

1. Estuaries

What is an Estuary?

Very simply an estuary is a place where the freshwater runoff from the land meets the salt water of the sea.

These places near the coast form in several ways where:

- a river or creek flows and empties directly into the sea;
- a large low lying area collects water and forms a large lake, bay or inlet that connects to the sea; or
- a smaller low lying area collects water from the surrounding land and forms a lagoon or small lake that may be open to the sea only occasionally. Such lagoons or 'little' lakes are also called ICOLLS – Intermittently Closed and Open Lakes and Lagoons e.g. Woolgoolga Lake, Avoca Lake, Narrabeen Lake, Lake Wollumboola and Durras Lake.

<http://naturalresources.nsw.gov.au/estuaries/what.shtml>

Investigate

ICOLLS, Tides, influences on salt water fresh water interface

<http://www.canri.nsw.gov.au/nrdd/records/ANZNS0359000400.html>

Estuaries are constantly changing with the rising of the tide (water flows in from the sea) and falling of the tide (water flows out to the sea) and with the effects of large storm generated waves which erode the coast and remove sand away from the mouth of estuaries. During periods of fair weather, sand is transported back to the mouth of the estuary from offshore. Sand also accumulates in estuary entrances during period of low flows such as in times of drought or when heavy rain has washed sediment downstream.

Estuaries are therefore dynamic places with many habitats and where living things have to cope with changing salinity, temperature and often wetting and drying. Estuaries are also often rich in food and nutrients and support complex food webs.

Investigate

An estuary food web

In NSW there are over 140 rivers, creeks, lakes, bays, inlets and ICOLLS that qualify as estuaries and are located all along the almost 2000 kilometre length of the states coastline.

http://naturalresources.nsw.gov.au/estuaries/inventory/index_ns.shtml

Investigate

What would these estuaries have been like thousands of years ago during periods of lower sea level?

What might these estuaries be like if global warming causes sea level rises or other changes to weather patterns in the future?

Why are Estuaries Important?

Estuaries are important for a number of reasons.

- Estuaries are usually teeming with a huge variety of life or biodiversity!
- They provide the nursery and feeding grounds for many living things that include:
 - shore birds and wading birds;
 - important fish species;
 - shellfish – molluscs and crustaceans; and
 - marine mammals and reptiles.



Clarence River Estuary, courtesy of DECC



Cuttagee Creek, South Coast NSW, source: OceanWatch Australia



Marsh sandpiper, The Entrance NSW

- Estuaries are also often surrounded by important wetland habitats that are the sites of visiting migratory bird species protected by international agreements.

Investigate JAMBA, CAMBA and RAMSAR

<http://naturalresources.nsw.gov.au/estuaries/whyimportant.shtml>

<http://www.fishnames.com.au/>

<http://www.mov.vic.gov.au/crust/page1a.html>

http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/speciestype_list.aspx?type=Marine+Mammals

<http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10901>

- They are the living place for critically important vegetation types such as:
 - mangroves;
 - saltmarsh; and
 - seagrasses.

These vegetation types are perhaps the most biologically productive of all ecosystems.

They provide a number of important environmental services that include:

- buffering shorelines from the erosive effects of storm waves and floods;
- trapping sediments and helping to stabilise or build up shorelines;
- filtering or removing pollutants and high levels of nutrients; and
- providing a refuge or nursery for fish, crustaceans, molluscs and worms.

- Estuaries can be great places to be near and so attract people who come to:

- live;
- fish;
- boat;
- recreate (swim, picnic, bird watch); and
- holiday (camp).

- Estuaries were an extremely important part of the lives of traditional indigenous coastal communities. The high productivity of estuaries meant that coastal Aboriginal people had a long tradition of utilising the resources provided by estuaries culturally and ceremonially. There is evidence that suggests Aboriginal people were possibly the earliest to practise traditional forms of aquaculture in estuaries. There is also a lot of evidence showing the importance of many coastal and estuarine animals in the day to day lives of Aboriginal communities.



Recreational fishing at Tathra, South Coast NSW, source: NSW DPI

Traditional Aboriginal communities operated in estuaries in a sustainable way that ensured that estuaries remained highly productive.

<http://www.livingharbour.net/aboriginal/index.cfm>

- Today coastal Aboriginal communities still pursue an active involvement in recreational and other parts of the fishing industry. Some indigenous coastal communities have also shown an interest in pursuing aquaculture in the less urbanised coastal areas of NSW. The NSW Government has ongoing initiatives to encourage greater involvement by indigenous people in these industries.

<http://www.dpi.nsw.gov.au/fisheries/nsw-ifs/nsw-ifs>

- Larger estuaries often form important transport routes and hubs where large vessels enter and leave the sea, carry cargo of all types as well as people and so are places important for commerce, trade and tourism.
- Estuaries provide an important buffering role and protect property from erosion forces of the sea and during flood.
- Estuaries that are naturally functional also serve as ‘filters’ that improve water quality and they are sites that contribute to groundwater supply recharge near the coast.
- Estuaries may also be productive commercial fishing grounds and areas for carrying out aquaculture that all make substantial contributions to the NSW and national economy . They provide us directly or indirectly with much of the sea food produce many people enjoy eating.

<http://www.seafoodservices.com.au/portal/>

<http://www.waterways.nsw.gov.au/>

<http://www.dpi.nsw.gov.au/fisheries/recreational>

<http://www.amsa.gov.au/Marine%5FEnvironment%5FProtection/>

Snapshot on Important Aquatic Estuarine Habitats

Mangrove forests fringe the estuaries and provide shade for and important habitat for fish and crustaceans as well as filter pollutants from entering the waterway. Many of these mangroves forests have been destroyed or removed for urban and agricultural development. Mangrove loss represents loss of fish habitat and brings change to the flows of nutrients and sediments in estuaries. In turn these changes lower fish productivity and reduce water quality.

Saltmarsh is usually found between the mangroves and the land-based vegetation in estuaries. It provides a very important habitat for juvenile fish and invertebrates and also helps to filter runoff from the land before it reaches the estuary. Large amounts of saltmarsh haven been lost due to reclamation for urban development and agriculture, and damage from stock grazing and recreational activities such as four wheel driving.

Seagrasses are sensitive aquatic flowering plants. They provide productive, shallow marine 'pastures' for animals such as fish to graze on, help to stabilise sediments and also contribute oxygen to the water column. These areas function as 'nursery' areas for fish, prawns and other species. Seagrasses are vulnerable to pollution from chemicals and being smothered by sediment and may never recover after losses from dredging or excavation. The most common types of seagrass in NSW are Strapweed Posidonia, Eelgrass or Ribbonweed Zostera and Paddleweed Halophila.

When you remove mangroves, seagrasses, saltmarsh or wetlands the rate of fish restock declines. These areas are critical to the world's fishing industry that harvests globally 100 million tonnes of fish each year of which 65% are fish that breed in or depend on estuarine habitats. Estimates of the extent of seagrasses in NSW undertaken between 1985 and 2005 have shown an overall slight increase in the amounts of seagrass but this is not uniform with some estuaries having lost more than 10 ha. It would appear that as improved understanding and education about the importance of seagrasses has occurred losses that had occurred prior to 1985 have been reduced. Increased nutrient loads and siltation that occur when unsustainable activities occur in the catchment are thought to be the major causes of seagrass loss.

[http://www.fisheries.nsw.gov.au/aquatic_habitats/aquatic_habitats/fishcare - saving our seagrasses fishnote](http://www.fisheries.nsw.gov.au/aquatic_habitats/aquatic_habitats/fishcare_-_saving_our_seagrasses_fishnote)

[http://www.fisheries.nsw.gov.au/aquatic_habitats/aquatic_habitats/fishcare - our mangrove forests](http://www.fisheries.nsw.gov.au/aquatic_habitats/aquatic_habitats/fishcare_-_our_mangrove_forests)

www.dpi.nsw.gov.au/primefacts

http://www.fisheries.nsw.gov.au/_data/assets/pdf_file/0015/5046/Saltmarsh-Fishnote-dec11.pdf

http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/veg1_home.aspx?name=Saline+wetlands



Mangroves on the Hawkesbury River, source: OceanWatch Australia



Saltmarsh Manning Island, source: OceanWatch Australia



Seagrass meadow, source: NSW DPI

What are the Issues in the Estuary?

The important natural functions of estuaries are often affected by the activities of people.

The sometimes competing uses and activities of people in estuaries can conflict with each other and/or cause problems for the natural functioning of the estuary.

Examples of some of the issues in estuaries are listed below and are worth exploring.

- Poorly managed or inappropriate catchment landuse practices affect water quality.
- Effects of poor water quality on the estuary eg on oyster growers, human health, fish habitat and fish health. Poor water quality can result from a wide variety of human activities. These include high nutrient runoff from agricultural land, toxic and high nutrient runoff from urban areas, discharges from sewage treatment plants (STPs) and other licensed activities and soil erosion from land clearing activities resulting in high turbidity.
- Silt and sand deposits in estuary entrances – riverine and coastal processes.
- Inappropriate coastal development – investigate Sustainability Assessments being undertaken for Coastal Lakes by the NSW Government, the role of Local Government in providing development controls and approvals, the “Tyranny of the small decision” and cumulative impacts.
- Natural versus artificial opening frequency of ICOLLs – the conflict between maintaining natural habitat values of ICOLLs and their surrounds vs flooding issues of nearby residents.
- Declines of fish stocks in estuaries – effect of commercial and recreational fishing versus loss of estuarine habitat due to encroaching development and poor land management practices.
- Recreational, port and other uses of estuaries – jetties, wharves, dredging, sea walls, constructed entrance changes, sullage disposal, marinas, canal estates, trawl fishing, bait collection, anchor drag, boating wake.
- Changes to water runoff rates/frequencies in catchments – hardstand surfaces, altered stream channels, flood gates, dams, weirs and other structures.



Beef cattle, Mid North Coast NSW,
source: OceanWatch Australia



Poor water quality, Mid North Coast,
source: OceanWatch Australia

<http://naturalresources.nsw.gov.au/estuaries/issues.shtml>

<http://www.environment.gov.au/coasts/publications/stormwater/index.html>

<http://www.environment.gov.au/water/quality/index.html>

<http://www.dpi.nsw.gov.au/fisheries/aquaculture>

Investigate a selection of the issues above

What is the Status of Estuaries in NSW?

Government Initiatives

Australian governments have recognised the need to monitor and report on environmental management performance.

In 1998 all the Australian, State and Local Governments agreed to establish a State of the Environment (SoE) reporting system by which the health of Australian environments could be measured. The most recent SoE report in 2006 provides some useful information about trends in the health of coastal environments including estuaries. <http://www.environment.gov.au/soe/themes/coasts/index.html>

However not all the ways of monitoring environmental health have occurred uniformly but trends since monitoring began still show continuing slow and cumulative decline in environmental quality of estuaries not just in NSW but across all of Australia. Most noticeable is the decline in estuary health around the main urban centres.

Measures of water quality, extent of mangroves and seagrasses as well as other indicators show this decline.

Estuary Management

Estuaries are complex not only in their functions and importance to people but also in the ways that they are managed.

Land ownership and management responsibility in NSW estuaries is spread across a variety of people and organisations. These include private landowners, industry, local government, Crown Land and other NSW government agencies.

To better coordinate and simplify decision making about what things can happen in an estuary there is a state wide approach to provide better estuary management that includes local input into the process.

This information and approach is outlined in the NSW River and Estuary Policy. A variety of local, state and national government legislation and policy controls the activities that occur in estuaries. It includes the establishment of an Estuary Management Committee for each important estuary area. These committees provide input into the sustainable use of each local estuary and allow for local communities to have a say.

The NSW State Plan provides evidence of the NSW Government's commitment to improving the condition of estuaries and Chapter 6 Environment for Living provides priorities and targets for biodiversity and quality coastal waterways. <http://www.nsw.gov.au/stateplan/download.aspx?id=7f9f401a-9e4e-4a08-8f15-29664d4af6c3>

Sustainability Assessments for coastal lakes have been prepared to look at the 'people pressure' on the natural values on many of the small lakes and estuaries of NSW.

http://www.planning.nsw.gov.au/plansforaction/pdf/cca24_131106v3.pdf

Other components of the governments strategy to protect the coast from over development include:

- NSW Coastal Zone
- Comprehensive Coastal Assessment (CCA)
- State Environmental Planning Policy No. 71 – Coastal Protection
- Coastal Lands Protection Scheme (CLPS)

<http://www.planning.nsw.gov.au/plansforaction/coastalprotection.asp>

The NSW governments Coastline Management and Floodplain Management programmes are now a part of the Department of Environment and Climate Change (DECC).

<http://www.environment.nsw.gov.au/warr/WorkWithLocalGov.htm>

<http://naturalresources.nsw.gov.au/estuaries/estmgt.shtml>

http://naturalresources.nsw.gov.au/water/pdf/nsw_river_estuaries_policy.pdf

<http://www.environment.gov.au/soe/publications/indicators/pubs/estuaries.pdf>

What is some of the Legislation that protects aquatic habitats in NSW?

- *Fisheries Management Act 1994* (Part 7 Protection of Aquatic Habitat) through Habitat Protection Plans, Aquatic Reserves, Protection of Mangroves and other Marine Vegetation (e.g. seagrass) from development and works that restrict stream flow or cause impoundments like weirs and dams. These activities require consideration of fish passage, environmental flows and water temperature release issues from large

reservoirs. The *Fisheries Management Act 1994* may also provide protection to aquatic habitat through part 7A that deals with threatened species, threatened species habitat and endangered ecological communities.

- Coastal Saltmarsh is listed as an “Endangered Ecological Community” and thus protected under the *NSW Threatened Species Conservation Act 1995*.
- Gaps – protection of water quality for fisheries (water quality is addressed under the *Protection of the Environment Operations Act 1997*, however, this regulates point source, not diffuse source pollution which often has the greater impact on fisheries e.g. agricultural runoff etc. The NSW Department of Environment and Climate Change (DECC) is developing a diffuse water pollution strategy to attempt to address this problem and some Catchment Management Authorities (see Factsheet 2. *Catchments*) are identifying special activity types and endeavouring to provide incentives and best practice guides as well as education to address these diffuse pollution sources.

Sources of Additional Information

<http://naturalresources.nsw.gov.au/estuaries/whyprotect.shtml>

<http://naturalresources.nsw.gov.au/estuaries/process.shtml>

http://www.dpi.nsw.gov.au/data/assets/pdf_file/0010/136729/output-637.pdf

<http://www.environment.gov.au/soe/2006/publications/emerging/lakes/index.html>

http://www.dpi.nsw.gov.au/aboutus/resources/factsheets/finder?topic=28389&queries_type=query_posted=1&queries_type_query=Factsheet&queries_topic-id_query=28389&queries_topic_query=Fishing%20and%20aquaculture&search_page_65537_submit_button=Submit

http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/ocean_planet_resource_room.html

<http://www.thew2o.net>

<http://www.oceanwatch.org.au/>

http://www.epa.nsw.gov.au/soe/soe2006/chapter6/chp_6.6.htm#6.6.84

http://www.epa.nsw.gov.au/soe/soe2006/chapter5/chp_5.6.htm#5.6.33

http://www.epa.nsw.gov.au/soe/soe2006/chapter5/chp_5.6.htm#5.6.59

http://www.epa.nsw.gov.au/soe/soe2006/chapter6/chp_6.10.htm

<http://www.livingharbour.net/index.cfm>

<http://www.mccn.org.au/>

Fact Sheets

<http://naturalresources.nsw.gov.au/estuaries/factsheets/index.shtml>

<http://naturalresources.nsw.gov.au/estuaries/factsheets/physical/intro.shtml>

<http://naturalresources.nsw.gov.au/estuaries/factsheets/physical/domain.shtml>

<http://naturalresources.nsw.gov.au/estuaries/factsheets/physical/limits.shtml>

<http://naturalresources.nsw.gov.au/estuaries/factsheets/physical/formation.shtml>

<http://naturalresources.nsw.gov.au/estuaries/factsheets/physical/tidal-behaviour.shtml>

<http://naturalresources.nsw.gov.au/estuaries/factsheets/physical/tidal-behaviour-nsw.shtml>

<http://naturalresources.nsw.gov.au/estuaries/factsheets/physical/movement.shtml>

<http://naturalresources.nsw.gov.au/estuaries/factsheets/physical/salinity.shtml>

<http://naturalresources.nsw.gov.au/estuaries/factsheets/physical/sediment.shtml>

<http://naturalresources.nsw.gov.au/estuaries/factsheets/physical/surface.shtml>

<http://naturalresources.nsw.gov.au/estuaries/factsheets/physical/references.shtml>

<http://www.dnr.nsw.gov.au/estuaries/factsheets/habitat/references.shtml>

<http://www.dpi.nsw.gov.au/aboutus/resources/factsheets/fishfacts>