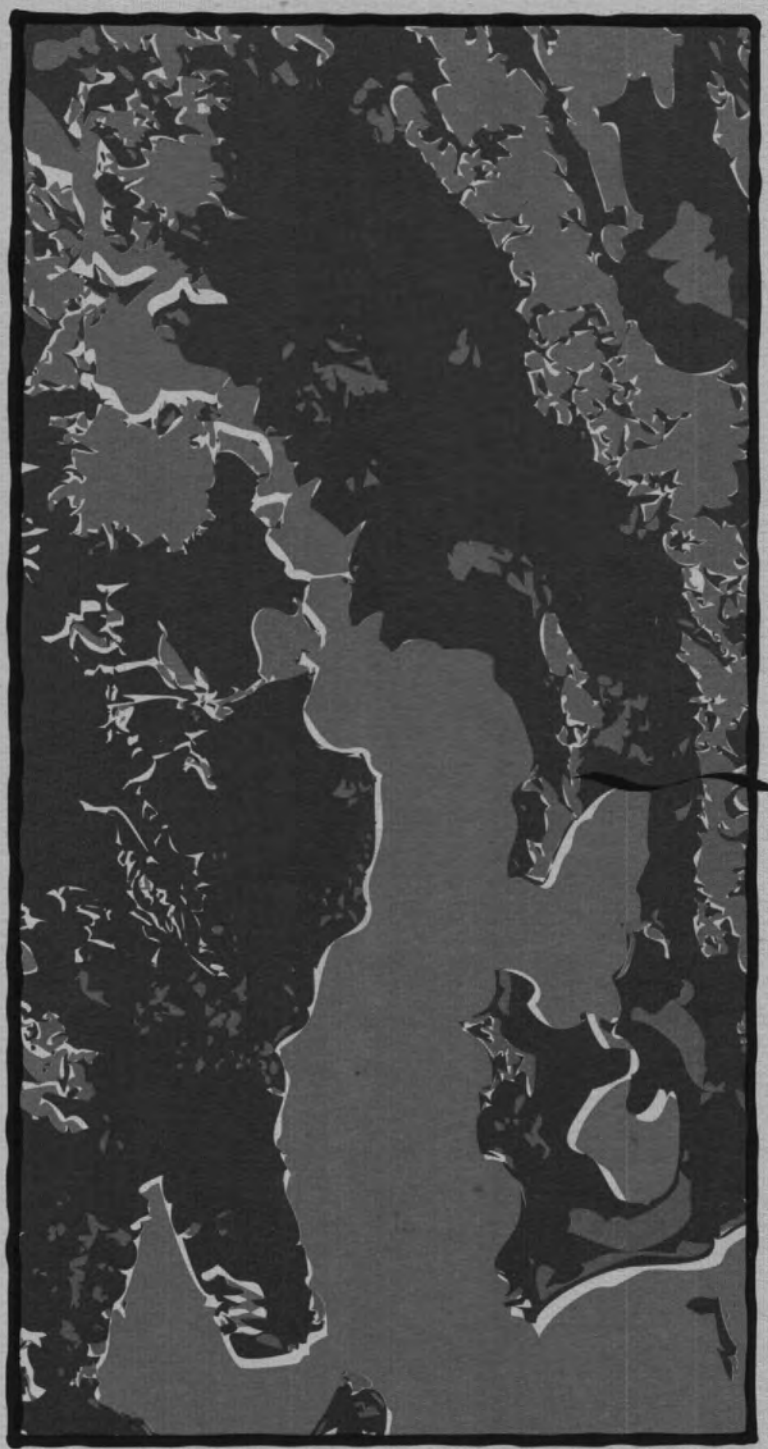
*supervising scientist report* 129



# State of the Derwent Estuary

**Christine Coughanowr**

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Tasmania

*supervising scientist report* 129

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## A review of environmental quality data to 1997

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- to undertake a series of capital works projects designed to reduce or remove significant historical sources of pollution;
- to invest in mechanisms that will provide for sustainable environmental improvement, beyond the completion of the capital works program;
- to develop practical and innovative mechanisms for improving environmental conditions which can be transferred to other areas of Tasmania and other Australian States;
- to produce public education/information materials.

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# Executive Summary

This report, prepared as an initial project of RiverWorks Tasmania, is a compilation and synthesis of existing information about the Derwent Estuary and was prepared to help identify significant pollution sources and evaluate proposed remediation works. The report provides a brief overview of the Derwent's physical setting and uses, identifies and quantifies major pollutant inputs, and reviews and synthesises environmental quality data on water, sediments and biota.

The Derwent is a relatively deep, microtidal estuary, which is highly stratified in its upper reaches, and well-mixed in its broad, lower reaches. Estuarine circulation is characterised by a relatively short residence time (approximately 2 weeks) and a large and consistent freshwater input from the Derwent River. Freshwater surface flows tend to flow along the eastern shoreline, and saline bottom water travels slowly up-river. The Derwent is affected by strong seasonal influences: temperatures, coastal currents, winds and other factors which ultimately affect water quality. The Derwent River catchment is very large and sparsely populated. Water quality from the catchment is generally good; flows are controlled for hydropower generation.

The Derwent, together with Mt Wellington, provide the focal point for Tasmania's capital city. The estuary is heavily used for recreation, marine transport, boating and fishing, and is internationally known as the venue for the Sydney-to-Hobart Yacht Race. The Derwent is Tasmania's third largest port, and supports two large metal and wood-processing industries. Despite existing degradation, the estuary is an important and productive ecosystem and was once a major breeding ground for the Southern Right whale.

Contaminants enter the estuary from a variety of sources. Point sources include 13 sewage treatment plants and two large industries (a paper mill and zinc refinery), while diffuse sources include urban runoff, tips and contaminated sites, catchment inputs carried by the Derwent and Jordan Rivers, and atmospheric contributions. Some pollutants may also be derived from contaminated sediments within the estuary itself. Contaminants associated with these sources include pathogens, nutrients, biochemical oxygen demand (BOD), total suspended solids (TSS), heavy metals, fluoride, arsenic and resin acids. There have been significant decreases in most end-of-pipe emissions over the past 5 to 10 years - particularly as a result of sewage treatment plant upgrades and improved treatment of wastewater from Australian Newsprint Mills - Boyer (ANM) and Pasminco Metals Hobart (Pasminco). At this point, the remaining of end-of-pipe emissions are derived primarily from ANM (BOD, TSS, resin acids) and from sewage treatment plants (nutrients, BOD). Significant diffuse source inputs also enter the estuary, particularly from urban runoff (sediments, pathogens and hydrocarbons) ground-and surface-water emissions from tips and contaminated sites (particularly heavy metals from Pasminco) and the catchment as a whole (nutrients and sediments).

There have been some improvements in the water quality in the Derwent over the past 10 years, as a result of reduced end-of-pipe emissions from sewage treatment plants and industries. Median faecal coliform levels, for example, have decreased markedly, particularly in the middle reaches of the estuary. Some improvements in sediment quality have also been reported, including a reduction in sludge-affected areas downstream of ANM, and a decrease in some of the extreme heavy metal concentrations in sediments off Pasminco. In many

respects, however, the Derwent remains a highly degraded estuary - and it is difficult to predict if or when it will fully recover.

***Heavy metals*** - particularly zinc, cadmium, lead and mercury - are the most severe and persistent problem, with concentrations in water, sediments and shellfish among the highest in Australia. Shellfish collected from most areas of the Derwent - particularly above the Tasman Bridge, the Eastern Shore and Ralphs Bay - should not be eaten. Human health issues aside, heavy metals undoubtedly also have significant toxic effects on the ecosystem, although this has not been quantified. Most troubling is the lack of substantial decreases in metal concentrations in sediments or biota, despite significant end-of-pipe improvements over past 20 years. It is unclear if this is due to continued diffuse source emission of heavy metals or to contaminated sediments continuing to release these metals over time.

There have been some clear improvements in contamination of waters by ***pathogens*** (faecal indicator bacteria), however, several embayments in the upper and middle estuary still do not meet ANZECC guidelines for primary contact recreation, particularly at Jordan River, Windemere Bay, Elwick Bay, New Town Bay, Prince of Wales Bay and Browns River. The largest contributor of faecal bacteria to Derwent in 1996 was untreated sewage discharged from the Sandy Bay outfall. In early 1997, this outfall was connected to sewer, resulting in a 500-1000 fold decrease in the bacterial load discharged to the Derwent from sewage treatment plants. Remaining sources of faecal bacteria include urban stormwater, agricultural runoff, sewage spills and poorly treated sewage from other sources.

***Suspended solids and organic matter*** are discharged to the Derwent via both natural and anthropogenic (human) sources. The main anthropogenic source of these contaminants is the ANM paper mill at Boyer. Direct effects include the accumulation of sludge, depressed dissolved oxygen levels, and impoverished benthic communities. With the advent of primary treatment in 1988, sludge-affected areas appear to be decreasing and there have been some improvements in benthic faunal communities. However, large areas of the estuary remain affected

The Derwent does not experience recurrent nuisance algal blooms, despite relatively elevated concentrations of ***nutrients*** in the middle and lower reaches of the estuary. These nutrients are derived predominantly from sewage and from seasonal influxes of nutrient-rich Southern Ocean waters to the estuary. Chlorophyll *a* concentrations (a measure of phytoplankton biomass) are typically low to moderate, with slightly higher values recorded in the middle reaches of the estuary, particularly in Prince of Wales Bay. This lack of phytoplankton response to available nutrients remains an unresolved puzzle - The Derwent may be physically unsuited to algal blooms (rapidly flushed, cold water, limited light availability), or alternatively, algal growth may be inhibited by some natural or anthropogenic substance or process (e.g. humic/fulvic acids, heavy metals, grazing by zooplankton). The upper estuary, in contrast to the middle and lower reaches, shows extremely low concentrations of orthophosphate at all times (< 2 µg/L), and algal growth in this area could potentially be phosphorus-limited.

Other environmental quality issues in the Derwent include toxic effects of ***resin acids*** on fish in the upper estuary. At present, resin acid concentrations within ANM's effluent plume exceed recommended thresholds for sensitive species for a distance of approximately 2 kilometers below the outfall. ***Hydrocarbons*** in sediments have been monitored in a few areas of the Derwent and were found to be elevated at sites in the upper estuary and several

embayments. ***Polycyclic aromatic hydrocarbons*** (PAHs) have only been measured in one embayment (Prince of Wales Bay) and were also found to be high. Few data are available for ***organochlorine pesticides, phenolics*** or ***polychlorinated biphenyls*** (PCBs). Severe ***sedimentation*** has also been identified as a problem in several embayments, particularly in New Town Bay.

***Introduced species*** and their effect on the Derwent's ecosystem have been identified as an issue of concern, particularly the northern Pacific seastar. This predator has colonised large areas of the Derwent, dramatically reducing the numbers and species of other benthic organisms. Blooms of the toxic dinoflagellate (*Gymnadium catenatum)* have also been observed in recent years.

***Wetlands*** and ***seagrass beds*** are vital components of the Derwent's ecosystem, however, little information is available about these ecosystem types, their distribution or condition. It has been reported that approximately 400 ha of seagrass beds have disappeared from Ralphs Bay during the past 50 years, and large wetland areas in the upper estuary have also suffered recent degradation (e.g. Murphys Flat).

Despite significant improvements in industrial and sewage emissions over the past 10 years, the Derwent remains a significantly degraded estuary - particularly with respect to heavy metals. Recently completed and planned improvements (specifically connection of the Sandy Bay outfall to Selfs Point, rehabilitation of the Loogana jarosite dump at Pasminco, and secondary treatment of ANM's effluent) are expected to improve the situation over the next 10 years, although long-term effects of sediment contamination are unknown. It is clear, however, that as point sources are progressively upgraded, the remaining diffuse sources will gradually predominate. These diffuse sources - urban and agricultural runoff, atmospheric inputs, ground-water contamination - are difficult and expensive to remediate and will require a strategic planning approach at a whole-of-catchment scale to resolve.

# CONTENTS

**Figures**

**Tables**

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