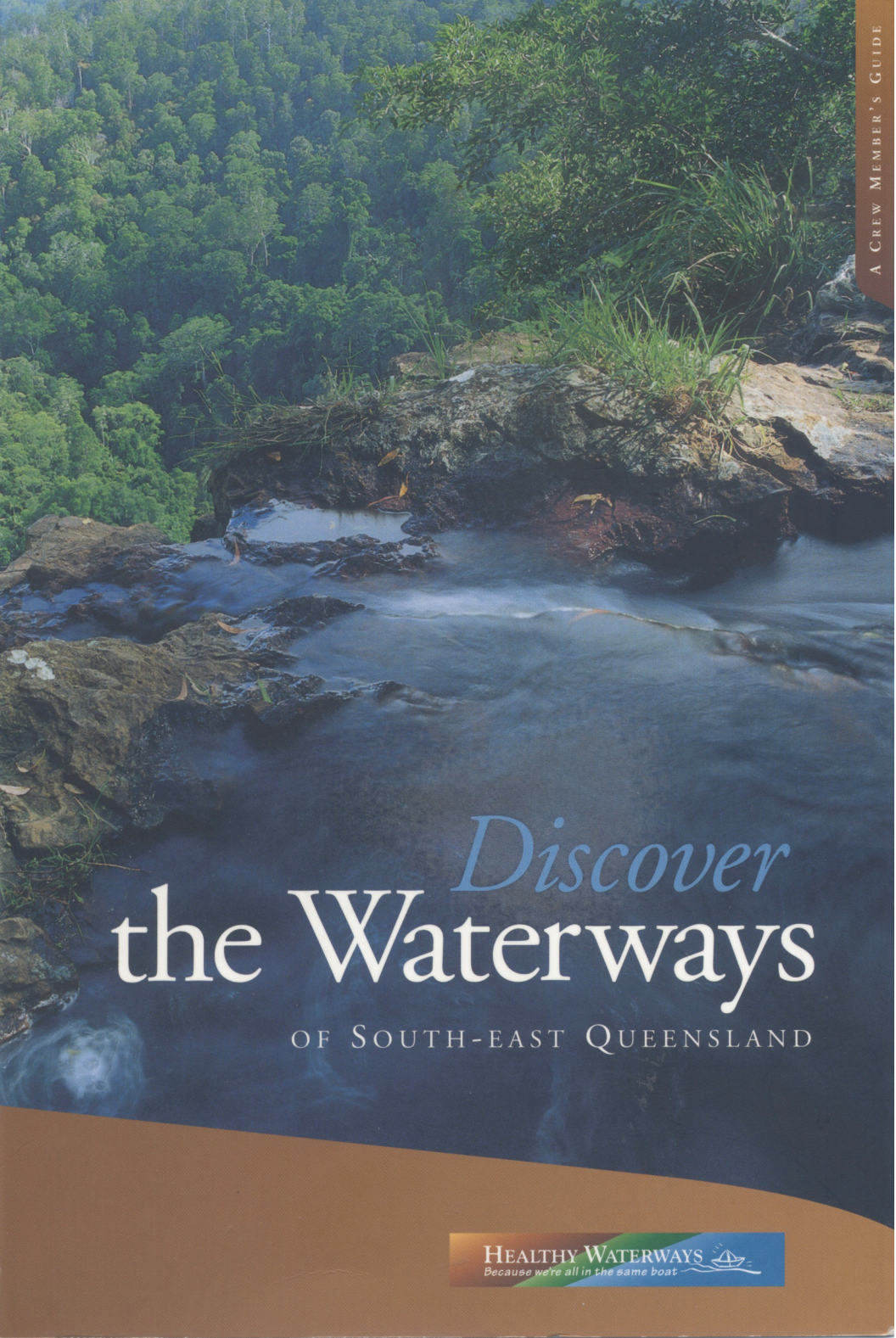

A Crew Member's Guide

Discover the Waterways

of South-east Queensland

Healthy Waterways
Because we're all in the same boat

Discover the Waterways

OF SOUTH-EAST QUEENSLAND

Discover the Waterways

OF SOUTH-EAST QUEENSLAND

Waterways health and catchment management
in South-east Queensland, Australia

by the South East Queensland Regional Water Quality Management Strategy Team

HEALTHY WATERWAYS
Because we're all in the same boat

Published by the South East Queensland Regional Water Quality Management Strategy
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In preparing this book, the traditional owners of the land and waterways of South-east Queensland are acknowledged.

This book was created in a unique manner – it was written by a team of scientists, resource managers, science communicators and planners – largely on or near the waterways. Site visits to selected **'Where to look'** locations to illustrate major water quality issues were carried out by scientists (Bill Dennison and Stuart Bunn) and science communicators (Catherine Collier and Andrew Watkinson). These site visits, from the hilltops overlooking the waterways, down to the water's edge, proved an essential element in the production of the book. Each location chosen presents an opportunity for everyone to see, for themselves, the important processes and challenges facing our waterways. Following these site visits, notes were transcribed to produce a manuscript which was added to by the South East Queensland Regional Water Quality Management Strategy (SEQRWQMS) team members, coordinated by Helena Malawkin and Eva Abal.

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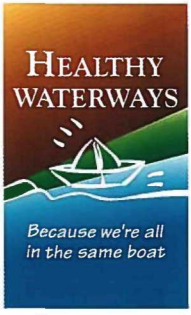


The Healthy Waterways Vision for South-east Queensland

Our waterways and catchments will, by 2020, be healthy ecosystems supporting the livelihoods and lifestyles of people in South-east Queensland, and will be managed through collaboration between community, government and industry.

Foreword

Over the past two hundred years the history of South-east Queensland's waterways has been a mirror image of how European settlement impacted both the Australian landscape and its Aboriginal inhabitants. At first our efforts of exploration and settlement made little impact. Then huge changes reshaped the landscape with the opening of the Brisbane River tidal bar, widespread clearing in the catchments and the establishment of sprawling settlements along the coast and in the hinterland.

However, most forgot during those times that quality of life is inextricably linked with the natural systems that provide clean water and air, productive farmlands and bountiful seafood. We also forgot the long history of sustainable use by the traditional owners of this land, and their kinship with it.

Then, in the 1970s a few began to ask questions. Why is the Brisbane River so dirty? Why can't we swim in our local creek and not risk getting sick? Why have the mud crabs gone from Oxley Creek? Why does eastern Moreton Bay support such a rich marine life when the western side seems to be failing?

These questions prompted us to take stock, and also check what was happening elsewhere in Australia and overseas. There was considerable debate, much shifting of blame and denial of many problems. However, slowly the extent of the problems became more apparent. The oral history of those who had lived and worked on our waterways and Bay was collated; this clearly showed that even in the 1940s the Brisbane River and Moreton Bay were very different – cleaner and more productive – than they are today. Research began to focus on understanding the impacts of present day use. The concept of integrated catchment management was promoted, and slowly the concept of a partnership between government, industry and the community caught on.

This partnership is essential if we are to find the resources and expertise to implement the solutions needed to reverse the decline in our waterways and estuaries. It is not a short-term partnership as many of the tasks such as replanting the banks of our waterways and restoring seagrass areas and dugong populations of the Bay will take decades.

We have made progress since the 1970s. There are signs of improvement, but also strong signals of ongoing problems. As the Healthy Waterways slogan says ... *"we're all in the same boat"*. So let's speed-up the progress, strengthen the partnerships, and understand and appreciate the values and benefits of South-east Queensland's creeks, rivers and estuaries.

Diane Tarte

National Coordinator,
Marine and Coastal Community Network

and formerly Executive Officer,
Australian Marine Conservation Society

Introduction

I am very pleased to be asked to introduce this most important publication. The South East Queensland Regional Water Quality Management Strategy for the first time has produced the data necessary to support united efforts to return our waterways and Moreton Bay to a healthy and ecologically sustainable state.

This book is about discovering the complex and beautiful waterways that are the lifeblood of the region in which we live.

The waterways of South-east Queensland begin as small mountain streams and gullies that become creeks and rivers as they work their way down through fertile valleys and plains to the sea. Moreton Bay, with its schools of dolphins, dugongs grazing the seagrass beds and sand islands in the background, is the eastern gateway to South-east Queensland. Our beaches are world famous and our estuaries abound with fish, crabs and prawns.

Part A of this book examines the waterways themselves, how they function and why they are so special. Waterways are an integral part of the South-east Queensland environment. They provide food, water and shelter, as well as beautiful, unspoiled places that, with care, can be enjoyed for generations.

The way we humans live has consequences for the whole environment and every year this takes a greater toll on the waterways and the landscapes through which they flow.

Fortunately, it is not too late to try and repair some of the damage.

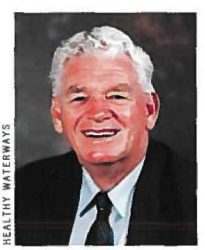
Many people are working hard on local restoration projects throughout the catchments and many are involved in community monitoring of our waterways. Also, all Councils, with the support of the State and Commonwealth are improving sewage treatment and stormwater management systems.

Part B of the book contains information about each of the major water catchments in South-east Queensland, their distinctive characteristics and their issues and problems. This information comes from the scientific study of the complete watershed of South-east Queensland, providing a picture of the overall health of the system, and of individual catchments.

We have also provided suggestions for places to visit in each catchment and included maps to guide you there.

Part C addresses the future for our waterways, where we've come from and where we're going. Some important milestones have been set for us all to achieve. Lastly, to find out more about what you can do to become involved or to join your local environment, Catchment, Waterwatch or Landcare group, we have included a useful listing of contacts.

We now have to maintain the links and unity among individuals and groups, so that over time we can reverse as much as possible the 200 years of degradation of our waterways. I recommend this publication to you.



HEALTHY WATERWAYS

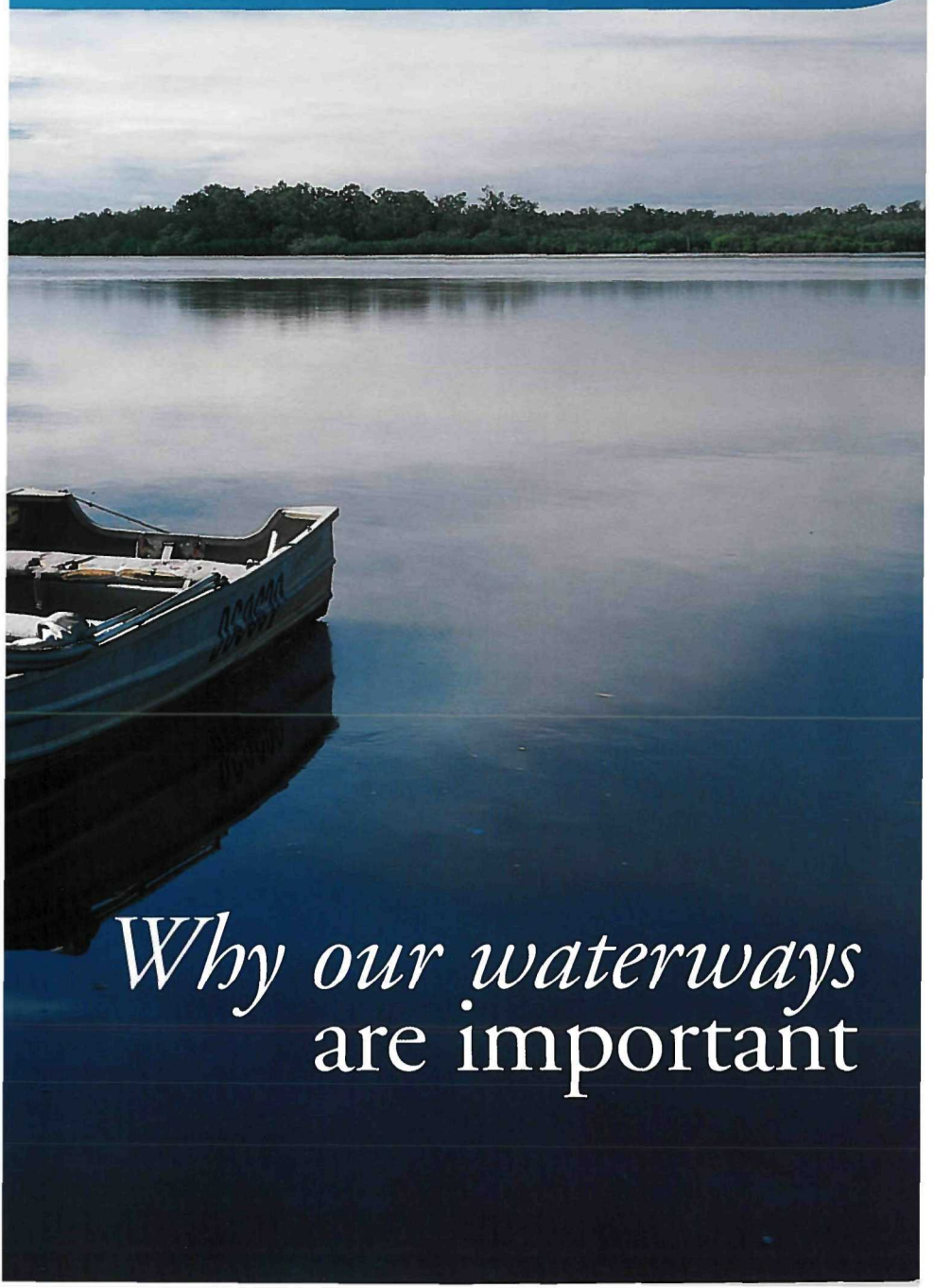
Councillor John Nugent

CHAIR,

SOUTH EAST QUEENSLAND REGIONAL WATER QUALITY MANAGEMENT COMMITTEE

Contents

PART A



Why our waterways are important

Understanding our waterways

Millions of years ago, geological activity formed the Great Dividing Range, creating the western boundary of the region known today as South-east Queensland. Rainfall and sea level changes since then have modified the landscape. Drainage channels have been incised, sediments deposited and a stunning variety of plants and animals have flourished to create diverse habitats. These processes formed what today is the region's rich network of waterways.

Some of these waterways are long and slow moving, flowing through relatively large catchments and into Moreton Bay, one of the world's most beautiful broadwater areas. In contrast, others are short with steep courses that rise in the coastal hinterlands and flow directly to coastal waters, fringed by stunning sandy beaches.

Understanding our waterways is the key to unlocking their heritage. It will also help to secure their future and with that, our future quality of life in this region.

ENVIRONMENTAL PROTECTION AGENCY

South-east Queensland experiences heavy rain fall during the spring and summer months

It never rains but it pours

The climate of South-east Queensland is subtropical. In the hot, humid summers, the prevailing winds are from the north-east and south-east. In winter, weather fronts moving west to east bring periods of cool, dry westerly winds.

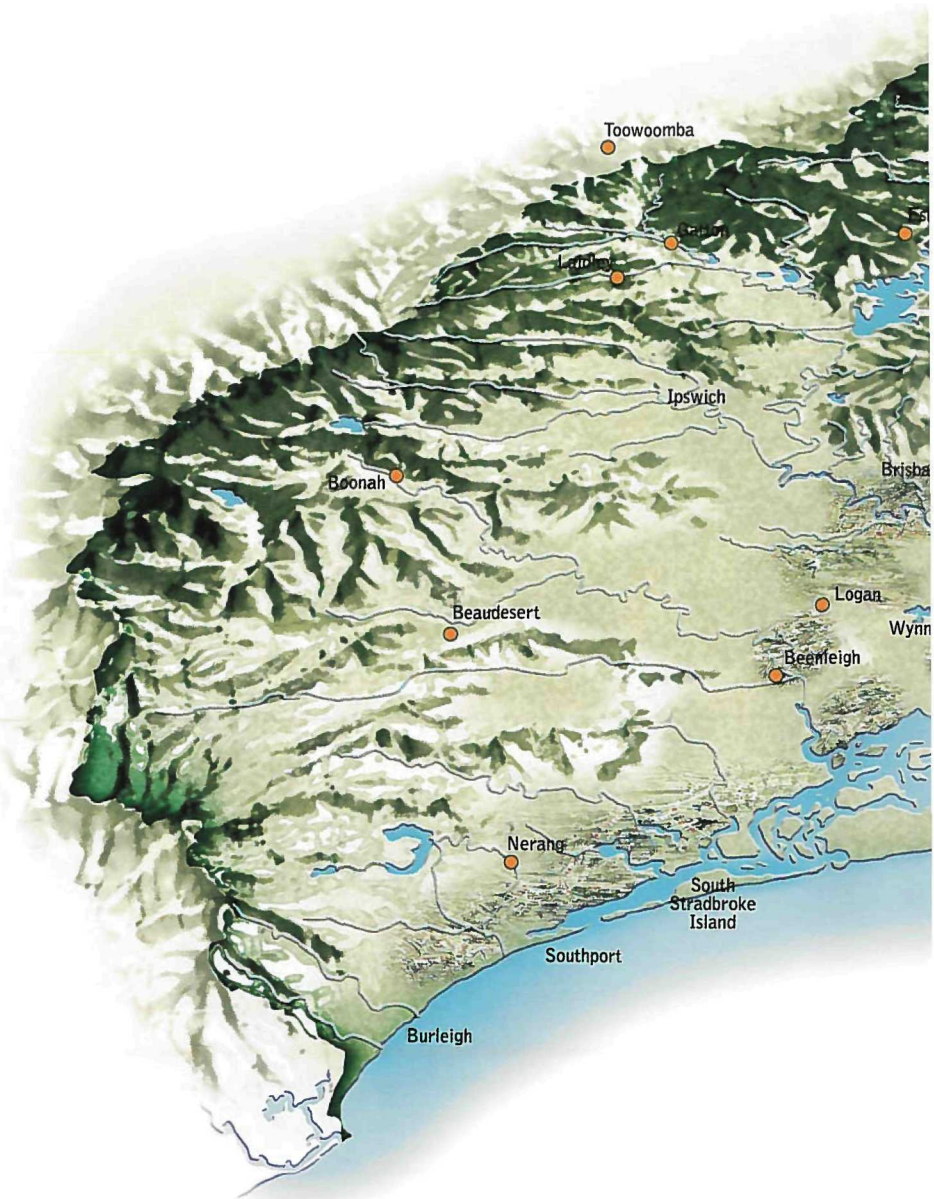
On average, about two-thirds of the annual rainfall occurs in the summer. In the spring and summer months, high intensity thunderstorms form in the mountains and move across the south-east, dumping heavy rain in short, sharp bursts. The sheer volume of water hitting the ground often causes erosion and flash-flooding.

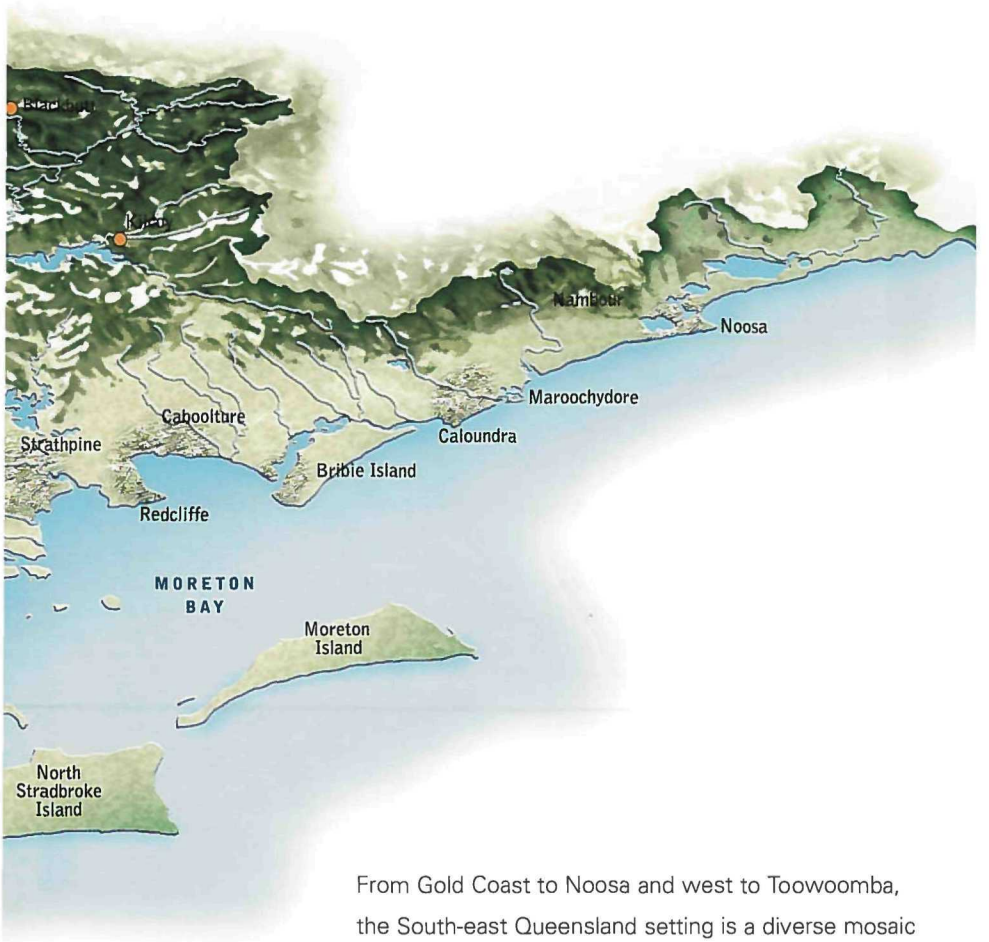
Monsoonal, low pressure systems also bring rain in the summer and early autumn, with periods of high run-off and occasional floods. The flood that devastated Brisbane in 1974 resulted from a cyclone, which had degraded into a low pressure system and hung over the region for many days.

Rainfall varies dramatically, however, from year to year – alternating between drought and flood depending on the large-scale, trans-Pacific weather patterns, called the Southern Oscillation. Changes in air pressure and sea temperatures in different parts of the Pacific Ocean change the intensity of the summer south-east trade winds, causing them to carry more or less moisture and thus more or less rainfall. This is also called the *El Niño-La Nina* cycle.

This climatic variation has a big influence on the way in which the waterways of the south-east function. The rivers flow in pulses, often flooding after heavy rain. During the rest of the year, many streams are just a series of interconnected waterholes or dry gullies.

South-east Queensland Setting





From Gold Coast to Noosa and west to Toowoomba, the South-east Queensland setting is a diverse mosaic of mountain ranges, hills, valleys, rivers, lakes, flood-plains, coastal embayments and islands supporting 2.3 million people and many rich and varied habitats, home to a great diversity of flora and fauna.

Life amongst the waterways

Many plants and animals in South-east Queensland have adapted to this drought-flood cycle and the pulsed flow of the rivers and streams.

Frog species such as the Green Tree Frog, the Graceful Treefrog and the Ornate Burrowing Frog breed in shallow, ephemeral ponds after summer rains. Their eggs usually hatch into free swimmers within 24 hours of rain, and leave the water within three weeks or less, as the ponds dry out.

Other species such as the Green-thighed Frog need more permanent water left by flooding rains and so are only able to breed every few years. They can bury themselves up to a metre below the surface and hibernate during the dry periods.

Other aquatic species are restricted to higher elevation, cool waters in areas such as the Conondale Ranges and Brisbane Forest Park and have become endangered, rare or threatened with extinction. These include the Gastric Brooding Frog, Conondale Day Frog, Marsupial Frog and the Mountain Tree Frog and also the Spiny Crayfish. The Bathurst Cod, which is thought to have inhabited parts of the Brisbane River until the early 1900s, is now extinct.

Because South-east Queensland is located at the overlap between the more temperate southern climatic regions and the tropical north: it is home to a remarkable diversity of plant and animal species. In addition, marked differences in temperature and rainfall and topography within the region mean a complex mosaic of wildlife habitats.

QUEENSLAND MUSEUM

Green Tree Frog, an inhabitant among our waterways

Migratory birds from the arctic northern hemisphere visit Moreton Bay and Pumicestone Passage during our summer months. At low tide, when extensive sand flats are exposed they feed on worms, small crustaceans and slugs, and roost in the sand banks at high tide.

Although much of the native vegetation has been removed since European settlement (only 20% remains), there are still significant areas of rainforest and eucalypt forest in the mountains of the McPherson, D'Aguilar, Darlington, Conondale and Blackall ranges. Grasslands and open woodlands grow on the slopes and plains and near the coast are the rapidly disappearing *melaleuca* wetlands and wallum (heathlands).

More than 350 migratory and non-migratory species of birds can be found within South-east Queensland, including many species of brilliantly-plumaged parrots such as the King Parrot of the mountain rainforests and the huge raucous flocks of Rainbow Lorikeets on the coastal plains – a common sight in urban gardens.

While many species are under threat of extinction the eucalypt forests of South-east Queensland still support a large colony of koalas and gliders and possums roam the woodlands (and suburbs) at night. Platypus, water dragons and water rats can be found in creeks.

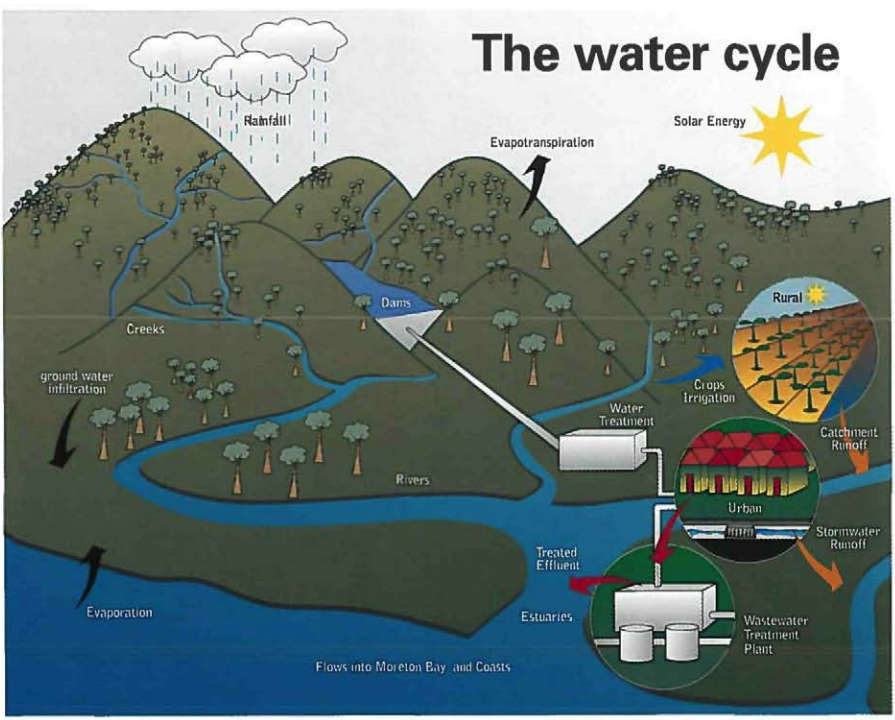
Fringing the estuaries and coasts are salt marshes, mangroves and tidal flats and seagrass beds grow in the shallow waters of Moreton Bay. Mangroves are nurseries for juvenile fish, crabs and prawns and the seagrass beds are grazed by dugongs and turtles.

Catchments – interconnected ecosystems

Although streams and rivers represent a small proportion of the total area of South-east Queensland, they have played (and continue to play) an important role in shaping the land as they carry water and sediment towards the sea. Rain falling on the land surface flows under the influence of gravity through a branching network of small gullies and streams and ultimately into larger rivers. The land surface is broken up into discrete, definable drainage areas known as catchments, each drained by a single major stream or river, fed by its many tributaries. These represent the arteries of the landscape and they carry the life blood for the plants and animals (including humans) that inhabit the region.

There are more than a dozen major catchments in South-east Queensland, as well as a myriad of sub-catchments. The largest of these is the Brisbane River catchment, which covers some 13,000 km^2 – more than half the total area of the south-east region. Its six main sub-catchments are the Upper Brisbane, Stanley, Mid-Brisbane, Lockyer, Bremer and Lower Brisbane catchments.

The remainder of South-east Queensland includes the smaller catchments of Noosa, Maroochy and Mooloolah; the numerous waterways of the Pumicestone Region (including Caboolture River and Burpengary Creek); Pine Rivers; the Logan – Albert (including Redlands, Tingalpa and Eprapah Creeks); and the waterways of the Gold Coast (including Currumbin and Tallebudgera Creeks, the Coomera, Pimpama and Nerang Rivers).



The water cycle is a continuous circulation of water between the earth and the atmosphere, powered by solar energy and gravity. Water from vegetation, soils and the oceans rises as water vapour to the atmosphere and condenses. Gravity brings rainfall to the earth where it infiltrates to groundwater or flows via waterways to the sea. Human uses include storage dams, irrigation, domestic and industrial use, treatment and return to waterways.

The invisible waterways

A large proportion of the total stream and river network in South-east Queensland is made of small gullies. For much of the time, these are dry and not easily identifiable as important parts of the waterways. However, after rain, they become the drainage lines, into which rainfall run-off collects and flows, forming a vast branching network that eventually coalesces to form larger streams and rivers.

In South-east Queensland these gullies, or 'first-order streams' make up a very large proportion of the total length of waterways – approximately 7,500 km of a total waterway length of almost 16,000 km.

Many of these smaller gully networks have been poorly managed in the past and have lost their native vegetation cover. Vegetation plays an important role in holding the soil in place and preventing gully erosion, particularly during heavy rainfall. It also creates a rough surface, which slows the surface run-off down and reduces its erosive force. The more protective vegetation cover these gullies have, the greater the chance there will be of healthy waterways downstream. Failure to recognise these small streams and gullies as important components of our local waterways has led to major problems downstream, and ultimately in Moreton Bay and other coastal environments.

A vast branching network of gullies coalesce to form larger streams and rivers, some with good native vegetation cover

Many gullies have lost their native vegetation cover, exposing the soil and eroding after heavy rainfall

LEFT AND RIGHT: ENVIRONMENTAL PROTECTION AGENCY

Life at the water's edge – riparian areas

Riparian vegetation is the ribbon of trees and other plants that lines the edges of watercourses and includes many species of native (and exotic) sedges, grasses, vines, trees and shrubs.

The roots of the trees hold the soil of the creek bank in place, reducing erosion during high flow events. The trees and plants also filter run-off flowing into the creek from the surrounding landscape – trapping sediment, nutrients and debris.

The riparian zone is important for many insects such as the dragonfly

QUEENSLAND MUSEUM

Riparian zones provide wildlife corridors so that small mammals and reptiles can move safely from one area to another. Honeyeaters, kingfishers, wrens and other small birds use dense riparian vegetation as protection from predators, and water dragons, platypus and water rats live among the roots and in the banks.

In Queensland's warm, subtropical climate, overhanging trees reduce water temperature through shading. This increases the amount of dissolved oxygen and prevents the excessive growth of aquatic weeds, allowing a greater diversity of plant and animal life to survive. The dappled light created by tree shading provides camouflage for predators and prey in the water.

Fallen branches from riparian trees form habitats in the river; and leaf litter and insects that fall into the stream are important food sources for fish and other aquatic organisms.

Dragonflies, mayflies and many other aquatic insects mate in the riparian zone, then lay their eggs in the water. Their nymphs (juvenile stage of growth) form part of the highly diverse communities that inhabit the stream.

The small things in life are important

From mountain streams to the waters of Moreton Bay, the waterways of South-east Queensland teem with life. Tiny single or multi-celled algae are important primary producers in all kinds of waterways. In larger, more open streams, micro-algae provide an important source of food for invertebrates (such as insect larvae and crustaceans). These small creatures are in turn the food of larger fish, frogs and birds. Microalgae also form a vast, single-celled 'hidden garden' on the shallow sediments of Moreton Bay.

Phytoplankton are another important group of microscopic algae, especially in the slower-flowing reaches of the rivers and in the estuaries and the Bay. These tiny floating plants live suspended in the water and come in many varied and beautiful forms. Some have ornate outer skeletons of silica, while others have whip-like tails (flagella).

Some microalgae belong to the large group of cyanobacteria or blue-green 'algae'. They can be *single-celled or multi-celled and filamentous.* Cyanobacteria occur naturally in all of our waterways. Some cyanobacteria are toxic and, if the system is out of balance, can dramatically increase their numbers, leading to an accumulation of toxins in the waterway.

Coastal floodplains

As they are fed by the creeks and streams, the rivers of South-east Queensland grow larger until they meander through the extensive floodplains near the coast. Brisbane and the Gold Coast areas are good examples of coastal floodplains.

The high intensity rainfall and variable flow of the rivers make flooding not only a common occurrence, but an essential part of the healthy waterway cycle. As the floodwaters spread out over the plains, they deposit silt that enriches the soil. The ephemeral pools that form are breeding grounds for frogs and a variety of invertebrate animals, and act as a food source for birds, lizards and small mammals.

In many areas, stands of trees are often grouped into age classes – that is, large numbers of them are the same age. This is because the floodwaters distribute the seed across the floodplain, and the thorough soaking causes the seed to germinate.

The connection of rivers with their floodplains through this flood cycle is important for the health of both the aquatic and terrestrial ecosystems. However, intensive development of urban areas and agriculture has placed major constraints on this vital link.

ENVIRONMENTAL PROTECTION AGENCY

Coastal floodplain near the Logan River mouth

Water beneath the land surface

Not all water falling within a catchment runs off immediately down the stream network. Some soaks into the soil and can flow underground or be stored in aquifers (water bearing rock formations). Sometimes the water flows between layers of rock along the channels of ancient rivers, long since buried. In the Lockyer catchment, (upper reaches of the Brisbane catchment), this underground water supply is tapped for irrigation of crops. Extraction of groundwater sometimes can exceed the rate of replenishment. As many irrigators are learning, this is not an unending supply but an important compartment of the entire water cycle.

The large sand islands off the coast of South-east Queensland – Stradbroke, Moreton and Bribie – contain large reserves of clean, fresh shallow groundwater that has been filtered through the sand. This water seeps out into small coastal streams or directly from aquifers into the Bay or ocean. In some cases, such as Blue Lake on Stradbroke Island, it also forms the spectacular 'water table window' lakes that are popular swimming spots.

Where the rivers meet the sea – bays and estuaries

Flooding has an important function in the health of the estuary – the lower section of the river where the fresh water and salt water meet.

Floodwaters act as a 'spring cleaning' agent – flushing out the accumulated sediment, nutrients and other material washed into the creeks and streams by rainfall run-off over time. Major floods, such as the one in 1974, scour out the estuary of the Brisbane River, taking its load of sediment out into Moreton Bay. The 1996 flood, though not as large, also delivered significant quantities of sediment and nutrients to the Bay.

The other important, and more regular, flushing mechanism in estuaries is the tide, which flows in and out twice a day. In pre-European times, the force of the tidal current was slowed down by sandbars across the mouths of rivers. The sandbars and islands have been removed from the mouth of the Brisbane River to allow shipping access, but a bar still remains across the mouths of the Maroochy and Noosa rivers, and across Tallebudgera and Currumbin creeks.

Because estuarine waters are brackish, their ecosystems differ from those in freshwater streams and in the sea. Mangroves line the edges of estuaries of South-east Queensland and perform an essential function in stabilising riparian areas and provide a nursery for juvenile fish, prawns and crabs. Leaves and other detritus are a food source, and the shading and fallen branches provide shelter from predators.

Mangroves grow between the high and low tide mark, and are specially adapted for survival in brackish water. Their leaves excrete salt as crystals, visible on the leaf surface. The Grey Mangrove has pneumatophores – aerial breathing roots that stick up out of the mud at low tide; other species of mangrove have aerial prop roots or arching stilt roots.

As well as the groups of algae described earlier, a red, sponge-like macroalgae called *Catenella* lives alongside the mangroves, attaching itself to the pneumatophores and soaking up nutrients from the surrounding water. Microalgae are visible along the banks of the rivers as a fine, green layer on the mud.

Seagrasses, on which the dugongs and sea turtles feed, grow in South-east Queensland estuaries, as well as in Moreton Bay, though many of these beds have now been lost because of pollution.

MARINE BOTANY GROUP, UNIVERSITY OF QUEENSLAND

Seagrasses grow in shallow, clear waters and need light. Many species of fish, crabs, prawns and squid live in the rich waters of the estuaries and Bays.

Seagrass beds need clear water and light to grow and are an important food source for dugongs and turtles

The sand conveyor belt

Beyond the Bay and estuaries, the waters of South-east Queensland's waterways disperse into the Pacific Ocean. The South-east Queensland coastline, with its white, sandy beaches and rocky headlands, curves northwards in a series of north-easterly sweeps. This is the influence of the 'sand conveyor belt', which deposits sand northwards along the coast. As the sand is churned up by the surf, the prevailing south-easterly winds create a 'longshore drift' of sand steadily northwards. This 'conveyor belt' causes sand to build up on the southern sides of headlands, and forms sand-bars and spits extending from the southern sides of river mouths. The Southport Spit is a good example of this – over many years it has gradually extended north, moving the mouth of the Nerang River northwards and forming The Broadwater.

During the ice ages, thousands of years ago, when sea levels were much lower, strong winds blew these accumulated sands into majestic dunes, some reaching hundreds of metres in height. When the earth warmed and the seas rose, these areas became surrounded by water and were stabilised by vegetation. The two sand islands that protect Moreton Bay – Moreton and North Stradbroke Islands – were formed in this way.

QUEENSLAND MUSEUM

Sand churned by the surf and prevailing south-easterly winds sweeps northwards like a 'sand conveyor belt'

QUEENSLAND MUSEUM

North Stradbroke Island formed by accumulated sands over thousands of years protects Moreton Bay

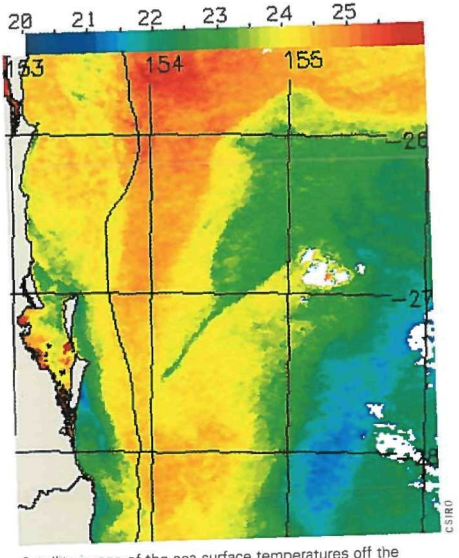
Moreton Island

On the edge of an oceanic desert

Further out from the coastline, along the edge of the continental shelf, the offshore water currents are dominated by the southward-flowing East Australia Current (EAC). This current provides an anti-clockwise circulation of water across the entire south Pacific Ocean.

The EAC begins in the Coral Sea, as a warm-water, low-nutrient current. The presence of the EAC offshore means a relatively consistent water temperature, and a low frequency of upwellings. Upwelling occurs when cool, deep ocean waters, rich in nutrients, are brought to the surface and stimulate plant growth and subsequent growth up the food chain. The great fishing grounds of the world are all located around upwellings.

The absence of upwellings means that South-east Queensland's coastline (and the rest of Australia's east coast) runs along the edge of an oceanic desert. Beyond the narrow coastal strip defined by the continental shelf, the waters off the east Australian coast are not rich with life.



Satellite image of the sea surface temperatures off the South-east Queensland coast show a dominance of warm waters flowing from the north. Blue colours indicate water at 20°C and red areas indicated water at 25°C.

Nutrients for South-east Queensland's marine life come from the land. Marine life (including fish, prawns and crabs) flourishes after floods in the rivers, as sediment and nutrients are washed out of the rivers and into the Bay and the ocean.

The human element

The waterways of South-east Queensland are a sophisticated and finely tuned system, which has had an additional element added to it – humans. Humans have relied on the waterways and the systems they support for food, water and shelter for thousands of years. Our use of the waterways, particularly in more recent times indicates however, that we are also its greatest threat.

Recreational use of waterways by humans

A life support system for millennia

South-east Queensland and its waterways have nourished humans for thousands of years, providing fresh water, food and shelter. Within its semi-circle of mountains, generations of people have settled to live and work, built their homes, farmed the land and created sprawling modern cities. They have also travelled its rivers, rested under its trees and enjoyed the beauty of the landscape.

Between the boomerangs

For millennia, Australia's Aboriginal people were the custodians of the waterways and lands now called South-east Queensland. Indigenous people have lived in the region through two ice-ages and witnessed the creation of Moreton Bay, when the sea-level gradually rose more than 6000 years ago.

The rivers of South-east Queensland and the waters of Moreton Bay provided a rich and varied source of food for the traditional owners. Perch and mullet migrated up the river each year, freshwater mussels were plentiful along the river banks, and eels were known to be readily available when the silky oak flowered.

The Aboriginal people of South-east Queensland also cultivated the shipworm (a bivalve mollusc), which they called *kambi*. Piles of cut timber (particularly Swamp She-oaks) were placed in the waterways between the high and low tide mark for up to a year, then the *kambi* were harvested and eaten.

The Aborigines hunted turtles and dugongs in Moreton Bay, fished for whiting at Luggage Point, caught mudcrabs at Doboy Creek and water lizards at Moggill.

Catchment Comment

QUEENSLAND MUSEUM

Uncle Bob Anderson,
Traditional owner and elder of Ngugi

The physical world and the creatures in it to us are our mother and father – our brothers and sisters. ... Our respect for the waters and lands of the world is the same as our respect for people. ...

I am now going to sing up the river country of South-east Queensland. Forgive me if I miss someone's special name for their country. The country I name is that of the clans who are my neighbours.

The Turrabul are in the centre of a large boomerang-shaped line of mountains to the west, and a boomerang-shaped line of islands to the east.

People that span the salt water and the freshwater like the Undambii, Gubbi-Gubbi, Ningy-Ningy, Turrabul, Gugingin, Bullongin, Kombumerri and Minjunbal are the spiritual connectors of the mountain and freshwater people and the salt water people.

The huge boomerang of mountains to the west of Quandamooka, includes nations of people whose custodianship flows into the next people's country.

The Wakka Wakka, the Yuggerra, Jaggera, the Ugarapul, the Mulunjalie, and the Birinburra, Migunberri and Wangerriburra people all have high areas of mountains that feed the rivers.

Finally we have the people of the salt water and the islands – the Joondaburrie, the Ngugi, the Noonuccal, the Geonpul, and the Koombermerri. The people who carry my own song.

QUEENSLAND MUSEUM

Pimpama River in 1903, Gold Coast catchments

Highways of the past and present – european settlement

In 1823, John Oxley first explored Moreton Bay as a possible site for a new convict settlement. On this journey, he met three ex-convicts from Sydney who were lost and had been befriended by Aborigines. One of the men, John Pamphlett, told him about a broad river that flowed into the Bay – the Brisbane River.

The discovery of a major river was of great significance in the decision to establish a colony in South-east Queensland. Ships were the main means of transport at the time, and establishing a sheltered port was crucial.

The initial settlement at Redcliffe in 1824 was soon moved to the site of what is now the Brisbane Central Business District.

Free settlers began to arrive in the 1840s and transport routes within the region – up and down the length of the river – became important. By the 1860s, the port of the Moreton Bay colony was extended to Ipswich, and wharves established on the banks of the Bremer River for ships to unload goods destined for the Darling Downs agricultural region. (The importance of this port declined after the establishment of the railway in 1875.)

JOHN OXLEY LIBRARY

Brisbane River in the early 1900s, looking towards Victoria Bridge from South Brisbane – the waterways were our highways of the past, transporting goods vital for maintaining early settlements

To allow the passage of ships, several navigational hazards in the river had to be removed, including Seventeen Mile Rocks. The river was also dredged in many places to deepen the channel and a deep cutting was made in the bar at the mouth of the river.

As glowing reports appeared in the southern press, free settlers flooded into the region.

> The principal settlement is on the Brisbane River, which rises in the coast range ..., and receiving the Bremer and many other considerable tributaries in its course, traverses a large extent of beautiful country, exhibiting all the luxuriant features of a tropical vegetation, constantly irrigated by abundant streams from the western chain, and refreshed by cool breezes from the South Pacific into which it falls at Moreton Bay, ... The country along its banks is pleasantly undulated, and richly clothed with timber ... The soil is varied, but mostly of the richest quality; ... and at the head of the navigation of the river a considerable seam of coal appears in its channel.
>
> – ***The Australian*, 24 February 1842**

The valuable hardwood timbers of the local forests soon began to attract timber-getters, and the rivers of South-east Queensland were used to float the logs down the sawmills, located in the lower reaches. Agricultural produce was also transported to the towns and the port via the rivers.

As the colony grew, so did the Port of Brisbane. It was moved across the river to what is now South Bank and more wharves were built downstream. Over the next hundred years the wharves were gradually moved further down towards the river mouth, to accommodate the larger ships until finally, the Fisherman Island Complex was built at the mouth of the river and the last of the wharves above the Hamilton Reach of the river were closed by 1990.

A source of water

Since European settlement, maintaining an adequate water supply has been a constant challenge and remains so today.

The first water supplies for Brisbane Town came from City Creek, but this quickly became insufficient and a dam wall was built near present day Tank Street. As the population grew, Enoggera Dam was built, followed by two brick reservoirs on Wickham Terrace and then Gold Creek reservoir.

The unpredictable nature of South-east Queensland's climate reinforced the need for access to more water to maintain supply and a pumping station was built at Mt Crosby in the 1890s.

Today, with South-east Queensland's population at more than 2.3 million (and still growing at a rate of around 2 per cent per annum), there are numerous dams across the region. In the Brisbane River catchment, dam construction has resulted in numerous lakes – Lakes Somerset and Wivenhoe supply the city of Brisbane and Lake Perseverance and Cressbrook supply Toowoomba and the surrounding populations. Advancetown Lake on the Nerang River supplies the Gold Coast; Lakes Samsonvale and Kurwongbah supply the northern parts of Brisbane and Redcliffe. In the Maroochy River catchment, Wappa, and Cooloolabin Dams supply parts of the Sunshine Coast.

There are also numerous weirs and extraction pumps along many of the creeks and rivers that supply irrigation water for crops and drinking water for cattle. The region supports cattle, pigs, poultry, forestry, sugarcane, fodder crops and fruit and vegetable production.

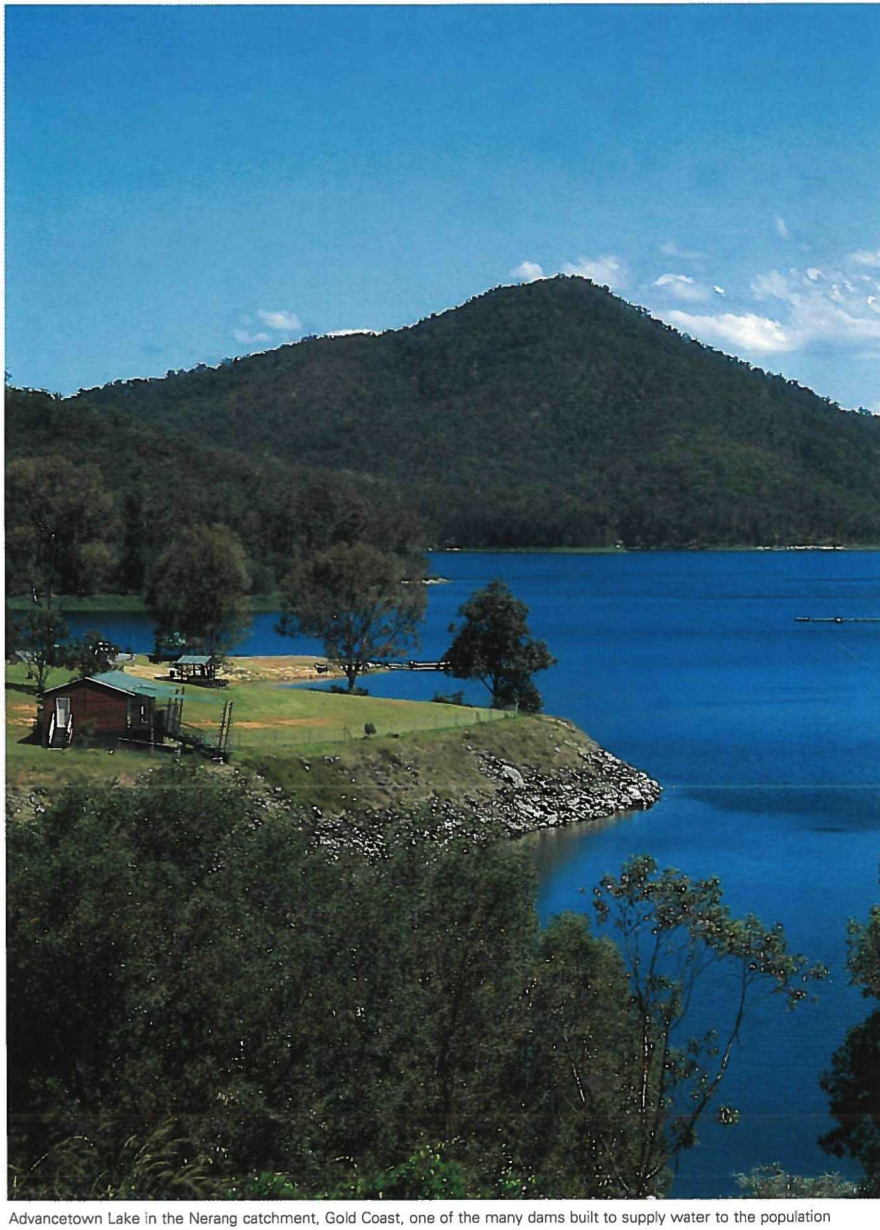
ENVIRONMENTAL PROTECTION AGENCY

My name is Auntie Mulanjarlie. I am Mulanjarlie woman from the Yugembeh group of peoples. I take my name from my ancestral homeland estate. I am that estate – the land and the animals and the rocks and the water and the air – all of it is me.

My grandfather made it clear to me that the water of our river – the Logan River – is our source of power and sustenance. As children, we went to the river after floods and cleaned the water of branches and other objects so it would remain a safe and clean source of food and life.

SEQ WATER CORPORATION

Somerset Dam and Lake Somerset behind, was completed in 1959



Advancetown Lake in the Nerang catchment, Gold Coast, one of the many dams built to supply water to the population of South-east Queensland

Value of agricultural industries in South-east Queensland for 1996/97

Industry	Value in 1996-97
Horticulture (fruit and vegetables)	$326 million
Poultry	$168 million
Dairy	$110 million
Forestry	$69 million
Beef	$60 million
Sugar	$28 million
Fuel crops	$28 million
Pigs	$11 million

SOURCE: 1996/97 AGRICULTURAL STATISTICS

In agricultural areas such as the Lockyer catchment, the region's salad bowl, competition for limited water supplies is intense; and in the Logan, upper Brisbane and Stanley Rivers, water is extracted for cattle to drink and to grow stock feed.

Every person in South-east Queensland uses an average of 410 litres of water a day for personal use (e.g. drinking, showering, toilet use, washing, watering the garden, cleaning the car, etc.) This does not include the water used in food processing, manufacturing, firefighting, leaking pipes and community gardens and fountains. This water use averages an additional 225 litres per person per day. We have one of the highest per capita rates of water consumption in the world. A damning statistic for the world's driest inhabited continent. As the region's population continues to rise, the total consumption also continues to increase, placing further pressure on our water resources.

As well, the waterways are subjected to more pressure through sewage effluent and stormwater outflows. Land is still being cleared to make way for housing and industry. This means more paved or concreted surfaces and roof area, and more stormwater run-off. About 80 per cent of the native vegetation, which once protected the soil and provided wildlife habitat, has been cleared in South-east Queensland.

Somewhere to get away from it all

Catchment Comment

UNIVERSITY OF QUEENSLAND

Bill Dennison,
Marine Scientist, University of Queensland

Development rates in South-east Queensland have an enormous impact on the future of the waterways, and on determining what will remain of the natural environments. But there are still unspoiled places that we can protect, for their own sake as well as for ours. The waterways provide us not only with our physical comforts, but can also nurture us with their peace and beauty. Within view of the city skyline, dolphins and dugongs can still be found in Moreton Bay. The sandhills of the islands are visible from city highrises, and it is only an hour's drive to some of the loveliest beaches in Australia.

GRIFFITH UNIVERSITY

Stuart Bunn,
Freshwater Ecologist, Griffith University

Within an hour's drive of Brisbane, you can be in the most amazingly quiet rainforests: massive *Auracauria* pines and headwater streams largely untouched by logging activities, containing some of the most unusual insects, crustaceans and fish on Earth.

The health of our waterways

More People, More Pressure

The steady population growth in South-east Queensland is a key factor driving the changes to our waterways. More people simply means more pressure on resources and the environment.

The region's population is growing at around 2 per cent each year. This means more water will be needed for households and industry, more land will be used for housing and infrastructure, more wastewater will be generated and more vegetation will be cleared.

As the human footprint grows, things could get much worse for the environment – unless we change our ways.

Changing the flow

The pattern of water flow in a river influences its ecosystem, from the habitats in and along the river to the depth and shape of the channel. When a river system is dammed, water flow is altered and this has far-reaching effects on the whole environment.

In South-east Queensland, dams and weirs provide a water supply for our towns and cities and for agriculture and stock. Flood mitigation has also been an important consideration because Brisbane, the Gold Coast and parts of the Sunshine Coast are built on coastal flood plains.

The dams have had a major impact on the natural water flow patterns. Instead of a climate-driven, pulsed flow, the rivers downstream of the dams only flow when water is released from the dam wall. Water flow in the lower Brisbane River is regulated through Wivenhoe Dam (as well as weirs downstream), and water is released according to the needs of the greater Brisbane City area. The Nerang and Maroochy Rivers have also been regulated with dams and weirs.

These changes not only affect food availability but also breeding patterns of aquatic organisms. Dams and weirs also create barriers to the natural movement of fish and other animals up and down the stream. Certain species of plants depend on flooding for seed germination. If all floods stopped, these species would be probably decline.

More people means more pressure on our waterways – unless we change our ways

Exposing our streams

Fringing (riparian) vegetation is vital to the health of our waterways (see Chapter 1). Current estimates indicate that only 20 per cent of South-east Queensland's native vegetation remains intact and there is even less riparian vegetation.

The absence of riparian vegetation, particularly in the often dry gullies, drainage lines and creeks of upper catchment areas, can lead to greatly increased rates of soil erosion. Vegetation traps the fine soil particles and nutrients carried in stormwater run-off. Without plant cover, this filtering process is reduced and the amount of sediment entering streams is greatly increased.

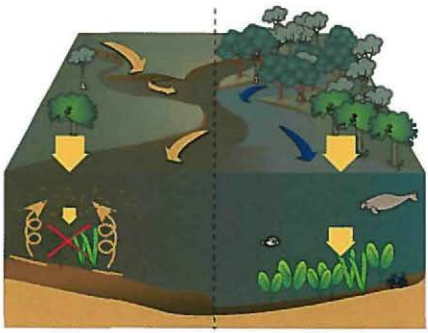
The sediment and nutrient loads are carried downstream where they accumulate in dams, larger rivers, estuaries and the Bay. (Research indicates that Wivenhoe Dam traps about 95 per cent of sediment loads from upper catchment areas of the Upper Brisbane and Stanley rivers).

Increased sediment loads in dams not only has the potential to reduce storage capacity, but the nutrients they bring can also increase the risk of blue-green algae (cyanobacteria) blooms. Depending on the nature and extent of these blooms, drinking water supplies may be put at risk.

Large quantities of fine sediments (muds) eroded from upper catchment areas have been traced to the central part of Moreton Bay. This 'mud patch' is constantly disturbed by tidal and wind generated currents and causes high levels of turbidity within the western parts (Deception, Bramble and Waterloo Bays) and southern parts (mouth of the Logan River) of the Bay. Sediment delivery to the Bay has increased significantly in the past 100 years. Turbidity reduces the amount of light that reaches the seafloor, causing loss of seagrasses in these areas.

Loss of riparian vegetation along permanent flowing streams further down the catchments also increases the amount of light entering the waterway and significantly increases water temperature. This can affect the types of plants that flourish in streams (encouraging macrophytes and filamentous algae instead of micro-algae) and their rates of growth. Other important

The presence of fringing, riparian vegetation is vital for the health of waterways



Seagrass loss occurs (left hand side) when high sediment inputs from the catchments, combined with wind and wave action stirs up the sediments, creating turbid water and reducing light for seagrass to grow. Reducing catchment sediment inputs (right hand side), reduces turbidity, allowing greater light for healthy seagrass.

factors, such as the levels of dissolved oxygen in streams and availability of food and habitat, are also influenced by these changes.

Land clearing and development

Land clearing for agricultural, industrial and housing development has had a major influence on the health of South-east Queensland's waterways, particularly through changes to the rainfall – runoff cycle. Removal of vegetation and construction of hardened land surfaces has changed run-off patterns and increased run-off volumes and rates.

Increased run-off volume and intensity increases soil erosion. Poor land management practices and removal of riparian vegetation exacerbate this problem and leads to increased sediment and nutrient loads entering the waterways (see above).

Other potential problems associated with land development include exposure of acid sulfate soils in low-lying coastal areas. These soils can generate high levels of acidity when lands are drained or excavated. The run-off from these soils can be high in dissolved metals, such as iron and aluminium and this can cause fish kills if released unchecked, into the waterways.

Nutrient over-enrichment

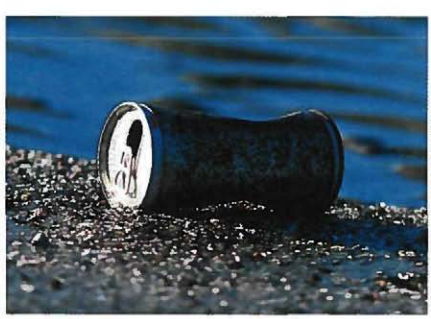
The most obvious change to our waterways in the past 100 years has been the huge quantity of wastewater (treated sewage and industrial effluent) discharged into them every day.

During dry times, treated sewage can represent almost the entire fresh water flow in the Brisbane River and in other smaller streams.

Although sewage treatment practices have improved in the past few decades, sewage and industrial wastewaters can still contain high levels of nutrients (nitrogen and phosphorus), that can lead to excess algal growth and sometimes blooms. This process, when one or more species of algae becomes dominant and grows 'out of control' is called eutrophication and is a sure sign that the health of the waterway has declined.

Research indicates that excess nitrogen is the main cause of algal blooms, particularly in marine and estuarine waters. Nitrogen removal is the focus of many of the sewage treatment improvements undertaken or planned by councils in South-east Queensland.

Stormwater from urban and rural areas can also contain high levels of nutrients, from fertilisers and animal droppings.



ENVIRONMENTAL PROTECTION AGENCY

Litter is transported to our waterways in vast amounts each time it rains

Taking action for the future

The health of South-east Queensland's waterways is deteriorating and the impact of our activities is unsustainable. To arrest this decline, we need to take action – both individually and as a community.

Prevention is better than cure

Compared to river systems in many of the world's industrialized countries, it is still relatively easy to solve the problems facing South-east Queensland's waterways. By acting now, we can save more of our remaining wildlife, spend less money, and get better results, than if we wait until the situation worsens. Every day that we delay taking action, we lose more of our precious natural environment.

For many river systems in industrialised nations around the world, preventative action is not an option, and much work and vast sums of money have been invested in attempting to reverse some very bleak situations.

The people of the Mersey River Valley in north-west England are more than half way through a massive, 25-year campaign to clean up their waterways. The Mersey catchment includes the cities of Liverpool and Manchester, as well as numerous rivers and streams that flow into the Mersey River and out into the Irish Sea.

The Mersey and its tributaries have been severely degraded over the past 200 years since the beginning of the Industrial Revolution in the late 18th century. At that time the river supported an important fishing industry, including sturgeon, mullet, lobster and oysters.

The decline of the river began as factories sprang up throughout the industrial midlands when the textile, chemical and paper industries expanded rapidly. Factories discharged untreated effluent directly into the nearest river or stream, already used as outlets for every kind of waste.

With the opening of the Manchester Ship Canal in 1894, Manchester became one of the busiest ports in the world, bringing more industrial growth, more people looking for work and greater demands on the river system. Some rivers became open sewers and most could no longer support any fish.

While stricter controls and regulations to deal with harmful waste were introduced during the 1950s and 1960s, it was not until the 1980s that the clean-up began in earnest.

The Mersey Basin Campaign, launched in 1985, is a community-wide partnership between organisations and individuals. Members of more than 20 River Valley Initiatives are working on local waterways, to improve water quality, clear contamination, enhance access, remove litter, plant trees and raise awareness.

MERSEY BASIN CAMPAIGN

Once a severely degraded waterway, the Mersey River flowing through Manchester and Liverpool in the north-west of England now supports an annual swimming event

This partnership, including government, industry and communities, is transforming derelict waterside land, revitalising the regional canal network and turning the riversides into popular recreation areas, with parks, walkways and other public spaces.

In 1985, only 50 per cent of the Basin's waterways could support any aquatic life. By 2000, this had jumped to 80 per cent. More than 35 fish species are now found in the rivers of the Mersey Basin.

By 2010, the campaign aims to have improved water quality to the point where all rivers, streams and canals are clean enough to support fish, stimulate attractive sustainable waterside environments and encourage everyone to value and cherish the waterways.

But these achievements have come at a cost. Already millions of pounds have been spent and the ambitious program still has more work to do. It is costs like these that the people of South-east Queensland can avoid by acting now, before it is too late.

Learning, then taking action

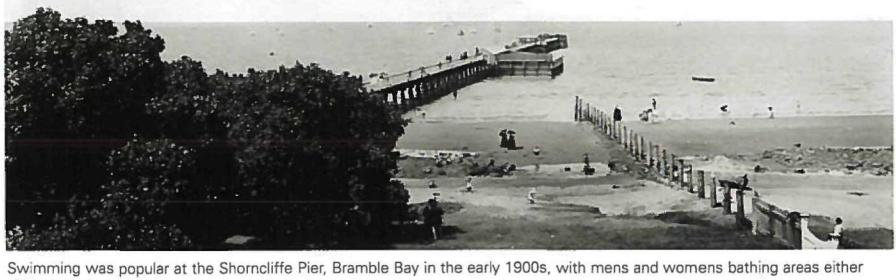
Taking action requires planning and knowledge. Extensive research and monitoring programs have been developed to tell us more about how the waterways systems work and how our activities are affecting them. Scientists have developed sophisticated new techniques for mapping plumes of sewage effluent flowing out of treatment plants into rivers and the Bay.

By mapping these plumes, the scientists have been able to determine where the effluent flows and what damage the nutrients it carries cause in the river and Bay ecosystems. This information has enabled many local governments in South-east Queensland to plan and implement sewage treatment and water recycling upgrades, and to reduce discharges and hence nutrient pollution. Government and industry have allocated more than $270 million to this work, which began in 1997 and will continue until 2005.

Bramble Bay (see Chapter 10) on the northern end of Moreton Bay near Redcliffe, has lost its seagrass beds and much of its marine life due to increased sediment loads. Research has revealed that these excess sediments were deposited in the Bay less than 90 years ago and came from basaltic soils in the upper reaches of the Brisbane River.

Scientific information indicates that restoring riparian vegetation along gullies, creeks and rivers, particularly in these upper catchment areas, will reduce sediment loads flowing into the rivers, coasts and the Bay and can be considered to be the single most effective action to improve the overall health of waterways. Many community groups are working with landholders in upper catchment areas to decrease soil erosion and protect waterways. In some rural areas, cattle grazing is being better managed by controlling cattle access to waterways, by fencing riparian vegetation, planting trees, removing weeds and providing off-stream watering points. The challenge ahead is to rehabilitate much more, as only a very small fraction of the many thousands of kilometres of waterways in need of attention have so far been rehabilitated.

Conservation and natural resource management groups (see Catchment Contact List) are working with Queensland Parks and Wildlife Service in



Swimming was popular at the Shorncliffe Pier, Bramble Bay in the early 1900s, with mens and womens bathing areas either side of the fence

Moreton Bay Marine Park, local Councils, industry and other state agencies. Partnerships between these groups assist with monitoring wildlife populations, such as migratory wader birds, dugongs, turtles and fish, to find ways to preserve their habitat and prevent extinctions. In Moreton Bay, for example, an artificial nesting site has been constructed for the endangered Little Tern on the Southern Bay Islands National Park, Woogoompah section (see Chapter 10).

Community groups throughout South-east Queensland are monitoring water quality, replanting riparian areas, cleaning up waterways, as well as raising awareness of environmental issues in their local school and community. Researchers and planners are also learning from traditional owners, whose peoples have lived along the waterways for thousands of years.

Monitoring of all these different aspects of waterway health is being undertaken by government, community and industry groups through an Ecosystem Health Monitoring Program (see Chapter 5) so that the effectiveness of these efforts can be measured and more information obtained about these systems and how they work.

This research and monitoring is providing the foundation for a plan of action involving local government authorities, state government departments, traditional owners, industry, catchment groups and individuals. This plan of action is the South East Queensland Regional Water Quality Management Strategy which is a key part of the Healthy Waterways Campaign.

Taking action in South-east Queensland

Like the Mersey Valley Campaign, cooperation is the key to the future in South-east Queensland if we are to succeed in protecting and restoring our waterways to excellent health. Community groups, individuals, farmers, industry and government all need to work together. What happens in one part of the catchment will affect other parts of the catchment. Problems can not be solved in isolation. Many people – either individually, or as part of community groups and organisations – are already working hard to achieve this.

Taking action in the dairy industry

On their Kilcoy dairy farm in the Stanley River catchment (see Chapter 9), Shane and Mary Lou Gittins are taking care of their creeks and improving the efficiency of their business at the same time.

"In an intensive industry like dairying, a large number of animals are concentrated in a relatively small area and producing a lot of waste, so there is always the risk of effluent finding its way into the gullies and then the creeks as a result of run-off.

Looking after the health of our creeks is very important to us, so we stop the effluent from our dairy, feeding areas and laneways from being washed into the creeks and instead spread it over our 48 hectares of irrigated pastures.

As a result, our pastures are looking better, we are using less fertiliser and irrigation water, as well as less power because the effluent is gravity-fed on to the pasture areas.

Using less irrigation water means we need to pump less water from the creek. We also catch run-off from the roofs of our buildings and use this in the dairy. Water is not plentiful in this area and droughts are frequent, so conservation is really important.

We also take faecal samples from the cows to measure starch and energy loss, to find out if the cows are using the feed efficiently – so nutrients are not going in one end and out the other. If we can get them to process their food efficiently, there are less nutrients in the effluent and our feed bill is reduced.

Our riparian areas are also very important to us, so we do not let the cattle graze directly along the creek banks. However, we are about to start a weed control program for Chinese Elm, which is now growing thickly along the banks and outcompeting the grass and other species that form the natural filtering mechanism for the creeks."

– Shane and Mary Lou Gittins

HEALTHY WATERWAYS LIBRARY

Shane Gittins with dairy cows

Taking action in the fruit and vegetable industry

Mick and Margaret McGinnis grow sub-tropical fruit, including low-chill stonefruit and persimmons, in their orchard at Woombye on the Sunshine Coast hinterland (see Chapter 7). They have developed an innovative production system designed to minimise the impact on the environment.

"Our orchard is a highly intensive enterprise, we have a large number of trees densely planted on just seven of our 20 hectares. We use a lot of fertiliser and chemicals, and everything we put on the ground has the potential to wind up in the local creek. To add to the challenge, we are on a steep slope in one of the highest rainfall areas in South-east Queensland.

My overall philosophy is to farm here without off-farm effects – without changing the natural balance around me. So I have designed my system to prevent erosion, stop transport of nutrients and other chemicals off the farm and leave the overall water balance of our creek system intact.

To achieve this, I have built a system of filter strips and settling areas. Instead of letting run-off water flow straight down the hill and into the creek, it zigzags across the hill through the filter strips that are heavily vegetated with grass and trees. This slows the velocity of the water down and traps sediment.

QLD DEPARTMENT NATURAL RESOURCES & MINES

The McGinnis farm makes use of vegetation buffer strips and settling ponds which help protect Petrie creek

The remaining water then flows into a series of settling dams where water plants suck up the nutrients. These dams are also connected to my irrigation system, so I can reuse this water.

The last stop before the creek is an artificial wetland area, which is yet another impediment to slow down water flow and remove sediment and nutrients. This area also doubles as wildlife habitat.

Our system was put to the test during the really high intensity storm in April 2001, when 195 mm of rain fell in just two hours. Although many of our neighbours suffered extensive erosion damage, our orchard was intact, thanks to our run-off control system.

All my life, I have been aware of the cost of farming to the Australian environment. Many of our production methods are simply not environmentally sustainable, but it will be difficult for farmers to change unless the rest of the community are prepared to pay the price of sustainably produced food."

*– **Mick McGinnis***

Taking action in community networking and local initiatives

Since it began in the late 1980s, Maroochy River Catchment Area Network Waterwatch Inc. (MRCAN) has evolved into a strong community-based network combining science and the arts in the exploration and celebration of the local waterways. Susie Chapman is the Waterwatch Coordinator and a member of the Maroochy-Mooloolah Catchment Management Group on the Sunshine Coast (see Chapter 7).

"In a densely populated catchment our community network brings together people from all walks of life.

We work on the basis that everyone has a valid story and an important place in the catchment. This way we are able to take the adversarial element out of catchment activities and allow people with different views and experiences to work side by side.

The water testing program plays an important role in this. We have a comprehensive Waterwatch monitoring program in Maroochy, with 60 families testing water quality at 140 sites every month.

HEALTHY WATERWAYS LIBRARY

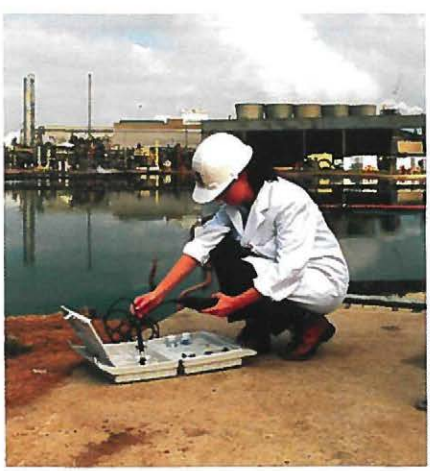
Laidley Creek in the Lockyer catchment is a thin green line of trees in the middle ground with fields of crops right up to the creek banks. This catchment is South-east Queensland's vegetable patch and losing soil to the sea (see Chapter 9). Many actions by all stakeholders are needed to help fix and find solutions.

We have been careful to maintain the objectivity and scientific nature of the monitoring program, so we can sit down at the table with the decision-makers and government agencies and all the different interest groups within the community to solve problems together. Canegrowers can sit down and talk with greenies, and community volunteers with government employees; and local people have an avenue and a forum to act and follow through with any problems and concerns. People respond emotionally to environmental issues and they need to know that they can make a difference.

Having a shopfront is very important. The catchment office is our meeting place and focus. People can come here to look for information or to meet and talk. We have just produced a music CD with a booklet of stories and photos and we hold a catchment festival each year.

I think it is the story of river systems everywhere, that the solutions are seldom easy and are always long-term. The strong ownership and involvement of the local community and the many active groups here means we are in for the long haul. While governments come and go, the community retains the issues and can build on our network from year to year."

– Susie Chapman
Coordinator, Maroochy River Waterwatch



HEALTHY WATERWAYS LIBRARY

Monitoring state-of-the-art technology at the Incitec fertiliser plant

Taking action in commercial industry fertiliser manufacturing

Incitec is a fertiliser manufacturing plant on Gibson Island (see Chapter 9), at the mouth of Bulimba Creek – Brisbane River.

"Although we are well within all environmental management licence and legal limits, we are applying state of the art technology and world's best practice to drastically reduce emissions and wastewater discharge.

Our newly commissioned granulated urea facility has reduced emissions of ammonia into air by more than 90 per cent, as well as reducing urea dust emissions into the air by more than 95 per cent. Because a lot of these air emission could potentially settle in the river and creeks, this is also reducing indirect release of nutrients into the river. Direct releases of nitrogen into the Brisbane River via wastewater discharge have been reduced by more than 90 per cent from 1997 levels. Not only is this an environmental win, it also makes sense for our business. Nitrogen is our product and the less of it we release as waste, the more product we have to sell.

Our aim is to reduce our wastewater releases into the Brisbane River to nil within the next three to five years. We are in the process of diverting effluent from our wastewater stream to our ammonium sulfate plant, which will reduce outflow of wastewater from 1 kilolitre to about 400 m^3 per day, as well as recycling nitrogen. We are also investigating using secondary treated sewage effluent, and treating it via a proposed wetland to be built adjacent to the plant. Constructed wetlands also provide important habitats for local fauna.

We have a community obligation to perform to the best of our ability if we are to maintain our presence within the Brisbane community, particularly as we are located in an environmentally sensitive area. We need to stay ahead of the game, and keep on making improvements."

– Keith Halford,
Group Environment Manager, Incitec

Taking action in community based landcare and catchment management groups

The Lockyer Catchment Centre is a community resource centre involved in land, air, water, wildlife and vegetation management in the Lockyer Catchment (see Chapter 9). It is managed by the Lockyer Catchment Coordinating Committee whose members are the many Landcare and catchment groups in the valley.

"Our Catchment Management Centre provides a focus to bring the local community together to discuss issues, as well as providing information and support to groups and individuals.

The centre has a very extensive library as well as a wide range of information materials on everything to do with environmental management and sustainable production. A number of full time staff are working on projects such as roadside vegetation management, wetlands mapping, education and revegetating creek banks. We are engaged in tree planting projects along the creek banks, which is helping to prevent erosion and trap sediment that would otherwise flow into the creeks.

Our greatest problem is a lack of resources and this is why it is so important to have a unified effort and a focus throughout the catchment centre.

We have recently released our water management strategy which has taken six years to develop. In this document we have outlined key areas we need to address to improve waterways health."

– Linton Brimblecombe, President, Lockyer Catchment Coordinating Committee

HEALTHY WATERWAYS LIBRARY

Members of the Indigenous Reference Group at a meeting

ENVIRONMENTAL PROTECTION AGENCY

For us, [looking after our waterways] is just like cleaning our shop – the place we went for food – and our church. Asking me to be involved in the Waterways Partnership is simply asking me to do what I have always done and always will do – to look after my country.

This is why I ask for effective involvement of our young people in the Waterways Partnership. How many Indigenous positions are there in the catchment groups, Waterwatch, Landcare and so on? Are there resources for me to go around my people and perform my duties to ensure they are active in the joint effort we must make to clean the water?

It has long been recognised that the health of our living culture and each of us as Aboriginal people, depends on our ability to look after our country – especially our water country. As Uncle Bob Anderson said ... – 'Healthy water means healthy people'.

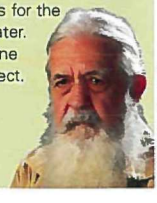
Aboriginal Traditional Owner involvement in waterways means the continuance of our living culture and all it has to offer and teach. Processes that exclude us from our country kill us. I am pleased to support the program to keep our water living – our water is me.

We have survived – perhaps a little in need of reclamation like the river – but we are still here. Recognising our rivers and making sure we have an active role in ensuring its continual health is, as it always has been since the beginning of time – the continuance of our living culture.

– Auntie Mulanjarlie,
Traditional Owner and elder of Mununjarlie

Our status as traditional owners is finally being recognised. We are finally able to fulfill at least some of our custodial responsibilities. We are now being asked to join in agreements for the joint management of land and water. We are at the beginning of genuine reconciliation and reciprocal respect.

– Uncle Bob Anderson,
Traditional Owner and
elder of Ngugi



QUEENSLAND MUSEUM

The future for South-east Queensland's waterways

The Vision for the future of South-east Queensland's waterways is Healthy Waterways.

> *Our waterways and catchments will, by 2020, be healthy ecosystems supporting the livelihoods and lifestyles of people in South-east Queensland, and will be managed through collaboration between community, government and industry.*

The Healthy Waterways Campaign represents a united effort to improve and preserve the health and beauty of our waterways.

The campaign catch-phrase – *Because we are all in the same boat* – is a reminder that we can only keep our waterways healthy by looking after all its interconnected parts, from the mountain streams all the way to the sea. The campaign invites people to "sign-up" and become "crew members", helping to steer the boat in the right direction towards the Vision. We are not only dependent on the health of the whole system, but we are also dependent on each other. By taking action now, future generations will be able to enjoy the natural beauty of South-east Queensland and its waterways.

Hugo the Healthy Waterways Turtle, the Healthy Waterways Campaign mascot with school children

What can you do?

Here are a few simple and effective things you can do as a Healthy Waterways crew member, to help keep our waterways clean.

1. Learn about your local environment

Where are the creeks and rivers in your area? How healthy are they? What are the problems?

2. Do not litter

Put paper, bottles, cigarette butts, plastic bags in the bins because, if they are dropped on the ground, they are washed into the storm-water drain, then into the creek, river and Moreton Bay and finally the sea.

3. Keep excess nutrients out of our waterways

- Wash the car on the lawn rather than the street so the soapy, nutrient-rich water soaks into the grass instead of running into a stormwater drain and into a creek.
- Put the garden clippings and kitchen scraps into a covered compost bin. Never hose them down the drain.
- Wrap the dog's droppings and put them in the bin. You use a toilet, so why should you leave your pet's droppings on the street.

4. Keep sediment out of our waterways

- Protect and rehabilitate riparian areas
- Keep exposed dirt to a minimum
- Adopt best land management practice e.g. agricultural code of practice and erosion sediment control measures in urban areas

5. Minimise the material going into the sewerage system

- Do not use an insinkerator, compost vegetable scraps instead.
- Do not put milk or other foodstuffs down the sink.

6. Conserve water

- Water the lawn at night or in the early morning
- Grow a waterwise garden – plant species that need less water.
- Do not leave the tap running when cleaning your teeth or peeling vegetables.
- Do not hose the driveway, sweep it instead and compost the grass and leaves.

7. Treat our waterways with respect

- Take rubbish away with you, do not drop it in the river.
- Do not release sewage from your boat, install a containment device.
- Reduce boat wave wash, observe speed limits

8. Buy produce from sustainable producers

- Look for products that come from sustainable growers.
- Ask for better labelling of food stuffs so that you can make choices.

Assessing the health of our waterways

Scientists have developed sophisticated monitoring systems to measure the health of waterways and assess physical impacts and indicators, such as degree of turbidity, dissolved nutrient concentrations and dissolved oxygen in the water. In South-east Queensland, this is being carried out through the Ecosystem Health Monitoring Program (EHMP), which uses the data to calculate 'report card ratings' for each waterway systems. These report cards are listed on the Healthy Waterways website at www.healthywaterways.env.qld.gov.au under the heading 'Report Card' and are updated annually.

GRIFFITH UNIVERSITY

Scientists gathering data for assessing the health of our waterways

Quick guide to waterways health assessment

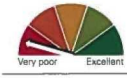
A Quick Guide can be used by everyone to better understand and assess the health of our waterways. Using this Quick Guide, we can develop a rating system which can be illustrated by a waterways health assessment gauge as follows.

- **Excellent health:** the catchment is in near pristine state, with healthy waterways with a healthy balance of life.

- **Good health:** the catchment is basically healthy, but there are some causes for concern.

- **Moderate health:** there are problems that require action, but things are not too bad yet.

- **Poor health:** there are serious problems in this catchment, for example, chronic algal blooms.



- **Very poor health:** the catchment is in serious trouble and urgent action is needed.

In Part B, the health of each major catchment in South-east Queensland is presented based on this rating system.

Visit some of South-east Queensland's waterways for yourself. Use the Quick Guide to check on their health. Check the Healthy Waterways website and see what the scientists think. By taking time to look and learn more about the local environment, you are contributing to the protection of our precious waterways.

Quick assessment guide

1. Colour

Water colour is a good indicator of what is going on in a river, creek or bay. It is a measure of what else is in the water (apart from the water molecules themselves).

Water Colour	What's happening
Blue or clear	A good sign that means clean water.
Brown/muddy	Usually indicates suspended sediments in the water (see 2.)
Green	Excessive algae in the water usually due to nutrient overload and inadequate shading.
Black	Indicator of soil disturbance.
Orange	Waterways are stained with acid run-off. When acid-sulfate soils are uncovered, they oxidise to sulfuric acid and the acid leaches minerals out of the surrounding rocks and soil into the waterways.
Tan/tea colour	Stained with tannins from *melaleuca* or mangrove run-off. This staining is part of the natural system.

ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL PROTECTION AGENCY

2. Clarity

The clearer the water, the less suspended sediment in it. Can you see the bottom of the waterway? The easiest test is to place something like a stick into the water and see how deep you can go and still see it. Walk into the water or put your arm in, if it's safe. Can you still see your feet? How much of your arm is clearly visible?

ENVIRONMENTAL PROTECTION AGENCY

3. Appearance

The appearance of the river (stream or creek) will tell you a great deal about what is in the water. How does the water look? Is there a surface scum? The following table lists some of the possibilities.

Appearance	What has happened
Froth on water surface	Detergents or other chemicals have been released into the waterway. However, froth at the beach is the result of phytoplankton mixing with the ocean waves and is a natural feature.
Oily film on the surface	Petrochemical product in waterway – this may be from a spill, or leakage from boats. Bacteria also leave an oily film on the surface.
Floating sawdust-dust like particles	This is likely to be a cyanobacteria (*Trichodesmium*) and is a healthy sign that can be seen in estuaries and the bays.
Rubbish – cans, paper, plastic	Litter in waterways can come from a long way upstream and is a serious threat to wildlife. Litter from a city street can end up in the Bay.

ENVIRONMENTAL PROTECTION AGENCY

4. Smell

Our sense of smell is an excellent early warning system in many situations. In a waterway, it may help you to pick up clues that are not visible. Rotten egg gas is *often a sign that water is anaerobic (does not contain* oxygen). Water released through the spillway from the lower layers of a dam may smell like this.

5. Sounds

When you stand on the bank/beach what can you hear? Industrial noise, birds, other animals, people, boats? What do these sounds tell you about the pressures there are likely to be on the waterway?

6. Land use

Look at land use around the waterway:

- Is the area extensively cleared?
- Is there significant urban development?
- Are there a lot of hardened surfaces, such as bitumen or concrete?
- Is there any farming or industry taking place around?
- Are there signs of erosion?

Again, what does this information tell you about the pressures there are likely to be on the waterway?

7. The edge of the waterway

The state of the riparian areas (or waterway edges) will tell you a great deal about the health of the waterway as they play a vital role in protecting waterways. Are the riparian areas (riverbank, beach, dunes, etc.) degraded or in an undisturbed state?

ENVIRONMENTAL PROTECTION AGENCY

Look out for the following:

- Structure such as walls, dams, weirs, marinas, groynes;
- Stormwater outlets or other pipes;
- Presence of intact fringing (i.e. riparian) *vegetation;*
- Presence of invasive weed species;
- Piles of rotting algae;
- Undercutting or erosion of the banks or foreshore.

8. Type of sediment on the edge of the waterway

What type of sediment can you see on the edge of lthe waterway? Sand and/or pebbles generally means *very little sediment being transported by the waterway.* Silty mud generally means that fine sediment has been carried down the river from upstream and deposited on the banks.

9. Invertebrate animal life

- Can you see insects and other invertebrates above the water surface and in the water? In a healthy freshwater system there is usually an abundance and great variety of dragonflies, mayflies and other bugs.
- Are there any yabbies, etc.? A piece of meat attached to string and lowered into the water will often tell you if these small crustaceans are present.
- In a bay, estuary or the sea, can you see lots of shellfish encrusting the piers of a jetty or rocks? Is there any life in the tidal rock pools?

10. Vertebrate animal life

Throw a small piece of bread in the water and see what comes up to eat it. This will give you some indication of how much life there is below the surface of the water.

Can you see fish, frogs, birds or turtles? Remember that these animals can be shy, so you may need to be quiet.

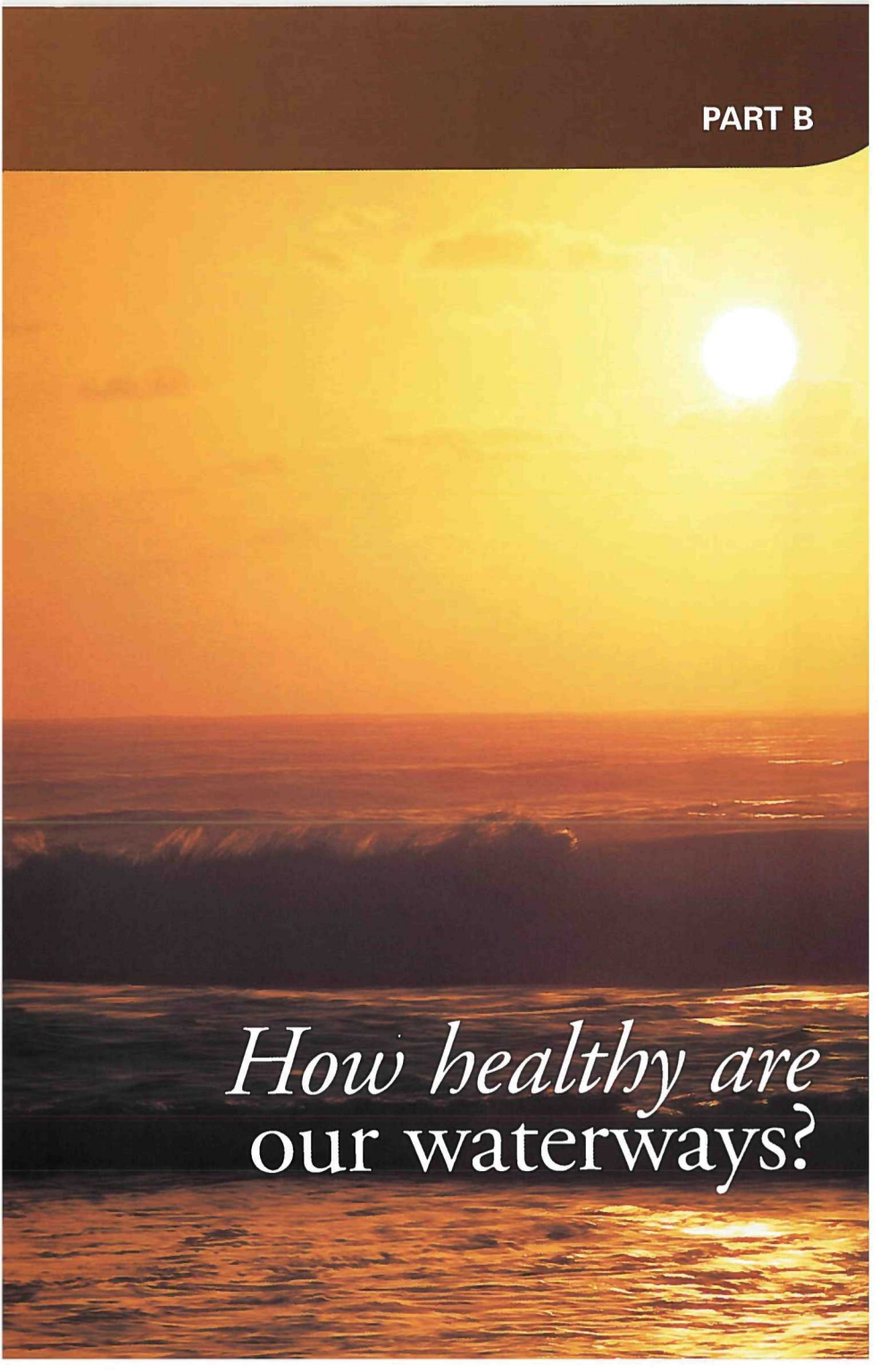
Count how many species of birds, reptiles, amphibians and mammals you can see.

- What other wildlife can you see along the banks? Water dragons are not necessarily a sign of a healthy waterway, as they will flourish in most environments, including drains around shopping centres.
- At the beach or bay, are there gulls and terns fishing in the water?

11. Presence of aquatic plants

Seagrass leaves washed up on a beach will often mean that there is some seagrass growing nearby. Can you see any mangroves or salt marsh?

PART B



How healthy are our waterways?

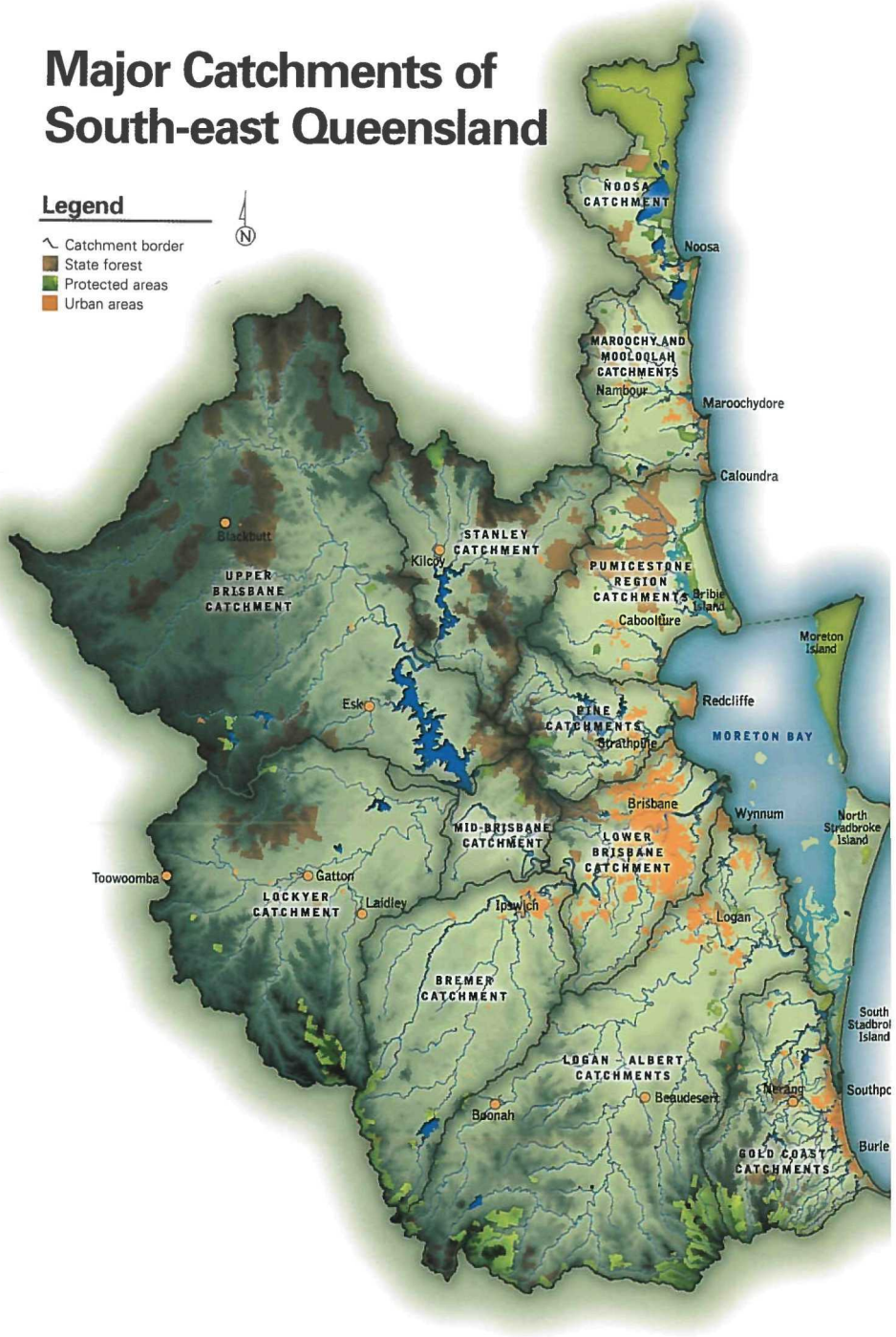
Introduction

The following chapters provide more detailed information on the health of the waterways within each of the major catchments in South-east Queensland (see map p.42). Waterway health issues are illustrated from a series of **'Where to Look'** locations within each of the catchments. Each location chosen presents an opportunity for everyone to see, for themselves, the important processes and challenges facing our waterways. As indicated in Chapter 5, up-to-date 'report card ratings' for each waterway system can be found on the Healthy Waterways website at www.healthywaterways.env.qld.gov.au.

QUEENSLAND MUSEUM

Melaleuca trees and wetland on Bribie Island

Major Catchments of South-east Queensland



Noosa Catchment

A green and pleasant place

The Noosa River catchment is the benchmark for healthy waterways in South-east Queensland. This small, pristine catchment, bordered by the Great Sandy National Park (Cooloola) on its northern edge and Noosa National Park in the south, is a beautiful place to live and world-famous as a holiday destination.

The catchment encompasses eucalypt forest, *melaleuca* wetlands and coastal banksia heath, nourished by a high rainfall. The Noosa River begins in the Great Sandy National Park, west of the Cooloola Sands, then snakes southward for 60 km, reaching the sea at Laguna Bay, just north of the Noosa Headland.

Fact File: Noosa Catchment

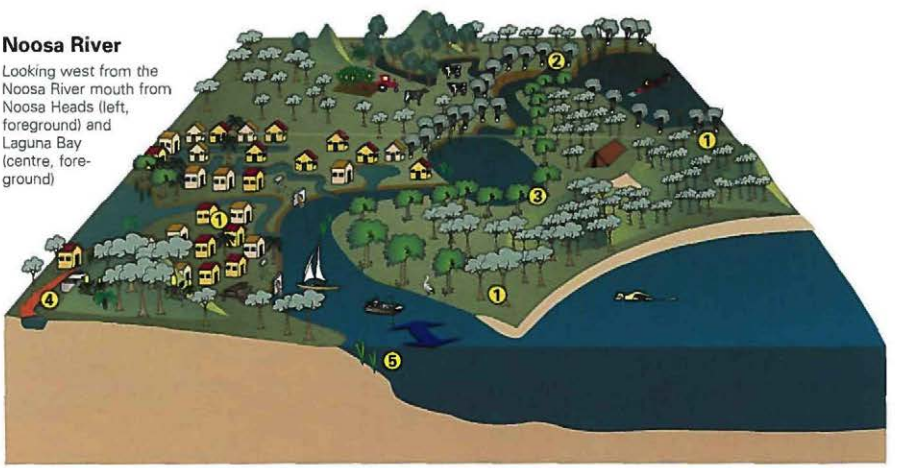
Catchment Area:	831 km^2
Catchment Population:	36,390*
Total length of streams:	600 km
Major land uses:	Natural forest, grazing, plantations, urban / tourism

* SOURCE: QLD DEP. LOCAL GOV. & PLANNING

Travelling down the river through the Great Sandy National Park, there are many beautiful natural areas to visit. Harry's Hut and The Everglades, an interlinking system of waterways and wetlands, are surrounded by eucalypt and melaleuca forests. Large trees overhang the river, sedges grow in the shallows and bird calls fill the air.

Noosa River

Looking west from the Noosa River mouth from Noosa Heads (left, foreground) and Laguna Bay (centre, foreground)



1. Catchment land-use is dominated by natural forest, with some grazing, agriculture and forestry (mid section) and urban (lower section)
2. Tea coloured run-off from creeks are high in organic substances
3. Riparian condition generally good
4. Sewage discharged to Burgess Creek, not Noosa River
5. Healthy seagrass beds and a unique faunal assemblage throughout the river

How healthy is the Noosa catchment?

Signs that the Noosa catchment waterways are in excellent health:

- The water is clean and clear, with very little sediment, though it is sometimes stained a rich, deep brown from tannins (see Chapter 5).
- Aquatic life in the waterways is plentiful and diverse.
- Creek and riverbanks and their riparian vegetation are mostly intact with only a small amount of stream bank erosion, mainly on the north bank of the river.

As the river flows south, it is punctuated by four shallow, natural lakes. At the southern end of the national park the river opens into Lake Cootharaba, the meeting place for the waters of Kin Kin and Cooloothin Creeks. Further south are Lake Cooroibah, Lake Doonella, and Lake Weyba. Their shallow beds support a mosaic of seagrass pastures, nurseries for juvenile fish and other marine life.

The waters throughout the Noosa River waterway system are clean and carry little sediment. In places, the water is stained a rich, deep brown from the tannins – organic nutrients that leach out of the melaleuca wetlands.

ENVIRONMENTAL PROTECTION AGENCY

Beaches, boating, swimming and fishing are popular activities associated with Noosa's waterways

Beautiful holidays

The Noosa catchment supports a lucrative tourist industry. During the tourist season (school holidays), holidaymakers flood in, often more than doubling the resident population.

Houseboats, canoes and other shallow-bottomed craft ply the waters of the river and the lakes. People fish and swim in the river, camp along its banks, and swim in the warm, clean waters of Teewah, Laguna Bay, Sunshine, Marcus, Sunrise and Peregian beaches. The world-famous Noosa triathlon is held here every September.

The tourist resorts, hotels and apartments are mostly clustered in a series of small villages grouped around the river estuary and along the beaches, where most of the catchment's 36,390 permanent residents also live. In the estuary, sections of the riverbanks have been hardened with concrete walls, jetties constructed in the township areas and there is a small amount of canal development.

Wastewater from households and businesses is treated and sprayed into ponds. It then filters through the sand until it seeps into Burgess Creek, which flows directly into the sea at Sunshine Beach, and into Six Mile Creek, which flows into the Mary River catchment.

The water supply for the townships comes from Lake Macdonald, part of the adjacent Mary River catchment. Almost all food production takes place in adjacent catchments.

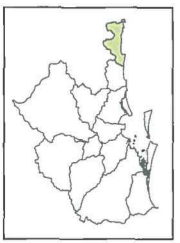
Much of the Noosa catchment is still in its natural state. Very little of the native vegetation has been cleared, apart from the small area cleared for agriculture, forestry and urban development.

The northern side of the river, in particular, is accessible only by ferry, and has few roads. The local council is working with the community to maintain the natural character of Noosa, however, managing and controlling future development is still an issue.

Noosa Catchment

Legend

- Catchment border
- Sub-catchment border
- State forest
- Protected areas
- Urban areas
- Where to look site



Where to look

■ Mt Tinbeerwah

From Mt Tinbeerwah, you have a birds-eye view of the catchment, from Great Sandy National Park down to the Noosa Headland and south beyond the Noosa National Park. You can see the lakes, and occasional glimpses of the Noosa River as it winds its way south. To reach the Mt Tinbeerwah lookout, turn left 16 km along the road from Tewantin to Cooroy. The lookout is a short (15 minute) walk from the carpark.

■ Lake Cootharaba

Take a look at Lake Cootharaba, its clean, shallow waters and the surrounding vegetation. This beautiful lake is accessible at Elanda Point and Boreen Point.

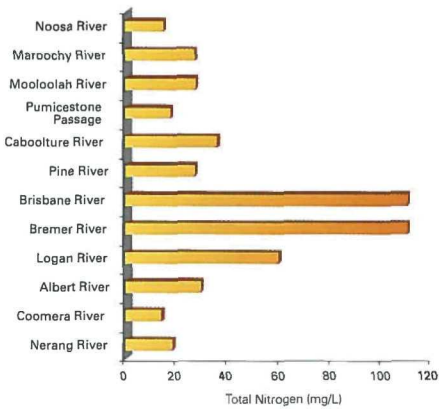
■ The Noosa River

You can access the Noosa River at a number of places along its length, from Great Sandy National Park, all the way down to the mouth. Check out the water, and the surrounding vegetation.

Will we love it to death?

The potential impacts of human activities need to be monitored and managed to ensure a healthy future for Noosa's waterways.

Noosa's waterways are clean and clear because little sediment, nutrients or other pollutants flow into the river. Because the water is clear, light can penetrate the water to provide energy for seagrasses and the tiny phytoplankton to photosynthesise. A diverse range of phytoplankton live in this river and provide a healthy balanced 'menu' for the microscopic zooplankton that are the next link in the food chain.



Total nitrogen concentration in South-east Queensland river estuaries shows low levels in Noosa River relative to other rivers

SOURCE: EHMP 2001 REPORT CARD

Soil erosion is minimal in this catchment because it is well-vegetated, clearing has been restricted and there is very little agriculture. The landscape is undulating with few steep slopes and the soils are sandy.

The abundant riparian vegetation lining the waterways throughout most of the catchment prevents streambank erosion, filters rainfall run-off and traps any sediment before it reaches the river. Streambank erosion is occurring in some sections of the Noosa River, however, and the reasons for this are being investigated. It is possible that the wash from the many boats using the river is a contributing factor.

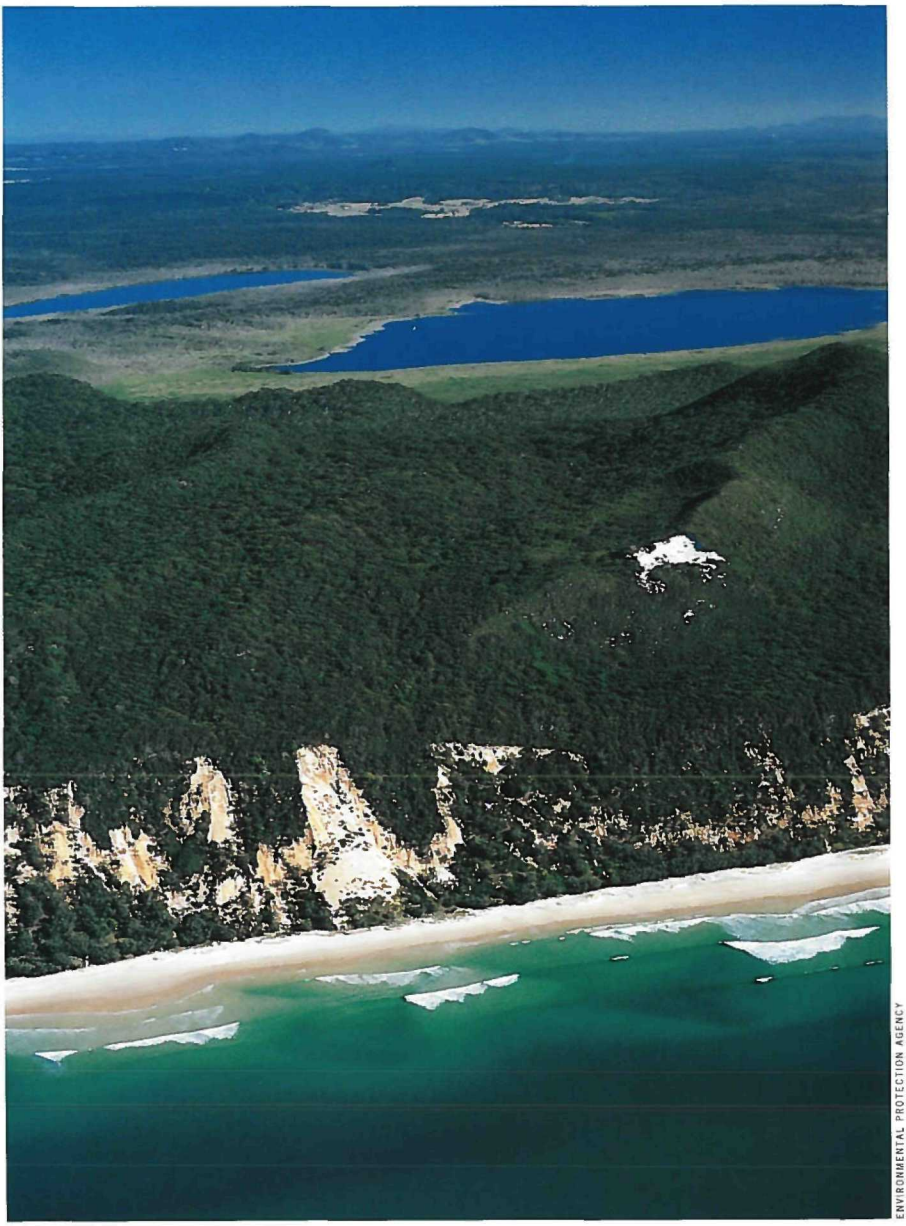
Streambank erosion can be a natural process in rivers as the force of the water current causes the locations of channels to shift over time. This is occurring in some places in the Noosa River where the northern bank is eroding and sediment is being added to the southern bank.

A potential source of pollutants is the stormwater from the Noosa townships that is washed into the river estuary. Here, tidal currents and the downstream flow from rainfall run-off flush contaminants out of the river to disperse in the ocean currents fairly quickly. Some coves, canals, inlets and streams close to the mouth of the river are less effectively flushed out by the tide and this can lead to potential problems.

Finally, the river flows out into Laguna Bay and the currents of the Pacific Ocean disperse sediments and contaminants.

The Noosa catchment is in excellent condition due to a combination of effective management by the local community and the assistance of natural processes. Human impacts on the catchment are decreased by a little bit of 'cheating'. Noosa residents source their food and water from other catchments (including that of the adjoining Mary River). As well, the Noosa River is not regulated by dams and weirs, so the natural, seasonal flows of the river has not been disrupted.

Development impacts on the landscape have been minimised. This has included keeping beaches, the Noosa River, dunes and waterways intact, as well as leaving a large proportion of the native vegetation in place. Most of population is situated near the river mouth to allow maximum tidal flushing of stormwater carrying the by-products of urban living. The local community is actively involved in Landcare and groups focussed on the health of the catchment and waterways.



ENVIRONMENTAL PROTECTION AGENCY

Great Sandy National Park with Lake Cootharaba in the background

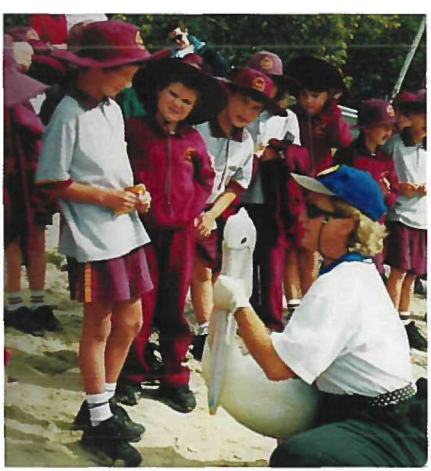
Safeguards for a healthy future

There is still much to do to maintain the excellent health of the Noosa River system.

Noosa residents place a high value on swimming in their waterways. Many participate in activities such as the monthly Australian Seabird Rescue demonstrations at Noosaville to show how litter and other foreign substances in the water harm birds and other aquatic wildlife.

The Noosa Integrated Catchment Association (NICA) encourages residents and visitors to get involved with waterways health. Its office is open to the public and is a major source of information. The NICA River Ranger can be found out on the Riverwatch boat, monitoring the area, talking to people and providing information about the waterways. As part of the regional commitment to the environment, NICA works closely with other environmental groups, such as Noosa Landcare, and also with the Noosa Council.

The Council has made a major investment in upgrading its sewage treatment plant to remove excess nutrients from effluent. The Council also provides funding and support for local environmental groups and sets stringent assessment criteria of future development proposals in the catchment.



HEALTHY WATERWAYS LIBRARY

Seabird Rescue group informing children about impacts on local bird life from litter such as plastic bags and fishing line

Local monitoring of waterways on the Riverwatch boat

The Council is also helping to protect Noosa's waterways from stormwater pollution through the Sunshine Beach Clean Ocean Project. This has involved the construction of a gross pollutant (sediment/litter) trap and education of local residents, tourists, surf lifesaving nippers and school children. Its brochures and signage carry the motto, *'we swim in what's put in'* and the project also has 'best practice' demonstration days for the building industry.

Through the Noosa and District Landcare Group, several projects are being undertaken to demonstrate the benefits of riparian vegetation, including mangrove rehabilitation at John's Landing on the Noosa River, weed (Camphor Laurel) removal on Kin Kin Creek and a large-scale riparian rehabilitation project on Sister Tree Creek.

The Noosa Parks Association is also working with Greening Noosa to revegetate the Noosa Spit, which was once a camping ground and is now becoming a showpiece of dune foreshore rehabilitation. Individual landholders are also taking direct action on their land through the Riparian Revegetation Grants Scheme, managed through Noosa and District Landcare Group.

Throughout the Noosa River catchment, the Council with NICA has installed road side signs to inform motorists they are entering the Noosa River catchment, as well as signage at boat ramps on the river to encourage boat users to reduce speed and wave wash.

Maroochy and Mooloolah Catchments

Rainforest and white beaches

The Maroochy and Mooloolah River catchments are set in the middle of the Sunshine Coast to the east of the Blackall Range. The catchments have rich, fertile soils and high rainfall. Many of the smaller creeks in the catchment begin their journey to the sea in the rolling, green foothills of the Blackall Range.

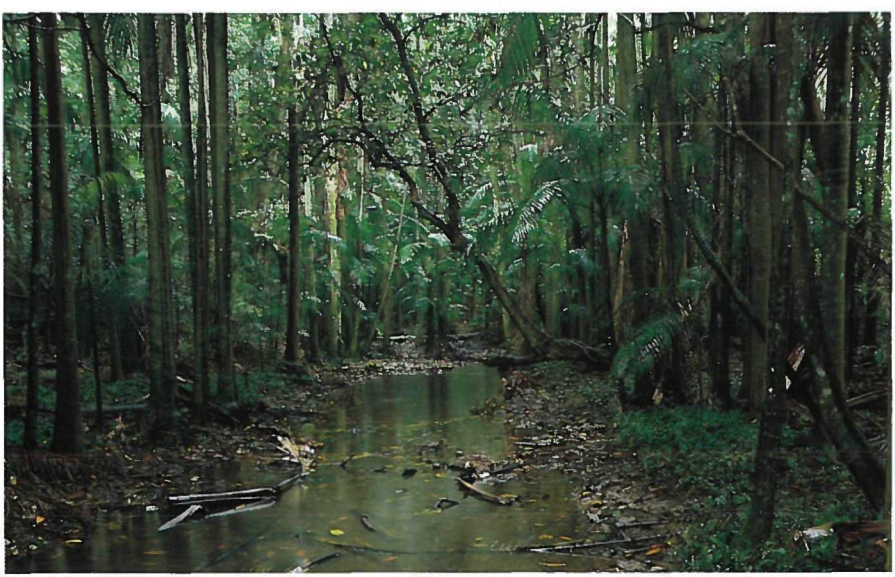
The creeks gradually join and enlarge, moving down from the hills to flow through the fertile, alluvial floodplains that were once covered in dense tropical rainforest. In many places, these floodplains are now a patchwork of sugarcane and small crops. The rivers flow on through melaleuca wetlands and mangroves, until they reach the coast at the townships of Maroochydore and Mooloolaba.

Beautiful, white sand surf beaches stretch along the coast to the east of the two catchments, from Coolum to just north of Caloundra, broken only by the rocky headlands at Point Arkwright (Coolum) and Point Cartwright (Mooloolaba).

Fact File: Maroochy and Mooloolah

Catchment Area:	848 km^2
Catchment Population:	153,437*
Total length of streams:	575 km
Major land uses:	Natural forest, grazing, agriculture, urban / tourism

* SOURCE: QLD DEP. LOCAL GOV. & PLANNING



QUEENSLAND MUSEUM

This waterway flowing through Mary Caincross National Park is well shaded with riparian vegetation

The Maroochy River, the larger of the two river systems, is named after the black swans, which were once abundant there. *Maroochy* is an Aboriginal word for 'red beak'. The black swans grazed the extensive seagrass beds that grew on the shifting sandbanks of the estuary. *Mooloolah* means 'place of the black snake', or literally translated, 'place of darkness' or 'dark thing'.

The major tributaries of the Maroochy include the North and South arms of the river, Coolum, Petrie, Paynter and Eudlo Creeks. Three tiny coastal streams – Currimundi, Stumers and Tooway Creeks – also flow directly into the sea.

Sunshine, surf and sugar

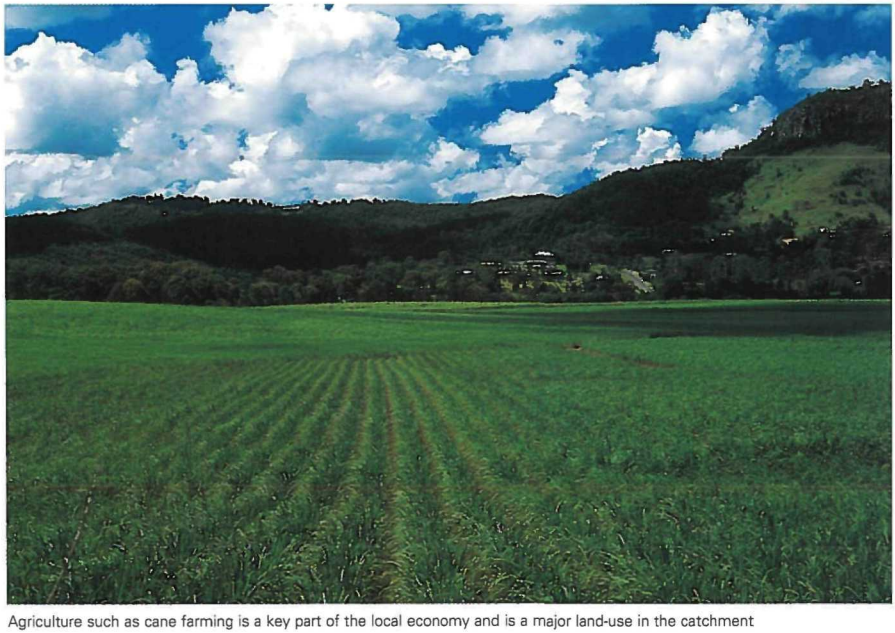
In 1842, the New South Wales Government (which then had jurisdiction over the region) proclaimed the area a reserve to protect the abundant bunya pines, which are still an important element of indigenous culture. However, in the 1860's, Europeans began to occupy the area and harvest timber from the rainforests.

Now, less than half the original vegetation cover remains, with around 40 per cent of the total land area used to grow sugarcane and other small crops, such as pineapple, bananas, nuts and ginger, which are sent to markets throughout Australia and the world.

Rapid population growth is the major impact on the catchment landscape. The surf beaches and green hills of these two catchments attract large numbers of tourists and holiday-makers each year.

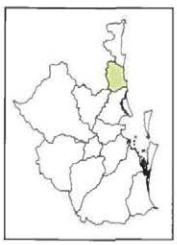
Water for local residents comes mostly from the Mary River catchment (Lake Baroon) with the rest sourced from three dams on tributaries of the Maroochy River – Cooloolabin, Wappa and Poona Dams.

Wastewater is treated and released from sewage treatment plants on the Maroochy River at Yandina, Coolum, Bli Bli and Maroochydore. Stormwater flows from the various townships into the creeks and rivers.



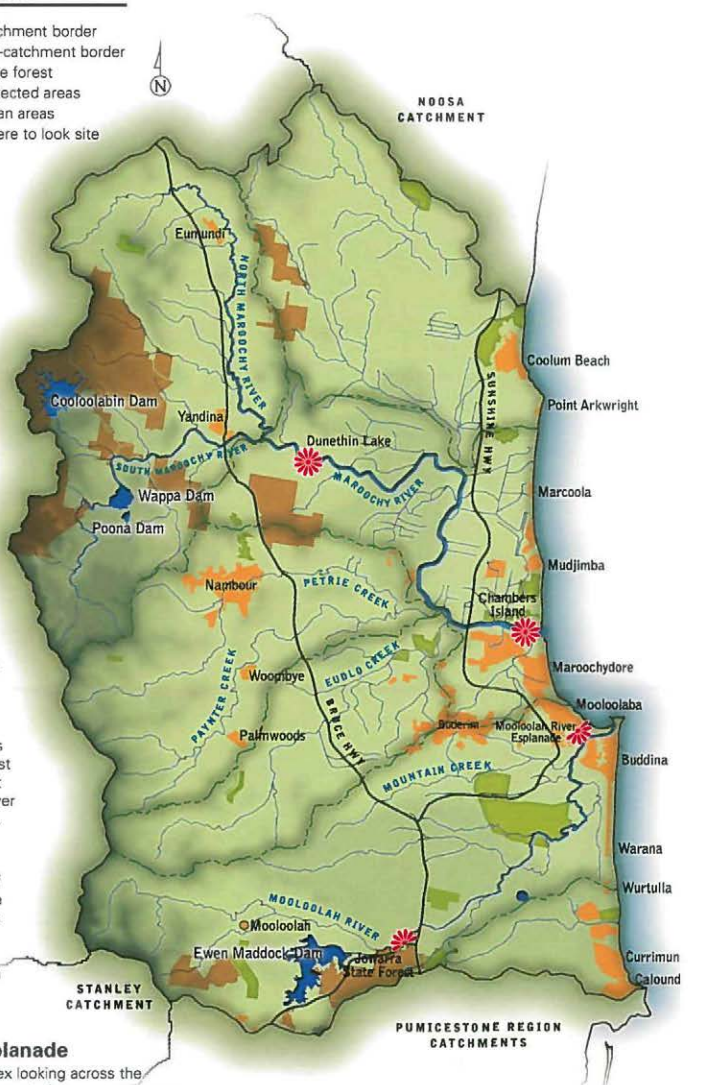
Agriculture such as cane farming is a key part of the local economy and is a major land-use in the catchment

Maroochy and Mooloolah Catchments



Legend

- Catchment border
- Sub-catchment border
- State forest
- Protected areas
- Urban areas
- Where to look site



Where to look

■ Dunethin Lake

The lake is approximately 20 km upstream of the Maroochy River mouth and is still in the tidal zone. Here you will see some riparian vegetation and some exposed banks, and across the river sugar cane fields extending almost to the water's edge.

■ Chambers Island

Access the island via the foot-bridge from Bradman Avenue in Maroochydore to see the contrasting river banks of the Maroochy River estuary. On the northern side and around the island there is a healthy vegetation cover of mangroves and saltmarsh. On the Maroochydore side all the riparian vegetation has been replaced with hardened walls and stormwater flows into the estuary from urban areas. Just upstream of Chambers Island the last remaining patch of seagrass in the river can be found (mouth of Eudlo Creek).

■ Jowarra State Forest

The Mooloolah River here consists of flowing, clean and clear water. Notice the healthy riparian vegetation on the river banks, providing shade and stabilising the banks. The fallen logs, branches and overhanging vegetation provide habitat for creatures living in the stream.

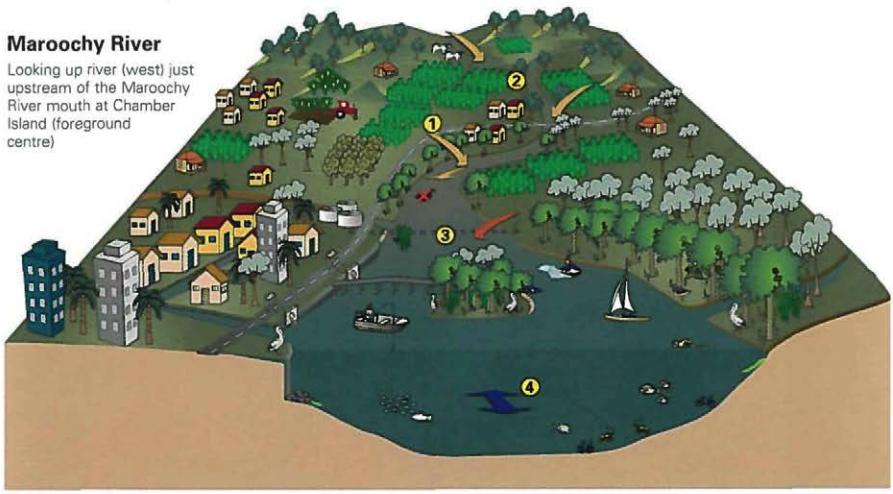
■ Mooloolabah River Esplanade

From the Mooloolabah Wharf Complex looking across the Mooloolah River you do not see any vegetation or mangroves – it has all been removed and replaced with hard walls. The marina and wharf complex hold many recreational and commercial fishing boats. The water here looks moderately clean.

Maroochy Catchment

Maroochy River

Looking up river (west) just upstream of the Maroochy River mouth at Chamber Island (foreground centre)



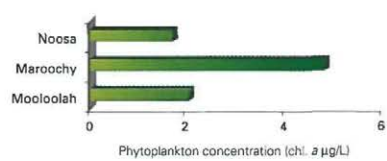
1. Catchment land-use dominated by natural forest, urban, agriculture and grazing
2. Riparian condition generally poor
3. Point source nutrients are distributed throughout the river
4. Tidal flushing in lower reaches maintains relatively good water quality

Canefields to the waters edge

Dunethin Lake on the Maroochy River (**see Where to Look, p.51**), is an excellent place to look at what is happening in the lower reaches of the Maroochy River. Little riparian vegetation remains on the banks, although there are still some mangroves, to provide a buffer and filter for run-off.

The pressures to use all available land (including riparian zones) for agricultural production are very great in this area. In many places sugarcane and other crops grow right down to the river's edge. Without protective riparian vegetation, rainfall run-off reaching the river can contain substantial loads of sediment, nutrients and other pollutants. As a result, the river is very turbid, contains significant concentrations of dissolved nutrients and experiences chronic phytoplankton or algal blooms and low aquatic species diversity.

Further down the river, in the estuary, it is a different story. From the footbridge to Chambers Island (**see Where to Look, p.51**), the sandy bottom is easy to see as are numerous fish. The bridge piles are encrusted with oysters and other creatures – a good sign. The area is popular for swimming, fishing and boating. Mangroves line the northern shore, which is relatively undeveloped compared to the southern bank.



Chlorophyll *a* concentration (a measure indicating plant response to nutrients in the water) in Sunshine Coast rivers from July 2000 to April 2001. Maroochy River experiences phytoplankton blooms.

SOURCE: EHMP 2001 REPORT CARD

Close to the mouth of the Maroochy River, the tidal currents are strong and the sediment load, which flows down from the upper reaches of the

How healthy is the Maroochy catchment?

Signs that Maroochy catchment waterways are in **moderate health**:

- The water is turbid and contains high concentrations of nutrients in the middle reaches.
- The estuary is relatively undisturbed where the sediment and nutrients from the upper reaches are flushed by the tide. However, nutrients from sewage discharges are widespread in the lower estuary.
- Little riparian vegetation remains in the upper and middle reaches of the river and, in places, the riverbanks are badly degraded.
- A fair percentage of the riparian vegetation remains in the estuarine section of the river, particularly on the northern bank.

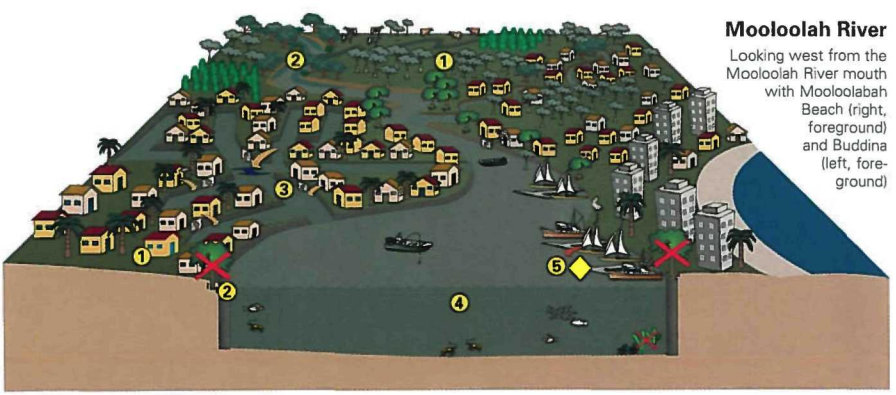
HEALTHY WATERWAYS LIBRARY

Upper Maroochy River with limited riparian vegetation and agriculture to the edges of the river

river, is flushed quickly out into the open ocean. Evidence of tidal movement can be seen in the sandbanks around the island. The locations of these sandbanks move over time, particularly at the mouth of the river, as tidal currents entrain and re-deposit sand.

Although the estuary looks healthy, the seagrass has almost disappeared (apart from a small patch near Eudlo Creek), as have the black swans. The large quantities of sediment washed down the river during floods may be responsible for the loss of seagrass.

Mooloolah Catchment



Mooloolah River

Looking west from the Mooloolah River mouth with Mooloolabah Beach (right, foreground) and Buddina (left, foreground)

1. Catchment land-use is dominated by natural forest, grazing and agriculture (upper reaches) and urban (lower reaches)
2. Riparian vegetation in upper reaches in good condition; hardened surfaces have replaced most riparian and aquatic vegetation in lower sections
3. Creation of canals has led to substantial channel modification
4. Water looks clean and clear in most sections
5. Ship pollution is a growing water quality issue

Cattle upstream; boats and houses downstream

The Jowarra State Forest **(see Where to Look, p.51)**, is a cool, shady rainforest that grows down to the banks of the upper Mooloolah River. This is how a large part of the Maroochy and Mooloolah catchments used to look.

The trees shade the river, which lowers the water temperature and increases the amount of available oxygen. This allows a greater diversity of plant and animal life to survive in the water. More shade also reduces the growth of nuisance algae and the likelihood of blooms. The rainforest trees also stabilise the banks of the river, protecting it from erosion and filtering rainfall run-off.

The Mooloolah River catchment is less developed than the Maroochy catchment, with less agriculture, housing and industry, and a higher percentage of native vegetation cover. For all these reasons, the water is clean and clear as it flows down through the catchment towards the river mouth.

The estuarine section of the Mooloolah River has been radically changed by development. The view from the Mooloolabah River Esplanade Park **(see Where to Look, p.51)** is of the Mooloolabah Wharf, Marina and the canal estates.

Mooloolabah attracts 'boaties' from all over the world and is also a popular diving location and the base for the pilot boats that guide large ships down to the Port of Brisbane. Ship pollution (such as sewage, oil, diesel and foreign organisms that live in the ballast water or on the hulls) is a growing water quality issue here.

Canal estates – all mangrove and fringing riparian vegetation has been replaced with hard walls

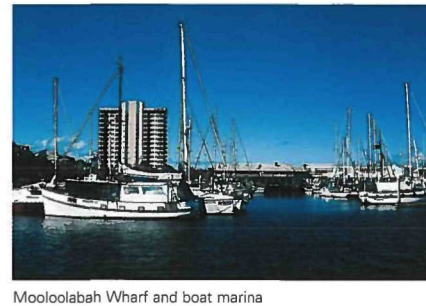
Concrete walls, jetties, abutments and piers line the lower reaches of the riverbanks meaning that the natural vegetation has been lost. Although the piers may provide some alternative habitat for fish and other life, the canal developments have created an extensive, convoluted system of channels, which prohibits effective flushing by the tide.

While the Mooloolah River does not carry the same sediment load as the Maroochy River, the flushing mechanism is less effective in the estuary, especially in canals.

How healthy is the Mooloolah catchment?

Signs that the Mooloolah catchment waterways are in good health:

- The riparian vegetation in the upper reaches of the river is largely in good condition.
- There is no impact from sewage in the lower estuary.
- The water looks clean and clear in most sections of the river.



Mooloolabah Wharf and boat marina

The black swan thrives once more

In their catchment management strategy, the Maroochy-Mooloolah Catchment Committee have painted a glowing picture for the future and what they and their local community are working to achieve.

The year is 2040-something

Sustainable agriculture, plantation forestry, fishing, nature-based tourism and low impact commercial activities support an increasingly aware community. In turn, these activities are enhanced by our enriched land and water resources.

While the population has more than doubled, it has now peaked at a stable level. Urban areas have not doubled in size because population density has increased significantly in the cities and towns. Environmentally sensitive planning and design have enabled this growth to be accommodated without impacting negatively on our waterways and other natural resources.

The relatively affluent community is happy to contribute financially so that landholders benefit as much from maintaining vegetated buffers and wildlife corridors as they would from farming sensitive riparian land.

Green belts and privately-owned conservation areas have expanded to complement and link with our National Parks. Streams are well maintained with ever increasing water quality and abundant aquatic life. Regrowth of seagrass supports abundant fish stocks in our estuaries and surrounding waters.

The black swan thrives once more on the Maroochy and Mooloolah Rivers.

– Excerpt from *Maroochy Mooloolah Catchment Management Strategy*, June 2000.

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The Black Swan has almost disappeared from the waterways

As part of bringing this vision to life, Maroochy-Mooloolah Catchment Management Group, with other community groups and the local council, has initiated a 'Riverwatch' program which, like its Noosa counterpart, employs a River Ranger. The Ranger records incidents of fish kills; supervises fish stocking, litter collections and water quality monitoring; and talks to boat owners about care of the waterways. So far, Riverwatch has been responsible for cleaning three tonnes of litter out of the river system.

The catchment also has an extremely active Waterwatch network, with 60 families testing more than 140 sites once a month (see Chapter 4).

Like Noosa, Maroochy and Mooloolah catchments are a popular tourist destination and the community is conscious of the need to maintain attractive recreational areas.

An increasing number of farmers are planting trees along sugar cane drains and mangroves along the riverbanks. By shading the cane drains the farmers are assisting with weed and algal control and restoring the vegetation filter, which reduces the amount of pollutants in run-off reaching the waterways.

A range of other groups, including Landcare and Catchment Care, environmental and community associations, indigenous groups and schools are actively involved in helping protect and restore the health of the region's waterways.

The rehabilitation of riparian vegetation is an important part of this work. A number of initiatives are underway, including creek and river bank vegetation projects and stream rehabilitation to protect and restore fish habitat and 'Land for Wildlife' Programs.

The Queensland Farmers Federation has adopted a voluntary Agricultural Code of Practice for activities such as fruit, vegetable and sugar cane growing and dairy farming. These codes contain water quality management measures, such as erosion minimisation, efficient irrigation, correct chemical storage and good fertiliser and pesticide application practices.

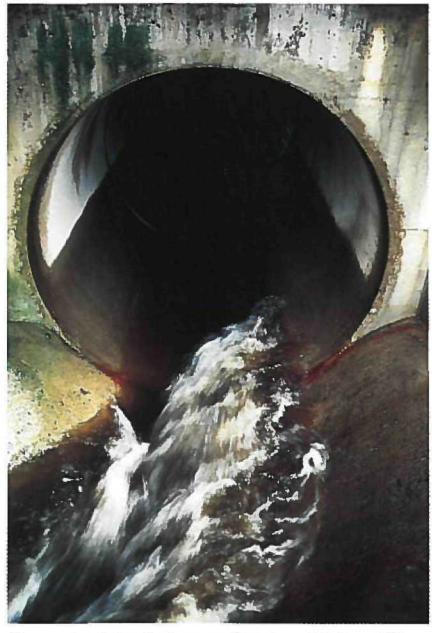
Caloundra and Maroochy Councils are implementing management plans to improve urban stormwater quality, including stricter enforcement and monitoring of stormwater run-off from a range of existing activities and new developments.

Maroochy Council's Bushland Management Program, Vegetation Protection Local Law and Conservation Assessment and Management Plans for Remnant Vegetation are also important initiatives for the protection of waterway health.

Maroochy Council has invested considerable funds in the removal of problem nutrients from sewage and the relocation of sewage outfalls away from small creeks to better locations.

Caloundra Council currently discharges treated sewage effluent from the Kawana Ocean outfall. Monitoring of this discharge is underway to assess future requirements.

Both Councils are actively investigating wastewater reuse. Treated sewage effluent is currently reused on golf courses and other areas. Councils are also investigating the many thousands of on-site sewage systems (e.g. septic tanks) that serve large areas of the catchment and are not currently connected to regional sewerage systems. The local impacts of these systems are not well understood, however, council investigations have indicated that a substantial number of systems do not work effectively, with resultant risks of partially or poorly treated wastes entering creeks and rivers via stormwater run-off and groundwater seepage.



Stormwater drains discharge sediments, nutrients and litter from urban areas

Waterways of the Maroochy and Mooloolah catchments end their journey in the sea

Pumicestone Region Catchments

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Bribie Island sands meet Pumicestone Passage

Fact File: Pumicestone Region

Catchment Area:	1070 km^2
Catchment Population:	120,116*
Total length of streams:	745 km
Major land uses:	Natural forest, plantations, agriculture, *grazing, urban*

* SOURCE: QLD DEP. LOCAL GOV. & PLANNING

A network of streams and channels

At the northern end of Moreton Bay lies Pumicestone Passage – a meandering system of channels, sandbanks and islands between Bribie Island and the mainland. The Passage is fed by a network of creeks, which form a series of parallel mini-catchments in a flat, low-lying landscape.

This magnificent waterway environment is in a remarkably good state. If you travel along the length of the Passage you have an uninterrupted view of sandbanks, saltmarshes, mangroves and tea trees, and the many animals that live in this rich landscape.

In summer, migratory shorebirds, from as far away as the Arctic, feed on the tiny organisms that live in the extensive intertidal flats. While here, the birds rest and build their body reserves before undertaking the long flight back to the Northern Hemisphere where they breed.

Seabirds and other water birds – herons, cormorants, sea eagles, pelicans, terns – are also abundant and the waters are rich with fish, prawns and other life. Hectares of seagrass beds provide food for dugongs, turtles and fish. You can see evidence of the seagrass growing in the Passage from the broken strands washed up on Golden Beach at Caloundra **(see Where to Look, p.59)**.

Pumicestone Song

Seagrass meadows green and wide
Creeks and swamps sing Nature's song
Land and water linked so strong
Land and water linked so strong

Let the Pumicestone creeks flow to the sea
Let the dugong and dolphin feed and swim free
Let the fruit of the land grow sweet and clean
Let the timbers grow strong
Let this land be a home to you and me
Let this land be a home to you and me

Whimbrels and curlews feed here today
With godwits soon they'll be far away
Let them come back to mudflats and
to mangrove green
Wallum creeks flowing black and clean
Wallum creeks flowing black and clean

Pumicestone – special food and shelter place
Mimburi shows us another face
As our footprints wash away with time and tide
Let these waters be clean and wide
Keep these waters clean and wide.

– Peter Oliver, *Dugong Rock CD,*
© Sundown Music

Golden Beach in the foreground and northern Pumicestone Passage and Bribie Island

According to the traditional owners, Bribie Island is shaped like a dugong (**see Mt Beerburrum – Where to Look, p.59**) with the head facing south towards the seagrass beds of Deception Bay. These seagrass beds are now interspersed with dark patches of *Lyngbya* a toxic blue-green algal that causes rashes and burns to humans who come in contact with it.

Pumicestone Passage is fed by tidal waters flowing north from Deception Bay and south from Caloundra's Golden Beach, which meet and mingle at The Skids, just south of Coochin Creek.

Freshwater also flows into the Passage from the mainland and Bribie Island. On Bribie, the catchment is low-lying and swampy and the tiny creeks that flow into the Passage are fed almost entirely by subsurface water.

If you drive up the Bruce Highway, you cross a number of these waterways, including the Caboolture River and Burpengary, Elimbah, Coonowrin, Coochin, Mellum and Bells Creeks. Many of these smaller coastal tributaries and their associated swamps are the home for rare and endangered freshwater fish species.

From the highway, or from Mt Beerburrum (**see Where to Look, p.59**), it is easy to see uniform rows of introduced pine plantations interspersed with stretches of bare, sandy soil where the plantations have been harvested. Small patches of native melaleuca swamp still remain. Tannins and folic acids leach out of the needles of the huge stands of pine trees and melaleucas, staining the waters of the creeks dark brown, particularly after rain.

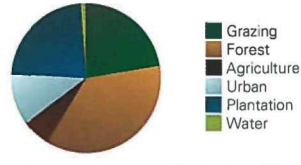
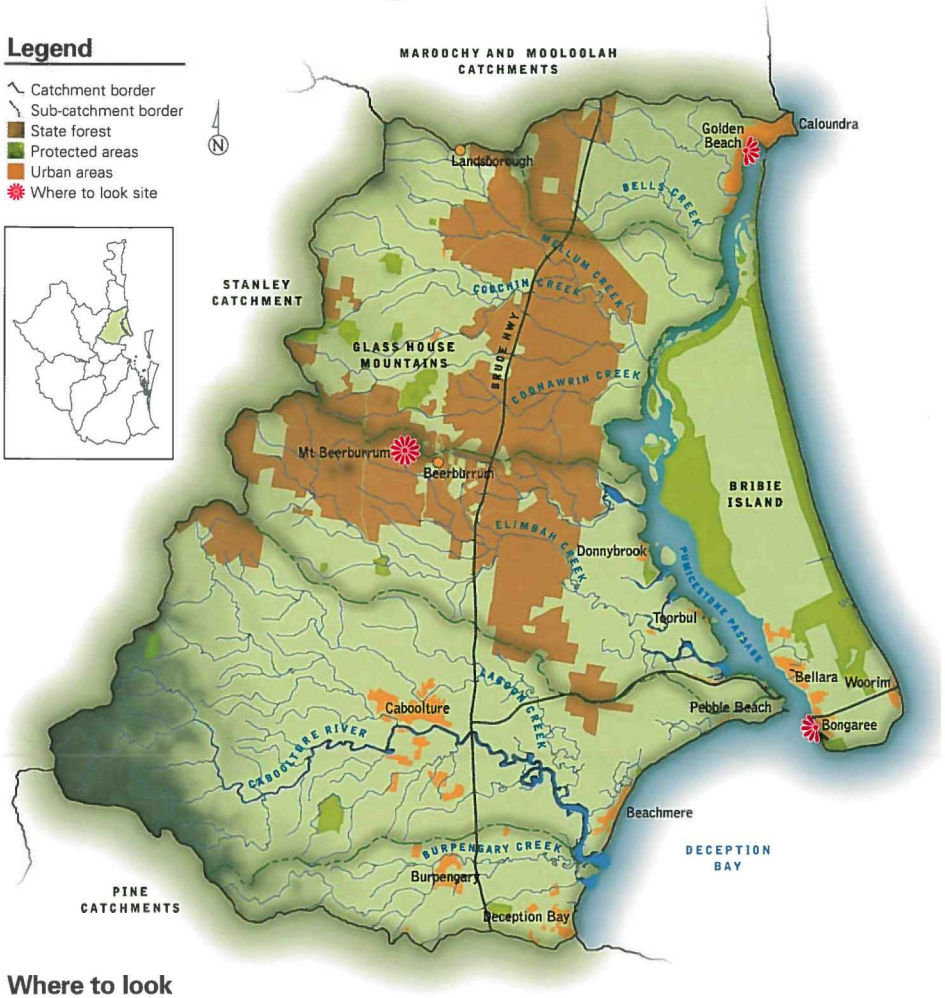


Chart showing the proportion of land under different uses in the Pumicestone Region catchments

On the western side of these catchments are the distinctive, jagged shapes of the Glasshouse Mountains (**including Mt Beerburrum – see Where to Look, p.59**). The vista from Mt Beerburrum is of orchards, farms and poultry sheds forming a patchwork around the bases of the mountains as far south as the Caboolture River.

Pumicestone Region Catchments



Where to look

■ Mt Beerburrum

From here, you have an excellent view of the whole of Pumicestone Passage and the catchment behind it, from Caloundra, right down to Deception Bay. The dugong-like shape of Bribie Island is also clearly visible to the east, with the head facing south and west towards the extensive seagrass beds of Deception Bay.

■ Bongaree, Bribie Island

From Bongaree, you can see the southern end of Pumicestone Passage, emptying into Deception Bay. At low tide, you can see seagrass beds, with mangroves behind on the other side of the passage, and the houses along Pebble Beach. Sometimes, you can also see the black patches of *Lyngbya*.

■ Golden Beach, Caloundra

As you stand on Golden Beach, you can see the northern tip of Bribie Island across the water. The waters of the Passage are generally clean and clear here, but may be stained a dark brown after heavy rain because tannins have leached into the runoff. Look out for strands of seagrass washed up by the tide.

Trees, timber and calm waters

James Cook named the Glasshouse Mountains as he sailed north in the *Endeavour* in 1770, and Pumicestone Passage was explored by Matthew Flinders in 1799, while searching for a source of freshwater. Flinders named the passage for the little pumicestones (small, light, volcanic stones) he saw on the beaches.

Subsequent European settlement has brought great changes to the Pumicestone and Caboolture catchments and Bribie Island. Where once there were mangroves and melaleuca swamp, there are now large areas of introduced pine plantations that are used for timber and paper production.

Eucalypt forest once covered the more fertile western and southern sections of this network of catchments. These have been replaced by orchards, pineapple farms, poultry and piggery sheds. The produce from these farms, along with the timber and fibre products from the plantations, are transported to consumers throughout Australia and the world. These intensive, high-input crops mean high outputs of fertilisers, effluent and other pollutants as well as sediment, which are washed into the creeks and out into Pumicestone Passage.

The region has the fastest growing population in South-east Queensland. Caloundra and Caboolture, the two largest population centres, are located at either end of the catchment area. In between, are a growing number of smaller towns and settlements, including the southern end of Bribie Island. In many places, even the pine plantations are giving way to housing development. These new estates are potential sources of pollutants and contaminants in the waterways, including sulfuric acid and metals from acid sulfate soils, which are common in low-lying parts of the catchment, such as tidal areas, wetlands and floodplains.

In Pumicestone Passage itself, there are few signs of human habitation, other than the townships of Toorbul and Donnybrook, and the southern settlements of Bribie Island.

The passage is a popular birdwatching, boating and fishing spot. Sailboarding, sailing and waterskiing are popular here, as is recreational fishing. Commercial fishing in the area has been banned.

Pumicestone Catchment

Rusty waters flow to the sea

The waters of some of the creeks in this catchment are a rusty colour. This is because they are carrying a lot of iron, which has been leached out of the local soils and rocks by sulfuric acid, produced when acid sulfate soils are exposed to air and water.

In some parts of the catchment, these acid sulfate soils have been exposed by dredging, excavation and drainage works for housing and other developments. These activities lower the water table. (Acid sulfate soils remain inactive and pose no threat provided they are waterlogged or covered by topsoil.)

The result of this activity (if not managed properly) can be very acidic waterways, often with high concentrations of iron and other metals toxic to plants, fish and other animals.

How healthy is the Pumicestone catchment?

Signs that Pumicestone catchment waterways are in **moderate health.**

- The creeks are often murky with sediment and carry a lot of dissolved nutrients.
- Exposure of acid sulfate soils has resulted in high acidity and high concentrations of metals in the creeks.
- The catchments have been extensively cleared either for farming, housing or pine plantations. The riparian vegetation is mostly intact in the upper sections of the catchment, but has been almost cleared in the lower sections.

In addition, most of the creeks in the Pumicestone catchment contain heavy sediment loads and high levels of dissolved nutrients, particularly after heavy or continuous rain and/or flooding. Extensive clearing in the catchment means there is little vegetation cover to hold the soil in place to slow down and absorb rainfall run-off.

Pumicestone Passage

How healthy is Pumicestone Passage?

Signs that Pumicestone Passage is in **good health:**

- The water is clear and healthy, but may become murky with sediment after heavy rain on the mainland.
- Intertidal zones, mangroves, salt marshes and melaleuca wetlands are intact along the edges of the Passage, and there are extensive seagrass beds and abundant fish and other wildlife.

Whimbrels and curlews feed here today

In the summer months, migratory waders feed in the intertidal zone of Pumicestone Passage. The branches of mangroves overhang extensive fish nurseries. It is even possible to see the occasional dugong surfacing to breathe before diving again to graze on the seagrass beds.

Despite high sediment and, nutrient loads and acidity flowing out through the creeks of the adjacent Pumicestone catchment and Bribie Island, Pumicestone Passage remains a generally healthy waterway. This is because the tidal flows through the Passage exceed the freshwater inflows from the creeks in the catchment, except after major flooding. Creek water is flushed out of the Passage by the tide, although this is more effective at the upper and lower ends, where the tidal flow is greater.

In the mid-section of the Passage, near The Skids, turbidity levels and nutrient concentrations are higher and dissolved oxygen concentrations are lower than at Caloundra and Deception Bay.

Bribie Island

How healthy is Bribie Island?

Signs that Bribie Island's waterways are in **good health.**

- The waters of Bribie Island, most of which flow underground, are clean, though often stained brown with tannins.
- The island is well-covered with vegetation, although a high proportion of this is pine plantation.

Water trickling through sand

The Bribie Island catchment differs from the Pumicestone mainland catchment, in that most of the water movement on the island occurs underground. The tiny creeks that flow into the Passage are fed almost entirely by subsurface water.

Like Moreton and Stradbroke Islands, Bribie Island is composed entirely of sand and contains sand aquifers – underground 'dams' full of clean, fresh water that has been filtered through the sand. This groundwater is the water supply source for the residents of Bribie Island, as well as for some parts of the mainland.

When it rains, water seeps down through the sand ground to top up the aquifers. This water flows underground and seeps out slowly into the tiny coastal creeks or straight into the Passage.

The island is well covered in vegetation, although the pine plantations are periodically harvested. The vegetation helps keep the watertable and groundwater movement in balance, as well as minimising sediment and nutrient run-off into the creeks.

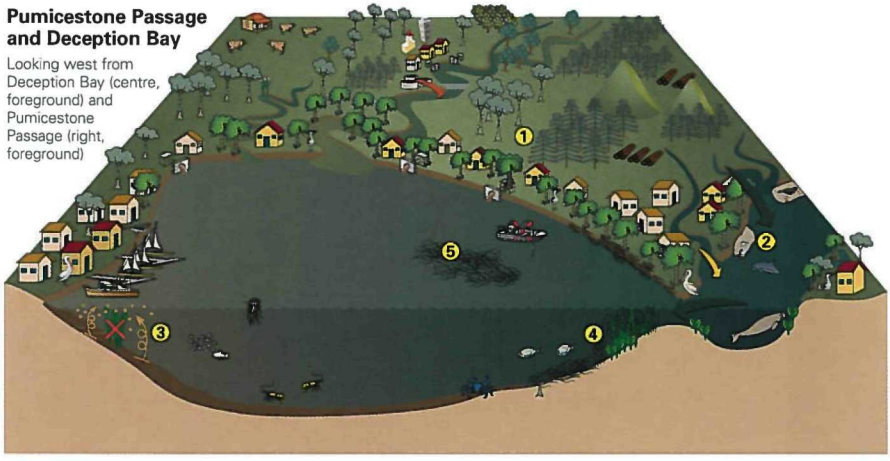
However, at the southern end of the island, where the housing development has occurred there are large areas of acid sulfate subsoils.

Bribie Island is one of the few places in Southeast Queensland where sewage is not discharged into a waterway, but onto land, so the potential contamination of aquifers needs to be managed.

Deception Bay

Pumicestone Passage and Deception Bay

Looking west from Deception Bay (centre, foreground) and Pumicestone Passage (right, foreground)



1. Catchment land-use dominated by plantations, agriculture and urban
2. Run-off from coastal creeks delivers iron and organic substances to Pumicestone passage
3. High turbidty killed seagrass in southern Deception Bay
4. Lyngbya blooms in northern Deception Bay
5. Rafts of Lyngbya drift throughout the Bay and are washed onto beaches

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Aerial view of Deception Bay and the mouth of Caboolture River in the background

Deception Bay, with its extensive seagrass pastures, is at the northernmost section of Moreton Bay.

The seagrass beds in Deception Bay are interspersed with dark patches of toxic *Lyngbya*. Scientists are investigating the potential causes of the *Lyngbya* blooms, which have been occurring for some time and increasing in intensity. The blooms were first brought to the attention of scientists in 1997. In 2000, the *Lyngbya* blooms throughout Moreton Bay were the largest recorded in the world.

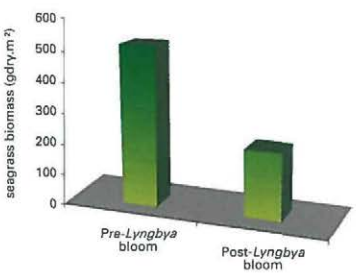
Lyngbya flourishes in the presence of high concentrations of iron, so disturbance of soils in adjacent catchments is thought to have some role in the toxic blooms. High concentrations of iron are flushed out of the creeks at the southern end of the Pumicestone catchment and Bribie Island into Deception Bay. This is evident after rain when water with an orange tinge (iron) flows out of the creeks at the southern end of Bribie.

The *Lyngbya* Threat

Lyngbya is a toxic blue-green algae that destroys seagrass and can cause rashes and burns humans who come into contact with it.

The long, hair-like strands of the algae grow in clumps on the seagrass, smothering and killing the plants. This destroys an important food source for dugongs, turtles and some fish.

Lyngbya clumps also break off and are washed up on the shores of the Bay leaving large, rotting piles on the beach. It also fouls fishing nets and crabpots, significantly reducing catches and has an offensive smell. Few creatures are able to eat *Lyngbya*, so it accumulates in vast mats.



The amount of seagrass (*Syringodium isoetifolium*) as dry weight (g/m²) pre and post the *Lyngbya* bloom in Deception Bay, 2000

SOURCE: WATKINSON ET AL., 2000

Solving the *Lyngbya* Problem

A coordinated research effort, involving the community, scientists and government is underway to address *Lyngbya* outbreaks in Deception Bay. Researchers are attempting to unravel the causes of the outbreaks and to identify effective control measures. The research, which has investigated local geology, hydrology, sediment character, environmental geochemistry and land use patterns, has indicated that iron and organic matter in run-off from cleared lands may trigger *Lyngbya* outbreaks. A range of stakeholders, including councils, state forestry and the development industry are assessing these findings and reviewing management practices to reduce potential causes.

Lyngbya (dark patches) smothers seagrass in Deception Bay

How healthy is Deception Bay?

Signs that Deception Bay is in **poor health**:

- Large seasonal *Lyngbya* blooms occur in northern Deception Bay.
- Areas once covered with seagrass have become barren, due to *Lyngbya* and elevated turbidity from increased sediment loads entering the Bay.

There have been no seagrass beds at the southern end of Deception Bay since 1996. This may be due to a major flood in that year, which washed massive amounts of sediment from the Caboolture River out into the Bay. The water still appears muddy and the seagrass is not likely to grow back while light penetration is so low. Research indicates that seagrass could grow back and recolonise up to 2500 ha of the Deception Bay if sediment loads in stormwaters entering the bay were to be sufficiently reduced to allow increased light penetration to the sea floor. At night, the greenish, phosphorescent glow of the water is due to an abundance of dinoflagellates (a type of phytoplankton).

The patterns of water movement also affect the health of Deception Bay. Prevailing south-easterly winds and tides and the shape of the Bay combine to create a backwater effect, which can 'trap' pollutants within the Bay for extended periods, magnifying potential problems.

Caboolture Catchment

Still, green waters

Once a predominantly agricultural catchment, Caboolture is experiencing increased pressures because of rapid urbanisation. The Caboolture Shire is one of the fastest growing regions in Queensland. Increased stormwater and sewage discharges have boosted the sediment and nutrient loads flowing into the Caboolture River.

The city of Caboolture sources its water supply from the Caboolture River, extracting from just upstream of the weir, which is below the main population area. Sewage discharge is upstream of the Bruce Highway bridge.

A combination of efficient nitrogen removal from sewage treatment and the natural processing by the river system has maintained the water quality in a moderate state of health. However, there are limited flows in the river, there is very little flushing and nutrients tend to accumulate leading to algal blooms.

How healthy is the Caboolture catchment?

Signs that Caboolture catchment waterways are in moderate health:

- The water is tinged green from phytoplankton blooms.
- The water is murky from sediment washed into the river from erosion associated with forestry, agriculture and urban development.
- There is little riparian vegetation on the lower sections of the river.

Meandering Caboolture River

Reviving and nourishing the network

Stakeholders in the Pumicestone Region are working hard to protect and restore catchment and waterway health.

The Pumicestone Catchment Management Association actively organises tree plantings, community education initiatives and a range of other activities, which bring together neighbourhood groups to collect seeds, eradicate weeds and propagate and plant trees. The association also works with local industry to improve management practices to reduce soil erosion and minimise sediment and nutrient loads entering the waterways.

The association, with the support of Caboolture Council and the State Government, has established the Pumicestone Catchment Centre, which provides a focus for improving public awareness of catchment management issues.

Caboolture and Caloundra Councils are also striving to support actions to improve the health of waterways. The Councils monitor waterway health with the help of community groups and provide education and development programs aimed at raising awareness of catchment management issues.

Caboolture Council has embarked on a number of projects to investigate the effectiveness of various stormwater quality improvement devices, including wetlands, grass swales and below-ground gross pollutant traps. Caboolture and Caloundra Councils have also undertaken a program to map erosion hazards within the region and to link hazards to management practices for erosion and sediment control.

Caboolture and Caloundra Councils are implementing management plans to improve urban stormwater quality, including stricter enforcement and monitoring of stormwater run-off from a range of existing activities and new developments. Councils also provide erosion and sediment control information to builders and developers.

Caboolture Council has been a leader in the improved treatment of sewage to reduce nutrient impact to waterways. Millions of dollars have been invested in treatment plant upgrades and this has reduced sewage problems in Deception Bay. The benefits of this investment have already been seen in measurable reductions in sewage impacts in Deception Bay.

A Water Reclamation Plant has been constructed to supply industry and further wastewater reuse options are being investigated. Council is also assessing the impacts of on-site sewage disposal systems (e.g. septic tanks) and developing strategies to reduce impacts in non-sewered areas.

CHAPTER 9

Brisbane Catchment

The Brisbane River catchment, the largest in South-east Queensland, is made up of a number of sub-catchments with an enormous diversity of environments in varying states of health. This catchment could be likened to a fig tree that has many branches converging to the trunk – in this case, the Brisbane River estuary that flows into Moreton Bay. The catchment provides water, food, building materials and beautiful wild places to visit, but all is not well – erosion, loss of riparian vegetation and streambank degradation are taking their toll.

A majestic river

The giant among catchments in South-east Queensland is the Brisbane River. The main channel of the river winds through the floodplain that is the city of Brisbane and empties into Moreton Bay. The extensive network of creeks and rivers that feed into the Brisbane River form a series of sub-catchments (like the branches of the tree). Each of these sub-catchments has its own characteristics, but it is water flow that connects them all and what happens in one sub-catchment influences the sub-catchments downstream.

The headwaters of the Brisbane River lie to the north and east of Nanango and flow south through extensive grazing lands to Lake Wivenhoe. The Stanley River, which begins near Kilcoy, also flows through grazing lands as well as forests, until it empties into Lake Somerset, just upstream of Wivenhoe.

The two dam walls have effectively isolated the upper Brisbane and Stanley Rivers. Fish and other aquatic animals can no longer move between these sections of the river. The pattern of water flow has also changed, affecting riparian and aquatic ecosystems.

The mid-section of the Brisbane River begins below the Wivenhoe Dam wall. Lockyer Creek, from the farming and upland grazing areas of the Lockyer catchment, flows into this section of the river. At the bottom of the mid-section (above the tidal limit of the estuary) is Mt Crosby weir where the main water treatment plant for Brisbane is situated.

The Bremer River joins the Brisbane River downstream from Mt Crosby, after flowing from the Scenic Rim. A major tributary Warrill Creek, rises near Cunningham's Gap and flows almost parallel with the Cunningham Highway past Warrill View and Harrisville and joins the Bremer near the southern urban parts of Ipswich City.

Finally, the Brisbane River – now an estuary – meanders across its floodplain, through the suburbs of Brisbane, the city centre, past the Port of Brisbane and eventually out into Moreton Bay at Luggage Point.

Starting from just above the Bremer junction and heading downstream to the Bay, the reaches of the Brisbane River are: Daly's; Moggill; Redbank; Goodna; Cockatoo Island; Goggs; Popes; Pullen; Two Mile; Mt Ommaney; Mermaid; Sherwood; Chelmer; Indooroopilly; Canoe; Log Pocket; Six Mile Rocks; St Lucia; Toowong; Milton; South Brisbane; Town (Petrie Bight); Shafston; Humbug; Bulimba; Hamilton; Quarries; Parker Island; Eagle Farm Flats; Pinkenba; Lytton; Quarantine Flats; Lytton Rocks; Swing Basin; Inner Bar Cutting; Outer Bar Cutting; and finally Entrance Channel.

HEALTHY WATERWAYS LIBRARY

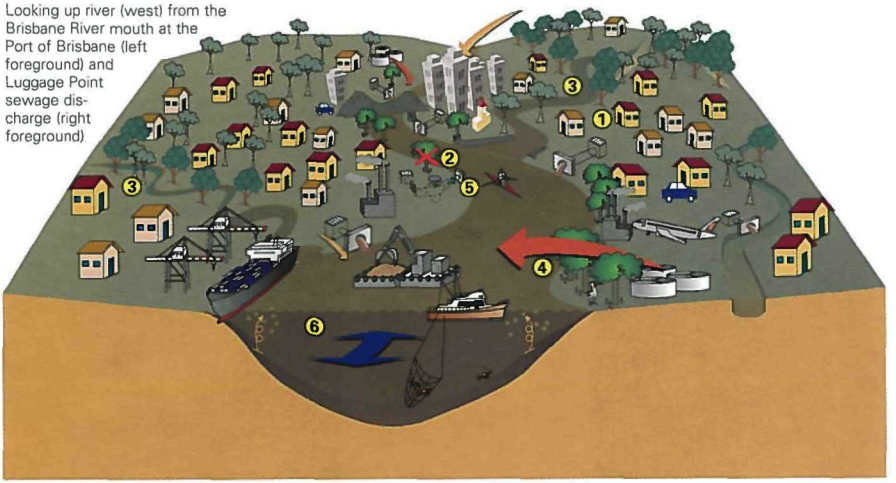
Public access walk and bike ways along the lower Brisbane River, Milton Reach

Brisbane Catchment

Lower Brisbane Catchment

Lower Brisbane River

Looking up river (west) from the Brisbane River mouth at the Port of Brisbane (left foreground) and Luggage Point sewage discharge (right foreground)



1. Catchment land-use is mostly urban
2. Riparian clearing along river banks
3. Numerous tributary streams
4. Large sewage discharges currently being upgraded
5. Numerous stormwater discharges; stormwater quality improvement devices are being installed
6. Sediment resuspension due to tidal flushing

A river winding through the floodplain

At the lower end of this diverse catchment, the estuarine-tidal section of the Brisbane River loops and bends through the coastal floodplain that is now occupied by the sprawling urban landscape. Wolston, Pullen Pullen, Moggill, Oxley, Cubberla Toowong, City, Enoggera, Ithaca, Breakfast, Norman and Bulimba Creeks all feed into this section of the river.

Before European settlement, the alluvial floodplain was covered in sub-tropical rainforest (of which a few remnants still exist). Fig trees, hardwoods and eucalypts towered over the riverbanks. In the shale hills surrounding the floodplain, open forest grew. Melaleuca wetlands and mangroves lined the river along the tidal zone, filtering run-off and providing wildlife habitats.

Fact File: Lower Brisbane Catchment

Catchment Area:	1,171 km^2
Catchment Population:	888,035*
Total length of streams:	845 km
Major land uses:	Urban, natural forest, grazing

* SOURCE: QLD DEP. LOCAL GOV. & PLANNING

"The country in the vicinity of the river was hilly, but well clothed with grass; the valleys and flats composed of rich soil, adapted to the production of tropical plants."

– *Sydney Gazette*, 21 October 1824

The alluvial floodplain was periodically inundated by rain (as it still is today) and massive amounts of water came down the river in a very short time. As the river burst its banks and spread out across the floodplain, it deposited rich silt from the upper sections of the catchment. This flooding cycle was, and still is, an important part of the river's natural processes.

The river was originally shallow and sandy-bottomed containing natural holes, some more than 7 metres deep. The channel has slowly shifted over time, scouring the inside of bends and depositing sediment on the outside, especially after floods.

There were abundant fish in the river, including the now extinct Bathurst Cod, which is thought to have been a close relative of the Mary River Cod. (This excellent eating fish has not been seen in the river since the early 1900s).

Bull Sharks were, and still are, a common sight in the river. The last shark attack was reported in the 1920s. There are photographs of people swimming in the river in the early 20th century, at Dutton Park and along the city reaches, in shark proof enclosures. Other photographs show bathers swimming in clear water near the Indooroopilly Bridge or sitting on the sandy beach at the river's edge.

'With creek and river joys we trifle...'

BRISBANE is a pleasant town,
Sometimes green and sometimes brown;
River curling everywhere,
Hills in plenty and to spare;
Flowering trees are a delight
Some, like tigers, "burning bright";
Quaint old houses up on stilts,
Modern homes for Vanderbilts.
And there's no need to mope or stifle
For with creek and river joys we trifle,
Ocean beaches near at hand,
Mountains, valleys, open land;
And here the days are mostly fine,
Cool at night, but hot sunshine;
And for the summer, if you're shrewd,
Wear your shorts and brave the prude.

– A. M. Roe 1937

From the Mt Coot-tha Lookout (**see Where to Look, p.71**) you can see the city of Brisbane spreading east and south into the distance, with glimpses of the river as it winds through the suburbs. The city's location on the floodplain has interfered with the river's natural flooding cycle. When the river does break its banks, as it did in 1974, the results can be devastating.

"From the vantage point of Mt Coot-tha, the view from the southeast to northwest was extensive and very grand, presenting an immense, thinly wooded plain, whose surface was gently undulating, and clothed with luxuriant grass".

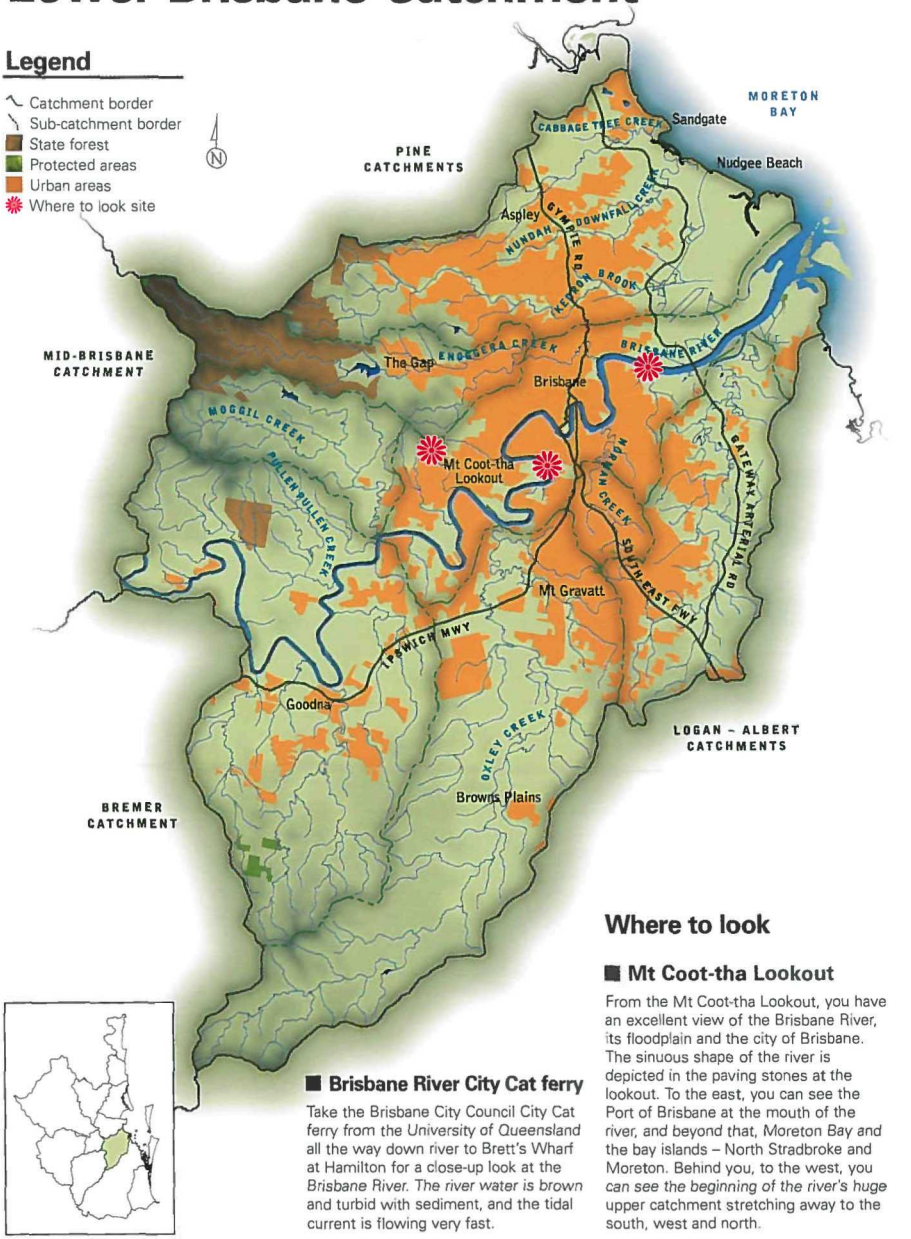
– from Steele, 1972

Like most major cities in Australia, extensive hard surfacing of the catchment has been carried out, although some of Brisbane's creeks are still visible. An extensive network of stormwater pipes drains the run-off from roads and roofs into these creeks or directly into the river. These changes to the catchment hydrology have increased surface water run-off rates and volumes. Coupled with impacts of urbanisation (e.g. fertilisers, pet droppings, sediments from building sites), this has increased pollutant loads entering waterways

From Mt Coot-tha, the Fig Tree Pocket and West End reaches of the river are visible, and the closest – the Indooroopilly Reach – looks very brown. This is the same section of river whose clear waters and sandy beaches were a popular swimming spot less than a century ago.

View of Brisbane River and city from Mt Coot-tha

Lower Brisbane Catchment



■ Brisbane River City Cat ferry

Take the Brisbane City Council City Cat ferry from the University of Queensland all the way down river to Brett's Wharf at Hamilton for a close-up look at the Brisbane River. The river water is brown and turbid with sediment, and the tidal current is flowing very fast.

Where to look

■ Mt Coot-tha Lookout

From the Mt Coot-tha Lookout, you have an excellent view of the Brisbane River, its floodplain and the city of Brisbane. The sinuous shape of the river is depicted in the paving stones at the lookout. To the east, you can see the Port of Brisbane at the mouth of the river, and beyond that, Moreton Bay and the bay islands – North Stradbroke and Moreton. Behind you, to the west, you can see the beginning of the river's huge upper catchment stretching away to the south, west and north.

How healthy is the Lower Brisbane catchment?

Signs that waterways of the Lower Brisbane catchment are in **poor health:**

- The water is brown and turbid because of large amounts of suspended sediments.
- Dissolved nutrient and toxicant concentrations are high.
- There is limited life in the river and only patches of riparian vegetation remain, although in some areas, mangroves are growing back.

Closer inspection of the river from the City Cat ferry **(see Where to Look, p.71)** shows large sections of the river bank have been hardened and, in some cases, straightened with rock and concrete walls. Roads and buildings have encroached into the riparian zone. However, in many places, mangroves are re-growing in abundance, even under the South-east Freeway in the city reach.

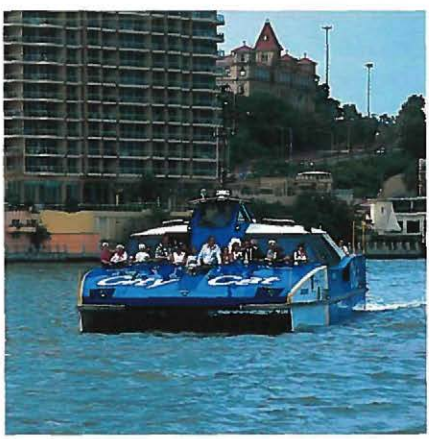
Just before the City Cat stop at Eagle Street (going downstream), it is possible to see the remains of City Creek. This creek was Brisbane's original source of fresh water and the main reason the city was located here.

A port to the world

The protected waters of Moreton Bay and safe anchorage in the river made Brisbane a suitable site for a major port in an era when access to sea transport was crucial. Downstream of the Eagle Street Pier is the old Customs House. In the 19th century, all ships arriving in Brisbane had to register here before proceeding to the port then located at South Brisbane. This meant the shallow river needed to be dredged and the bar at the river mouth removed to allow passage of ships.

Until recently, Brisbane City kept its back firmly turned on the river, which continued to be used as a port, but was otherwise treated as a drain, sewer and gravel mine. Over the past 15 years, Brisbane has become the 'River City'. The port has been re-located to the mouth of the river, walkways and boardwalks line the banks, as do parks and public spaces such as South Bank. Extractive dredging has ceased (although navigational dredging continues) and the river is now celebrated as one of the city's greatest recreational assets.

Private boats move up and down the river. In the early mornings, rowers in their skiffs train for regattas. The murky water and swift tidal currents generally make the river generally unsuitable for swimming, but this may change in the future.



HEALTHY WATERWAYS LIBRARY

Travel the Brisbane City Council, City Cat ferry for a closer look at the turbid Brisbane River

HEALTHY WATERWAYS LIBRARY

Port of Brisbane, mouth of the Brisbane River

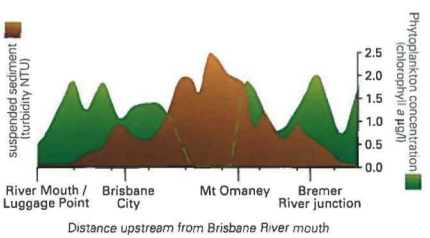
An estuarine 'mud-shake'

From a Brisbane City Council City Cat (**see Where to Look, p.71**), it is easy to see the river is brown and turbid. The heavy sediment load from the upper catchments and urban areas does not settle on the river bottom because of tidal movement. Along the banks, where current movement is slower, there is an oozy coating of deposited mud.

Because dredging removed the sandbar and islands at the mouth, tidal flow is more forceful. Take a look at the water rushing against the pylons of the nearest bridge and you will get an idea of how quickly the current is flowing.

It would take a major engineering structure at the river mouth to reduce tidal energy whilst allowing continued navigation. Furthermore, as the sediment settles and turbidity reduces it becomes even more important to reduce nutrients to avoid future algal blooms.

Although the nutrient concentration in the river is very high, algal blooms do not currently occur, nor is there much animal life. This is because little light penetrates the turbid water. However, the strong tidal action means there is plenty of oxygen in the water for the few hardy species that can survive, such as prawns, catfish and mullet.



Concentrations of phytoplankton (µg/L) in green and suspended sediment (mg/L) in brown from the Brisbane River mouth to the tidal limit (90 km upstream). As suspended sediment peaks between Brisbane City and Bremer River junction, phytoplankton dramatically decreases because light is unable to penetrate the turbid water to support plant growth.

Research indicates that although much of the problem sediment comes from the upper catchments (delivered mainly during large floods), treated sewage and stormwater from the city itself (delivered during summer storms) are also significant sources of sediment, litter, nutrients and other contaminants.

Treated sewage is released into the river at Luggage Point, Oxley Creek and a number of other sites. Sewage treatment plant upgrades are underway and will greatly reduce the amount of nitrogen released into the river. During drought (times of low flow), treated sewage accounts for most of the freshwater flow in the river. River pollutants tend to accumulate in Moreton Bay rather than dispersing into the open ocean because the Bay is sheltered by Moreton and North Stradbroke Islands.

Putting the river on a diet

The city's location poses a number of environmental challenges.

> "We have allowed our large town to grow up without the proper sanitary arrangements... that will cost something like a million of money, but it will be money well expended."
>
> **– 1884 (In Johnstone 1988)**

It is crucial that Moreton Bay remains healthy and continues to function as an important wildlife habitat, fishery resource and recreational area. For this to occur, pollutants discharged into the Bay need to be reduced.

Brisbane City Council operates a number of wastewater treatment facilities that discharge into the lower Brisbane River. The Oxley Creek Wastewater Treatment Plant, at Rocklea, is the largest, treating wastewaters from both domestic households and industry. (The Luggage Point Wastewater Treatment Plant, the largest sewage treatment facility in South-east Queensland, discharges at the mouth of the river – see Chapter 10). Brisbane City Council has a major program to upgrade the Oxley Creek Plant to reduce nutrient concentration (particularly nitrogen). Similar upgrades at smaller plants are aimed at reducing impacts on tributary streams.

Brisbane City Council has also carried out extensive rehabilitation of former hazardous and domestic waste landfill sites at Willawong, Chandler, Nudgee and Fitzgibbon, and several smaller sites, to reduce the amount of pollution leaching into waterways.

Brisbane City Council and more than 100 community Bushcare and catchment groups are working to improve water quality through various projects. This work involves removing weeds and replanting riparian vegetation to provide additional filters and buffers for the river and the tributaries that flow into it.

One of the largest challenges facing the residents of Brisbane City is to reduce the demands on our water resources and water related infrastructure.

Through the Integrated Water Management Strategy, Brisbane City Council is working in partnership with a range of industry and research groups to develop and implement innovative and practical alternatives to achieve many of the traditional aspects of water, wastewater and stormwater management. Projects will also aim to achieve sustainable water use; a healthy environment; cost-effective solutions appropriate for South-east Queensland; and community and industry involvement.

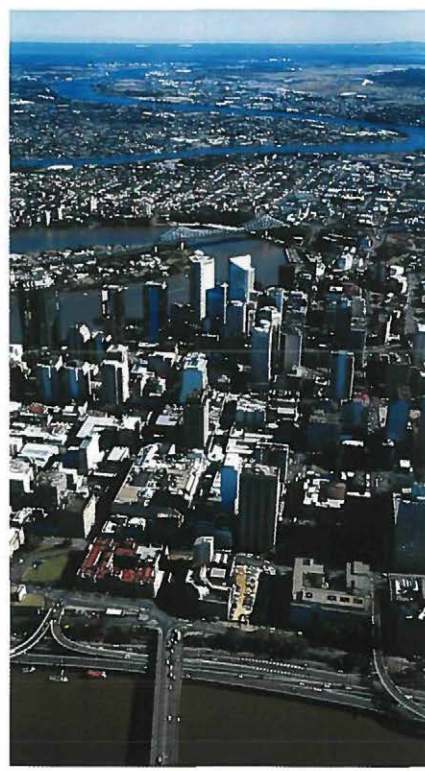
Progress towards Integrated Water Management include encouraging the building industry to implement water sensitive urban design (e.g. installing rainwater tanks) and installing stormwater quality improvement devices (SQIDs).

Council is installing Stormwater Quality Improvement Devices (SQIDs) across the city to filter stormwater and trap gross pollutants, such as litter, before these reach the river. Council is also experimenting with building artificial wetlands. It has developed comprehensive guidelines for sediment and erosion control, conducts education programs for builders and developers and carries out enforcement programs to ensure compliance. The Council also monitors stormwater run-off from a range of land uses in the city.

These activities are supported by publicity campaigns encouraging residents to undertake simple tasks, such as picking up dog droppings and washing the car on the lawn. (A detailed list can be found in Chapter 4).

Industry is doing its bit to keep our waterways clean – Brisbane's oil refineries have implemented major recycling programs aimed at significantly reducing the amount of treated wastewaters discharged to the river.

Maritime Care volunteers continue to haul in more than 12,000 pieces of rubbish per month, with plastics making up 5,000 items of either bottles, bags or plastic packaging (e.g. chip packets). In one year, 135,000 pieces of rubbish were removed from the tidal section of the Brisbane River.

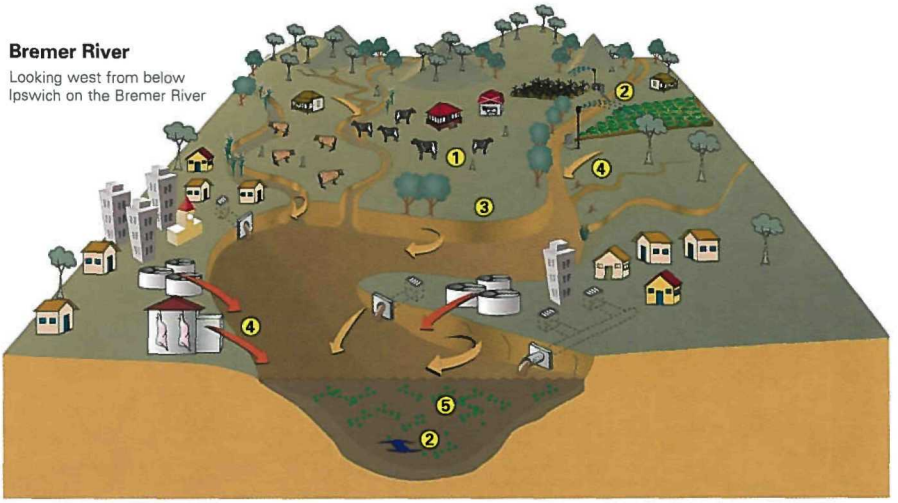


Aerial view of the Brisbane River, meandering across an urbanised flood plain, toward Moreton Bay

Bremer Catchment

Bremer River

Looking west from below Ipswich on the Bremer River



1. Catchment land-use dominated by grazing, agriculture and natural forest (in upper catchment)
2. Downstream flow reduced by water extraction; poor tidal flushing in the lower reaches
3. Riparian condition generally poor
4. Large sewage discharges currently being upgraded, numerous other point sources of nutrients
5. Water quality generally very poor; high turbidity organics and phytoplankton

Fact File: Bremer Catchment

Catchment Area:	2,022 km^2
Catchment Population:	88,752*
Total length of streams:	1,445 km
Major land uses:	Grazing, natural forest, agriculture

* SOURCE: QLD DEP. LOCAL GOV. & PLANNING

HEALTHY WATERWAYS LIBRARY

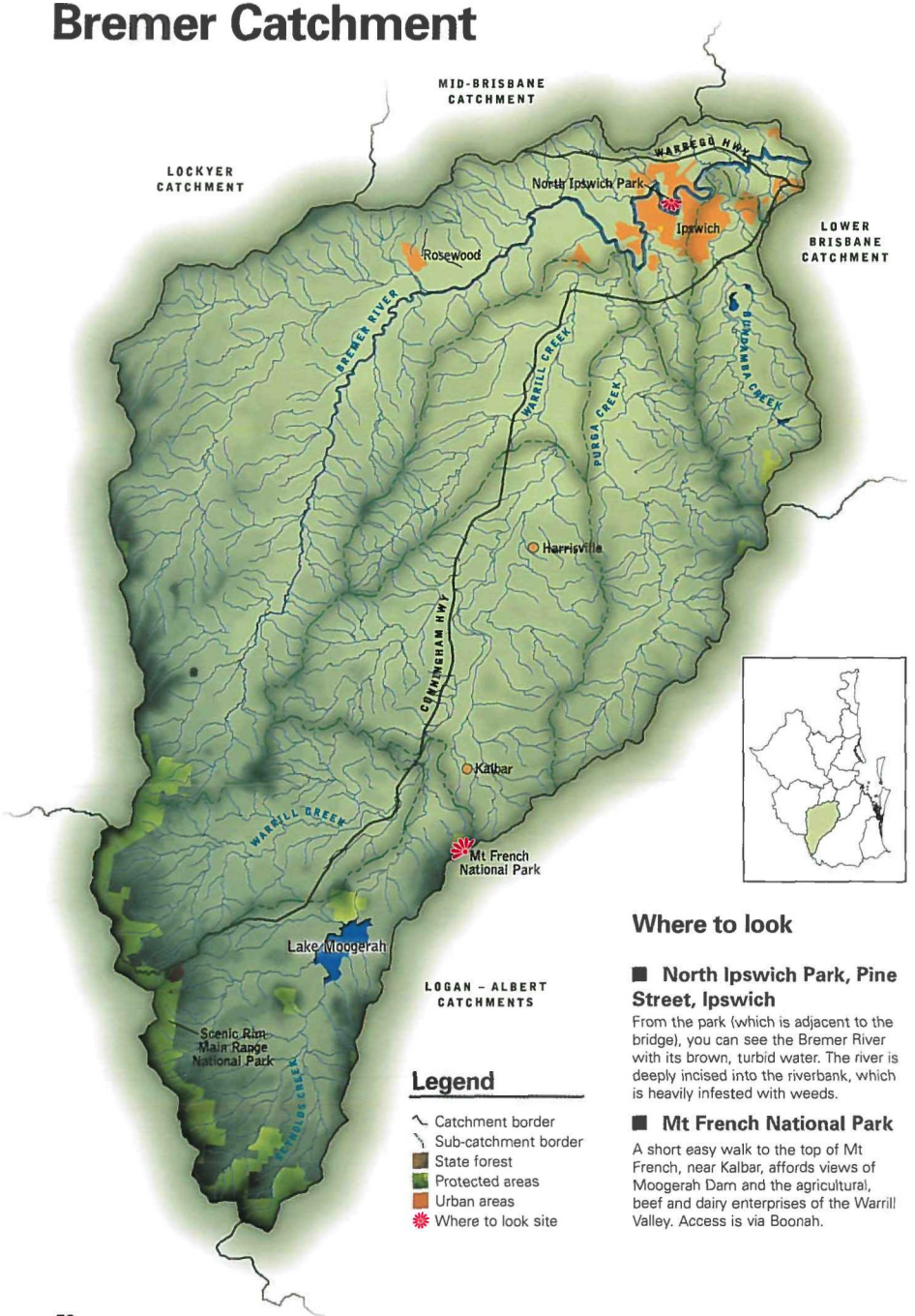
Lockyer Creek near the Warrego Highway

Country streams and city river

Between Mt Cordeaux and Wilson's Peak, on the Great Dividing Range, many of the creeks and streams of the Bremer River catchment begin. Reynolds, Warrill and Purga Creeks and the Greater Bremer River and others flow down from the Scenic Rim and into the valleys of the Brisbane region.

They flow past the townships of Aratula, Kalbar, Warrill View, Peak Crossing and Rosewood and through extensive dairy and beef grazing pastures. Next time you go to the butcher, you may be buying a steak produced in the Bremer River catchment. The catchment supplies water for irrigated pastures, crops, livestock, and for the towns and other smaller settlements. Moogerah Dam was built in 1961 to supply water for agriculture, industry and urban use **(see Where to Look – Mt French National Park, p.76)**.

Bremer Catchment



Where to look

■ North Ipswich Park, Pine Street, Ipswich

From the park (which is adjacent to the bridge), you can see the Bremer River with its brown, turbid water. The river is deeply incised into the riverbank, which is heavily infested with weeds.

■ Mt French National Park

A short easy walk to the top of Mt French, near Kalbar, affords views of Moogerah Dam and the agricultural, beef and dairy enterprises of the Warrill Valley. Access is via Boonah.

When explorers Cunningham and Oxley arrived in the Bremer catchment in the 1820s, they described forests of towering Hoop Pine on the hills and Blue Gums on the plains. Majestic Red Cedar, Crows Ash and Black Bean trees lined the watercourses, interspersed with melaleuca swamps.

Most of these trees have long since disappeared – either harvested by timber-getters or cleared for farming or towns. Much of the riparian vegetation has also been removed – to allow cattle access to the creeks and to make the best use of the flats and floodplains for grazing and agriculture.

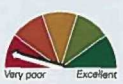
Further down the catchment these creeks and streams merge into the Bremer River, which flows through the city of Ipswich, the second largest city in South-east Queensland.

The lower Bremer is an estuarine river because the tidal flow reaches beyond the junction of the Brisbane and Bremer Rivers. The Bremer is home to a small colony of Bull Sharks, which can also be found in the Brisbane River.

A stagnant soup

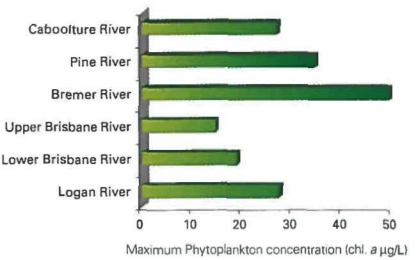
By the time it reaches Ipswich, the Bremer River is a stagnant, smelly soup, full of sediment and organic matter, with little dissolved oxygen. Only a limited variety of phytoplankton, which thrive on the too-plentiful organic matter, live in this water, often forming algal blooms that tinge the water green.

How healthy is the Bremer catchment?



Signs that the Bremer catchment waterways are in **very poor health**:

- The water is extremely turbid and contains a large amount of organic matter.
- There is widespread gullying and channel erosion in the network of small tributary streams.
- The water in the lower reaches is a dense greenish-brown and has an offensive odour.
- Almost no riparian vegetation remains apart from woody weed infestations.



Phytoplankton reaches the highest concentration in the tidal Bremer River compared with other tidal rivers flowing into Moreton Bay

SOURCE: EHMP 2001 REPORT CARD

The lower Bremer River has become a drain. It collects waste from abattoirs, industry, sewage treatment plants, stormwater and agricultural run-off from further up the catchment. The pollutants are not flushed away effectively because downstream flow has been reduced by water extraction higher up in the catchment.

Straining the soup

The challenge for government, industry and residents is to find out where the contaminants originate – particularly the overload of organic matter. Scientific research indicates that diffuse sources of pollutants along the river's banks (i.e. historical or current waste disposal activities) may be responsible and investigations are being carried out to identify and fix these sources.

Other problems are only too clear and initiatives of local catchment groups are tackling these head on, including weed removal, replanting riparian revegetation, reconnection of habitat remnants, creation of wildlife corridors and planting of vegetation screens for industrial estates.

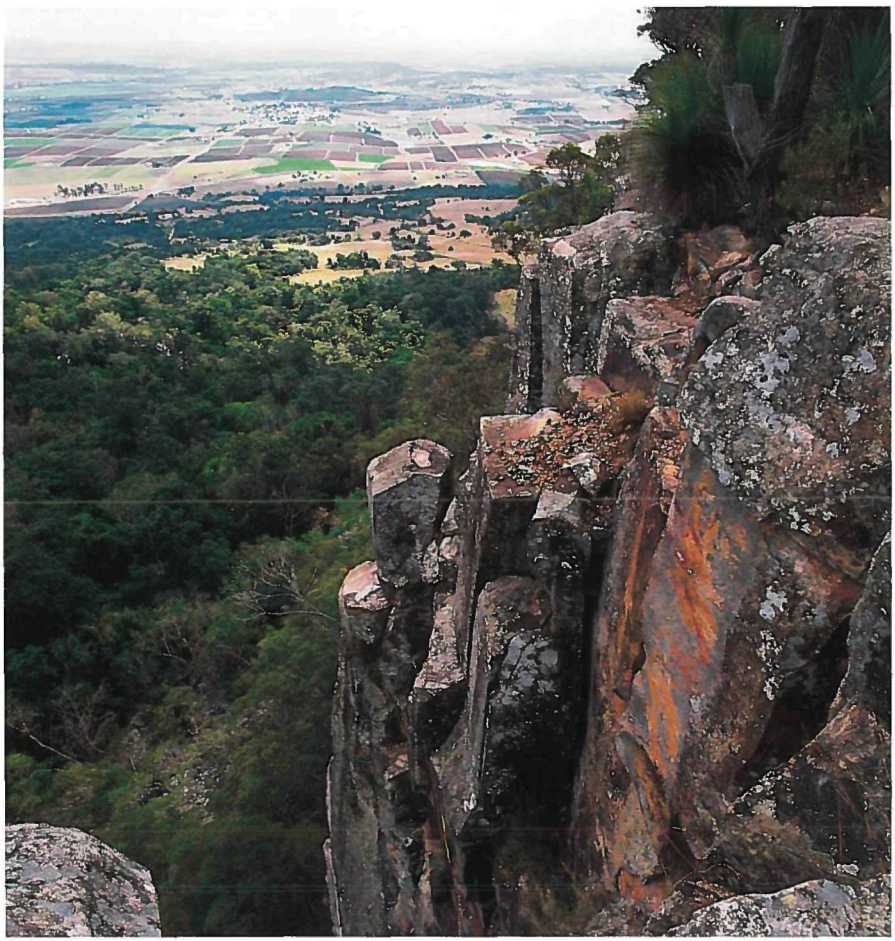
Through the work of the catchment care groups, many kilometres of streambanks have been cleared of weeds, several hectares of land revegetated, tens of kilometres of fencing erected, and a series of offstream watering points for stock established. All of this takes place on a voluntary basis with landholders matching government grants with 50 per cent of their own time and resources.

Industry, including Australian Hardboards and Australian Meat Holdings, have supported riverbank restoration projects. Australian Meat Holdings has spent millions on upgrading its meat processing factory and wastewater treatment facilities.

Ipswich City Council has implemented a series of major upgrades of its sewage treatment plants, to improve treatment standards.

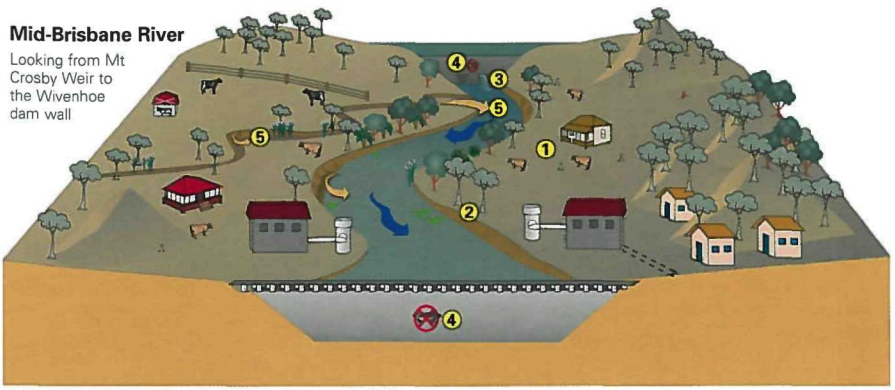
A major new urban development at Springfield has provided an opportunity to trial innovative water recycling techniques with State Government's Water Recycling Strategy. This has attracted financial assistance from the Commonwealth Government.

Around Kalbar and Warrill View, several active groups are working on local flora/fauna surveys, while at Boonah, Landcare groups are undertaking gully erosion and sediment control projects with landholders.



View from Mt French with agricultural farmland and crops in the background

Mid-Brisbane Catchment



All the way to the kitchen tap

If you could follow the pipe that connects to the kitchen tap in a Brisbane suburban house all the way back to its source, you would end up at the Mt Crosby Weir, in the mid-section of the Brisbane River.

This city's water supply comes from this section of the river. Water released from the Lake Wivenhoe and Somerset storages flows down to the Mt Crosby Weir, where it is extracted and treated.

A river flowing to a new rhythm

The catchment area of the mid-section is relatively small. It is bounded by the dams in the north, the mountains of the D'Aguilar Range (part of Brisbane Forest Park) to the east, and shares boundaries with the Lockyer Creek and the Bremer River sub-catchments to the west and south.

Oxley and Cunningham were the first Europeans to visit this section of the river, in 1824. They found a river with a sandy, shingled bed, its banks lined with Bribie Island Pines, Hoop Pines, Crows Ash, Moreton Bay Chestnuts and Blue Gums.

Since European settlement, the land has been gradually taken up for grazing and now includes a growing number of rural residential townships and outlying suburbs of Brisbane.

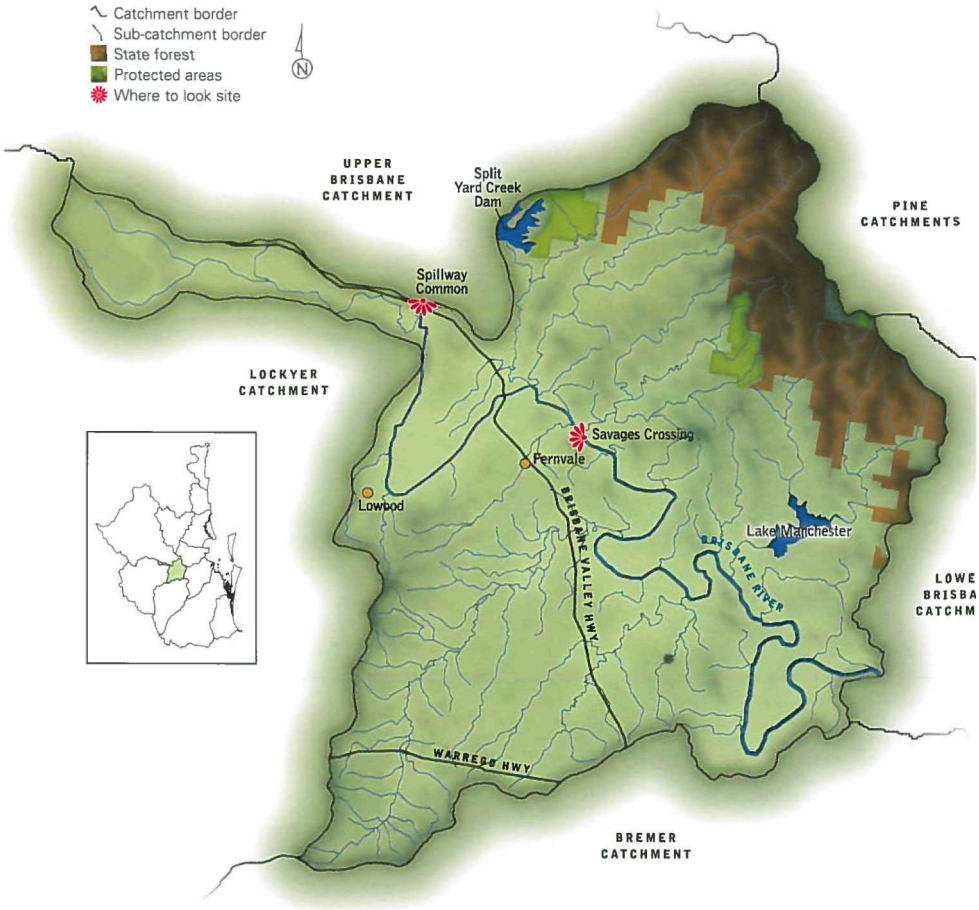
Water from Mt Crosby began supplementing the Brisbane supply in 1893, and a weir was constructed in 1902. In 1919, a treatment plant was set up to extract silt from the water. Somerset Dam was completed in 1953 (it was started in 1935 and finished 1953 – with a break because of World War II), followed by Wivenhoe Dam in 1985, to provide water for the growing urban population and to provide flood mitigation.

Fact File: Mid Brisbane Catchment

Catchment Area:	518 km^2
Catchment Population:	8,174*
Total length of streams:	366 km
Major land uses:	Natural forest, grazing, agriculture, urban

* SOURCE: QLD DEP. LOCAL GOV. & PLANNING

Mid-Brisbane Catchment



Where to look

■ Spillway Common

Here the water flows through the dam gates into the river below, on its way to the Mt Crosby water treatment plant. The water eventually ends up in kitchens and bathrooms across Brisbane. A path from the Spillway Common leads down to the Brisbane River and from here, you can see the banks and main channel of the river which are eroded and weed infested, and the main channel has shifted since the dam was built.

■ Savages Crossing, Brisbane River

This crossing, near the township of Fernvale, is reached by travelling east on Banks Creek Road for about 3 km. Either side of the river crossing you can see patches of relatively intact riparian vegetation. The Brisbane River is wide and always flowing with clean, clear water. Savage's Crossing is a good place for paddling or just floating down the river in a canoe.

Finding rhythm to a new beat

As for other waterways in South-east Queensland, the water flow in this section of the river has been substantially altered (see Chapter 3) and this has had a major effect on how this section of the river functions.

Instead of being based around seasonal weather patterns, dam releases are timed to suit water needs in the city. Water released from the lower layers of the dam is much colder than the upper layers, so when dam releases are made from the lower layers (as they are periodically) the river water is much cooler than usual. This sudden drop in temperature influences the survival of fish species and other animals. It disrupts fish spawning, killing eggs and slowing growth rates. The life-cycles of aquatic insects (an important link in the food chain) may also be disrupted, with adult insects emerging at the wrong time when food sources are not available and vice versa.

The releases can also potentially cause river bank slumping. When the water level in the river rises, the bank is slowly saturated. If the water level drops too quickly, the bank may slump due to the weight of the water that has soaked into it. The South East Queensland Water Corporation has taken steps to change operational practices to reduce these potential impacts.

Very low flows are an important part of the natural cycle of the Brisbane River, but now there is a sustained level of high flows between Wivenhoe and Mt Crosby because of the city's water needs. This high flows drown out the natural riffle and pool habitats in the river, further disrupting flora and fauna.

The dam water settles into layers, with progressively lower layers containing less and less dissolved oxygen, and containing chemicals such as ammonia and hydrogen sulphide. If you stand on the spillway viewing platform when water is being released, you can often smell 'rotten egg' gas. The water is gradually re-oxygenated as it flows downstream to the Mt Crosby treatment plant.

This small catchment sits between active catchment groups in the Bremer, Lockyer and upper Brisbane catchments, and also includes an area between Brisbane and Ipswich City Councils – and the smaller rural Esk Shire Council. Unfortunately, there is no local catchment care group in this area.

The catchment area does, however, present many opportunities for greater action in the future, because it is close to major population centres and is easily accessible for recreation. This section of the Brisbane River is one of only two freshwater swimming locations with good public access to a medium-sized, flowing river and is popular as a canoe trail. The area, near Lowood, also forms part of the Brisbane Valley Trail (for horses, biking, walking, hiking and cycling).

The Queensland Parks and Wildlife Service are rehabilitating some neglected stretches of riparian vegetation by removing weeds that choke native vegetation. The South East Queensland Water Corporation maintains a regular water quality monitoring program at several sites downstream from Wivenhoe Dam wall.

Research is also underway to investigate the effects of different flows on flora and fauna in the Brisbane River between Wivenhoe Dam and Mt Crosby. This will help refine release patterns from Wivenhoe to ensure the least disruptive effect on stream banks and flora and fauna.

The Esk Shire Council has a youth program to rejuvenate youth and social connection to the waterways.

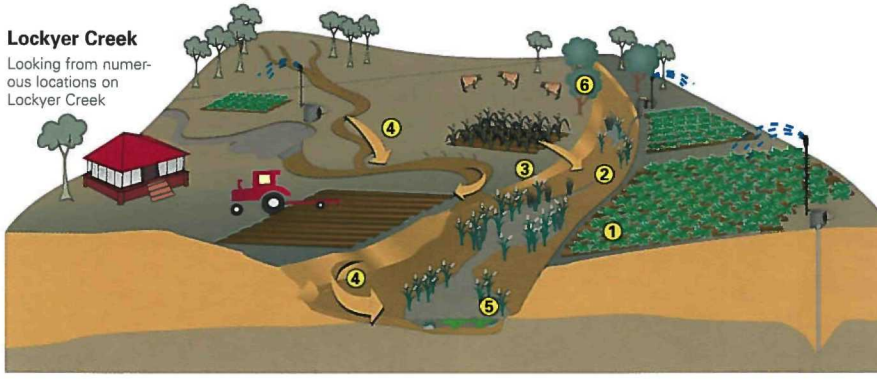
How healthy is the Mid-Brisbane catchment?

Signs that the Mid-Brisbane catchment is in **poor health**:

- The water is brown and murky with suspended sediment.
- During high flow events, poor quality water enters from Lockyer Creek.
- Most of the riparian vegetation has been lost and the riverbanks are badly eroded.
- The diversity of aquatic animal species has been greatly reduced because the dam walls have altered flow patterns and restricted movement between river sections.

Lockyer Catchment

Lockyer Creek
Looking from numerous locations on Lockyer Creek



① Catchment land-use dominated by agriculture, grazing and natural forest

② Little or no permanent surface water in the creek and its tributaries

③ Riparian condition generally poor – only a narrow ribbon remians along some sections

④ Exposed hillslopes and channels are easily eroded during rain

⑤ Much of the creek and its tributaries are weed infested

South-east Queensland's vegetable patch

Lockyer Creek sub-catchment is South-east Queensland's 'vegetable patch'. The fertile alluvial soils in its valleys and along its creeks are almost entirely treeless, cultivated for vegetable crops (potatoes, pumpkin, onion, beetroot), soybeans, lucerne and sorghum.

Water from the creek and from shallow bores (groundwater) is used to irrigate these crops, and there is high demand from farmers for this precious resource. There are three irrigation-scheme dams in the central and lower Lockyer catchment – the Bill Gunn and Atkinson Dams and Lake Clarendon.

Before Europeans settled here in the 1840s, these alluvial plains were dotted with Blue Gums, Acacias and Moreton Bay Ash. Dense riparian vegetation filtered and trapped silt during frequent floods.

Fact File: Lockyer Catchment

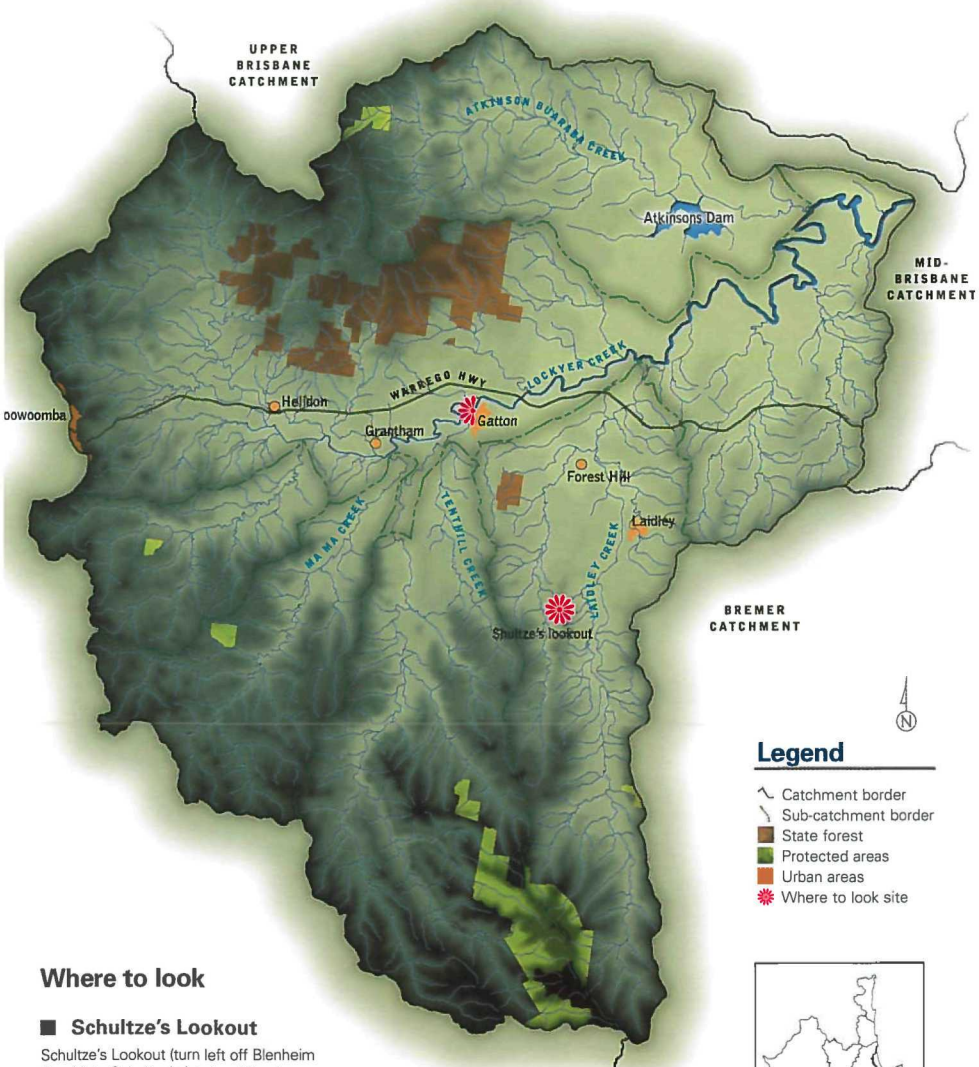
Catchment Area:	2,996 km^2
Catchment Population:	33,331*
Total length of streams:	2,062 km
Major land uses:	Grazing, agriculture, natural forest

* SOURCE: QLD DEP. LOCAL GOV. & PLANNING

> Lockyer described extensive "level country, fine appearance, thinly wooded" with "hills of pines very thick"
>
> **– from Steele, 1972**

The steep escarpments of the Great Dividing Range form the western boundary of the catchment, and to the east, the Little Liverpool Range separates Lockyer Creek from the Bremer. The Lockyer Creek sub-catchment makes up about one-quarter of the total Brisbane River catchment.

Lockyer Catchment



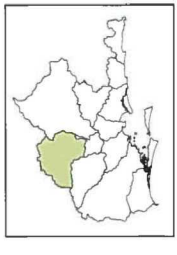
Where to look

■ Schultze's Lookout

Schultze's Lookout (turn left off Blenheim Road into Schultze's Lookout Road, a few kilometres out of Laidley) has views of Sandy Creek to the north and its sub-catchment (left) and Laidley Creek sub-catchment (right). Laidley Creek is a single thin line of trees with fields of crops right up to the creek banks.

■ Lockyer Creek, Gatton

As you drive towards Toowoomba, along the Gatton Bypass, you will cross a bridge over Lockyer Creek. The creek is choked with weeds and there is usually no water (or very little) flowing.



At Schultze's Lookout (**see Where to Look, p.83**), you are standing between the Sandy Creek (left) and Laidley Creek (right) sub-catchments. There is more vegetation cover on the hills than in the valley flats, although some of the hill slopes are grazed by cattle.

To the north-east, Laidley Creek winds through the patchwork of the cultivated alluvial flats. Only a narrow ribbon of riparian vegetation remains along some sections of the creek, and much of what remains is weed infested (e.g. Chinese Elm). In many places, cultivation extends down to the edge of the creek.

How healthy is Lockyer catchment?

Signs that Lockyer catchment waterways are in **very poor health**:

- The water in the creeks is turbid – full of sediments and nutrients washed from the cultivation areas.
- There is widespread evidence of channel erosion and very little riparian vegetation remains.
- There is very little permanent surface water in Lockyer Creek and its tributaries rarely flow except during flood times.
- Evidence of high nutrients in groundwater and, in places, saline groundwater is an issue

Losing soil to the sea

The major issues for the Lockyer catchment are water availability and erosion. Most of the time, there is little flow down Lockyer Creek and its tributary streams. During rain, soil from the cultivated paddocks washes straight into the creeks. However, recent evidence indicates much of the soil transported downstream comes from channel erosion within streams and gullies. This points to an urgent need to revegetate and protect these stream banks and gullies.

During floods, this soil is eventually carried into the Brisbane River and then into Moreton Bay. The resulting turbidity kills seagrass, the food source for dugong and turtle. Much of the mud now suspended in Bramble Bay originally came from upper Brisbane catchments such as the Lockyer (see Chapter 10).

Most people are unaware of this problem, because the movement of the sediment in the creeks only occurs during floods. If nothing is done to prevent this, the next flood in the Brisbane region could deposit hundreds of thousands of tonnes of extra silt into Moreton Bay.

Keeping the soil in the vegetable patch

State and Local Governments are assessing the viability of piping treated wastewater from various sewage treatment plants in the Ipswich, Brisbane and Logan areas to the Lockyer catchment for reuse

Irrigation of crops grown in Lockyer catchment

HEALTHY WATERWAYS LIBRARY

Laidley Creek

as irrigation water. This would supplement the limited supplies available from the creeks and aquifers.

Although a recycling scheme would make more water available in the Lockyer catchment, it would not change the amount of water in the whole catchment system. The water, and any nutrients or contaminants, would simply be relocated.

The Lockyer Catchment Centre at Forest Hill, is the local referral agency for landholders, and provides a broad range of information on soils, agricultural best practice, weed and erosion control.

With this support, landholders and community groups are revegetating creek banks and improving farm and water management practices. In the Helidon Hills area, through the Murphys Creek Landcare Group, landholders are rehabilitating waterways and implementing sustainable farm management plans. Similar initiatives are underway in the Atkinson and Buaraba Creek catchments.

Many more kilometres of waterway in the Lockyer catchment are being restored through the catchment's Creek Management Plan. Landholders are being helped with waterways revegetation through a funding scheme and native seedling nursery, both managed by the catchment centre. An increasing area of land in the Lockyer catchment is being used for farm forestry. This alternative to cropping and grazing, in both the floodplains and upland areas, will help controlling soil stability and salinity.

A small group of *Brassica* (broccoli) growers have implemented and are now promoting integrated pest management as an alternative to chemical controls. This will help reduce pesticide and herbicide residues in waterways.

A Waterwatch coordinator provides schools and the general public with information about surface and ground water resources to help build local understanding and knowledge of waterway health and quality in the Lockyer catchment.

The end result of these improvements will be more soil on farms – where it is needed for the future – and less excess mud in Moreton Bay – where it is not wanted!

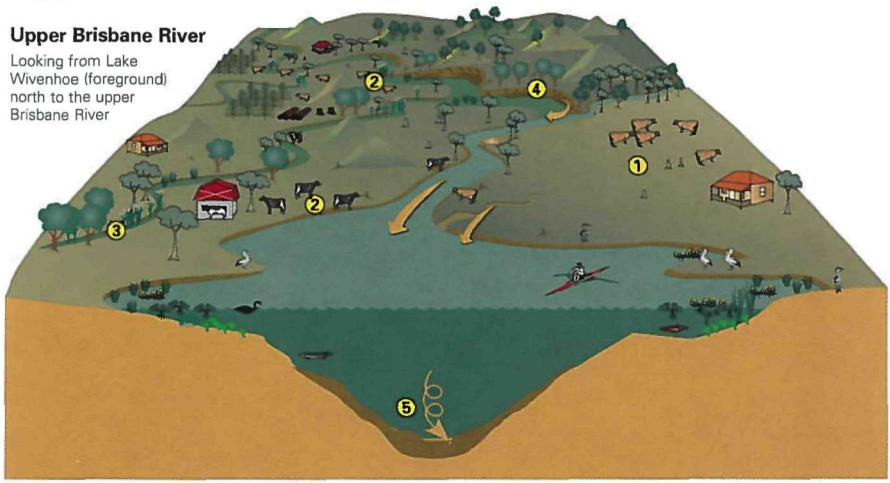
ENVIRONMENTAL PROTECTION AGENCY

Degraded land and eroding soil

Upper Brisbane Catchment

Upper Brisbane River

Looking from Lake Wivenhoe (foreground) north to the upper Brisbane River



1. Catchment land-use dominated by grazing and natural forest (in upper sections)
2. Uncontrolled cattle access to the dam, river and its tributaries
3. Riparian condition generally poor – streams are often choked with weeds
4. Exposed hillslopes and channels are easily eroded
5. Most sediment is deposited in Lake Wivenhoe

Grasslands, beef and water

Before European settlement, the Upper Brisbane catchment was predominantly grasslands dotted with Blue Gums and Ironbarks. Bottlebrushes, Figs, Blue Gums, River Oaks, Red Cedars and Black Beans grew along the creeks and rivers.

These creek and river banks have now been extensively cleared, to allow grazing along the river flats and to give cattle direct access to the water. Beef production is the main agricultural industry in the catchment, with three-quarters used as pastures for cattle.

Along with the Stanley River catchment, this sub-catchment is the source of Brisbane's water supply. Water is stored in Lake Wivenhoe and released as needed to supply Brisbane households.

Fact File: Upper Brisbane Catchment

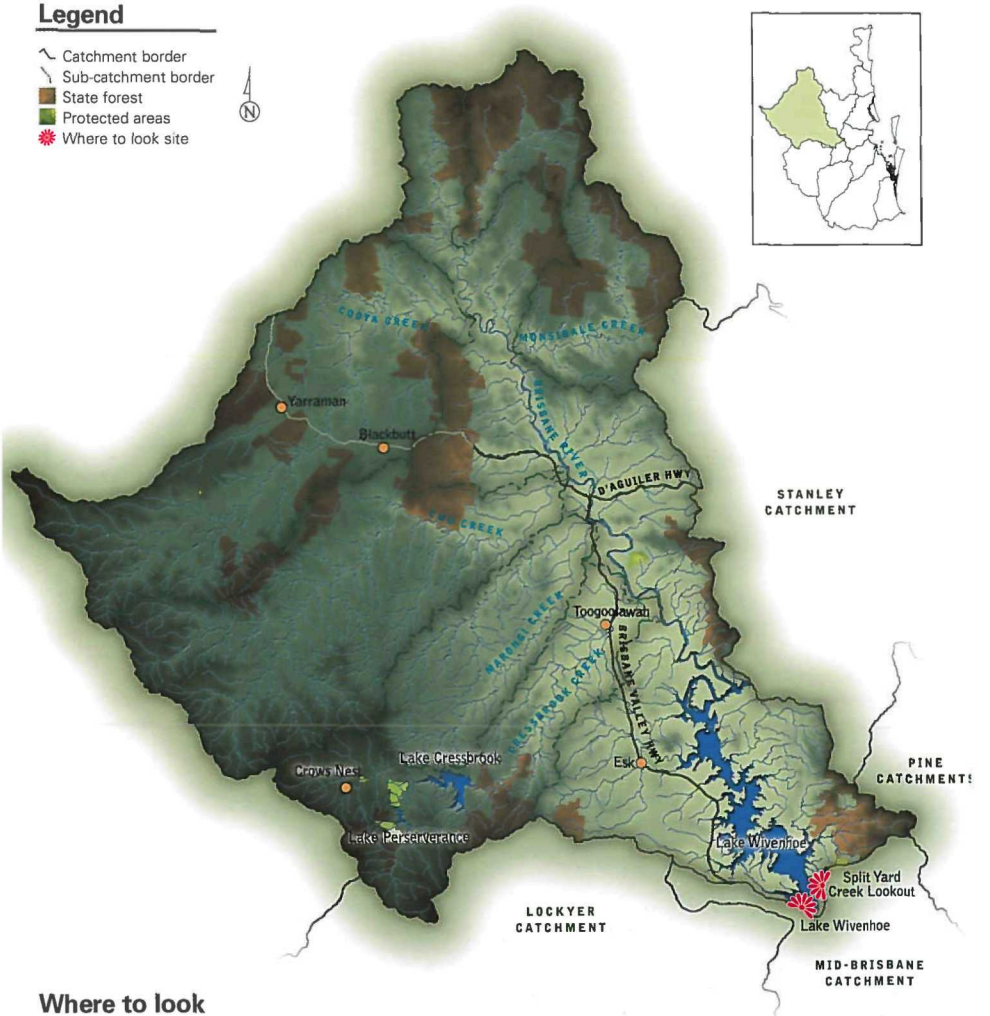
Catchment Area:	5,438 km^2
Catchment Population:	5,480*
Total length of streams:	3,817 km
Major land uses:	Grazing, natural forest, plantations, agriculture, water storage

* SOURCE: QLD DEP. LOCAL GOV. & PLANNING

Lockyer described water in the streams flowing into the Brisbane River upstream of the Stanley River confluence was of "excellent" quality.

– from Steele, 1972

Upper Brisbane Catchment



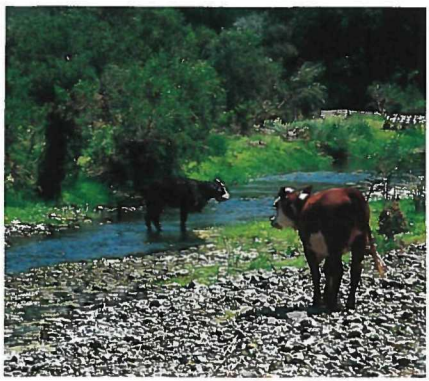
Where to look

■ Split Yard Creek Lookout

While driving along the Brisbane Valley Highway, before reaching Lake Wivenhoe, take the tourist drive turnoff for Split Yard Creek. From here, the lookout affords views of a substantial section of Lake Wivenhoe and beyond to the upper Brisbane River catchment and its many creeks flowing off the Great Dividing Range.

■ Lake Wivenhoe

Take a closer look at Lake Wivenhoe itself from one of the many public access points, such as Cormorant Bay or Hays Landing. Depending on the day or time of year, the waters can be like a mill pond, glassy, calm and quiet or churned up by the wind and showing white-toped caps on the wind generated waves. Also, black swans come here as well as many other water fowl, e.g. herons. No motor powered boating is allowed on the lake so it is a peaceful and safe water body for more passive boating activities such as sailing and paddling.



HEALTHY WATERWAYS LIBRARY

Grazing beef cattle accessing waterways for drinking water in the upper Brisbane catchment

Streams choked with algae

The waterways of the upper Brisbane River catchment carry large sediment loads because of streambank and gully erosion due to clearing. The streams are also often full of algae due to excess nutrients.

These impacts can be linked to uncontrolled stock access to streams in many cases. Cattle can cause riverbank and riparian vegetation degradation due to trampling and water quality deterioration can result from their excrement.

ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL PROTECTION AGENCY

Above: River water with no algae growth on the surface
Above right: River water with excessive algae growth on the surface

Cattle with dry feet

Landholders in the Crows Nest area (headwaters of tributary creeks) are working with Landcare extension officers on developing best practices in grazing management, including improving native pasture ground cover. Managing weeds, such as lantana, in grazing areas and riparian corridors is a constant battle for landholders because of limited resources. Landcare groups based in the adjacent Rosalie Shire are also undertaking weeding and riparian revegetation projects on upper catchment streams.

The South East Queensland Water Corporation has planted extensive areas around Lake Wivenhoe, producing buffer strips to improve sediment filtering. Land use, slope and vegetation characteristics of the upper Brisbane catchment have also been assessed to identify higher risk sub-catchments (i.e. those more likely to deliver greater sediment and nutrient loads). The Corporation is also installing automatic monitoring points across the catchment to measure how much sediment is being delivered into the storage during storm events.

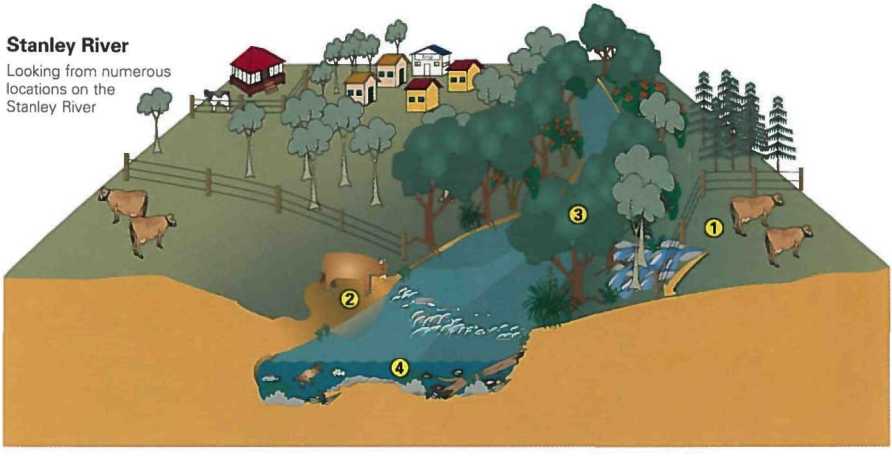
Toowoomba and Crows Nest Councils are also working together to develop catchment management plans and improve sewage treatment in the upper catchment water storages at Perseverance and Cressbrook Dams. These dams supply drinking water to Toowoomba City and its surrounding areas.

How healthy is the Upper Brisbane catchment?

Signs that the Upper Brisbane catchment waterways are in **poor health**:

- Vast areas of the catchment have been cleared and are prone to erosion, gullies in particular.
- Streams are often choked with aquatic macrophytes and filamentous algae, and water quality is low.
- Exotic species of fish are widespread.
- Creek banks are often degraded with little riparian vegetation and the water is cloudy with suspended sediment.

Stanley Catchment



1. Catchment land-use dominated by grazing, natural forest (in upper catchment) and plantations
2. Uncontrolled stock access to the river and creeks causes bank degradation and erosion in some areas
3. Riparian vegetation shades much of the river
4. Water quality and in-stream ecosystem generally healthy

Beef, milk, timber and water

The Stanley River is a tributary of the Brisbane River, joining the Brisbane just upstream from Wivenhoe Dam. The headwaters of the catchment begin in the relatively undisturbed forests of Jimna and Conondale in the Conondale Range, which separates it from the Maroochy-Mooloolah and Mary River catchments. Some timbered areas are National Park and some are State Forest areas that have been selectively harvested.

Most of the headwater streams in this area remain in excellent condition, with their diverse fauna and flora intact. The rare Rainforest Spiny Crayfish is found only in the Conondale Ranges.

The valleys, which were once open forest and grasslands, have been extensively cleared for cattle.

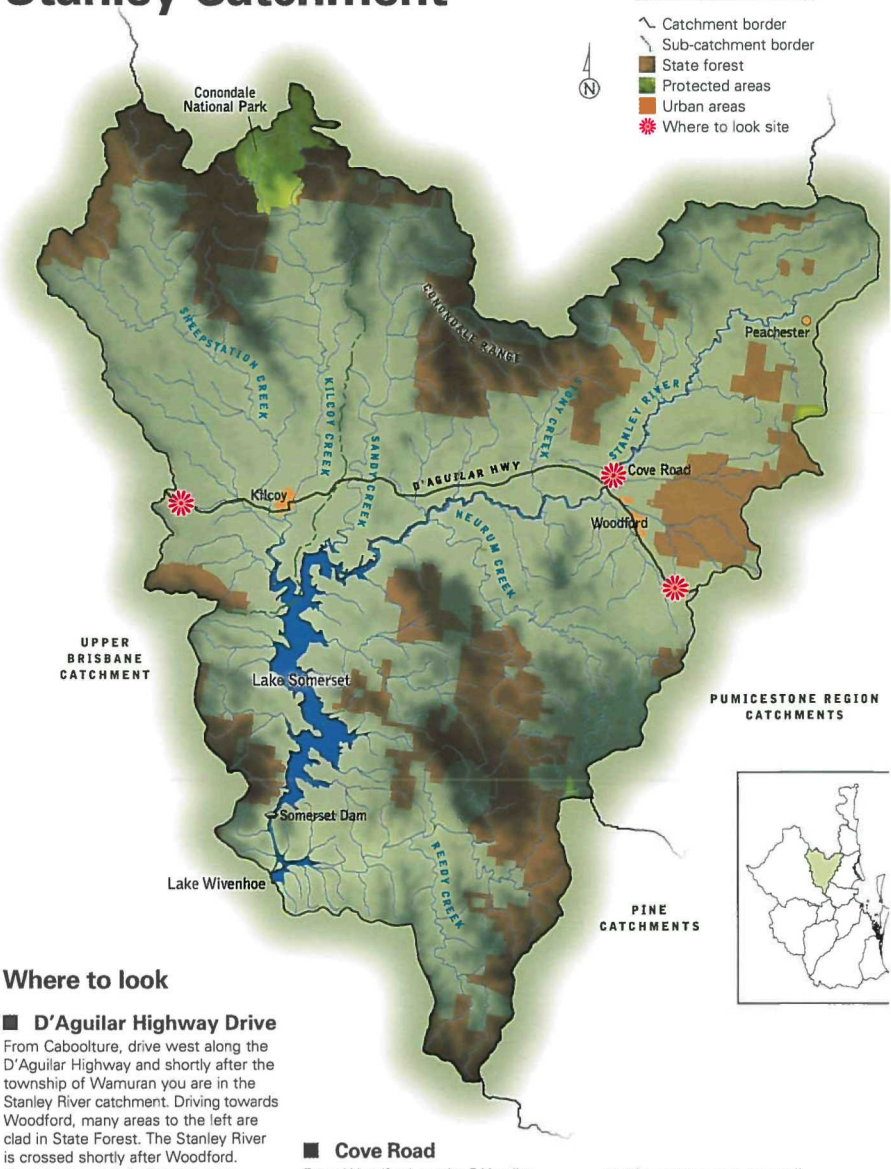
Fact File: Stanley Catchment

Catchment Area:	1,527 km^2
Catchment Population:	10,417*
Total length of streams:	1,045 km
Major land uses:	Grazing, natural forest, plantations, water storage

* SOURCE: QLD DEP. LOCAL GOV. & PLANNING

The Stanley River catchment is principally a beef and dairying area. However, the best known product from the Stanley River catchment is its water. Lake Somerset has been supplying Brisbane residents and industries with water since the early 1950s. Somerset Dam divides the catchment into two segments: the bulk of the catchment upstream of the dam, including the headwaters; and the short, lower section below the dam.

Stanley Catchment



Where to look

■ D'Aguilar Highway Drive

From Caboolture, drive west along the D'Aguilar Highway and shortly after the township of Wamuran you are in the Stanley River catchment. Driving towards Woodford, many areas to the left are clad in State Forest. The Stanley River is crossed shortly after Woodford. From here and including the many creek crossings ahead, you can see the relatively intact riparian vegetation cover of this river and the many creeks that flow into it.

■ Cove Road

From Woodford, on the D'Aguilar Highway, take the Kilcoy-Beerwah Road turn off and after about 1.5 km, turn right onto Cove Road. Proceed for a short distance towards Stanley River. At this spot you can see well vegetated good riparian cover of the river, clear shallow water over a sandy bed, surrounded by mostly cleared grazing land.

How healthy is the Stanley catchment?

Signs that the Stanley catchment waterways are in **moderate health**:

- Most of the upper catchment is relatively undisturbed, although three-quarters of the lower catchment has been cleared for grazing.
- The water is fairly clean and clear with low sediment and nutrient loads.
- Riparian vegetation along most of the waterways, particularly in the upper catchment, is relatively undisturbed.

Using the water supply catchment

Of the freshwater sub-catchments in the Brisbane catchment, the Stanley is by far the healthiest largely because it retains a fair proportion of its protective vegetation covering, both along the waterways and across the catchment. Although three-quarters of the catchment is affected by clearing, much of the upper catchment vegetation, including riparian zones, is intact.

This vegetation helps to increase rainfall infiltration, reduce erosion and filter pollutants out of run-off before they reach the waterways. The streams in this catchment have stony and sandy beds and are fast flowing due to their high slope. This provides lots of oxygen for the many creatures that inhabit them.

The biggest human impact is Somerset Dam. About 90 km of river environment has been converted into a lake and the two sections of the river are now cut off from each other, prohibiting movement of migratory fish (see Chapter 3). The 'lake' habitat does not function as a 'true' lake, however, because the continuous changes in water levels prevent the establishment of the productive littoral habitat essential to functioning ecosystems.

Clean water to drink

Small regional centres like this, with limited access to resources, often need assistance in gathering information on waterway and catchment management. The Brisbane Valley – Kilcoy Landcare group, which has been operating for more than 10 years, is attempting to meet these needs and reach more people. The group has been involved in a number of riparian revegetation projects along the Stanley and Brisbane Rivers and is now focussing on the smaller 'first-order' (headwater) streams. A Waterwatch program has been working with schools and local landholders to provide regular information on stream health.

Kilcoy Shire Council has developed a wastewater reuse scheme that avoids the impacts associated with previous discharge of effluent to Sheep Station Creek (which flows into Lake Somerset).

Again, the South East Queensland Water Corporation is playing an important role in the area, working with the Council and landholders to protect the quality of drinking water supplies in Lake Somerset. The Corporation has been preparing land development and management guidelines for town planning schemes aimed at minimising sediment and nutrient loads from the catchment entering the water storage.

Local industries are also doing their bit, with dairy farmers adopting best practices to achieve both on farm improvements and to enhance sustainability (see Chapter 4).

Moreton Bay

Within easy reach of Brisbane is beautiful Moreton Bay with its varied habitats and its rich wildlife. Although the eastern side remains healthy and diverse, all is not well in Moreton Bay – a brown, murky tide is encroaching from the western shore, killing coral and seagrass and driving away the fish, dugongs and other wildlife.

Rich and diverse waters

Quandamooka, the traditional owners' name for Moreton Bay, was declared a Marine Park in 1993. It is a mosaic of rich reefs, seagrass beds, mangroves, white sandy beaches and mud flats populated by an amazing variety of wildlife.

Moreton Bay is wedge-shaped, the pointed end facing south. Moving northward, the Bay opens out to include Waterloo Bay, Amity, Bramble Bay and, at the far northern end, Deception Bay.

The shallow, productive waters of the Bay are protected from the open ocean by the two large sand islands – Moreton and North Stradbroke. Like Bribie Island, they were formed by the movement of sand northward along the coast (see Chapter 1). Other islands within the Bay, such as St Helena, Peel and Coochiemudlo, were once hills on the mainland. When the sea level rose and formed Moreton Bay, about 6000 years ago, they were inundated, leaving only their tips exposed. Before this, the Brisbane River entrance flowed to the north and east of Amity Point on North Stradbroke Island, where Rous Channel now flows. It would have been possible to walk from Brisbane to Amity.

QUEENSLAND MUSEUM

Moreton Bay a large body of relatively shallow water is a fishing, recreation and natural icon of South-east Queensland which also receives major international shipping traffic

Fact File: Moreton Bay

Catchment Area:	1,523 km^2 (Bay area)
Catchment Population:	7,081* (Bay islands)
Total length of streams:	Not applicable
Major land uses:	Marine Park with National Park sections, fishing, recreation, transport

* SOURCE: QLD DEP. LOCAL GOV. & PLANNING

The Bay supports a variety of environments and habitats, from estuarine to marine. In the eastern Bay, near Amity Point, are the Moreton and Amity Banks. The clear waters around this network of sandbanks support lush seagrass pastures which are grazed by dugong and turtle and other marine life.

Corals grow on rocky outcrops in Moreton Bay along with sponges, anemones, fish and turtles. While some of the corals on the western side of the Bay have fallen victim to the tide of mud flowing out of the rivers, there are still living patches to be found near many of the Bay islands – Peel, Coochiemudlo, King, Green and St. Helena. Myora Reef in the Rainbow Channel also supports a wide variety of coral species.

The western side of the Bay has abundant mangroves and is more 'muddy' than the eastern Bay. The mangroves are important nurseries for fish, crabs and prawns. While some 'muddiness' is part

of the natural state of this part of the Bay, human activities have intensified this.

The Bay is an important site for bird rookeries and feeding grounds. It is the summer feeding ground for the wader birds that migrate down the Australasian Flyway from the Northern Hemisphere. These whimbrels, curlews and sandpipers feed in the rich intertidal zones along the shores, before returning to the Northern Hemisphere. Moreton Bay has been listed under the United Nations Convention on Wetlands of International Importance (Ramsar Convention).

Southern Moreton Bay is a network of channels that weave around a series of low-lying islands, including Macleay, Garden, Lamb, Karragarra, Russell, Long, Pannikin and Lagoon. These shallow waters support seagrass beds and are an important fish nursery.

The fringes of these islands support extensive mangrove forests and saltmarsh, although large sections have now been cleared for housing.

ENVIRONMENTAL PROTECTION AGENCY

Moreton Bay provides South-east Queensland with a rich fishery for prawns, fish and other seafood and prawn trawlers can often been seen on Bramble Bay

Brisbane's playground and seafood basket

Moreton Bay provides South-east Queensland with a rich fishery for prawns, fish and other seafood – estimated to be a 10 per cent (around $30 million) of the total commercial catch for the entire east coast of Queensland.

Holiday-makers, locals and international tourists come to the Bay to fish, sail, cruise, swim, bird-watch and enjoy the spectacularly beautiful waterscape.

The western shores of the Bay are lined by the Brisbane suburbs of Sandgate, Nudgee, Wynnum, Manly and Cleveland. North Stradbroke Island and the network of islands to the south of Wellington Point also support growing populations. These western sections, including Bramble Bay and Waterloo Bay, to the north and south of the Brisbane River mouth are suffering from the impacts of the river catchments that flow into the Bay waters.

The Brisbane, Pine, Logan and Caboolture River catchments have the biggest environmental impact on Moreton Bay, as do the Tingalpa, Cabbage Tree, Downfall, Kedron Brook, Hilliards and Eprapah Creek catchments, which all empty into the Bay. These heavily modified and polluted catchments combined take up more than ten times the area of the Bay they flow into. This means that human activities over this vast land surface are likely to have a big effect on the health of this smaller "receiving" waterbody.

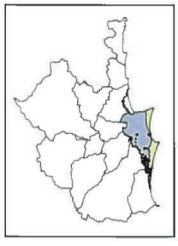
Ships travelling to and from the Port of Brisbane (at the mouth of the Brisbane River) use the shipping lanes running to the northern end of Moreton Island. These channels often need to be dredged to maintain their depth in the shifting sands of the Bay.

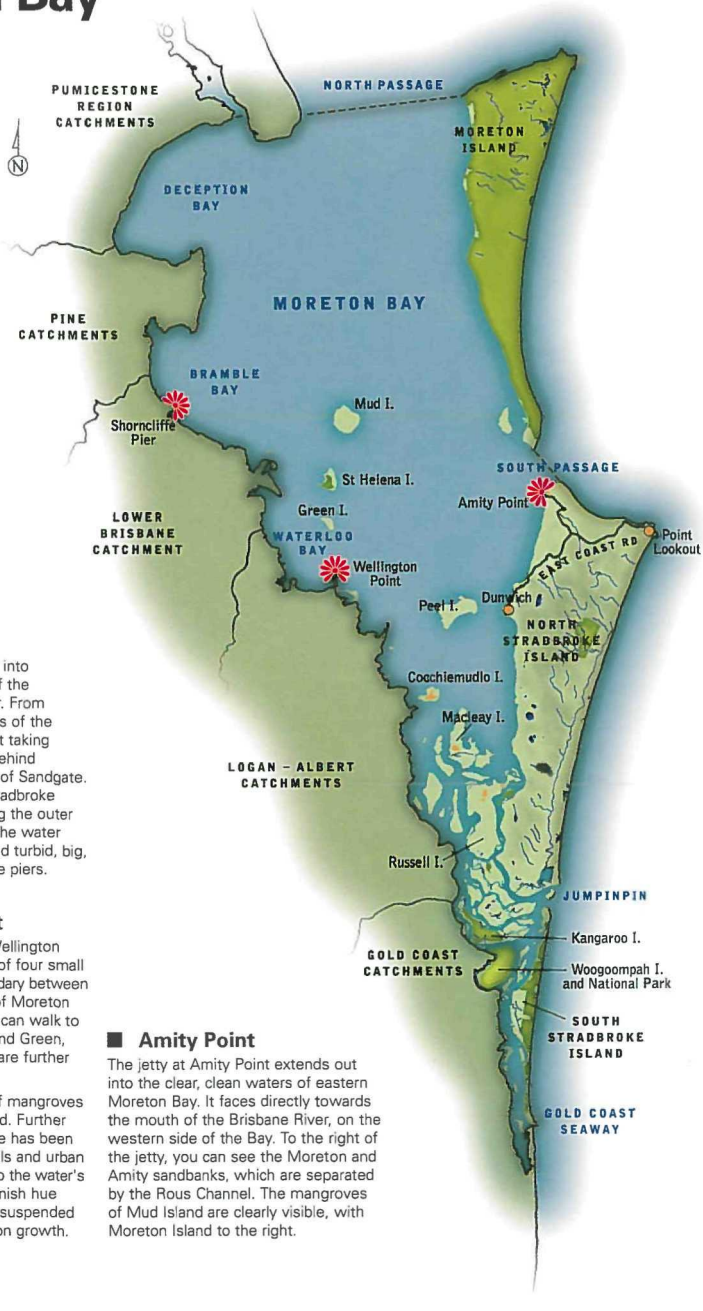
Treated sewage flows directly into the Bay from Luggage Point at the mouth of the Brisbane River, as well as from Pine River, Hays Inlet and Tingalpa Creek.

Moreton Bay

Legend

- Catchment border
- Sub-catchment border
- State forest
- Protected areas
- Where to look site





Where to look

■ Shorncliffe Pier

The Shorncliffe Pier juts out into Bramble Bay, to the north of the mouth of the Brisbane River. From here, you can see the cranes of the Port of Brisbane, and aircraft taking off from Brisbane Airport. Behind you, is the Brisbane suburb of Sandgate. To the east, you can see Stradbroke and Moreton Islands forming the outer boundary of Moreton Bay. The water around the jetty is brown and turbid, big, blue jellyfish float around the piers.

■ Wellington Point

From the northern end of Wellington Point, you can see a series of four small islands which form the boundary between Waterloo Bay and the rest of Moreton Bay. King Island (which you can walk to at low tide) is the closest, and Green, St Helena and Mud islands are further out into to the Bay.

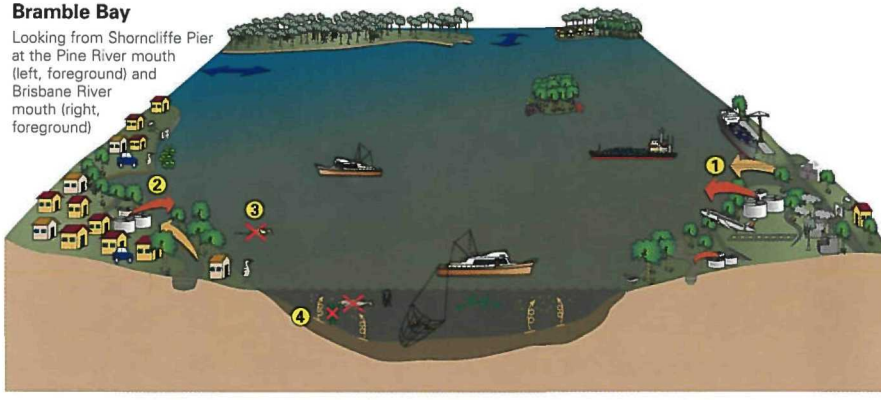
South of the pier, is a line of mangroves with muddy tidal flats behind. Further round the Bay, the foreshore has been hardened with concrete walls and urban development extends right to the water's edge. The water has a greenish hue from moderate amounts of suspended sediments and phytoplankton growth.

■ Amity Point

The jetty at Amity Point extends out into the clear, clean waters of eastern Moreton Bay. It faces directly towards the mouth of the Brisbane River, on the western side of the Bay. To the right of the jetty, you can see the Moreton and Amity sandbanks, which are separated by the Rous Channel. The mangroves of Mud Island are clearly visible, with Moreton Island to the right.

Bramble Bay

Bramble Bay
Looking from Shorncliffe Pier at the Pine River mouth (left, foreground) and Brisbane River mouth (right, foreground)



1. Catchment loads of sediment and nutrients from Brisbane and Pine Rivers
2. Large sewage discharges, currently being upgraded
3. High turbidity, nutrients and phytoplankton contribute to poor water quality – few people swim here now
4. Seagrass loss caused by sediment resuspension

"The blacks would catch them at Fisherman's Island, at St. Helena, at a place near Dunwich they called "Gumpi", Dugong, at Bribie Passage, and at the mouth of the Pine River."

– **Petrie, 1904**

"Great quantities of turtle were seen in the old times at Humpybong (Redcliffe), and they were also plentiful in Bribie Passage."

– **Petrie, 1904**

How healthy is Bramble Bay?

Signs that Bramble Bay is in **poor health:**

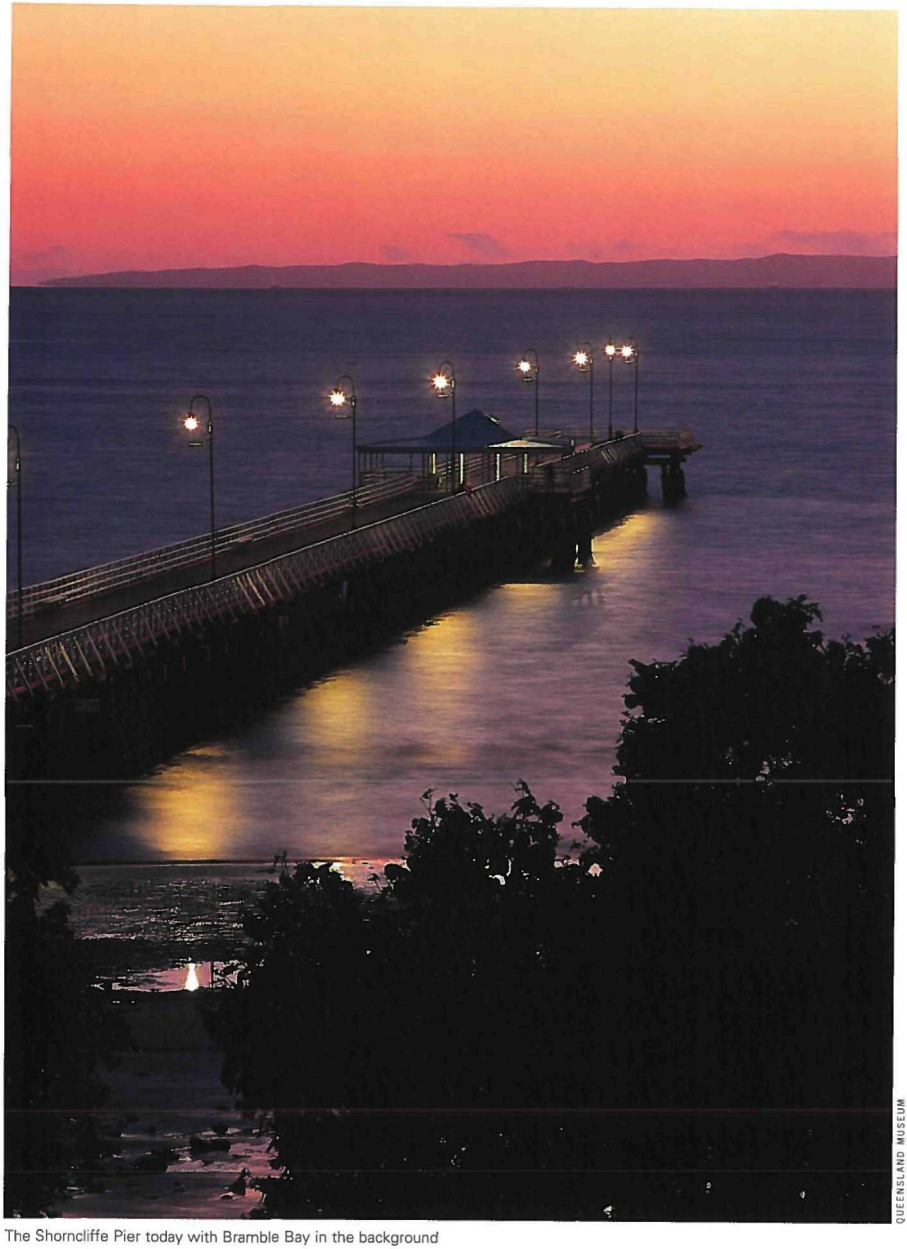
- The shallow waters are brown and turbid.
- Phytoplankton blooms often give the water a greenish tinge.
- There is no seagrass left here, and very little wildlife other than prawns and jellyfish.

Few people swim here these days

Bramble Bay, in the north-west of Moreton Bay, shows clear signs of poor health and imbalance because of human activity **(Where to Look, Shorncliffe Pier, p.95)**. The water is brown and muddy from topsoil washed from gardens and construction sites and the upper catchments of the Brisbane River.

After heavy rain, water flowing out of the Brisbane River usually carries a load of sediment (mud), as well as nutrient and sewage pollutants. This plume of water spreads out, mainly to the north into Bramble Bay. The tidal currents are less vigorous in the western part of Moreton Bay, so these sediments don't disperse easily.

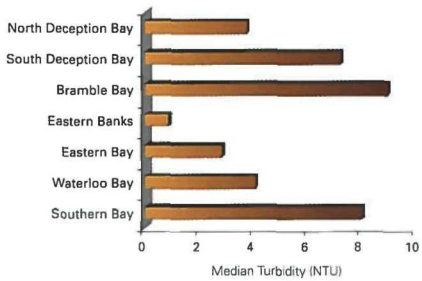
Because Bramble Bay is so shallow, the small silt particles are kept in suspension by wind and wave action. The waters of Bramble Bay are only clear for a few weeks during the winter months, because of still conditions. Few people swim here these days because of the turbidity. In contrast, in the



QUEENSLAND MUSEUM

The Shorncliffe Pier today with Bramble Bay in the background

early part of the 20th century, many Brisbane people caught the train to Sandgate and Shorncliffe on weekends to picnic on its beaches and swim in the shark proof enclosure. To the north of the Shorncliffe Pier you can still see the remains of the swimming enclosure piers protruding from the water.



Turbidity, a measure of the murkiness of water is highest in Bramble Bay compared with other locations in Moreton Bay July 2000 – April 2001

SOURCE: EHMP 2001 REPORT CARD

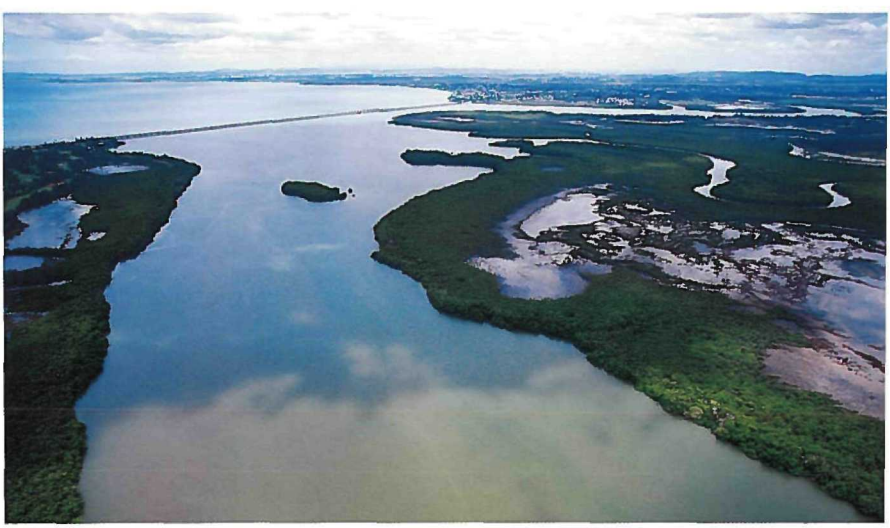
The turbidity of the water has had dire consequences for aquatic animals in Bramble Bay. Because light no longer penetrates the cloudy water, the once abundant seagrasses have gone, as well as the turtles, dugong and other creatures which fed on it. Prawns, which can tolerate most environments, are still plentiful and at night you can often see the lights of the prawn trawlers.

In addition to the cloudiness of the water, high concentrations of nutrients (particularly nitrogen) leads to algal blooms in Bramble Bay. These are visible as a greenish tinge in the brown water or along the shore. Along the shore at Redcliffe, sea lettuce blooms periodically turning the beaches and rocks green coloured.

The nutrients which cause the algal blooms come not only from the suspended sediments, but also from the sewage discharges from Luggage Point and Hays Inlet that are "trapped" in Bramble Bay.

The mangroves lining the river mouth and much of the foreshore absorb some of these excess nutrients, but they cannot cope with the massive daily loads of nutrients in the water.

Recently, the Councils in the Bay area have greatly reduced the amount of nitrogen released into the water through extensive upgrades of the various *sewage treatment plants*.

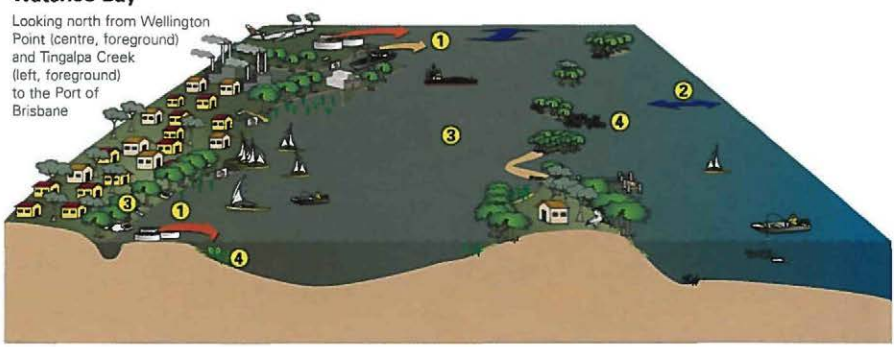


Hays Inlet (foreground) with Bramble Bay in the background (left) and Pine River mouth (right)

Waterloo Bay

Waterloo Bay

Looking north from Wellington Point (centre, foreground) and Tingalpa Creek (left, foreground) to the Port of Brisbane



1. Sediment and nutrient inputs from Brisbane River, Tingalpa Creek, and numerous creeks and stormwater drains
2. Flushing occurs from tidal exchange through North and South Passages
3. There is a steep water quality gradient from shore to Bay
4. Seagrass beds remain in shallow areas of western shore; corals occur on fringing islands

A system teetering on the brink

Look left from the jetty at Wellington Point **(Where to Look, Wellington Point, p.95)** and you will see the water is brown and cloudy. In many places, the once abundant coral reefs have died and are covered with brown algae.

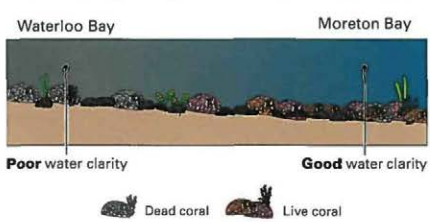
Towards the east, there is a gradual change in the water from brown to blue. If you looked under the water you would notice an increase in the amount of live coral and a decrease in algae. This is evidence of a very steep water quality gradient – with poor water quality close in shore and improving rapidly further out into the Bay. The water to the east of Waterloo Bay is cleaner because of the tidal flushing through the northern and southern channels – between Mud Island and the northern tip of Moreton Island, and between Moreton Island and North Stradbroke Island.

The dead coral boulders, which remain close to the western shore, are evidence of the 1974 flood that poured tonnes of muddy sediment out into the Bay and killed the coral. This process continues to a lesser extent as a result of sediments, sewage discharge and other pollutants flowing out from

How healthy is Waterloo Bay?

Signs that Waterloo Bay is in **moderate health**:

- Although water clarity is better here than elsewhere in western Moreton Bay, the turbidity is still quite high and the water has a greenish hue from phytoplankton blooms.
- The water becomes rapidly clearer to the east and there are still some corals and seagrasses to be found, mainly in the eastern section of Waterloo Bay.



An improving water clarity gradient, west to east exists from Waterloo Bay to eastern Moreton Bay resulting in the presence of dead coral nearer to Waterloo Bay and live coral where the water clarity is better

the Brisbane River at the northern end and Tingalpa Creek at the southern end of Waterloo Bay.

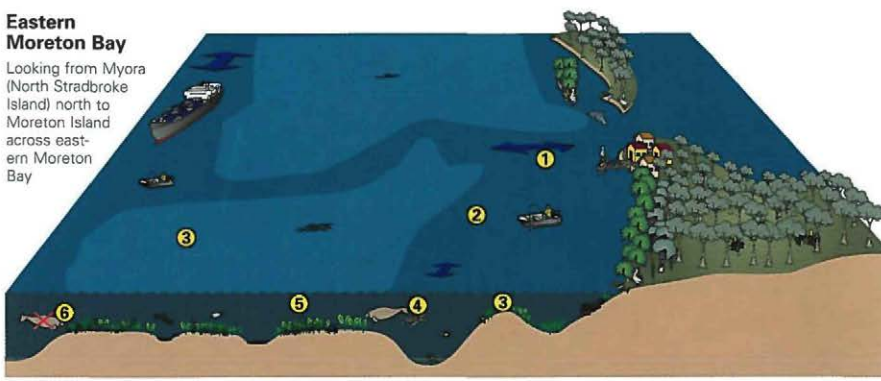
The good news is that recent sewage treatment upgrades have improved water quality. Some seagrasses also still grow here, feeding the occasional dugong or turtle. During the summer months, flocks of migratory waders can be seen poking around for food on the mud flats. There are usually plenty of people out on the tidal flat pumping yabbies, fishing, sailboarding or boating.

Wellington Point with King Island in the foreground and Waterloo Bay in the background

Eastern Moreton Bay

Eastern Moreton Bay

Looking from Myora (North Stradbroke Island) north to Moreton Island across eastern Moreton Bay



1. Tidal flushing through the North and South Passages
2. Eastern Moreton Bay has clear, blue and clean water
3. Amity and Moreton Banks support extensive seagrass beds
4. Populations of dugongs and turtles and fish feed on the seagrass beds
5. Lyngbya blooms blanket large areas of seagrass beds
6. Lyngbya deters dugong grazing

How healthy is Eastern Moreton Bay?

Signs that Eastern Moreton Bay is in **good health**:

- The water is clear, blue and clean.
- Abundant dugong, turtles, fish and other marine creatures feed on the extensive seagrass pastures; mangroves and other vegetation on North Stradbroke, Moreton and Crab islands are healthy and plentiful.

Dugongs, dolphins and turtles

If you stand on the jetty at Amity Point (**Where to Look, Amity Point, see p.95**), you can see straight across the Bay to the mouth of the Brisbane River.

On a sunny day, the water is clear and blue with clean white sands near the shoreline. On weekends, the sound of seagulls and terns calling mingles with the slap of water against boat hulls, the whine and ratchet of fishing reels and the splash of swimmers around the jetty.

In Moreton Bay their favourite feeding grounds are upon shallow flats that are never totally dry at low water, but have from six feet to twenty feet on them at high tide. All over these shallow sandbanks and flats a marine plant grows, which very much resembles clover in appearance. It throws out a small green leaf from a thick mat of white succulent roots, very tender and sweet; and it is upon these roots, which are known among fishers as dugong grass, that the animal chiefly feeds.

– **Welsby, 1907**

Rainbow Channel flows in front of the Amity Point jetty, and out into the open ocean. Over the years, several blocks of land have been eroded away by the fast flowing current and a rock wall along the Amity foreshore has been built to slow this process.

To the north and west of Amity, the shifting sands build up as sandbars and islands, providing important habitat for migratory wader birds and shallow sandbanks for the plentiful seagrass pastures. This is the largest area of seagrass pasture remaining in South-east Queensland and is a very important habitat. Nowhere else in the world can you see dugongs, dolphins and turtles living within view of a major city skyline.

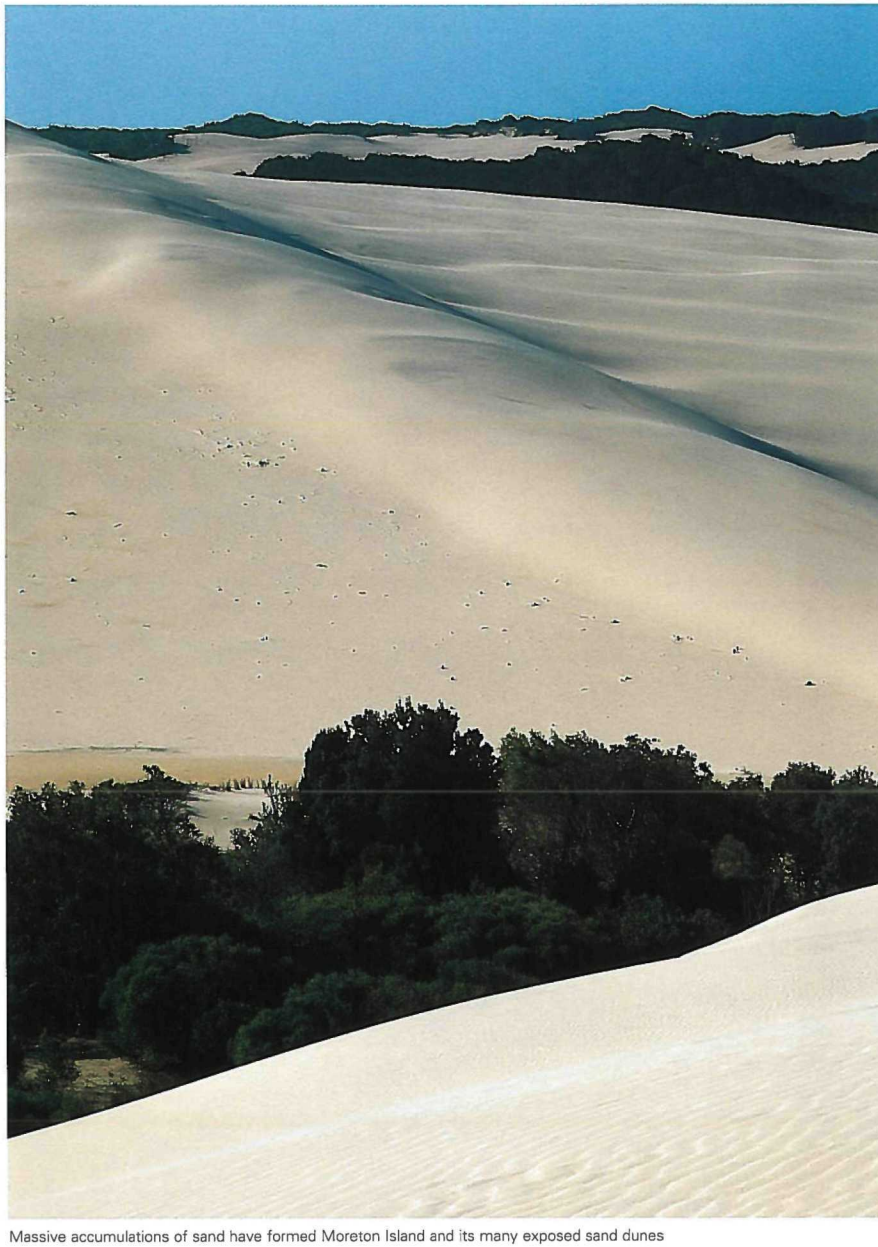
ENVIRONMENTAL PROTECTION AGENCY

Dugongs feed on the seagrass beds in Moreton Bay

There are extensive coral beds in the Eastern Bay, particularly near Myora, to the south and east of the Amity jetty. Eastern Moreton Bay has so far escaped the sediment and nutrient loads that have degraded the western Bay. The water in the eastern part of the Bay also stays cleaner because of the flushing of the tide and currents through the North and South Passages to the open ocean.

Very little run-off comes from North Stradbroke or Moreton Islands. These two sand islands have few creeks, as water flow occurs largely beneath the surface. The islands represent massive sand aquifers – underground 'dams' full of clean, fresh water which has been filtered through sand. Some of this underground water is pumped to the mainland for use by the residents of Redland Shire. There has been some disturbance to the groundwater through the sand-mining on North Stradbroke. Unfortunately blooms of the the toxic algae, *Lyngbya* (see Chapter 8), were documented near Amity Banks for the first time in early 2000, blanketing large sections of seagrass and forming continuous mats of long strands from the Amity jetty right down to Peel Island.

You can see also check out how the seagrass is faring from the evidence washed up on the shore at Amity. Piles of single leaves and stems is evidence of natural shedding. However, if the whole plant washes up, roots intact – it has either been uprooted by a storm or killed by *Lyngbya*.



Massive accumulations of sand have formed Moreton Island and its many exposed sand dunes

Southern Moreton Bay

A mangrove maze

Southern Moreton Bay's network of channels create a series of low energy environments where the deposition of sands and muds has created extensive intertidal and shallow sub-tidal areas.

Because of the convoluted channels flowing between the islands, 'residence' times for waters in southern Moreton Bay are long, and there is little flushing of sediment and nutrients. The main ocean inlet at Jumpinpin bar is also constricted, limiting exchange with the open ocean.

This means that the muddy mix of water and sediment which flows out of the Logan River, particularly after heavy rain (see Chapter 11) is adding significant sediment and nutrient loads to the habitats in southern Moreton Bay. Increased turbidity has led to the loss of some seagrasses, particularly in western parts of southern Moreton Bay around Behm's Creek.

Extensive beds of green macroalgae have colonised some areas (e.g. Pelican Banks east of Coochiemudlo Island and Canaipa Passage east of Russell Island) and there is concern that this algae may be able to outcompete and displace seagrasses in some areas.

Housing development on the islands has also led to loss of mangrove habitat and has the potential to increase pollutant loads entering the system (via urban stormwater).

The eastern parts of southern Moreton Bay are still quite productive, with healthy seagrass beds, and are important recreational fishing areas.

How healthy is Southern Moreton Bay?

Signs that southern Moreton Bay is in **moderate health.**

- The water is turbid in the western sections from sediment from the Logan River.
- Loss of seagrass and wetlands (western part).
- Extensive seagrass beds in the network of channels (eastern part).
- The shoreline is lined with mangroves and saltmarsh.
- Some loss of mangroves due to hail damage.

QUEENSLAND MUSEUM

The network of channels of Southern Moreton Bay have aided the deposition of sands and muds creating a mangrove maze

Pine Catchment

Overloaded and overworked

The North and South Pine Rivers are named for the Hoop Pines, which were once abundant in the lowland rainforest that covered the area. Much of this forest has now given way to growing urban, rural residential and industrial development. The catchment also supports substantial rock, sand and gravel extraction industries, particularly since extractive dredging was banned in the Brisbane River.

> "Oxley was impressed by 'a great many very fine cypress (Hoop Pine)' and 'good soil'
> – **John Oxley (1783 – 1823)**

The two rivers are short, and both rise in the forested slopes of the D'Aguilar Range, west of the Bruce Highway, before flowing into Hays Inlet and then into Bramble Bay. The water quality in the twin rivers is poor, with high nutrient levels from sewage effluent, urban run-off, forestry and agriculture. Sediment levels are also high due to erosion, from agricultural areas and residential developments.

Fact File: Pine Catchment

Catchment Area:	816 km^2
Catchment Population:	177,300*
Total length of streams:	553 km
Major land uses:	Urban, grazing, natural forest

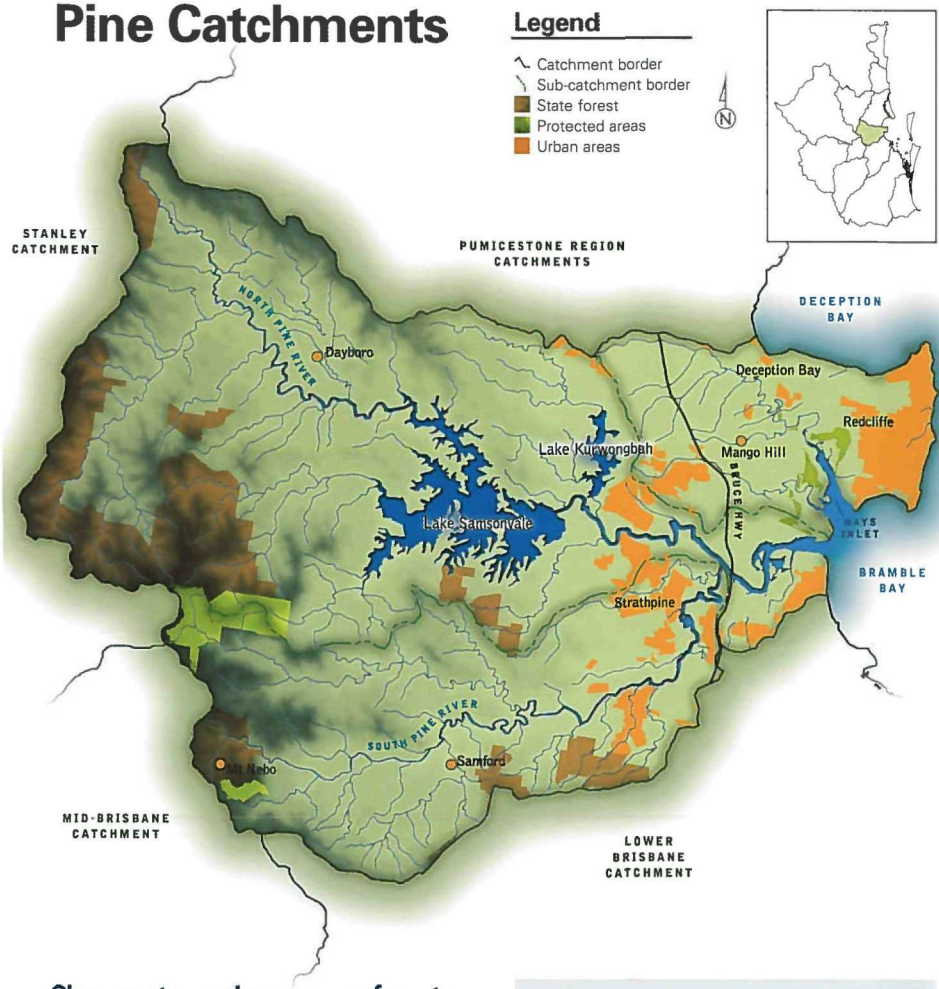
* SOURCE: QLD DEP. LOCAL GOV. & PLANNING

The most significant impoundments on the two rivers are Lake Samsonvale and Lake Kurwongbah, which provide water to the people of Redcliffe, Pine Rivers and the northern suburbs of Brisbane. Because of these dams, there is little freshwater flow in the river and little flushing of pollutants.

Little riparian vegetation remains, particularly in the eastern part of the catchment. The exception is the mangrove haven of Hays Inlet, which is an important nursery and feeding ground for fish and many other aquatic species.

Aerial view of Pine Rivers catchment with Lake Samsonvale in the foreground and the D'Aguilar Ranges in the background

Pine Catchments



Clean water and mangrove forests

The key to protecting and preserving Moreton Bay and its Marine Park status is to limit the pollutant loads flowing into the Bay via the river systems. The management actions needed to achieve this are already underway in the Pumicestone, Brisbane, and Logan-Albert catchments (see Chapters 8, 9 and 11).

The location of Brisbane City on a floodplain and its proximity to the Bay have created biolog-

How healthy is Pine catchment?

Signs that Pine catchment waterways are in poor health:

- The water in the river and inlet is brown and murky.
- Blue-green algal outbreaks have occurred in Lake Samsonvale.
- There is very little flow in the river below the dam, so flushing is minimal.

ical challenges. The lack of water currents in the western part of the Bay means that pollutants flowing out of the mouths of the rivers and creeks entering the Bay simply stay put, particularly in Bramble Bay, thus magnifying their impacts.

Monitoring the wildlife, habitat and ecological processes in Moreton Bay is important as these will give indications of where future efforts should be focussed. Queensland Parks and Wildlife Service, Moreton Bay Marine Park rangers regularly monitor the numbers of marine animals such as dugong, turtles and annual humpback whale migrations.

Trained community volunteers are also involved in a seagrass watch program as well as monitoring migratory birds numbers and feeding patterns. As described earlier (see Chapter 8), a major collaborative research effort is also underway to identify address causes and effective control measures for *Lyngbya* outbreaks.

Boral Resources has provided support through the development of artificial nesting sites for endangered species such as the Little Tern (*Sterna albifrons*). The State Government has also installed public moorings at popular dive spots to prevent coral damage and to maintain access for reef activities.

Marine Park rangers also conduct regular patrols of the Marine Park – an important part of public contact and enforcement of rules governing both commercial operators and recreational boaters – and the State Government also regulates fishing in the Bay.

Signage has been erected at key boundaries on the Moreton Banks, Amity Banks, Peel Island and Prices Anchorage, informing boaters to 'go slow' in these important turtle and dugong grazing areas. Signage at major boat ramps show the zoning provisions for Moreton Bay Marine Park with details of permissible and prohibited fishing and boating activities.

An indigenous ranger working with the Queensland Parks and Wildlife Service, particularly with turtle and dugong management, is part of an active partnering with the indigenous traditional owners and elders. The Quandamooka Aboriginal Land and Sea Management Agency (QALSMA) and Quandamooka Land Council (QLC) are also involved in a number of projects on North Stradbroke Island, including studies to better understand turtle biology, cultural programs, and camping and recreation management.

In recent years many Councils have made major investments in improving the level of treatment for wastewaters entering the Bay. One of the most significant projects of these has been Redcliffe City Council's upgrade of its sewage treatment plant. Costing around $18 million, it is the single biggest capital project ever undertaken by the Council. The project aims to substantially reduce nutrient concentrations in effluent entering Hays Inlet and Bramble Bay.

At the opening of the new plant in June 2001, attended by all Redcliffe Council members, elected representatives openly expressed their childhood memories of the Bay and their deep desire to restore its health, vitality and beauty for future generations.

Pine Rivers Shire Council has also invested substantial funds in completing a number of important upgrades to its sewage treatment plants, again targeting reduction in problem nutrients, aimed at improving conditions within Hays Inlet and Bramble Bay.

Redland Council has undertaken upgrades to its Thorneside and Capalaba Sewage Treatment Plants at a cost of approximately $15 million and has plans for further upgrades at the Cleveland and Victoria Point plants. These upgrades are aimed at reducing impacts to Tingalpa Creek, Waterloo Bay and western Moreton Bay. Redland Council has established wastewater reuse schemes to irrigate turf farms and golf course and is investigating further wastewater reuse options.

Brisbane City Council operates the largest wastewater treatment facilities discharging into Moreton Bay. The Luggage Point Sewage Treatment Plant alone treats wastewaters from an equivalent of approximately 800,000 people and is the largest in South-east Queensland, receiving wastes from both domestic households and industry (in about equal quantities).

The Council has embarked on a major program to upgrade the Luggage Point Plant to reduce the effluent concentrations of problem nutrients

CR A. SUTHERLAND

Alan Sutherland at Redcliffe jetty, 1968 – recent upgrades by Redcliffe City Council are aimed at restoring the health, vitality and beauty of our waterways

CR A. SUTHERLAND

Cr Alan Sutherland – Deputy Chair, South East Queensland Regional Water Quality Management Committee, at Redcliffe jetty, 2000

(particularly nitrogen) in an effort to reduce algal blooms and other potential adverse impacts to Bramble Bay.

With the financial assistance of the Queensland and Commonwealth Governments, Brisbane has also constructed a major wastewater recycling facility, which supplies the adjacent BP Amoco Oil Refinery and is actively investigating both local and regional scale wastewater reuse schemes. Upgrades to the Sandgate and Wynnum Sewage Treatment Plants are also aimed at reducing nutrient levels discharged to Bramble and Waterloo Bays, respectively.

Revegetation of riparian areas, reducing erosion, and cleaning up stormwater in the Brisbane, Pine Rivers and Redlands catchments are also important actions to preserve the Bay. Many of these actions being undertaken in the Brisbane area are discussed in Chapter 9.

In Pine Rivers, the Council is undertaking a series of initiatives to reduce the impacts of stormwater run-off. These include a number of urban stream restoration programs, aimed at returning more natural flow, bed and bank features, weed removal and planting to restore riparian vegetation. School students are also involved in water quality monitoring, weed removal, soil testing, and tree planting.

Land uses in Redland Shire include poultry farming, plant nurseries, flower farms, market gardens, urban areas and bushland. As such, there is significant potential for sediment and nutrient loads from this area to impact on Waterloo Bay. The rapid development and urbanisation of the Shire in the past decade has introduced even further pressures.

To address these problems, Redland Council supports a range of riparian restoration projects by community groups. Council has also introduced initiatives such as strategic plans, development control plans, vegetation protection and pest management plans and catchment and waterway management plans to guide and control future development activities.

Logan-Albert Catchments

Fact File: Logan-Albert Catchments

Catchment Area:	4,133 km^2
Catchment Population:	407,513*
Total length of streams:	2,828 km
Major land uses:	Grazing, natural forest, urban, agriculture

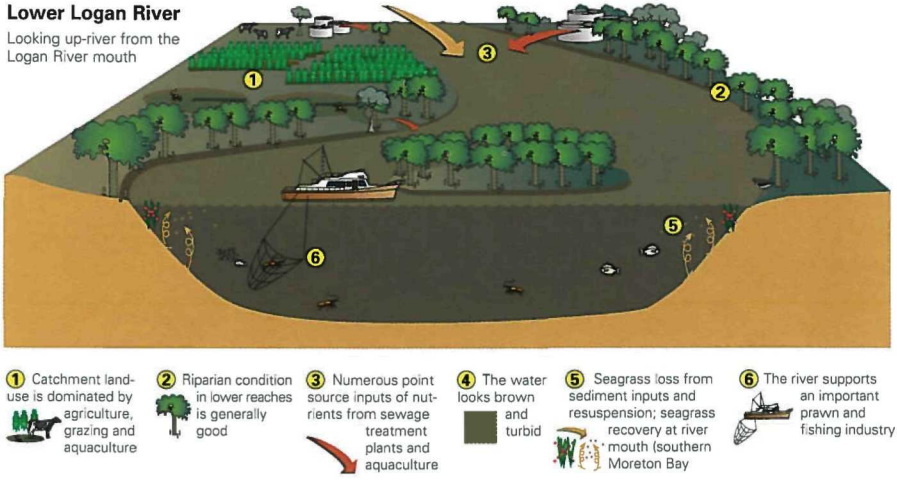
* SOURCE: QLD DEP. LOCAL GOV. & PLANNING

From the mountain headwater streams to the Logan estuary, the catchment supports a variety of human activities, including agriculture, urban development, sand and gravel extraction and fisheries. Apart from the lush rainforests and open eucalypt forests that clothe the mountains at the top of the catchment, much of the native vegetation has been cleared, resulting in significant soil erosion and a decline in waterways health.

From ancient rainforests to bay waters

The headwaters of the Logan and Albert Rivers flow from the mountains of the Scenic Rim, which separate Queensland and New South Wales. These mountains are covered in subtropical rainforest, drier eucalypt forest and hoop pines, and cool temperate forest on the upper slopes, including ancient Antarctic beech forests. From here, a multitude of small creeks begin winding down through steep gorges and valleys to the plains below, where they eventually join to become the Logan and Albert Rivers.

At the time of European settlement, the rolling hills through which the Logan and Albert Rivers flow were covered with an extensive mosaic of open forest, woodland and grassland. Much of the forest and woodland has been cleared to make way for farming and urban settlement and today



the catchment is covered with grassland, patches of scrub, a scattering of majestic eucalypts and riparian vegetation in poor condition.

The estuarine section of the two rivers flows through Beenleigh and the southern suburbs of Logan City before joining near Alberton. Mangrove forests are still largely intact along the river banks and at the river mouth, as well as seagrass beds that have reappeared in the shallow waters after many years absence.

The Logan-Albert empties into southern Moreton Bay among a network of islands and channels to the north of Jumpinpin (see Chapter 10).

Horses, beef, sugar and prawns

Most of the open forest in the mid-section of the catchment has been cleared to make way for the large numbers of horses (for racing and other sports) and beef cattle. Driving down the Mt Lindsay Highway, the horse studs with their white timber fences and the cattle grazing on irrigated pastures are a familiar sight.

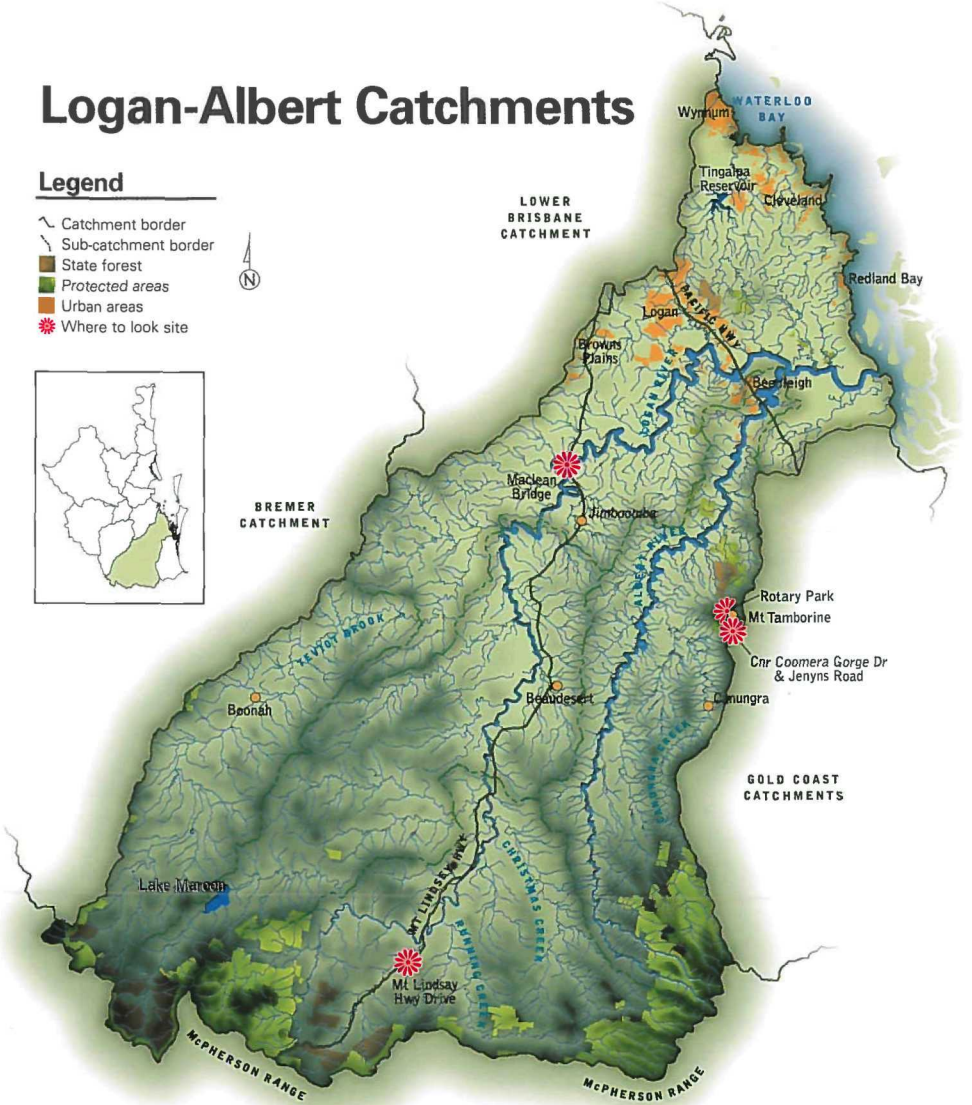
In between the farming areas, which support cropping, dairying and poultry, more and more rural residential housing is being developed and the major towns, Beenleigh and the City of Logan, are steadily spreading outwards. To support and service the growing population, currently nine sewage treatment plants discharge treated wastewater high in nutrients into the Logan and Albert Rivers, contributing to poor health of the waterway in the tidal reaches.

The catchment also supports a growing aquaculture industry – freshwater species such as Redclaw Crayfish, eels in the mid-section of the catchment and prawns in the estuary. About 20-30 tonnes per year of prawns are harvested from the two rivers.

Large areas of sugar cane form a dense green lining in the Logan River estuary before it empties into the southern Moreton Bay. The network of channels in this part of the Bay support an important fishery, yielding good supplies of fish and prawns.

Unlike other rivers in South-east Queensland, there are currently no major dams or water storages along the Logan and Albert Rivers, although there is some water extraction for irrigation and household use. Sand and gravel are extracted from the bed of the Logan River at a number of points along its length. The sand and gravel is used to make concrete for the building industry.

Logan-Albert Catchments



Where to look

■ Mt Tamborine Rotary Park

Near the entrance to Witches Falls National Park, you have a clear view to the west and can see Canungra Creek (closest to the lookout) and the Albert River (in the background) both flowing north to where they join up.

■ Mt Tamborine – Cnr Coomera Gorge Drive and Jenyns Road

Facing north-east, you have a bird's eye view of the lower sections of the Logan-Albert catchments. A green blanket of sugarcane fields interspersed with Melaleuca wetlands and mangrove extend down to the river mouth.

■ Maclean Bridge and Mt Lindsay Highway drive

A drive down the Mt Lindsay Highway, will take you from the urban development of Logan City, through a largely rural landscape and to the catchment headwaters in the McPherson Range. The Maclean Bridge crosses the Logan River on the way to Jimboomba and there is a park on the Brisbane side of the river where you can safely stop. The Logan River here is deeply incised into the riverbank which is heavily infested with weeds and the water often looks brown from the sediment load it is carrying from catchment runoff.

How healthy are the Logan-Albert catchments?

Signs that the Logan-Albert catchments waterways are in **poor health**:

- Most of the riparian vegetation has been lost, though in many places massive weed infestations have taken over. Exotic freshwater fish, including carp, are common.
- A large proportion of the catchment has been cleared, increasing erosion and contributing heavy sediment loads to the waterways.
- The waterways – in particular the Logan River – are cut deeply into the heavily eroded banks.
- The water in the rivers looks brown and turbid.
- The Logan River contains high nutrient concentrations from the many sewage treatment plants, aquaculture and other activities in the catchment.
- However, the lower tidal reaches are well vegetated with mangroves.

Sending our soil to the sea

If you take a close look at the Logan River at Maclean Bridge **(see Where to Look, p.111)**, you will see the water is brown and murky with suspended sediment. This sediment comes from the eroded soil that is washed into the creeks and rivers by rainfall run-off. Here the riverbank has been cut away so that the water is now a long way below the level of the surrounding land. This is a common sight in this catchment.

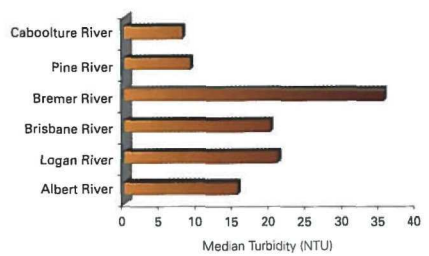
From Mt Tamborine Rotary Park **(see Where to Look, p.111)**, it is possible to see that the catchment below has been extensively cleared for grazing and only pockets of trees still remain. You can also see creek bank slumping on Canungra Creek in the valley below.

As you drive down the Mt Lindsay Highway **(see Where to Look, p.111)**, you can see erosion in some paddocks. The hillsides also show signs of slumping and many of the gullies have been scoured out by heavy rain.

The lower estuarine reaches of Logan River and in the background extensive fields of cane farms in the background

ENVIRONMENTAL PROTECTION AGENCY

Severe river bank erosion typical of some parts of the Logan River catchment



Turbidity, a measure of the murkiness of water, is high in the Logan and Albert Rivers resulting from delivery of catchment sources of sediment and channel erosion

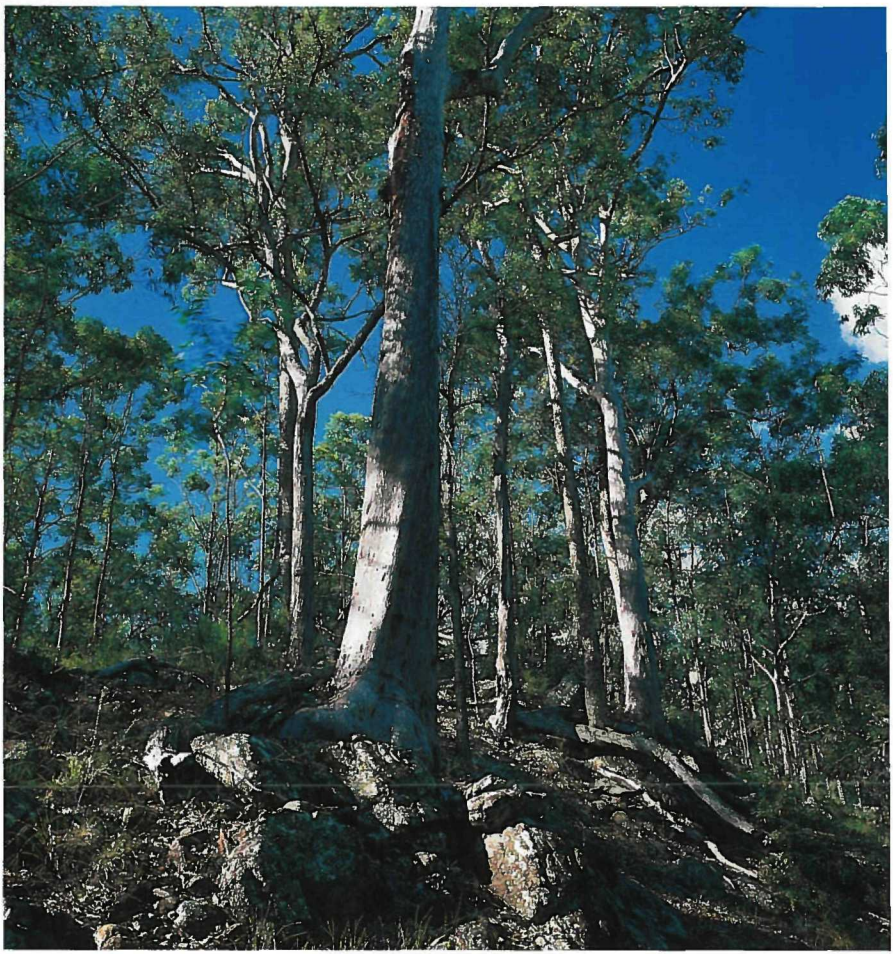
All these sediments flow downstream to be joined by more in the urban and estuarine sections of the river. Like the Maroochy catchment, sugarcane in the estuarine floodplain is grown almost to the water's edge, adding more sediment and nutrients to the murky water.

Exotic pests and modified habitats

The freshwater flora and fauna that live in the waterways struggle to survive in the warm muddy soup, which remains after the shading and food source of the riparian vegetation has been removed.

An exception to this is carp, an introduced species flourishing in the Logan and Albert Rivers. Carp feed on vegetation, invertebrates and insects by foraging through sediments. They can tolerate the muddy conditions and even dig holes in the riverbanks, causing instability and erosion, which has the potential to increase sediment and nutrient loads entering the rivers. Carp compete with native freshwater fish species and are considered a major menace.

The prawn farms in the estuary have the potential to add to the sediment and nutrient loads, although water recycling is becoming a common practice among farmers in this area.



Open Eucalypt Forest, typical of the Upper Logan-Albert catchments

Sand and gravel extraction in the Logan and Albert Rivers has altered the river bed and banks. Extraction can have a domino effect. Firstly, the adjacent river banks often slump, because they have been undermined by the drop in the level of the river bed. The end result is a widened river channel and degradation of riparian areas. Secondly, there is often a corresponding upstream effect. As the water hits the lip of the hole left after extraction, it erodes back upstream and can continue this process for kilometres. Sand and gravel extraction at one point in the river can result in erosion of the river bed miles upstream. These impacts from sand and gravel extraction can be seen in many South-east Queensland's waterways.

On a more positive note, the current lack of water storages or dams along these river catchments means there is less disruption to the downstream flows, providing some flushing of the waterways.

Reclothing the land and restoring habitat

One of the major problems faced by communities in the Logan-Albert region in the past has been a lack of coordination of catchment management activities. The formation of the Logan and Albert Catchment Group, provides an opportunity to bring these groups and their activities together.

The protection and rehabilitation of riparian vegetation, erosion control, habitat restoration and community education programs represent key activities already underway or planned by a variety of groups within the catchment.

A major revegetation demonstration project is underway along Blue/Rocky Creek, which flows into Barney Creek adjacent to Mt Barney National Park. The project is taking place on the Yugambeh Land Enterprises property managed by the local indigenous people in partnership with Queensland Parks and Wildlife Service, neighbours, government and technical experts. Rehabilitation of riparian vegetation will involve fencing, planting, controlling cattle access, application of indigenous land management knowledge and training programs.

Community groups at Mt Tamborine, concerned that habitats in the escarpment were becoming increasingly ecologically isolated, have taken action to re-establish riparian corridors linking Mt Tamborine to Canungra creek below. This will provide corridors for wildlife as well as protecting the water quality of these headwater creeks.

The Boonah Landcare Group is working with landholders and Boonah Shire Council to control gully erosion, fencing and planting trees to limit sediment loss from the upper reaches of Logan River and Teviot Brook.

Beaudesert Landcare holds regular demonstration days for revegetation works and fencing along riparian corridors. Their work includes the Spring Creek revegetation and restoration project. The creek flows through parts of Beaudesert township.

There is an increasing trend towards farm forestry in upper headwaters and particularly in the riparian zones of smaller creeks and tributaries of Logan River. This will ensure extra buffering against storm flows and floods.

Beaudesert Shire Council also supports a weed management program that aims to keep waterways, especially headwater streams, free of weeds.

The Carp Busters Group is working on the Logan River and its tributaries. This group is removing carp from the waterways and restocking with native fish. Attempts are being made to re-establish previously lost species of fish including Cod, Saratoga and Lungfish into the Logan River.

Learning about catchment management is becoming an increasing part of the work program in most primary and secondary schools. Through the Logan-Albert Catchment Group, an annual catchment congress for school children is held in Logan City.

Logan, Gold Coast, Boonah and Beaudesert Councils are planning upgrades and increased reuse of wastewaters from their sewage treatment plants, to substantially reduce nitrogen to waterways.

Boonah Council currently reuses around 90 per cent of the effluent from its Kalbar sewage treatment plant and about 60 per cent of the effluent from its Boonah plant for irrigation purposes. Beaudesert Council is investigating options for increasing effluent reuse at its Beaudesert and Canungra plants.

Logan Council is investigating large wastewater re-use schemes to potentially supply agriculture in the Lockyer Valley and local sugar cane farm irrigation. Gold Coast City Council is also investigating sewage effluent reuse as part of its Northern Wastewater Strategy (see Chapter 12).

Gold Coast Catchments

Green hills, golden sands and rolling surf

Mention the Gold Coast – and rolling surf and endless sandy beaches backed by high rise apartment blocks immediately spring to mind. But, what was the Gold Coast like before the high rise blocks and the big hotels?

Most of the area (from Jumpinpin and Jacobs Well, south to Currumbin) was (and still is) a floodplain inundated by the rivers and creeks flowing through a network of catchments either directly into the sea (Currumbin and Tallebudgera Creeks) or into the Broadwater (Nerang, Coomera and Pimpama Rivers, and Loders Creek).

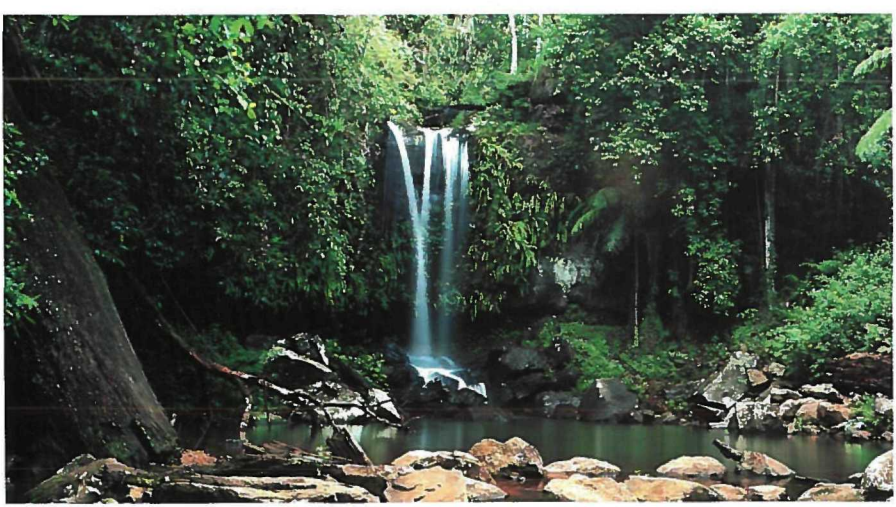
The Gold Coast area is a series of elongated, parallel catchments, flowing from the McPherson Range down to the sea. These catchments were carved out millions of years ago from the once massive, ancient shield volcano that is now Mt Warning.

From Binna Burra to Natural Bridge and Springbrook, these fast flowing creeks and plunging waterfalls flow down through rainforest and rugged gorges to the valleys below. This hinterland area has the highest rainfall in South-east Queensland. Large volumes of water flow down from the hinterland, causing frequent flooding on the coastal floodplain.

Fact File: Gold Coast Catchments

Catchment Area:	1,302 km^2
Catchment Population:	366,319*
Total length of streams:	859 km
Major land uses:	Urban / tourism, natural forest, grazing, agriculture

* SOURCE: QLD DEP. LOCAL GOV. & PLANNING



TOURISM QUEENSLAND

Most waterways of the Gold Coast catchments begin their journey in the forested steep hinterland

From Mt Tamborine **(see Where to Look, p.119)**, you can see the floodplain stretching out in front of you and catch glimpses of Tallebudgera Creek, and the Nerang and Coomera Rivers as they wind their way to the ocean.

The floodplain was once covered by open forest interspersed with melaleuca wetlands and thick fringing mangroves and saltmarsh along the waterways. It is bounded to the east by the seemingly endless stretches of white sand beaches, north from Point Danger to Cooloongatta, past the Currumbin Creek entrance, the rainforested, rocky hill that is Burleigh Head and the mouth of Tallebudgera Creek.

Opening up to the north, you can see the southern end of Moreton Bay that begins in a network of islands and shallow channels at the top end of South Stradbroke Island.

South of Jumpinpin is the Broadwater, sheltered in the lee of South Stradbroke Island and the Southport Spit. The only links with the open ocean are the Jumpinpin bar and the Southport Seaway. The Broadwater's shallow waters and many sandbanks are a rich seagrass, mangrove and wader bird habitat.

There are a number of declared fish habitat areas on the Gold Coast. These include Jumpinpin, the Broadwater, Pimpama River, Coomera River, Coombabah Lake, McCoy, Tallebudgera and Currimbin Creeks. Coombabah River is also an internationally declared area for the protection of migratory birds. The waters off the Gold Coast are estimated to support at least 1600 marine species.

City by the sea

Europeans first settled in the Gold Coast area in the 1840s, when timber-cutters came to harvest Red Cedar and other valuable hardwood trees in the hinterland forests. After the timber-cutters, came sugarcane and small crop farmers. Farming (sugarcane, orchards, bananas, dairying and beef farming) continues in the area today.

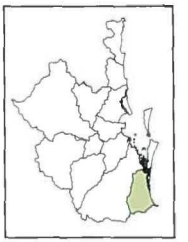
The urban development of the Gold Coast City, which covers most of the floodplain, is gradually expanding up through the catchments, preceded by a vanguard of rural residential blocks and hobby farms.

The Gold Coast is a holiday mecca for millions of tourists each year, attracted by long stretches of beautiful beaches, rainforest-covered mountains and the warm, subtropical climate. Nearly all of the floodplain is now densely developed, with clusters of skyscrapers amid tourist resorts, golf courses, canal estates and housing. In the mountains at Natural Bridge and Springbrook, much of the original rainforest remains and the area is a popular mountain retreat.

The Gold Coast City sources its water supply from Hinze Dam, in the upper section of the Nerang River.

Gold Coast city buildings rise from the sand and Nerang River flows behind towards the Gold Coast Broadwater

Gold Coast Catchments



Legend

- Catchment border
- Sub-catchment border
- State forest
- Protected areas
- Urban areas
- Where to look site

Where to look

■ Mt Tamborine – Cnr Coomera Gorge Drive and Jenyns Road

Facing east and south, you have a bird's eye view of the Gold Coast catchments including slivers of the Coomera and Nerang rivers and Tallebudgera Creek. To the north you can see the Broadwater, Southport Seaway and South Stradbroke Island.

■ Mouth of Currumbin Creek, Duringan Street, Currumbin

Standing on the clean, white sands you can see the sparkling waters of the creek.

■ Tallebudgera Creek on the Burleigh Heads National Park track

From the walking track, you can see the waters look clean and clear, there are oysters on the rocks, seagrasses just offshore, and lots of people swimming and fishing.

■ Nerang River, Council Chambers

From here, you can see that Nerang River has become a huge, labyrinthine network of canals. To your left is Chevron Island and to the right the Isle of Capri.

■ Jabiru Island, Phil Hill Environmental Park

Jabiru Island is at the junction of Coombabah Creek and the Coomera River. On one side of the river, you can see undisturbed mangrove and saltmarsh, and on the Paradise Point side, there is a canal estate, with hardened foreshore and no native vegetation. Take a closer look at the mangrove and saltmarsh from the boardwalk on the eastern side of the island.

Encroaching concrete

Canal estates, golf courses and more and more buildings have replaced most of the original native in the region.

Because so much of the ground surface is now impermeable concrete, the volume and velocity of stormwater run-off is much greater than it would have been previously. This means more flash-flooding and erosion.

At the same time, the estuarine river and creek banks – once important habitat areas – have been straightened and hardened with concrete and levy banks have been constructed to restrict flooding, which was once an important part of the river's ecological processes.

Traditional owners have expressed their grave concerns at the impacts of these changes on the health of the coast's waterways and catchments.

Catchment Comment

Written by Graham Dillon and presented by T. Nozieres
on behalf of the Ngarang-Wal Gold Coast Aboriginal People, Gold Coast, 2001

On behalf of the Ngarang-Wal – the Nerang River people and the Kombumerri traditional Custodians of the Gold Coast waterways, rivers, land and sea regions.

A special welcome to our brothers and sisters at the Northern end of Quandamooka the Nunukul, Nooglie Moreton Bay. Welcome to eminent guests, Mr Chris Hubbert, Shane Coghill, Ladies and Gentlemen, organisers and sponsors.

As we can see down here on the Gold Coast. We are right in the middle of a catastrophe which needs to be addressed urgently by all us, including the government, and indeed by all people who use our river systems. It is a massive yet achievable task and a long term salvage operation – it must be done and can be done, as a combined joint venture – by all those who love and care for our land. Our people have diminished in numbers since colonial take over 150 years ago, but our spirit has not been broken and our passion to preserve a clean living environment for future generations is one of our most important missions.

As custodians, we have survived this cultural and spiritual degradation of ourselves, and of our waterways, this has been hastened by the canal development of the Gold Coast City wetlands from the early 1950's. In just under two generations – our local rivers (Nerang, Tallebudgera, Coomera, Tweed) which has provided our people with ample fish supplies, the surrounding land had an abundance of eatable plants and games which sustained our families in their customary life-styles which had been a successful part of our hunter-gather traditions for millennia.

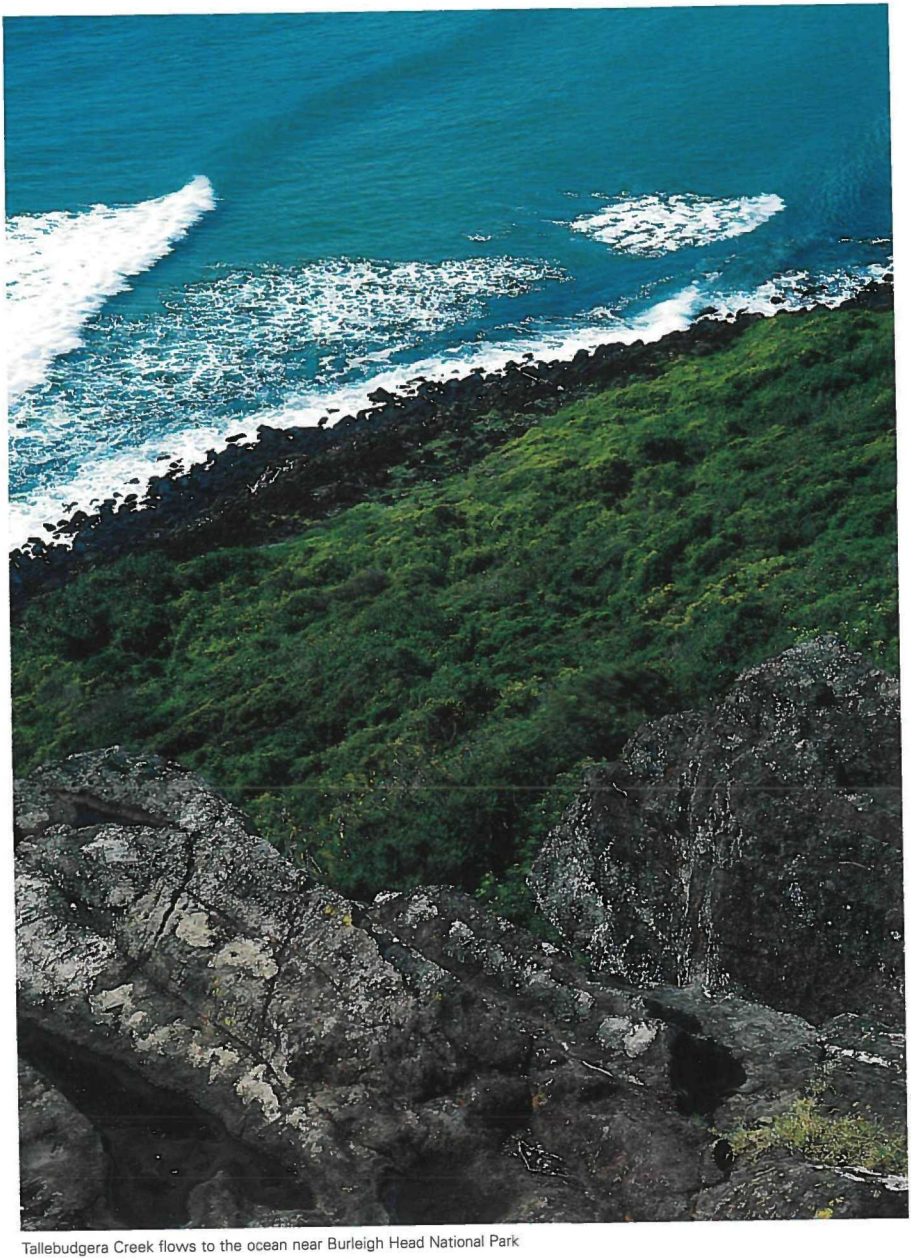
Our rivers were then clean – they are now polluted. The replenishment systems along our Coastal region assured us of a healthy and pristine environment then.

Gone now are most of the wading banks and sea-grass flats where our TOTEM bird the Nankeen Night Heron has been reduced to a handful. Our magnificent Ibis has lost his sea grass feeding grounds and now is reduced to a mean scavenger at Council rubbish tips and refuse scrap bins in picnic parks and is seen as a menace.

Our people were not the cause of this kind of environmental destruction; they depended on nature for their survival. This environmental destruction has led to the loss of our natural foods sources and the disappearance of over 90% of mangroves, which were a natural breeding grounds for prawns, crabs, oysters and a haven for sea birds, local and migratory – and so the list goes on.

It is a wake up call for everyone who cares for the future of the environment and all the good things it offers in return. The environment belongs to us all, we are a living part of this environment and we must keep it in pristine condition for our well being, and for the future generations of Australians whether they are indigenous or not, using whatever means it takes to maintain it. Our future depends on it. It is up to all of us.

On behalf of our Custodians, Bernie, Victor and myself are hoping that the outcome of this meeting will help to improve and preserve our most precious asset, our environment.



QUEENSLAND MUSEUM

Tallebudgera Creek flows to the ocean near Burleigh Head National Park

Currumbin/Tallebudgera Catchments

Hinterland, through backyards to the sea

Rising in the Gold Coast hinterland, Currumbin and Tallebudgera Creeks are relatively small and narrow, both about 30 km in length. While there has been some modification of habitats in the tidal areas (e.g. some canals and hardened foreshore areas), remnant mangroves and saltmarshes remain. The headwaters flow off steep forested land, and the middle reaches are mostly rural residential with intact riparian vegetation along the waterways. Water quality remains generally good except for occasional recordings of elevated nutrients following rain.

Tallebudgera and Currumbin Creeks are the two healthiest waterways in this area. This is due to the absence of sewage effluent (diverted into the Southport Seaway in the early 1990s). Problems associated with stormwater are on a smaller scale than for other waterways in the Gold Coast because there is less development than in either the Nerang or Coomera catchments. Tidal exchange with the open ocean maintains these clean, clear waters at the creek mouths **(see Where to Look, p.119)**.

From the mouths of these two creeks you can see the results of the north flowing 'sand conveyor belt' (see Chapter 1). Both creeks are located adjacent to escarpments that provide a place for sand accumulation, as well as stabilising the mouths of the creeks.

The mouth of Currumbin Creek is almost separated from the ocean by a sandbar extending from Currumbin Rock on the southern side across the mouth. At the mouth of Tallebudgera Creek, an artificial groin has been built to stabilise the creek mouth, as the escarpment is to the north of the creek. Strong tidal currents regularly flush the system contributing to its good health.

If you stand on the beach at the mouth of Currumbin Creek **(see Where to Look, p.119)**, you can see the clean blue water. On the opposite bank and upstream (past the Gold Coast Highway bridge), mangroves line the banks.

From the Burleigh Head National Park track, the waters of Tallebudgera Creek **(see Where to Look, p.119)** look clean and clear and there are usually lots of people swimming or fishing. There are seagrass beds here and plenty of fish.

How healthy are the Currumbin/Tallebudgera catchments?

Signs that the Currumbin/Tallebudgera catchment waterways are in **good health**.

- The water is clean and clear with little sediment.
- Aquatic life is plentiful and diverse.
- There are still significant areas of intact riparian vegetation along the length of the creeks.
- People regularly swim, windsurf and fish in these creeks.

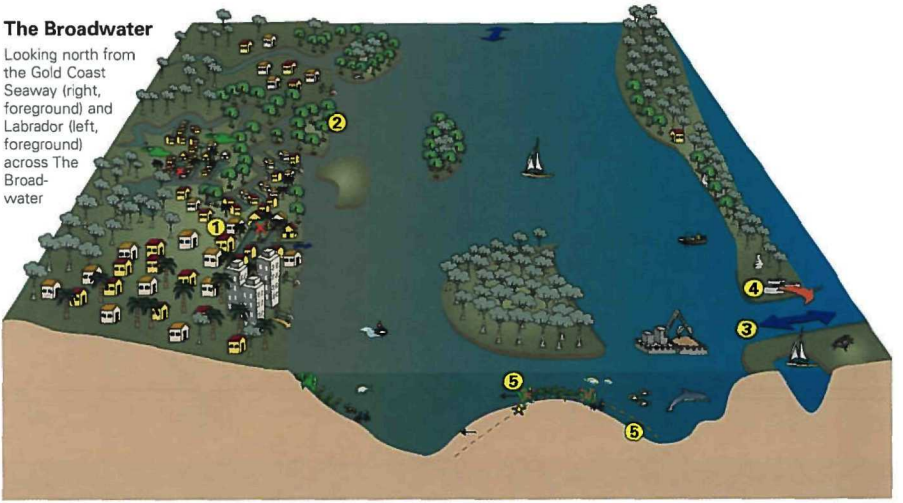
HEALTHY WATERWAYS | IRRADY

Tallebudgera Creek, clean and clear waters

Gold Coast Broadwater

The Broadwater

Looking north from the Gold Coast Seaway (right, foreground) and Labrador (left, foreground) across The Broadwater



1. Catchment is heavily urbanised (lower reaches) with natural forest and grazing in the upper reaches
2. Some areas of mangrove and saltmarsh remain
3. Increased tidal exchange from stabilisation of The Seaway entrance
4. Sewage discharged at The Seaway on outgoing tide
5. Sandbanks and seagrass habitat are dynamic

How healthy is the Gold Coast Broadwater?

Signs that the Gold Coast Broadwater is in **good health**:

- The water looks clear and blue, with very little sediment.
- There are extensive seagrass beds, mainly in the northern section.
- People swim and fish in the area.

Warning signs:

- Most of the riparian vegetation and the natural banks in the southern section have been lost because of urbanisation – marinas, rock walls and jetties can be seen everywhere.

Broad catchment, shallow water

The waters of the Gold Coast Broadwater are healthy, despite being at the receiving end of a series of heavily urbanised catchments, almost 7000 times the area of the enclosed Broadwater.

The main reason for this is that the Gold Coast Seaway (with help from the Jumpinpin Bar) allows efficient tidal flushing of the Broadwater.

Treated sewage effluent is no longer released into any of the Gold Coast rivers, or the Broadwater. Since 1993, the Gold Coast City Council has piped all treated effluent out to the Seaway entrance where it is released on the outgoing tide. The tide, combined with the prevailing northward-flowing currents along the coast, effectively disperse the effluent.

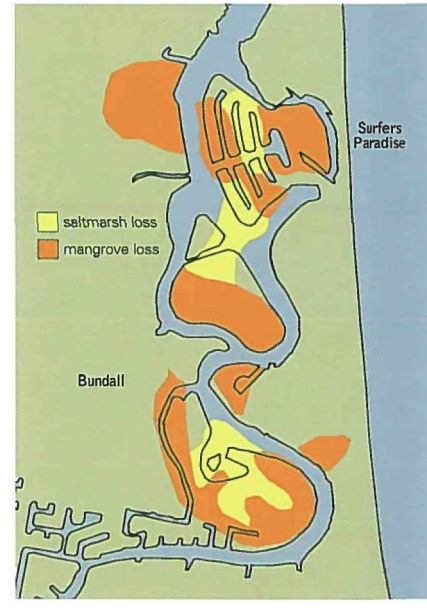
Between the township of Nerang and the Gold Coast Broadwater, the Nerang River has been heavily modified with many additional channels (canal estates) and replacement of fringing vegetation with hard walls

Most of the sediment and nutrients in the river comes from stormwater draining off urban areas such as Surfers Paradise, Ashmore and Nerang. Because there are so many waterway banks and so little vegetation, this stormwater is unfiltered and carries a substantial load of the by-products of urban life – sediment, pet droppings, fertilisers and other chemicals, and litter – into the river, where it often remains trapped for extended periods due to poor flushing.

Upstream of the canal estates, the Nerang River flows through rural residential development as far as Hinze Dam, though urban development is steadily moving up through the catchment. Water is released from Hinze Dam to maintain a certain level of flow in the river, but this flow has little impact on the canal estates.

Above the dam, however, things are in good shape, with 75 per cent of catchment still forested. This includes a buffer zone of 5000 hectares around the shores of Hinze Dam and protected areas of Lamington and Springbrook National Parks.

The rest of the upper catchment is either state forest or national park, with a small proportion of beef production, dairying and rural residential.



Between 1955 and 1998, development of the lower Nerang River for urban land uses has resulted in the loss of saltmarsh (yellow) and mangrove (orange) vegetation

Coomera Catchment

Low lying soils

The Gold Coast supports the largest area of saltmarsh in South-east Queensland. The Coomera River is a prime example. As you walk along the mangrove walk on Jabiru Island, at the mouth of the Coomera River **(see Where to Look, p.119)**, look down and you will see these small shrubs and grasses above the line of mangroves. Saltmarsh generally grows in the salty sediment behind mangroves, in areas less regularly inundated by salt water from tidal movements. It plays an important role in stabilising the sediment and in providing habitat.

In this area (on the mangrove walk) you can see evidence of mangroves encroaching on saltmarsh. Because the tidal range has increased and the tide goes higher, the mangrove can grow further up the shore and into the saltmarsh habitat. The saltmarsh can't survive in these elevated water levels and generally they are prevented from growing any further back. This has meant that saltmarsh communities are declining.

At Paradise Point, mangrove and saltmarsh habitats are being replaced with hardened canal walls and houses. The ability of the canal estates in the Gold Coast region to support marine fauna is still unclear and under detailed investigation.

ENVIRONMENTAL PROTECTION AGENCY

Freshwater Lamington Spiny Crayfish, a resident of headwater streams of the Gold Coast hinterland and Lamington National Park

How healthy is the Coomera catchment?

Signs that the Coomera catchment is in **good health.**

- Some remaining riparian vegetation, saltmarsh and mangrove.
- Relatively low turbidity levels within the river.
- Intact catchment headwaters located in Lamington National Park.
- *Platypus in mid-lower area of the river.*
- Occasional phytoplankton blooms in the river.

A clean source

The headwaters of the Coomera River lie in Lamington National Park, near Binna Burra. It is possible to see Freshwater Lamington Spiny Crayfish in the clean waters of the park's rainforest streams. The middle section of the Coomera River runs through rural areas and is fed by the clean mountain streams.

Phytoplankton blooms are occasionally observed in the lower river and elevated levels of other contaminants (such as insecticides) have also been recorded. The mid-lower area of the Coomera River supports many platypus and the river is a declared fish habitat. The Coomera River emerges towards the southern end of Moreton Bay. Turbidity levels within the Coomera River, even at this point, generally remain low.

HEALTHY WATERWAYS LIBRARY

The upper catchment of Coomera River which rises in Lamington National Park (Coomera Falls)

Pimpama Catchment

How healthy is the Pimpama catchment?

Signs that the Pimpama catchment is in **moderate health.**

- Land-use dominated by intensive agriculture.
- River brown and turbid.
- Algal blooms from high nutrient levels in the river.
- Acid sulfate soils impacts – low dissolved oxygen and a low pH in some parts of the river.

Acid run-off

The Pimpama River drains a small coastal catchment dominated by intensive agriculture. Water quality in the river ranges from generally good in the upper reaches to polluted in the mid-estuary.

Problems have arisen due to the disturbance of acid sulfate soils which can lead to the release of high acidity, low dissolved oxygen waters with elevated levels of heavy metals.

Acid run-off problems have been most prevalent during periods of heavy rain that follow extended periods of drought. Metal-bearing waters stored in sediments during the dry periods are flushed out during floods causing an increase in the water's acidity. If untreated, such run-off has the potential to damage and even destroy the aquatic ecosystems.

Phytoplankton blooms are observed in the river and turbidity levels are often high. Elevated levels of other contaminants (such as insecticides) have also been recorded.

Preserving and restoring habitat

From their relatively intact upper reaches through the middle reaches dominated by rural residential to the modified lower reaches, the coast's waterways are essential to its tourist industry and the lifestyle enjoyed by its residents.

The communities of the Gold Coast are acutely aware of the special values of their waterways and have instigated a range of actions to protect and restore their health.

The Loders Creek Integrated Catchment Management Community Association undertakes community and industry education, revegetation projects and organises waterways events.

The Coombabah Catchment Management and Biggera Creek Catchment Groups have also undertaken tree planting and schools educational/awareness activities.

The North-east Albert Landcare and Catchment Management Group has established and maintains its own native plant nursery, with seeds sourced from the local area to grow its own supplies of native plant stock. The group has developed information materials for 'Weedbuster Week' and regularly works on private land planting riparian vegetation and reducing weed infestation. The group is also involved in the Waterwatch community water quality monitoring program.

The Tallebudgera Catchment Care Group regularly participates in tree planting activities and has established an education officer to develop materials for schools and the general community.

The Springbrook Catchment Management Landcare and Numinbah Valley Landcare Groups have been successful in gaining Commonwealth funding for revegetation and weed (camphor laurel) management projects.

Other groups, like the Mudgeeraba Catchment Management Group have embarked on awareness raising and planning activities.

These community groups are supported by the Gold Coast City Council through a Catchment Liaison Officer and the Council's Bushcare Management Unit.

TOURISM QUEENSLAND

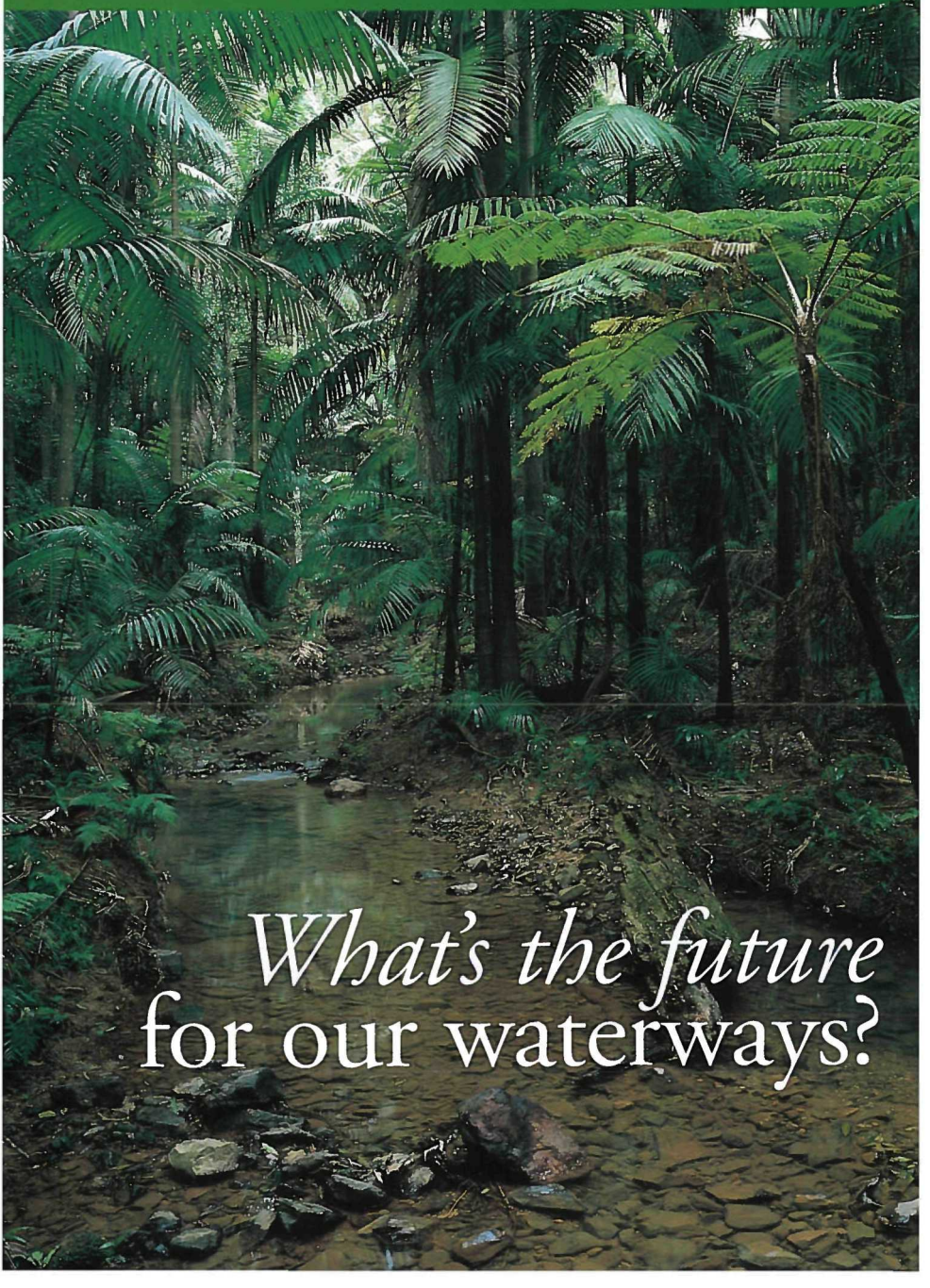
Effective management of urban stormwater flows will ensure our beaches maintain high recreation values

The Council is installing a number of stormwater quality improvement devices (SQIDs) and has been successful in securing Commonwealth funds to undertake a major urban stormwater improvement and acid sulphate soil management projects involving a range of waterway stabilisation and revegetation works. Council is also implementing management plans to improve urban stormwater quality, has prepared a best practice guide to manage stormwater from building sites and is developing approval conditions relating to stormwater and riparian zone management.

The Council, with the State Government, the Logan, Redland and Beaudesert Councils completed the Logan, Coomera, South Moreton Bay Regional Wastewater Study in the mid-1990s. This study provides the basis for managing the future collection, treatment and disposal of sewage in the Logan and Coomera areas.

The Council's Northern Wastewater Strategy and Reclaimed Water Scheme provides the basis for provision of sewerage systems for future growth areas in areas between the Logan and Coomera Rivers. This scheme is considering source management, upgrades and diversion of sewage, advanced nutrient removal, and wastewater reuse, including opportunities for sugar cane, and wetland creation and regeneration.

PART C



What's the future for our waterways?

Where we've come from

In the early 1990's it became apparent that population increases over the next 30 years had the potential to seriously impact on the health of Moreton Bay and South-east Queensland's waterways and catchments.

In response to this threat, South-east Queensland's Councils, with the help of the State and Commonwealth Governments, worked with community and industry representatives to develop a coordinated, regional strategy to protect these crucial resources into the next millennium. In so doing, it was recognised that the health of South-east Queensland's waterways was fundamental to the region's future social, economic and environmental well-being.

The South East Queensland Regional Water Quality Management Strategy, published in 2001, represents the culmination of several years dedicated research, consultation and analysis by literally hundreds of scientists, community, industry and government participants. The Strategy forms the basis of the information contained in Parts A and B of this book – the information we need, if we want to make a difference to our future.

HEALTHY WATERWAYS LIBRARY

Scientists and traditional owners and elders of Mununjarlie inspecting Rocky Creek in the Logan-Albert Catchment. We are all learning to better collaborate and form lasting working partnerships so we can halt current waterways health decline.

Where we're going – The Healthy Waterways Strategy

The South East Queensland Regional Water Quality Management Strategy seeks to deliver the Healthy Waterways Vision. It comprises actions committed to voluntarily by governments, industry and community organisations to achieve this common goal, based on good scientific information, local initiative, effective communication and regional cooperation, coordination and support.

Successful implementation of the Strategy will only be possible if this coordinated and cooperative effort continues. Whilst ongoing monitoring and auditing programs have been set up to help, it will only be through community awareness, understanding and commitment to achieving the Vision that the Strategy will ultimately succeed.

Effective public involvement represents the future of the Strategy – ensuring a continued open flow of information between researchers, government representatives, community groups and the public, addressing relevant local issues, using the best resources available.

This also means providing places or forums for communities and decision-makers to get together on a regular basis – to discuss results and progress – to be heard and to listen to others – to provide support – and steer the ship should the course need altering.

The Moreton Bay Waterways and Catchments Partnership, formed in 2001, seeks to bring together South-east Queensland's Healthy Waterways Partners. State ministers, Council mayors, community, industry and Commonwealth Government representatives have made commitments to provide the necessary resources and impetus to support the on-the-ground activities of the many Healthy Waterways Crew Members who are working hard to deliver the Vision.

Minister's Comment

The Hon. Dean Well
Minister for the Environment

For too long we have tended to turn our backs on our most life giving arteries, our rivers. Today we realise that river systems need to be carefully nurtured and properly managed.

We have begun to take an holistic approach to their care by giving attention whole river catchments – from the source to the sea. We have begun to realise that to sustain our waterways and have them as vibrant contributors to the quality of our lives, we have to restore the ecological balance of both land and water.

The Moreton Bay catchment supports more Queenslanders than any other. We use its water to give ourselves and our land a drink. We travel on its surfaces for business and pleasure, and we expect it will continue to support and enhance the quality of our recreational and commercial pursuits well into the future.

Common Sense and science now tell us that our current levels of use are not sustainable and that we, as a whole community, have a responsibility to take all measures necessary to pass on a healthy and energetic system to our children and their future.

The new Moreton Bay Waterways and Catchments Partnership will set the future direction in waterways and catchment management and will build on the work of the BRMG and the South East Queensland Regional Water Quality Management Strategy (SEQRWQMS).

The Partnership is a whole-of-government whole-of-community partnership, focusing on leadership, commitment and voluntary cooperation for the sustainable management of South-east Queensland's waterways and catchments.

Major milestones on the journey to 2020

In setting out on our journey, we have charted a course towards 2020 and described the place we want to be. But there is much to be done if we are to reach our destination. We will need to pass a number of milestones and be honest about our true achievements at each point of the journey, if we want to arrive safely and deliver the Healthy Waterways Vision.

By 2003

Improved management practices in urban and rural areas will halt the current environmental decline and lead to increased community involvement in and enjoyment of the waterways.

When some original Crew Members first charted our journey, it was expected that we could reach this milestone by 2000. Already we have seen how difficult the task will be. Although many of the achievements required to reach this milestone, as listed below, have been completed or are well underway, monitoring has shown that we will need to redouble our efforts to arrest the decline in the health of our waterways by 2003.

- implementation of administrative arrangements for cohesive and effective catchment, river and bay management
- significant reduction in pollutant loads (especially nitrogen) from the major sewage treatment works at Luggage Point
- further nitrogen removal from other key sewage treatment plant discharges
- industry action to reduce impact of industrial discharges, where required
- cessation of extractive dredging in tidal reaches of the Brisbane River
- implementation of environmental management plans for navigational dredging in the Brisbane River and Moreton Bay
- development of a Regional Extractive Resource Management Plan for the bay, rivers and catchment area
- continued development of stormwater management infrastructure in major urban areas
- development of plans to restore marine habitats and riparian corridors in priority areas
- better monitoring of ecological health of Moreton Bay and its estuaries
- implementation of risk management procedures for ballast water discharges in Moreton Bay

By 2007

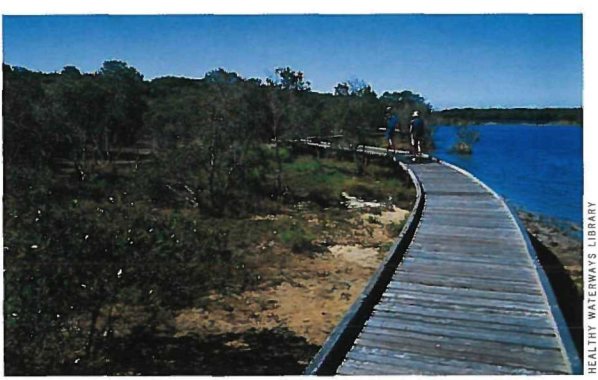
Current trends will be reversed. Waterway amenity will be restored to allow for safer recreational use, and water supply security will be enhanced to provide for the needs of agriculture, industry and urban growth. To reach this milestone, we will have achieved:

- best practice nitrogen removal from all treatment plants and improved treatment for other pollutants, such as phosphorus and pathogens
- reduced sewer overflows and impacts from urban stormwater discharges in the major urban areas increased levels of wastewater reuse and development of agreed infrastructure plans for major water supply and wastewater management works
- stakeholder agreements and *government support for effective* land management strategies to reduce land degradation and waterway pollution
- effective water supply management for all agricultural, industrial and urban users
- provision of environmental flows from major water storages
- improved fisheries
- implementation of plans to restore marine habitats and
- recognition of riparian corridors rehabilitation as a major regional infrastructure works program and the protection of intact areas, maintenance and rehabilitation of other areas to be a major focus

By 2020

The ecological functions and processes in all waterways will be restored and the natural values and biological diversity protected. To reach this milestone, we will have achieved:

- *best practice wastewater treatment* achieved at all municipal and industrial wastewater treatment facilities
- high level of wastewater reuse contributing to secure water supply *for agricultural, industrial and urban* growth needs
- major reduction in pollutant loads from urban stormwater and rural catchments
- restored marine habitats
- restored riparian corridors and
- restoration of sustainable in-stream ecology in all waterways



HEALTHY WATERWAYS LIBRARY

By 2007, waterways health is restored allowing for safer recreational use

By 2020 and having achieved the Vision, the ecological functions, and processes, natural values and biological diversity in all waterways are restored

Working together

As people we react to human crisis and tragedy. We help each other in times of need and danger. Our social fabric is woven with the threads of moral fibre. Our waterways and catchments can't afford to wait for crisis for us to take action. It is up to us to see for ourselves, feel and voice our concern, and through working together, start on the road back.

As we have journeyed through the catchments of South-east Queensland, we have seen that some of our waterways are in need of urgent and immediate attention. For others, there is a looming need to take preventative and timely action.

Some community groups, businesses and government agencies have identified the need for action and are already leading the way. Contact details for these groups are provided at the end of this book. But it is clear that much more is needed – and from many more of us – if we are to reach our goal.

Without water there is no life, for humans, plants or animals.

To date we have been busy learning about our catchments and waterways – understanding how they work and how our influences have affected them. The next step is to get on with it – to keep the good bits good, and to put on our hats and gloves and work to restore the damaged and neglected bits, with purpose and with focus.

The Lord Mayor's Comment

The Right Hon. The Lord Mayor Jim Soorley
Chair – South East Queensland Regional Organisation of Councils

Since the first Crew Members' Guide to Health of our Waterways was released in 1998, much has been achieved and scientific research has provided new insights. However new issues of serious concern have arisen, including the world's largest bloom of Lyngbya algae on Moreton Bay in the summer of 2000.

While celebrating our achievements we must face up to these new challenges if we are to realise the Healthy Waterways vision. I am optimistic we will succeed if, at all levels of government, industry and the wider community, we continue to co-operate and find consensus.

Why put aside our differences and work together for this vision? Consider what makes South-east Queensland attractive to so many people.

The reasons fall into two categories. First the gifts of nature: the sparkling clean waters of Moreton Bay fringed by safe, sandy beaches and abundant in healthy fish and prawns. There are ancient turtles and the strange and wonderful dugong; the wide Brisbane River fed by shady creeks where children can still see platypus, frogs and powerful owls, below the green backdrop of forested hills.

Then there are the human creations: the rich cultural heritage bequeathed by indigenous people and more recently by hardworking settlers from all over the world; the wealth creating pulse of commerce and industry and the farms growing healthy food. Above all, there is the diversity of modern lifestyles, cultures and recreation as well as the slower-paced outdoor living unique to our 'timber and tin' suburbs.

How many of us realise that our human-created lifestyles depend entirely on the natural assets of the region, in particular, our waterways? Polluted water destroys fish and other marine life, and jobs in fisheries, tourism and dependent industries worth $300 million a year. And that means less money for things like education, health, the arts, parks and recreation.

We are fortunate that unlike other major cities, we have started to act before irreversible losses occurred. Even more remarkable, we did it without compulsion or new bureaucracies. Country and city folk, academics, scientists, people from industry, gov-ernment and the community have come together, vigorously debated and reached consensus on many issues. We generated rigorous sci-ence to help minimise the disputa-tion and to foster consensus and decisive action. And decisive actions have followed: sewage plant up-grades, stormwater cleaning struc-tures and artificial wetlands, educa-tion programs and much more.

Yet we still have serious problems in our Bay and waterways. And while we are moving rapidly to address them, time is short and it will take vigilance, courage and above all, cooperation, to see it through to the final vision of a healthy Bay and waterways, supporting our wonderful lifestyle in the year 2020 and beyond.

Catchment Contact List

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Brisbane River Catchment

Brisbane River Estuary

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www.healthywaterways.env.qld.gov.au

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Habitat Brisbane –
Community Care for Bushlands, Wetlands and Waterways
Waterways –
City Wide Catchment Group
Brisbane Water –
supplies water and wastewater *services*
Call Centre: 07 3403 8888
www.brisbane.qld.gov.au

Bremer Catchment

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www.ozbird.com/rosalieshire.htm

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PO Box 3021 Village Fair
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Fax: 07 4638 3830
E-mail:
Council@toowoomba.qld.gov.au
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Toowoomba and Regional Environment Council,
The Coordinator
P O Box 1306
TOOWOOMBA Q 4350

Moreton Bay

Moreton Bay Marine Park
Qld Parks & Wildlife Service
127 Russell Street
PO Box 402
CLEVELAND Q 4163
Tel: 07-3821 9000
Fax: 07-3821 9001
www.env.qld.gov.au

Australian Marine Conservation Society (AMCS)
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Email: patchett@powerup.com.au
Email: amcs@amcs.org.au
www.amcs.org.au/about/contacts/

Moreton Bay Research Station
University of Queensland
PO Box 138 DUNWICH Q 4072
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Fax: 07-3409 9839
E-mail: mbrs@mailbox.uq.edu.au
www.marine.uq.edu.au

Moreton Bay Environmental Alliance
91 Yabba Street
ASCOT Q 4007
E-mail: baycare@rag.org.au

Eprapah Creek Catchment Landcare Association Inc.
Also Eprapah Creek Waterwatch
14 Spinkbrae Street
FIG TREE POCKET Q 4069
Tel: 07-3378 4115; 0411 145 053
Tel: 07-3206 4792; 0412 659 918
Fax: 07-3378 9004
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Bayside Environmental Network
PO Box 5020
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Moreton Bay Environmental Education Centre
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PO Box 167
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Stradbroke Is Management Organisation
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North Stradbroke Island Q 4184

Moreton Island Protection Committee
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INDOOROOPILLY Q 4068

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E-mail:
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Redland Shire Council
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CLEVELAND Q 4163
Tel: 07-3829 8999
Email: rsc@redland.qld.gov.au
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Indigiscapes Environmental Centre
17 Runnymede Road
CAPALABA Q 4157
Tel: 07-3824 8611
E-mail: RosalieE@Redland.qld.gov.au
www.redland.net.au

Bramble Bay Pine Rivers Catchment

Pine Rivers Catchment Association Inc
Also Pine Rivers Waterwatch
PO Box 2066
STRATHPINE CENTRAL Q 4500
Tel: 07-3325 1577
Fax: 07-3325 1588
Email: pinerivers@bigpond.com
www.environment.prsc.qld.gov.au/prca

Bunya Sanctuary Environmental Centre
Bunya Pine Court
EATONS HILL Q 4037
Tel: 07-3264 3953
Fax: 07-3264 3953

Dayboro Landcare Group
Lot 3 Mt Mee Road
DAYBORO Q 4521
Tel: 07-3425 1262

Pine Rivers Shire Council
PO Box 5070
STRATHPINE Q 4500
Tel: 07-3205 0555
Fax: 07-3205 4658
www.prsc.qld.gov.au

Osprey House Environmental Centre
Dohles Rocks Road on Pine River
Tel: 07-3886 4463
Fax: 07-3886 4463
www.prsc.qld.gov.au

Nudgee Beach Environmental Education Centre
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the.principal@nudgeebheec.qld.edu.au

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Boondall Wetlands
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Boondall Entertainment Centre exit
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www.stories.powerup.com.au/boondall

Sunfish North Moreton
PO Box 17
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E-mail: sunfnm@logicworld.com.au

Logan Albert & Southern Moreton Bay

Logan Albert Catchments

Logan Albert Catchment Coordinating Association
The Coordinator
C/- Logan City Council
PO Box 3226
LOGAN CITY DC Q 4114
Tel: 07-3826 5670
Fax: 07-3808 0014
E-mail: BrookeHynch@logan.qld.gov.au

Logan City Council
150 Wembley Road
PO Box 3226
LOGAN CENTRAL Q 4114
Logan Bushcare
Logan City Waterwatch
Logan Water & Waste
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Tamborine Mountain Natural History Association
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Logan and Albert Conservation Association
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BEAUDESERT Q 4285

Boonah and Districts Landcare
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BOONAH Q 4310
Tel: 07-5463 4150

Scenic Rim Farm Foresters
"Tobermorey"
MS 98
LAMINGTON via Beaudesert Q 4285
Tel: 07-5544 8220
E-mail: Houston@fan.net.au

Gold Coast

Gold Coast Catchment Management Association
C/- Gold Coast City Council
PO Box 5042
GCMC 9729
Tel: 07-5581 6488
www.goldcoast.qld.gov.au

Gold Coast Waterwatch
Tel: 07-3488 9660
Fax: 07-3488 9678
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Beechmont District Landcare Association
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BEECHMONT Q 4211
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Coombabah Catchment Management Committee
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SOUTHPORT Q 4215
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treesteve@bigpond.com

Mudgeeraba Catchment Management Group
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rwhiteonestep@primus.com.au

Tallebudgera Catchment Care Group
PO Box 726
BURLEIGH HEADS Q 4211

North East Albert Landcare and Catchment Management Group
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182 Pocket Road
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Springbrook Catchment Management – Landcare Group
The Secretary
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GOLD COAST GCMC 9729
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Gold Coast Water
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webmaster@goldcoast.qld.gov.au
www.goldcoast.qld.gov.au

Whole of SEQ Associations, Organisations and Agencies

Remember...
because we're all in the same boat
www.healthywaterways.env.qld.gov.au

Indigenous & Cultural Heritage

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Bushcare Support
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State Coordinator & SEQ Facilitator
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Wildlife Preservation Society Queensland
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http://www.wildlife.org.au/
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National Parks Assoc Qld Inc
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South East Queensland Water Corporation
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BRISBANE Albert St Q 4002 &
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www.seqwco.com.au

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Queensland Fruit & Vegetable Growers Ltd
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Queensland Dairy Organisation
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PO Box 504
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www.awa.asn.au

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Fax: 07-3832 2101
www.ieaust.org.au

Urban Development Industry Association – Queensland
GPO Box 2279
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14 Edmondstone Street
PO Box 3573
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Fax: 07-3846 3794
E-mail: qld_enquiry@hia.asn.au
www.buildingonline.com.au

Stormwater Industry Association Inc. of Queensland
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Education

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Griffith University EcoCentre
Nathan Campus
NATHAN Q 4111
Tel: 07-3875 7992
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Marine Education Society of Australasia
National organisation – information for marine teachers and others.
E-mail: mesaadmin@britter.com.au
www.mesa.edu.au

Science Teachers Association of Queensland
C/- School of Mathematics, Science & Technology Education
QUT Kelvin Grove Campus
Victoria Park Road
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State Government Agencies

Gateway to Queensland Government Internet resources
www.qld.gov.au

Environmental Protection Agency
SEQ Coastal Management Plan
Moreton Bay Waterways &
Catchments Partnership
PO Box 155
Albert Street Brisbane Q 4002
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Fax: 07-3225 1501
www.env.qld.gov.au
www.healthywaterways.env.qld.gov.au

Coast Care Support
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Queensland Parks & Wildlife Service – Bushcare Support
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www.dnr.qld.gov.au/water/water-recycling

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www.qld.waterwatch.org.au
www.landcareqld.org.au

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Local Government and Planning
PO Box 31
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Regional Planning
SEQ 2021 – a sustainable future
C/- Department Local Government
& Planning
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Queensland Transport
www.transport.qld.gov.au

Tourism Sport and Racing
www.dtsr.qld.gov.au

State Development
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Cooperative Research Centre for Catchment Hydrology
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Glossary

Acid Sulphate Soil – When exposed to air, waterlogged soil, common in coastal lowlands of South-east Queensland, is converted into acid and releases metals such as iron.

Aerobic – With oxygen

Algae – A very broad group of simple plants including phytoplankton, and benthic microalgae and macroalgae that live in fresh or salt water and are capable of photosynthesis

Alluvium – Sediment that has been eroded, transported and deposited by water

Ammonium – A form of nitrogen easily absorbed by aquatic plants

Anoxic (anaerobic) – Without oxygen

Aquifer – Underground storages of water or 'dams'

Bacteria – Microscopic, single celled life forms that are so diverse, they can be found living virtually everywhere on earth

Benthic Microalgae (BMA) – Microscopic plants that live in the sediment (mud or sand) and which are an important food source for animals such as prawns

Billabong – A body of water which remains from a sealed off bend of a river

Biodiversity – The range of different species

Catchment – An area of land bounded by natural features such as hills, from which rain falls and flows to a common point, usually ending in a river or creek and eventually the sea

Channel erosion – Erosion of the bank or bed within a stream channel

Chlorophyll *a* – Pigment that captures light for photosynthesis, found in plants and bacteria

Coral – Soft polyps containing a plant and animal, many of which secrete a limestone cement that builds up in various patterns over years (Check this entry)

Crustacean – Animals such as crabs, prawns and shrimps which generally have a hard shell

Cyanobacteria – Often called blue-green algae; a primitive life form that grows in fresh and seawater and which may contain toxins

Denitrification – Conversion of biologically available nitrogen to biologically unavailable nitrogen gas, by specialised bacteria.

Deposition – Settling of particles on the sediment bed

Dissolved oxygen – Oxygen (from the atmosphere or from a bi-product of metabolic processes) dissolved in the water and available for animal and plant uptake

Dugong – Sea mammal that feeds on seagrass

Ecological Health – Describes how healthy an ecosystem is in terms of the ability of a system to be productive, biologically diverse and resilient to change

Ecosystem – The environment and the plants and animals that depend on it

El Nino/La Nina – See Southern oscillation

Embayment – A small bay with a wide opening such as Deception, Bramble and Waterloo Bay

Estuary – The tidal section of a river which is influenced by inputs of freshwater and tidal movements

Eucalypt – A gum tree; group of trees native to Australia

Eutrophication – Over-enrichment of a waterway with nutrients, which can lead to excess algal growth and sometime algal blooms

Floodplain – The area of land on either side of a creek or river which can be naturally covered with water when the waterway gets too full

Flushing – exchange of water from one location to another, generally referring to a pulse of rain water flowing through a river or creek or to tidal exchange

Groundcover – Low growing plants covering the ground which stabilise soil and help reduce erosion

Groundwater – Water that has soaked into the soil and moves through the ground in close interaction with surface water

Habitat – The environment, including physical and biological features, in which an animal or plant lives

Heathland – A type of vegetation generally found on poor quality soils in coastal lowlands

Hill slope erosion – Erosion of sediment from hillslopes by surface wash or by rills

Hydrogen sulphide – A compound found in acid sulphate soils, which, when exposed to the air and water, produce sulphuric acid

Invertebrates – Animals without backbones

Iron – An element essential in small quantities, to all biota

Irrigation – Application of water to the land

Longshore drift – The northwards movement of sand along the east coast Australia

Lyngbya – A toxic marine cyanobacteria which blooms annually in Moreton Bay

Macroalgae – Multicellular plants with a leafy appearance that grow in water and are visible to the human eye

Mangrove – Salt-tolerant trees or shrubs that have their lower trunk and roots in the water usually in the intertidal zone

Meandering – Winding, as a river winds through the floodplain

melaleuca – Also called tea tree

Microalgae – Small plants that live in the water and can't be seen by the naked eye

Native vegetation – Vegetation which originates where it is found

Nitrogen – A nutrient which is essential to all biota, including plants, animals and bacteria; needed to form proteins and genetic material

Nitrogen fixation – Conversion of gaseous nitrogen (in the air that we breathe) into a form which can be taken up by plants, carried out by only certain bacteria and cyanobacteria

Nutrients – Essential elements required by biota

Organic matter – Any material originating from biota

Organism – Any living thing

Oxidation – The addition of oxygen to a compound

pH – A measure of acidity

Phosphorescence – Luminescence produced by certain groups of marine phytoplankton and animals

Phosphorus – A nutrient which is essential to all biota, including plants, animals and bacteria, found in energy molecules and membranes of cells

Photosynthesis – Conversion of light and carbon dioxide into organic molecules carried out by plants, algae and some bacteria

Phytoplankton – Microscopic algae that float in the water

Pine Plantation – Forests of pine tree grown for timber, generally the northern hemisphere exotics Pinus elliotti and Pinus caribaea

Pneumatophores – Mangrove roots which poke out of the mud enabling the tree roots to soak up oxygen when the tide is out

Point Source – A single point discharge of, for example, nutrients or sediments rather than run-off from the land

Pollutant – A substance which may naturally occur but be present at harmful levels (e.g. sediment or nutrients) or which may be unnatural in the environment (e.g. pesticides)

Productivity – The rate that organic molecules are formed from photosynthesis

Quandamooka – The Aboriginal name for Moreton Bay

Rainforest – Forests that develop in areas with high rainfall

Residence time – The amount of time that water or substances in the water stay in an area

Riparian Vegetation – Vegetation/plants along a waterway or on land which adjoins and influences a waterway

Salinity – Salt content of water

Saltmarsh – herbs or small shrubs which grow behind mangroves at the upper limit of the tidal range

Sea lettuce – Ulva lactuca; a green macroalgae with 'sheets' of green cells radiating from one point, resembles a lettuce

Seagrass – Marine flowering plant that grows submersed in seawater

Secchi depth – A black and white plate sized disc is lowered into the water column, the depth in the water that it can no longer be seen is the secchi depth, used for measuring water clarity

Sediment – Sand or mud that are generally derived from the land and can be found suspended in the water column or on the waterway bottom

Sewage – Wastewater from toilets, showers, the kitchen sink, laundries and industrial discharge and has entered the sewerage system

Sewage effluent – the liquid resulting from the treatment of sewage

Sewage Treatment Plant – (STP); the place where sewage is treated, and many of the solids and nutrients removed before the left-over liquid is discharged into the waterways

Southern Oscillation – Climatic variation, particularly rainfall, caused by changes in air pressure and sea pressure in the Pacific Ocean; also known as *El Niño-La Nina*

Sponge – Simple animals which look like sponges under water, covered in small openings

Stormwater – Water, often containing pollutants, that runs off roofs, roads and other urban surfaces and drains directly into waterways

Stormwater Quality Improvement Device (SQID) – Devices, including trash racks and wetlands, that trap some of the pollutants in stormwater, particularly sediments and rubbish, before it reaches waterways

Stream order – Refers to the relative size of the streams in the catchment, with the lowest stream order at the headwaters and the highest stream order is the main river trunk

Sulfuric acid – An acid that is released when acid sulphate soils are exposed

Suspended sediment – Sediment held in the water column making the water turbid

Tannins and folic acids – Organic nutrients derived from humus and tee trees (eg. *melaleuca*), which are secreted into the groundwater and waterways staining the water a tea colour and which combine with iron making it available for uptake

Tea tree – A group of trees and shrubs (including paper barks, genus name *melaleuca*) which secrete organic substances (tannins) which stain water a tea colour

Terrestrial – Of the land

Tidal flushing – Exchange of water from the ocean during the tidal cycle

Transpiration – Evaporation of water from plants

Turbidity – The amount of sediment in the water

Vegetation – A general term for the plant cover in an area

Wallum – Heathland that grows in sandy, low nutrient, acidic soils on the lowlands and offshore islands of South-east Queensland

Water cycle – The cycle of water through the environment including rain, flow over and under the land and transpiration back into the atmosphere

Water quality – Physical, chemical and biological characteristics of the water column, including nutrients, sediment and chlorophyll a.

Water treatment plant – Where water extracted from waterways or dams is treated for drinking

Waterway – A passage for water including any stream, river or bay which sometimes or always contains water

Weir – Dam across a river or stream to control flow

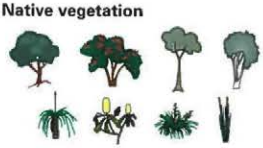
Wetland – An area of vegetation, either temporarily or permanently flooded with fresh or salt water, including mangrove, marsh and *melaleuca* wetlands

Zooplankton – Animals that live in the water column

Icon Glossary

Biota

Native vegetation



Native freshwater fauna

Marine fauna

Aquatic weeds

Aquatic birds

Carp

Phytoplankton

Mangrove

Seagrass

Sea lettuce

In-stream habitat

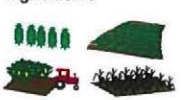
Coral

Dead coral

Lyngbya

Land/water use

Agriculture



Urban

Recreation

Grazing

Forestry

Orchard

Industry

Dairy

Poultry

Abattoir

Port

Dredging

Trawling

Water supply facility

Water extraction

Gravel extraction

Inputs

Stormwater

Sewage Treatment Plant

Litter

Toxicants

Stormwater Quality Improvement Device

Point source nutrients

Diffuse sediment and nutrients

"Black water" run-off

Iron run-off

Processes

Tidal flushing

Sediment resuspension

Sediment deposition

Seagrass loss

Mangrove loss

Bank erosion

Eroded banks

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This book is your guide to the health of South-east Queensland's waterways and catchments. It describes how they function and why they are so special and important to our lives.

It includes information on each of the region's major catchments covering their distinctive characteristics, issues and problems. It also describes projects being undertaken by community groups, industry and government to protect and restore catchment and waterway health.

A list of contacts is included so that you can get involved and help achieve the Healthy Waterways Vision:

Our Waterways and catchments will, by 2020 be healthy ecosystems supporting the livelihoods and lifestyles of people in South-east Queensland, and will be managed through collaboration between community, government and industry.

HEALTHY WATERWAYS
Because we're all in the same boat

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