GOVERNMENT OF WESTERN AUSTRALIA
WATER AND RIVERS COMMISSION JULY 1997

Water facts 3

River and estuary pollution

Water pollution occurs when waste products or other substances change the physical, thermal (heat), chemical or biological characteristics of the water, adversely affecting living species and reducing the water's beneficial uses.

A river or estuary is polluted when a substance which degrades the water quality enters the waterway and alters its natural functions. Polluted water can harm plants and animals, restrict recreation (boating and swimming), spoil scenery, damage economic uses or pose a threat to fisheries.

Why are waterways prone to pollution?

Rivers and estuaries have always been a focus for human settlement and recreation. The waters are used for transport, irrigation, recreation and development of port and boating facilities.

The banks are a focus for residential, recreational, tourist and industrial development and roads. In the past, they were often used as convenient dumping grounds for sewage, rubbish and industrial wastes, as part of filling marshland.

Fertile river floodplains are used for intensive agriculture, including market gardens and vineyards. The wider catchments often support a range of land uses such as housing, agriculture, mining and forestry.

All these activities can pollute waterways. Waste discharges, accidental spills, urban and agricultural runoff, and groundwater flow carry a wide range of pollutants. Some of the pollutants flow to the sea and can disperse in such large volumes of water. However estuaries are semi-enclosed waterbodies and some of the pollutants stay in the water or bottom sediments.

How badly an estuary is affected depends on the type and amount of pollutants and also on characteristics of the waterbody itself, especially how well the estuary is flushed by tides (see 'The impact of pollution').

Water from across the catchment eventually finds its way into the estuary. This means that pollutants from all land uses in the catchment can also end up in the estuary. (See Table 1)

How do pollutants enter waterways?

Pollutants may enter directly from industrial waste discharges, in wastes from boats, or in water flowing into the estuary as surface (creeks, rivers or drains) or groundwater flow from the surrounding catchment.

A catchment is the area from which the river or estuary collects its water. It can be very large, for example the Avon River, which feeds Perth's Swan River, has a catchment of over 120,000 square kilometres. The Peel-Harvey Estuary catchment is about 12,000 sq km and the Leschenault Estuary catchment is nearly 5000 sq km.

Sources of pollution

Pollutants enter a river system from a range of land uses across its catchment. Often, poor water quality is the result of the combined effects of a variety of activities in the catchment. Some pollution comes from sources which can be pin-pointed, for example a factory or intensive agriculture discharging its wastes into a drain. These are called 'point' sources. However, many of the pollutants which enter estuaries come from a wide area, for example fertilisers used throughout a farming area, or on parks and gardens. These 'non-point' (diffuse) sources are harder to manage.

What pollutants can harm waterways?

Nutrients are required by plants and animals for growth. People get their nutrients from the food they eat. Algae in the estuary take their nutrients from the water. When excessive amounts of nutrients, especially nitrogen and phosphorus, enter the estuary it may suffer from 'eutrophication' (nutrient enrichment). The nutrients fertilise the growth of algae in the water just like fertiliser on a lawn. Some algae will grow in vast amounts (called a 'bloom') particularly during summer when warmth and light stimulate growth. Blooms upset the delicate natural balance of plants and animals in the estuary and deplete oxygen levels in the water. Large stores of nutrients can build up in the sediment of the estuary floor, forming a nutrient 'bank'. Under certain conditions these can be released and used by algae.

Toxins are substances which are poisonous to living organisms. Chemicals such as pesticides and petroleum products (petrol, oil, diesel) can cause illness or death to plants and animals when present in high concentrations.

Some toxins, including heavy metals (such as lead, copper, mercury) and some chemicals (such as some hydrocarbons) build up in the sediments. They can be taken up by plants or animals over a period of time and passed to the food chain without causing obvious ill-effects. Symptoms such as lesions (skin damage) on fish, thinning of birds' egg shells, or birth defects, appear as the level of the toxin builds up. Some animals, such as mussels, store toxins in their fat tissues and can become poisonous if eaten by animals or people.

Some toxins are of living, rather than chemical origin. These 'biotoxins' can be produced by microscopic plants (blue-green algae, diatoms or dinoflagellates) which may occur naturally or be introduced into a waterway from somewhere else. Filter-feeding animals can take up the tiny plants and become poisonous, so care should be taken when eating shellfish or mussels from an estuary if there is an algal 'bloom'.

Oil is a particularly unpleasant pollutant which, as well as being toxic, irritates animals' eyes and skin, clogs the gills of fish and smothers plants and small animals.

Detergents can disrupt the life cycle of aquatic animals and harm waterbirds.

Pathogens are microscopic organisms (bacteria and viruses) which cause disease in plants or animals. The presence of some bacteria, such as *Escherichia coli*, in an estuary usually indicates pollution by sewage. It is rare for pathogens to be present in Western Australian estuaries in levels high enough to cause illness in people.

Physical pollutants include litter and sediment (soil particles) from dredging activities or erosion. Rubbish, especially plastics and fishing line, can kill birds, dolphins and fish which accidentally eat it or become entangled. Sediments in the water can clog fish gills, smother bottom-living plants and animals, reduce the clarity of the water (so that birds such as cormorants cannot see their underwater prey), and restrict the light available for growth of seagrass.

The impact of pollution

Effect on the waterways

The effects of pollution can vary from localised damage to disturbance to the ecology of an entire waterway. The impact of pollution depends on the type and amount of contamination, the period of exposure, and on the characteristics of the waterway itself, especially how well an estuary is flushed with sea water when the tides go in and out. Water exchange between an estuary and the sea is limited by the tidal range (rise and fall), size of the estuary, size and depth of the inlet channel and often by a seasonal sand bar at the mouth. An estuary with a deep, open channel to the sea will be flushed by the tide and able to cope with more pollution before showing symptoms than an estuary with restricted tidal exchange.

See Table 2 for a summary of pollutants, monitoring and control measures.

For example, the Peel-Harvey estuary is a large shallow water body with originally a narrow, five kilometre inlet channel to the sea. Although the entrance has been dredged and is kept permanently open, tidal movement of sea water in and out is limited and the estuary has shown the excessive growth of algae which is a symptom of eutrophication. The Dawesville Channel now provides another channel to aid flushing. The Swan River estuary receives nutrient inputs similar to those of the Peel-Harvey estuary, but so far has shown less impact because it has good tidal exchange through the channel at Fremantle.

Are Western Australia's waterways polluted?

Most of our rivers and estuaries have good water quality. The waterways are generally safe to swim in, have abundant plant and animal life and usually offer good catches of fish, crabs and prawns. At present the greatest concern is rising nutrient levels in many south-west waterways. Some are already showing signs of environmental damage such as recurrent algal blooms and others are on the brink. For example:

The **Peel-Harvey estuary** at Mandurah has had blooms of large green algae ('weed') since the early 1970s. The weed accumulates in the shallows and along the shoreline, where it rots with an unpleasant odour. Growths of the toxic blue-green alga *Nodularia* turned the water green almost every spring from 1978 until the opening of the Dawesville Channel in 1994. The increased flushing has improved water quality in the estuary but algal blooms still occur in the lower reaches of the rivers.

The **Swan River estuary** has been noted for its good water quality even though it flows through a large city. In recent years, however, blooms of microscopic algae in the upper reaches have led to public concern that the river may be on the verge of serious damage due to increasing land use pressures.

The **Leschenault Estuary** at Bunbury is another estuary which still has good water quality, but like the Swan River it has reached the point where any further increase in nutrient inputs could upset the estuary's balance. The Leschenault Estuary has about the same amount of weed as Peel Inlet, but it does not usually cause a noticeable problem because the weeds do not often blow up onto beaches near residential areas.

The **Avon River**, which becomes the Swan River at Wooroloo Brook, collects water from a huge agricultural catchment. The Avon has been showing signs of pollution, including elevated salinity levels, silting and high nutrient levels, for many years. One of the most serious problems is rising salinity levels, and the associated impact on the native plants and animals.

Princess Royal Harbour at Albany is under pressure from both nutrient enrichment and industrial pollution. Identification of lead and mercury in fish from the harbour caused the western side of the harbour to be temporarily closed to fishing. Foreshore industries have now minimised discharge to the harbour. Excessive growth of algae has continued to smother the seagrass meadows and about 90% of the seagrass beds in Princess Royal Harbour and 80% in Oyster Harbour have been lost gradually since the 1960s.

N**orth West rivers** generally are not subject to the same development and land use pressures as occurs in the South West. As a consequence, pollution threats are different. The wet season in the Kimberley and cyclone induced floods in the Pilbara and Gascoyne tend to ensure catchments receive adequate flushing. Big tides in the North West also regularly flush coastal estuary systems. "Pollution" in the form of sediment mobilisation occurs naturally but has been compounded by overstocking in the past.

Preventing pollution

The Water and Rivers Commission manages the water resources of Western Australia, including groundwater, wetlands, rivers and estuaries.

The Commission works closely with the Department of Environmental Protection which has delegated powers under the Environmental Protection Act to prevent pollution of the environment including waters. The strategies the Commission uses to control pollution of rivers and estuaries are to:

- develop effective objectives and plans to control point and non-point sources of pollution;
- advise on planning controls and management practices which minimise the generation of pollutants and limit their transport to surface and groundwater;
- prepare policies and guidelines covering activities aimed to prevent pollution;
- ensure the adoption of land-use practices designed to minimise soil erosion, land degradation and runoff;
- use the combined expertise and legislative responsibilities of other State Government agencies to ensure that acceptable pollution prevention standards are established.

What is the Water and Rivers Commission doing about pollution?

Detecting pollution by investigation

- identifies the most important water quality problems caused by point and non-point sources in rivers/estuaries and catchments;
- maintains routine surveillance of the waterways and catchment activities that may pollute the waterways;
- monitors water quality to detect signs of pollution or contamination;
- maintains surveillance of industrial activities in the catchments;
- follows up complaints and concerns referred by the community.

Controlling sources of pollution

- uses land planning processes to prevent high risk activities from establishing close to vulnerable or high value water resources;
- determines the most effective management practices for catchments and identifies locations where action should be taken to control and prevent pollution problems;
- integrates policies for pollution control and prevention within management plans prepared for landuse activities;
- facilitates coordination among public authorities and communities involved in land-use and water pollution management;
- advises on effluent discharge to ensure its quality is consistent with the beneficial uses of the receiving waterways.

Cleaning up the mess

- maintains foreshore and river systems in declared Management Areas to minimise litter and nuisance algae;
- responds to and facilitates clean up of small scale oil spills which threaten the waterways; and
- assists other emergency services to clean up hazardous and chemical spills by providing advice or materials.

Table 1
Pollutants from land uses

Land use	How contaminants enter waterways	Potential pollutants
URBAN		
	Stormwater drainage (pipes, drains and watercourses) Runoff from roads, parks, gardens	• Nutrients (fertilisers) • Pathogens (bacteria and viruses) • Fuel and oil from vehicles • Tyre rubber • Heavy metals (e.g. lead from petrol, chromium, cadmium) • Pesticides/herbicides • Litter (e.g. paper, plastic, bottles, cardboard, aluminium cans) • Sediments • Colour (tanins)
	Groundwater from areas with septic tanks Sewage effluent	• Nutrients • Chemicals (e.g. fats, soaps, detergents, solvents, disinfectants, grease) • Pathogens (bacteria and viruses)
	Groundwater (leachates) and surface runoff from sanitary landfill ("tips") and liquid waste disposal sites	• Nutrients • Bacteria, especially *Salmonella* (spread by scavenging birds, rodents and insects) • Toxic substances depending on nature of wastes • Acids and alkalis
	Runoff from foreshore recreation areas and and marinas, bilge and ballast water from watercraft	• Litter • Nutrients (fertiliser and watercraft discharges) • Pathogens (bacteria and viruses) • Oil and hazardous chemicals in bilge water • Heavy metals (anti-fouling paint) • Oil & petrol (e.g. from boat exhausts)
INDUSTRY		
	Industrial waste discharges Accidental spills Runoff and groundwater from industrial areas	• Nutrients • Chemicals depending on industrial process (e.g. acids, alkalis, heavy metals, oil, solvents, organic chemicals) • Heated water
AGRICULTURE AND HORTICULTURE		
	Runoff, water from agricultural drains, groundwater	• Nutrients (fertilisers & animal wastes) • Sediment (from soil erosion) • Bacteria • Heavy metals • Pesticides (herbicides, fungicides, insecticides) • Salt
FORESTRY		
	Runoff and groundwater	• Herbicides/pesticides • Sediment
MINING		
	Runoff from mined areas, refuse heaps and tailings ponds Mine process or cooling water	• Sediment • Acid and alkaline wastes • Toxic substances depending on process (e.g. heavy metals, cyanide, oil, solvents)

Table 2
Sources of pollutants

Pollutant	Major sources	Effect	Measurement	Control/Prevention
NUTRIENTS especially nitrogen (N) phosphorus (P) organic matter (organic carbon) (C)	• Stormwater drainage • Fertilisers from parks and gardens • Sewage • Agricultural runoff containing fertilisers and animal wastes • Phosphate detergents • Leachates from rubbish tips and septic tanks • Organic industrial wastes • Estuary sediment banks	• High nutrient levels cause excessive growth of algae, disturbing ecological balance in estuary and reducing recreation values • Lowered oxygen levels in bottom waters leading to fish kills	• Monitor N,P inputs to estuaries	• Catchment management to reduce nutrient inputs • Clean up algae to keep beaches clean • Increase flushing of estuary to sea • Public education
TOXINS poisons including pesticides, petroleum, heavy metals, acids, solvents, oil and detergent	• Pesticides and herbicides in runoff from urban areas, agriculture, horticulture and forestry • Spills or industrial waste discharges of petroleum products or toxic chemicals • Anti-fouling paint from boats • Leachates from tip sites • Some species of microscopic algae introduced in ballast water from ships from other parts of the world	• Poisoning of plants and animals causing defects, illness or death • Sometimes toxins accumulate in the food chain • Oil and detergents kill wildlife	• Monitor industrial effluent discharges • Measure heavy metals in sediments or 'indicator' species • Monitor water quality, e.g. pesticides and metals • Measure pesticide levels in fish	• License and control waste discharges • Store and transport petroleum and chemical products carefully • Clean up accidental spills before they reach waterways • Manage waste disposal sites carefully • Restrict use of pesticides and herbicides
PATHOGENS bacteria and viruses	• Sewage and septic tank effluent • Animals wastes • Organic wastes from industry (e.g. food processing) • Runoff from stock holding areas	• Disease in plants or animals, including people	• Public health monitoring of biological indicators	• Sewer urban development • Discharge sewage away from watercourses • Control waste discharges
PHYSICAL POLLUTANTS litter, sediment, salt, debris, plastic, heated wastewater	• Rubbish and litter dumped or blown into waterways • Sediments from erosion of foreshores, catchment soil loss, dredging, mining, building and road construction • Suspended solids and saline discharge in industrial wastes • Heated wastewater discharge from industry	• Plastic entangles or suffocates wildlife • Sediments reduce water quality, smother bottom - dwelling plants and animals and reduce light penetration • Litter causes visual pollution	• Visual inspection of waters and foreshores • Measure water clarity (secchi disc)	• Control rubbish and litter • Restrict dredging • Stabilise banks • Soil conservation measures in catchments • Control waste discharges • Public education

Catchment management

The key to preventing pollution is good catchment management. The Water and Rivers Commission is working closely with other agencies concerned with planning and land management, including local government, catchment groups and land owners, to make sure that our waterways are protected for the future.

Monitoring

The first step in preventing waterway damage from pollution is to identify the problems: Where is pollution occurring now and where is it likely to happen in the future?

An important way to detect pollution in its early stages is to keep a close eye out for any changes in water quality. Water quality monitoring programmes are carried out to gather information on the current condition of the waterways and to pick up changes over time. Government and community monitoring, including the Ribbons of Blue programme, provide an early detection for pollution problems and an understanding of what is happening to our waterways. This information is vital to future management.

YOU CAN HELP

- **Use pesticides and fertilisers with care — remember that water that runs off your garden can end up in your local stream, wetland or groundwater. If you must use pesticides, follow manufacturers' directions carefully and dispose of used containers appropriately.**
- **Use water wisely in your home and garden.**
- **Make your own compost from garden refuse and kitchen scrapes, and reduce your rubbish at the same time.**
- **Never tip paint, chemicals or oil into street drains — they carry the contaminants to groundwater, wetlands, rivers and the ocean.**
- **Switch to household detergents without phosphates, or use soap.**
- **Avoid using abrasive or chemical cleaners, ammonia or bleach in sinks or toilets. Try 'green' (i.e. environmentally-friendly) products which reduce pollution.**
- **Plant local native plants in your garden and on your road verge to save water and fertiliser.**
- **On picnics or fishing trips to the river, dispose of your litter, bait, fish and prawn scraps and plastic wrappings carefully in a bin or take them home with you.**
- **Boat owners, make sure that no bilge discharges, fuel spills or litter pollute the waterway.**
- **Notify your local Water and Rivers Commission office or the Swan River Trust immediately you notice signs of obvious pollution or see any accidental spills to a drain, creek or river.**

How to report pollution

Report all significant liquid chemical spills or water contamination problems which could pollute water resources including rivers and estuaries to the regional office nearest to you.

Water and Rivers Commission
Head Office (Perth)
Tel: (08) 9278 0300 (office hrs)
Fax: (08) 9278 0587

Swan River Trust
(Swan and Canning Rivers)
Tel: (08) 9278 0400 (office hrs)
Pager Service: 016 982 027
Fax: (08) 9278 0401

Swan Region (Perth Metro)
Tel: (08) 9362 0516 (office hrs)
Mobile: 018 928 799
Fax: (08) 9362 0500

North West Region
Tel: (08) 9144 2000 (office hrs)
Mobile: 041 994 6609
Fax: (08) 9144 2610

Mid West-Avon Region
Tel: (08) 9690 2821 (office hrs)
Mobile: 015 193 245
Fax: (08) 9622 7155

South West Region
Bunbury
Tel: (08) 9721 0666 (office hrs)
Mobile: 041 791 6506
Fax: (08) 9721 0600

Mandurah
Tel: (08) 9535 3411 (office hrs)
Fax: (08) 9581 4560

South Coast Region
Tel: (08) 9842 5760 (office hrs)
Mobile: 017 850 419
Fax: (08) 9842 1204

For hazardous or major chemical spills statewide call '000'.

For further information on pollution contact:

Department of Environmental Protection library
'Westralia Square Building'
141 St Georges Terrace Perth
Tel: (08) 9222 7000
Fax: (08) 9322 1598

Swan Catchment Centre
108 Adelaide Tce Perth
Tel: (08) 9221 3840
Info Line (08) 9325 5320
Fax: (08) 9221 4960

OR

WATER AND RIVERS COMMISSION

Level 2, Hyatt Centre
3 Plain Street
EAST PERTH WA 6004
Telephone: (08) 9278 0300
Facsimile: (08) 9278 0301
or your regional office

ISSN 1328-2042
ISBN 0-7309-7296-8

CUSTOMER FOCUS WESTERN AUSTRALIA

This Water Facts sheet is one in a series providing information on water issues of interest to the community. This Sheet has been updated from the Waterways Information booklet "River and estuary pollution" published by the Waterways Commission in 1991. Printed on recycled paper.