Whole-of-catchment scale water quantity and quality modelling framework
An Overview of Source Catchments

- Flexible Modelling framework
- Prediction of the quantity and quality of runoff entering streams
- Assessing the effects of climate and landscape characteristics on runoff and contaminant loads in unregulated catchments
- Scenario analyses and decision support to assist catchment managers in choosing the most appropriate management options
- Source to sea, catchments at a scale of 10 km$^2$ to 100,000 km$^2$
Technical underpinning

• Lumped conceptual framework
• Node link network
• Uses concept of functional units (FUs)
All facets of model investigations in a single framework

- Model development; validation; data manipulation
- Different modes of simulation functions
- Range of analysis and reporting features
Model Strengths

✓ Flexible design supporting a range of modelling options

✓ Tried and tested across Eastern Australia (50+ applications)

✓ QA & Best Practice Modelling Principles

✓ Range of support options available
Source Catchments Farm Dam Model

Assessing the impacts of farm dams on streamflow
Problem

• Farm dams provide a vital source of water for irrigation and stock in times of water scarcity
• Excessive development has seen increased effort to quantify the cumulative impact of farm dams on catchment hydrology

Solution

• Farm dam model developed based on TEDI model (Tool for Estimating Dam Impacts)
• Simulates daily water balance components of individual farm dams
Angas River Example

- DWLBC wanted to assess the impacts of farm dams on the Angas River catchment in the Eastern Mount Lofty Ranges, SA
  - linking land use and management with areas of high and low farm dam densities.
  - Major water source
  - 1000+ dams
Customisation of FUs for high and low farm dam density and land use

<table>
<thead>
<tr>
<th>Functional Unit</th>
<th>Farm Dam Density (ML/km²)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Densities</td>
<td>Low Densities</td>
</tr>
<tr>
<td>Grazing, modified pasture</td>
<td>21</td>
<td>2</td>
</tr>
<tr>
<td>Urban</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Cropping</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Horticulture</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>All other land uses</td>
<td>No farm dam model applied</td>
<td></td>
</tr>
</tbody>
</table>
Results: The impact of farm dams at the catchment scale

- Farm dams reduce mean annual catchment runoff by 14%
- Mean annual flows post-1993 show a decreasing trend to more frequent, below average runoff patterns.
Addressing Real world problems
Source Catchments Trial Application Projects

- Assessing the impacts of urban development, farm dams on water quality and quantity
- Water quality impacts due to investment in improved agricultural practices
- Flow management impacts on ecology
- Land use change and small farm dams impacts on metropolitan reservoirs
Cattai & Nattai Applications Projects

Cattai –
Simon Morton/Richard Beechum

Nattai –
Lih Chong/Penny Knights

Partners:
SKM, NOW, DECCW, SCA, Sydney Water
Cattai & Nattai Applications Projects

Objectives

- Assess affects of increased development on sediment and nutrient loads exported from catchment
- Evaluate performance against catchment models in use
- Assess farm dam impacts on hydrology
Hydrology Calibration Completed
WQ validation underway

Figure 20 Observed and predicted low and load comparison, Events 2 – 7, Site E210 (Smallwoods Crossing) and Site E206 (The Crags)
Application in the Great Barrier Reef, Qld

Chris Carroll, David Waters, Ross Searle, Rob Ellis, Louise Hateley, Gillian McCloskey, Cameron Dougall, Banti Fentie, Helle Vittinghus,
Program Goal

To assess and report on progress towards meeting Reef Water Quality targets
Reef WQ Targets

By **2013**, at the end of catchment

- 50% reduction in Nitrogen, Phosphorus, Pesticides
- 50% late dry season groundcover on dry tropical grazing land

By **2020**, at the end of catchment

- 50% reduction in sediment loads
Approach

1. Source Catchment to be used to evaluate relative improvement in water quality due to investment

2. Applied across 35 Reef catchments

3. Unique features
   - Coupling of paddock scale models to Source Catchments
   - Incorporating SedNet/ANNEX sediment/nutrient generation models into Source Catchments
   - Linking PEST parameter estimation software
4 Lines of Evidence

1. Practice Effectiveness
2. Prevalence of Practices
3. Water Quality Reductions (Long-term monitoring)
4. Water Quality Outcomes (Catchment modelling)

Simulations
Plot
Paddock
Land Use
Bare Ground Index
Riparian
Sub-basin
Basin
Marine
Deliverables

Modelled load estimates for:
- Natural
- Current (2009)
- Impact of management practices change on WQ (post Reef Plan 2009)

Target 50%
GBR Summary

- Reef modelling program will assess progress towards meeting WQ targets
- Very ambitious and challenging project
- Offers an opportunity to become flagship for Source Catchments
- National and International significance
Summary

- Source Catchments offers a flexible modelling framework to suite a broad range of modelling needs
- QA & Best Practice Modelling Principles
- Fully supported by a range of support options