


2 Inland Waters

River Murray Mouth
Photo: Michael Bell, courtesy Murray-Darling Basin Commission

River Murray

Trends

- **Salinity levels in the River Murray: predicted to INCREASE significantly over the next 50 years without further remedial action.**
- **Other water quality in the River Murray (nutrients, heavy metals, algae and faecal coliforms): NO SIGNIFICANT CHANGE since the *State of the Environment Report 1998*. Water quality in general shows a marked deterioration progressively downstream towards Tailem Bend.**
- **Use of water from the River Murray: INCREASING – too much water is being taken for irrigation from across the Murray-Darling river system.**
- **Health of rivers, streams and wetlands of the River Murray floodplain: DECLINING due to increasing extraction of water for agricultural, industrial and domestic use and the impact of salinity.**

Goal

To achieve the 'Objectives for a Healthy River Murray' as specified in Section 7 of the *River Murray Act 2003*. See **What are we doing about it?**

What are the issues?

The *River Murray Act 2003* was assented to on 31 July 2003, and came into operation in October 2003. The Act effected an amendment to the *Environment Protection Act 1993* that requires *State of the Environment Reports* for South Australia to provide a specific assessment of the health of the River Murray.

This chapter provides an overview of the major environmental issues facing the River Murray in South Australia. It also provides an assessment of the activities that are underway to address the 'Objectives for a Healthy River Murray' as outlined in Section 7 of the *River Murray Act 2003* (see **What are we doing about it?**).

Due to the short time frame between proclamation of the Act and closure of drafting on this Report the assessments are preliminary only. Future *State of the Environment Reports* for South Australia will provide a more detailed assessment on the health of the River Murray and progress towards meeting the fifteen objectives as specified in the Act.

Concerns over the deteriorating health of the River Murray are now high on the public agenda. Regulation of the river's natural flows to ensure a reliable source of water for irrigation, agricultural, industrial and domestic needs has had a significant impact on the ecology of the river and its wetlands. Some areas now receive too much water, others not enough. Artificially maintained water levels have affected the breeding cycles of plants and animals and resulted in the deterioration of water quality.

Irrigation development is placing increasing demands on water from the river. Abstractions for irrigation and other uses have reduced flows through the Murray Mouth to approximately 27% of natural flows. Prolonged dry conditions over the last two years have exacerbated the situation. In 2003/04 water flows in the South Australian section of the River Murray could be as low as 59% of the flows that we are entitled to under the Basin-wide agreement. In an effort to conserve water, the State Government imposed water restrictions in July 2003.

Without further remedial action modelling indicates that salinity levels will increase significantly in the long term (Murray-Darling Basin Ministerial Council, 1999). This will have significant environmental, social and economic implications, particularly for

Adelaide, which relies heavily on the River Murray to provide domestic water supplies. In an average year we receive around 60% of our urban water supplies from the River Murray, in a dry year we may draw up to 90% of public water supplies from the River.

Environmental indicators

CONDITION INDICATORS

- **Exceedences of water quality guidelines for rivers and streams** (reported on in the *State of the Environment Report 1998*)

The quality of water in South Australia's rivers and streams is assessed against national water quality guidelines.

- **River health assessed according to the Australian River Assessment System (AUSRIVAS)** (new indicator)

Provides an indication of the ecological health of rivers and streams by assessing the type and numbers of macroinvertebrates present.

- **The extent and condition of wetlands** (reported on in the *State of the Environment Report 1998*)

Gives a rating on the health of wetlands by region.

PRESSURE INDICATOR

- **Use of surface water resources versus availability** (new indicator)

Gives an indication of the sustainability of present use levels from various resources.

River Murray Lock two at Waikerie
Photo: Michael Bell, courtesy Murray-Darling Basin Commission

Findings

Making progress

The River Murray Improvement Program, to be funded by the River Murray Levy over the next four years, is a significant commitment and represents an important step towards improving the health of the River Murray. This will be complemented by action under the South Australian River Murray Salinity Strategy. These initiatives must be built upon to see a long term improvement in the health of the river.

The *River Murray Act 2003* is a significant development that will provide for greater control over the way in which the River is used.

A Wetlands Strategy for South Australia was released in early 2003 providing, for the first time, a framework for an integrated approach to wetlands management in South Australia.

The State Government's plan for rehabilitation of the lower Murray irrigated dairy pastures should see an improvement in water use efficiency and water quality in the region.

Attention required

Sustainable use of the River Murray is seriously threatened because too much water is being taken from across the Murray-Darling river system, primarily for irrigation. Regulation and water diversions have reduced the flow at the Murray Mouth to approximately 27% of the natural flow, with serious implications for the environment.

In 2003/04 the flow of River Murray water to South Australia could be as low as 59% of our entitlement flow under the Murray-Darling Basin agreement due to the drought. This has serious repercussions for water supplies for urban settlements, industry and irrigated agriculture as well as the health of the river.

Increasing salinity in the River Murray poses a serious threat to our drinking water over the next fifty years unless further action is taken to intercept saline groundwater as it drains towards the River – a process set in train largely by past land management practices.

Water quality in the River Murray deteriorates progressively downstream. At Tailem Bend levels of faecal bacteria exceed national guidelines for drinking water and recreational use (i.e. swimming). This is due largely to pollution from irrigated dairy pastures.

Wetlands, Murray Bridge

What more should we be doing?

The Environment Protection Authority recommends that:

2.1 Cooperative policies and practices with Murray-Darling Basin partners that reduce water extractions from the Murray-Darling Basin to within sustainable limits continue to be developed and implemented.

2.2 Long term environmental flow objectives for the River Murray are established.

2.3 The Murray-Darling Basin Commission reintroduces a minimum of 1500 gigalitres of water per year to the River Murray in South Australia to achieve minimum restoration of environmental health. Consideration should be given to reintroducing 500 gigalitres in the short term.

2.4 Risk assessments of the key threats to water quality in the River Murray are undertaken within a three-year timeframe.

2.5 Action is progressed to increase the efficiency of water use and improve river health. These should include improved wetland management, irrigation system rehabilitation and the upgrading of water regulating barrages and weirs.

2.6 Community consultation is undertaken to establish environmental values and associated water quality objectives for the South Australian reaches of the River Murray within a three-year timeframe.

2.7 A range of measures are introduced that focus on the rationalisation of existing activities that contribute to the degradation of the River Murray environment.

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KEY FACTS

- **If current degradation continues, the quality of River Murray water will be unsuitable for most uses – with serious, if not catastrophic, environmental, social and economic implications.**

WHAT ARE MACROINVERTEBRATES?

Macroinvertebrates are aquatic animals without backbones that are large enough to be seen with the naked eye. They include insects, crustaceans, snails, worms, mites and sponges. The insects include the larvae of flying insects (e.g. midges, two-winged flies, dragonflies, mayflies, stoneflies and caddisflies) and adults of some groups (e.g. waterbugs, beetles and springtails). The more familiar crustaceans include yabbies and freshwater shrimps and prawns. Macroinvertebrates are used in biological monitoring studies because they are common, widely distributed, easily sampled and most can be identified by experienced biologists.

Lock three at Overland Corner, River Murray

Photo: Michael Bell, courtesy Murray-Darling Basin Commission

What is the current situation?

CONDITION INDICATOR: Exceedences of water quality guidelines for rivers and streams

One of the most significant threats to water quality in the River Murray is rising salinity. The River is a natural drain for all salt moving through regional groundwater systems in the Murray-Darling Basin. Groundwater salinity in some areas is naturally high and can exceed that of seawater. As a consequence, salinity has always been a natural feature of the River Murray. Irrigation development and vegetation clearance, however, have compounded salinity in the River.

Monitoring by the Environment Protection Authority indicates that salinity levels in the river have complied with national water quality guidelines over the last few years (and indeed over the last decade) and have often been better than the guideline (Map 2.1). However, this is due primarily to a combination of the effect of major salt interception schemes, prevailing hydrological and climatic conditions and the protection that the minimum entitlement flow agreement with the Murray-Darling Basin Commission provides.

Modelling indicates that without further action, salinity levels could rise significantly over the next 20 to 50 years. Measures are currently being implemented to address this predicted rise in salinity (see **What are we doing about it?**).

While increasing salinity in the River is of paramount concern, there are other water quality issues associated with pollution from stock grazing, industrial discharges and urban stormwater, agricultural run-off, fuel and other wastes from houseboats and other recreational boating, and seepage from septic tank systems.

Map 2.1 provides a summary of water quality from selected sites along the River Murray and the lower lakes from January 2000 to February 2002.[1] Information is provided for a range of physical characteristics and a rating is given depending upon how the water is to be used. These ratings are based on national water quality guidelines. A 'good' rating means that levels are better than the guidelines stipulate most of the time; a 'moderate' reading means that the guidelines are exceeded only occasionally; and a 'poor' rating means that the guidelines are exceeded regularly.

The variability of flow in the River Murray is reflected in a corresponding variability in water quality, making it difficult to determine trends. However, allowing for seasonal variations, overall water quality in the River Murray has been fairly constant over the past five years since the *State of the Environment Report 1998*, which indicated that most water quality characteristics were well within, or better than, national guidelines. Major conclusions that can be drawn from the information presented in Map 2.1 follow.

Salinity was generally rated as good (i.e. levels were well within guidelines) at all sites and for all uses, with the exception of the Goolwa Barrages due to marine influences.

Water clarity, or turbidity, was poor at all sites in terms of suitability for drinking and maintaining ecosystem health. Water clarity at Tailem Bend poses a risk for recreation.

Nutrients (soluble phosphate) at Lock 5, Morgan and Tailem Bend were at levels that pose a threat to ecosystem health. High nutrient levels can result in algal blooms, which can impact on plant and animal communities.

Microbiology (faecal coliform levels) was poorest at Tailem Bend, compromising water quality for drinking, irrigation, recreation and livestock use. This is due, in part, to the impact of drainage water from flood irrigated dairy pastures in this section of the river.

Levels of naturally occurring heavy metals (copper and iron) were rated poorly for ecosystem health at Morgan and for ecosystem health, drinking and irrigation purposes at Tailem Bend. The poor rating for drinking water quality is based on iron levels that can rust plumbing.

Algal levels in the Lower Lakes and Goolwa Barrages were rated poorly for ecosystem health. Blooms of toxic algae (cyanobacteria) in the Lower Lakes have also precluded the use of the water for stock, recreational and drinking purposes for lengthy periods on a number of occasions in the past (Australian Water Quality Centre, pers. comm.). It is worth noting that blooms of cyanobacteria have been a problem on a number of occasions over the whole length of the River Murray. This problem pre-dates European settlement, but modified flow regimes have been a major contributing factor to the increased risk of blooms in the past two decades. See also chapter on **Water Consumption in Urban Settlements**.

CONDITION INDICATOR: River health assessed according to the Australian River Assessment System (AUSRIVAS)

Since 1994 the EPA has been conducting a comprehensive survey of river and stream health across the State as part of the Australian River Assessment System (AUSRIVAS). AUSRIVAS is assessing river and stream health by monitoring the type and number of aquatic macroinvertebrates found in a particular river or stream and comparing the results with the type and number of aquatic macroinvertebrates found in a similar type of river or stream that has not been disturbed or affected by human activities (referred to as a 'reference' site). For more information on the AUSRIVAS see the chapter on **Rivers, Streams and Wetlands.**

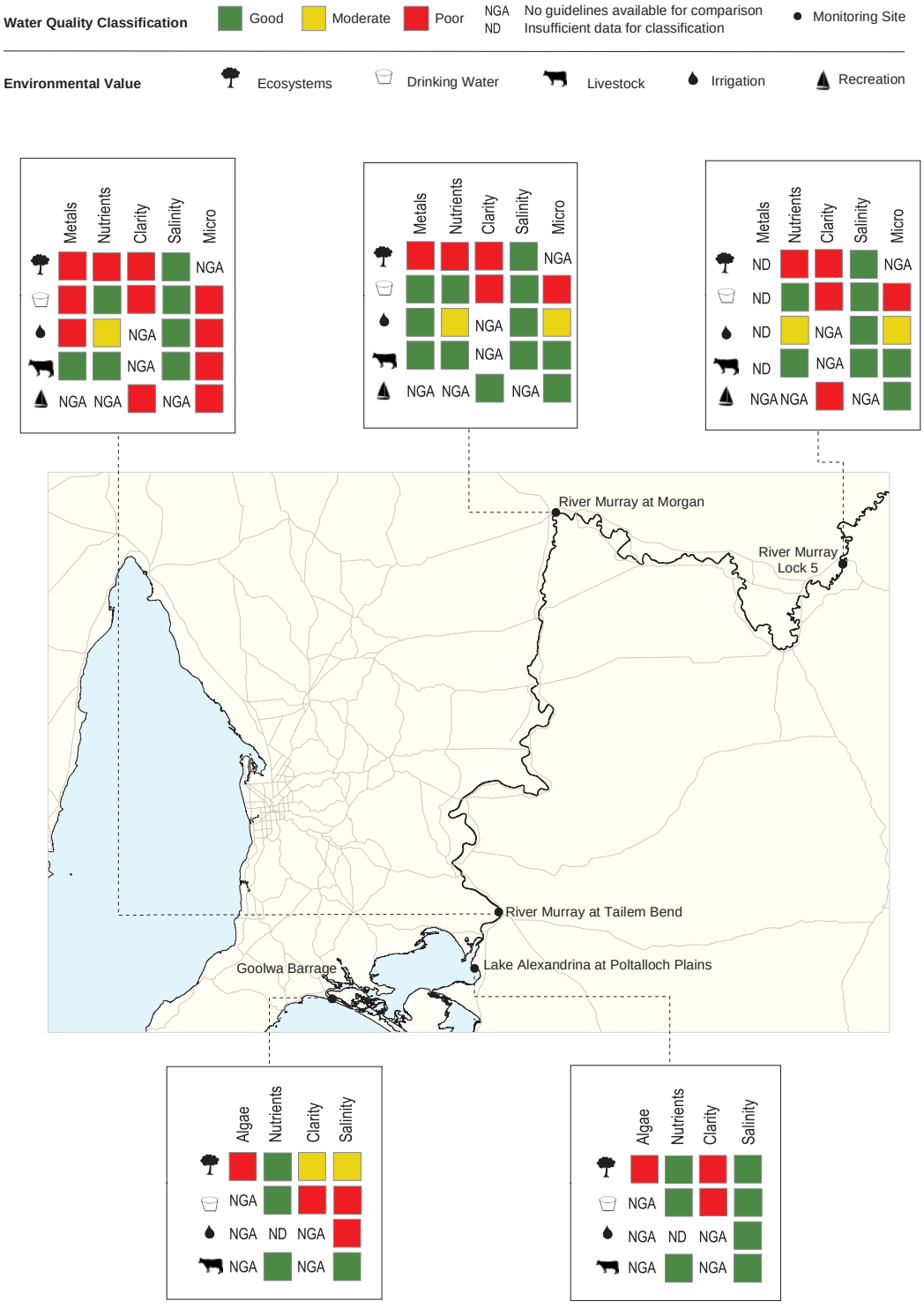
Analysis of the AUSRIVAS data indicates that sites on the River Murray floodplain were generally in poor condition, particularly along the main channel. The poorest sites were around Morgan and Blanchetown, and in the Riverland and lower reaches. Floodplain sites in good condition were the freshwater wetlands and anabranches at Chambers, Katarapko, Pilby and Monoman creeks, Pike River and Little Duck Lagoon.

[1] *For more information on water quality monitoring in the River Murray refer to Ambient Water Quality Monitoring of the River Murray 1990–1999 Report No. 1 (EPA, 2001).*

Map 2.1: Water quality at selected sites along the River Murray and Lower Lakes – January 2000 to February 2002

Assessments are based on the Australia New Zealand Environment Conservation Council Guidelines for Fresh and Marine Water Quality (2000), the Environment Protection (Water Quality) Policy (2003) and the Australian Drinking Water Guidelines (NHMRC & ARMCANZ 1996).

SOURCE: EPA



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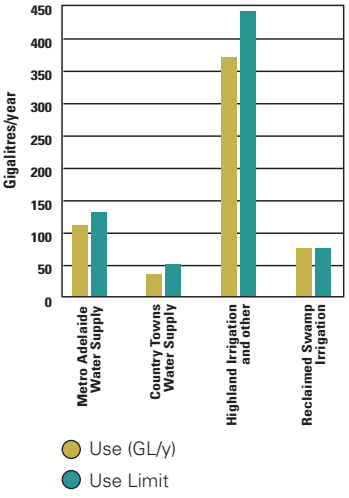
KEY FACTS

- Too much water is being taken from along the whole length of the River Murray, putting at risk the river's ecological health and the sustainable use of the River Murray in South Australia.

Figure 2.1: River Murray prescribed watercourse – water use summary (five-year average)



Note: Use Limit is the maximum permissible use under the SA River Murray cap. Five-year average figures are for the period 1993/94 to 1997/98. The highland irrigation and other diversions Use Limit includes diversions for pumped irrigation plus stock and domestic, recreation, environment and industrial use and can vary from year to year due to inter-State and internal water trade.

SOURCE: STATE WATER PLAN, 2000 (modified)

CONDITION INDICATOR: The extent and condition of wetlands

The *State of the Environment Report 1998* was not able to comment in detail on the extent and condition of wetlands due to a lack of information. In 2003 there is more known about individual wetland complexes, however, there is still no comprehensive, scientifically based information on the condition or extent of wetlands across the State.

The extraction of water for irrigation, domestic and industrial use has profoundly affected the health of River Murray wetlands and many continue to decline. Grazing on the floodplain is also affecting the health of wetlands via trampling of native vegetation and the impact of faecal contamination on water quality. Only around 400 hectares of relatively natural wetlands remain of an estimated 10,500 hectares of floodplain wetlands in the Mannum to Wellington reach of the river because of reclamation for dairying.

Low river flows have seen floodplain wetlands along the River Murray endure 10 years without flooding. This has affected the health of River Red Gums along the floodplain and in the summer of 2002/03 around 20% of these trees died.

The Murray Mouth closed in 2002 for the first time since 1981 due to low river flows and the subsequent build up of sand at the mouth. This posed a serious threat to the condition of habitats in the Coorong, Lake Albert and Lake Alexandrina. Dredging of the Mouth has been undertaken to open the Mouth and restore tidal flows to the Coorong.

PRESSURE INDICATOR: Use of surface water resources versus availability

Five-yearly average figures on water use from the River Murray (Figure 2.1) indicate that of all diversions from the River Murray, 18% is for metropolitan Adelaide drinking water, almost 62% is for highland irrigation and other diversions, and almost 14% is for the irrigation of reclaimed swamps.

The South Australian cap on extractions from the River is 740 gigalitres per year; however, it has been recognised recently that this does not represent a sustainable level of diversions, particularly during extended periods of low flow or drought. This over-use of water from the river is acknowledged across the whole of the Murray-Darling Basin and has been exacerbated by drought conditions in 2002/03. Flows entering the River Murray in South Australia for 2003/04 are forecast to be only 59% of our entitlement flows agreed to under the Murray-Darling Basin Agreement[2]. Water restrictions were put in place in South Australia in July 2003 in an effort to conserve water. This has significant implications not only for urban communities but also for industry, manufacturing, irrigated agriculture and the ecological health of the river.

[2] The Murray-Darling Basin Agreement ensures that South Australia receives an agreed share of the available water – this is called our Entitlement Flow. The Entitlement Flow to South Australia is 1850 gigalitres per year. Due to the prolonged dry conditions, South Australia has received only Entitlement Flow since December 2001 and there has been insufficient water to release through the barrages and out through the Murray Mouth since that time.

What impact will the continuing decline in the health of the River Murray have?

Impact on aquatic plant and animal communities. Regulation of the River Murray for irrigation has disrupted natural flooding regimes, having a significant environmental impact on dependent plant and animal communities. It is likely that between 30% and 50% of the River Murray floodplain in South Australia will be adversely affected by salinity within the next 50 years (Murray-Darling Basin Ministerial Council, 1999).

Loss of agricultural productivity. Increasing salinity will reduce the yield from irrigated crops and may permanently damage plants.

Loss of recreation and tourism. Poor water clarity (muddiness) in the river can pose a danger to swimmers by restricting visibility. Water clarity at Tailem Bend and Lock 5 is rated poorly in this regard. The River Murray also provides a major focus for tourism – its continued declining health will have a significant social and economic impact.

Impact on drinking water. Increasing salinity levels threaten drinking water supplies for most South Australians – unless we take significant remedial action.

Risks to human health. In surface waters, such as the River Murray and Lake Alexandrina, human health may be jeopardised by high levels of toxic blue-green algae, which grow in response to high nutrient levels. Toxins from these algae can cause liver damage, stomach upsets, skin rashes, eye irritation and nervous system disorders.

Cultural impact. The River Murray is of great cultural and spiritual importance to Indigenous people. The threats to its health will compromise these values.

What are we doing about it?

The State Government has established a number of important initiatives over the last two years in recognition of the significant issues faced by the River Murray.

The **River Murray Improvement Program**, announced by the State Government in June 2003, includes a number of initiatives to improve the River Murray. These initiatives will be funded by a new **River Murray Levy** and include the establishment of a **River Murray Water Trust** to increase environmentally crucial water flows and the implementation of a series of initiatives to improve river health. On a basin-wide scale, the Murray-Darling Basin Commission has initiated the **Living Murray** project to investigate ways to restore environmental flows to the river. This is the largest community consultation project ever undertaken by the Commission.

The **South Australian River Murray Salinity Strategy (2001–2015)** (DWR, 2001) establishes a fifteen-year vision to maintain salinity in the River Murray in South Australia at current levels, that is, to maintain salinity levels at less than 800 Electrical Conductivity[3] (EC) Units at Morgan for 95% of the

time. The Strategy outlines on-ground action and strategies to ensure that this commitment is achieved.

In recognition of the significant problems faced by the River Murray, the ***River Murray Act 2003*** was proclaimed in July 2003. The intention of this Act is to give the Government clear powers over the way in which the river is used and to better manage planning, irrigation practices, pollution and rehabilitation programs. The Act also establishes fifteen **Objectives for a Healthy River Murray.** These relate to four major areas: river health, environmental flows, water quality, and the human dimension. Progress towards meeting these objectives is reported in the following sections, as required by the *River Murray Act*.

River health objectives

(a) The key habitat features in the River Murray system are to be maintained, protected and restored in order to enhance ecological processes.

The River Murray system contains a complex array of terrestrial and aquatic habitats. The distribution of these habitats is influenced by flow regime, groundwater flows, river operation and floodplain management practices. Over the past 12 months the distribution and condition (or health) of the vegetation on the entire South Australian River Murray floodplain has been comprehensively documented and mapped for the first time.

Groundwater data have been collected from over 300 sites to assist in determining the specific factors contributing to the decline in floodplain health. Already, this work is being used to assess various flow management and salt interception scenarios in the Chowilla region and will be used to prioritise other flow enhancement and salinity management projects and policy for other areas of the floodplain.

The manipulation of river levels to mimic more natural variation also provides an opportunity to maintain, protect and restore key habitats. A natural flood peak was enhanced between Lock 5 and Lock 6 in spring 2000 by raising the lock level 50 centimetres higher than normal. Detailed investigations are underway to look at the feasibility of manipulating river levels in other reaches of the river.

(b) The environments constituted by the River Murray system, with particular reference to high-value floodplains and wetlands of national and international importance, are to be protected and restored.

Along the River Murray in South Australia there are over 1100 individual wetlands in approximately 250 floodplain locations. Forty-two of these locations, including a number of nationally and internationally important sites, have management plans and have been the focus of on-ground works to rehabilitate degraded areas or enhance wetland ecology. Management plans for the Riverland and Banrock Ramsar sites (wetlands of international importance) are currently being prepared. Map 2.2 in the Rivers, Streams and Wetlands chapter shows wetlands of national and international significance.

Many wetland sites, including sections of nationally important wetlands like Spectacle Lakes, Gurra Lakes and Loveday Swamp (Map 2.2), are managed by community groups. A further 40 wetlands are currently undergoing monitoring, evaluation and assessment to determine appropriate on-ground works and management regimes.

(c) The extinction of native species of animal and vegetation associated with the River Murray system is to be prevented.

The River Murray and its floodplain supports a diverse range of plant and animal species otherwise absent from the South Australian Murray-Darling Basin. A detailed vegetation survey conducted in 2002–03 documented 353 species of native plant which included a number of species of conservation significance and one species previously believed to be extinct in the region. Detailed fauna surveys conducted in 2003–04 will add to our understanding of the ecology and importance of the riverine corridor and provide a comprehensive inventory of River Murray fauna (mammals, birds, reptiles, fish and amphibians). The knowledge generated by these projects is being used to prioritise sites for remedial works and to prevent future degradation of key habitats and species.

The effects of the current drought are also being monitored to determine the consequences for key species such as River Red Gum. The technical report *Preliminary investigations into observed River Red Gum decline along the River Murray below Euston* was released in March 2003 (DWLBC, 2003).

The removal of gill net fishing will reduce pressure on native fish stocks.

(d) Barriers to the migration of native species within the River Murray system are to be avoided or overcome.

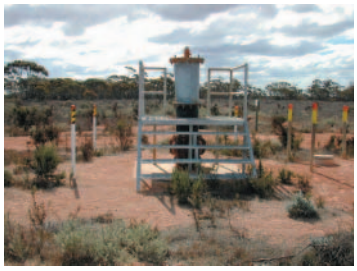
It is recognised that the River Murray barrages and the lock and weir structures present a barrier to the movement of fish up and down the river. Fish movement has been recognised in the Murray-Darling Basin Commission's (MDBC) Native Fish Strategy (MDBC, 2002) as one of the key components to a sustainable native fish population.

South Australia is a partner in the $25 million MDBC project to provide fish passage from the sea to Hume Dam. Construction has commenced on the first two vertical slot fish ladders at Lock 7 and Lock 8 and these are due to be completed by September 2003. Work has also commenced on a project to install four fish ladders at the barrages, two at Tauwitchere and two at Goolwa.

Environmental flows objectives

(a) Ecologically significant elements of the natural flow regime of the River Murray system are to be reinstated and maintained.

As mentioned previously, a trial was undertaken in October 2000 to raise the water level between Lock 5 and Lock 6 to mimic natural flows. This trial inundated sections of the surrounding floodplain and the ecological and public response indicated support for future trials. These will be undertaken with a view to raising and lowering the water levels in different sections of the river. Baseline surveys are now



Bore 19, Woolpunda Salt Interception Scheme
Photo: Gary Schultz, courtesy SA Water

[3] EC Units are a common measure of salinity in the River Murray. To convert a measure of salinity expressed in EC units to milligrams per litre or parts per million (ppm) the EC measure must be multiplied by a factor of 1.82.

Dairy cattle grazing on floodplain

underway to better inform the ecological assessment of these events.

(b) The Murray Mouth should be kept open in order to maintain navigation and the passage of fish in the area, and to enhance the health of the River Murray system and estuarine conditions in the Coorong.

In October 2002 a sand-pumping project began at the Murray Mouth to protect the Mouth from closing and to maintain fish passage and tidal variation within the Coorong.

A model of the Murray Mouth has been developed to aid in the prediction of the effect of barrage water releases on the shape and form of the Murray Mouth. A Murray Mouth intervention system is being developed to alert managers to when future sand pumping should occur. A lake operating strategy is also to be developed to achieve ecological benefit through increasing estuarine conditions in the Coorong.

(c) Significant improvements are to be made in the connectivity between and within the environments constituted by the River Murray system.

The connection between the River Murray and its floodplains and wetlands is highly modified due to river regulation and water extraction. As a result, many areas of floodplain are permanently dry while others remain permanently inundated. There have been preliminary investigations into the patterns of floodplain inundation and opportunities to enhance floodplain inundation or reintroduce seasonal wetland drying. In addition, there has been significant on-ground works to ensure floodplains cut off from the river are reconnected at higher flows and that permanently inundated areas receive appropriate drying. Further flow modelling and analysis will identify the key barriers to floodplain inundation and help to prioritise sites for on-ground works.

Water quality objectives

(a) Water quality within the River Murray system should be improved to a level that sustains the ecological processes, environmental values and productive capacity of the system.

The National Water Quality Management Strategy (2002) has established a framework for the management of water resources based on environmental values. In the case of the River Murray, appropriate environmental values need to be established through a consultation process, possibly coordinated by the River Murray Catchment Water Management Board or the Natural Resource Management Board. Only once environmental values are established can appropriate water quality objectives be determined.

Furthermore, a risk assessment process is required to identify the primary threats to water quality in the river. This process should be undertaken in parallel with the environmental values consultation process in order to ensure that appropriate management decisions are made to achieve water quality objectives.

(b) The impact of salinity on the ecological processes and productive capacity of the River Murray system is to be minimised.

A comprehensive review of future salt loads into the South Australian portion of the River Murray, to 2050, has been completed. This will guide the planning of salt interception schemes to prevent additional salt entering the river due to the delayed impact of recent irrigation development.

The Murray-Darling Basin Ministerial Council has approved the construction of the Bookpurnong Salt Interception Scheme which, when operational, will provide 33 Electrical Conductivity (EC) credits towards River Murray salinity management. The construction of the Loxton Salt Interception Scheme will follow after hydrogeological investigations are completed, and schemes at Pike River, Murtho and Chowilla are under investigation. Salt interception schemes consist of a series of underground pumps and bores that intercept saline groundwater before it reaches the river, and divert it to areas off the floodplain.

The above actions will reduce the volume of salt reaching the River Murray and contribute to improved floodplain health.

(c) Nutrient levels within the River Murray system are to be managed so as to prevent or reduce the occurrence of algal blooms, and to minimise other impacts from nutrients on the ecological processes, environmental values and productive capacity of the system.

Current initiatives to reduce nutrients in the River Murray include improved irrigation and dairy shed management practices, the investment of $32 million in rehabilitation of the Lower Murray Irrigation Areas, implementation of the Environment Protection (Water Quality) Policy, 2003, and Codes of Practice for stormwater management, the dairy industry and houseboat management.

The restructuring and rehabilitation of the Lower Murray Irrigation Areas is a five-year plan involving major infrastructure improvements and land management change to reduce, by approximately 80%, the return of polluted drainage water to the river system from irrigated dairy pastures.

On-ground works by Councils, the River Murray Catchment Water Management Board and the Murray-Darling Basin Commission seek to further reduce nutrient inputs into the river system. Community education programs complement these initiatives. The Lower Murray Irrigation Action Group has achieved significant improvements in irrigation management of the Lower Murray swamps, which have resulted in reduced drainage water returning to the river.

(d) The impact of potential pollutants, such as sediment and pesticides, on the environments constituted by the River Murray system is to be minimised.

Sediment and pesticide management strategies have focused on reducing the impact associated with bank erosion, urban and agricultural run-off and irrigation drainage.

Revegetation and stock management strategies in the Eastern Mount Lofty tributaries are targeted at reducing sediment loads into streams and rivers. The Environment Protection (Water Quality) Policy, 2003, and Codes of Practice for stormwater management provide measures to reduce stormwater pollution, including pollution by sediments and pesticides.

On-ground works such as urban wetlands and planning strategies by Councils and the River Murray Catchment Water Management Board are starting to reduce sediment loads going into the river system.

Implementation of the Pesticide Code of Practice, a cross-Government initiative, will provide management guidance and enforcement to minimise pesticide pollution risks.

Human dimension objectives

(a) A responsive and adaptable approach to the management of the River Murray system is to be implemented taking into account ecological outcomes, community interests and new information that may become available from time to time.

Progression of the Natural Resource Management (NRM) reform process will enhance the service delivery of NRM groups and will lead to the streamlining of on-ground works. Active engagement with Local Action Planning (LAP) Groups and statutory groups has occurred over the last five years.

(b) The community's knowledge and understanding of the River Murray system is to be gathered, considered and disseminated in order to maximise environmental flows and the ability to provide appropriate levels of water for environmental reasons, and to promote the health and proper management of the system.

Knowledge and understanding of the health of the River Murray system has been enhanced through the Murray-Darling Basin Commission's Living Murray public consultation process. In addition, the State has undertaken a campaign highlighting the plight of the Murray (e.g. the recent closure of the Murray Mouth).

(c) The interests of the community are to be taken into account by recognising indigenous and other cultural, and historical, relationships with the River Murray and its surrounding areas, and by ensuring appropriate participation in processes associated with the management of the River Murray system.

The South Australian Government, together with the other Murray-Darling Basin jurisdictions, is actively negotiating a Memorandum of Understanding (MoU) with the Murray-Darling Rivers Indigenous Nations to establish a framework for the participation of the Indigenous Nations in the management of the natural resources of the Murray and Darling River catchments. It is anticipated that this MoU will be signed at the Murray-Darling Basin Ministerial Council meeting in November 2003.

Indigenous traditional owner groups are being actively involved in major natural resource management projects such as the Murray Mouth dredging project to ensure that cultural and Native Title issues are adequately addressed. This involvement will be expanded as new projects are commenced.

(d) The importance of a healthy river to the economic, social and cultural prosperity of communities along the length of the river, and the community more generally, is to be recognised.

The South Australian Government is actively participating in assessment of the economic and social impact of the push for improved flows in the River Murray being undertaken by the Murray-Darling Basin Commission as part of the Living Murray project. This involves significant data collection and economic modelling of the benefits and costs of different water recovery options as well as the 'do nothing' scenario. These assessments will be used by the Ministerial Council when considering its position on water recovery at its meeting in November 2003.

In addition the Department of Water, Land and Biodiversity Conservation is overseeing a major investigation into the socioeconomic impacts of changes in river flow, water quality and water levels in the river downstream of Blanchetown.

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Further information

Department of Water, Land and Biodiversity Conservation – River Murray homepage
www.dwlbc.sa.gov.au/water/river_murray/index.html

Living Murray
www.mdbc.gov.au/TLM/thelivingmurray.html

Murray-Darling Basin Commission
www.mdbc.gov.au

National Water Quality Management Strategy
http://ea.gov.au/water/quality/nwqms

River Murray Catchment Water Management Board
www.rivermurray.sa.gov.au

2 Inland Waters

KEY FACTS

- Seventy per cent of our wetlands have been significantly modified since European settlement.
- Rivers, streams and wetlands support unique communities of plants and animals that are not found elsewhere.

Willow trees, Torrens River
Photo: Waterwatch SA

Rivers, Streams and Wetlands

Trends

- **Health of rivers, streams and wetlands in the Mount Lofty Ranges: DECLINING due to increasing extraction of water for industrial, agricultural and domestic use.**
- **Health of rivers, streams and wetlands in other regions: VARIABLE but generally in decline due to increasing extraction and drainage for agricultural purposes.**

Goal

To sustain and, where necessary, restore ecological processes, habitats and biodiversity of water-dependent ecosystems.
State Water Plan, 2000

That wetlands are recognised and managed as ecological and community assets for the benefit of present and future generations.
Wetlands Strategy for South Australia

What are the issues?

Rivers and streams are generally flowing water habitats, although they may dry out seasonally. In the arid zone rivers may only flow occasionally but can flood across vast areas. Wetlands are the swamps and marshes found along rivers and on floodplains and occasionally in arid areas, where they occur as mound springs and seasonal lakes. Wetlands can also be found along the coast as mudflats and salt marshes and are generally areas of standing water rather than flowing water. They can be permanently, seasonally or episodically full, with periods of complete drying.

It is important to recognise that both surface water and groundwater support riverine and wetland ecosystems. Groundwater dependent ecosystems are only recently being better recognised.

Rivers, wetlands and streams support unique communities of plants and animals that are not found elsewhere. Since European settlement the extraction of water for agricultural, domestic and industrial use has left many of our rivers, streams and wetlands deprived of water. This has affected the health of aquatic plants and animals and resulted in a decline in water quality.

While there are some regional differences in the pressures that are placed on wetlands and rivers, all are commonly affected by weeds, water extraction and regulation, and grazing by introduced animals. Pollution is a significant threat via the disposal of treated wastewater and urban stormwater into waterways, seepage from septic tank systems, faecal contamination from grazing animals, disposal of excess irrigation drainage and illegal waste dumping. Unregulated drainage to alleviate seasonal flooding of agricultural land has also lead to a negative impact on wetlands.

Although difficult to predict the effects with any certainty, climate change will have an effect on wetlands and rivers as daily temperatures rise and rainfall events become less frequent in winter and more frequent in summer. Increases in sea level will see a change in the distribution of saltmarshes and mangroves as they move further inland.

The information on river and stream health in this chapter is based on data collected as part of the Australian River Assessment System (AUSRIVAS). For information on rivers, streams and wetlands associated with the River Murray see the chapter on the **River Murray**.

See also chapters on the **River Murray**; **Water Quality**; and **Water Use**.

Environmental indicators

PRESSURE INDICATORS

- River health assessed according to the Australian River Assessment System (AUSRIVAS) (new indicator)

Provides an indication of the ecological health of rivers and streams by assessing the type and numbers of macroinvertebrates present.

- The extent and condition of wetlands (reported on in the *State of the Environment Report 1998*)

Gives a rating on the health of wetlands by region.

What is the current situation?

CONDITION INDICATOR: River health assessed according to the Australian River Assessment System (AUSRIVAS)

Concern over the declining health of our rivers and streams has prompted increased attention and investigation into the state of their health. Since 1994 the Environment Protection Authority (EPA) has been conducting a comprehensive survey of river and stream health across the State as part of the Australian River Assessment System (AUSRIVAS). This national program was referred to in the *State of the Environment Report 1998*, however, results from the monitoring surveys have only recently become available for reporting.

AUSRIVAS is assessing river and stream health by monitoring the type and number of aquatic macroinvertebrates found in a particular river or stream and comparing the results with the type and number of aquatic macroinvertebrates found in a similar type of river or stream that has not been disturbed or affected by human activities (referred to as a 'reference' site).

Aquatic macroinvertebrates are very sensitive to changes in their environment, so monitoring the type and numbers of these aquatic animals at a particular location over time can provide an accurate and long term indication of environmental conditions, such as changes in water quality.

Findings

Making progress

State Government policy and programs now place more focus on the water requirements of rivers, streams and wetlands as a consequence of the growing recognition that a decline in the health of aquatic ecosystems will have a significant and long term impact on the environment, society and the economy. The *Water Resources Act 1997* provides a legislative base for assessing environmental water requirements and making environmental water provisions.

The first assessment of river health throughout the State has been completed as part of the Australian River Assessment System (AUSRIVAS). We now have a quantitative, scientific baseline against which we can monitor changes in river health over time.

A Wetlands Strategy for South Australia was released in early 2003 providing, for the first time, a framework for an integrated approach to wetlands management in South Australia.

Wetland education and restoration projects are drawing more attention to the importance of rivers, streams and wetlands. These projects require the application of good science and focused monitoring to ensure that actions on the ground are actually improving the health of aquatic habitats and improving our knowledge about the way wetlands and rivers function and change over time.

The Environment Protection (Water Quality) Policy 2003, has been implemented and provides statutory tools to assist in the management of the diffuse sources of pollution that have an impact on our rivers, streams and wetlands.

Attention required

Many rivers, streams and wetlands continue to decline and the threats to their long term health persist, particularly the threats posed by inadequate water flows and the lack of baseline information. It is important that State Government policy on providing more water for these systems is backed up with comprehensive baseline studies on their environmental water requirements.

The *State of the Environment Report 1998* was not able to comment in detail on the extent or condition of wetlands due to a lack of information. In 2003 there is still no comprehensive, State-wide, scientifically based information on the overall condition or extent of wetlands in South Australia. This leaves a large gap in our knowledge and puts the long term health of our wetlands at risk.

What more should we be doing?

The Environment Protection Authority recommends that:

2.8 Environmental water requirements of major rivers, streams, watercourses and wetlands are assessed and, based on this knowledge, water management programs are developed and implemented.

2.9 The Wetlands Strategy for South Australia is fully implemented.

2.10 Intergovernmental agreements are implemented for the management of wetlands whose health is dependent on natural resource management decisions that are made across State Government boundaries. This includes the River Murray, the Lake Eyre Basin, the Great Artesian Basin, South East watercourses and the groundwater resources of the Otway and Murray Basins.

2.11 Codes of Practice (linked to the Water Quality Environment Protection Policy) are developed in consultation with stakeholders that aim to reduce pollution from diffuse sources entering watercourses and water bodies.

The AUSRIVAS program is the only State-wide assessment of river/stream health available, and it must be recognised that it uses only one indicator of river health. In time other indicators or multi-indicator tools may be found to be more useful.

Over 600 sites have been monitored on a seasonal basis in South Australia ranging from Eight Mile Creek in the South East to Cooper Creek in the Far North. Overall, the results have provided a useful assessment of river and stream health, although refinement of the monitoring technique is required to more effectively assess the health of rivers and streams associated with the River Murray and those occurring in the western Lake Eyre Basin. For maps showing the AUSRIVAS results see the *State of the Environment 2003 Supplementary Report.*

The following sections provide an overview of river and stream health in the regions as assessed by the AUSRIVAS program. For information see chapter on the **River Murray**.

River and stream health in the Mount Lofty Ranges

The construction of water supply reservoirs, farm dam development, land clearance and agricultural and horticultural development have significantly affected river and stream health in the Mount Lofty Ranges.

Use of the Torrens and Onkaparinga Rivers as aquaducts to transfer River Murray water to metropolitan reservoirs, and the discharge of treated effluent into the Sturt River and Hahndorf Creek, have impacted upon the ecology of these watercourses. Flows of River Murray and effluent water are of very different water quality compared to the natural flows in waterways in the region.

WHAT ARE MACROINVERTEBRATES?

Macroinvertebrates are aquatic animals without backbones that are large enough to be seen with the naked eye. They include insects, crustaceans, snails, worms, mites and sponges. The insects include the larvae of flying insects (e.g. midges, two-winged flies, dragonflies, mayflies, stoneflies and caddisflies) and adults of some groups (e.g. waterbugs, beetles and springtails). The more familiar crustaceans include yabbies and freshwater shrimps and prawns. Macroinvertebrates are used in biological monitoring studies because they are common, widely distributed, easily sampled and most can be identified by experienced biologists.

River swept debris
Photo: Waterwatch SA

2 Inland Waters

Macroinvertebrate diversity indicates freshwater condition
Photo: Waterwatch SA

Watercourse in the Adelaide Hils

Healthy AUSRIVAS sites were generally found in catchments with large proportions of native vegetation such as Scott, Bakers Gully, Echunga, Brown Hill, Sixth and Jacob creeks, the rural section of the Little Para River, parts of the North Para River and most of the main channel of the Onkaparinga River. A number of urban sites on Dry Creek and the Torrens River from Silkes Road to Windsor Grove were also in good condition on most occasions.

The rivers and streams that rated poorly generally flow through urban areas or receive considerable run-off from agricultural lands. Urban stormwater pollution was noted from part of the North Para River, the lower reaches of the Little Para and Torrens rivers, and the lower part of the Onkaparinga River.

Pollution from horticultural and agricultural activities was evident in Cox, Lenswood, Aldgate and Inverbrackie creeks, and the impact of wastewater treatment discharge was noted on sections of the Sturt River and Hahndorf Creek.

Information on the quality of water in selected rivers and streams in the Mount Lofty Ranges is provided in the chapter on **Water Quality**.

River and stream health of the Eastern Mount Lofty Ranges

Regulation of flows in the River Murray, and agricultural, irrigation and mining development have had a major impact on the health of rivers and streams in the Eastern Mount Lofty Ranges region.

Healthy AUSRIVAS sites tended to occur in the high rainfall part of the region. These included sites on Mount Barker, along Meadows, Bull, Rodwell, Tookayerta and Preamimma creeks and the North Rhine River.

The waterway that received the poorest rating was Dawesley Creek near Nairne in the Mount Lofty Ranges. This stream's health has been severely affected by acid water leaching from the disused Brukunga mine (see the chapter on **Water Quality** in the *State of the Environment 2003 Supplementary Report*). Other streams with poor ratings include Mount Barker Creek, Salt, Rocky Gully and Long Gully creeks, and parts of Reedy, Nairne and Baker creeks and the Marne River.

See also chapter on the **River Murray**.

River and stream health on the Eyre Peninsula

Salinity is a major issue for rivers and streams on the Eyre Peninsula. Since 1930 land clearance has significantly increased the salinity of the Tod Reservoir (the region's major water supply) and its current average salinity is over 6000 milligrams per litre. As a guide, fresh water has a salinity level of less than 3000 milligrams per litre and seawater has a salinity of about 35,000 milligrams per litre.

Healthy AUSRIVAS sites were typically located in the Tod River catchment, the region's major surface water resource, and several nearby coastal streams. Coonta Creek and a small, unnamed creek south of the Tod River both had more species present than expected for lowland brackish streams, and were given a high rating. Sites from Edillilie and Minniribbie creeks were generally in good condition in relation to other saline streams in the State.

Sites that rated poorly were generally in the most saline streams such as Dutton River, Driver River, some sites at Salt Creek near Cleve and several smaller salty waterways.

River and stream health in the Far North

The major pressures on streams in the Far North are faecal pollution from stock and high salt concentrations, particularly when some pools dry during summer. High turbidity, or muddiness, caused by stock having access to water, is also a problem in some areas. The extraction of water in the upper sections of the Lake Eyre Basin could also affect the health of some rivers and streams.

AUSRIVAS sites in good condition were located on Coopers Creek, Diamantina River, Macumba River and part of the Neales River. The poorest sites were Yellow Bullock and Mabel creeks west of Lake Eyre, Salt Water Springs on Jeremiah Creek near Copley and isolated sites from the Diamantina and Alberga systems. There were also a group of sites from the Neales, Margaret and Derwent waterways that were so unusual that they were unable to be assessed by the current AUSRIVAS models.

River and stream health in the Flinders Ranges

The major impact on the health of streams in the Flinders Ranges is nutrient enrichment and erosion by stock, land clearance, and discharges from disused mines and saline groundwater systems.

Healthy AUSRIVAS sites were located on Baroota, Coonatto, Bunyeroo, Yadnapunda and Oratunga creeks and Baratta Springs. Pekina Creek was particularly noted for its biodiversity as were many of the reference sites in the region including sites from Brachina, Parachilna, Bunyeroo and Spring creeks.

Tributary streams in the upper reaches of Willochra Creek were in good condition with diverse biological communities. Where the creeks flowed onto the Willochra Plain they rated poorly due to the low numbers of macroinvertebrates that are able to tolerate the very high salinity of water in these lower reaches.

Wilpena Creek, Aroona Creek, Arcoona Creek, Crows Nest Creek, and Arkaroola Creek showed evidence of moderate to severe impact from human activity. Sites from Paralana Hot Springs and Nilpena Creek were so unusual that they were, as expected, unable to be assessed by the current AUSRIVAS models.

River and stream health on the Fleurieu Peninsula and Kangaroo Island

Most rivers and streams in this region were in good condition and similar to other reference rivers in the State. This is not surprising given the wet climate, high amount of vegetation cover, and less severe impact of land use in this region compared to more urban areas.

Particularly diverse sites were located in the Carrickalinga area and the Inman River catchment. Poor sites included the Inman River downstream from the Victor Harbor wastewater treatment plant discharge, Myponga River downstream from the Myponga reservoir and No Where Else Creek. Streams

in poor condition on Kangaroo Island included sites on Middle River, Timber Creek and Springy Water Creek.

River and stream health in the Mid North

Salinity is a major issue for rivers in the region. The salinity of the lower Broughton River is typically around 4000–5000 milligrams per litre, the Wakefield River ranges from 4000 to nearly 9000 milligrams per litre and the Light River is generally between 8000 and 11,000 milligrams per litre.

Faecal pollution from grazing by stock and irrigation, stock trampling habitat, lack of fringing vegetation and high salt concentrations are the major issues associated with streams in the region.

Most waterways were rated as equivalent to reference river condition, including sites from each major river system. This means that for moderately saline streams most were in good condition compared to other saline waterways in the State.

Several sites were healthier than expected, including Julia, Ross and Allen creeks in the Light catchment, and Broughton River at White Cliffs and Rocky River in the Broughton catchment. However, the sites with the highest biodiversity were typically from reference sites such as Mary Springs and Skillogallee Creek.

Fox Creek near Kapunda, Eyre Creek at Watervale, and several sites from the Hutt River and Baldry Creek in the Broughton catchment received poor ratings.

River and stream health in the South East

There are no natural rivers in the South East region of the State other than a small reach of the Glenelg River in the Lower South East; however, a series of significant creeks run westward from Western Victoria into the South East. A series of 13 distinct dunes or ranges in the South East that follow the current shoreline in a north-west to south-east direction have prevented the natural development of waterways flowing into the sea.

The low-lying areas between the dunes collect rainfall in a series of swamps and watercourses that slowly drain in a north-westerly direction. A network of drainage channels, constructed from the 1860s to the present day, allows excess water to drain to sea, thus allowing agricultural development, transport routes and human settlement. These drainage channels and modified watercourses now display a range of different stream habitats.

The waterways in the best condition were freshwater habitats at Drains L and M, Mosquito Creek, Naracoorte Creek, Reedy Creek-Mount Hope Drain and Jip Jip Waterhole, and saline sites at Jacky White and Blackford drains.

The waterways that rated poorly included Morambro, Tatiara, Naracoorte (an urban site), Yelloch and Benara creeks and several coastal drains. Many of these were affected by high turbidity and nutrients, poor habitat structure and altered hydrology. Several drains were also so unusual that they were unable to be assessed by the AUSRIVAS models.

CONDITION INDICATOR: The extent and condition of wetlands

The *State of the Environment Report 1998* was not able to comment in detail on the extent and condition of wetlands due to a lack of information. Now there is more known about individual wetland complexes, but there is still no comprehensive, scientifically based information on the condition or extent of wetlands across the State.

Nevertheless, the environmental status of selected regional wetlands has been assessed by the Department for Environment and Heritage (Seaman, 2002a, b, c and d). The assessments covered a range of representative wetlands from regional areas and are intended to provide a one-off snapshot of wetland condition and conservation value. Seaman acknowledges that these assessments of wetland condition are very subjective and the results must be interpreted with this in mind.

Regions covered by the assessments are the **Mount Lofty Ranges, Eyre Peninsula, Kangaroo Island** and the **Northern Agricultural Districts**. Table 2.1 provides a summary of the results.

Of the total number of wetlands assessed in the surveys, around 17% rated a low environmental value, 62% a moderate environmental value and 21% a high environmental value. Environmental value was based on factors such as water quality and the health of surrounding vegetation, in combination with the level of disturbance including vegetation clearance, grazing damage, rubbish dumping and altered water flows. Wetlands with medium and high environmental values were recommended for follow-up work with regard to possible protective measures.

For more information see chapter on the **River Murray**.

Table 2.1: Environmental status of selected regional wetlands

Region	High value	Moderate value	Low value	Total number assessed
Mount Lofty Ranges	19	54	11	84
Eyre Peninsula	8	16	3	27
Kangaroo Island	6	15	6	27
Northern Agricultural Districts	2	19	8	29
Total	**35**	**104**	**28**	**167**

Source: Seaman, 2002a, b, c and d.

KEY FACTS

- **Information on the extent and condition of our wetlands is poorly documented.**

Lake Killamperpunna, Far North
Photo: Kym Nicolson

Inman River
Photo: Kym Nicolson

2 Inland Waters

KEY FACTS

- South Australia has 69 wetlands of national importance.
- To Indigenous Australians many wetlands and their immediate surrounds are of great spiritual or cultural significance.

Bool Lagoon, Naracoorte, Limestone Coast, South Australia
Photo: South Australian Tourism Commission

Wetlands in the South East

Agricultural development, transport infrastructure and human settlement have significantly affected around 98% of wetlands in the South East and little of this area remains in original condition. While restoration projects are helping to improve the health of selected remnant wetlands the condition of many in the region continues to decline. In particular, the condition of wetlands in the Morambro Creek, Mosquito Creek and Naracoorte Creek catchments are declining and the rising spring wetlands along the Lower South East coast are being degraded from threatening processes such as drainage, stock grazing and groundwater extraction.

Wetlands in the Far North

The extraction of groundwater, grazing, mining development and pest plants and animals pose a threat to wetlands in the Far North. Knowledge on wetlands in this region is focused primarily on wetlands of the Lake Eyre Basin and mound springs of the Great Artesian Basin (GAB).

It is estimated that the uncontrolled flow of water from uncapped groundwater bores in the GAB has reduced the water flows from mound springs by 30% over the past century which has had an impact on plants and animals in the area. Most of these formerly free-flowing bores have now been capped as part of a bore-capping program involving the Department of Water, Land and Biodiversity Conservation and the Arid Areas Catchment Water Management Board (see the chapter on **Water Use**).

Significant wetlands in South Australia

Map 2.2 shows the location of significant wetlands in South Australia. These are either wetlands of international importance (Ramsar wetlands) or wetlands of national importance listed in the Directory of Nationally Important Wetlands (Environment Australia, 2001).

Wetlands of international importance are commonly referred to as Ramsar Sites, after the city in Iran where the Convention on Wetlands was signed in 1971. Wetlands of International Importance are designated according to certain criteria outlined in the Convention and all countries have a responsibility to manage these wetlands wisely. South Australia's five wetlands of international importance are:

- the Coorong and Lakes Alexandrina and Albert;
- the Riverland region;
- Bool and Hacks Lagoon in the South East;
- Coongie Lakes in the Far North;
- Banrock Station Wetland Complex in the Riverland (added since the *State of the Environment Report 1998*).

The Great Artesian Basin Springs of the Far North have similar protection as Ramsar Sites under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and are also recognised as having very high conservation value.

Sixty-nine wetlands in South Australia have been designated as wetlands of national importance following criteria developed under the auspices of the Australia New Zealand Environment Conservation Council (ANZECC). A total of 851 wetlands are listed nationally (Environment Australia, 2001).

There is the potential to nominate other wetlands to the Ramsar Convention in South Australia that fulfil criteria related to karst and groundwater-fed ecosystems. In addition, further regional wetland inventories are likely to lead to more listings in the Directory of Nationally Important Wetlands.

What is the impact of declining river and wetland health?

Some of the environmental, social and economic effects associated with declining river and wetland health are listed below to illustrate the broader significance for sustainability.

Decline in the maintenance of healthy water systems. Wetlands purify water through their highly productive plant communities, recharge underground aquifers, store water and slow down floodwaters.

Impact on plants and animals. Wetlands and rivers provide critical habitat for birds and animals during times of drought, provide important habitat for migratory waterbirds and breeding habitat for fish, and support sustainable populations of threatened species.

Loss of economic opportunities. A decline in the health of rivers and wetlands could result in depleted resources for fishing industries, decreases in tourism, and restricted or lost access for boating.

Lost opportunities for recreation. Wetlands and rivers are the focus of many recreational activities including bird watching, boating and camping. Declining wetland health will threaten these activities.

Lost opportunities for the biotechnology industry. The continuing decline of rivers and wetlands could result in the extinction of species that could be potential sources of medicine.

Cultural impact. Many wetlands and their immediate surrounds are of great spiritual or cultural significance to Indigenous Australians. Declining wetlands and river health can degrade the archaeological, historic or traditional values of water sources.

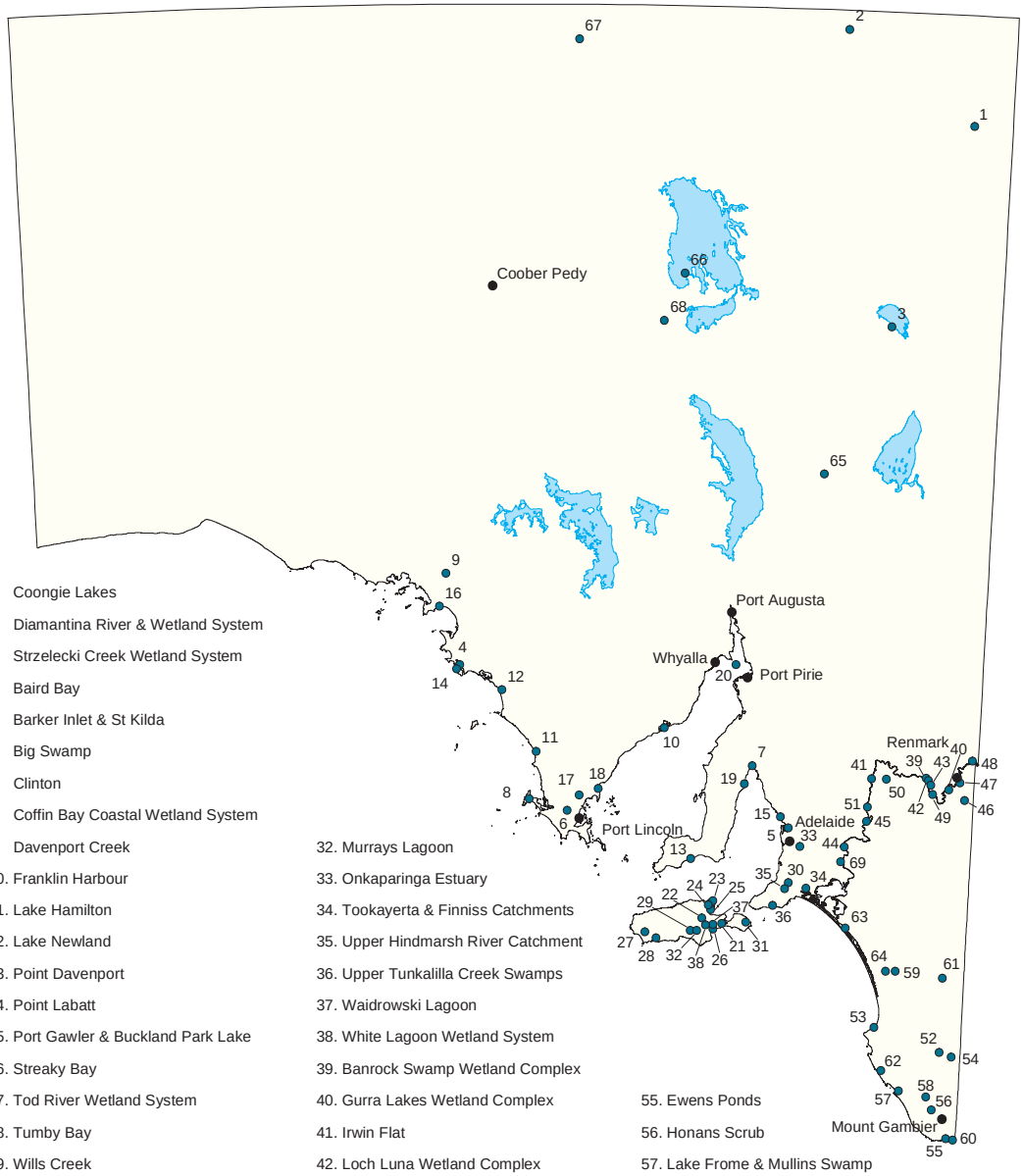
What are we doing about it?

State Government policy and programs and the work by Catchment Water Management Boards now place more focus on the water needs of rivers, streams and wetlands. The ***Water Resources Act 1997***, and the statutory plans under it, the **State Water Plan 2000, Catchment Water Management Plans** and **Water Allocation Plans** provide a coordinated approach for managing both surface and groundwater extraction and environmental water provisions for wetlands and rivers. The ***River Murray Act 2003*** will provide a further framework for sustainable management of the River and its associated wetlands and streams. The ***Native Vegetation Act 1991*** provides protection against deliberate or negligent degradation of vegetation dependent upon wetland and river hydrology.

In addition to legislative controls that address water for the environment, a number of other **research and investigative projects** have been initiated by State Government and Catchment Water Management Boards to improve our knowledge of environmental water requirements. These include the

Map 2.2: Internationally and nationally significant wetlands in South Australia

SOURCE: DEH



1. Coongie Lakes
2. Diamantina River & Wetland System
3. Strzelecki Creek Wetland System
4. Baird Bay
5. Barker Inlet & St Kilda
6. Big Swamp
7. Clinton
8. Coffin Bay Coastal Wetland System
9. Davenport Creek
10. Franklin Harbour
11. Lake Hamilton
12. Lake Newland
13. Point Davenport
14. Point Labatt
15. Port Gawler & Buckland Park Lake
16. Streaky Bay
17. Tod River Wetland System
18. Tumby Bay
19. Wills Creek
20. Upper Spencer Gulf
21. American River Wetland System
22. Birchmore Lagoon
23. Busby & Beatrice Islets
24. Cygnet Estuary
25. Cygnet River
26. D'Estrees Bay
27. Flinders Chase River Systems
28. Grassdale Lagoons
29. Lake Ada
30. Lanacoona Road Swamps
31. Lashmar Lagoon
32. Murrays Lagoon
33. Onkaparinga Estuary
34. Tookayerta & Finniss Catchments
35. Upper Hindmarsh River Catchment
36. Upper Tunkalilla Creek Swamps
37. Waidrowski Lagoon
38. White Lagoon Wetland System
39. Banrock Swamp Wetland Complex
40. Gurra Lakes Wetland Complex
41. Irwin Flat
42. Loch Luna Wetland Complex
43. Loveday Swamps
44. Lower Murray Swamps
45. Marne River Mouth
46. Noora Evaporation Lakes
47. Pike Mundic Wetland Complex
48. Riverland Wetland Complex
49. Spectacle Lakes
50. Stockyard Plain
51. Swan Reach Wetland Complex
52. Bool & Hacks Lagoons
53. Butchers & Salt Lakes
54. Deadmans Swamp
55. Ewens Ponds
56. Honans Scrub
57. Lake Frome & Mullins Swamp
58. Marshes Swamp
59. Naen Naen Swamp & Gum Lagoon
60. Piccaninnie Ponds
61. Poocher & Mundulla Swamps
62. South East Coastal Salt Lakes
63. The Coorong, Lake Alexandrina & Lake Albert
64. Watervalley Wetlands
65. Inland Saline Lakes
66. Lake Eyre
67. Dalhousie Springs
68. Lake Eyre Mound Springs
69. Murray Bridge Army Training Area Wetlands

2 Inland Waters

KEY FACTS

- State Government policy and programs and the work by Catchment Water Management Boards now place more focus on the water needs of rivers, streams and wetlands.

Vale Park Primary School students sampling river water
Photo: Waterwatch SA

establishment of scientific advisory panels, water manipulation trials (see **Case Study**), research projects on the environmental water requirements of specific ecosystems and modelling work.

The **Stressed Resources Project 2002–03** being conducted by the Department of Water, Land and Biodiversity Conservation is seeking to develop a framework and methodology to identify and prioritise water resources under stress or at risk of stress. In doing this the methodology will attempt to integrate ecological, as well as water quality and quantity issues.

The **Wetlands Strategy for South Australia**, released in 2003, provides for the first time a framework for an integrated approach to the management of all wetlands in the State. Partnerships between Government, industry, private landholders, researchers and regional and local communities underpin successful implementation of the strategy. To ensure that outcomes are achieved on the ground, the support of ongoing public resources and longer term strategic investment by the private sector will be essential.

In the Far North, the development of **Catchment Plans for the Coopers Creek and Georgina-Diamantina Catchments**, and the development of policies and strategies under the umbrella of the **Lake Eyre Basin Agreement**, sets out a coordinated approach to managing wetlands and rivers across State boundaries. The **Great Artesian Basin (GAB) Strategic Management Plan** is a whole-of-basin approach to managing resources including the GAB Springs. A recent bore-capping program and prescription of groundwater resources of the GAB will further help ensure the sustainability of GAB springs and associated ecosystems. The environmental flow requirements of selected rivers in the Lake Eyre Basin is being investigated as part of the **Environmental Flow Requirements for Australian Arid Zone Rivers Project (ARIDFLO)** that will improve our knowledge of arid rivers and provide important information to help underpin management regimes.

Implementation of the **National Action Plan for Salinity and Water Quality** in the Murray, South East and Mount Lofty Regions will enable the operation of salinity management schemes that lead to positive biodiversity outcomes for wetland and river ecosystems. This may occur through improvements in water quality flowing into wetlands and streams and protection of wetland and riparian habitats from grazing and development threats.

The **Australian River Assessment System (AUSRIVAS)** represents the first national biological assessment of river health to be conducted on a continental scale anywhere in the world. It has involved sampling over 6000 sites across Australia, including around 650 sites in all regions of South Australia. These sites will be re-visited by the Environment Protection Authority to allow the ongoing assessment of river and stream health.

By contrast, information on the extent and health of our wetlands is poorly documented. In some parts of the State **wetland education and restoration projects based on Government and community partnerships** are drawing more attention to the importance of wetlands and rivers. The reinstatement of natural water regimes in some wetlands in the South East and Murray-Darling Basin is attempting to restore former wetland habitat. To ensure effective outcomes, it is important to ensure that these projects are based on sound scientific principles and include focused monitoring to ensure that actions on the ground are actually improving the health of aquatic habitats.

The EPA has developed and implemented the **Environment Protection (Water Quality) Policy**, a statutory policy under the *Environment Protection Act 1993*, which provides a regulatory basis for dealing with waste discharges into waters, including from diffuse (non-point) sources. This Policy enables the setting of environmental values and the establishment of water quality objectives for watercourses and water bodies.

Community-based monitoring programs, including **Waterwatch** and the **Frog Census**, have expanded over the last five years and continue to play a significant role in engaging the community in wetland management.

For more information on programs and initiatives see the *State of the Environment 2003 Supplementary Report*.

CASE STUDY – Environmental water provisions for the Clare Prescribed Water Resources Area

Flows in the streams of the Clare Valley are seasonal and highly variable from year to year. Surface water run-off is captured in on-stream farm dams with a smaller volume diverted to off-stream farm dams.

Following a comprehensive assessment of the status of the biology, hydrology, geology, geomorphology and ecology of the area's streams by the Department of Water, Land and Biodiversity Conservation, environmental water requirements were determined and subsequently embedded into the water allocation policies in the region's water allocation plan.

The key policies that now provide water for the environment include:

- limits to the amount of surface water that can be captured by farm dams;
- no further surface water development (farm dams and off-stream pumping) is allowed for most sub-catchments in the Clare Valley;
- trading rules for water licences that address environmental concerns, particularly by preventing t rade upstream;
- a ban on direct pumping from permanent pools of water and on wells being constructed within a specified buffer zone.

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Further information

AUSRIVAS
http://ausrivas.canberra.edu.au

Catchment Water Management Boards
www.catchments.net

Environment Australia – wetlands
www.ea.gov.au/water/wetlands

Monitoring River Health Program
www.ea.gov.au/water/rivers/nrhp/index.html

Watercare
www.watercare.net

Waterwatch South Australia
www.sa.waterwatch.org.au

Wetland Care Australia
www.wetlandcare.com.au

Wetlands in South Australia
www.environment.sa.gov.au/biodiversity/ecocons.html

Wetlands Strategy for South Australia
www.environment.sa.gov.au/biodiversity/pdfs/wetlands/wetlands_strategy.pdf

River Torrens, City

2 Inland Waters

Polluted creek

Stormwater pollution

Water Quality

Trends

- **Water quality in rivers and streams of the Mount Lofty Ranges: MODERATE TO POOR no significant change since the *State of the Environment Report 1998*.**
- **Groundwater quality: DECLINING in some regions, the single biggest threat to groundwater quality across the State is salinity.**

Goal

The purpose of the Environment Protection (Water Quality) Policy (2003) is '*... to achieve the sustainable management of the waters of the State by protecting and enhancing water quality while allowing economic and social development'.*

What are the issues?

South Australia's surface waters (rivers and streams) support important aquatic ecosystems that sustain a diverse range of plants and animals and supply drinking water for most of the State's population. They also sustain much of our irrigated agriculture, manufacturing, food processing and winemaking industries and provide a focus for water-based recreational activities and eco-tourism. The pollution of rivers and streams and reduced stream flow may compromise these values.

Major pollution stresses are evident in two of the State's major surface waters: the River Murray and the rivers and steams in the Mount Lofty Ranges. Information on water quality in the River Murray can be found in the chapter on the River Murray.

The catchments of the Mount Lofty Ranges are used for many different purposes including agriculture, recreation, intensive horticulture, urban living and conservation. This diverse range of land uses places pressure on water resources and can impact on water quality. The Mount Lofty Ranges Watershed is a Water Protection Area under the *Environment Protection Act 1993,* and a special management area regulated under the *Water Resources Act 1997,* to protect the quality and quantity of drinking water supplies to metropolitan Adelaide. Maintaining good quality water in this environmentally sensitive region is of paramount importance. Nutrients from urban and rural areas can run off into rivers and streams and enter water supply reservoirs where they can cause algal blooms. Faecal contamination from animals and poorly maintained septic tank systems can also cause water pollution problems.

South Australia's groundwater resources are also critical to the State, providing social, economic and environmental benefits. Groundwater provides much of the State's irrigation water for horticulture, agriculture and viticulture and an invaluable drinking water supply to regions where there is little surface water run-off and effective storage sites are not available. Groundwater is also fundamental to maintaining flows in many of the State's creeks, rivers, wetlands and coastal waters.

Groundwater close to the surface is generally the most at risk of pollution. Local pollution from industrial discharges and spills can introduce nutrients, pesticides, heavy metals and organic pollutants that may seriously degrade local and regional groundwater quality. Microbiological contamination is also an issue in some groundwater systems. Diffuse nitrate pollution from fertilisers, stock and septic tanks may also threaten water quality for a number of uses. Polluted groundwater may compromise biodiversity and reduce agricultural and horticultural productivity. Human health may also be at risk if contaminated groundwater is used for domestic supplies in an untreated state.

See also chapters on the **Health of the Marine and Coastal Environment** (marine water quality); **River Murray**; **Rivers, Streams and Wetlands**; **Water Consumption in Urban Settlements** (considers issues relating to water quality in metropolitan reservoirs); and **Water Use**.

Environmental indicators

CONDITION INDICATORS

- Exceedences of water quality guidelines for rivers and streams (reported on in the *State of the Environment Report 1998*)

The quality of water in South Australia's rivers and streams is assessed against national water quality guidelines.

- Exceedences of water quality guidelines for groundwater (reported on in the *State of the Environment Report 1998*)

The quality of water in groundwater is assessed against national water quality guidelines.

What is the current situation?

CONDITION INDICATOR: Exceedences of water quality guidelines for rivers and streams

Major pollution stresses are evident in two of the State's most significant surface waters: the River Murray system, and rivers and streams in the Mount Lofty Ranges. These rivers and streams support unique ecosystems and together provide the majority of our drinking water and water for agricultural, horticultural and industrial activities. The information in this chapter will focus on the Mount Lofty Ranges. For information on water quality see the chapter on the **River Murray**.

Water quality in selected rivers and streams of the Mount Lofty Ranges

Water catchments in the Mount Lofty Ranges are a significant source of drinking water for Adelaide and support a number of important aquatic environments.

Water quality in the region is compromised by poorly maintained septic tank systems, livestock

Findings

Making progress

The Environment Protection (Water Quality) Policy and the *River Murray Act 2003* will provide an important regulatory framework for consistent water quality management across the State. The State Government's proposal for the reform of Natural Resource Management arrangements will better integrate efforts towards improved water quality.

Catchment Water Management Boards and regional Natural Resource Management Boards provide a regional focus for water quality management and conduct action on the ground.

An integrated, cross-agency water quality monitoring program is being developed to provide more efficient and cost-effective monitoring than previous uncoordinated monitoring.

In the Mount Lofty Ranges, the Watershed Protection Office and the Mount Lofty Ranges Catchment Program are undertaking action to achieve improvements in water quality through enforcement, coordination, on-ground activities and education.

Attention required

Ecosystem health and drinking water supplies in some areas of the Mount Lofty Ranges are compromised by poor water quality. The frequent detection of the water-borne parasites *Giardia* and *Cryptosporidium* is cause for concern.

Salinity levels in groundwater resources of the Northern Adelaide Plains and in some parts of the South East are increasing due to leakage of shallow saline groundwaters into the principal low salinity aquifers through corroded bore casings and through intensive extraction for irrigation. This has implications for the sustainability of groundwater supplies.

Elevated levels of nitrates and naturally occurring heavy metals in groundwater pose a threat to private water supplies and ecosystem health across some areas in the South East. Nitrate levels exceed drinking water guidelines in the Coonawarra region.

What more should we be doing?

The Environment Protection Authority recommends that:

2.12 A risk management approach is used to identify and prioritise areas across the State where short and long term action is required to improve water quality and prioritise actions implemented through the Natural Resource Management (NRM) framework.

2.13 An independent auditing process is established to assess on a regular basis the effectiveness of water resource management programs undertaken by NRM Boards.

KEY FACTS

- **Pollution has reduced water quality and compromised the environmental values of watercourses in the Mount Lofty Ranges.**

River Torrens

grazing along watercourses, excessive applications of fertiliser, vegetation clearance, major water supply reservoirs and farm dams.

Map 2.3 provides a summary of water quality from four rivers and streams in the Mount Lofty Ranges from January 2000 to February 2002. Information is provided for a range of physical characteristics and a rating is given depending upon how the water is to be used. These ratings are based on national water quality guidelines. A 'good' rating means that levels are better than the guidelines stipulate most of the time; a 'moderate' reading means that the guidelines are exceeded only occasionally; and a 'poor' rating means that the guidelines are exceeded regularly.

The *State of the Environment Report 1998* provided information on water quality from fifteen rivers and streams around the State (including the four reported on here) based on monitoring data collected by the Environment Protection Authority between 1995 and 1997 (EPA, 1998). Analysis of the data presented in the *State of the Environment Report 1998* did not provide a rating for water quality depending upon its use but rather an overall good, moderate or poor rating for key physical characteristics. It is therefore difficult to highlight specific trends; however, on the whole, it appears that water quality has remained relatively constant over the last five years. Major conclusions that can be drawn from the information presented in Map 2.3 are:

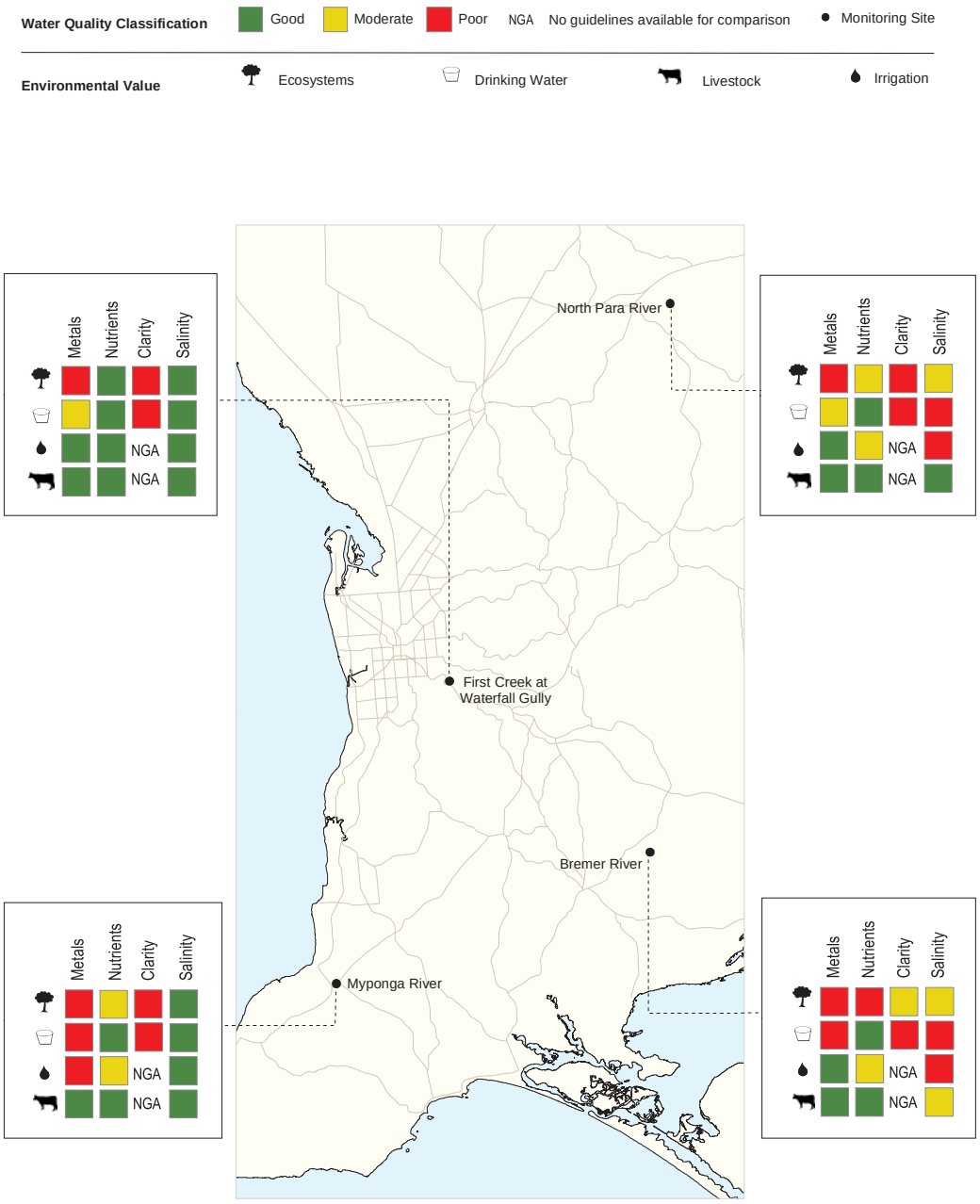
- **salinity** levels were poor to moderate in the North Para and Bremer Rivers, particularly for drinking and irrigation purposes. Levels were good in the Myponga River and First Creek. These ratings are similar to those provided in the *State of the Environment Report 1998*.
- **heavy metals** were poor to moderate in all watercourses particularly in terms of suitability for drinking and maintaining ecosystem health (heavy metals of concern were zinc, copper and aluminium). These elevated heavy metal levels are most likely due to a combination of natural geological sources and pollution. These results compare with those provided in the *State of the Environment Report 1998*.
- **water clarity** was generally rated as poor in all watercourses. The *State of the Environment Report 1998* reported moderate water clarity for the North Para and Bremer rivers and First Creek, and poor

2 Inland Waters

Map 2.3: Water quality of selected rivers and streams in the Mount Lofty Ranges – January 2000 to February 2002

Assessments are based on the Australia New Zealand Environment Conservation Council guidelines for fresh and marine water quality (2000), the Environment Protection (Water Quality) Policy (2003) and the Australian Drinking Water Guidelines (NHMRC and ARMCANZ, 1996).

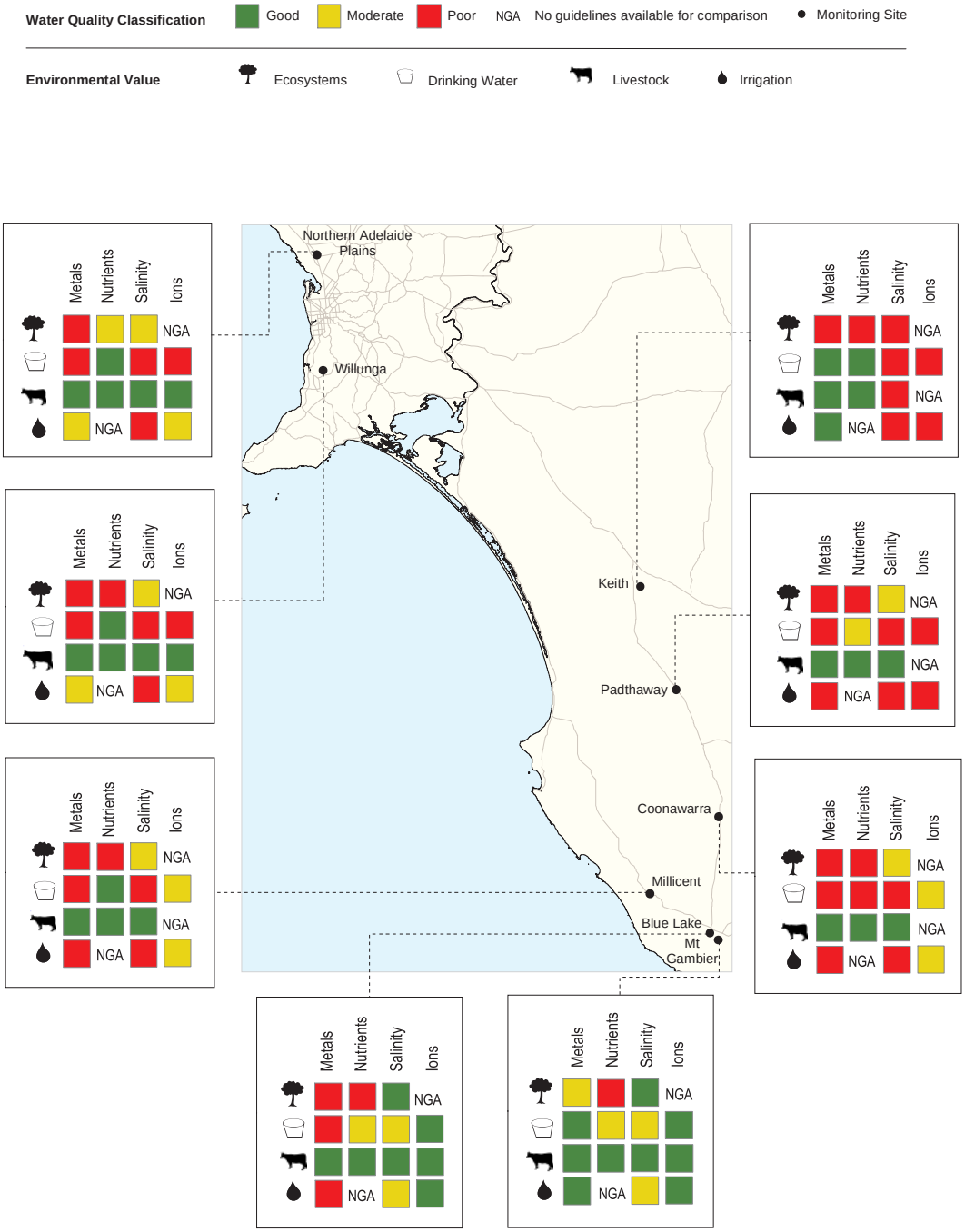
SOURCE: EPA



Map 2.4: Groundwater quality from selected groundwater resources in South Australia – January 1998 to February 2001

Assessments are based on the Australia New Zealand Environment Conservation Council Guidelines for Fresh and Marine Water Quality (2000), the Environment Protection (Water Quality) Policy (2003) and the Australian Drinking Water Guidelines (NHMRC and ARMCANZ, 1996).

SOURCE: EPA



2 Inland Waters

WATER QUALITY CHARACTERISTICS

Some **heavy metals** such as zinc and copper are important in small quantities for biological processes and they occur naturally in many river systems. However, when they are discharged in large quantities from sewage or industrial or agricultural run-off, they can be extremely harmful. They can accumulate in sediments and move up the food chain into human food sources.

High **salinity** can adversely affect plant and animal communities. Salinity is also a major issue for irrigators and affects the supply of drinking water to South Australians.

Algae (or phytoplankton) are naturally occurring aquatic organisms and important components of a healthy ecosystem. Their presence in large numbers, however, can cause problems. The algae of greatest concern are the blue-green algae such as *Anabaena, Microcystis* and *Nodularia*. These are known to have caused death in cattle and horses and have also caused illness in humans. High nutrient levels can stimulate algal blooms.

Faecal coliforms are bacteria found in high numbers in the faecal matter of warm-blooded animals such as livestock and humans. High levels can make water unsafe for swimming in and drinking.

Clarity refers to the cloudiness, or turbidity, of the water. It is influenced by the concentration of suspended clay, silt and fine particles of organic and inorganic matter. High turbidity can adversely affect plant growth and the survival of some aquatic animals and can pose a danger to swimmers due to low visibility.

The major **nutrients** found in surface and ground waters are nitrogen (nitrate and nitrite) and phosphorus. Major sources of nutrients include sewage treatment works, industrial activities, intensive agricultural activities and stormwater run-off. High nutrient levels can deplete the water of oxygen and cause the growth of blue-green algae.

Ions include bicarbonate, calcium, chloride, fluoride, magnesium, potassium, sodium and sulphate. Ions can affect the hardness of water (bicarbonate and calcium), impart an unpleasant taste (sulphate) and damage soil structure (sodium).

water clarity for the Myponga River. Rainfall and the volume of flows can influence water clarity.

- **nutrients** (nitrogen oxides) in the Bremer River were rated as poor in relation to the health of aquatic ecosystems. Levels were good to moderate at other sites. This compares to ratings in the *State of the Environment Report 1998*.

Information is also collected on the occurrence of waterborne parasites in rivers and streams in the Mount Lofty Ranges. The parasites of particular concern are *Giardia and Cryptosporidium*, which can contaminate drinking water and cause illness. The major source of these parasites is faecal matter.

The frequent detection of these parasites in rivers and steams flowing into reservoirs in the Mount Lofty Ranges is cause for concern. *Cryptosporidium* is of particular concern because it cannot be effectively controlled by chlorination and is difficult to remove from water supplies. Detection of *Cryptosporidium* in the Sydney water supply in 1998 led to the issuing of 'boil water' notices for the whole of the metropolitan area.

The Department for Human Services is advised when the levels of *Giardia and Cryptosporidium* reach a certain concentration (ten viable organisms per litre) that poses a potential risk to human health. These are referred to as Type 1 incidents. In 2000/01 there were 16 Type 1 incidents reported in the source waters flowing into Mount Lofty Ranges reservoirs; in 2001/02 there were 23 Type 1 incidents reported and in 2002/03 there had been 9 incidents reported at the time this chapter was written (June 2003). The number of samples taken vary from year to year depending on the frequency of significant rainfall events.

CONDITION INDICATOR: Exceedences of national water quality guidelines for groundwater

The Environment Protection Authority regularly monitors groundwater through programs that target key groundwater resources and areas known to be under stress from significant pollution sources. These key areas include the South East, the Northern Adelaide Plains and the Willunga Basin. Map 2.4 shows water quality monitoring results for selected locations in these key areas between January 1998 and February 2001.

The assessment of groundwater quality as shown in Map 2.4 was based on the same process used for the assessment of water quality in the Mount Lofty Ranges. It should be noted though that groundwater management and the assessment of water quality is difficult because there can be many years separating cause and effect. Seasonal variations (e.g. rainfall) can also mask the impact of management regimes and make assessing their effectiveness difficult.

Groundwater quality in the South East

Around three-quarters of all South Australia's groundwater resources are located in the South East. There is still some groundwater that is unallocated in the region and therefore potentially available for further development; however, salinity levels are elevated and soil types are less suitable for intensive horticulture.

The *State of the Environment Report 1998* did not provide detailed monitoring data relating to groundwater quality, but the issues it raised in relation to groundwater quality in the South East, such as increasing salinity in some areas and widespread nitrate contamination, still persist. Major conclusions that can be drawn from the information presented in Map 2.4 are:

- **salinity** levels were generally rated as poor in most locations for drinking and irrigation purposes, with the exception of Mount Gambier and the Blue Lake. High salinity levels tend to occur in the upper South East, particularly around Keith. Parts of the Padthaway irrigation area also have high salinity levels, which are threatening the sustainability of vineyards. The elevated groundwater salinity levels at Padthaway in particular are approaching the practical limits for the irrigation of vines resulting in a decline in yield and quality.
- **high nutrients** (mainly nitrates and nitrites) pose a threat to ecosystem health across the South East. As reported in the *State of the Environment Report 1998*, low level **nitrate** contamination of the unconfined aquifer[1] is widespread and exceeds the National Health and Medical Research Council's drinking water guidelines in a number of areas, particularly at Coonawarra and to the south and south-east of Mount Gambier. A variety of causes for this contamination have been suggested, including direct (point) sources of pollution and more diffuse pollution from activities such as fertiliser run-off from intensive agricultural practices.
- the level of some naturally occurring **heavy metals** (zinc, lead, copper and iron) is rated as poor across most areas for drinking, irrigation and ecosystem management. These pose a threat to ecosystem health. The elevated heavy metal levels are likely to be due to the combination of natural geological sources and pollution.

Groundwater quality on the Northern Adelaide Plains

Groundwater resources of the Northern Adelaide Plains provide the major source of irrigation water for the Virginia and Angle Vale horticultural regions, which supply Adelaide with a large proportion of its vegetables, fruit trees, vines, cut flowers and nursery plants.

Groundwater in the region is currently being used above the estimated sustainable limit and this is having an associated impact on water quality, notably salinity (see also chapter on **Water Use**).

As indicated in Map 2.4 salinity is rated as poor for drinking and irrigation purposes, heavy metals (cadmium and zinc) pose a threat to ecosystem health, and iron levels impair the quality for drinking water purposes.

Groundwater quality in the Willunga Basin

Groundwater in the Willunga Basin is a significant resource because it supports the commercially

[1] *Most groundwater in the South East is drawn from a shallow unconfined aquifer which overlies a deeper confined aquifer.*

important vineyards and orchards grown in the McLaren Vale-Willunga region. The area is also undergoing major urban expansion. Groundwater in the region is used primarily for irrigation but also for watering domestic gardens and drinking water supplies. Groundwater resources in the region are fully allocated (see also chapter on **Water Use**).

Map 2.4 indicates groundwater quality in the region. High levels of zinc pose a threat to ecosystem health as do high levels of nitrates. Salinity is rated poorly for drinking water and irrigation use.

What impact will deteriorating water quality have?

Impact on drinking water quality and human health. Many rivers and streams in the Mount Lofty Ranges are the source waters that feed into major metropolitan reservoirs. Deteriorating water quality will have a potential impact on drinking water quality, potentially affecting human health (the gut parasites *Giardia* and *Cryptosporidium* are frequently detected in the source waters of major reservoirs), and increasing the costs associated with water treatment.

There are potential risks to human health if groundwater contaminated with disease-causing micro-organisms or a high concentration of nitrate from fertilisers, stock and septic tanks is used for drinking purposes.

Reduced productivity. The use of irrigation water that has high salinity levels can affect horticultural and agricultural productivity by affecting plant and soil health.

Damage to infrastructure. High salt content in water can corrode water distribution systems and cause damage to household appliances and industrial infrastructure.

Increased water treatment costs. Deteriorating water quality can have an economic impact associated with additional water treatment to make the water safe for drinking. Pesticide contamination of source waters to three major reservoirs in the Mount Lofty Ranges Watershed in 1997 resulted in the expenditure of more than $1 million by SA Water to treat domestic water supplies (see the chapter on **Land Use**).

Biodiversity. Declining water quality will have an impact on the health of aquatic plant and animal communities, particularly pollution from heavy metals, high nutrient and salinity levels and toxic blue-green algae. Deteriorating groundwater quality will have an impact on the ecological communities that rely on groundwater rather than surface water to survive, such as coastal springs.

Recreation and tourism. Polluted water bodies jeopardise recreation and eco-tourism activities.

What are we doing about it?

Policy and programs

From a State-wide perspective, new initiatives such as the **Environment Protection (Water Quality) Policy** and the proposed integration of **Natural Resource Management** arrangements and activities will provide a solid framework for improving water quality across the State.

The Environment Protection (Water Quality) Policy will provide, for the first time, a consistent State-wide approach to the protection of water quality across all South Australian water bodies (marine and fresh). Importantly, it will set **water quality objectives** for all waterbodies, **mandatory provisions** to ensure that essential practices are met and **discharge limits** for listed pollutants.

The *Environment Protection Act 1993* **requires certain activities that potentially pose a risk to the environment to be licensed**. This includes wastewater treatment plants, septic tank effluent disposal schemes and industrial activities that have the potential to pollute water resources. Licence conditions may impose certain restrictions or require improvements to operations.

The Environment Protection Authority has published **Codes of Practice** to help prevent stormwater pollution and pollution from dairy waste. Codes of practice are currently being drafted that deal with pesticide use and overflows from wastewater systems.

SA Water is continuing to implement **Environment Improvement Programs** at its country based wastewater treatment plants to reduce the level of nutrients being discharged into rivers and streams. One hundred per cent of the treated wastewater produced from the Gumeracha, Mannum, Murray Bridge and Myponga wastewater treatment works is now reused. There is also some reuse at the Millicent, Bird-in-Hand and Angaston wastewater treatment plants.

Catchment Water Management Boards and **regional Natural Resource Management Boards** play a major role in the protection of water quality across the State and place a major focus on community partnerships to achieve results.

The **National Action Plan (NAP) for Salinity and Water Quality** will support action by Catchment Boards, regional communities and landholders in catchments and regions highly affected by salinity, or at great risk.[2] South Australia was the first jurisdiction to sign a bilateral agreement with the Commonwealth committing to undertake the NAP. Since its inception around 55 programs have been funded through the NAP.

The **State Water Monitoring Coordinating Committee** was established in 2000 to better coordinate water monitoring across the State. Water monitoring is undertaken by a range of organisations. The Environment Protection Authority's **surface water and groundwater quality monitoring program** expanded in 2003 from 150 monitoring sites to around 300 monitoring sites. This will provide additional data to support management decisions and monitor the effectiveness of management strategies.

Community involvement in the management and protection of rivers and streams is increasing. This is a positive development which will contribute

[2] *In South Australia these regions are the South Australian Murray-Darling Basin, the Mount Lofty Ranges-Kangaroo Island, Northern and Yorke Agricultural Districts and the South East.*

KEY FACTS

- **Programs such as Waterwatch, Landcare, Saltwatch and WaterCare are involving the community in the sustainable use and management of our water resources.**

Students monitoring salinity in the Little Para River
Photo: Waterwatch SA

significantly towards a greater community awareness of the issues facing water resources. **Waterwatch South Australia** began in 1993 with about ten Waterwatch groups. It has since grown to over 490 school and community groups monitoring water quality at about 810 sites.

Mount Lofty Ranges

The **Mount Lofty Ranges Catchment Program** was established in 1993 to accelerate on-ground action towards the sustainable use and development of the natural resources of the ranges, in line with recommendations from the 1993 Mount Lofty Ranges Regional Strategy Plan. The Catchment Program involves partnerships between a range of State Government agencies, Local Government and community groups. The protection and enhancement of water quality is one of the Program's broad objectives. Since its establishment the Program has been involved in significant on-ground works involving over one thousand land owners.

The **Mount Lofty Ranges Watershed Protection Office** was established in 2000 by the Environment Protection Authority specifically to protect and improve the quality of water resources in the watershed. It works across many different groups to achieve its goals and its work is complemented by that of the Mount Lofty Ranges Catchment Program. Since its establishment it has, among other things, conducted an audit of all 99 dairies operating in the watershed, been involved in policy and planning activities, conducted water quality monitoring and assessments and promoted best land management practices. The **Myponga Watercourse Restoration Project**, run out of the office, has resulted in significant on-ground works including the fencing off of 30 kilometres of watercourses from stock and the installation of 20 off-stream watering points and 13 stock crossings to manage stock activity over watercourses.

The Torrens, Patawalonga, Onkaparinga, River Murray and Northern Adelaide and Barossa **Catchment Water Management Boards** all cover parts of the Mount Lofty Ranges. All have a strong focus on on-ground works and have made significant achievements towards improved water quality and water management since their inception.

For more information on programs and initiatives see the *State of the Environment 2003 Supplementary Report.*

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Murray–Darling Basin Ministerial Council (1999). *The Salinity Audit of the Murray-Darling Basin.* Murray-Darling Basin Commission, Canberra.

SA Water (2001). *Drinking Water Quality Report 2001.*

South East Catchment Water Management Board (2003). DRAFT. Catchment Water Management Plan.

Further information

Catchment Water Management Boards
www.catchments.net

Mount Lofty Ranges Catchment Program
www.mlrcp.sa.gov.au

National Action Plan for Salinity and Water Quality
www.napswq.gov.au

Northern Adelaide and Barossa Catchment Water Management Board
www.nabcatchment.net

Onkaparinga Catchment Water Management Board
www.onkaparinga.net

WaterCare
www.watercare.net

Waterwatch South Australia
www.sa.waterwatch.org.au

Water Use

Trends

- **Water use in areas of the State where use is required to be licensed: RELATIVELY STABLE in most areas, use of groundwater is currently above the estimated sustainable limit in the Northern Adelaide Plains and parts of the South East.**
- **Water use in areas of the State where use is not required to be licensed: UNCERTAIN AND LIKELY INCREASING, use of surface water is currently above the estimated sustainable limit in the Mount Lofty Ranges.**
- **The management of water resources is increasingly integrated with land management.**

Goal

To establish a system for the use and management of the water resources of the State that ensures that the use and management of those resources sustain the physical, economic and social well-being of the people of the State and facilitate the economic development of the State while:

- ensuring that those resources are able to meet the reasonably foreseeable needs of future generations and;
- protecting the ecosystems (including the biological diversity) that depend on those resources and, that by requiring caution and other safeguards, reduces to a minimum the detrimental effects of that use and management.

Water Resources Act 1997

What are the issues?

Water is essential for the future prosperity of the State. It supports human life and sustains the natural environment. A sustainable supply of good quality water underpins industrial, agricultural, mining and urban development and provides opportunities for human recreation.

South Australians mainly use water from two source types – groundwater and surface water, in particular water from the River Murray. Groundwater is water that occurs naturally below ground level. This is accessed via pumping from bores and wells. Surface water is any water that occurs on the land surface including run-off, creeks, streams, dams and reservoirs. The River Murray is an important source of water in South Australia providing, on average, two-thirds of all Adelaide's water supplies (for more information see chapter on the **River Murray**).

In some areas of South Australia water resources are prescribed under the *Water Resources Act 1997*. This occurs in areas where activities associated with regional development can potentially cause stress on water sources, warranting a higher level of management than in other areas. In these areas, a licence is required before water can be taken for irrigation or other purposes. There are currently 24 prescribed water resources in South Australia: 16 areas for groundwater resources, six areas for surface water resources and two for both.

Urban and agricultural development since European settlement has had a profound impact on the nature of our water resources. In some areas of the State, water supplies are being used beyond estimated sustainable levels. This is, in part, because of increasing irrigation development. In the Mount Lofty and Flinders Ranges, major reservoirs intercept surface water flows, depriving aquatic environments further downstream of water. Farm dams in the region and elsewhere in the State also disrupt natural surface flows. This increasing demand for water is affecting the environment and restricting further urban and agricultural developments that depend on reliable sources of water. In localised areas in the north of the State, the mining industry also has a significant impact on water resources.

See also chapters on **Land Use**; **River Murray**; **Rivers, Streams and Wetlands**; **Water Consumption in Urban Settlements**; and **Water Quality**.

Environmental indicator

PRESSURE INDICATOR

- Use of surface and groundwater resources versus availability (new indicator)

Gives an indication of the sustainability of present use levels from various resources.

What is the current situation?

PRESSURE INDICATOR: Use of surface and groundwater resources versus availability

An average of 1245 gigalitres[1] of water per year is used in South Australia for agricultural, industrial, commercial, recreational and domestic activities. This is approximately 5% of the estimated total national water use, (NLWRA, 2001).

On average 49% of the water we use in South Australia is taken from the River Murray, 37% from groundwater resources and 11% from surface water sources (run-off , creeks, streams, dams and reservoirs). Around 3% of our water is supplied by re-using stormwater run-off and treated wastewater from wastewater treatment plants. A significant amount of the 20 gigalitres of stormwater run-off that is re-used (Figure 2.2) is only used for 'aesthetic' purposes, that is, it is held in temporary storage in large constructed wetlands before it is ultimately discharged to sea. To relieve pressure on traditional sources of water it is important that we increase our efforts to re-use these alternative water supplies (see chapter on **Water Consumption in Urban Settlements**).

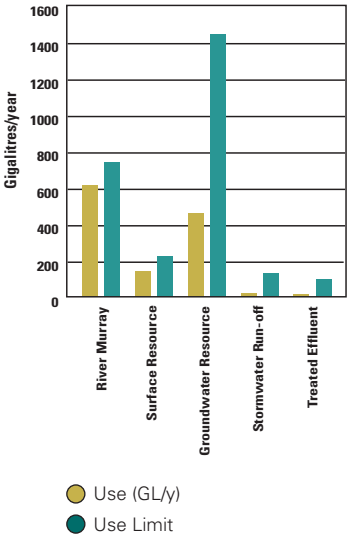
[1] *A gigalitre (GL) is one thousand million litres or 1000 megalitres. One gigalitre would cover the Adelaide Oval to a depth of 50 metres (about a 15-storey building).*

2 Inland Waters

Vines, Barossa Valley, South Australia
Photo: South Australian Tourism Commission

Farm dam
Photo: M. Young, Rural Solutions SA

Figure 2.2: South Australia – water use summary



Note: Use Limit is the estimated total maximum annual volume of water that can be made available for use by human activities without serious impact on the environment.

SOURCE: DWLBC & SA WATER

Findings

Making progress

There has been a more integrated approach to water resource use and management in South Australia, particularly via the Catchment Water Management Boards, over the last five years. The South Australian Government's Natural Resource Management Reform Program aims to integrate and support with legislation, water resource, soil conservation and pest plant and animal control management.

Water allocation plans now also take into consideration environmental requirements for water, in line with the Water Resources Act 1997, which recognises the environment as a legitimate user of water. Water use is now within sustainable limits in many (but not all) prescribed areas.

Management of groundwater resources in the Great Artesian Basin (GAB) is set for improvement following a number of initiatives over recent years. This includes programs by the Arid Areas Catchment Water Management Board-Department of Water, Land and Biodiversity Conservation supported by Commonwealth Government funding to cap artesian bores and enclose bore drains. Prescription of groundwater resources in the Great Artesian Basin occurred in March 2003, providing greater legislative control over water use in the region.

The Stressed Resources Project 2002–03 being conducted by the Department of Water, Land and Biodiversity Conservation is seeking to develop a framework and methodology to identify and prioritise water resources under stress or at risk of stress. In doing this the methodology will attempt to integrate ecological, as well as water quality and quantity issues.

Attention required

We do not know how much water is being used in areas of the State where use is not licensed. In particular, there is cause for concern in the Mount Lofty Ranges, where the use of surface water resources currently exceeds a trigger for closer monitoring and assessment.

In spite of a systematic approach to water allocation in areas where water use is required to be licensed, groundwater is currently being used beyond estimated sustainable limits on the Northern Adelaide Plains, Tatiara (Hundred of Stirling) and Padthaway due to intensive irrigation development.

What more should we be doing?

The Environment Protection Authority recommends that:

2.14 Urgent attention is required to develop measures that ensure the sustainable management of ground and surface water resources in the Mount Lofty Ranges.

2.15 Irrigation efficiency is increased through the promotion and adoption of improved irrigation practices, new technology, and the upgrading of infrastructure. Consideration should be given to achieving this through the use of appropriate economic and regulatory tools. Water saved from improved irrigation practices should be used for environmental outcomes rather than be allocated to additional irrigation.

Figure 2.2 summarises South Australia's water use in any given year. Overall this indicates that the use of our surface water (including the River Murray) and groundwater resources is within estimated sustainable limits, however, in a few regions of the State water resources are either fully allocated or are being used beyond their sustainable limits. The estimated sustainable limits are based on limited information and may vary in the future with improved knowledge of these water resources. The lack of available water has been identified as a major obstacle to development in some regions. Particular areas of concern are summarised in the following section.

Areas of concern

Mount Lofty Ranges Watershed

The use of surface water resources in the Mount Lofty Ranges Watershed currently exceeds a trigger for closer monitoring and assessment. Surface water use in the watershed is estimated to be 120 gigalitres per year while the estimated sustainable limit is around 44 gigalitres per year (DWR, 2000). The Mount Lofty Ranges Watershed is a management area regulated under the *Water Resources Act 1997* to protect water supplies to metropolitan Adelaide; the bulk of surface water collected in the watershed is used for the Adelaide metropolitan water supply. A number of major reservoirs in the region capture most of the surface water flows. This is seriously disrupting natural flows and depriving downstream rivers and streams of water.

Farm dams in the Mount Lofty Ranges Watershed are also reducing surface water flows. Cumulatively these private water supplies can reduce inflows to reservoirs leading to increased pumping from the River Murray. Individually they can have an impact on local environmental requirements for water and other private water supplies. In recognition of this, the development of farm dams has been regulated in the Mount Lofty Ranges Watershed for more than ten years. There are currently no formal water licensing arrangements in the area; however, in October 2003, the State Government announced its intention to prescribe water use in the Eastern Mount Lofty ranges to ensure the more sustainable use of the region's surface water and groundwater.

Groundwater resources

Groundwater resources are being used beyond estimated sustainable limits in the **Northern Adelaide Plains region**, one of the State's major horticultural production areas. Licensed water use is around 17 gigalitres per year, rising to around 24 gigalitres in dry years (NABCWMB, 1998). The estimated sustainable limit is around 8 to 10 gigalitres per year (currently under review). Increasing irrigation development to support high value horticultural crops is the reason for over-use of groundwater supplies. Over-use has caused a decline in groundwater levels and an accompanying increase in salinity, particularly in the summer months. While treated effluent from the Bolivar Wastewater Treatment Plant is providing an alternative source of water to some parts of the Northern Adelaide Plains, groundwater resources are still being managed unsustainably. The region's water allocation plan includes measures for better managing the problem.

Groundwater supplies in the **Padthaway and Tatiara (Hundred of Stirling)** areas are also being used beyond estimated sustainable limits due to increasing irrigation development. Increasing salinity is the main cause for concern in these regions.

Groundwater-dependent ecosystems are only recently being better recognised. These ecosystems include river baseflow systems, surface wetlands, cave systems and estuarine and near shore marine systems. Better understanding of these systems and their environmental water requirements will inform future estimates of sustainable limits for groundwater systems.

Pressures caused by increasing **viticultural and other horticultural development** in the Barossa and Clare Valleys and increasing horticultural development (including viticulture) in the Mount Lofty Ranges is placing strong demands on water in areas that are already developed to their sustainable limit. Increasing water needs will place pressure on existing sources of water including the River Murray.

Climate change

Predicted increases in temperature and changes in rainfall patterns associated with climate change and variability will influence surface and groundwater resources across all regions. It is estimated that flows in rivers and streams in the eastern-central Murray-Darling Basin could reduce by up to 20% by 2030 and by up to 45% by 2070, thereby increasing competition for scarce water resources (CSIRO, 2001). Trends cannot be predicted with any certainty, so it would be prudent for South Australians to conserve and re-use water resources.

River Murray

Too much water is being regularly taken from along the whole length of the River Murray to support agricultural, industrial and urban development. This is threatening the river's plant and animal communities by depriving them of water. If this level of use continues, there will be significant social and economic consequences as water supplies for drinking, agricultural and industrial uses are limited during periods of low flow and water quality deteriorates. For more information see the chapter on the **River Murray**.

What are our water resources used for?

Eighty per cent of all water used in South Australia is for irrigation, which is applied to various crops on around 5500 farms across the State. The 1997 farm gate value (the value of a crop as it leaves a farmer's property) of irrigated crops was $890 million, representing around 25% of the State's total agricultural production.

Forty per cent of the water used for irrigation comes from the River Murray, 50% from groundwater in the South East and most of the rest from smaller groundwater and surface water systems originating in the Mount Lofty Ranges. Around 10% of the State's total water use is for domestic water supply (see chapter on **Water Consumption in Urban Settlements**) and the vast majority of domestic water use is within the Adelaide metropolitan area.

Although the *Water Resources Act* recognises the environment as a legitimate user of water, it does not appear in water use figures. This is because ecosystems require a certain pattern and seasonality of water flows that cannot be adequately expressed in volumetric terms. Figure 2.3 shows water use by sector in South Australia. This tends to remain relatively constant from one year to the next.

What impact will over-using surface and groundwater resources have ?

Some of the environmental, social and economic effects of over-using surface and groundwater resources are listed below to illustrate the broader significance for sustainability.

Impact on aquatic plant and animal communities. Large domestic water supply storages and farm dams in the Mount Lofty Ranges are depriving downstream rivers and streams of water flows, which is affecting the health of plants and animals and their natural breeding cycles.

The use of some rivers and streams as aquaducts to transport water from the River Murray to water supply reservoirs is degrading water quality and modifying flow regimes and flow volumes, which in turn affects aquatic plants and animals. Many streams and rivers in the State are affected by this practice including the River Torrens, which flows through metropolitan Adelaide.

Losses in horticultural productivity. Over-use of groundwater supplies in the Northern Adelaide Plains and parts of the South East is increasing salinity, with a consequential effect on irrigated crops and production levels.

Increased pumping costs. There will be increased costs associated with pumping water from the River Murray if the overuse of surface water supplies continues in the Mount Lofty Ranges. Declining groundwater levels in the Northern Adelaide Plains will also increase pumping costs for irrigators.

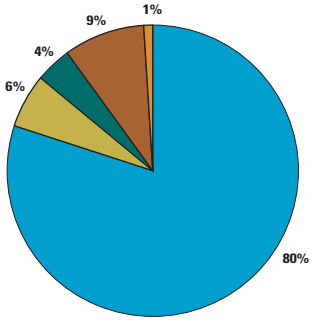
Costs associated with the provision of alternative water supplies. The costs associated with the provision of alternative water supplies on a broad scale if traditional supplies continue to dwindle would be very high.

KEY FACTS

- Water use benefits South Australia in many ways, but in some regions of the State, surface and groundwater resources are being used beyond their sustainable levels.
- 80% of all water used in South Australia is for irrigation.

Scenic view, Murray River, Murraylands, South Australia
Photo: South Australian Tourism Commission

Figure 2.3: Water use (%) by sector in South Australia



SOURCE: DWR, 2000

2 Inland Waters

Hope Valley Reservoir

Cultural sites threatened. Sites of cultural significance such as the Tjilbruke Dreaming Trail freshwater springs on the Fleurieu Peninsula are threatened by declining groundwater levels.
Loss of value of existing assets. Infrastructure assets will not be fully utilised, and hence lose value, is there is little water to be transported via the infrastructure system. This will be the case particularly if the operating and maintenance costs are greater than the benefit received from a reduced volume of water.

What are we doing about it?

The environment is now recognised as a major contender for water. If we continue to deprive aquatic environments of water, the consequences will be significant, if not catastrophic economically and socially. Consequently, the South Australian Government, industry and the community is now placing **more focus on the needs of the environment** when considering the management and use of water resources. The proposed reform of natural resource management in the State and review of the current institutional arrangements and decision-making processes should further improve this situation.

The State's eight **Catchment Water Management Boards** have made a significant contribution to improving water management, and provide a catchment-based focus rather than the ad hoc approach that was taken previously.

The ***Water Resources Act 1997*** formally recognises the environment as a legitimate user of water and contains a range of planning and control provisions to address the sustainable use of all water resources in the State. Likewise, the **State Water Plan 2000** sets out State-wide policy directions to ensure a greater focus on the wise management of our water resources.

In addition to legislative controls that address water for the environment a number of other **research and investigative projects** have been initiated to improve our knowledge of environmental water requirements. These include the establishment of scientific advisory panels, water manipulation trials, research projects on the environmental water requirements of specific ecosystems and modelling work.

Agreed management regimes between the Commonwealth and State Governments are now in place to provide a framework for sustainable management of most major interstate water resources[2]. **Groundwater resources in the far north** of the State were prescribed in March 2003. This, combined with a recent program to complete bore capping and enclose bore drains by the Arid Areas Catchment Water Management Board and the Department of Water, Land and Biodiversity Conservation, with support from the Commonwealth Government, will significantly reduce loss of artesian pressure and water from the Great Artesian Basin.

As a consequence of the drought there is a high level of uncertainty in South Australia surrounding the availability of water from the River Murray into 2003/04. As a safeguard the State Government has moved to adopt a **drought management strategy** aimed at ensuring there will be equitable access to available water for all users. A key element of this strategy is the need to introduce **water restrictions** from July 2003.

The **Stressed Resources Project 2002-03** seeks to develop a framework and methodology to identify and prioritise water resources under stress or those at risk of stress. The project will attempt to integrate ecological as well as water quality and quantity issues.

The **Water Conservation Partnership Project** aims to reduce the dependency of urban and rural users outside the Murray-Darling Basin on water from the River Murray. On a broader scale, **WaterProofing Adelaide** is a major initiative of the State Government to provide a long term, integrated strategy for ensuring water use in Adelaide and adjacent areas is sustainable.

The **re-use of water sources** such as stormwater and treated wastewater are initiatives aimed at reducing the pressure on more traditional water sources and minimising pollution of the marine environment. These non-traditional sources of water are increasingly being used in some parts of the State, particularly Adelaide, to supplement water supplies. Some new urban developments incorporate facilities to allow the re-use of stormwater for irrigating parks and gardens for example. However, although we are an international leader in the field of water re-use technology, we still only re-use a comparatively small proportion of the available stormwater and treated wastewater. More effort needs to be made in this regard. For more detailed information on this issue see the chapter on **Water Consumption in Urban Settlements**.

For more information on programs and initiatives see the *State of the Environment 2003 Supplementary Report.*

[2] *The Murray-Darling Basin, Great Artesian Basin, Otway Basin and Lake Eyre Basin.*

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Northern Adelaide and Barossa Catchment Water Management Board (NABCWMB) (1998). *Groundwater below the Northern Adelaide Plains – a dwindling resource.* Northern Adelaide and Barossa Catchment Water Management Board and Primary Industries and Resources South Australia.

Further information

Department of Water, Land and Biodiversity Conservation
www.dwlbc.sa.gov.au

Catchment Water Management Boards (South Australia)
www.catchments.net

SA Water
www.sawater.com.au

State Water Plan
www.dwlbc.sa.gov.au/publications/waterplan.html

Water Conservation Partnership Project
www.environment.sa.gov.au/sustainability/conservation.html

Creek in the Flinders Ranges
Photo: Kym Nicolson