1994	17/12/1997
2123.00 Hydroxide as OH (mg/L)	6	0	-	-	-	0	0	0	15/10/1994	17/12/1997
2124.00 Carbonate as CO3 (mg/L)	6	0	-	-	-	0.04	0.015	0.01975	15/10/1994	17/12/1997
2125.00 Bicarbonate as HCO3 (mg/L)	6	16.5	-	-	-	37	27.46167	9.05048	15/10/1994	17/12/1997
2132.00 Hardness as CaCO3 (mg/L)	6	19.5	-	-	-	29.72	23.15667	4.39897	15/10/1994	17/12/1997
2141.00 Hydrogen as H (mg/L)	6	0	-	-	-	0	0	0	15/10/1994	17/12/1997
2169.00 Total Diss. Solids (mg/L)	6	68	-	-	-	88.88	76.03667	8.41878	15/10/1994	17/12/1997
2170.00 Total Diss. Ions (mg/L)	6	66	-	-	-	95.31	79.54167	11.20684	15/10/1994	17/12/1997
2172.00 Total Suspended Solids	6	3	-	-	-	10	7.66667	2.87518	15/10/1994	17/12/1997
2302.00 Calcium as Ca soluble (mg/L)	6	2.4	-	-	-	4	3.1	0.75631	15/10/1994	17/12/1997
2311.00 Chloride as Cl (mg/L)	6	22.5	-	-	-	29.67	26.07833	2.51845	15/10/1994	17/12/1997
2322.00 Magnesium as Mg soluble (mg/L)	6	3.2	-	-	-	4.8	3.75	0.6253	15/10/1994	17/12/1997
2331.00 Nitrate as NO3(mg/L)	6	0	-	-	-	1.17	0.445	0.43145	15/10/1994	17/12/1997
2336.00 Kjeldahl Nitrogen (mg/L)	6	0.129	-	-	-	0.312	0.23283	0.06965	15/10/1994	17/12/1997
2351.50 Oxygen (Dissolved) (mg/L)	6	5.3	-	-	-	7.48	6.51333	0.80117	15/10/1994	17/12/1997
2363.00 Total Phosphorus as P (mg/L)	6	0.003	-	-	-	0.0136	0.00992	0.00411	15/10/1994	17/12/1997
2381.00 Potassium as K (mg/L)	6	1.1	-	-	-	1.6	1.33333	0.20656	15/10/1994	17/12/1997
2391.00 Sodium as Na (mg/L)	6	15	-	-	-	19.6	17.06667	1.60955	15/10/1994	17/12/1997
2401.00 Sulphate as SO4 (mg/L)	6	0	-	-	-	2	1.165	0.93303	15/10/1994	17/12/1997
2502.00 Aluminium as Al soluble (mg/L)	6	0	-	-	-	0.19	0.05667	0.06976	15/10/1994	17/12/1997
2551.00 Boron as B (mg/L)	6	0	-	-	-	0.1	0.05	0.05477	15/10/1994	17/12/1997
2622.00 Copper as Cu soluble mg/L	6	0	-	-	-	0.05	0.03	0.0228	15/10/1994	17/12/1997
2641.00 Fluoride as F (mg/L)	6	0	-	-	-	0.2	0.07667	0.07394	15/10/1994	17/12/1997
2682.00 Iron as Fe soluble (mg/L)	6	0	-	-	-	1	0.42	0.45625	15/10/1994	17/12/1997
2712.00 Manganese as Mn soluble (mg/L)	6	0	-	-	-	0.02	0.01	0.01095	15/10/1994	17/12/1997
2762.00 Silica as SiO2 soluble (mg/L)	6	7	-	-	-	13.2	10.26667	2.07429	15/10/1994	17/12/1997
2822.00 Zinc as Zn soluble (mg/L)	6	0	-	-	-	0.02	0.01167	0.00983	15/10/1994	17/12/1997

APPENDIX C

CAPE YORK PENINSULA NATURAL RESOURCE MANAGEMENT PLAN,
CAPE YORK PENINSULA PEST SPECIES

6.2 Asset Categories

The planning process identified eight categories of natural resource management assets for Cape York Peninsula. These are listed in Table 7 (along with the Code Letter used to denote each asset throughout the document):

Table 7: Asset categories and codes

ASSET	CODE
community capacity	C
cultural heritage	H
natural heritage	N
land country	L
water	W
sea country	S
biodiversity	B
Ecologically sustainable development	D

It is important to note that there is much overlap between these assets. For the sake of readability the discussion of some issues such as pest plants and fire management have been dealt with primarily under a single asset.

In reality these issues affect many of the other assets as well. For example fire management is discussed mainly under the heading of Land Country, but cross-references are made under other headings such as Biodiversity where fire management is equally important.

This is important to consider when discussing achievable management actions as those actions that have benefit across a range of assets may represent greater value for money. For example, pest plants and animals impact on all aspects of natural resource management and are considered the major threat to a number of the identified assets. Consequently pest plant and animal management is identified as a high priority.

6.3 Threats to Assets

A range of threats to the region's natural resource assets are recognised in this Plan. They were identified from literature reviews and a range of workshops, scientific review and discussions.

Table 8 provides a summary of the main identified threats. The top thirteen issues are listed in a preliminary priority order as identified during the consultation process.

Table 8: Summary of main identified threats and links to targets

IDENTIFIED THREAT	ASSET THREATENED*							
	C	H	N	L	W	S	B	D
Pest species (plants and animals)	•	•	•	L2 & L4	•	•	B2	•
Economic capacity of the region to undertake natural resource management activities (including social capacity)	C1	•	•	•	•	•	•	•
Ineffective institutional arrangements (including short term planning cycles, damage to community goodwill, coordination of decision making, enforcement of regulations)	C2	•	•	•	•	•	•	•
Inappropriate fire regimes		•	•	L3	•		•	•
Loss of Indigenous knowledge and failure to incorporate existing knowledge into natural resource management (lack of knowledge of how to engage with community especially Indigenous community in cooperative management)	•	H1,2, 4,5&6	•	•	•	•	B1	•
Unmanaged visitation		H5	•	•	•	•	•	D1
Inappropriately Managed Grazing Activities (eg erosion and loss of biodiversity)		•	•	L2 & L4	W6		B4	•
Loss of management skills and experience in the region.	C1	•	•	L3	•	•	B2	•
Over harvesting of threatened species.			•			S1,2,3 ,4&5	•	•
Human population issues (increasing population and decentralisation)	•		•	•	•	•	•	•
Lack of knowledge of ecosystems			•	L1	•	•	B1	•
Climate Change		•	•	•	•	•	•	•
Riparian Degradation		•	•	•	W3 &4		•	•
New Developments (including alienation of land and subdivision followed by real estate and tourism development large scales – pastoral lease to freehold to subdivision and incremental development)			•	•	•		•	D1
Exploration Permits and Practices for Minerals		•	•	•	•		•	
Mining		•	•	L4	•		•	D1
Inappropriate Use of Groundwater			•		W1		•	•
Marine Debris (including oil spills)			•			S1	•	•
Infrastructure Development		•	•	•	•		•	D1
Lack of security of land tenure	C2		•					•
Lack of land use planning		•	•	•	•		•	D1
Future possible land clearing and industrial scale logging		•	•	•	•		•	•
Irrigation impacts			•	•	•		•	D1
Lack of awareness of global, national and regional heritage (both natural and cultural) values of the region (including a perception that Cape York Peninsula is protected).	•	H1	N1& 2	•	W6	•	B1, 2	•
Lack of agreed value systems	•		•					
Lack of information sharing (difficulty of communications eg phones, radio, newspapers)	•	•	•	•	•	•	•	•
Risk of patronage politics in place of addressing priority threats to natural resource assets.	C1	•	•	•	•	•	•	•
Biosecurity (the risk of introduction of exotic diseases and pests)	•	•	•	L4	•	S4	•	•
Acquired properties lying dormant with little management practices								•
Poor road standards and design on PDR causing environmental damage through land degradation and pollution	•	•	•	•	•	•	•	•
The loss of local knowledge	•	•	•	•	•	•	•	•
Potential for unsustainable water extraction / dams & weirs			•		•		•	•

* The Asset Codes explained in Table 3 are also used in this table. While it is clear that most of the threats listed in this table apply to more than one asset category, this table shows the primary asset class where the particular threat is discussed in Chapter 7. Where the code letter is followed by a number in the body of the table, this refers to the relevant Aspirational Target detailed in Chapter 7. For example, L2 refers to the Land Country Aspirational Target Number 2.

APPENDIX D

MAJOR PEST SPECIES OF CAPE YORK PENINSULA

Major pests of Cape York Peninsula

(Those causing significant economic, environmental or social impact)
(Cook Shire Council, 2004)

Common Name	Species Name
Antelope – Indian blackbuck	*Antilope cervicapra*
Brumbies (Feral horses) Wandering or domestic horses	*Equus caballus*
Feral cattle	*Bos.spp*
Feral/wandering cats	*Felis catus*
Feral pigs	*Sus scrofa*
Rabbits	*Oryctolagus cuniculus*
Rusa deer	*Cervus timorensis*
Dingoes	*Canis familiaris dingo*
Wild dogs Uncontrolled/mangy domestic dogs	*Canis familiaris*

Problem animals of Cape York Peninsula

Common Name	Species Name
Black and white cockatoos	*Calyptorrhynchus banksii, Cacatua galerita*
Wallabies	*Various species*

APPENDIX E

LAKEFIELD NATIONAL PARK
RARE & THREATENED SPECIES LIST

QUEENSLAND PARKS AND WILDLIFE SERVICE

Visitor Information

Lakefield
National Park

Species List

Habitat

F	Freshwater
R	Riverine forest
S	Schlerophyll forest
E	Estuarine

Status

M	Migratory
O	Occasional
R	Resident

Species	Habitat	Status	Species	Habitat	Status
Emu	SG	R	Black-shouldered Kite	SR	R
Great Crested Grebe	F	O	Pacific Baza	ER	O
Australian Grebe	F	R	Black Kite	SR	R
Australian Pelican	F	O	Square-tailed Kite	SR	R
Darter	F	R	Black-breasted Buzzard	SR	R
Great Cormorant	F	R	Brahminy Kite	SR	R
Pied Cormorant	F	R	Whistling Kite	SR	R
Little Black Cormorant	F	R	Brown Goshawk	SR	R
Little Pied Cormorant	F	R	Collared Sparrowhawk	SR	R
Great-billed Heron	F	R	Grey Goshawk	R	RO
Pacific Heron	EF	R	Red Goshawk	R	RO
White-faced Heron	EF	R	White Bellied Sea-eagle	RE	R
Pied Heron	F	R	Wedge-tailed Eagle	GS	O
Cattle Egret	F	R	Little Eagle	GS	R
Great Egret	F	R	Spotted Harrier	SR	R
Little Egret	F	R	Marsh Harrier	ER	R
Intermediate Egret	F	R	Black Falcon	SR	R
Eastern Reef Egret	F	R	Peregrine Falcon	SR	R
Striated Heron	EF	R	Australian Hobby	SR	R
Rufous Night Heron	R	R	Brown Falcon	SR	R
Little Bittern	F	O	Australian Kestrel	SR	R
Black Bittern	EF	R	Australian Brush Turkey	R	R
Black-necked Stork (Jabiru)	SGEF	R	Brown Quail	SG	R
Glossy Ibis	F	R	King Quail	SG	R
Sacred Ibis	F	R	Painted Button-quail	SG	R
Straw-necked Ibis	F	R	Red-cheated Button-quail	SG	R
Royal Spoonbill	F	R	Buff-banded Rail	EF	R
Yellow-billed Spoonbill	F	O	Purple Swamphen	F	O
Magpie Goose	F	M	Black-tailed Native-hen	EF	R
Wandering Whistling-Duck	F	R	Eurasian Coot	EF	R
Plumbed Whistling-Duck	F	R	Brolga	FGS	R
Black Swan	F	O	Sarus Crane	FGS	R
Rajah Shelduck	F	R	Australian Bustard	SG	R
Pacific Black Duck	F	R	Comb-crested Jacana	F	R
Grey Teal	F	O	Bush Thick-knee	GS	R
Pink-eared Duck	F	R	Beach Thick-knee	EF	R
Hardhead	F	R	Pied Oystercatcher	EF	R
Maned Duck	F	R	Masked Lapwing	ESF	R
Cotton Pygmy-Goose	F	O	Red-kneed Dotterel	FR	R
Green Pygmy-Goose	F	R	Oriental Plover	ESF	R
Osprey	E	R	Red-capped Plover	FRG	R

Species	Habitat	Status	Species	Habitat	Status
Black-fronted Plover	FE	R	Forest Kingisher	FR	R
Black-winged Stilt	EF	R	Red-backed Kingfisher	FR	O
Eastern Curlew	GS	MR	Sacred Kingfisher	FR	R
Wood Sandpiper	EF	MR	Buff-breasted Paradise Kingfisher	R	O
Whimbrel	GS	MR	Rainbow Bee-eater	RS	R
Little Curlew	GS	MR	Dollarbird	S	M
Common Sandpiper	EF	MR	Singing Bushlark	S	R
Marsh Sandpiper	E	MO	Welcome Swallow	S	R
Lathams Snipe	EFR	O	Tree Martin	S	R
Bar-tailed Godwit	FG	MO	Fairy Martin	S	R
Sharp-tailed Sandpiper	EF	M	Richards Pipit	S	R
Curlew Sandpiper	EF	M	Black-faced Cuckoo-shrike	S	R
Oriental Pratincole	EG	M	White-bellied Cuckoo-shrike	GS	R
Australian Pratincole	EG	M	Yellow-eyed Cuckoo-shrike	GS	O
Silver Gull	E	R	Cicadabird	GS	R
Whiskered Tern	FE	R	Lemon-bellied Flycatcher	S	R
White-winged Tern	FE	R	Jacky Winter	S	R
Gull-billed Tern	FE	R	White-browed Robin	S	R
Casplan Tern	FE	R	Grey Whistler	S	R
Torresian Imperial Pigeon	SR	M	Rufous Whistler	S	R
Peaceful Dove	S	R	Little Shrike-thrush	S	R
Diamond Dove	S	R	Grey Shrike-thrush	S	R
Bar-shouldered Dove	S	R	Spectacled Monarch	S	O
Emerald Dove	S	R	Broad-billed Flycatcher	FS	R
Common Bronzewing	S	R	Leaden Flycatcher	FS	R
Squatter Pigeon	S	R	Satin Flycatcher	FS	R
Red-tailed Black-Cockatoo	RS	R	Shining Flycatcher	FS	R
Galah	S	R	Restless Flycatcher	S	R
Little Corella	EF	R	Rufous Fantail	S	O
Sulphur-crested Cockatoo	SR	R	Grey Fantail	S	O
Rainbow Lorikeet	SR	R	Northern Fantail	S	O
Scaly-breasted Lorikeet	RS	O	Willie Wagtail	S	R
Varied Lorikeet	RS	O	Grey-crowned Babbler	S	R
Red-winged Parrot	RS	R	Golden-headed Cisticola	S	O
Pale-headed Rosella	GS	R	Rufous Songlark	S	R
Oriental Cuckoo	S	R	Glamorous Reed-Warbler	S	O
Pallid Cuckoo	S	R	Variegated Fairy-wren	FS	R
Fan-tailed Cuckoo	S	O	Red-backed Fairy-wren	FS	R
Brush Cuckoo	S	R	Tropical Scrubwren	FS	R
Black-eared Cuckoo	S	R	Weebill	S	R
Horsefield Bronze Cuckoo	S	R	Large-billed Gerygone	RFE	R
Little Bronze Cuckoo	S	R	Fairy Gerygone	RFE	R
Common Koel	FS	M	White-throated Gerygone	RFE	R
Channel-billed Cuckoo	FS	M	Brown Treecreeper	S	R
Pheasant Coucal	S	R	Helmeted Friarbird	RS	R
Southern Boobook	S	R	Silver-crowned Friarbird	S	R
Barking Owl	S	R	Noisy Friarbird	S	R
Barn Owl	S	R	Little Friarbird	S	R
Tawny Frogmouth	GS	R	Blue-faced Honeyeater	FS	R
Papuan Frogmouth	GS	R	Yellow Spotted Honeyeater	FS	R
Australian Owlet Nightjar	FS	R	Varied Honeyeater	FS	R
Spotted Nightjar	FS	R	White-gaped Honeyeater	FS	R
Large-tailed Nightjar	FS	R	Yellow Honeyeater	FS	R
Fork-tailed Swift	FS	R	Yellow-tinted Honeyeater	FS	R
Azure Kingfisher	FS	R	Black-chinned Honeyeater	FS	R
Little Kingfisher	SR	R	White-throated Honeyeater	FS	R
Laughing Kookaburra	S	R	Brown Honeyeater	FS	R
Blue-winged Kookaburra	S	R	White-streaked Honeyeater	FS	R

Species	Habitat	Status	Species	Habitat	Status
Brown-backed Honeyeater	FS	R	Nutmeg Mannikin	FG	R
Bar-breasted Honeyeater	FS	R	Metallic Starling	R	R
Rufous-banded Honeyeater	FS	R	Yellow Oriole	R	R
Rufous-throated Honeyeater	FS	R	Olive-backed Oriole	R	R
Banded Honeyeater	FS	R	Figbird	SR	R
Dusky Honeyeater	FS	R	Spangled Drongo	R	R
Red-headed Honeyeater	FS	R	Great Bowerbird	SR	R
Yellow-bellied Sunbird	FS	R	Spotted Catbird	R	O
Mistletoe Bird	FS	R	Apostle Bird	S	R
Red-browed Pardalote	SF	R	Australian Magpie-lark	S	R
Striated Pardalote	SF	R	White-breasted Woodswallow	FR	R
Silvereye	SF	R	Masked Woodswallow	FS	R
House Sparrow	S	R	Little Woodswallow	FS	R
Red-browed Firetail	SF	R	Black Butcherbird	FS	O
Star Finch	FG	R	Black-backed Butcherbird	FS	O
Crimson Finch	FG	R	Pied Butcherbird	FS	R
Double-barred Finch	FG	R	Australian Magpie	S	R
Masked Finch	FG	R	Pied Currawong	S	R
Black-throated Finch	FG	R	Torresian Crow	S	R
Chestnut-breasted Mannikin	FG	R			

APPENDIX F

RARE AND/OR THREATENED PLANTS OF THE NORMANBY RIVER CATCHMENT

Rare and/or Threatened Plants of the Normanby River Catchment (Courtesy of John Clarkson, QLD DPI&F, July 2005)

Acanthaceae	X	Rhaphidospora cavernarum (F.Muell.) R.M.Barker
Alismataceae	R	Astonia australiensis (Aston) S.W.L.Jacobs
Boraginaceae	V	Carmona retusa (Vahl) Masam.
Caesalpiniaceae	R	Caesalpinia hymenocarpa (Prain) Hattink
Campanulaceae	R	Lobelia douglasiana F.M.Bailey
Cucurbitaceae	E	Muellerargia timorensis Cogn.
Dilleniaceae	R	Hibbertia cymosa S.T.Reynolds
	R	Hibbertia echiifolia R.Br. ex Benth.
Euphorbiaceae	V	Chamaesyce carissoides (F.M.Bailey) D.C.Hassall ex P.I.Forst. & R.J.F.Hend.
Fabaceae	R	Tephrosia savannicola Domin
Lamiaceae	X	Teucrium ajugaceum F.M.Bailey & F.Muell. ex F.M.Bailey
Menispermaceae	R	Tiliacora australiana Forman
Mimosaceae	R	Acacia albizioides Pedley
	R	Acacia armitii F.Muell. ex Maiden
	R	Albizia retusa Benth. subsp. retusa
Myrtaceae	R	Acmenosperma pringlei B.Hyland
	R	Austromyrtus lucida (Gaertn.) L.S.Sm.
	R	Austromyrtus sp. (McIlwraith Range B.P.Hyland 11148)
	R	Homoranthus tropicus Byrnes
	R	Syzygium rubrimolle B.Hyland
Orchidaceae	V	Dendrobium phalaenopsis Fitzg.
Phormiaceae	R	Dianella incollata R.J.F.Hend.
Poaceae	E	Coix gasteenii B.K.Simon
	V	Ectrosia blakei C.E.Hubb.
	R	Lepturus xerophilus Domin
Polygalaceae	R	Polygala pycnophylla Domin
Rubiaceae	R	Gardenia rupicola Puttock
Simaroubaceae	V	Quassia sp. (Kennedy River J.R.Clarkson 5645)
Sterculiaceae	R	Brachychiton grandiflorus Guymer
	R	Brachychiton vitifolius (F.M.Bailey) Guymer
	R	Brachychiton vitifolius (F.M.Bailey) Guymer
	R	Stylidium trichopodum F.Muell.
Thymelaeaceae	V	Jedda multicaulis J.R.Clarkson

APPENDIX G

LIST OF FINFISH SPECIES
FROM RESEARCH NETTING SURVEYS
IN THE NORMANBY RIVER ESTUARY

List of Finfish Species
From Research Netting Surveys
in the Normanby River Estuary

This list of fish species is compiled from results of netting surveys in the estuarine reaches of the Normanby River and adjacent foreshores completed during 2003-2004 as part of Coastal Fisheries Resource Monitoring supported by the Reef Research Centre and QDPI&F (Northern Fisheries Centre).

Family	Species	Common Name
Carcharhinidae	Carcharhinus dussumieri	Whitecheek Shark
Carcharhinidae	Carcharhinus leucas	Bull Shark
Carcharhinidae	Carcharhinus amboinensis	Java Shark
Carcharhinidae	Carcharhinus cautus	Nervous Shark
Carcharhinidae	Carcharhinus tilstoni	Australian Blacktip Shark
Carcharhinidae	Carcharhinus limbatus	Common Blacktip Shark
Carcharhinidae	Galaeocerda cuvier	Tiger Shark
Carcharhinidae	Rhizoprionodon acutus	Milk Shark
Carcharhinidae	Rhizoprionodon taylori	Australian Sharpnose Shark
Dasyatidae	Dasyatis sp.	Stingray unidentified
Pristidae	Pristis zijsron	Green Sawfish
Pristidae	Pristis microdon	Freshwater Sawfish
Rhinobatidae	Rhinobatus typus	Giant Shovelnose Ray
Rhinopteridae	Rhinoptera neglecta	Australian Cownose Ray
Rhynchobatidae	Rhynchobatus australiae	White-spotted Guitarfish
Sphyrnidae	Sphyrna lewini	Scalloped Hammerhead Shark
Albulidae	Albula neoguinaica	Bonefish
Ariidae	Arius thalassinus	Giant Salmon Catfish
Ariidae	Arius sp.	Catfish
Ariidae	Arius macrocephalus	Pointed-Nosed Salmon Catfish
Ariidae	Arius graeffei	Lesser Salmon Catfish
Belonidae	Tylosurus crocodilus	Crocodile Longtom
Carangidae	Alectus indicus	Diamond Trevally
Carangidae	Atule mate	Scad
Carangidae	Carangoides fulvoguttatus	Turrum
Carangidae	Caranx tille	Tille Trevally
Carangidae	Caranx ignobilis	Giant Trevally
Carangidae	Parastromateus niger	Black Pomfret
Carangidae	Pseudocaranx dentex	Silver Trevally
Carangidae	Scomberoides commersonnianus	White Queenfish
Carangidae	Scomberoides tala	Barred Queenfish
Carangidae	Scomberoides tol	Needleskin Queenfish
Centropomidae	Lates calcarifer	Barramundi
Chanidae	Chanos chanos	Milkfish
Chirocentridae	Chirocentrus dorab	Wolf Herring
Clupeidae	Anodontostoma chacunda	Mud Herring
Clupeidae	Herklotsichthys castelnaui	Herring
Clupeidae	Nematolosa come	Bony Bream (Marine)
Clupeidae	Nematolosa erebi	Bony Bream (Freshwater)
Cynoglossidae	Paraplagusia sp.	Tongue Sole
Drepanidae	Drepane punctata	Sickle Fish
Elopidae	Elops hawaiiensis	Giant Herring
Engraulidae	Thryssa hamiltoni	Hamilton's Anchovy
Gerreidae	Gerres sp.	Siver Biddy (unidentified)

Family	Species	Common Name
Gerreidae	Gerres filamentosus	Long finned Silver Biddy
Haemulidae	Plectorhinchus gibbosus	Mowong
Haemulidae	Pomadasys kaaken	Banded Grunter
Lutjanidae	Lutjanus argentimaculatus	Mangrove Jack
Megalopidae	Megalops cyprinoides	Tarpon
Mugilidae	Liza subviridis	Flat Tail mullet
Mugilidae	Liza vaigiensis	Diamond Scale Mullet
Mugilidae	Mugil cephalus	Sea Mullet
Mugilidae	Valamugil seheli	Blue tail mullet
Mugilidae	Valamugil buchanani	Buchanans Mullet
Plotosidae	Tandanus tandanus	Freshwater Eel-Tailed Catfish
Polynemidae	Eleutheronema tetradactylum	Blue Threadfin
Polynemidae	Polydactylus macrochir/sheridani	King Salmon
Pristigasteridae	Pellona ditchela	Ditchelee
Scatophagidae	Scatophagus argus	Spotted Butterfish
Scatophagidae	Selenotoca multifasciata	Striped Butterfish
Sciaenidae	Nibia soldada	Silver Jew
Sciaenidae	Protonibea diacanthus	Black Jew
Scombridae	Thunnus tonngol	Northern Bluefin Tuna
Sparidae	Acanthopagrus berda	Pikey Bream
Toxotidae	Toxotes chatareus	Spotted Archer Fish
Toxotidae	Toxotes jaculatrix	Banded Archer Fish

N.B. Rendahls Catfish (*Porochilus rendahli)* is also known from the Normanby complex (Abrahams et al., 1995).