

# Workshop on Environmental Water Requirements for Australian Estuaries

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## Outcomes and Future Directions

**Report to**

**Environment Australia**

**By**

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## 1 Introduction

The environmental water requirements of aquatic systems has emerged as a key issue in Australian natural resource management over recent years. Despite the recent attention that this area is beginning to attract amongst the scientific community and resource managers, including a number of comprehensive studies, environmental flows and the effect they have on aquatic systems are not fully understood. This is particularly the case for estuaries. Filling the knowledge gap of environmental water requirements for estuaries is a critical part of developing good water management practices for these systems.

So how can resource managers determine appropriate environmental water requirements for Australian estuaries? And what kind of methodology can resource managers use to determine these flows? Is there a model that is applicable to all Australian estuaries? And what are the information gaps and impediments to measuring and implementing environmental flow requirements of estuaries

These questions have been addressed in a report recently released by Environment Australia "Environmental Water Requirements to Maintain Estuarine Processes" (Peirson et al., 2002). The report was launched at a Workshop on 30th May 2002, held at the Water Research Laboratory, the University of New South Wales, King St, Manly Vale, Sydney.

The Workshop allowed an opportunity for the report's first author, Bill Peirson, to present a summation of the recommended approach. Other speakers presented perspectives on water and estuarine management from different levels of government and community groups. The focus of the Workshop later shifted onto future directions.

This report summarises the presentations from the Workshop, and suggests some possible future directions for management of environmental flows in Australian estuarine environments.

A web copy of full report available at  
<http://www.ea.gov.au/water/rivers/nrhp/estuarine/index.html>

A hard copy of the report is available on request.

Please contact: Environment Australia. Community Information Unit: ph 1800 803 772

## 2 Background

In 1999 EA commissioned three investigations into water requirements for three areas that had received less attention than non-tidal rivers, especially rivers below dams. The three areas were: wetlands of high importance, groundwater dependent systems, and estuaries. EA also has a wider national programme of NHT funded environmental flows investigations.

EA was seeking to find those estuaries that were at threat by changes to flow regime, and to develop a method whereby the environmental water requirements of estuaries could be assessed. The Water Research Laboratory were contracted to conduct the estuarine environmental flows study (Peirson et al., 2002).

The report by Peirson et al. (2002) acknowledged the existence of many knowledge gaps. In attempting to provide some future directions for estuarine water management, advice is given on how to close these gaps. The States have recently been addressing imperative estuary water management problems, and there are specific issues relevant to the various states. This report provides edited summary papers of the situation in South Australia, New South Wales, Tasmania and Queensland (whose representatives presented papers at the Workshop) as well as an attachment (Annex A) outlining the Natural Heritage Trust extension arrangements. The Workshop also included a presentation by the Independent Chair of the NSW Coastal Council (Prof Bruce Thom).

The Workshop was important not only as a vehicle for the launch of the report by Peirson et al. (2002), but also because it provided an opportunity for a gathering of those working in the relatively new field of estuary environmental water management.

### **3 Environmental water requirements to maintain estuarine processes (based on summary in Peirson et al. 2002)**

Peirson et al. (2002) presents and explains a method of determining appropriate levels of environmental flows to Australian estuaries. In this context, environmental flows are that component of the flow regime maintained solely for environmental reasons, to maintain the health and biodiversity of a particular waterbody.

Estuaries are the downstream reaches of rivers where they enter the coastal ocean and are influenced by tidal motions. The upstream catchment supplies an estuary with fresh water which mixes with salt water entering from the sea. The physical, chemical, sediment, water quality and ecological processes within estuaries are complex, involving dynamic mixing processes, stochastic influences, strong antecedent effects, and numerous ecological linkages.

The objectives of Peirson et al. (2002) were to:

- a) Provide a methodology to identify those estuaries in Australia that are threatened by current or future changes to the fresh water flow regime;
- b) Develop a method for determining appropriate environmental flows that will protect these estuaries against decline in their ecological character;
- c) Identify information gaps in determining environmental flow requirements of estuaries;
- d) Identify the requirements for measuring the effectiveness of environmental flow allocations to estuaries; and,
- e) Identify the practical limitations and opportunities available for implementation of environmental flows to these systems.

Objectives (a) and (b) were achieved by:

1. Developing a checklist of major ecological processes by which changes to estuary fresh water inflows may cause impacts on estuarine ecosystems and the adjacent marine environment; and,
2. Providing a systematic, multidisciplinary adaptive management methodology that uses the checklist to ensure to assess the risk to the estuarine ecosystems associated with reduced fresh flows to estuaries.

The checklist was adapted and expanded from Bishop (1999) who developed a checklist based on a literature review (which strongly relied on the review of Drinkwater and Frank, 1994) and was presented in terms of three ranges of estuarine fresh water inflow:

#### **Low magnitude inflows (Low-):**

- Low-1: increased hostile water-quality conditions at depth
- Low-2: extended durations of elevated salinity in the upper-middle estuary adversely affecting sensitive fauna
- Low-3: extended durations of elevated salinity in the upper-middle estuary adversely affecting sensitive flora
- Low-4: extended durations of elevated salinity in the lower estuary allowing the invasion of marine biota

- Low-5: extended durations when flow-induced currents cannot suspend eggs or larvae
- Low-6: extended durations when flow-induced currents cannot transport eggs or larvae
- Low-7: aggravation of pollution problems
- Low-8: reduced longitudinal connectivity with upstream river systems

**Middle and high magnitude inflows (M/H-):**

- M/H-1: diminished frequency that the estuary bed is flushed fine sediments and organic material (physical-habitat quality reduction)
- M/H-2: diminished frequency that deep sections of the estuary are flushed of organic material (subsequent water quality reduction)
- M/H-3: reduced channel-maintenance processes
- M/H-4: reduced inputs of nutrients and organic material
- M/H-5: reduced lateral connectivity and reduced maintenance of ecological processes in waterbodies adjacent to the estuary

**Across all inflow magnitudes (All-):**

- All-1: altered variability in salinity structure
- All-2: dissipated salinity/chemical gradients used for animal navigation and transport
- All-3: decreases in the availability of critical physical-habitat features, particularly the component associated with higher water-velocities

The methodology was developed from literature review of the (limited) studies undertaken overseas as well as experience with investigations on the Richmond River, New South Wales (Peirson et al., 1999). The method proposes two phases of investigation: preliminary evaluation and detailed investigation.

Once the preliminary evaluation of different estuaries has been completed, the estuaries should be able to be categorised according to risk from reduced fresh water inflows.

The methodology is presented as a single pass process. However, because relevant information is often limited, it may be necessary to repeat steps of the methodology when better information becomes available.

The structure of the methodology is as follows:

**Preliminary Evaluation Phase**

- PEP Step 1: Define the environmental flow issue to be investigated.
- PEP Step 2: Assess the value of the estuary
- PEP Step 3: Assess changes to inflow
- PEP Step 4: Assess the vulnerability of the estuary.

**Detailed Investigative Phase**

- DIP Step 1: Examine the likely impact of current water use on transport, mixing, water quality and geomorphology using catchment runoff and estuarine flow models
- DIP Step 2: Define environmental flow scenarios for the estuary
- DIP Step 3: Use the established models to assess the impact of proposed scenarios.
- DIP Step 4: Assess the risk to estuarine biota

- DIP Step 5: Licensing and development approval
- DIP Step 6: Adaptive Management

Upon completion of the assessment for a given estuary, the impacts of changed development scenarios can be assessed by repeating DIP Steps 2 to 6.

The information and measurements required to set flow requirements are documented in Peirson et al. (2002). If undertaken in an appropriate way, these data will also allow the effectiveness of environmental flow allocations to estuaries to be assessed.

Quality physical, chemical, water quality and ecological data for estuarine systems is fundamental to robust predictions of appropriate environmental flows and review of implemented fresh water flow regimes.

The collection and facilities of the Water Reference Library were found to be invaluable to the preparation of Peirson et al. (2002). It is important that all documents, data and models relevant to individual Australian estuaries be assembled within reliable archives and properly maintained.

The practical limitations and opportunities available for implementation of environmental flows to estuarine systems are discussed within Peirson et al. (2002).

At present, there appears to be limited communication between estuary managers at Australian State and Federal level. It is recommended that an appropriate forum be developed to improve communication between these agencies.

According to Peirson et al. (2002), the best test of the adequacy and robustness of the checklist and methodology would be a trial determination of appropriate environmental flows for an Australian estuary. Peirson et al. (2002) recommends that this be commenced as soon as possible.

## **4 Environmental water requirements for Tasmanian estuaries**

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### **Background:**

- The Tasmanian government's vision is to double the value of primary industry production by the year 2008 including aquaculture and fisheries, but excluding forestry and mining.
- To meet this vision a Water Development Plan for Tasmania was launched in August 2001. The plan identifies water development opportunities and emphasises the need to advance this development to meet Tasmania's economic and social objectives.

- The Water Development Plan identifies that specific opportunities exist through increased availability and reliability of irrigation water supplies throughout Tasmania.
- One outcome is that many sections of the Tasmanian farming community now believe that collecting and storing water for irrigation is essential to ensure the long-term viability of their properties.
- This process of “drought proofing” is being vigorously pursued through a program of water abstraction to offstream storage or through construction of instream dams.
- In the past, environmental water requirements for estuaries has been largely ignored, with an assumption being held that those Water Provisions determined for rivers would allow adequate water for estuarine and near-coast systems.
- Colin Shepherd, Senior Environmental Officer for Marine Environment Section, DPIWE was responsible for putting together the examples of estuarine studies that are given here.
- The *Water Management Act 1999*
- the *Act* recognises the “environment” as a legitimate user of water
- Encompassed within the Act is the provision for issuing of licenses for: water allocations, water diversions, approval for dam building (both on- and off-stream)
- The *Act* also provides for management of the State's groundwater resources

**The Marine Environment concerns focus on:**

- Increasing pressures facing aquatic ecosystems that are forced to absorb the potential loss of both base flows and flood flows from dam construction and water abstraction with unknown consequences.
- The effect these reduced flows have on downstream processes is largely unknown, especially on estuarine systems.
- There is a need for greater consideration of estuarine systems during the assessment of water licences and dam applications

**Tasmanian estuaries relatively well studied:**

- Koehnken (1986) - Macquarie Harbour study
- Pirzl and Coughanowr (1997) - Tamar Estuary study
- Derwent Estuary Program 1999-2002
- Edgar *et al* (2000) - Classification of Tasmanian estuaries
- Huon Estuary Study 2000. Undertaken in southern Tasmania from 1996-1999. This study investigated the interplay of human activity and natural processes upon the waterway. The projects aims and objectives were to:
  - Determine the sources, distribution and cycling of nutrients. Trace the links between nutrients and algal blooms.
  - Evaluate the processes such as fish farming and rainfall that contribute organic matter to sediments.
  - Determine the distribution and composition of organic material beneath fish cages.
- Monitor environmental quality.
- Barrett *et al* (2001) - Mapping of inshore marine habitats

- Murphy *et al* (In prep) Estuarine Health in Tasmania (Tasmanian component of National Land and Water Audit)

**Only two environmental flow studies undertaken:**

- Davies and Kalish (1994) examined effects of upstream storages on the flushing of the Derwent Estuary
- Davies *et al* (2002) investigated specific flow requirements for upper Derwent Estuary through modelling examining relationship between flows and ecosystem functioning

**Other environmental flow programs in Tasmania:**

- Setting of minimum environmental flows is underway for rivers using a range of methodologies including rapid desktop, holistic, and habitat-based assessment, mainly using IFIM.
- By ignoring estuarine flow requirements it has been largely assumed that the minimum flows determined for rivers would protect downstream estuarine processes.
- There is now growing recognition that estuaries need separate environmental flow assessments, with a need for a flow regime.

**Future plans:**

- To develop a separate process of assessing Environmental Water Requirements for Tasmanian estuaries to be incorporated into future Water Management Plans.
- Better communication and information exchange between estuarine and freshwater ecologists, recognizing the river continuum to the estuary and near coast environments.
- An effort is currently being made to bring the Marine Resources and Water Resources Divisions together to help progress determination of environmental flows for estuaries.

## **5 Environmental water requirements for NSW estuaries**

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**Introduction**

This paper is a general overview of estuaries in NSW and how they are managed. It also provides an update on developments with environmental flows and water sharing plans.

## **Background**

NSW has over 130 estuaries, located within 12 coastal water management areas. NSW estuaries have a diverse range of environmental, social and economic values. Many of these values may be influenced by freshwater inflows.

## **Classification of Estuaries**

- NSW estuaries come in a range of shapes and sizes.
- The climate is temperate.
- Classified as wave-dominated, barrier estuaries with a low tidal range.
- The north coast tends to have large mature rivers and smaller coastal creeks and lagoons.
- The central coast has lakes and drowned river valleys.
- The south coast is characterised by Intermittently Closed and Open Lakes and Lagoons with smaller catchments.

## **Condition**

- The NLWRA has classified estuaries from near pristine to severely modified.
- Unfortunately, NSW has a high percentage of modified or severely modified estuaries when compared to the National average:
  - 10% near pristine
  - 38% slightly modified
  - 26% modified and
  - 26% severely modified

## **Water use**

- Coastal water management areas have been divided into 470 sub-catchments.
- Sub-catchments were classified as having high, medium or low hydrologic stress by the Stressed Rivers Assessment Reports 1999.
- Approx 30% of sub-catchments were classified as “high stress” based on irrigation demands on low flows.
- 15% have a high conservation classification.
- The condition of many of the smaller coastal sub-catchments remain unresolved due to a lack of information.

## **Administration**

- Historically, administrative responsibility for estuaries has been separated from water resource management.
- There are three relevant planning approaches:
  - Estuary management focused on the coastal zone,
  - Water management, traditionally focused on river flows and water allocations, and
  - Catchment management.

## **Estuary management process**

- Establishes Estuary Management Committees under the NSW Coastal Policy.

- Identifies future direction for estuary planning, conservation, restoration, public access and amenity.
- Coastal focus, local scale, and consensus based.
- Staged approach with scientific investigations linked to issues of concern.

### **Water management**

- Establishes regional Water Management Committees under the Water Management Act 2000.
- Consensus based with Ministerial appointments.
- Establish rules for sharing water between the environment and water users, and between competing water users.
- Plans are gazetted and have legal standing for 10 years.

### **Water sharing plans**

Water Sharing Plans are a specific type of management plan that can be prepared under the Water Management Act 2000. Water Sharing Plans are designed to establish:

- environmental water rules
- requirements for basic landholder rights
- requirements for water extraction under access licences
- bulk access regime for extraction licences.

Water Sharing Plans establish environmental water rules for an area or sub-catchment in relation to the following three classes of environmental water:

- environmental health water
- supplementary environmental water
- adaptive environmental water

Environmental health water is water that is committed for fundamental ecosystem health at all times, and may not be taken or used for other purposes.

Supplementary environmental water is water that is committed for specified environmental purposes at specified times or in specified circumstances, but may, at other times and in other circumstances, be taken and used for other purposes.

Adaptive environmental water is water that, pursuant to an access licence, is committed for specified environmental purposes, either generally or at specified times or in specified circumstances.

Water Sharing Plans must recognise and be consistent with the following priorities:

(a) sharing of water from a water source must protect the water source and its dependent ecosystems,

(b) sharing of water from a water source must protect the basic landholder rights of owners of the land, and

Sharing or extraction of water under any other right must not prejudice the principles set out in paragraphs (a) and (b).

A Water Sharing Plan, which will have a life of 10 years, may also contain provisions dealing with:

- preservation and enhancement of the quality of water in the water source in the area,

- monitoring and reporting requirements that should be imposed as conditions of approvals having effect within the area,
- conditions to which access licences and approvals having effect within the area are to be subject (mandatory conditions), and
- indicating the circumstances in which, the matters in respect of which and the extent to which the plan may be amended by the Minister during the period for which it is in force.

In respect of the bulk access regime, the Water Sharing Plan:

- must recognise and be consistent with any limits to the availability of water that are set in relation to the water sources to which the regime relates,
- must establish rules according to which access licences are to be granted and managed and available water determinations to be made,
- must recognise the effect of climatic variability on the availability of water, and
- may establish rules with respect to the priorities according to which access licences are to be adjusted as a consequence of any reduction in the availability of water.

#### **Current situation**

- The initial rounds of water sharing plans have focused on inland rivers and “high stress” sub-catchments east of the divide.
- 17 coastal Water Sharing Plans are currently on exhibition and can be viewed on [www.dlwc.nsw.gov.au](http://www.dlwc.nsw.gov.au).
- Next round of water management plans will focus on broader catchment objectives including estuaries.

#### **Issues**

- Lack of appreciation of the importance of freshwater flows to estuaries within managers and community.
- NSW has a limited information base on estuarine processes and ecosystems.
- Discharge information on unregulated coastal streams is limited.
- Significant proportion of water extraction may be unlicensed and volumes are unknown.
- Translating the rhetoric and policy advice into practical outcomes and justifiable water sharing rules.

#### **Reaction to report by Pierson et al. (2002)**

- Pros
  - raises profile and awareness of issues
  - establishes initial classification of water use
  - provides useful methodology for discussion
  - identifies information gaps
- Cons
  - limited information base and high level of uncertainty
  - resource requirements for investigations
  - time frames for second stage

- level of community and stakeholder involvement in determining flows

### **Gaps**

- NSW does not have the information required to determine environmental flows at this stage. Gaps exist with respect to:
  - unlicensed extraction
  - discharge quality or quantity
  - streamflow gauging
  - bathymetry of estuaries
  - tidal behaviour
  - salinity structure
  - water quality
  - biota assemblages
  - biotic condition indicators

### **Future plans**

- The next round of water sharing plans will focus on broader catchment based objectives that also cover estuaries.
- There is an opportunity to incorporate recommendations from Peirson et al. (2002) into policy advisory notes to the water management committees.
- There is an opportunity to develop a greater appreciation of the importance of environmental flows to coastal waters.
- The imperative should be to fill data gaps and provide information using water sharing plans that:  
*“...can be completed at a modest cost provided that the data is being gathered by the responsible government authorities...”*

## **6 Environmental water requirements for Queensland estuaries**

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### **Introduction**

This paper is presented from the perspective of the Department of Natural Resources and Mines, which is the authority responsible for the Water Resource Plans (WRP). Whilst the

WRPs consider the influences of riverine flows on estuaries, overall estuarine and marine management is the responsibility of the Queensland EPA.

### **Water Resources Planning In Queensland**

- A process to provide frameworks for fair, efficient and ecologically sustainable use of water at the Basin scale through the Water Act 2000
- Formulated to fulfil Queensland's commitment to the COAG water reforms, National Competition Policy agreements and the National Principles on the Provision of Water for Ecosystems.
- Considers ecological, economic, social and cultural issues to determine balance between water for the environment and water for consumptive purposes
- Based on best available data/information/knowledge and Adaptive Management

### **Water Resources Planning Process**

- Data collation, hydrologic modelling (IQQM), existing rights and entitlements, geomorphology and ecology.
- Establish community reference panel (CRP) for notification of intention to prepare Plan, and identification of allocation and flow-related issues.
- Establish Technical Advisory Panel (TAP) for preparation of current environmental conditions and impacts of existing water resource development, and environmental flow objectives.
- Development of economic and social impact models, water use options and impacts (balance between competing uses), translation of existing entitlements, and allowance for future demands, leading to a Draft Plan.
- Statutory review and approval process leading to Implementation of Plan, then Review.

This paper concentrates on the scientific assessment aspects (TAP) of the process.

### **Methodology**

All eastern and northern flowing Queensland rivers have estuarine systems. Southern and western flowing ones are not relevant in this respect (i.e. those of the MDB and Lake Eyre systems).

#### *Benchmarking*

The WRP currently uses the “benchmarking” methodology for the whole of basin:

1. Divide study area into relatively homogenous reaches.
2. Select benchmarking sites with range of levels/types of existing water resource development and flow regulation (whole suite of flow statistics considered).
3. Determine current environmental conditions –overall and due to non-WRD and due to WRD factors (change from natural).
4. Consider impacts of full utilisation of existing entitlements and future WRD scenarios – risk assessment.

Homogenous reaches are generally selected for the riverine reaches, although parts of the estuary may also be partitioned and considered separately. Riverine reaches are currently assessed in much more detail than estuaries and coastal systems. This is largely due to the lack of appropriate data, information or knowledge on estuarine systems.

The TAP members use specific expertise, multidisciplinary approaches and existing information for riverine ecological condition assessment. They make use of several different

indicators and methods. Currently, for estuaries and coastal ecosystems the overall condition is assessed, using a method that is effectively a combination of PEP and DIP, as defined in the Estuarine Flows Method (Pierson et al., 2002).

Moreton Bay has a reasonable amount of information available on the estuary. The WRP for Brisbane and associated rivers is yet to be done. Conceptual models are used to help understand cause-effects and process-responses.

*Assessment of current condition of sites/reaches*

Based on a five-point scale ranging from natural to very major modification:

- natural/near natural
- minor modification from natural
- moderate modification from natural
- major modification from natural
- very major modification from natural

*Assessment of geomorphological condition*

The geomorphological assessment addresses three main aspects:

- Channel morphology (size, shape, substrate):
  - comparisons of recent and historical aerial photographs
  - site inspections
  - aerial videography
  - anecdotal information
- Hydraulic habitat
  - hydrological data
  - site inspections
- Sediment transport processes
  - inferred from hydrological data
  - inferred from presence and nature of dams/weirs forming barriers to sediment movement

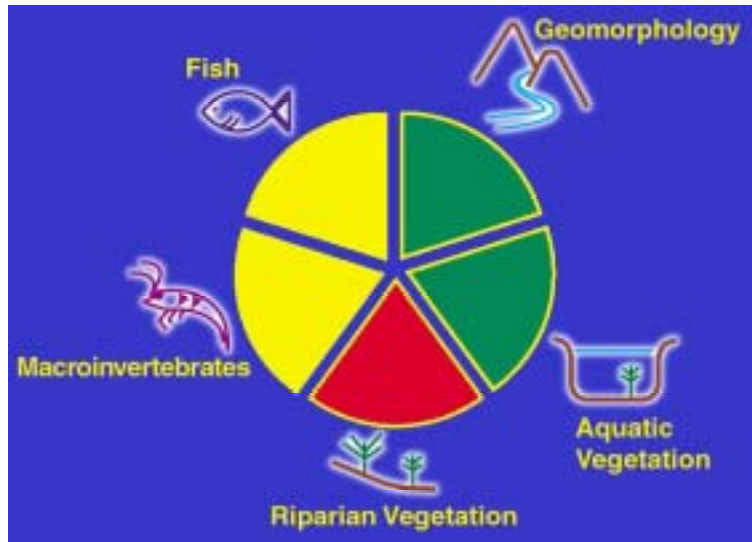
*Assessment of fish communities*

Fish communities are assessed mainly on existing information:

- Review of existing data and prior studies
  - total number of native species present within a reach
  - species composition predicted from reference sites (O/E Index)
- Additional factors considered
  - hydrological impacts of water resource development
  - water quality
  - barriers to fish movement

*Assessment of Impacts of Water Resources Development*

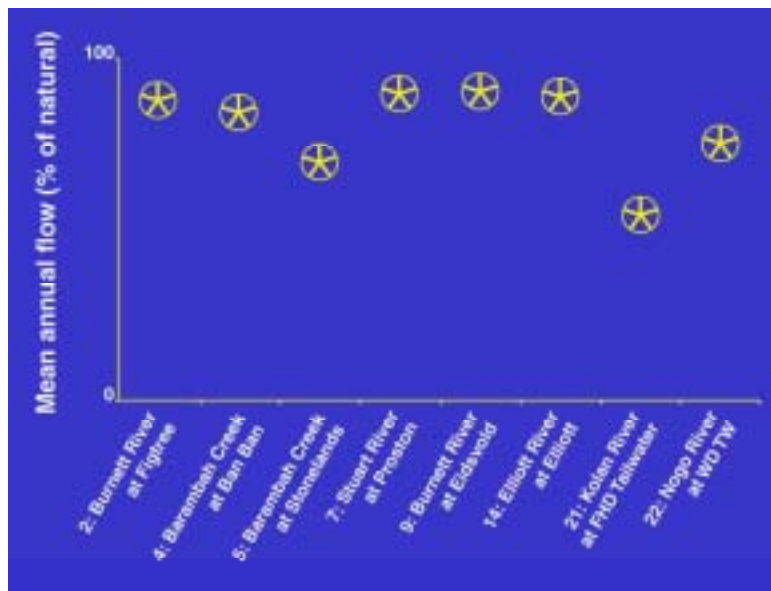
Impacts are assessed in terms of geomorphology, aquatic vegetation, riparian vegetation, macroinvertebrates and fish. Levels of impacts (no/minor, moderate or major/very major) for each “indicator” are colour coded and integrated as a pie chart (Figure 1):



**Figure 1. Predicted impacts of Water Resources Development for each “indicator”**

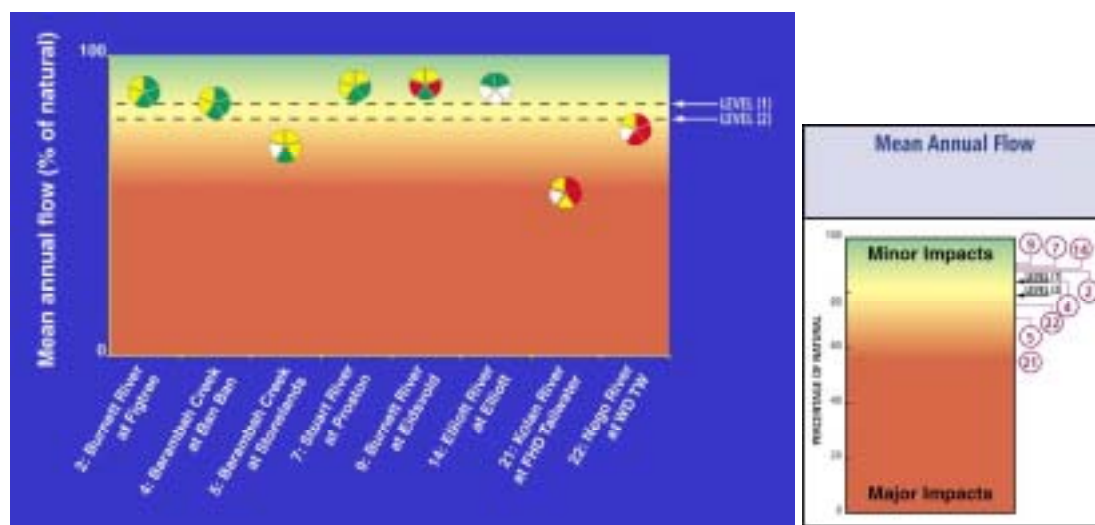
*Risk assessment*

To develop risk assessment diagrams, the integrated assessment of each site is placed on a graph against the determined “change from natural” of each hydrological parameter (eg. mean annual flow) (Figure 2).



**Figure 2. Current impacts of water resource development on the flow are assessed using indices like annual flow. Regimes are determined using recorded and modelled flow data.**

Data on flow regime change and environmental impacts of water resource development are then combined, and two key levels of departure from the natural flow regime are identified. This information is used to produce a risk assessment diagram (Figure 3).



**Figure 3. Risk Assessment Diagram, showing combined Environmental and Flow Regime Impacts, with key levels of departure from natural. Selected reference site locations are indicated by numbers on the right-hand side of the risk assessment diagrams.**

*Existing condition and condition under full utilization of existing entitlements (FUS)*

Below are examples of existing environmental condition (first number) and condition under full utilization of existing entitlements (FUS) for different estuaries in the Pioneer River system (central Qld). Overall = overall condition, non-WRD = condition resulting from non water resource development (eg. due to landuse), WRD = condition due to water resource development. 5 = very major modification from natural, 4 = major, 3 = moderate, 2 = minor modification from natural:

- Upper Pioneer Estuary: overall 5 (5), non- WRD 5 (5), WRD 4 (4)
- Lower Pioneer Estuary: overall 5 (5), non- WRD 5 (5), WRD 3 (4)
- Bakers Ck Estuary: overall 3 (2), non-WRD 3 (2), WRD 1 (1)
- Sandy Ck Estuary: overall 2 (2), non-WRD 2 (2), WRD 2 (2).

**Comparison of Current Queensland Method with Pierson et al. (2002)**

- Whilst many components of the Pierson et al. (2002) checklist of major ecological processes are considered, some are not.
- Preliminary Evaluation Phase (PEP) of Pierson et al. (2002) is used.
- Only some of the Detailed Investigative Process (DIP) of Pierson et al. (2002) phase is addressed.

Therefore, there is scope to improve on the existing Queensland process.

**General Issues and Problems Experienced in Queensland Assessments**

- Generally very qualitative assessment (using expert judgment), little data, existing data may not be appropriate, data gaps, need work on appropriate indicators.
- Benchmarks/Reference estuaries/sites – difficulties with differences with test sites and uncertainties about processes at those sites.

- Spatial variability in estuarine conditions.
- Temporal issues of short-vs. long-term, and lag effects in impacts.
- Difficulty separating flow vs. non-flow impacts – confounding or conflicting factors.

### **Conclusions**

- Assessing ecological condition of estuaries is a difficult problem.
- There are many questions regarding the choice of indicators, and temporal and spatial issues.
- There is uncertainty in the definition of good/acceptable ecological condition.
- There is a need to understand how ecological condition is affected by flow (and the different components of the flow regime) and non-flow factors (eg. landuse).
- There is a need to establish relationships between flow regime (choice of flow statistics) and ecological condition (choice of indicators) at the appropriate scale (separate flow and non-flow related influences). Currently, all are hypotheses that need testing.
- Only when the above relationships are established (predictive models) can the effectiveness of environmental flows be quantified and be more readily defended.
- There is a need to know future flow allocation and other development scenarios in order to assess risks.

## **7 Environmental water requirements for South Australian estuaries**

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### **Water resources planning framework**

The Water Resources Act 1997 (the Act) sets the legal framework for water resource management and allocation in South Australia. It establishes different planning processes to address different problems.

At the highest level the State Water Plan sets the strategic statewide policy and describes the resources at a state level. All other plans produced under the Act must be consistent with the State Water Plan.

At a regional scale catchment water management plans address a range of water management issues such as water quality improvement and protection, ecosystem protection, riparian and wetland management, stormwater management etc. Skills-based community catchment water

management boards (Figure 4) develop the plans. There are currently eight boards covering approximately 90% of the State.

Where the major water resource issue is the level of extraction then the resources (ground and/or surface water) can be prescribed. Only licensed water users can then extract water. Allocations must be on the basis of a water allocation plan developed mainly by Boards. Currently there are 21 prescribed areas in the State (Figure 5).

The Act establishes an adaptive management framework where all plans must establish monitoring and evaluation arrangements and all plans must be reviewed at least every five years. Water allocations can be altered including reduced (without compensation) at either the revision of a water allocation plan or at any time if a series of conditions occur.

### **South Australian estuaries**

Numerous definitions of estuaries exist. Under the National Land and Water Resources Audit a broad range of systems were included as estuaries in South Australia. These included coastal lagoons, semi-enclosed bays and river deltas. A total of 37 systems were identified for the Audit in South Australia.

### **Estuaries policy**

In 1998 the South Australian government released a marine and estuarine strategy, *Our Seas and Coasts*. This sets out a number of strategies related to estuaries, particularly in relation to stormwater management.

The State Water Plan 2000 recognised the linkages between catchment management and estuarine health, and included policy principles related to estuaries. It also specifically identified the need for further work to develop an agreed statewide approach to estuary management including clarification of roles and responsibilities and to review current legislation. That policy and institutional review is due to commence in 2002/3.

### **Water related management initiatives for estuaries**

#### *River Murray*

Currently the focus of most initiatives is on the estuary of the River Murray. Although the area is listed as a wetland of international importance under the Ramsar treaty, it has been altered substantially over the years by upstream water extractions reducing the natural flow out of the river mouth by 72%. This reduced flow has led to the construction of a series of barrages in the 1940s to prevent saltwater intrusions into the Lower Lakes so that the fresh water needs of the towns and industries surrounding the lakes could continue to be met. These barrages have created a physical barrier between the Lower Lakes and Coorong, preventing the passage of aquatic fauna between these systems and substantially reducing the size of the estuary.

In 1998 the South Australian Department for Environment Heritage and Aboriginal Affairs produced a report for the Murray Darling Basin Commission evaluating flow needs for the Lower Lakes and Coorong. That report identified 15 opportunities for improved hydrological management over various timescales and recommended numerous additional investigations. Many of these are now in progress.

The South Australian Department for Water, Land and Biodiversity Conservation (DWLBC) now has prime responsibility for water-related management of the Murray estuary.

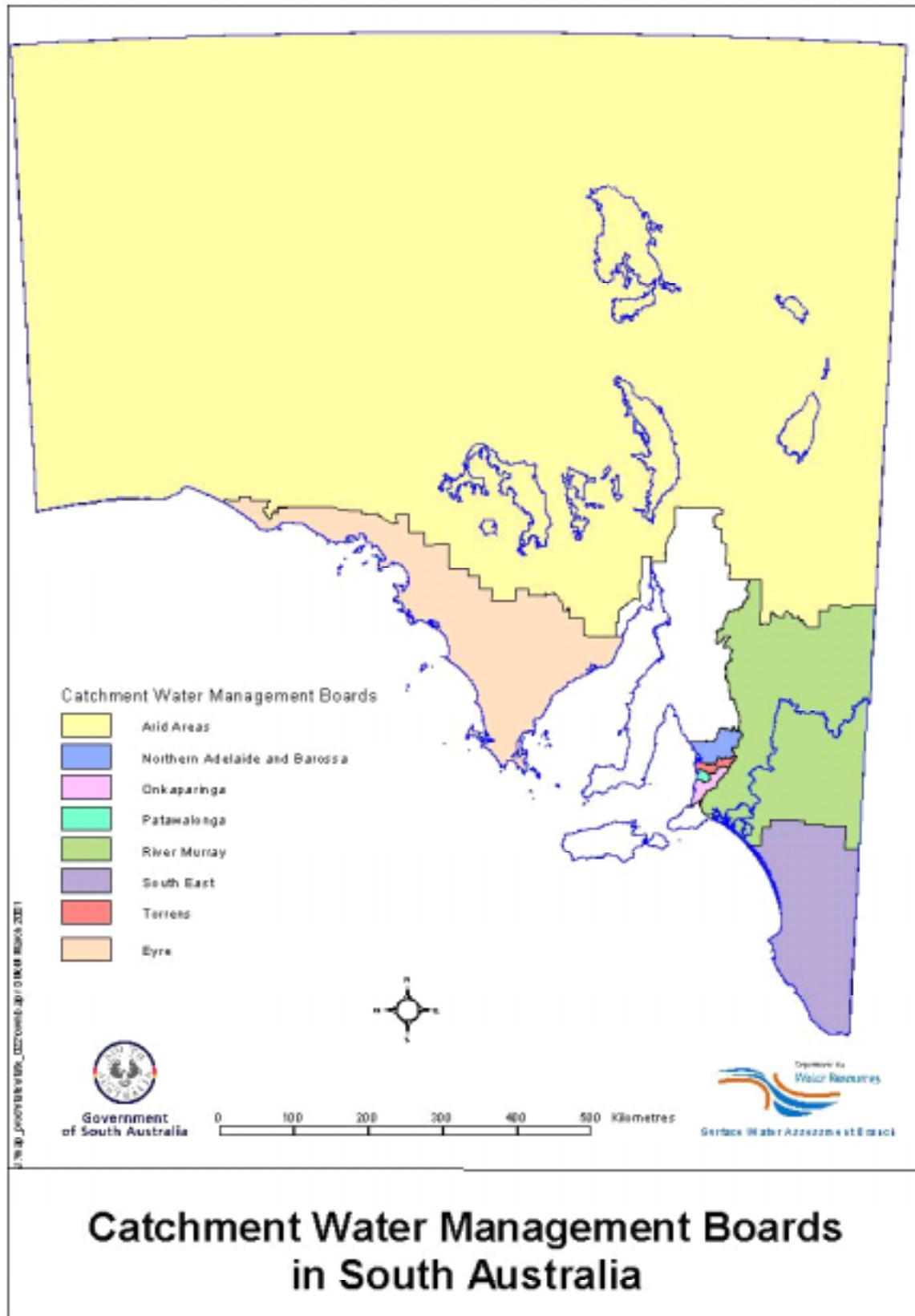
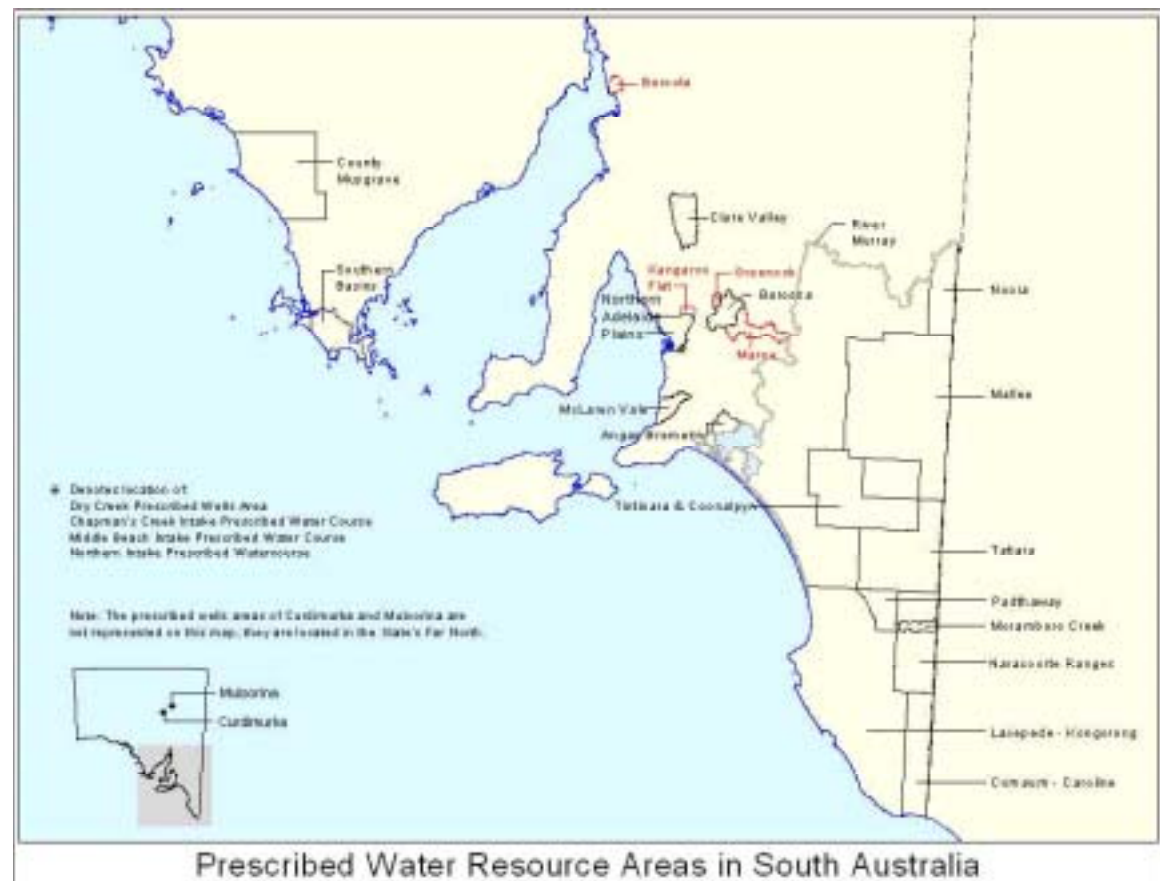


Figure 4. South Australia's current catchment water management board areas.



**Figure 5. South Australia's prescribed water resource areas.**

Current initiatives for the Murray estuary include the:

- development of a morphological model of Murray Mouth to gain a greater understanding of sand and water movement. This will then be used to look at different scenarios and flow regimes for better barrage management to improve environmental outcomes.
- automation of some barrage gates to provide increased flexibility in barrage operation to meet a range on water supply and environmental outcomes
- South Australian Research and Development Institute is doing a study of fish passage around the barrages - looking at what is there and what may move through barrage gates
- development of an Environmental Flows Strategy for the River Murray in SA with policies to develop a comprehensive barrage operation plan to control barrage management for environmental outcomes for biota, and also to provide more water to the Coorong and Mouth
- MDBC has a major environmental flows project for the entire River Murray - looking at clawback of water from all users to improve environmental flows for the river. One of its goals is to keep the Murray Mouth open.
- MDBC has written a report on the best way to keep the Mouth open. The report states that an increase in river flows by 2 000 ML/d is needed.
- DWLBC is compiling a report on the Implications of Mouth Closure in relation to fish, water quality, recreation, vegetation, birds, Aboriginal culture, and tourism.

- Undertaking modelling of a range of filling strategies for the Lower Lakes to optimise environmental benefits while operating within the water resource requirements.
- Local Action Planning groups (community groups funded through MDBC) are managing wetlands around the lakes
- Local Action Planning groups are already addressing lakeshore erosion - i.e. revegetation and exclusion of stock but we are interested in trialing lower lake levels

#### *Rest of South Australia*

Some work has been done in other estuaries in relation to their environmental water requirements, although at this stage not to the level of detail for the Murray.

The Onkaparinga estuary just south of Adelaide has been the subject of water quality investigations but little flow related work. The Onkaparinga Catchment Water Management Board is conducting an environmental water requirements assessment project for the Onkaparinga River that is near completion. It has not addressed the estuary in any detail but that may be considered for a subsequent project to build on the current work.

Detailed river management plans have been developed for three Mid-North rivers, which are currently outside of a catchment water management board area. . These plans have included assessments of environmental water requirements, including some consideration of estuarine requirements.

A new project being conducted by DWLBC will investigate environmental water requirements for rivers on Kangaroo Island and this will include consideration of estuarine requirements.

As indicated above, groundwater is a significant water resource in South Australia and from limited information it appears that there are ecosystems dependent on groundwater discharges to estuaries. One catchment water management board is developing a project to clearly identify groundwater-dependent ecosystems in near-shore environments.

#### **South Australia's response to Peirson et al. (2002)**

The framework set out in the report needs to be trialed in several different types of estuaries to critically evaluate its usefulness. It is expected with the increasing interest in estuarine management being shown by relevant agencies in South Australia that the framework will be trialed in the near future.

The major issue that will limit the usefulness of the framework is the lack of information and data. Critical general issues that need to be addressed include:

- Better understanding of groundwater inflows
- Better information on estuarine morphology and water quality including sediment and water quality modelling
- Better information on ecological needs and tolerances of different biota.

Some specific information needs that are required are:

- examples of sand and sediment build-up in river mouths, and how this is managed.
- examples of other river mouths that have structures similar to the barrages at their entrance - and how these structures are manipulated to benefit the environment.
- studies on fish movement around estuaries - especially species that are found in the Coorong, i.e. how far up rivers do they venture?
- birdlife - examples of how birds use the estuary, season by season.
- flow needs of different fish species.

## 8 Recommendations

### Adoption of Recommended Method

NSW recognise that the Recommended Method raises profile and awareness of issues, establishes initial classification of water use, provides useful methodology for discussion, and identifies information gaps. However, given the limited information base available, there may be a high level of uncertainty in the results. South Australia also noted that the major limiting factor in application of the Recommended Method is the lack of suitable high quality information and data. Detailed studies have high resource requirements and require long time frames. There is only a low level of community and stakeholder involvement prescribed under the Recommended Method, which could be a weakness.

Queensland sees potential for the Recommended Method to improve on the existing process. A process akin to the Preliminary Evaluation Phase of Pierson et al. (2002) is already in use, but only some of the Detailed Investigative Process (DIP) is currently being addressed.

While Peirson et al. (2002) defined environmental flows purely in terms of environmental needs, it is likely that in estuaries, which often have high levels of competing water use, that other social, economic and cultural issues will become inextricably linked to the process of formulating flows.

The environmental flow issue in estuaries is not simply about fresh water input from the catchment. It is also about how this incoming water is distributed within the estuary. Estuaries often have structures that control flows, in which case structural solutions need to be investigated. Structures are also used to control salt water ingress, and this is another aspect of the water distribution problem that may require investigation.

A potential ecologically limiting factor in estuaries is water quality. Peirson et al. (2002) adopted the stance that flows should not be used to dilute pollution, rather, that pollution should be treated at its source. However, there may be circumstances where dilution flows are deemed necessary.

It is fair to say that estuaries have had little attention compared to rivers when it comes to environmental flow assessments. One problem is that there is often a jurisdictional boundary at the tidal limit. However, it is also recognised that the characteristics of estuaries are sufficiently different to rivers that a different approach is required there. It is important that if estuaries are made a compliance point in riverine environmental flow assessments, then the method for estuaries is compatible with the methods being employed for rivers. The method of Peirson et al. (2002) is necessarily focussed on estuaries, but it can also be used as a module in a wider catchment-based environmental flow study.

*This report concludes that the method of Peirson et al. (2002) is suitable for application to determination of environmental water needs of Australian estuaries, and it is recommended for trial adoption by the States. The method is sufficiently flexible and comprehensive as to allow application to a range of assessment types. The Preliminary Investigation Phase would seem to be the minimum approach to take, while larger studies will employ aspects of the Detailed Investigative Phase.*

### Suggested future directions (see also the previous chapters)

#### *Technical aspects*

- There is a need to maintain and in some areas, increase, basic hydrological and biological data collection to provide inputs to flow models. Quality data are required to reduce the level of uncertainty in model predictions.

- There is a clear need for research on indicators of estuarine health, and levels of impact. The most pressing need is for hydrological/hydrodynamic indicators that are clearly linked to estuarine ecological, water quality, and geomorphological processes.
- Table 5 in Peirson et al. (2002) “Initial Classification of Fresh Water usage” attempts to grade the level of catchment water use (which deprives the estuary of water inflow) using two variables. It is recommended that this index be refined through further research (perhaps using NLWR Audit data).
- While States are encouraged to apply the Recommended Method, a separate independent trial is also recommended.
- Current riverine environmental flow assessment methods should include the estuary as a compliance point, which will ensure that recommendations for upstream reaches are compatible with the needs of estuaries.
- Work is required on the definition of acceptable estuarine health, particularly in heavily used estuaries.
- Hypotheses linking flows to estuarine ecology, water quality, hydraulics, and geomorphology require scientific investigation. This work is necessary so that recommendations can be defended with an acceptable level of confidence. Currently, recommendations regarding water requirements of estuaries are likely to be fragile.
- Given the limited resources available, it is necessary to develop a system of prioritizing estuaries for environmental flows assessment.

#### *Information transfer and communication*

- To improve the prospects for implementation of environmental flows to estuaries, it is important to build capacity in the agencies, and the wider community.
- Some stakeholders view estuary closures negatively, even where this is a natural process. It is important to explain to the wider community the important ecological role of natural closures.
- The Workshop was regarded by participants as a success, and it is recommended to reconvene in 12 months time to review experiences with application of the Recommended Method.
- The Coastal CRC and the CRC for Freshwater Ecology were identified as important groups leading research in the water requirements of estuaries. It is recommended that efforts be made to ensure that these efforts are optimised through collaboration.
- It is important to make efforts in each State and Territory to draw together the different government agencies responsible for freshwater and marine environments.

#### *Funding opportunities*

- While funding for NHT Phase I stopped at the tidal limit, the NHT Extension (Phase II) explicitly includes estuaries. There are opportunities to fund estuarine R&D here, and agencies are encouraged to explore this avenue.

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## ANNEX A

### FRAMEWORK FOR THE EXTENSION OF THE NATURAL HERITAGE TRUST

1. Lessons learnt from the first phase of the Trust and the establishment of the National Action Plan for Salinity and Water Quality (the NAP) have been taken into account in the finalisation of the framework. There will be a fundamental shift in the Trust towards more strategic investment.
2. The model for regional investment under the extension of the Trust will be based on that used for the NAP, including bilateral and regional partnership agreements, investment against accredited regional plans, and the provision of foundation and priority funding.

#### Trust objectives

3. The Trust will have three overarching objectives.
  - (i) Biodiversity Conservation - the conservation of Australia's biodiversity through the protection and restoration of terrestrial, freshwater, estuarine and marine ecosystems and habitat for native plants and animals.
  - (ii) Sustainable Use of Natural Resources - the sustainable use and management of Australia's land, water and marine resources to maintain and improve the productivity and profitability of resource based industries.
  - (iii) Community Capacity Building and Institutional Change - support for individuals, landholders, industry and communities with skills, knowledge, information and institutional frameworks to promote biodiversity conservation and sustainable resource use and management.

These overarching objectives have been the basis for defining the four programs and the development of the ten areas of activity.

#### Trust programs

4. The Trust will have four programs. These programs establish the resource condition outcomes that will be sought through Trust investment. Detailed descriptions of the programs are at Attachment A.
  - (i) The Landcare Program will invest in activities that will contribute to reversing land degradation and promoting sustainable agriculture.
  - (ii) The Bushcare Program will invest in activities that will contribute to conserving and restoring habitat for our unique native flora and fauna which underpins the health of our landscapes.

- (iii) The Rivercare Program will invest in activities that will contribute to improved water quality and environmental condition in our river systems and wetlands.
- (iv) The Coastcare Program will invest in activities that will contribute to protecting our coastal catchments, ecosystems and the marine environment.

### Scope of Activity

5. The following 10 areas of activity define the scope of Trust investment:
  - i. protecting and restoring the habitat of threatened species, threatened ecological communities and migratory birds;
  - ii. reversing the long-term decline in the extent and quality of Australia's native vegetation;
  - iii. protecting and restoring significant freshwater, marine and estuarine ecosystems;
  - iv. preventing or controlling the introduction and spread of feral animals, aquatic pests, weeds and other biological threats to biodiversity;
  - v. establishing and effectively managing a comprehensive, adequate and representative system of protected areas;
  - vi. improving the condition of natural resources that underpins the sustainability and productivity of resource based industries;
  - vii. securing access to natural resources for [productive purposes];
  - viii. encouraging the development of sustainable and profitable management systems for application by land-holders and other natural resource managers and users;
  - ix. providing land-holders, community groups and other natural resource managers with understanding and skills to contribute to biodiversity conservation and sustainable natural resource management; and
  - x. establishing institutional and organisational frameworks that promote conservation and ecologically sustainable use and management of natural resources.
6. Natural resource management priorities will vary between regions and between States/Territories, as will the extent to which the areas of activity identified for Trust investment are addressed in regional plans. It is, therefore, not anticipated that each regional NRM plan will necessarily address all of the ten areas of activity. Similarly, equal emphasis may not be applied to all components of a single area of activity within a regional plan.
7. Investment under the Trust will be available for salinity and water quality measures across Australia, including in NAP regions. At least \$350 million of the Trust funds will be invested directly on measures to improve water quality.

### Levels of investment

8. Investment under the Trust will occur at three levels: national/state; regional; and local. Transitional arrangements will be necessary to provide support for ongoing work consistent with expected regional priorities, to build on the

outcomes of existing Trust investments, and to maintain momentum and continuity within communities.

9. National / State Investments

Investment at this level will address activities that have a broadscale, rather than a regional or local, outcome. This will include activities at the state-wide level, as well as those that cross over state and regional boundaries. It will also address matters of direct Commonwealth jurisdiction, such as those relating to Commonwealth waters.

10. National/State investments can be grouped together into three sets:

- *Commonwealth activities*: giving effect to Federal Government environmental and natural resource responsibilities and priorities, and implemented solely by the Commonwealth or in partnership with other jurisdictions;
- *Joint Commonwealth and State/Territory activities*: including cross-jurisdictional activities, identified and agreed jointly by the Commonwealth and the States/Territories; and,
- *State-wide and within-State activities*: identified and agreed to jointly by the Commonwealth and the States/Territories.

11. Investment priorities are likely to cover National / State activities such as resource assessment, research, industry strategies, innovative approaches to managing NRM issues such as weeds, marine species and protected areas, reserve acquisitions, training and information, and national coordination/facilitation.

12. While at the National / State level the four programs will form four discrete funding sources, complementary outcomes will be pursued. Investment priorities will be funded from one or more of the four programs depending on the nature of the activity in question.

13. Regional investments

This will be the principal delivery mechanism for the Trust and will follow, as far as practical, the model developed for the NAP. Under this model, investment is made on the basis of an accredited, integrated NRM plan and investment strategy/proposal developed by the region.

14. Plans which seek accreditation for Trust investment will identify all of the NRM issues in a region (based on the best available scientific and technical information) develop actions to address these issues and then prioritise the most important issues for action. They will also set resource condition and management action targets based on agreed national standards.

15. The requirement that plans be based on rigorous scientific and technical information, and that they set achievable natural resource condition targets, will require the Trust to invest in research. As many plans will be based on existing regional and catchment plans, the nature and subject of the research for which funding may be provided will need to be carefully targeted and determined on a case by case basis.

16. Investment proposals for Trust funding submitted to the Commonwealth and relevant State/Territory after plan accreditation must demonstrate how the actions for which funding is sought meet the areas of activity for investment established for the Trust.
17. In the NAP priority regions the delivery of Trust and NAP funding will be integrated, subject to the requirements necessary to meet separate auditing and evaluation requirements for the two programs.
18. A process is currently under way to review the accreditation criteria developed by the NAP to ensure that plans accredited under the criteria can be used as a basis for investment under a range of programs including the NAP and the Trust.
19. At the regional level the four programs will be integrated and complementary outcomes will be pursued.
20. Regional boundaries will be established using the following principles:
  - i. regions will be based on integrated NRM considerations;
  - ii. regions reflect, where possible, existing regional arrangements; and
  - iii. relevant regions incorporate coasts and adjacent waters.

A consequence is that the NRM regions used for the Trust will not be inconsistent with the NAP arrangements.
21. Where regional arrangements are less well defined, for example in the rangelands, the Commonwealth, rangelands States and the Northern Territory will jointly determine the approach to be taken. Cross border arrangements for any region would need to be developed on a case-by-case basis.
22. Trust investment in the rangelands may occur outside a regional framework, but still within the areas of activity identified for Trust investment.
23. Interim Regional Arrangements  
A process for managing the transition to regional implementation is a high priority. Arrangements will need to be flexible to provide a level of certainty and predictability for regions, support for ongoing work consistent with expected regional priorities and to build on the outcomes of existing projects.
24. Funds will be available for some activities prior to accredited plans being in place.
25. There will be investment against two categories of activities in this interim period:
  - *Foundation* funding to support the process of developing or refining a regional integrated NRM strategy, including support for the regional organisation to undertake activities such as evaluating existing plans, information gap filling, plan development and community consultation; and
  - *Priority funding* for regions to continue to address pressing NRM issues through large-scale actions, prior to the accreditation and implementation of a regional NRM plan, as well as technical support and capacity building.
26. Continued funding for facilitators and coordinators is needed during the interim period to facilitate community input into the development of regionally strategic NRM plans, assist community groups with Local Action Grants and project

reporting, assist the community to finalise projects and submit final reports for the first phase of the Trust, provide technical support and community development needs, and support Commonwealth obligations.

27. There will only be one interim funding round (2002-03), unless circumstances in some regions justify a second round. Any project extension would be subject to review against progress in completing regional plans and implementing individual projects. Overall investment in interim projects will be small in proportion to investment following the accreditation of regional plans. Interim projects should address the most time critical priority issues in a region, clearly demonstrated through sound scientific and planning processes.
28. Approved interim projects will need to demonstrate:
- contribution to the objectives of the Natural Heritage Trust and consistency with the identified priority areas of activity;
  - that the range of natural resource management issues were adequately considered in putting together the bids;
  - consistency with existing plans;
  - consultation with stakeholders and community support;
  - a need for early commencement (such as the opportunity to avoid more significant impacts, the window of opportunity is small, or the opportunity to link with other activities);
  - support for continuity and momentum in existing community capacity;
  - value for money;
  - approval for the work from the land manager; and
  - receipt of any statutory approvals that may be necessary, and compliance with any relevant legislation.
29. The process for managing this funding will involve seeking bids from each region (principally from established regional groups), assessment and prioritisation of bids on a state-wide basis by a panel with a majority community membership and a community chair, and consideration of the recommended bids by the Commonwealth and relevant state and territory as joint investors. Where regional arrangements are less well established, the Commonwealth and States will discuss arrangements further.
30. Local Action Grants  
 These grants will provide the opportunity for community groups, in particular those that have had little or no previous engagement with the Trust, to build capacity through:
- gaining experience in addressing NRM issues on a relatively small scale;
  - finding out about the range of approaches to addressing these issues;
  - building networks with others addressing similar issues; and
  - participating in the development and implementation of broader regional approaches to natural resource management.
31. Local Action Grants will assist groups to undertake:
- small on-ground projects tackling local problems;
  - projects in areas where regional plans are not yet well developed; and
  - important local projects.
- Activities should not be inconsistent with regional plans.

32. A process for managing this grants program will be negotiated with those jurisdictions willing to administer the grants on behalf of the Commonwealth.
33. While at the Local Action Grants level the four programs will form four discrete funding sources, complementary outcomes will be pursued.

### ***Funding***

34. The Trust is only one of a range of potential sources of investment funds for any individual integrated natural resource management plan, and regional communities are expected to seek, as they consider appropriate, investment for different activities and outcomes under their plans from different sources.
35. Up to 3-year funding will be provided for funding based on accredited regional plans subject to annual review against milestones.

### ***Bilateral and Regional Agreements***

36. The Trust bilateral agreements will be based primarily on the structure used for the NAP bilateral agreements, and will draw on the existing Trust Partnership Agreements and Memoranda of Understanding.
37. The bilateral agreements will establish a framework under which the Parties will work cooperatively for the purposes of section 19 of the *Natural Heritage Trust of Australia Act 1997*.
38. The bilateral agreements will address institutional change required to underpin Trust delivery. This will include the institutional reforms agreed under the NAP IGA being applied to Trust regions.
39. Where coastal areas are included in NRM regions, the NRM plans to be accredited under the extended Trust are to be developed in cooperation with the land managers/agencies that have statutory coastal management responsibilities within each jurisdiction.
40. All jurisdictions support the engagement of local government in the delivery of the Trust. To implement regional delivery of Trust investment, agreements will be developed with each agreed local government/regional group describing the management and accountability arrangements. The process for developing the agreements within each State and Territory will be determined through the bilateral agreements.

### ***Monitoring and Evaluation***

41. The NRM Ministerial Council is overseeing the development and implementation of a national monitoring and evaluation framework that will cover both the Trust

and the NAP and which will enhance the capacity to monitor and measure progress against the objectives of both programs.

42. Monitoring and evaluation is an ongoing activity in NRM. It will be necessary to determine the level of Trust funds required to support monitoring and evaluation at all levels of investment, further to that already provided from other sources.

## ATTACHMENT A

### RIVERCARE

#### National Goal

To improve water quality and environmental condition in our river systems and wetlands.

#### Priorities

In seeking to achieve this goal, Rivercare will principally deliver the following Trust priorities:

- to improve the condition of water resources that underpins the sustainability and productivity of industries dependent on water resources;
- to secure access to water resources for productive and recreational purposes;
- to encourage the development of sustainable and profitable management systems for water resources for application by land-holders and other natural resource managers and users;
- to protect and restore significant freshwater ecosystems in rivers and wetlands;
- to prevent or control the introduction and spread of aquatic pests, weeds and other biological threats to biodiversity and productivity; and
- to protect and restore the riverine and wetland habitat of threatened species, threatened ecological communities and migratory birds.

Rivercare will assist in giving effect to the following elements of the Trust priorities:

- to reverse the long-term decline in the extent and quality of Australia's native vegetation in riverine and wetland areas;
- to establish and effectively manage riverine and wetlands elements of a comprehensive, adequate and representative system of protected areas; and

Rivercare, in conjunction with all other Trust programs will contribute to the following Trust priorities:

- to provide land-holders, community groups and other natural resource managers with understanding and skills to contribute to biodiversity conservation and sustainable natural resource management; and
- to establish institutional and organisational frameworks that promote conservation and ecologically sustainable use and management of natural resources.

#### National Outcomes

The principal outcomes sought by Rivercare are: improved water quality and reliable allocations for human uses, industry and the environment; and effective management and sustainable use of rivers, streams, wetlands and

groundwater, and their associated biodiversity. Specific outcomes will be pursued in the following areas:

- improved water quality in rivers and streams, and in coastal and estuarine environments affected by river systems.
- improved resource security and sharing arrangements between the environment, human uses and industries;
- sustainable and productive land and water management systems, including
- caps on the extractive use of water from all surface and groundwater systems that are over-allocated or approaching full allocation, and a strategy and timetable for meeting the caps; and ;
- removal of impediments to the effective operation of trading markets in, and integrated management of, both surface and groundwater systems;
- improved water use efficiency and re-use;
- improved adoption of clean wastewater and stormwater systems;
- protection, conservation and restoration of wetland systems;
- conservation of the biodiversity of aquatic and riparian systems;
- restoration of important fish migration routes through such activities removal of barriers and the construction of fish passage devices;
- protection of priority instream, riparian and floodplain habitats, including Ramsar sites, nationally significant wetlands and migratory water bird habitat;
- reduction in inputs of nutrients, sediments and other pollutants into waterways and groundwater;
- reduced impact on water quality and biodiversity from feral animals and weeds;
- prevention or control of the introduction of aquatic pests and weeds and reduction of their ecological and economic impact;
- engagement of the community in monitoring and protecting Australia's waterways, wetlands and groundwater;
- improved awareness, understanding and support among the wider community of the need for sustainable water management and aquatic biodiversity conservation;
- development of data collection, information, research and skills to support decision making; and
- improved and integrated management of aquatic systems, rivers, streams, wetlands and groundwater and their associated environments as a single integrated resource, while not discounting the special requirements of any aspect of that resource.

## COASTCARE

### **National Goal**

To protect our coastal catchments, ecosystems and the marine environment.

### **Priorities**

**In seeking to achieve this goal, Coastcare will principally deliver the following Trust priorities:**

- to protect and restore significant marine, coastal and estuarine ecosystems,
- to protect and restore the coastal, estuarine and marine habitats of threatened species, threatened ecological communities, and migratory shorebirds and waterbirds;
- to prevent or control the introduction and spread of introduced marine pests, coastal weeds and other biological threats to biodiversity,
- to establish and effectively manage a comprehensive, adequate and representative system of marine protected areas, and
- to improve the condition of coastal, estuarine and marine resources that underpin the sustainability of coastal, estuarine and marine-based resource industries.

Coastcare will assist in giving effect to the following Trust priorities:

- to reverse the long-term decline in the extent and quality of Australia's native coastal and estuarine vegetation;
- to secure access to marine and coastal resources for productive purposes;
- to encourage the development of sustainable and profitable management systems for application by coastal and marine resource managers and users.

Coastcare, in conjunction with all other Trust programs, will contribute to the following Trust priorities:

- to provide land-holders, community groups and other natural resource managers with understanding and skills to contribute to biodiversity conservation and sustainable natural resource management, and
- to support institutional and organisational frameworks that promote conservation ecologically sustainable use and management of natural resources.

### **National Outcomes**

The principal outcomes sought by Coastcare are protection of the environmental values of our coasts, estuaries and marine environment, sustainable development of their resources and enhanced amenity of coastal areas. Specific outcomes will be pursued in the following areas:

- an improved national framework for integrated coastal zone management;
- implementation of more coordinated and effective planning regimes for coastal, marine and estuarine areas, including addressing ribbon development in the coastal fringe;

- development and implementation of recovery plans and threat abatement plans for nationally listed coastal, marine and estuarine species and ecological communities;
- identification and conservation of estuarine, coastal and marine biodiversity hotspots;
- development of a national framework to reduce the threats to coastal and marine species;
- inclusion of under represented marine regions in the national representative system of marine protected areas;
- achievement of target reductions in marine, coastal and estuarine pollution from source, particularly in coastal and urban water quality hot spots, including the Great Barrier Reef lagoon;
- development and application of appropriate economic and market-based measures to support the conservation of coastal and marine native biodiversity;
- integration of coastal water quality protection and biodiversity conservation into the core business of regional/catchment organisations;
- improved management of important migratory shorebird sites, including enhanced conservation of habitat for nationally and internationally significant shorebirds;
- prevention or control of the introduction of coastal weeds and introduced marine pests, and reduction of their ecological and economic impact;
- effective control of the loss of native coastal and marine vegetation;
- minimising the impact of land-based sources of pollution and nutrients on coastal, estuarine and marine habitats;
- improved ecologically sustainable use of fisheries resources in estuarine and marine environments;
- effective control of the loss of critical coastal, estuarine and marine fish nursery areas through measures to ensure biodiversity conservation and the productivity of fisheries;
- the commitment, skill and knowledge of coastal and marine managers to manage coastal and marine environments sustainably and make well-informed decisions; and
- understanding and appreciation by coastal communities, including indigenous communities, of the role of coastal and marine native biodiversity in Australia's rural and urban landscapes and an enhanced involvement in coastal and marine management activities;

Coastcare will work with the other Trust programs to achieve improved marine, coastal and estuarine water quality, habitat protection and biodiversity conservation outcomes, and promote the ecologically sustainable use of marine and coastal natural resources

## LANDCARE

### National Goal

To reverse land degradation and promote sustainable agriculture.

### Priorities

In seeking to achieve this goal, Landcare will principally deliver the following Trust priorities:

- to improve the condition of land resources that underpins the sustainability and productivity of resource based industries;
- to secure access to land resources for productive purposes;
- to encourage the development of sustainable and profitable land management systems for application by land-holders and other natural resource managers and users; and
- to prevent or control the introduction and spread of feral animals, weeds and other biological threats to productivity.

### Landcare will assist in giving effect to the Trust priorities:

- to protect and restore the habitat of threatened species, threatened ecological communities and migratory birds on agricultural land;
- to reverse the long-term decline in the extent and quality of Australia's native vegetation on agricultural land; and
- to protect and restore significant freshwater, marine and estuarine ecosystems by improving the management of land resources.

Landcare, in conjunction with all other Trust programs will contribute to the following Trust priorities:

- to provide land-holders, community groups and other natural resource managers with understanding and skills to contribute to biodiversity conservation and sustainable natural resource management; and
- to establish institutional and organisational frameworks that promote conservation and ecologically sustainable use and management of natural resources.

### National Outcomes

The principal outcome sought by Landcare is increased profitability, competitiveness and sustainability of Australian agricultural industries, enhancement and protection of the natural resource base, and improved land use leading to better soil health, water quality and vegetation condition. Specific outcomes will be pursued in the following areas:

- measures to reduce land degradation, including its impact on water quality;
- improvement in clarity and certainty of property rights to underpin sound management practices;
- the use of land resources within their capabilities;
- development and implementation of best practice systems, including codes of practices and environmental management systems;

- maintenance and improvement of the productivity and efficiency of land resource use;
- equipping individual farmers and communities with the understanding, skills, self-reliance and commitment necessary to maintain economic viability and sustainably manage natural resources
- increased capacity of natural resource managers to make well informed decisions; and
- support for institutional arrangements for regional delivery.

## BUSHCARE

### National Goal

**To conserve and restore habitat for Australia's unique native flora and fauna that underpin the health of our landscapes.**

### Priorities

In seeking to achieve this goal, Bushcare will principally deliver the following aspects of the Trust priorities:

- to protect and restore terrestrial threatened species habitat and threatened ecological communities, and migratory birds;
- to reverse the decline in the extent and quality of Australia's native vegetation;
- to establish and effectively manage a comprehensive, adequate and representative system of terrestrial protected areas; and
- to prevent or control the introduction and spread of feral animals, terrestrial pests, weeds and other biological threats to biodiversity.

Through the above priorities Bushcare will assist the Landcare program in achieving the Trust priority of improving the condition of natural resources that underpin the sustainability and productivity of resource-based industries.

Bushcare, in conjunction with all other Trust programs will contribute to the following Trust priorities:

- to provide landholders, community groups and other natural resource managers with understanding and skills to contribute to biodiversity conservation and sustainable natural resource management; and
- to support institutional and organisational frameworks that promote conservation and ecologically sustainable use and management of natural resources.

### National Outcomes

The principal outcome sought by Bushcare is a reversal of the trend of depletion of the nation's key terrestrial biodiversity assets. The following specific outcomes will be pursued:

- development and implementation of recovery plans and threat abatement plans for nationally listed terrestrial threatened species and ecological communities;
- identification and conservation of terrestrial biodiversity hotspots;
- implementation of effective measures to control the clearing of native vegetation, specifically including:
- prevention of clearing of endangered and vulnerable vegetation communities and critical habitat for threatened species;
- limitation of broadscale clearing to those instances where regional biodiversity objectives are not compromised;
- a substantial increase in the area and quality of the national reserve system;
- enhanced engagement with indigenous communities, leading to an expansion of the Indigenous Protected Area network;

- integration of biodiversity conservation as part of the core business of regional/catchment organisations;
- development and application of appropriate economic and market-based measures to support the conservation of terrestrial native biodiversity;
- improved protection and management of World Heritage properties;
- conservation and enhancement of remnant native vegetation;
- more sustainable management of rangeland ecosystems through measures including identification and protection of areas of high conservation significance, improved fire management and implementation of total grazing management practices to conserve biodiversity;
- increased revegetation, integrating multiple objectives including biodiversity conservation, salinity mitigation, greenhouse gas abatement, improved land stability and enhanced water quality;
- reduction in the impact on terrestrial biodiversity of feral animals and weeds, focussing on weeds of national significance and “sleeper” weeds;
- improved quarantine controls and enhanced risk assessment procedures to eliminate the introduction of new live organisms harmful to native biodiversity;
- the commitment, skill and knowledge of land managers to manage terrestrial native biodiversity sustainably; and
- understanding and appreciation by communities of the role of terrestrial native biodiversity in Australia’s rural and urban landscapes.