

# Making the connection between healthy waterways and healthy catchments

Moreton Bay Waterways and Catchments Partnership

Stuart Bunn, Eva Abal, Bill Dennison,  
Paul Greenfield & Di Tarte

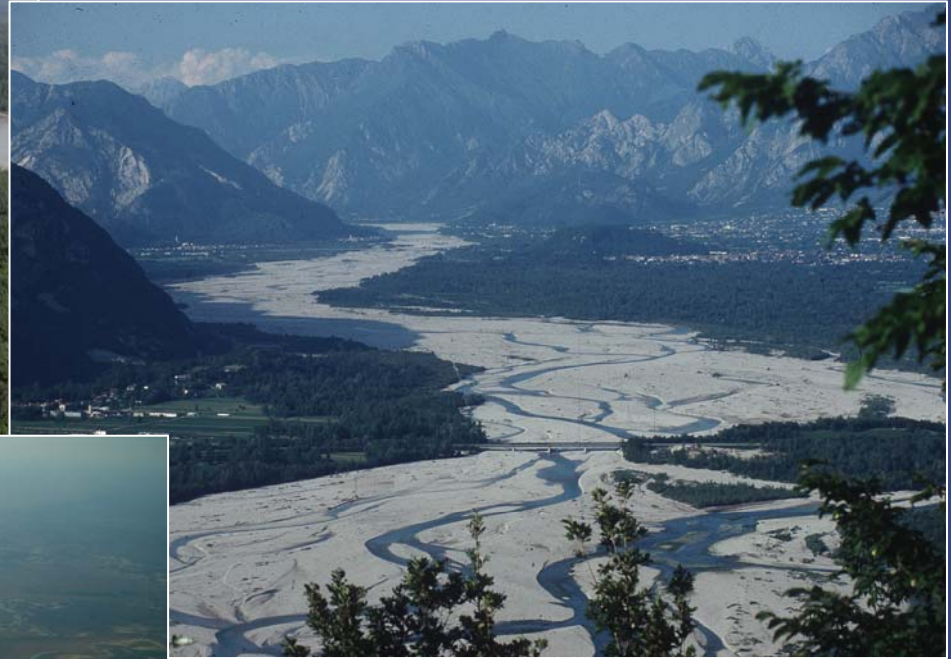
**HEALTHY WATERWAYS**

*Because we're all in the same boat*





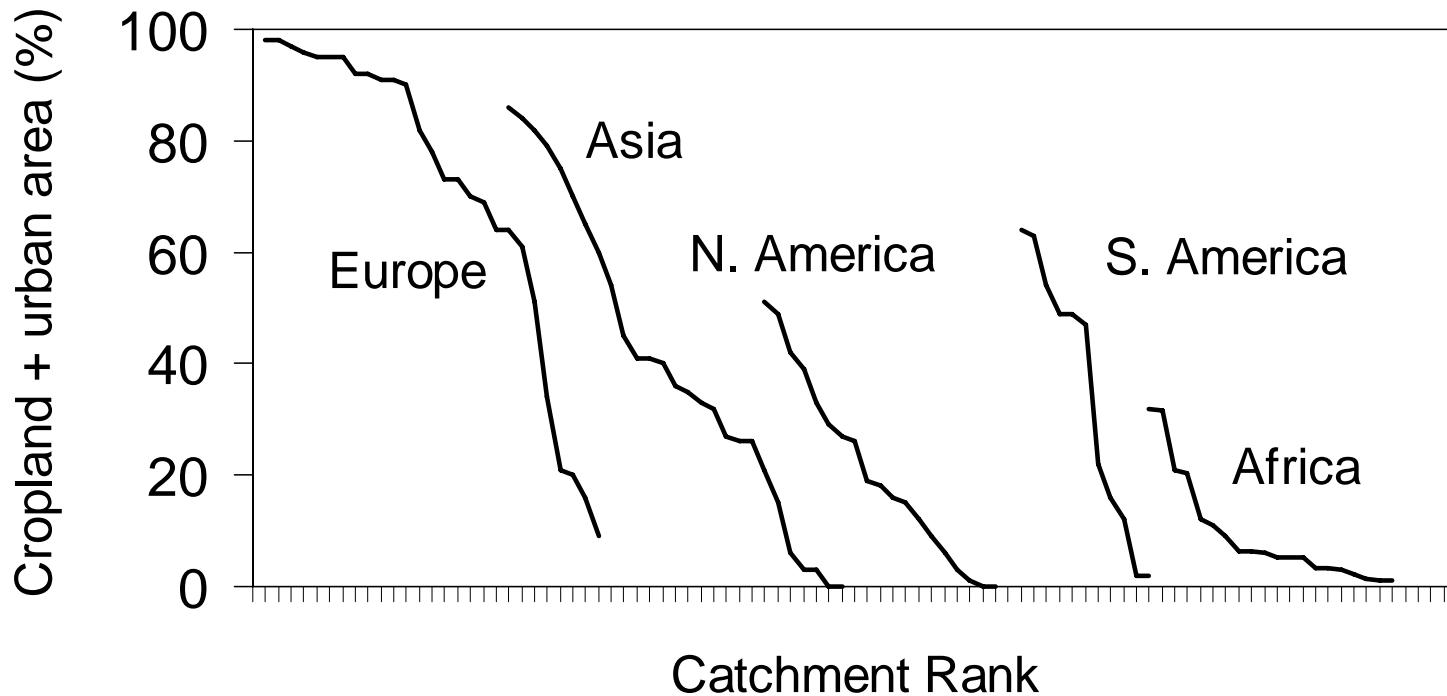
# Rivers and floodplains - threatened ecosystems



# Transformation of river corridors



% riparian zones (2 km wide) along all major river corridors that have been transformed into urban or agricultural areas.



Tockner *et al.*  
(in press)

Increasing urbanization is a major threat - most (90%) expected population increase in less-developed regions (>2 billion by 2025)



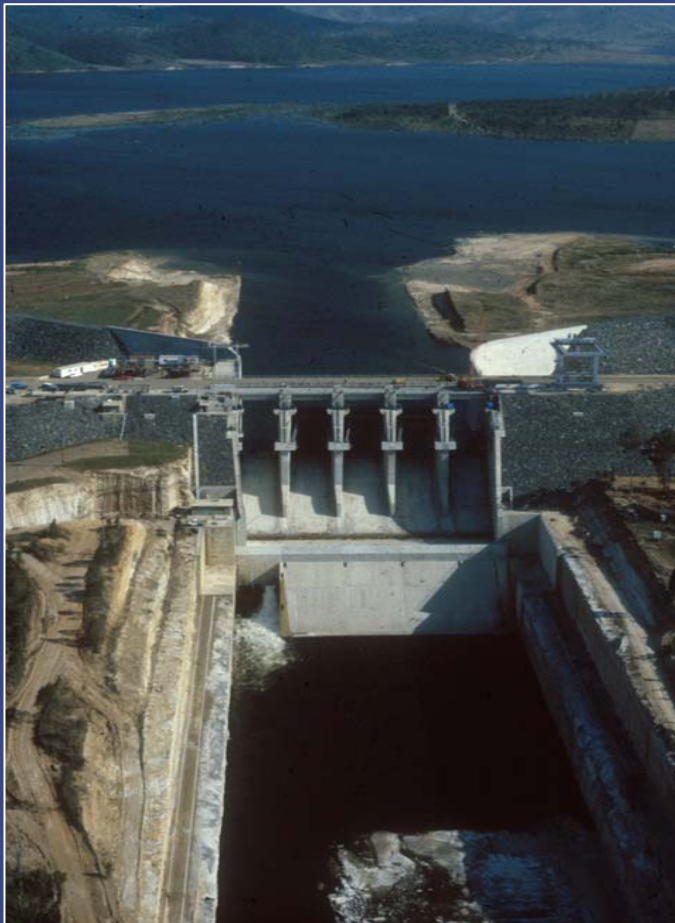
# Floodplains - functionally extinct



# Flow diversion - major threat



## Evidence of unsustainable water use in the late 1990s:



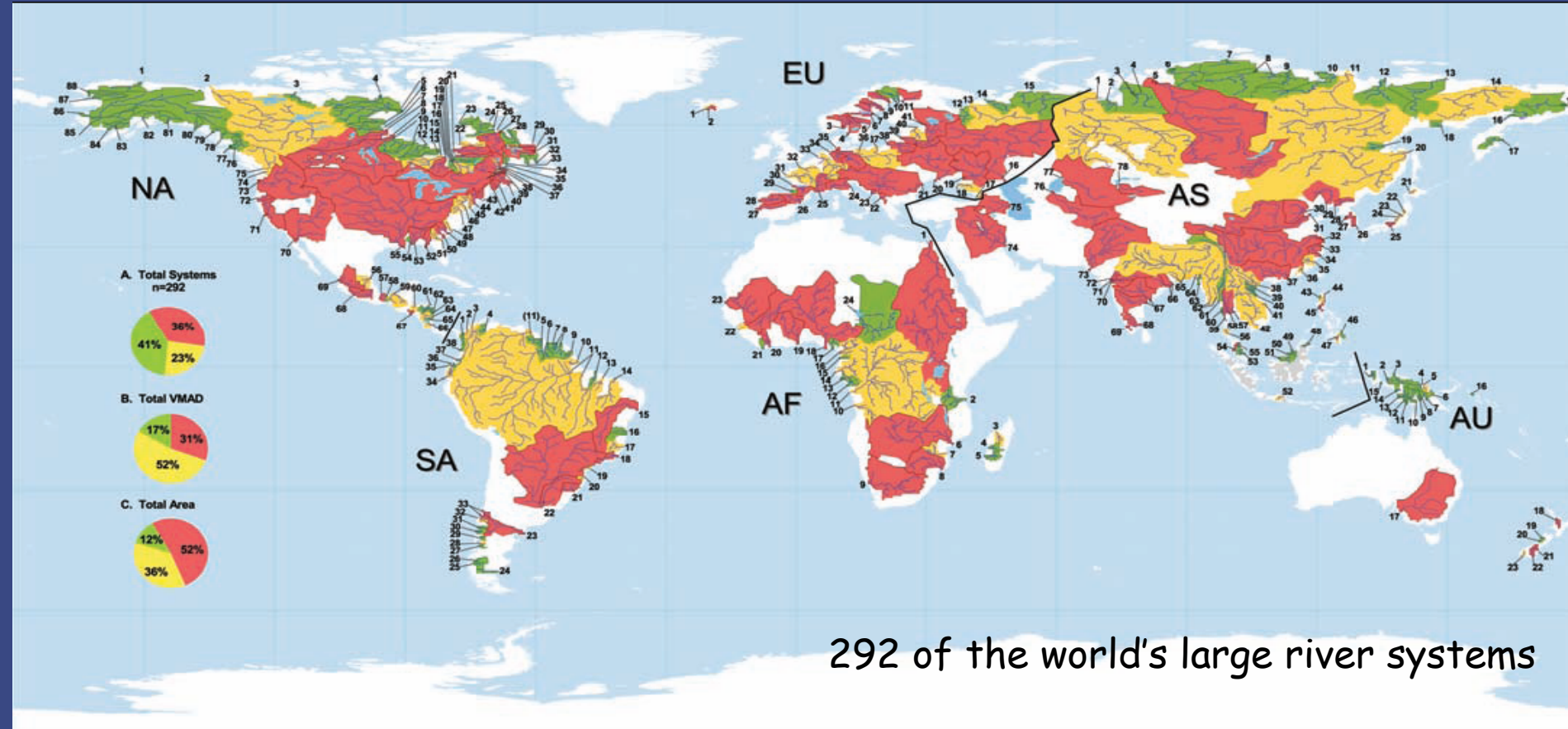
- The Hwang He & Colorado rivers no longer flowed to the sea in the dry season.
- The surface area of the Aral Sea had shrunk by 25,000 km<sup>2</sup>.
- Groundwater tables fell in important food-producing regions of the world
- More than 20% of all freshwater fish species are now threatened or endangered

Currently use about 50% world's average annual renewable freshwater resource (4,000 km<sup>3</sup> yr<sup>-1</sup>)

(Postel *et al.*, 1996, Postel 1998, and World Water Council 1999)



# Channel fragmentation and flow regulation by dams



unimpacted      moderately impacted      strongly impacted

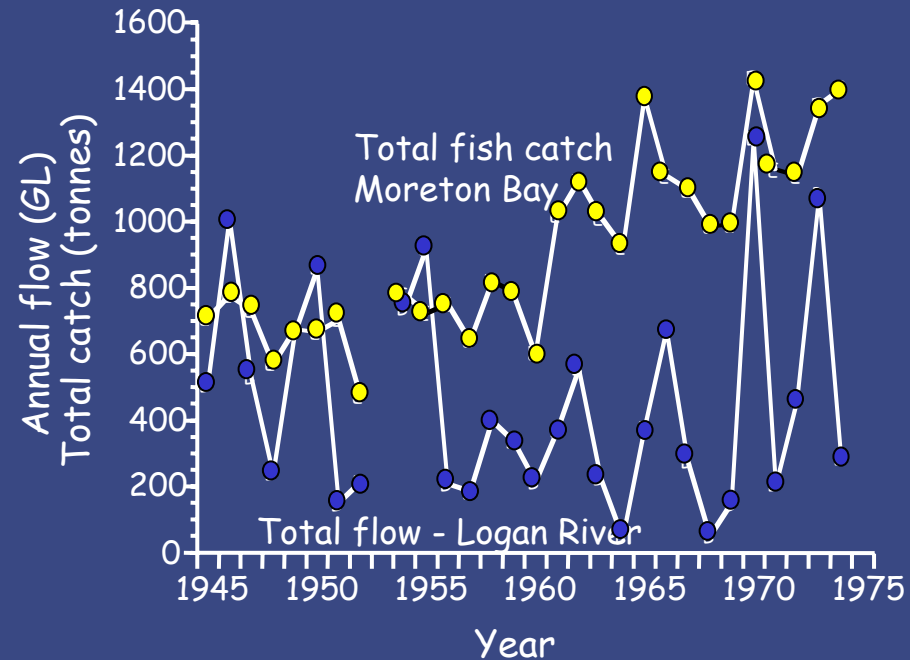
# Impact on migratory species and coastal fisheries



Loss of  
migratory  
species



## Implications for coastal fisheries



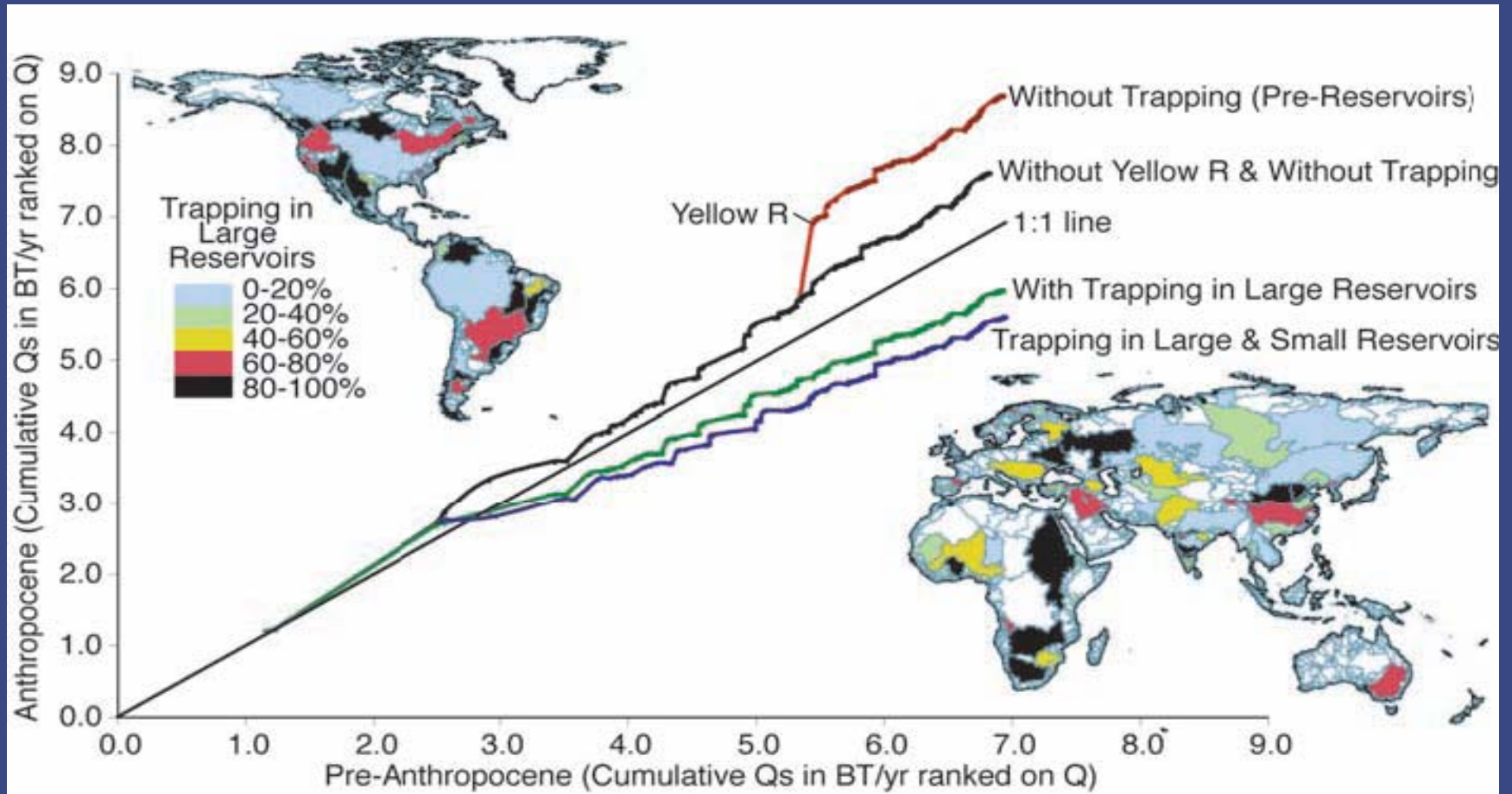
## Flow-fisheries relationships

Loneragan & Bunn (1999) *Aust. J. Ecol.* 24, 431-440

# Impacts on sediment transport to oceans



Sediment transport by global rivers increased by 2.3 billion tonnes pa through erosion, yet flux of sediment to the world's coasts decreased by 1.4 billion tonnes pa because of retention within reservoirs.





# Outline



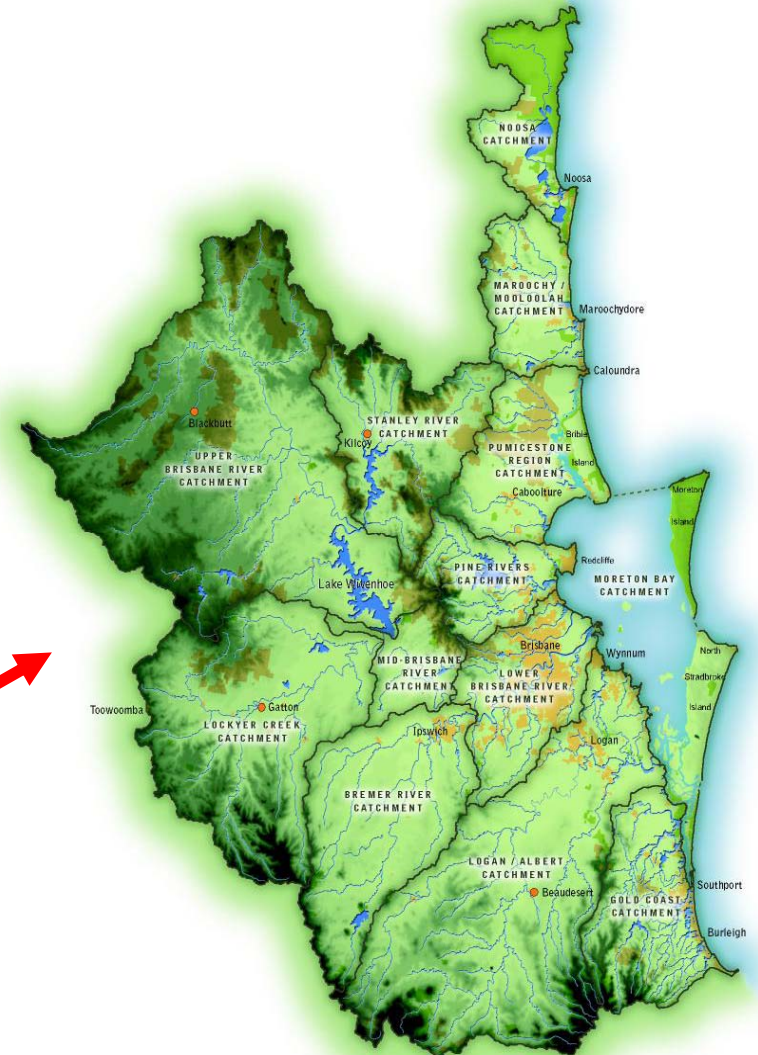
## Case study:

- Moreton Bay catchment in eastern Australia - rapidly expanding population
- Development of partnership (science, managers, policy makers) to deal with issues affecting coastal waterways
- Development of science and monitoring program
- Communication with stakeholders
- Implementation of actions

# Background to the study region



- ◆ 15 major catchments
- ◆ 22,672 km<sup>2</sup>
- ◆ 19 local government areas
- ◆ Population 2.5 m
- ◆ Fastest growing region in Australia

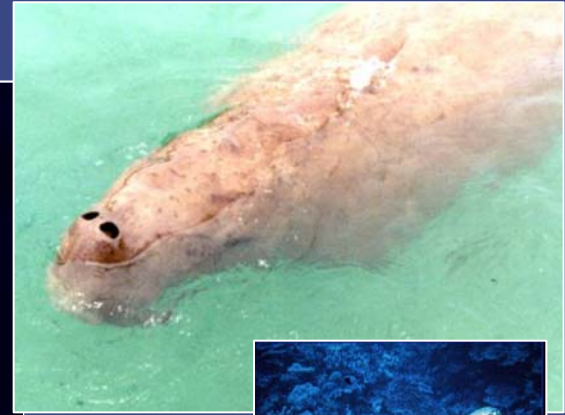




# Importance of the region's waterways:



- High conservation significance (Ramsar)
- Major commercial and recreational fisheries
- Water supply (urban and rural)
- Recreation & transport



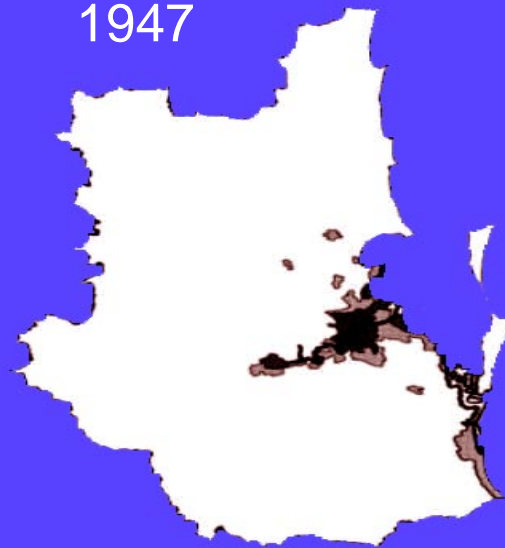
# The human footprint:



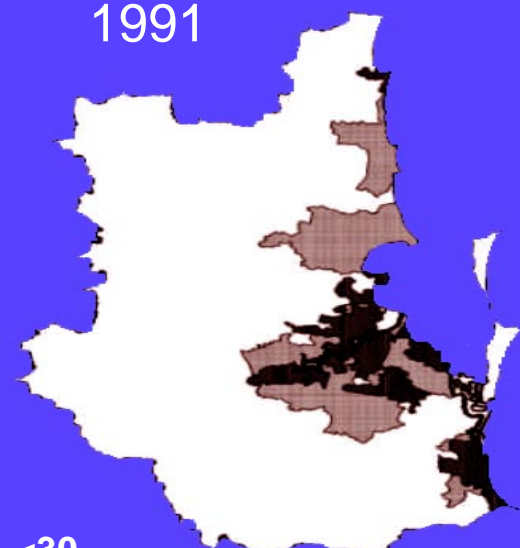
## Since European settlement:

- 20% of original vegetation remains - less adjacent to streams
- Altered hydrology - dams & weirs
- Declining water quality (nutrients & sediment)
- Declines in aquatic diversity

1947



1991



 <30  
 30-250  
 250-5,000 Persons km<sup>-2</sup>



# Catchments drain into Moreton Bay

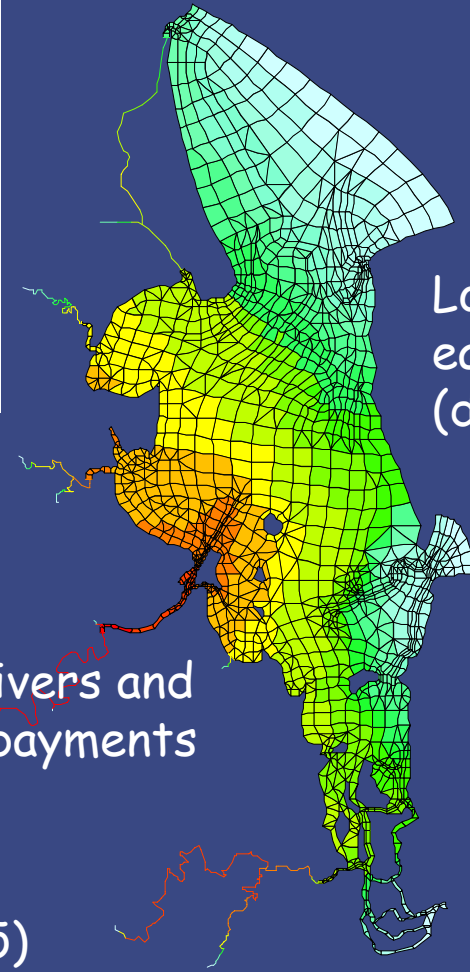


Catchment to Bay Ratio:  
**14:1**

Brisbane River

## Residence Time

Residence time (days)	
116 to 188	Red
73 to 116	Dark Orange
62 to 73	Orange
58 to 62	Light Orange
55 to 58	Yellow-Orange
51 to 55	Yellow
48 to 51	Light Green
45 to 48	Green
41 to 45	Light Green
38 to 41	Green
31 to 38	Light Green
24 to 31	Light Green
19 to 24	Light Green
9 to 19	Light Green
6 to 9	Light Green
0 to 6	Light Green



Lowest in eastern Bay (days)

Highest in rivers and western embayments (months)

Abal *et al.* (2005)

# Key drivers for change



- Fast growing population
- Security of water supply (quantity and quality)
- Concerns about industry viability - tourism, fishing and agriculture.
- Increasing community expectations about improving water quality and ecosystem health

Recognition - cheaper to protect than to restore ...





# Formation of the Partnership

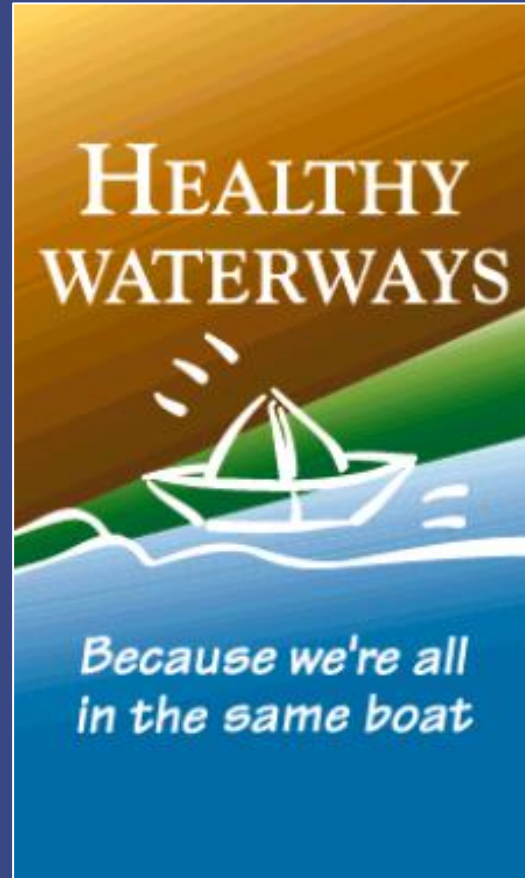


## 3 levels of government

- Local councils (6; 19)
- State Government agencies (6)
- plus Federal funding

## Strong research support

- 3 Universities
- CSIRO
- 3 Cooperative Research Centres



## Community & industry advisory groups (>40)

- indigenous
- conservation
- catchment & landcare
- commercial industry
- rural industry



# Developing a common vision:



“South-east Queensland’s catchments and waterways will, by 2020, be **healthy living ecosystems** supporting the livelihoods and lifestyles of people in South-east Queensland and will be managed in collaboration between community, government and industry.”



# Achieving the vision:



Set values that reflect the vision

- numerous workshops with stakeholders

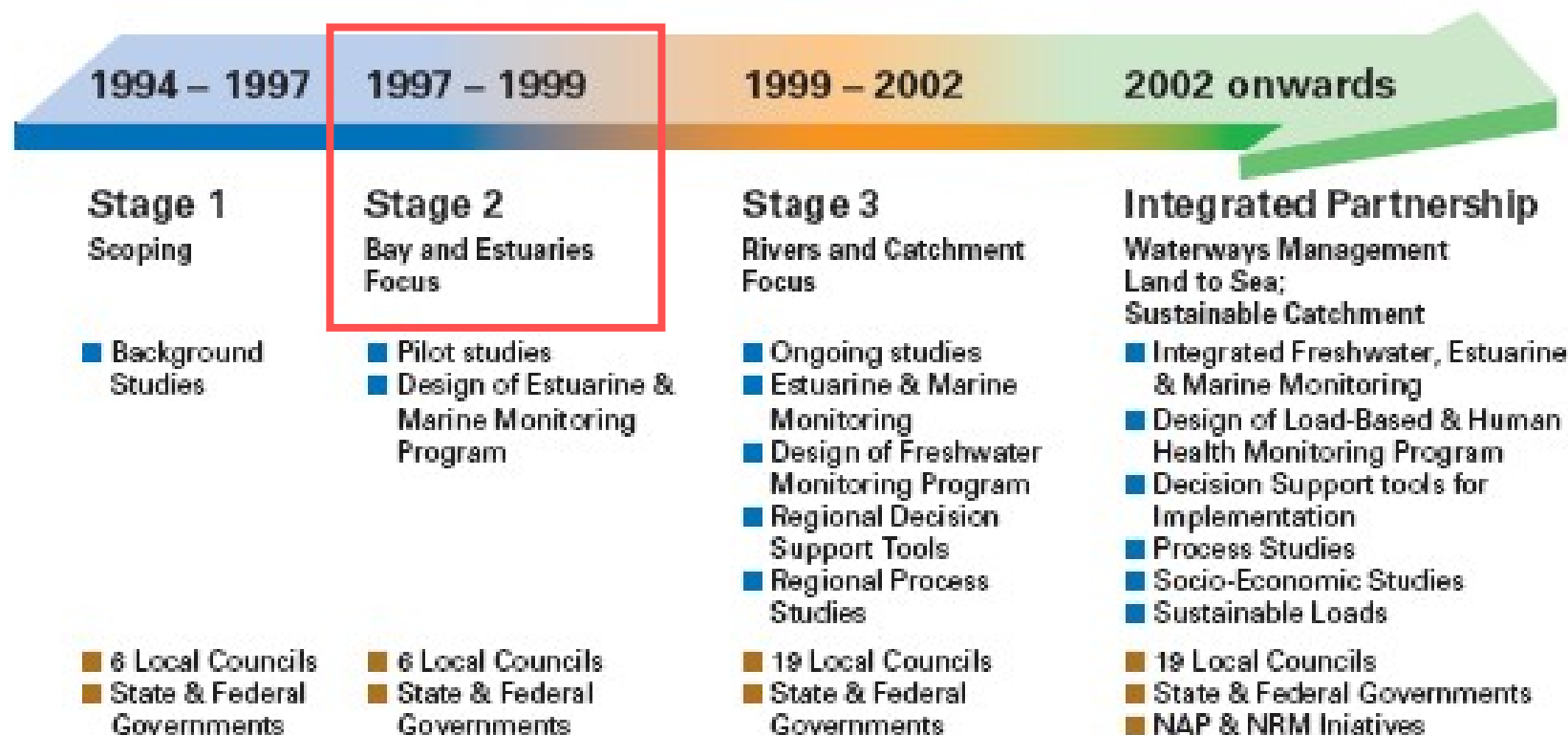
Measurable water quality or ecosystem health objectives that protect the values

- underpinned by sound science

Management actions to achieve these objectives

- working with policy makers

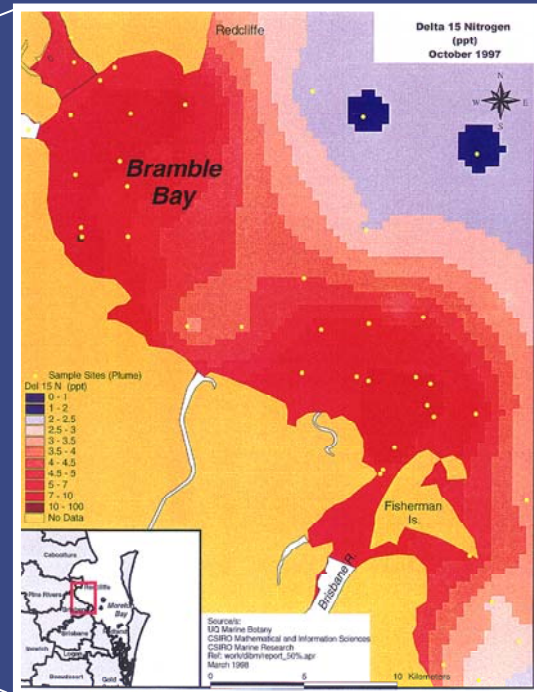
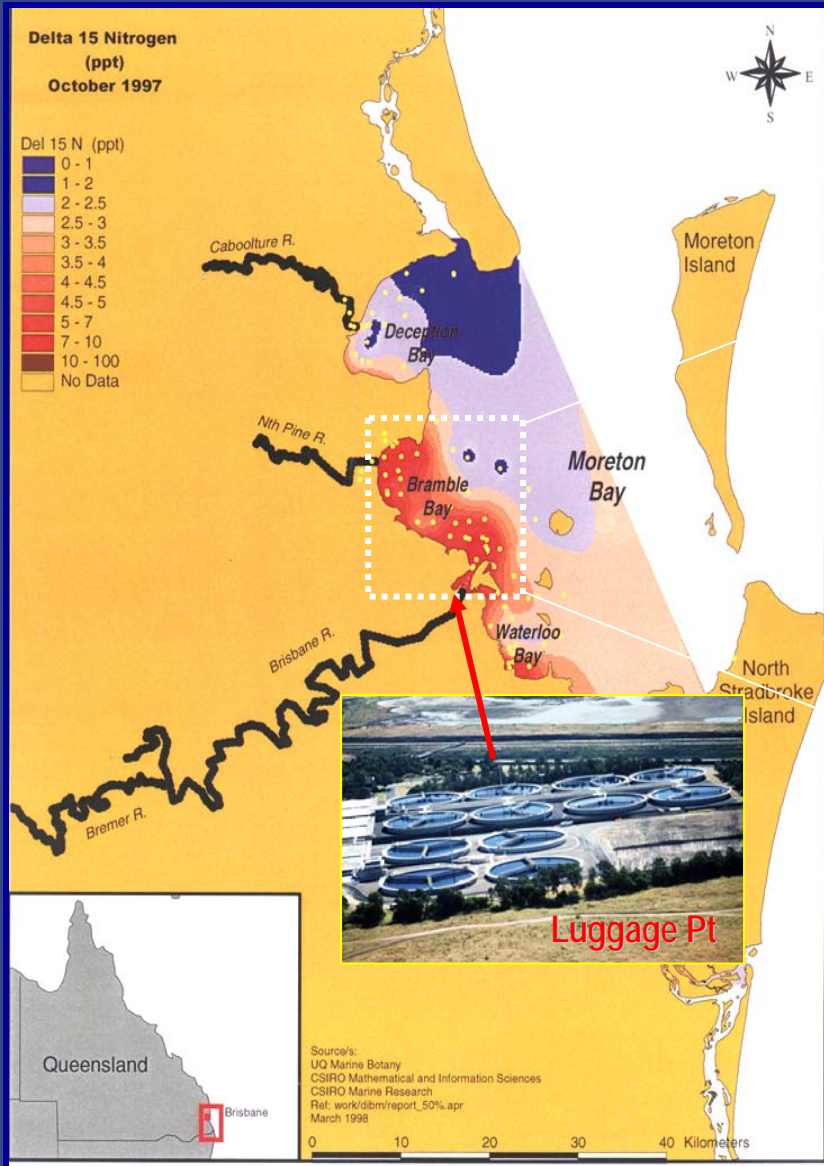
# A staged approach: Stage 2- Moreton Bay



A staged approach was adopted by the Study, with each stage having a different focus, targeted objectives and clear outcomes.



# Sewage Plume Mapping (using $\delta^{15}\text{N}$ )

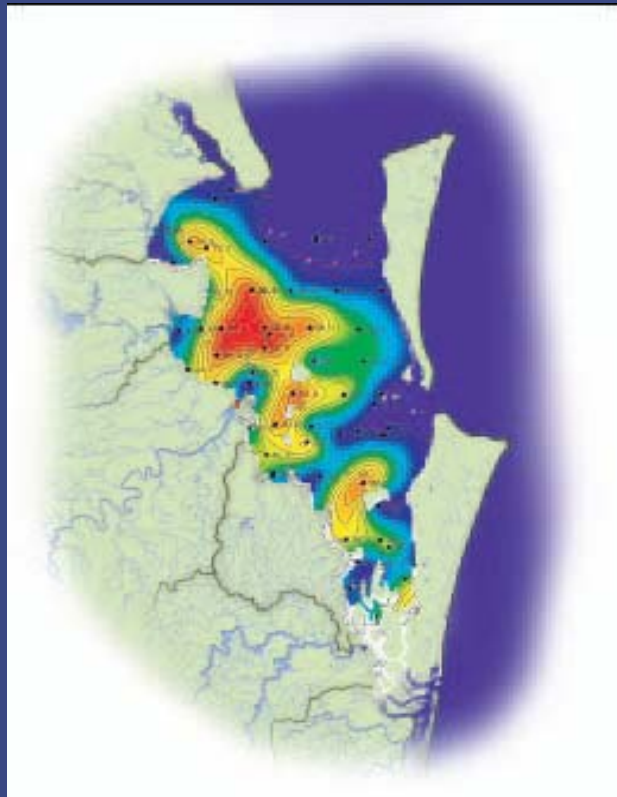


*Marine Botany, University of Queensland  
 CSIRO Mathematical and Information Sciences  
 CSIRO Marine Research*

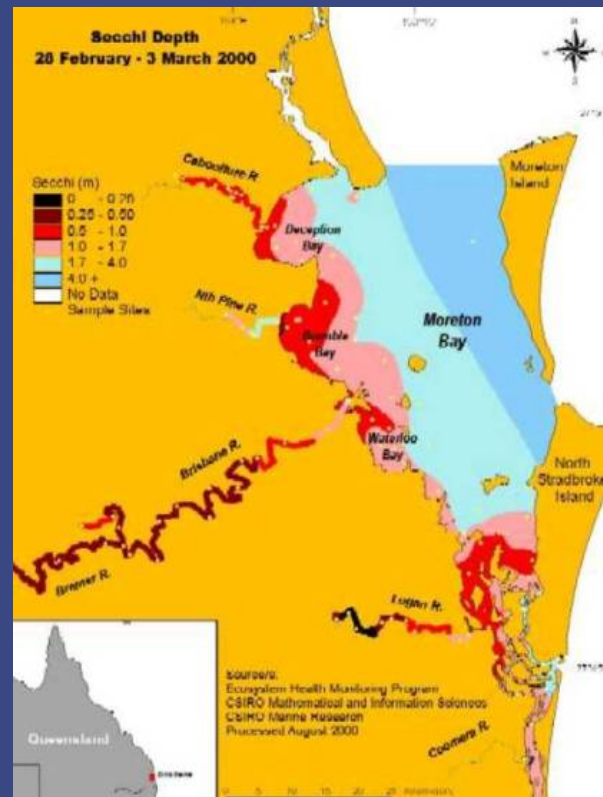
# Sediments in Moreton Bay and seagrass loss



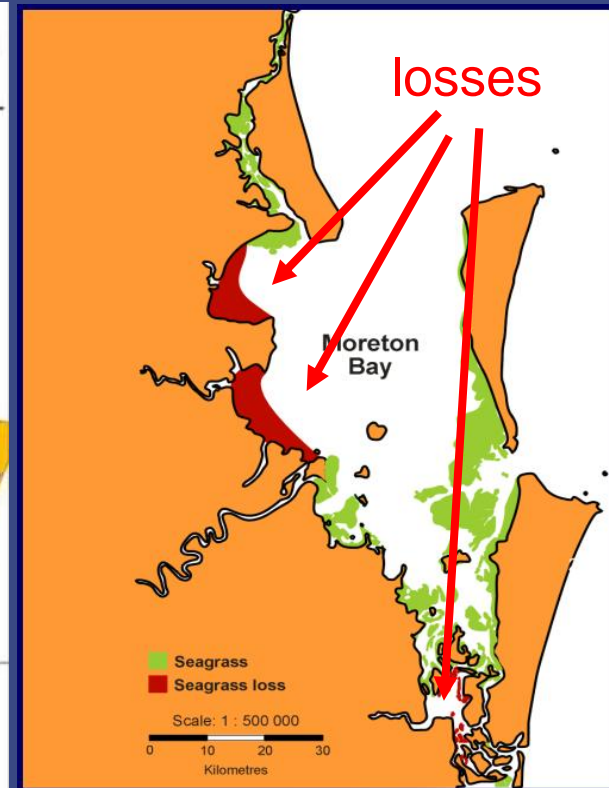
## Sediments in the Bay



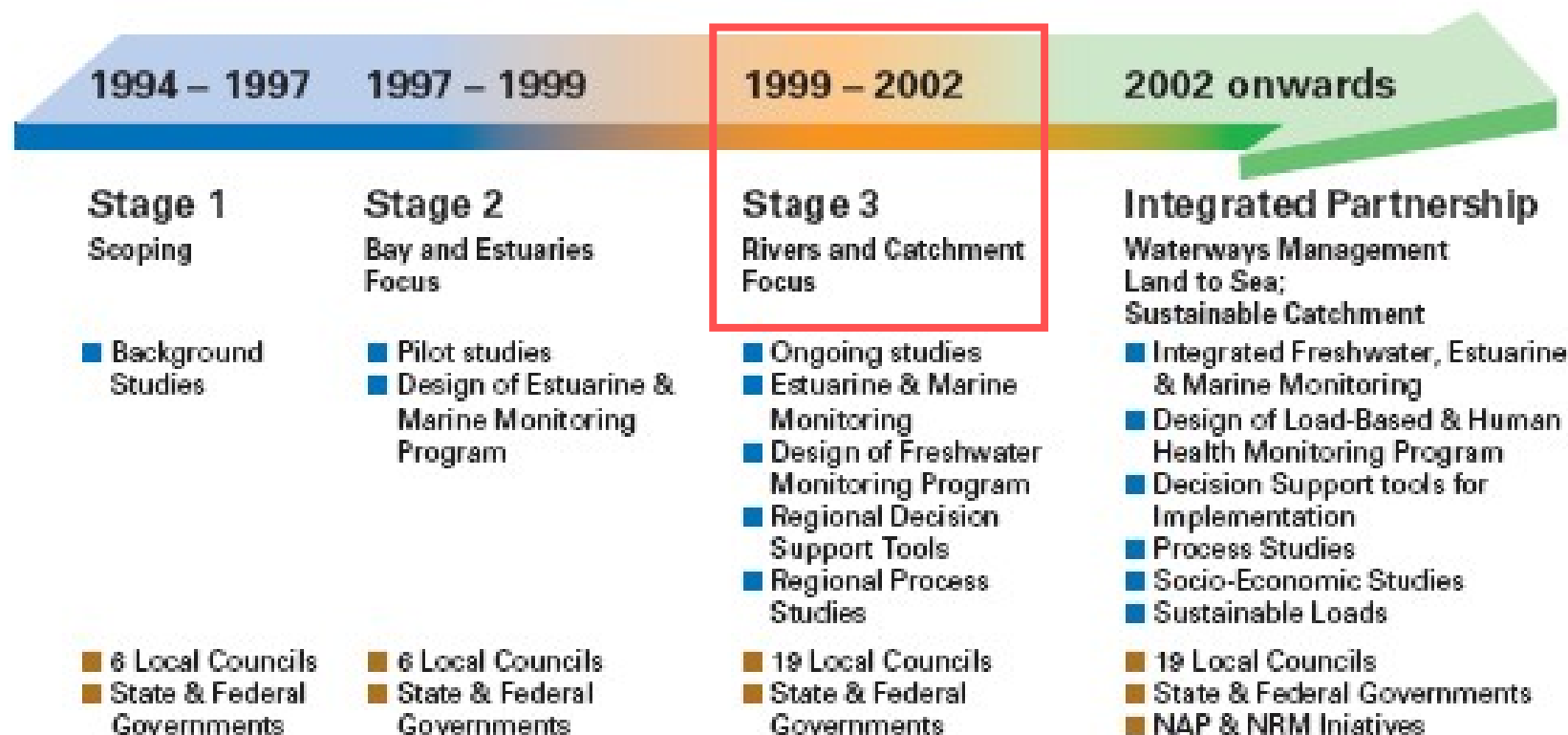
## Turbidity



## Seagrass distribution



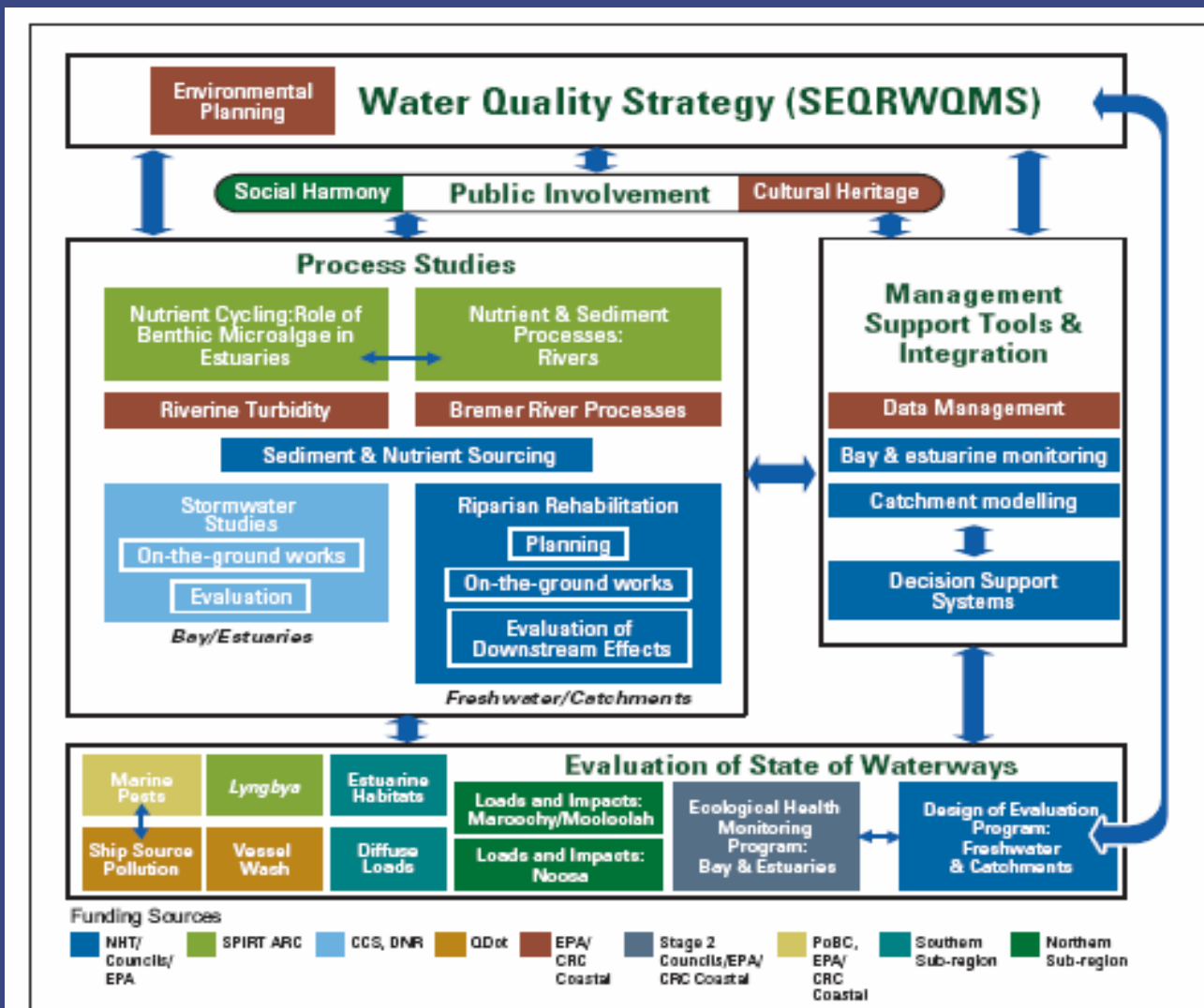
# A staged approach: Stage 3- catchments



A staged approach was adopted by the Study, with each stage having a different focus, targeted objectives and clear outcomes.

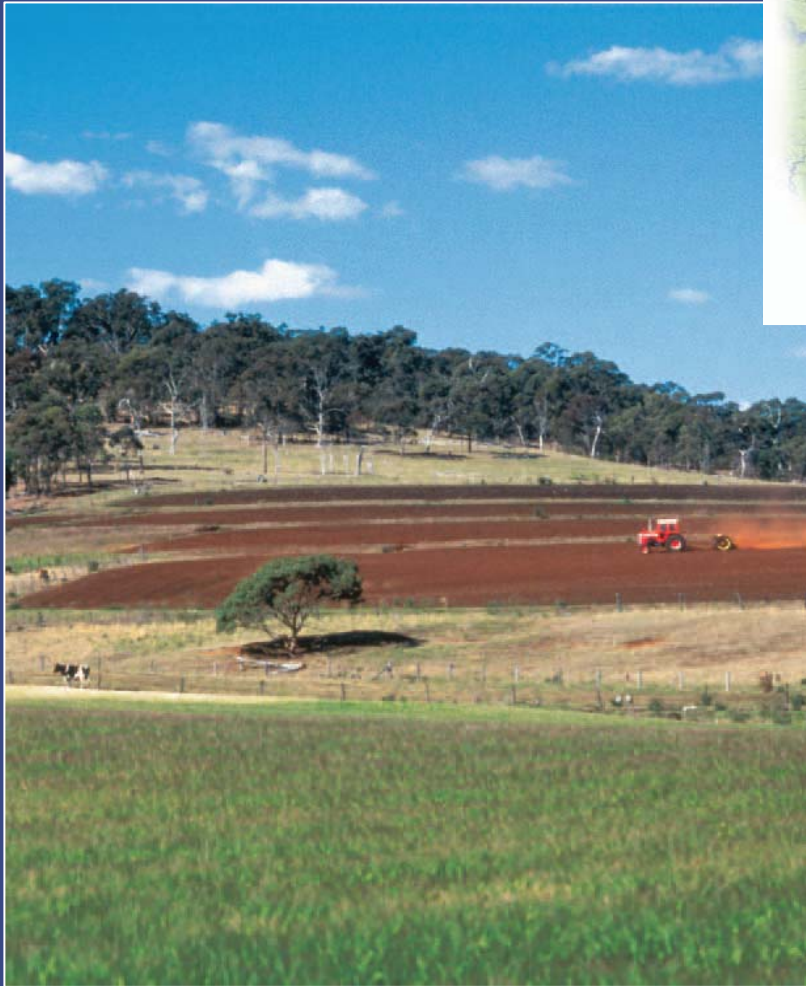
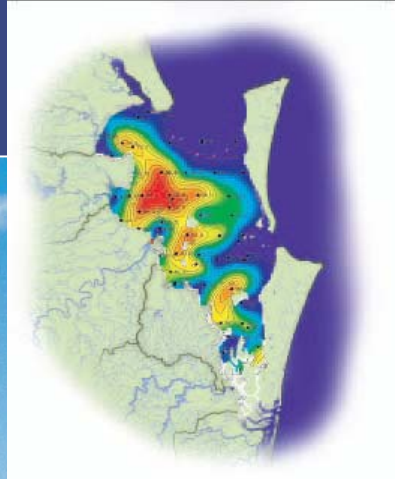


# Stage 3 Scientific Tasks



Stage 3 task architecture, showing the integration and linkages of tasks aimed at providing input into the development of the SEQ Regional Water Quality Management Strategy.

# Sources of sediment in Moreton Bay

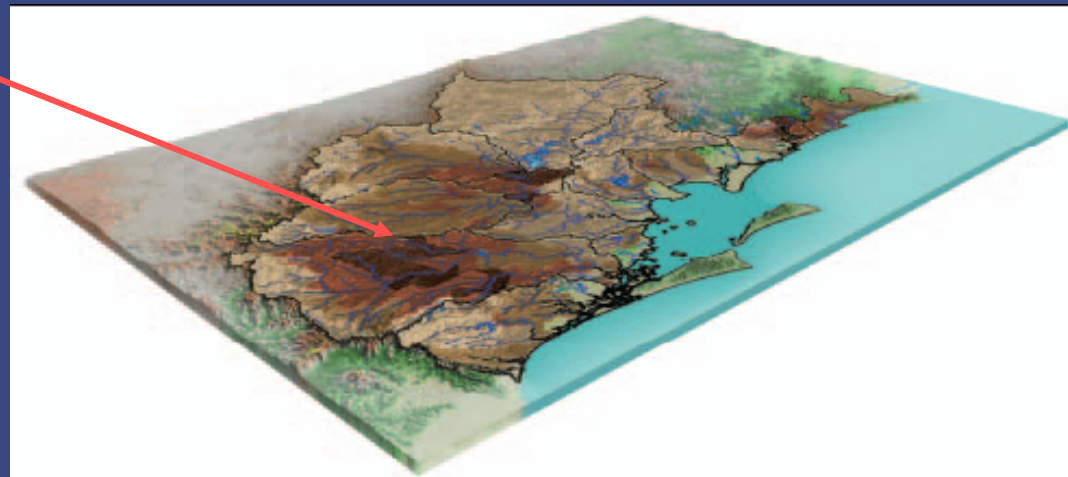
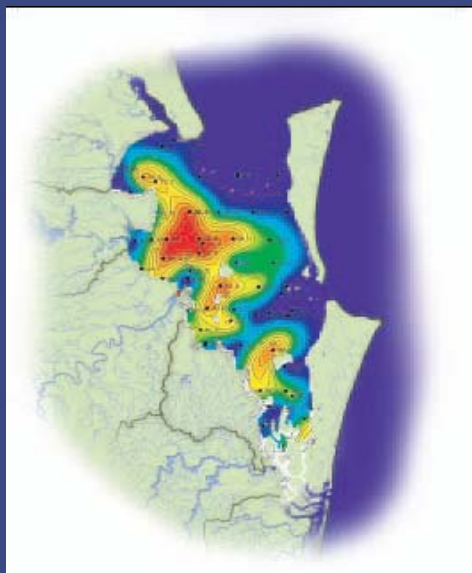


- Where does it come from?
- What are the processes that generate it?

# Source of sediment in Moreton Bay



Modelling suggests 70% sediment in Bay comes from <30% catchment area



Tracer study confirms that most sediment comes from soils on Marburg formation rocks





# Dominant processes generating sediment?



**Hillslope erosion**  
Key issue in steeper pasture and intensively cropped floodplain

**Solutions:**

- promote ground cover
- maintain soil structure
- trap eroded sediments



Illustration of channel and hillslope erosion processes. Channel erosion includes gully and streambank erosion and hillslope erosion includes sheetwash and rill (shallow [ $<20$  cm] channel) erosion.

# Dominant processes generating sediment?

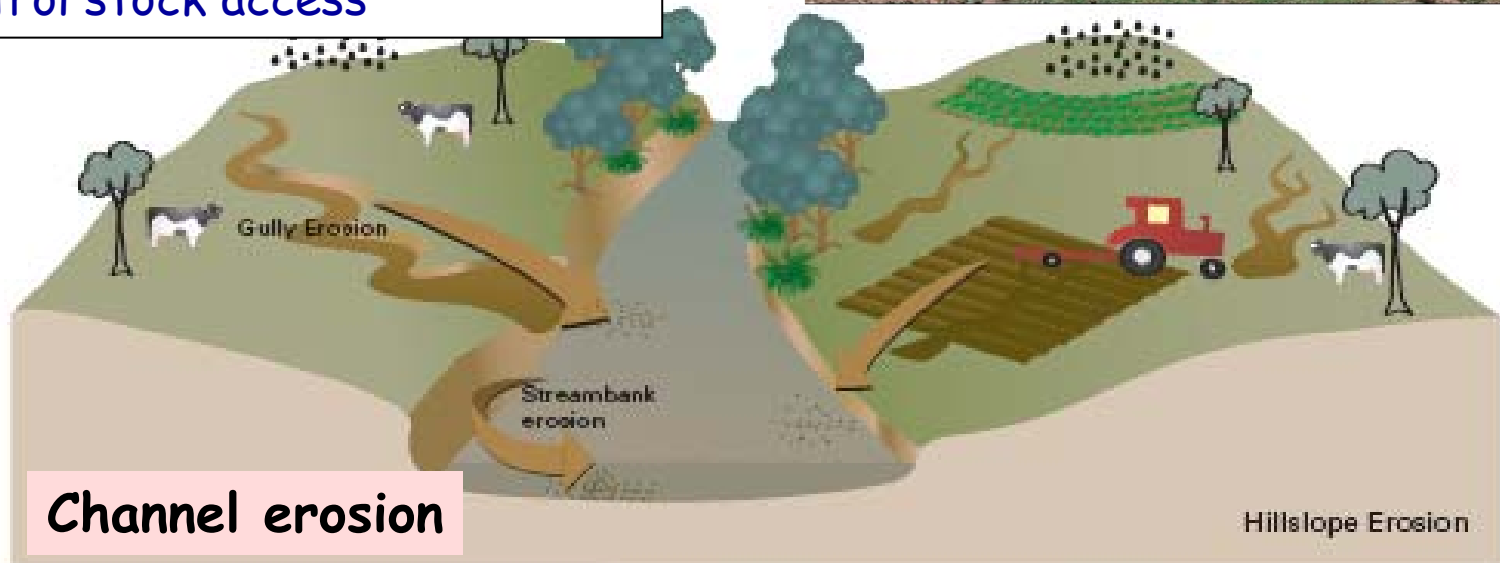


## Channel erosion

Promoted by high stream energy, riparian vegetation clearing, and floodplain degradation

### Solutions:

- protect riparian vegetation
- re-establish riparian vegetation
- control stock access



## Channel erosion

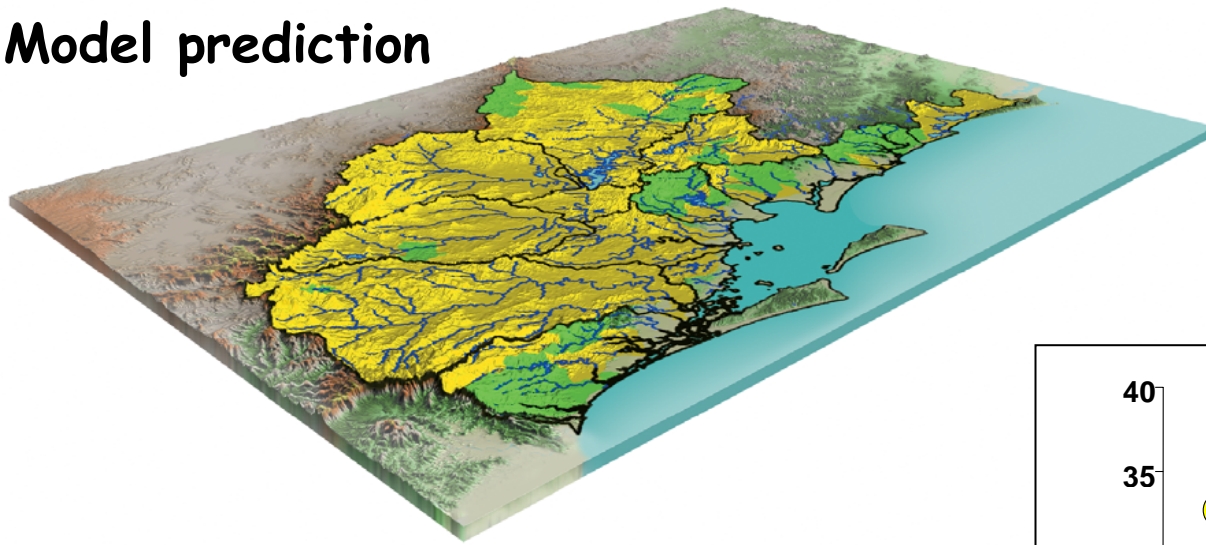
Hillslope Erosion

Illustration of channel and hillslope erosion processes. Channel erosion includes gully and streambank erosion and hillslope erosion includes sheetwash and rill (shallow [ $<20$  cm] channel) erosion.

# Channel erosion dominates in the region



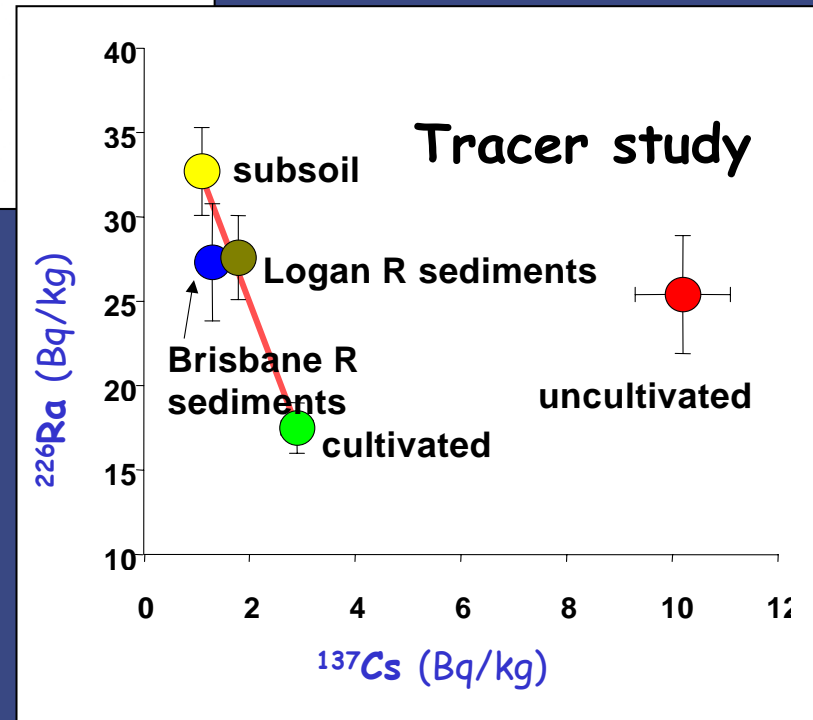
## Model prediction



Hillslope:channel erosion ratio

- 0-1 (channel erosion dominates)
- 1-10 (hillslope erosion dominates)

- Channel erosion is source of most sediments delivered to the lower Brisbane & Logan Rivers
- Other source is cultivated surface soils



Caitcheon & Howes (2005)

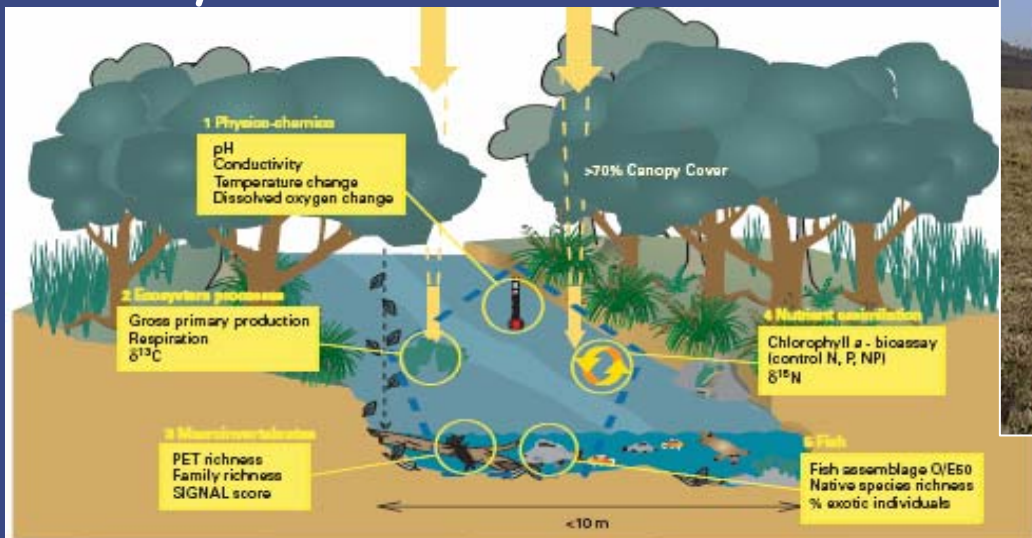


# Degraded riparian lands

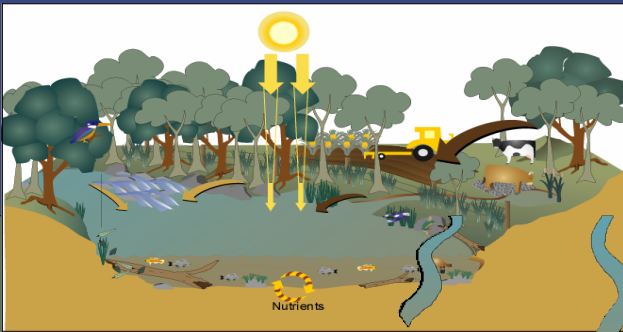


About 50% of the 48,000 km of streams in SEQ has poor riparian condition

Riparian condition also has a large influence on stream ecosystem health



# Recommendations for riparian management



High flow events

Riparian rehab. for:

- filtering sediments & nutrients
- stabilisation
- altering water flows

Streams are dry most times of the year

Permanent flowing streams



Canopy cover > 70%

Riparian rehab. for:

- stream health
  - stabilisation
  - wildlife corridor
  - habitat protection
- Riparian rehab. for:
- stabilisation
  - wildlife corridor
  - habitat protection

SQIDS/Wetland



# Using Decision Support Software

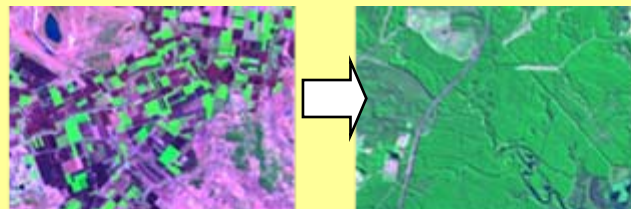


## EMSS

- Synthesise process understanding of the system (links catchment to water)
- Facilitates decision making process to select actions to best protect waterways



Land use and land management change



Wastewater Treatment (city)



Wastewater treatment (industrial)

Stream bank re-vegetation



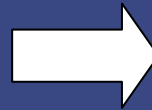
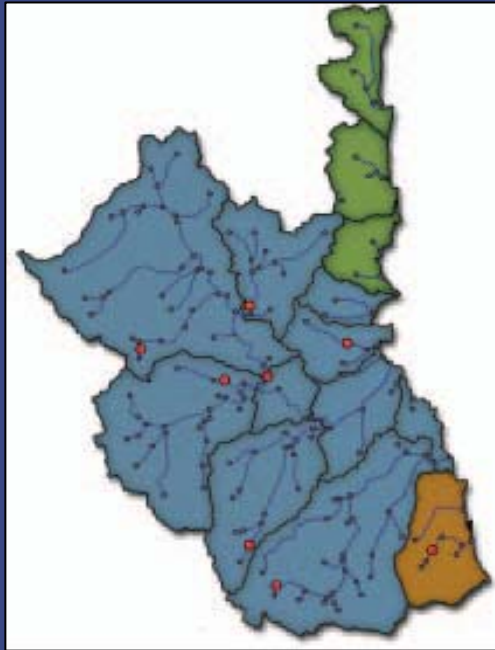
Environmental Management Support System



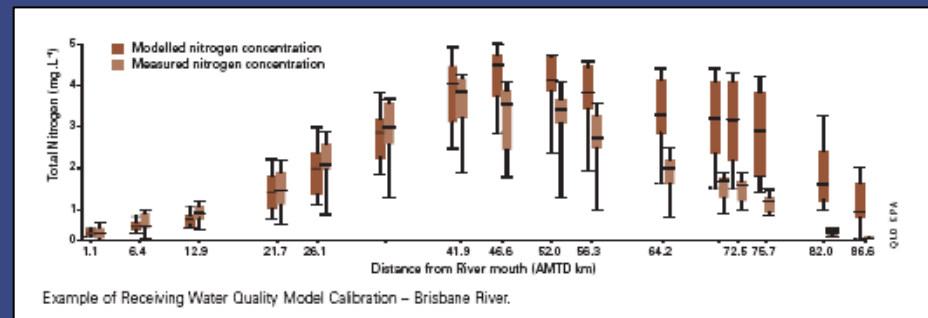
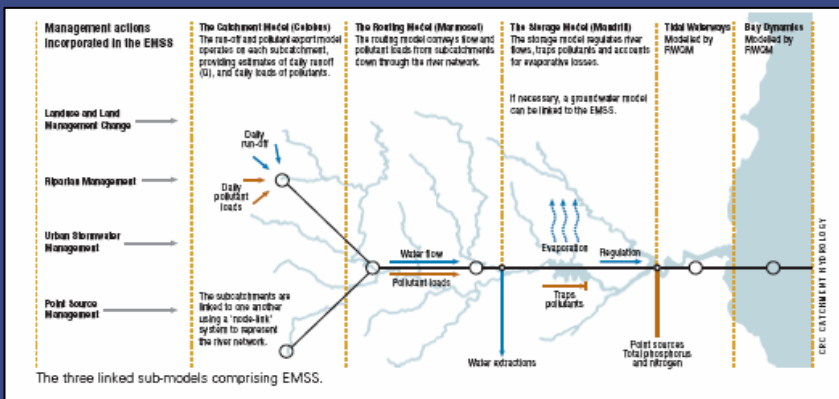
# Using Decision Support Software



EMSS



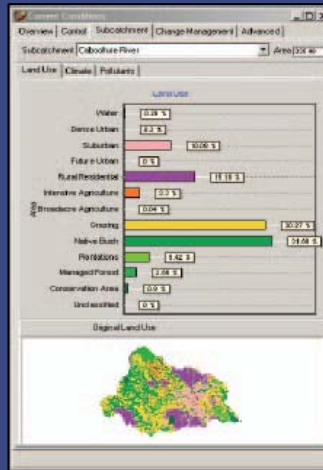
Receiving Water Quality Model



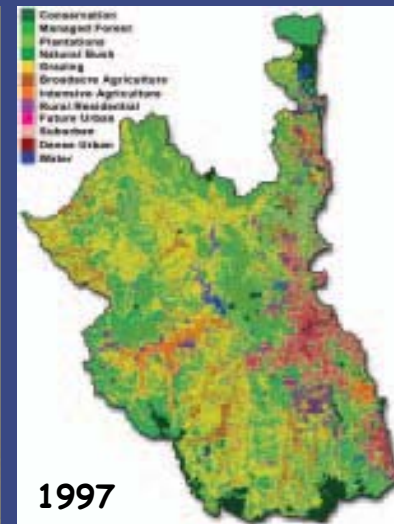
Example of Receiving Water Quality Model Calibration – Brisbane River.

Vertessey & McAlister (2005)

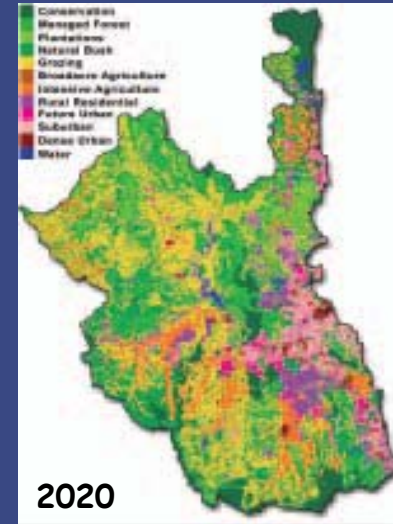
# Scenario testing



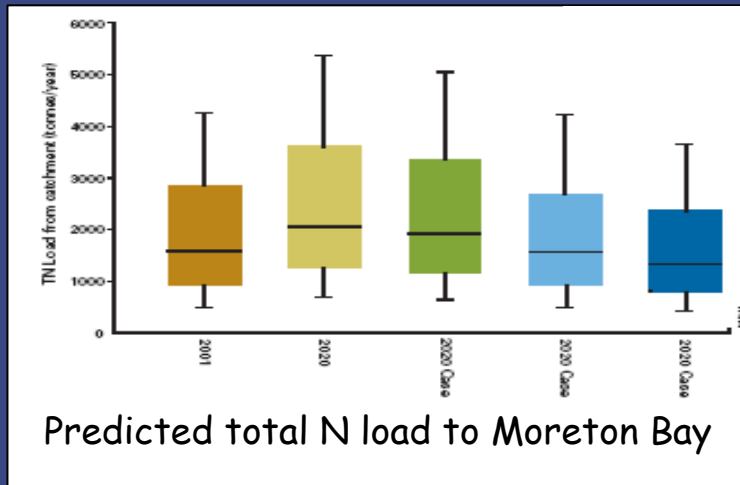
Past



Present



Future



- Current TN loads
- 2020 "do nothing" scenario
- 2020 achieve objectives for future urban land
- 2020 achieve objectives for future urban land + SQID retrofit
- 2020 achieve objectives for future urban land + SQID retrofit + riparian management



# Ecosystem Health Monitoring Program

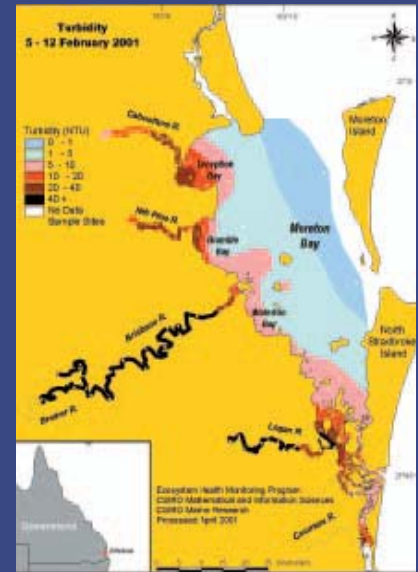


Assess effectiveness of environmental protection measures (e.g. stormwater controls, STP upgrades, riparian vegetation)



Estuarine and marine EHMP  
- Designed stage 2  
- Implemented Stage 3

260 sites (sampled monthly)





# Ecosystem Health Monitoring Program



## Freshwater EHMP - Designed stage 3 ; Implemented 2002

### Integrated monitoring for South East Queensland waterways

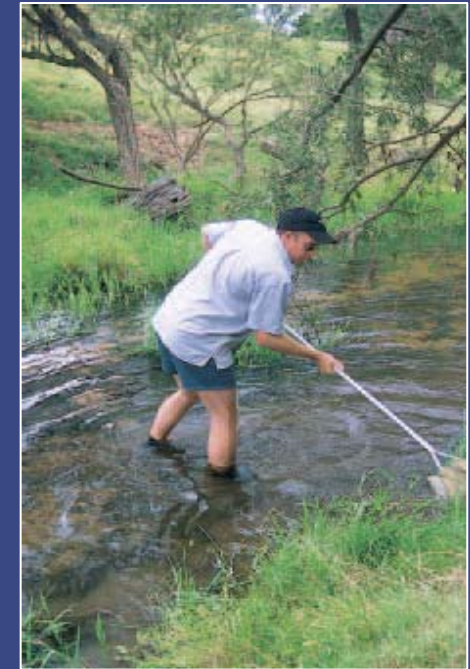
- Upland streams and lowland rivers (including coastal and wellum)
- Estuaries and Moreton Bay (and Broadwater)



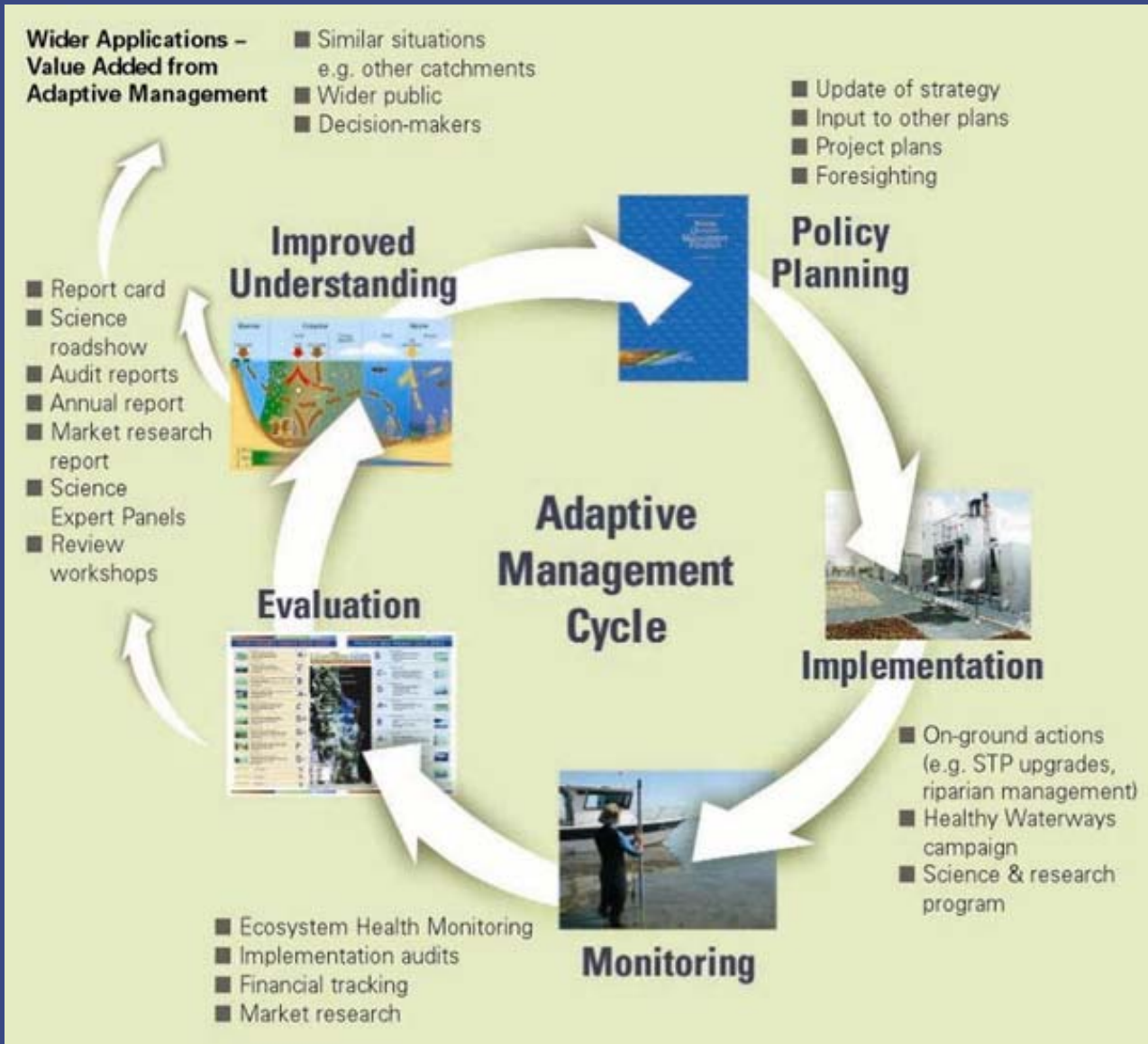
The South East Queensland (SEQ) Ecosystem Health Monitoring Program has two integrated components; the estuarine and marine EHMP includes Moreton Bay, the Broadwater and all of the SEQ estuaries. The freshwater component includes rivers and streams above the estuaries.



120 freshwater sites  
(sampled 2x/yr)



# Adaptive management framework



- ongoing knowledge acquisition
- critical role of monitoring
- continuous improvement in the identification and implementation of management.
- effective communication of knowledge for policy/planning



# Report cards on progress

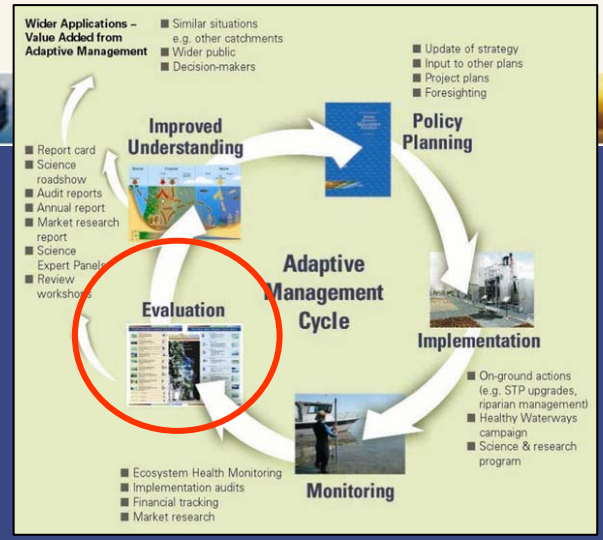


HEALTHY WATERWAYS

Ecosystem Health Monitoring Program



## Report Card 2004 for the waterways of South East Queensland



Ecosystem Health Monitoring Program

### Freshwater Report Card 2004

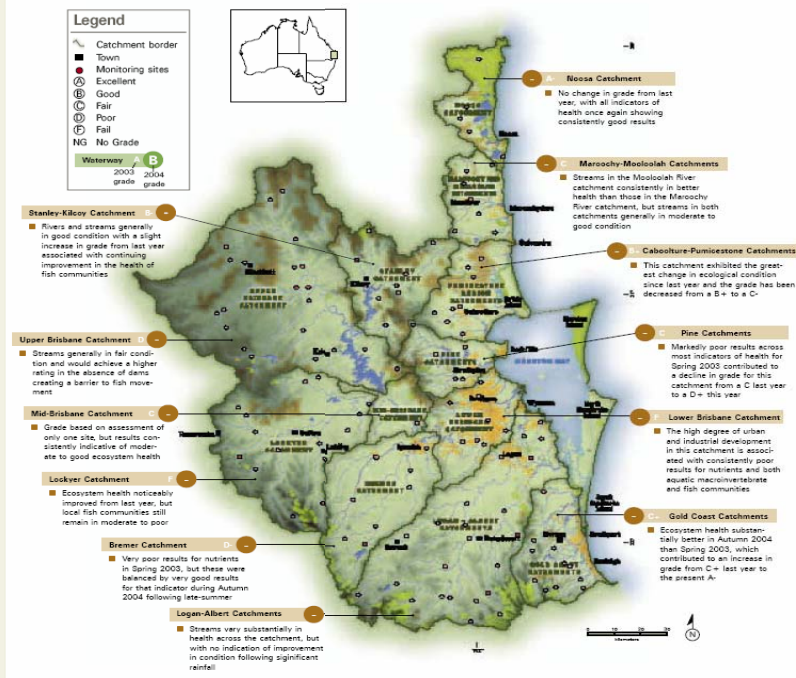
A comprehensive monitoring program  
The Ecosystem Health Monitoring Program (EHMP) delivers a regional assessment of ecosystem health for the waterways of South East Queensland. With its "catchment to coast" philosophy, the program targets both freshwater and estuarine/marine environments, in an area extending from Noosa in the north, south to the NSW border and west to Toowoomba. The EHMP uses rigorous science to identify waterway health incorporating a range of biological, physical and chemical indicators. The monitoring of appropriate indicators for the estuarine/marine component of the EHMP started in Moreton Bay in 1999, expanded north to the Sunshine Coast in 2001 and south to the Gold Coast in 2002, and now includes 250 monitoring sites. The EHMP expanded into the freshwater catchments in 2002, with a total of 120 freshwater sites now being monitored in South East Queensland's rivers and streams.

A partnership approach  
The EHMP was established in response to requests by the 19 Local Governments and other stakeholders in South East Queensland for provision of an independent audit of the effectiveness of environmental protection and management measures undertaken by their agencies. The program is managed by the Moreton Bay Waterways and Catchments Partnership on behalf of the various stakeholders and is implemented by a large team of experts from the Queensland Government (Natural Resources and Mines, Environmental Protection Agency, Queensland Health Scientific Services), universities (University of Queensland, Griffith University) and CSIRO.

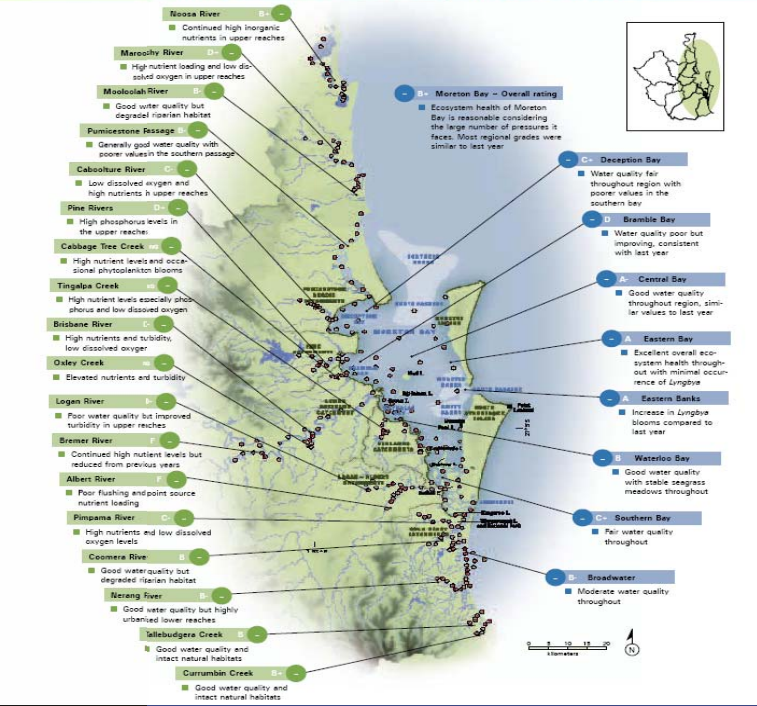
Integrated into an adaptive management framework  
The EHMP reports on regional ecosystem health condition, which can be used to provide long-term feedback on the effectiveness of management actions undertaken to protect South East Queensland catchments, waterways and Moreton Bay, and to identify emerging issues that may require management intervention. To achieve this, the program is embedded into the Partnership's adaptive management framework that links monitoring to management objectives and regular review and evaluation of the effectiveness of our actions.

The EHMP has received national and international recognition, and is considered one of the best comprehensive marine, estuarine and freshwater ecosystem health monitoring programs in Australia.

Detailed information on the indicators and methods employed in the EHMP can be found in the Ecosystem Health Monitoring Program 2002 - 2003 Annual Technical Report published by the MBWCP, or by visiting the Healthy Waterways website at [www.healthywaterways.org](http://www.healthywaterways.org).

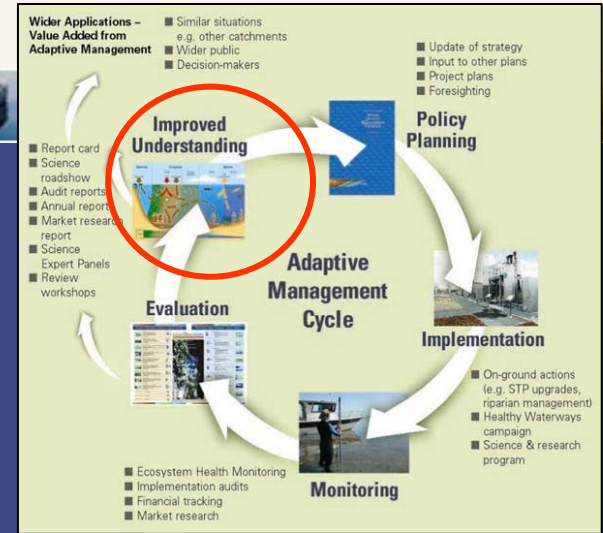


### Estuarine and Marine Report Card 2004

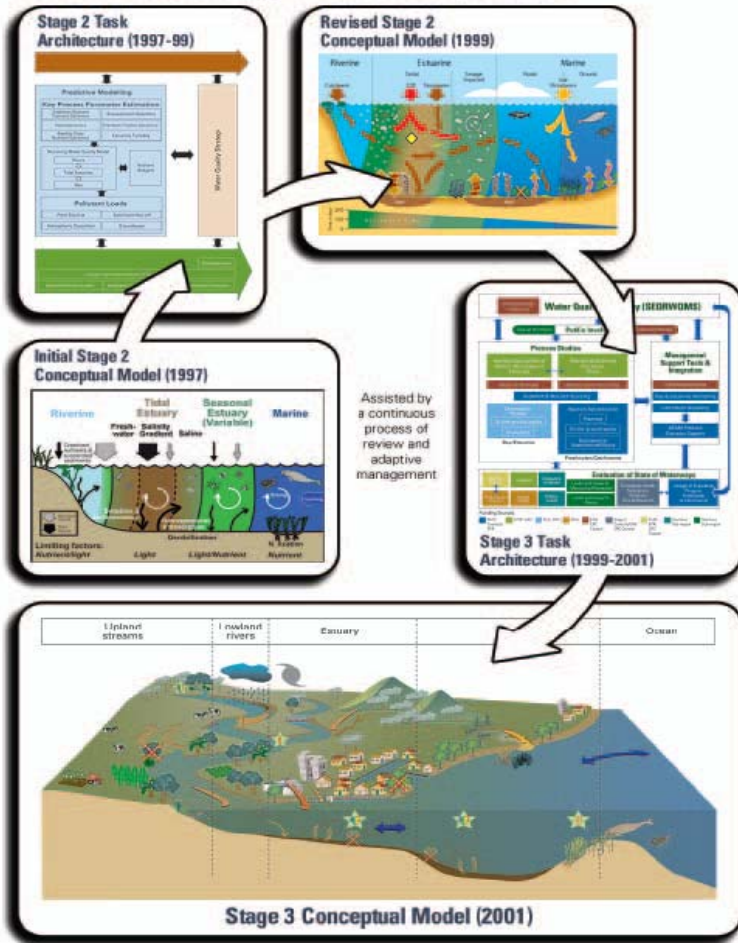




# Improvement of understanding

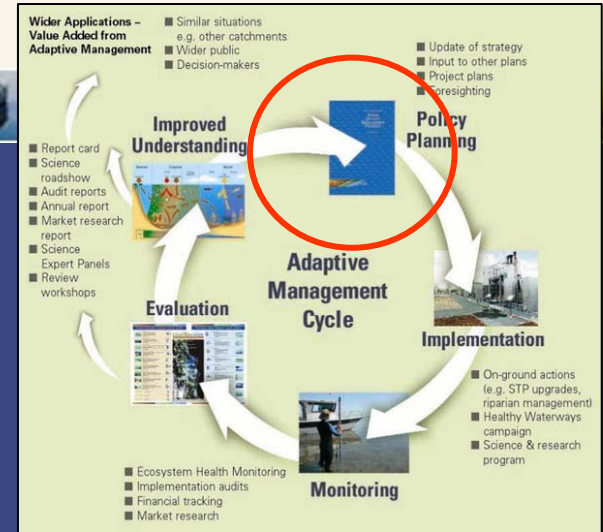
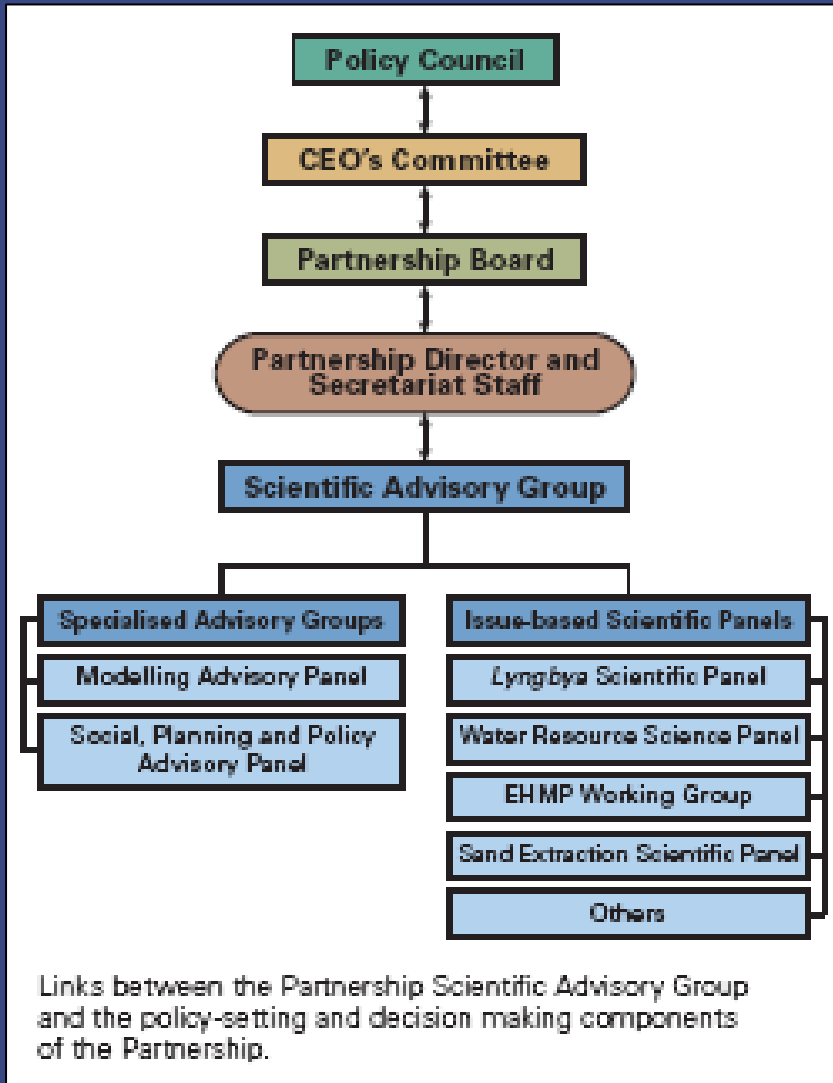


## How our understanding of SEQ waterways evolved



Continual refinement and testing of conceptual models

# Links to policy



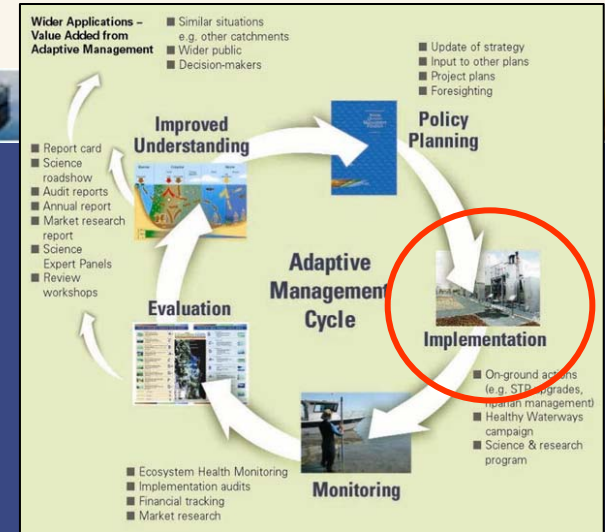
Strong link between science and policy makers



# Targeted management actions



Sewage Treatment Plant upgrades



Stormwater Quality Improvement Devices

Riparian Rehabilitation

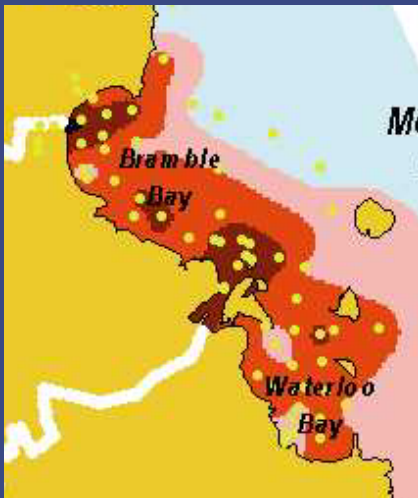
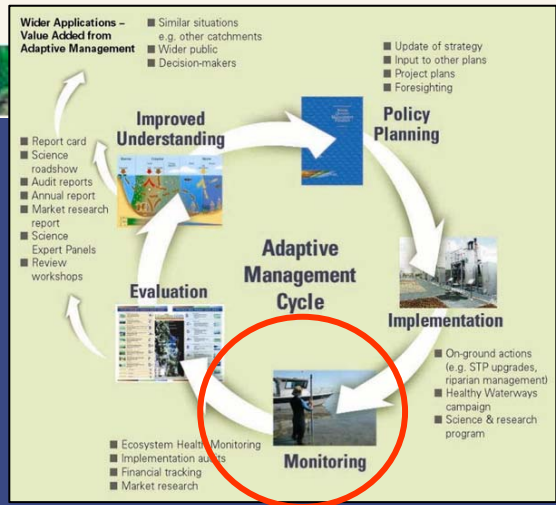




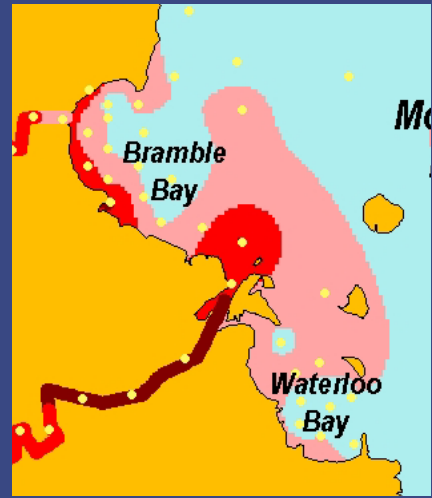
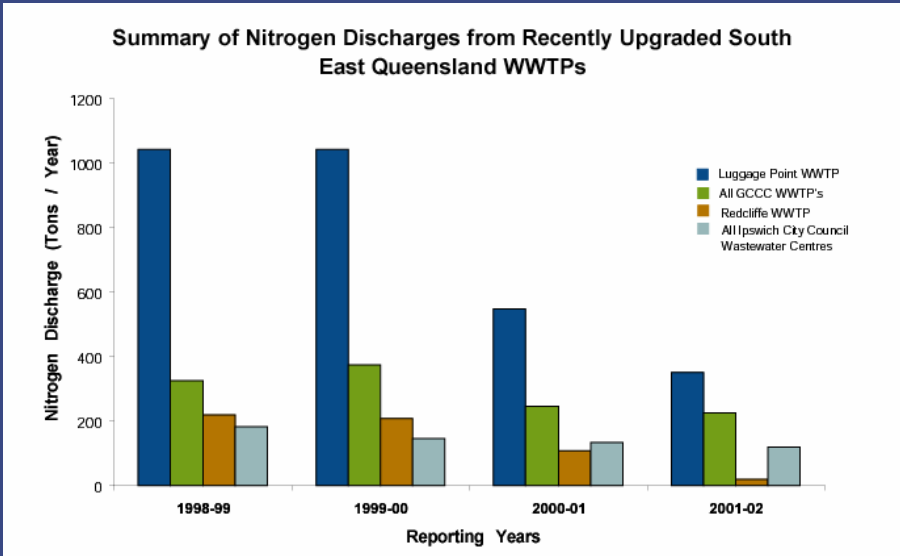
# Effectiveness of management actions



~\$500M commitment by local government to reduce wastewater



$\delta^{15}\text{N}$  Sewage Plume 1998 (summer)

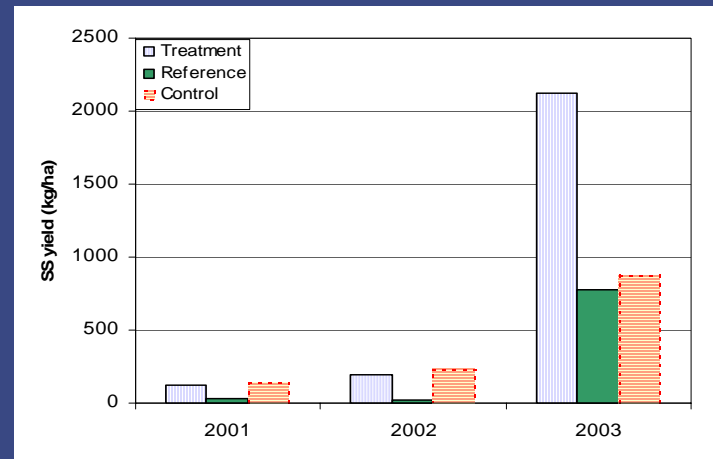
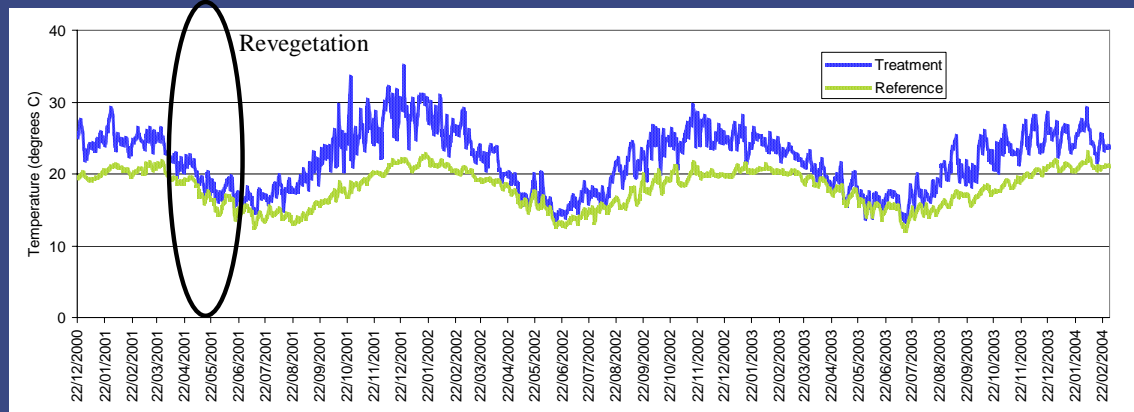


$\delta^{15}\text{N}$  Sewage Plume 2001 (summer)

# Riparian rehabilitation experiments

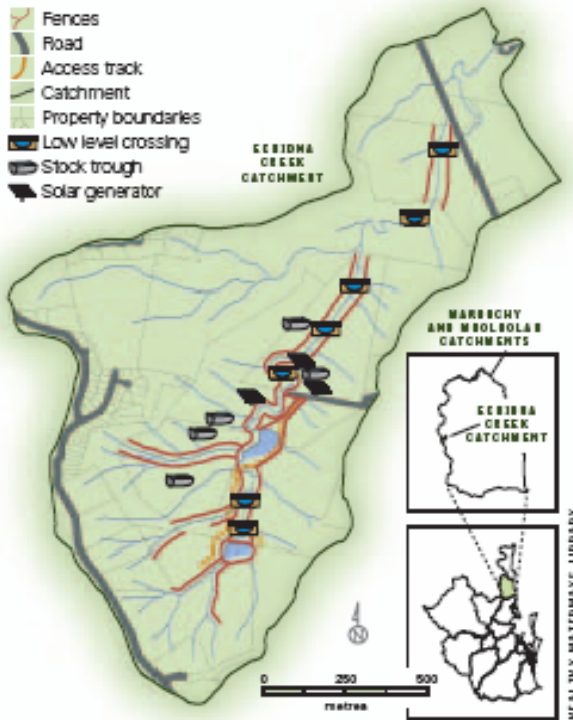


## temperature regimes



sediment yield

## Echidna Creek case study



Echidna Creek, a tributary of the South Maroochy River, is a focal catchment in the riparian rehabilitation demonstration projects.





November 2001





February 2003

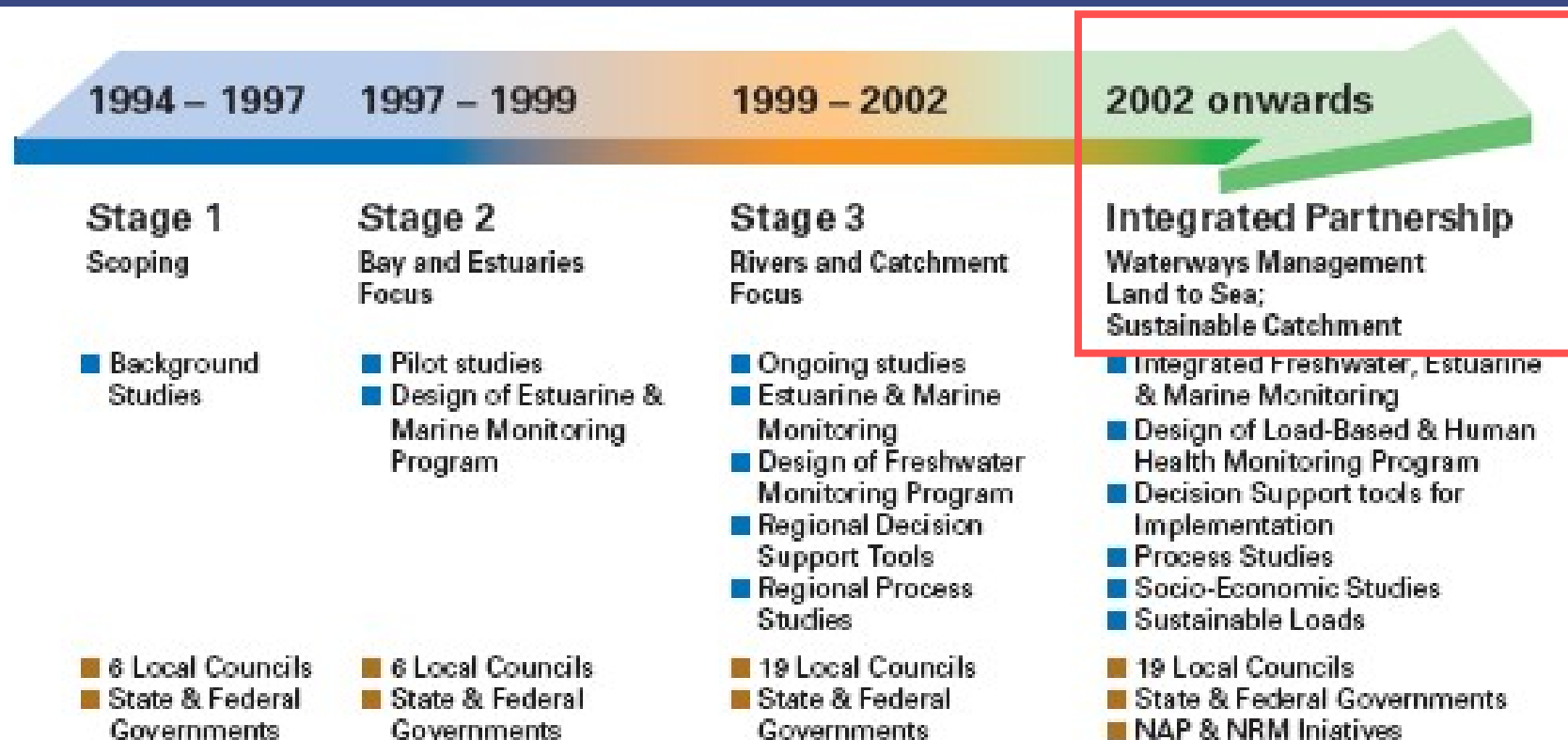




March 2004



# The future



A staged approach was adopted by the Study, with each stage having a different focus, targeted objectives and clear outcomes.



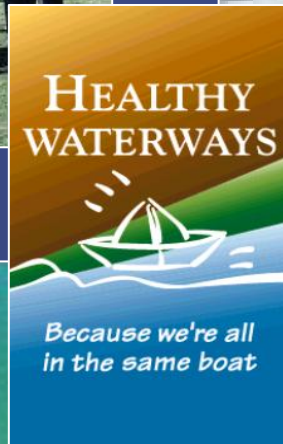
# Summary - Key lessons



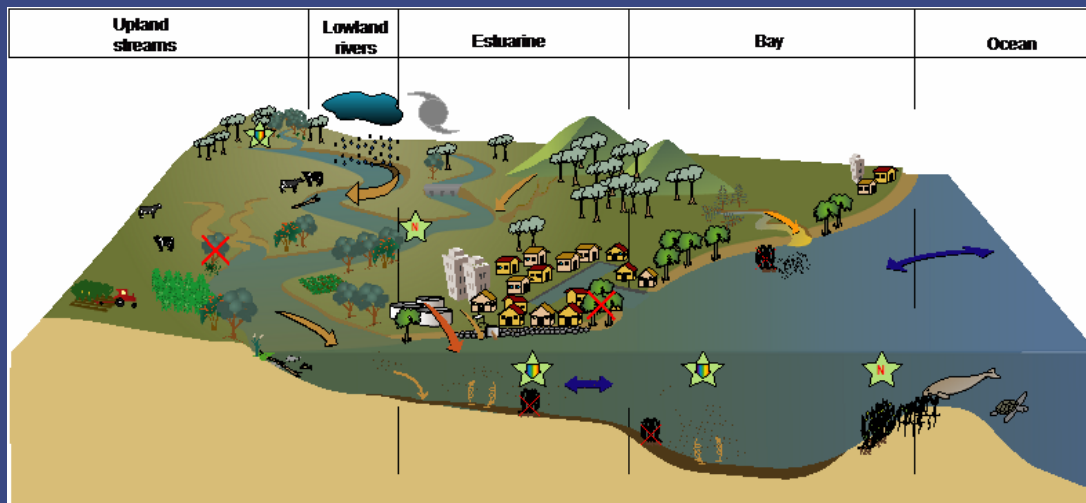
Common Vision



Committed Individuals



# Defensible science and effective communication





# Science involvement in cultural celebration



## Annual Riverfestival and International Riversymposium



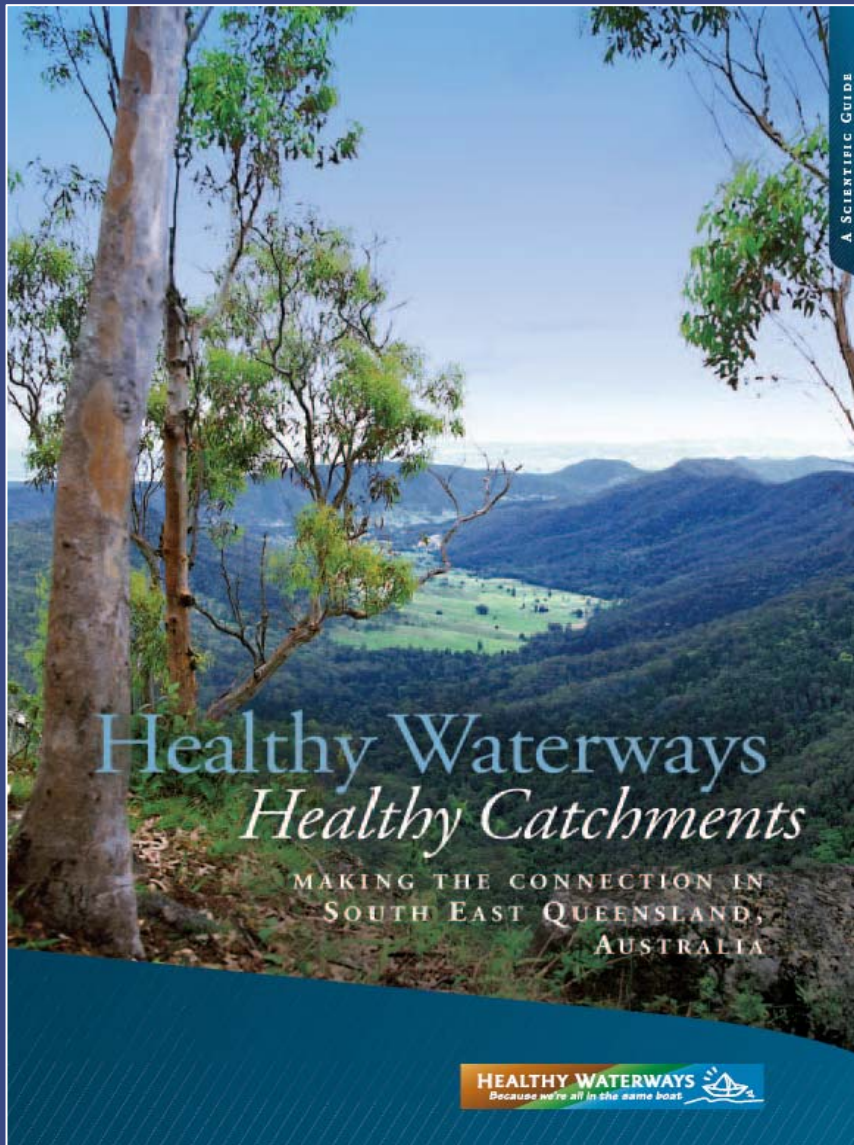
Water and Food Security - rivers in a global context

6<sup>th</sup> - 9<sup>th</sup> September 2005

[www.riversymposium.com](http://www.riversymposium.com)



# Science book - published soon



Thankyou

