Department of Water
Government of Western Australia

A fresh future for water

Warren River — Revised management options

Why update the Salinity Situation Statement?

This update of the *Salinity Situation Statement: Warren River (2006)* presents a revised set of salinity management options based on the more recent (2004) land use in the catchment. A marked increase in the area of plantations by 2006 has meant that, with no further action, the projected stream salinity in 2030 has decreased by 100 mg/L Total Dissolved Solids (TDS) from 800 to 700 mg/L (Fig. 1).

Salinity recovery — potable water by 2030

The Warren River (above the Barker Road Crossing gauging station) has a mean annual flow (1993–2004) of 258 GL, making it one of the largest surface water resources in the south-west of Western Australia (Fig. 2). While considered a potential future water resource, the water is currently too salty for human consumption. In 1996, under the Salinity Action Plan, it was made a recovery catchment and the Water and Rivers Commission, now the Department of Water, was asked to work with the community to investigate how salinity could be reduced to potable levels by 2030.

This updated modelling of projected river salinity enables catchment planning to proceed with the most recent and accurate available information. All management options are conceptual only at this stage and much additional work would be done before any on-ground works began.

Before clearing, the river water was fresh, about 120–350 mg/L TDS, but by the 1960s was, on average, more than the 500 mg/L limit for potable supplies.

Key updates:

- The current average annual salinity (1993–2004) is 1015 mg/L (range 717–1570 mg/L), up from the 1990-2001 average of 895 mg/L.
- The salinity of the river at the Barker Road Crossing gauging station is now expected to stabilise at 700 mg/L by 2030 with no additional land-use changes in the catchment and the existing 24 300 ha tree

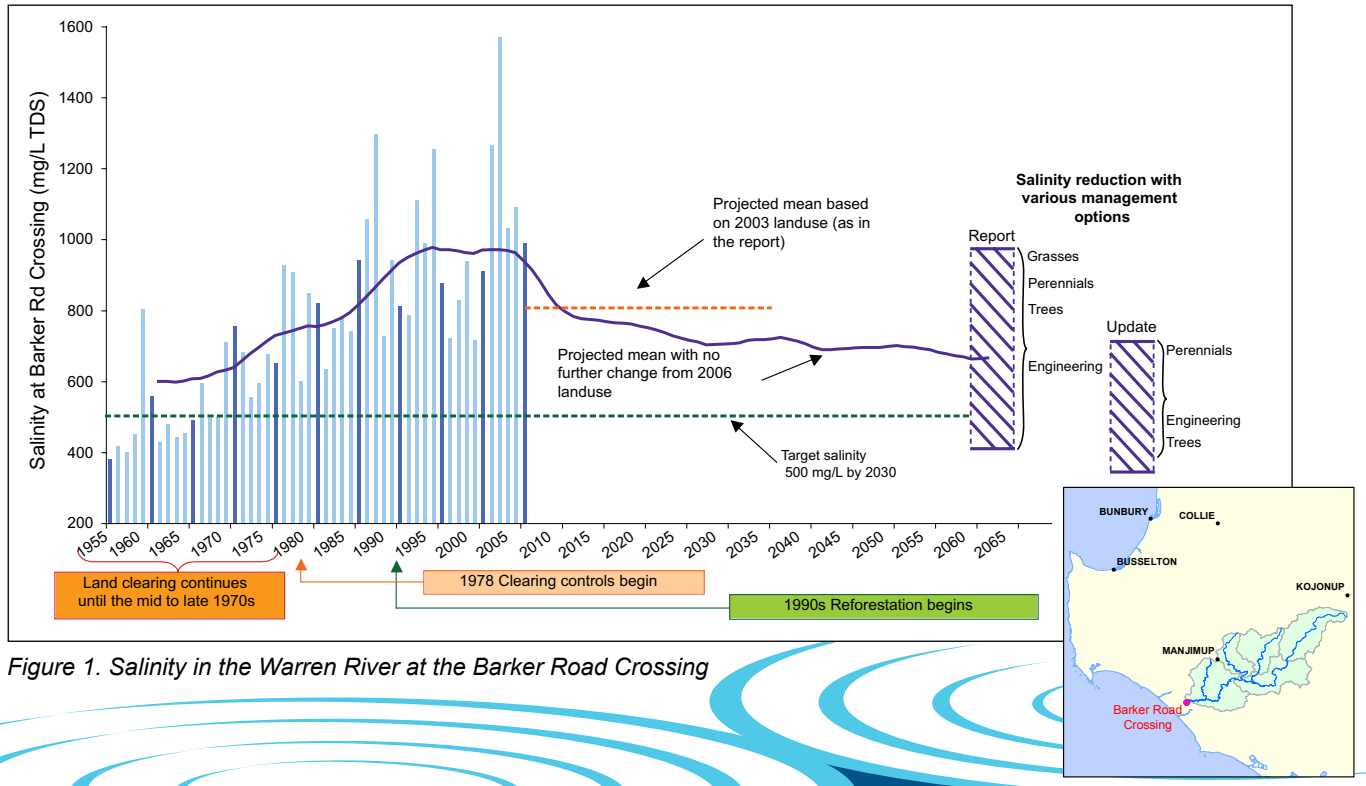

Figure 1. Salinity in the Warren River at the Barker Road Crossing

plantations. This is 100 mg/L less than the previous projection of 800 mg/L, based on 2003 land use with 18 100 ha of tree plantations.

- Using projections from the 2006 land use, the area north-east of the Tone River gauging station would contribute 55% of the catchment's salt load from only 13% of the streamflow (Fig. 2).
- Some intervention will be needed to achieve potable water at Barker Road Crossing; for example, by replanting up to 50% of the cleared land (in 2004) with trees (previously 70% based on 2000 land use) or by diverting 11 GL, or 35% of the flow (previously 100%) of the saline Tone River.

Update since the 2006 report

Revised information results from two major changes:

- using a dynamic model which simulates continual changes in catchment hydrology using daily time steps and that accounts for salt leakage from the soil. The previous modelling assumed that these processes were static over the simulation period.
- including the 8900 ha increase in plantations between 2000 and 2004 (Fig. 3).

Salinity trends in the Warren River

The 2006 report cited that the average annual salinity (1990–2001) was 895 mg/L and increasing. The average annual salinity of the 1993–2004 period was 1015 mg/L. The upper parts of the catchment, above the Tone River gauging station, currently (1993–2004 average) contribute 74% of the salt load in only 17% of the streamflow — a trend which will continue without additional management (Fig. 2).

In the 1970s, the mean salinity of the river water varied from 875 mg/L at the Barker Road Crossing gauging station to 6275 mg/L at the Tone River gauging station. In 1978, concerns that the potable water source might be lost led the Western Australian Government to legislate to extend the powers of the *Country Areas Water Supply Act*, with the introduction of clearing control legislation to prevent additional loss of native forest in the Warren River catchment area.

Plantations established since the 1990s have reduced the cleared area above the Barker Road Crossing from a maximum of 1230 km^2 (or 30% of the area) to 960 km^2 (or 24%) in 2006. While there was a short-term increase in salinity, the long-term annual average salinity will decrease due to these plantations.

Tree planting has generally been in the higher rainfall areas in the western parts of the catchment, with areas west of Tonebridge being 67–97% forested as compared with the drier areas such as Upper, Middle, Lower Tone with only 17–46% tree cover (Fig. 3). This is reflected in salt loads associated with the salinity projection in Figure 2 and needs be considered when applying suitable management options to the catchment.

Revised management options

Despite the beneficial effects of recent tree plantations, the salinity in the Warren River at the Barker Road Crossing gauging station is projected to stabilise at 700 mg/L TDS by 2030. So additional intervention via increased land use changes or engineering works will be required in order to meet the 500 mg/L target (Fig. 1). The management options in the tables are compared to the 2004 land-use, or base case scenario. There are other management options however, that would lead to greater reductions in salinity. Some of these options are included in the list below.

To reach 600 mg/L

Three management options that would reach the target of 600 mg/L:

- Plant 9200 ha trees north-east of the 600 mm rainfall isohyet together with 3800 ha of perennial pastures across the catchment.
- Plant 13 200 ha of trees north-east of the 600 mm isohyet, 1900 ha in the south-west and establish 3700 ha of perennial pastures across the catchment.
- An engineering option is to pump groundwater from 157 bores at 15 kL/day in the north-eastern part of the catchment.

To reach 500 mg/L

Two options that would reach the 500 mg/L target:

- Plant 27 100 ha trees north-east of the 600 mm rainfall isohyet, 1900 ha of trees in the south-west together with 3700 ha of perennial pastures across the catchment.
- Divert 11 GL of highly saline water from the Tone River annually. Pump the water when the river salinity exceeds 3200 mg/L at the Tone River gauging station.

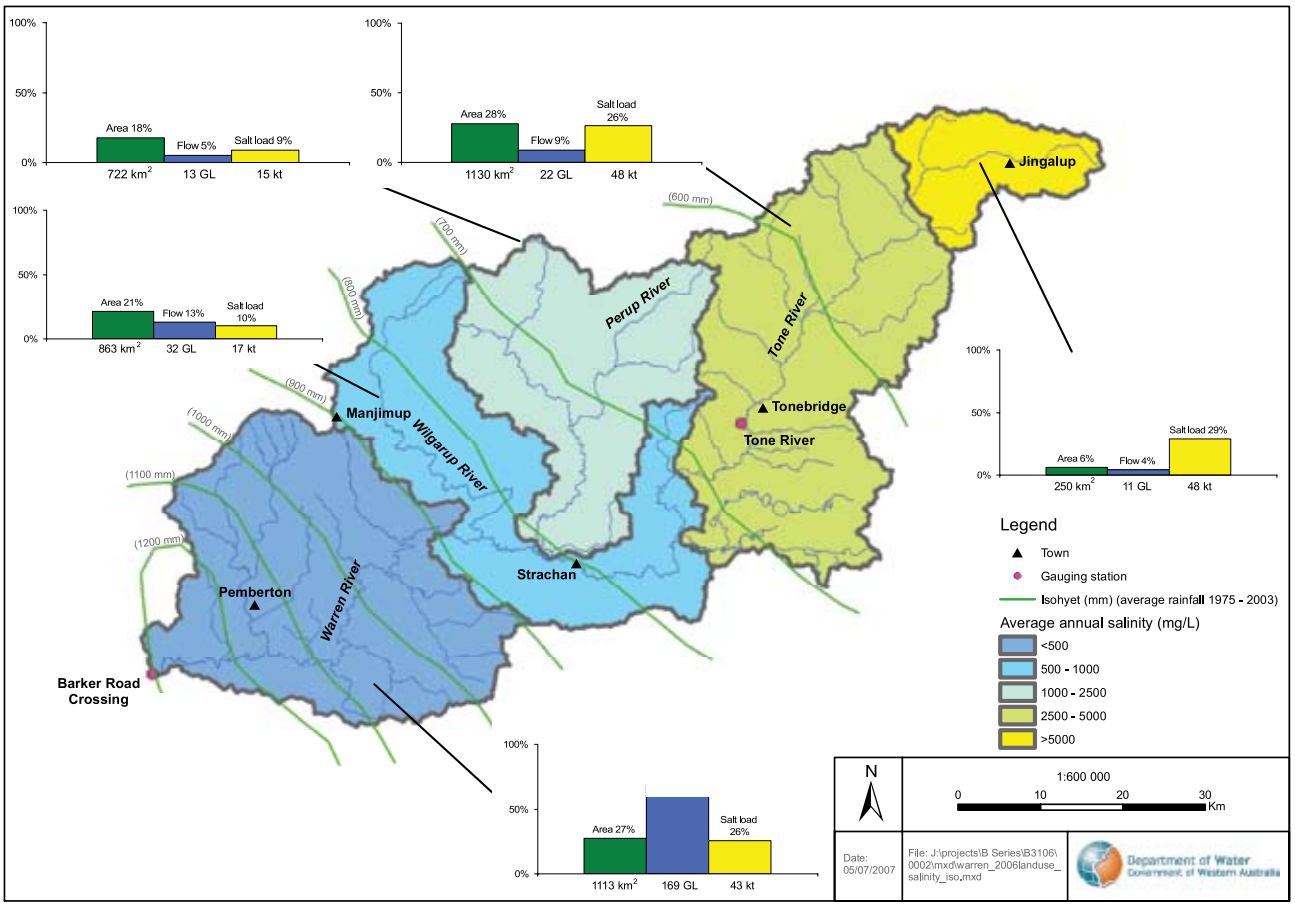

Figure 2. Projected average annual salinity, streamflow and salt load contributions to the Warren River based on 2006 land use.

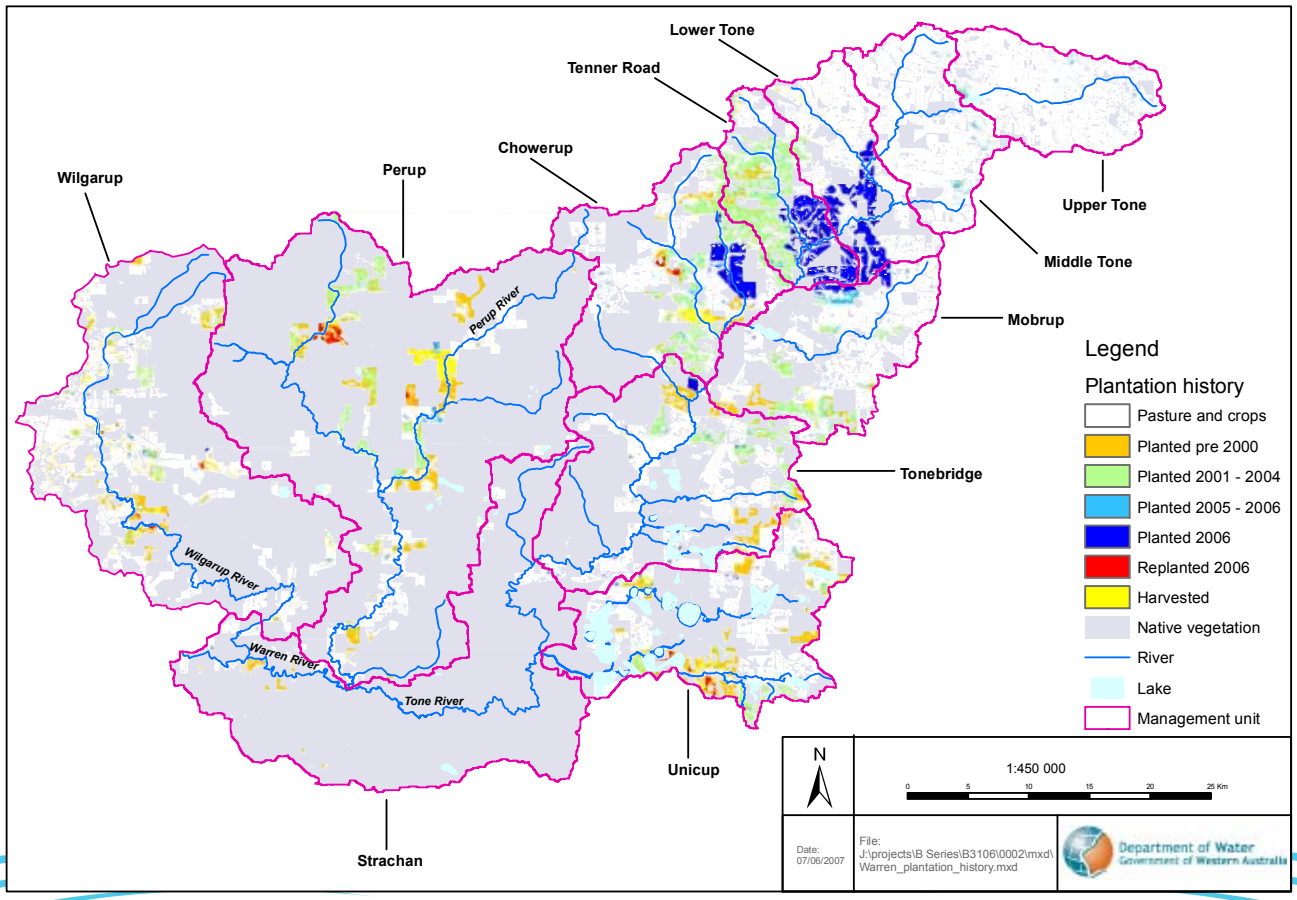

Figure 3. Plantation history

How effective are management options expected to be?

Of the land remaining cleared in 2004, nearly 50% is estimated to be suitable for some form of tree plantation. However, suitability for commercial forestry within these areas varies and more detailed work is needed to better resolve the capabilities of the land.

Table 1. Summary of average projected salinity, streamflow and salt load (2025–36) for revised revegetation management options

Revegetation management option *Applied to 2004 land use*	**Comments**	**Cleared land (2004) replanted**		**At Barker Road Crossing gauging station**		
				Salinity	*Streamflow*	*Salt load*
		(km^2)[a]	*(%)*	*(mg/L)*	*(GL)*	*(kt)*
'Base'	2004 land use	0	0	760	250	190
Commercial trees						
2006 land use		55	7	700	245	170
Bluegums and sawlogs	Bluegums 3% & sawlogs 9% on suitable land	97	12	685	245	165
Bluegums and sawlogs	On suitable land, but not sited by land capability	381	48	450	230	105
Perennial pastures						
	Variations of LAI[b] include: constant LAI, winter peak cycle and summer peak cycle					
Deep rooted	On suitable land	97	12	680–710	245–250	165–175
Shallow rooted	On suitable land	244	31	625–700	240–245	150–170

a Area conversion: 1 km^2 = 100 ha

b Leaf area index (LAI) is used as a proxy for water use and is the total area of leaves divided by the area occupied by the plants. Perennial pastures and trees use more water for more of the year than the annual pastures on the cleared land.

Barker Road Crossing looking upstream

Table 2. Summary of average projected salinity, streamflow and salt load (2025–36) for engineering management options

Engineering management option *Applied to 2006 land use*	**Comments**	**Volume of water pumped or diverted** *(GL)*	**At Barker Road Crossing gauging station** *Salinity (mg/L)*	*Streamflow (GL)*	*Salt load (kt)*
2006 land use			700	245	170
Groundwater pumping					
	15 kL/day/bore from 157 bores above Tenner Road management unit	1	600	245	145
Diversion of saline water (at Tone River)					
	Pipehead dam (20% of salt load diverted)[a]	4	635	240	155
	Pipehead dam (30% of salt load diverted)[b]	7	600	240	145
	Pipehead dam (57% of salt load diverted)[c]	11	500	235	120
	Full diversion	31	355	215	75

a 27 ML/day pumping capacity and no salinity threshold
b 46 ML/day pumping capacity and no salinity threshold
c 246 ML/day when salinity above a 3200 mg/L threshold

A partnership approach

In November 1997 the Water and Rivers Commission established a local Recovery Team that encourages full stakeholder involvement and fosters partnerships between state government agencies, NRM groups, local government, industry, research institutions, local community groups and catchment landholders to achieve the water quality target.

The Warren Recovery Team is an active partnership between the community of the Tone River and Perup River subcatchments and key government agencies. The role of the Team is to bring parties together at the local level and implement the 2000 State Salinity Strategy recommendations for the Warren River. The Team is a non-statutory, non-incorporated decision-making group.

The Team has strong community representation with six well-recognised landholders from the upper catchment and locally-based representatives from the State's major Natural Resource Management agencies: the departments of Agriculture and Food, Environment and Conservation and Water. The Chairperson is Mr Chris Evans from Mobrup and executive support is provided by the Department of Water.

The Recovery Team's vision is 'The Warren River catchment has a healthy, productive and profitable environment, capable of sustaining a diversity of human activities and values and of generating potable water and a range of other products.'

Where to from here?

This update focuses on conceptual salinity reduction options — to understand the extent of the land-use changes required to achieve the salinity target. The first step in the recovery approach (Fig. 4) was the Salinity Situation Statement. With new modelling methods and the great increase in plantation area between 2003 and 2006, updated projected salinities associated with various management options were required before commencing the next step.

More work will be done on the effectiveness of perennial pastures in this landscape. The benefits of perennial pastures and commercial tree plantations will be analysed and take into account the increased value of less saline water. The lower the salinity the more valuable the water is to irrigators, industry, and potable water suppliers.

The new information will be used in the evaluation of the management options. In this step, water quality objectives are defined and, in consultation with key stakeholders, scenarios to meet these objectives will be evaluated considering social, economic and environment aspects. Additional and more detailed modelling will be used. In the 'Recovery Plan' step the major components of management options to be implemented are identified, an implementation strategy developed and funding sources identified.

The final step will be to implement this plan and to recover this major river from salinity.

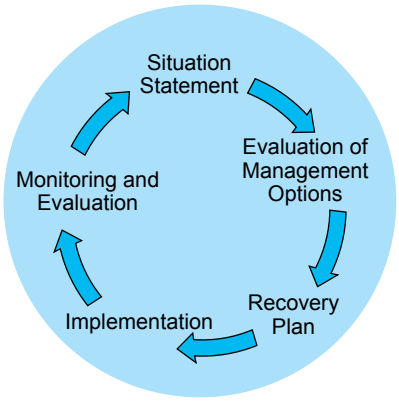

Figure 4. The recovery approach

Tone Bridge

Where can you go for more information?

For more information contact John Platt, Department of Water, Bunbury on (08) 9726 4119 or email john.platt@water.wa.gov.au

For copies of the *Salinity Situation Statement: Warren River* report (WRT 32) contact 6364 7800

Copies of this brochure are available at www.water.wa.gov.au

The Warren Salinity Situation Statement update – revised management options report is in press.

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