

Tuggerah Lakes Estuary Management Plan



October 2006



Estuary management process

Tuggerah Lakes Estuary
Process Study, 2001

Tuggerah Lakes Estuary
Management Study, 2005

Tuggerah Lakes Estuary
Management Plan, 2006

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about the Tuggerah Lakes
Estuary Processes Study, and
Estuary Management Study
and Plan on Wyong Shire
Council's web site

www.wyong.nsw.gov.au

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NSW Government

DEPARTMENT OF NATURAL RESOURCES

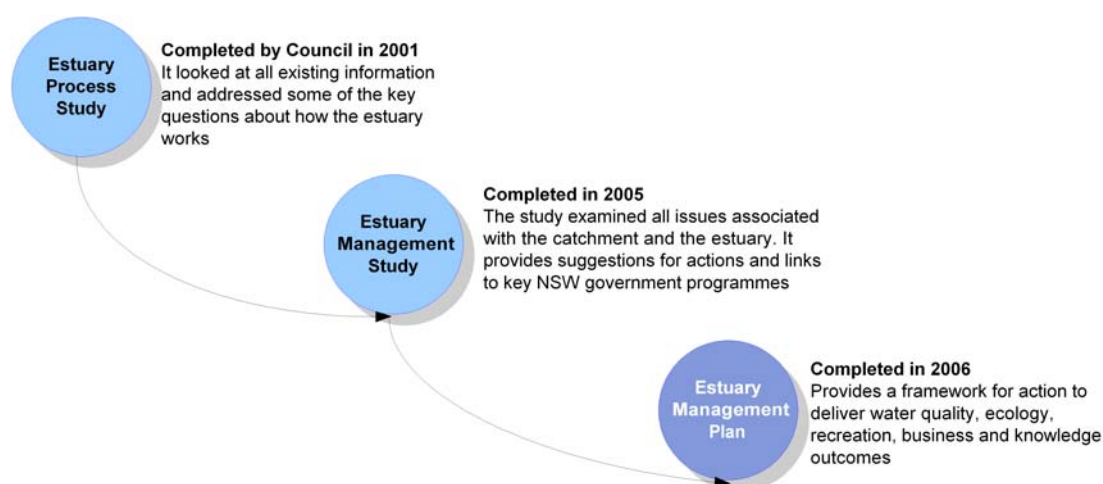
Executive Summary

The Tuggerah Lakes

The Tuggerah Lakes estuary is located on the central coast of NSW, and is comprised of three shallow coastal lagoons, Tuggerah Lake, Budgewoi Lake and Lake Munmorah. The three lakes occupy an area of 70 km², are interconnected and open to the sea at The Entrance. The catchment of the Tuggerah Lakes is 670 km² in size, which represents around 80% of the area of Wyong Shire. The Tuggerah Lakes estuary has always been important to the Shire in terms of its value to tourism, recreation and fisheries.

Plan Process

Wyong Shire Council, in partnership with the Department of Natural Resources, has been developing an estuary management programme for the Tuggerah Lakes. The programme has so far involved the preparation of an Estuary Process Study and an Estuary Management Study.



Findings from the Estuary Process Study

The objective of the Tuggerah Lakes Estuary Process Study was to identify data gaps and key estuarine processes so that there was better understanding of how the estuary “worked”. It was completed in 2001, and some of its key findings include:

- Sedimentation in the estuary is slow. At current rates, it would take over 1000 years to fill completely, making it one of the slowest infilling estuaries on the NSW coast.
- Investigations on pollutants within the sediments indicated very small amounts of pesticides whilst heavy metals were below those found to cause adverse ecological effects.
- The sediments have significant concentrations of nutrients which are available for plant growth

-
- Nutrient concentrations in the water column are above the water quality guidelines while the estuary can be classified as having a medium nutrient status.
 - The entrance is now kept open to the sea by a sand dredge, however, the overall effects of flushing are believed to be small given the size of the estuary.
 - Turbidity in the estuary has decreased since the 1980's and whether this was due to reduced patterns of rainfall and/or reduced concentrations of suspended material in the water is unknown.
 - The extent of seagrass habitat has declined by over 50%. The saltmarshes of the estuary have continued to decline (more than 80% have been lost) as a result of disturbance.
 - The process study found that the Tuggerah Lakes estuary was "healthier" than it was during its eutrophic stage in the 1980's and 1990's. The question is whether this level can be sustained with increased future development or whether the system would be pushed over some threshold, returning it to the previous eutrophic state of the 1980's.

Findings from the Estuary Management Study

The Estuary Management Study was completed in 2005. The study was guided by 6 estuary/catchment management principles (five were taken from the Central Coast Catchment Blueprint, and an additional one added to cover ongoing knowledge and management improvement). These were used to develop management objectives for the Tuggerah Lakes.

Existing and potential problems in the estuary and catchment make it hard for Council to meet these objectives. These "issues" were identified and prioritised by technical, business and community groups. Some of the most significant issues can be summarised as:

- Increased sediment and nutrient loads from development
- Erosion of creeks and banks
- Pollutants in stormwater runoff
- Reduced freshwater flow to the lakes
- Continuing development pressure
- Degraded foreshores
- Community perceptions
- Business needs and compatibility with the estuary
- Future funding and management of the estuary

Twenty-seven programmes were then developed that would address the most pressing issues over the next 5 years, and are the focus of actions in this Estuary Management Plan.

Consultation Process for the Management Plan

While Council and the Department of Natural Resources have been the main drivers behind the planning process, its long-term success depends on the Estuary Management Plan being “owned” by all stakeholders including the community, business groups and State agencies. These stakeholders have been consulted extensively at all key stages of the Estuary Process Study and Estuary Management Study. The Estuary Management Plan differs in that it was developed at a time when Wyong Shire Council was exploring ways of increasing funding for estuary management activities. The preferred funding source was through the establishment of a new stormwater levy. As this marries estuary management with an increased charge to residents, it was more important than ever to consult with the community.

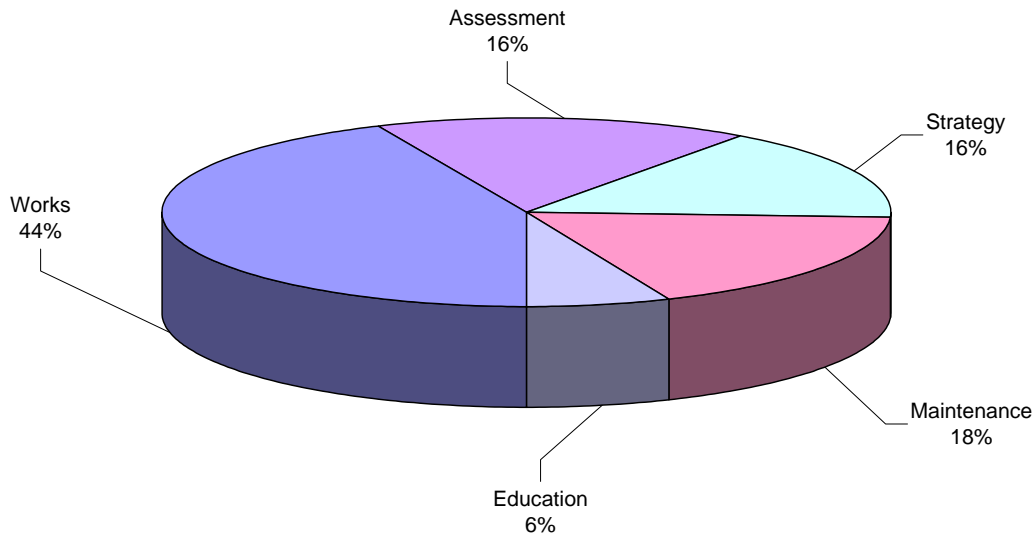
This was achieved through a number of different mechanisms:

- Open days at Lakehaven, Westfield Tuggerah and Bay Village shopping centres
- Poster displays at Council chambers and local libraries
- Advertorials on key lakes issues in local newspapers
- Community input called for in newspapers, on display posters and through media interviews on local radio
- Guiding local media on a tour of the estuary to discuss issues
- Workshops with technical, community and business focus groups
- Ongoing liaison with the Tuggerah Lakes Estuary, Coastline and Floodplain Management Committee
- Engaging local school children to assist with developing a logo for the lakes
- Public Exhibition of the draft Estuary Management Plan
- Field Day Sessions held at three locations around the estuary

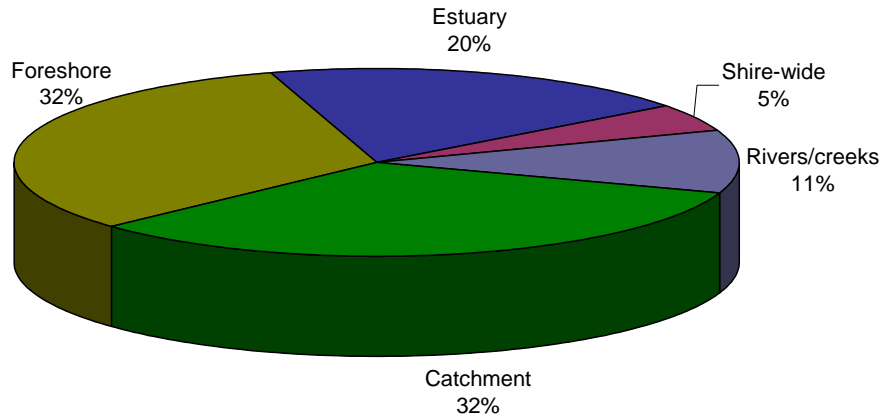
Investment

The programmes identified in this Estuary Management Plan represent a funding requirement of approximately \$9.3 million p.a. This is an increase of \$6.9 million above Council’s existing expenditure on similar programmes of \$2.4 million p.a. (Council spends \$3 million annually, but only \$2.4 million of it can be compared with lakes programmes in this plan). It is thought that between \$1.5 and \$2 million will be raised by the stormwater levy, and Council expects that this will be matched with funding from the State and Federal Governments (including the Hunter-Central Rivers Catchment Management Authority).

The funding in the action plans is spread across the catchment and estuary, and is distributed through a range of different actions. These are displayed in the following figures.



Distribution of funds by type of action



Distribution of funds across the catchment

Action Plans

The Tuggerah Lakes Estuary Management Plan provides the platform for sustainable, co-operative management of the lakes system. The twenty-seven priority programmes from the Estuary Management Study have been grouped into four main action plans that deliver outcomes for:

- Water Quality \$3.2 million (increased from \$868,000)
- Ecology \$1.5 million (increased from \$50,000)
- Socio-economics \$3.4 million (increased from \$1.2 million)
- Knowledge and Management \$1.2 million (increased from \$199,000)

While the estuary management plan will be revised every 5 years, these action plans that sit underneath will be developed each year to set out actions, responsibility and allocate funding for the

coming year. This is a big improvement on traditional estuary management plans which have 5-10 year life cycles that can't adapt to annual budget changes or be modified to access new grant opportunities. For example, many existing estuary management plans were developed before the Catchment Management Authorities (CMA's) came into existence, so more traditional plans would not be able to reflect the priorities of the CMA until they came up for review in 5 to 10 years time. This Estuary Management Plan has been developed at the same time as the H-CRCMA CAP. As the CAP is still being finalised, it was not possible to directly incorporate its priorities and vision for estuary management. However from the outset, the plan was based on the overarching principles of the Central Coast Catchment Management Blueprint so that its direction will be consistent with the CAP. As this Estuary Management Plan can be modified annually through its action plans, priorities and directions in the final CAP can be included as they become available.

What's happening on the ground?

The on-ground actions that will be implemented are spelt out in the tables contained within each of the four action plans. The actions do not always refer to specific sites for implementation (although some are shown in the accompanying maps). This is to avoid being overly prescriptive, allowing Council to shift its focus year-by-year depending on funding and new knowledge. The exact locations will be set by the Action Teams that will be responsible for developing their respective action plans in co-operation with all stakeholders (however general locations have been identified in Action Plan maps).

Within the tables, the actions are laid out in the order that they should be undertaken. For example, before starting on-ground works, it is often necessary to prioritise which sites to target first, liaise with local residents/businesses, gain necessary approvals and prepare detailed designs for any construction. In the Action Plans, this means that the actual "doing" component is often the third or fourth item, rather than the first. After the works have been completed, it is sensible to review the success of the project so that any lessons can be incorporated into the next project. It is important to recognise that these initial and final stages generally cost a fraction of the total cost of each project, and are necessary to ensure public money is spent wisely.

Each action plan has a number of goals. The funding associated with these goals is set out in the following table.

Action Plan	Goal	Funding (\$ p.a.)
Socio-economic	Improve recreational facilities around the lakes and creeks	\$2,200,000
	Provide estuary positive business opportunities	\$127,000
	Develop sustainable targets for development	\$116,000
	Maintain creek mouths for navigation and water flow	\$550,000
	Maintain flow through the entrance	\$432,000
Water Quality	Improve quality of stormwater from the catchment	\$2,180,000

Action Plan	Goal	Funding (\$ p.a.)
	Ensure beaches meet primary water contact requirements	\$81,000
	Stabilise foreshore and streambank erosion	\$640,000
	Encourage sustainable use of water	\$269,000
Ecology	Improve foreshore habitat	\$629,000
	Protect and restore catchment habitat	\$564,000
	Protect estuary habitat	\$18,000
	Learn how changes to flow in the rivers affect plants and animals in the estuary	\$296,000
Knowledge & Management	Establish an estuary management body	\$381,000
	Learn more about key processes in the estuary	\$343,000
	Develop partnerships with universities	\$52,000
	Provide the community with current information on the estuary	\$459,000

The tables contain a significant number of new works projects to help restore parts of the estuary, and provide facilities and conditions that encourage people back to the lakes. Overall expenditure on works is approximately \$3 million per year for the 5-year life cycle of the plan. Some of the specific works recommended for inclusion in the Year 1 Action Plans include:

- Replace boat ramp at Saltwater Creek and upgrade facilities (toilets and contained wash-down area)
- Provide toilets and fish-cleaning facilities at Wyong River boat ramp
- Beach nourishment at northern Lake Munmorah baths
- Fix wrack accumulation zones in Wallarah Pt (nr bridge), Prawn Beach, Rocky Point
- Dredge boat ramps at Tumby Creek, Kanwal, San Remo, Budgewoi Aquatic Club, Colongra Bay, Elizabeth Bay, Toukley Aquatic Club
- Continue wrack harvesting and beach cleaning at Canton Beach, Gorokan, Toukley Sailing Club, Budgewoi, Elizabeth Bay, Long Jetty
- Establish an estuary management body
- Stabilise the streambanks in Tumby Creek to minimise sediment deposition at the creek mouth
- Trial best practice water saving devices for i) residential developments, and ii) for industrial development

-
- Implement WSUD and sediment/nutrient control devices for the Wyong Economic Zone and Warnervale Development Areas – focus on maintaining health of downstream aquatic ecosystems
 - Retrofit nutrient and sediment controls to Tumby Creek and Saltwater Creek catchments as a matter of priority. Focus on controlling both of these pollutants at the source
 - Identify sources of faecal pollution and use this information to improve water quality at lakes swimming beaches

This Estuary Management Plan is the platform for managing the Tuggerah Lakes Estuary for the next 5 years. Its Action Plans provide the flexibility to redirect effort and funding each financial year and call for significant involvement from a host of stakeholders including the community of Wyong Shire and State Agencies. It is a plan for managing one of the most unique estuaries in Australia, and one of Wyong Shire's most valued natural assets.

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1 Introduction

In a geological time frame the Tuggerah Lakes system is a very recent phenomenon, having been formed only since the ocean reached its current level about 6,500 years ago (Roberts, 2001). Since their formation, the lakes have been gradually infilled by marine sand brought in from the sea and by sediment washed down from the catchment in floods.

The supply of sediment from the catchment has probably always been somewhat above natural background levels, initially as a result of Aboriginal burning practices and subsequently in response to European development. Also, particularly in response to farming and urbanisation practices over the past century, the quality of water flowing into the lakes from the catchment has been progressively degraded. Whilst that level of degradation has been somewhat reduced since construction of a reticulated sewage system with an ocean outfall, water quality entering the estuary remains a problem because of ongoing urban, commercial and agricultural activities that cannot readily be retrofitted to achieve outputs that are equivalent to natural water quality standards.

As indicated in the Estuary Management Study (Roberts & Dickinson, 2005), the Tuggerah Lakes system reached a eutrophic state prior to finalisation of the reticulated sewage system and prior to provision of the permanently open entrance now maintained by Council's dredge. However, in spite of these works, and the significant counterbalance they provided to pollution from the catchment at the time, the threat of eutrophication remains a potential future concern as urbanisation of the catchment intensifies.

Apart from water quality, there are many other significant ecological and anthropological concerns that have to be addressed in drawing up the Estuary Management Plan, including the need to ensure that the lakes and their surrounds provide and maintain a high standard of public amenities such as walking tracks, bicycle tracks and boating facilities as well as passive recreation areas and habitats reserved exclusively for flora and fauna.

1.1 Estuary Management Planning Process

The estuary management planning process in NSW commenced in response to a policy platform of the NSW Government in 1975. The first actions to give effect to this policy concerned the preparation of waterway planning studies undertaken on behalf of the NSW Government by consultants engaged by government agencies. In this era, many waterway planning studies were completed prior to publication of the Estuary Management Manual (DLWC, 1992).

Major coastal lake systems were a feature of these early planning studies because they were the subjects of much public concern. Whilst studies were undertaken in respect of several major coastal lake systems similar to Tuggerah Lakes in scale such as Lake Illawarra, Brisbane Water and Lake Macquarie, the situation in the Tuggerah Lakes system was considered to be so dire as to warrant the

establishment of a special interdepartmental committee to investigate and report to the NSW Government on its plight.

One result of this concern was the commencement of a \$15 million NSW Government investment in remedial works within the Tuggerah Lakes system that included extensive removal of black odorous sediments from the shallows caused by eutrophication, design and construction of a customised dredge to keep the entrance open to guarantee flushing from the ocean and minor works designed to treat water entering the lakes system from stormwater drains.

In the same era, Wyong Shire Council and the NSW Government also jointly began the construction of the reticulated sewage system that relieved Tuggerah Lakes of a massive unnatural nutrient load built up as a result of household septic tanks. Notably, all of this work was undertaken without the prior benefit of a detailed understanding of how the Tuggerah Lakes system actually works and without any solid public input into determination of solutions.

To address such shortfalls in fully understanding the needs of Tuggerah Lakes and other estuaries throughout the state, the NSW Government, established a second estuary focussed interdepartmental committee, in 1988, to develop a methodology for optimal management of all estuaries and coastal lakes. That committee soon realised that, despite ownership of the bed of estuaries (Department of Lands), management of fishery activities (Department of Primary Industries - Fisheries), control of coal extraction (Department of Mines) and catchment management responsibility (now Hunter and Central Rivers Catchment Management Authority) being under government agency control, the body most able to effectively manage an estuary was undoubtedly Wyong Shire Council.

The outcome of this committee's deliberations was the establishment of a NSW estuary management policy and the publication, in 1992, of the NSW Government's Estuary Management Manual. The policy, amongst other things, places responsibility for estuarine management firmly with local Councils, whilst the manual documents a sequential estuarine managerial planning process designed to assist Councils to maintain or restore estuarine "wellbeing".

In the case of Tuggerah Lakes, the local community has the greatest interest and the most to gain from ensuring the future wellbeing of the lakes and, despite significant past and future assistance from the NSW Government, it is Wyong Shire Council, as the sole representative of the community surrounding the lakes and occupying their catchment, that is best placed to both adopt and implement an Estuary Management Plan.

Estuary management responsibilities necessarily impose a significant cost on the entities charged with their implementation and in this regard it is important to recognise that Council and the H-CRCMA are potentially able to raise funds through an environmental levy to improvement of the wellbeing of the Tuggerah Lakes system and its catchment.

The 8-stage estuary management planning process is briefly described in the following subsections (Figure 1).

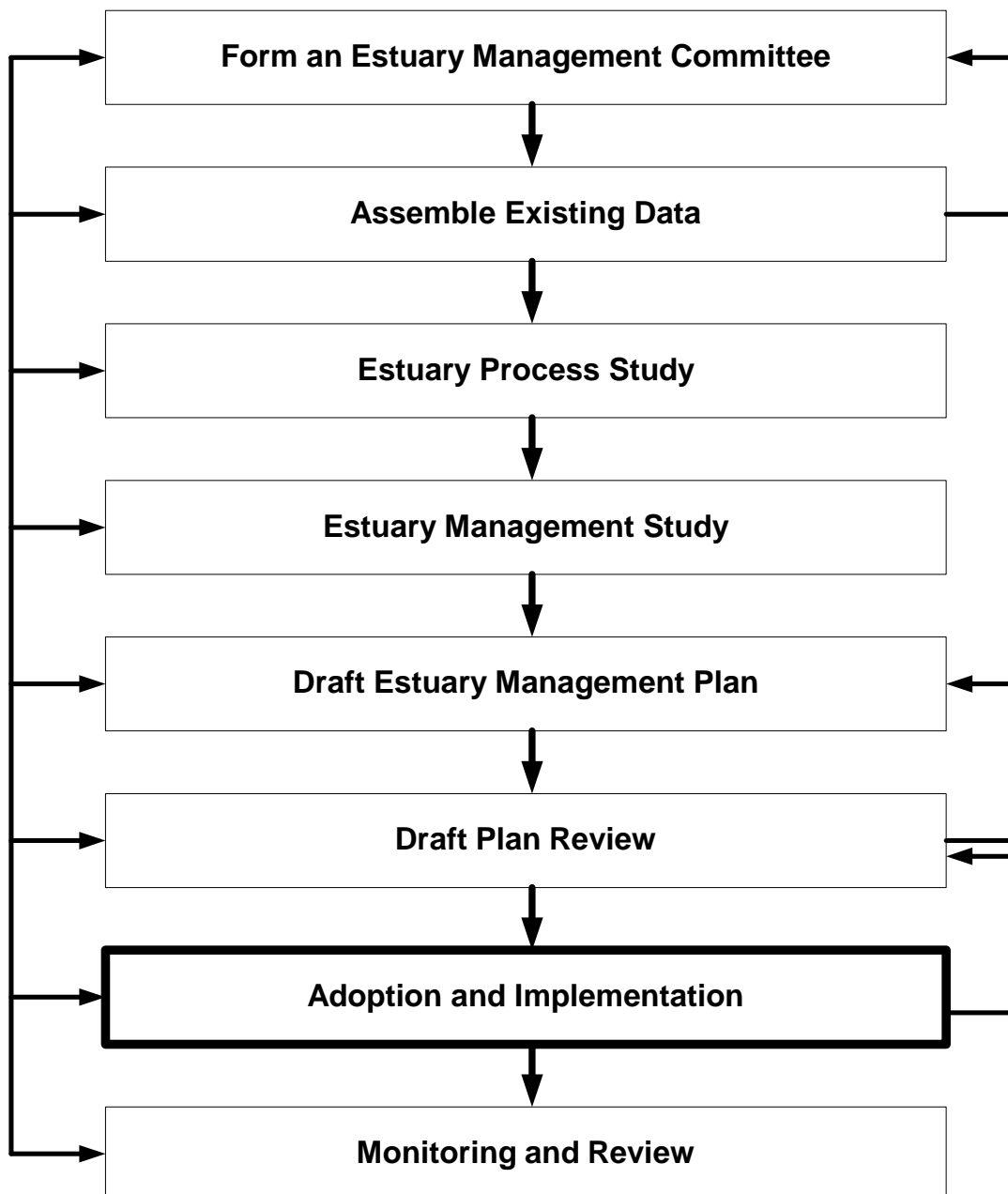


Figure 1. Estuary Management Planning Process (after DLWC, 1992)

1.1.1 Estuary Management Committee

Estuary Management Committees are chaired by local Councils as the only bodies fully representative of the local community that is most closely concerned about the wellbeing of an estuary. Committee membership includes agency representatives from the NSW Government, a catchment management authority representative and representatives from local environmental groups and other action groups as appropriate.

The committee facilitates direct access to the specialist knowledge of state agencies, and to appreciation of local community concerns. It steers the estuary management process from the start right through to monitoring implementation of an adopted plan.

In many cases, councils have combined estuary, flood and coastline management considerations under the auspices of a single coast and estuary management committee, such as is the case with the committee established by Wyong Shire Council, the Tuggerah Lakes Estuary, Coastal and Floodplain Management Committee.

1.1.2 Assembling existing data

Most NSW estuaries are the subject of historical development and the recording of related technical and scientific data. As a first step in its deliberations, an estuary management committee oversees the assembly and preliminary analysis of existing databases.

Such data are often more extensive than initially anticipated, particularly when historical sources are tapped, including local Aboriginal history where it is available. Data collection and analysis are usually undertaken in the first instance by consultants commissioned on behalf of the committee by the Council.

1.1.3 Estuary Process Study

This study was needed to establish a factual basis on which practical future managerial options could be based (Roberts, 2001). A process study is usually undertaken by specialist consultants primarily to detail the oceanographic, hydraulic, geologic, anthropogenic and ecological conditions of the estuarine system.

One important aspect of a process study concerns the determination of the extent to which human activities have modified or disrupted natural estuarine processes, particularly in regard to impacts on water quality, flora, fauna and public amenity.

1.1.4 Estuary Management Study (EMS)

This study uses past data, an understanding of estuarine processes and any necessary additional information (particularly community input) to define managerial objectives and measures most appropriate to achievement of future improvement of estuarine wellbeing.

In summary, an estuary management study seeks to:

- Identify the significance of the estuary in terms of broader coastal planning issues;
- Identify the essential features of the estuary be they physical, chemical, biological, aesthetic, social and/or economic;
- Document current uses and conflicts of use in the estuary;
- Identify possible future land uses and assess their impact on the essential features;
- Assess the need for nature conservation and remedial measures;
- Identify and assess management objectives from the foregoing; and

-
- Assess planning controls, works and other strategies that might be applied to achieve these objectives.

In the case of Tuggerah Lakes, a number of primary issues were highlighted as part of the management study agenda particularly water quality, fauna and flora degradation and public recreation demands. The net result was the preparation and adoption by Wyong Shire Council of a comprehensive Estuary Management Study for the Tuggerah Lakes system and its catchment (Roberts & Dickinson, 2005).

1.1.5 Estuary Management Plan (EMP)

The process and management studies provided the factual basis for the formulation of this Estuary Management Plan, which takes into account the considered view of all parties on the Tuggerah Lakes Estuary, Coastline and Floodplain Management Committee (TLECFMC). Plans usually require trade-offs and compensatory balances, particularly between ecological and anthropogenic needs and this will doubtless be the case with the Tuggerah Lakes system where human impact in the catchment has had an impact on the water quality of the lakes and on the flora and fauna of both the lakes and their catchment.

In many ways, formulation of the plan is the most important part of the process because it translates the understanding developed in previous stages into practical actions directed squarely at improving the wellbeing of an estuary.

It is clear from the simple aim specified in the estuary management manual "...estuary management plans should reflect the agreed position of regulatory authorities and interested parties in relation to the future nature conservation, rehabilitation and development of the estuary..." that an effective estuary management plan needs to achieve a balance between anthropogenic and ecological needs. To be effective, any such plan also requires community support and it must be capable of cost-effective implementation by means of direct expenditure (eg. remediation) and management control of estuarine and catchment practices (eg. planning/development controls).

1.1.6 Plan review

The process of public display and subsequent review of the Estuary Management Plan provided all interested and potentially affected parties with an opportunity to assess what is proposed for the estuary and to register objections and/or suggestions for consideration by the TLECFMC and by the Council. This feedback was taken into account and appropriate modifications to this final text were made.

1.1.7 Adoption and Implementation

This final Estuary Management Plan has been prepared for the consideration and formal adopted of the Council. Following adoption, it will be the responsibility of Council and relevant State authorities to implement the four action plans.

1.1.8 Monitoring and review

Once the Estuary Management Plan is adopted and its implementation commenced, it will always be necessary to undertake ongoing monitoring and evaluation activities because estuaries are very complex and dynamic systems and many of their natural processes, particularly ecological processes, are not yet fully understood.

In general, ongoing monitoring will involve the collection of baseline data related to overall wellbeing and any necessary specific studies. It should be reviewed and assessed by the TLECFMC, which should make recommendations to Council for amendments to the action plans where findings indicate a need for change.

In this regard, it should be noted that the DLWC (1992) manual stated that "... continuing monitoring and review are essential elements of the estuary management process..." because "... an Estuary Management Plan is not a static instrument but rather one that needs to be reviewed on a regular basis and updated where necessary to cater for the changing needs and desires of society...".

Wyong Shire Council has reached the point of preparing its Estuary Management Plan (Figure 1). This plan has been through extensive public review and comment and was revised as necessary before being formally adopted by Council for implementation.

1.2 Aims & Objectives

The NSW Government's estuary management policy is a component of its Rivers and Estuaries Policy that in turn comes under the umbrella of its catchment management framework, which, as far as the Tuggerah Lakes are concerned, is now administered by the Hunter-Central Rivers Catchment Management Authority. As noted above, within this policy hierarchy, primary responsibility for implementation of Estuary Management Plans remains the responsibility of local Councils.

The Tuggerah Lakes Estuary Management Plan is based on the findings of the Estuary Process Study (Roberts, 2001) and the recently published Estuary Management Study (Roberts and Dickinson, 2005) prepared for Wyong Shire Council. When adopted, Council, assisted by the NSW and Federal Governments, will implement it. In order to resource this responsibility, if it so decides, Council may collect an environmental levy from ratepayers, subject to approval from the NSW Government.

1.2.1 Aims

At its most simple level, as defined in the Estuary Management Manual (1992), an Estuary Management Plan "... consists of a scheduled sequence of recommended activities that need to be undertaken to achieve the estuary management objectives..." To deliver this outcome, an Estuary Management Plan utilises the information presented the Estuary Management Study to define actions directed at maintaining and/or improving estuarine wellbeing and it provides indicative cost estimates for the implementation of those actions.

As also defined in the manual, these aims essentially target achieving an ecologically healthy system that provides for anthropogenic needs. This is necessarily a balancing act within which the concepts of ecologically positive development and socially/economically acceptable ecological remediation need to be applied alongside an ongoing improvement in understanding of the lakes system through data collection, analysis and public education.

1.2.2 Objectives

In the case of Tuggerah Lakes, the Estuary Management Study used six principles, which dovetail with the Central Coast Catchment Management Blueprint (a forerunner to the Hunter-Central Rivers Catchment Management Authority and its Catchment Action Plan), as a basis for producing a schedule of objectives (Table 1). The relationship between the Blueprint, the Estuary Management Study and this Plan, is shown in Figure 2.

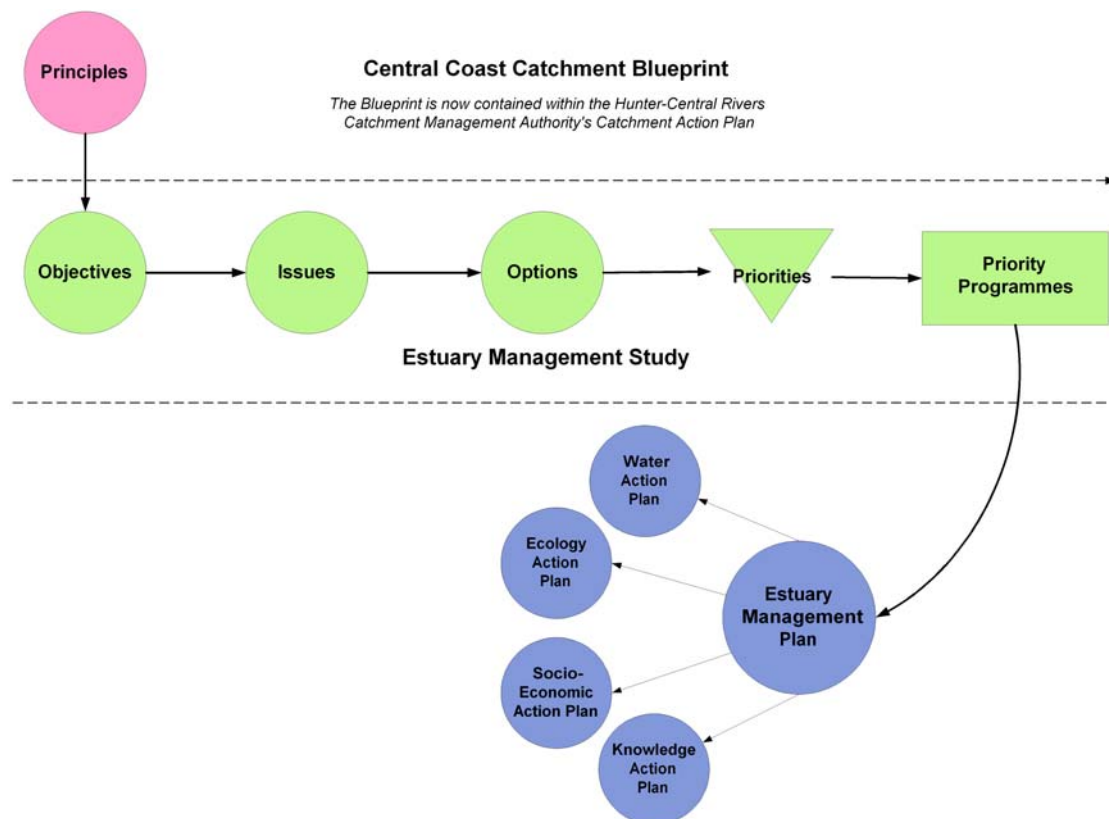


Figure 2. Catchment Blueprint, Estuary Management Study and Plan

Table 1. Principles and Objectives for the Tuggerah Lakes Estuary

Principles (Catchment Blueprint)	Objectives (Estuary Management Study)
Water quality and quantity meet community needs and natural ecosystem requirements	<ul style="list-style-type: none"> • To provide adequate environmental flow to sustain estuarine and riverine ecology (Joint Water Authority responsibility). • To maintain water quality to protect healthy ecosystem function in the estuary and rivers. • To provide water quality in rivers and the estuary safe for primary human contact. • To maintain flow patterns while minimising flooding threat to life and property. • To provide adequate water for community water supply (Joint Water Authority responsibility). • To minimise changes to groundwater flow/stores (Department of Natural Resources responsibility).
The physical structure and vegetation of river, lake and wetland riparian zones are protected (and rehabilitated where required) to sustain healthy ecosystems	<ul style="list-style-type: none"> • To protect, maintain and restore freshwater wetland vegetation. • To protect, maintain and restore aquatic and semi-aquatic estuarine vegetation. • To protect, maintain and restore floodplain vegetation. • To protect, maintain and restore aquatic and riparian vegetation.
Conserve the diversity of all native plant and animal species and to protect and assist the recovery of threatened and endangered species	<ul style="list-style-type: none"> • To maintain the biodiversity and ecological function of the catchment in a manner that protects the estuary. • To minimise human disturbances that affect ecological function. • To maintain and protect environmentally significant areas and threatened species/communities. • To ensure fishery is sustainable (DPI Fisheries responsibility).
Human settlement, primary production and other land uses take place while protecting and enhancing Aboriginal cultural heritage, soil, water and ecosystem health	<ul style="list-style-type: none"> • To ensure management of the estuary and catchment protects and enhances indigenous and non-indigenous cultural heritage. • To provide for economically and socially justified levels of development whilst containing adverse ecological impacts. • To support forestry, agriculture and other industries in the catchment while viability of downstream ecology is maintained. • To protect and restore soil landscapes and improve understanding of land capability and suitability in the catchment.
The coastal zone environment is protected whilst providing for the social and economic needs of the community.	<ul style="list-style-type: none"> • To support existing industry where it is ecologically responsible. • To ensure that any new commercial venture is socially and economically justified and is ecologically compatible with the estuary. • To provide for public access and amenity at designated recreation areas.
Improve knowledge of catchment and estuarine systems	<ul style="list-style-type: none"> • To identify extent of information gaps and where appropriate undertake studies to improve understanding • To ensure community is pro-actively involved in estuarine health and management

In addition to the foregoing, Council and the local community need to remain mindful of the need to dovetail the Estuary Management Plan into regional planning and catchment planning instruments administered by the NSW Government's planning and natural resource agencies.

1.2.3 Vision for Tuggerah Lakes

The Tuggerah Lakes Estuary is a complex system experiencing significant pressure from activities in the catchment. It is valued by the community as an aesthetic, recreational and commercial resource. It is important that the vision for the lakes be a realistic one, considering both its unique characteristics and community expectations.

The following vision of Tuggerah Lakes is suggested:

Table 2. Vision for the Tuggerah Lakes Estuary

Attribute	Description
Water Quality	Current water quality does not deteriorate in the face of new development. Recreational water quality is improved at lake and creek swimming areas.
Foreshores	Healthy foreshores that promote saltmarsh growth which in turn aid in the natural breakdown of seagrass wrack.
Public facilities	Excellent recreational facilities at access points.
Rivers and Creeks	Healthy rivers and creeks that connect well with the estuary and provide good habitat for estuarine animals.
Ocean entrances	Existing exchange with the ocean is maintained. A permanent entrance is not a cost-effective solution and will have unknown ecological impacts.
Seagrass wrack	Seagrass wrack will be harvested from locations where it accumulates too frequently to be broken down naturally. Wherever possible, saltmarsh will be used to encourage natural odourless decomposition of wrack on the foreshores.
Fish and prawns	Sustainable fish and prawn populations and habitat that provide for long-term recreational and commercial fishing

2 The Tuggerah Lakes Estuary and Catchment

2.1 History

The Tuggerah Lake estuary was formed around 6,500 years ago when sea levels rose after the last ice age. The estuary is comprised of three coastal lagoons (Tuggerah Lake, Budgewoi Lake and Lake Munmorah) and is open to the sea at The Entrance. The estuary is shallow with an average depth of 1.7m. Most of the physical features of the estuary are no longer active except for the protruding river deltas of Wyong and Ourimbah Creeks and the tidal delta at The Entrance. The Tuggerah estuary is one of the slowest infilling estuaries on the NSW coast and its flushing characteristics show that tides contribute very little to water circulation and mixing. The main area of the three lagoons consists of large central mud basins with shallow seagrass meadows surrounding the edges. The bottom sediments of the estuary range from sandy sediments in the shallow seagrass areas to fine mud in the central basins.

The estuary has passed through three recent historical stages. In the first stage, prior to large-scale development in the 1950's, the estuary was considered to have been nutrient poor (oligotrophic). During this period the entrance was not dredged and the entrance was often closed to the sea by a sand bar which was only removed after heavy flooding or high seas. The large catchment provided the necessary freshwater, nutrients and sediments, which made the estuary a productive ecosystem. There were abundant seagrass and saltmarsh habitats that were consistent with the geomorphology and quality of the water of the estuary at this time and the shoreline was relatively undisturbed.

After the 1950's, pressure was placed on the Tuggerah Lakes as the region primarily changed from a major holiday destination to urban development. The flows of nutrients and sediments from the sub-catchments increased, whilst freshwater flows from the wider catchments were reduced as more water was taken from the rivers. Rapid urbanisation and sewage discharges increased the amount of nutrients entering the estuary. The shorelines of the estuary were heavily modified as a result of urbanisation and around 80% of these are now considered to be disturbed (Figure 4). In this period, the estuary became eutrophic (nutrient enriched) causing increased occurrences of blooms of macroalgae (Figure 5) in the shallow seagrass areas close to the shoreline and the production of organic black sediments. The modified shorelines around the estuary also had a negative impact on the mechanisms by which seagrass wrack would be recycled in the estuary (Figure 6).

Today the estuary has been classed as mesotrophic (medium nutrient status). The entrance is kept open to the sea by a sand-dredge (Figure 7), which allows some limited flushing and mixing to occur, however, the overall effects of flushing are small when the size of the estuary is taken into account. The completion of the sewerage scheme helped to reduce the amount of nutrients entering the estuary. Symptoms of eutrophication still occur, especially around some of the developed foreshores, as small-scale blooms of drift macroalgae. The extent of seagrass habitat within the estuary has not increased since declining during the 1980's. The native saltmarsh vegetation around the estuary has

also declined as a result of disturbance (Figure 8). In summary, the Tuggerah Lakes are considered to be “healthier” than they were during the eutrophic stages in the 1980’s and 1990’s (Roberts, 2001; Roberts & Dickinson, 2005) however without appropriate funding and implementation of the management plan they could return to the eutrophic conditions of the past.

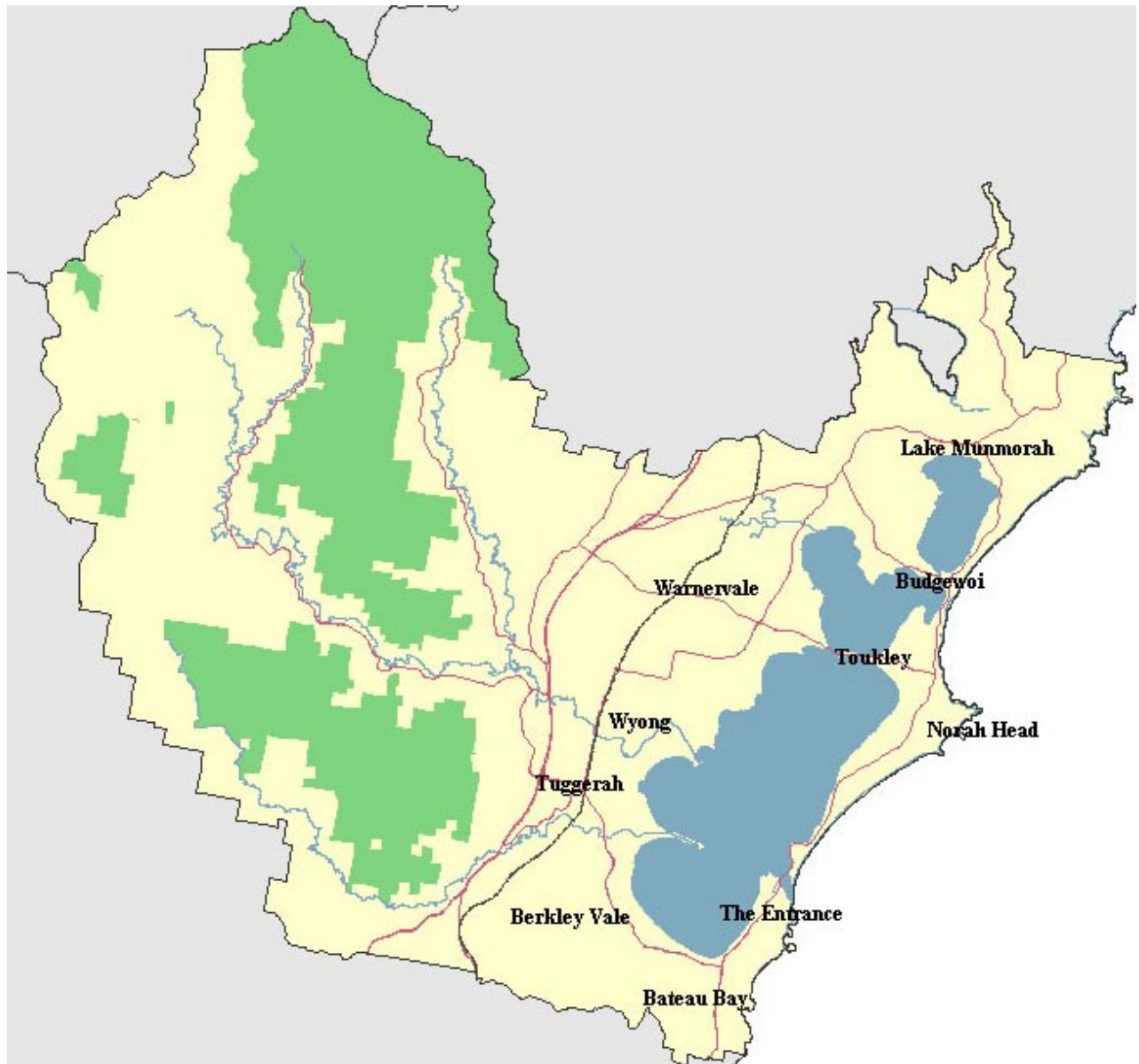


Figure 3. The Tuggerah Lakes estuary and catchment.

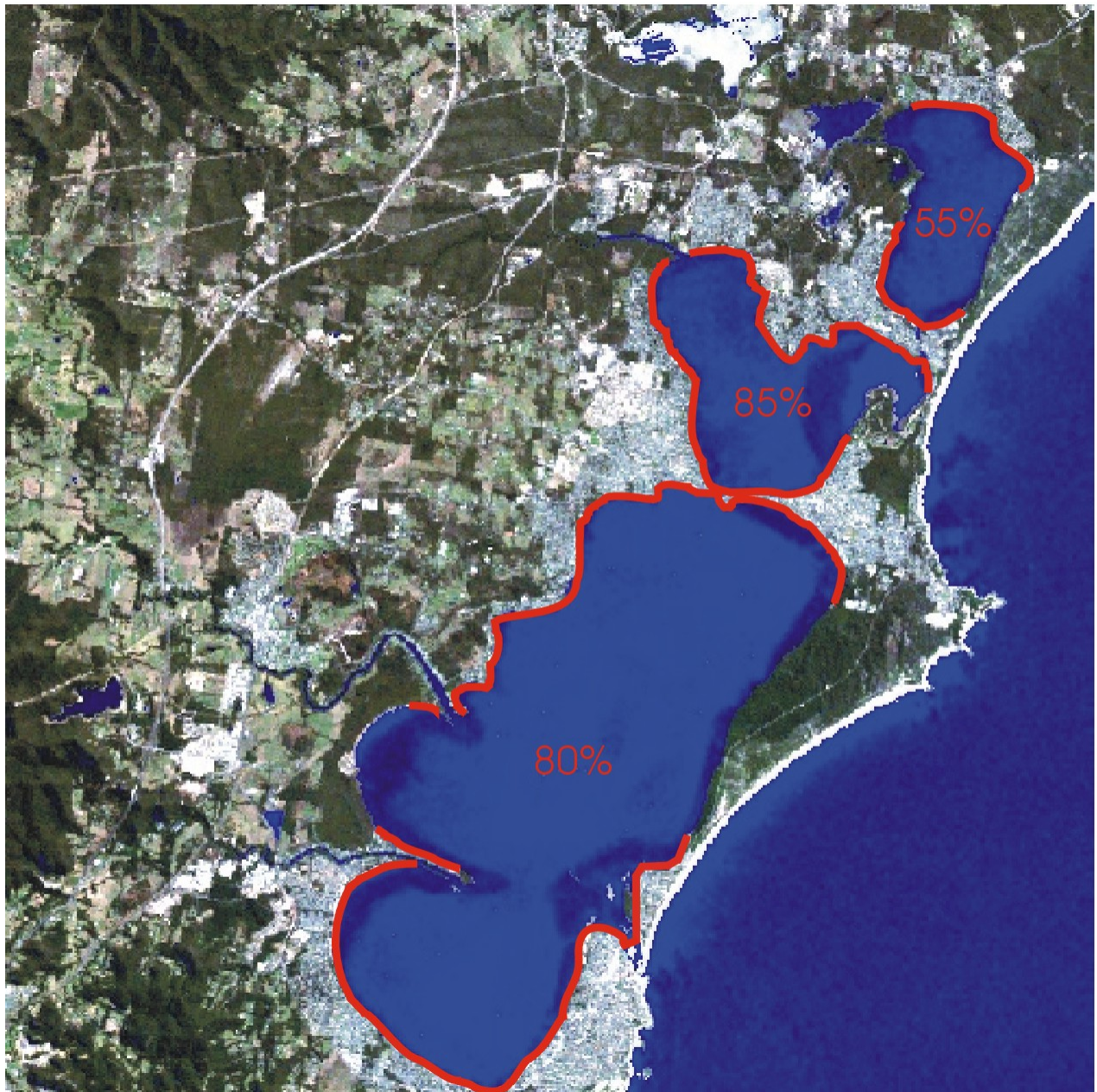


Figure 4. Extent of modified shorelines around the Tuggerah Lakes estuary.



Figure 5. Example of a bloom of macroalgae.



Figure 6. Seagrass wrack accumulation zone caused by modifications to the shoreline.