



Making Sustainable Management Operational – the Application of Failure Pathways and Sustainability Strategies

Bryan Jenkins

PROBLEMS OF EFFECTS-BASED APPROACHES FOR RESOURCES AT SUSTAINABILITY LIMITS

The purpose of effects-based legislation like the Resource Management Act is sustainable management. The concept is to allow resource use and development activities while operating within environmental limits. However, when resource availability or cumulative effects of development reach environmental limits, effects-based assessment of activities for further development can only lead to rejection of development if environmental limits are applied, or, impacts beyond environmental limits if development is approved.

SYSTEMS APPROACH FOR SUSTAINABLE OUTCOMES

This paper puts forward the approach of failure pathways and sustainability strategies when sustainability limits have been reached. The seven elements of the methodological framework are shown in Figure 1.¹ The concept of nested adaptive systems devised by Gunderson and Holling² provides the basis for defining failure pathways - processes that can cause system failure and shift the system to an alternative degraded state. The elements of the adaptive cycle are set out in Figure 2. Sustainability strategies are then devised to address the failure pathways that create the greatest vulnerability for system collapse. Four generic approaches to achieving sustainability are shown in Figure 3.³

FAILURE PATHWAY ANALYSIS FOR TE WAIHORA / LAKE ELLESMERE

One example of applying failure pathways is the management approach to Te Waihora/Lake Ellesmere after problems with effects-based analysis. Comprehensive investigations in the 1990s identified many issues of significant degradation.⁴ Effects assessment of mitigation actions to address individual issues indicated adverse effects on

¹ Jenkins BR (in press) Water Management in New Zealand's Canterbury Region: A Sustainability Framework, Springer, Dordrecht.

² Gunderson LH, Holling CS (2002) Panarchy: Understanding Transformations in Human and Natural Systems. Island Press, Washington

³ Jenkins BR (in press) Water Management in New Zealand's Canterbury Region: A Sustainability Framework, Springer, Dordrecht.

⁴ Taylor KJW (1996) The Natural Resources of Lake Ellesmere (Te Waihora) and its Catchment. Canterbury Regional Council, Christchurch

other issues. No action resulted from this analysis because of the conflicting results of effects assessments.

However, using a nested-adaptive-systems approach incorporating resilience analysis⁵, a rehabilitation strategy was formulated. Vulnerable components of the lake system were identified where critical variables exceeded resilience thresholds. Management interventions were tested for effects on other components. Acceptable interventions were combined into a rehabilitation strategy.⁶

SUSTAINABILITY STRATEGY FOR CANTERBURY WATER MANAGEMENT

For water management in Canterbury, a sustainability strategy approach based on collaborative governance was undertaken because of the failure of effects-based approach to address water management at sustainability limits. Initial strategic investigations of water supply and demand indicated that water availability was at sustainability limits and recommended increasing water availability through storage on alpine rivers.⁷ However, effects assessment of storage options indicated significant water quality implications of further land use intensification as well as downstream effects of storage on alpine rivers.⁸ There was public opposition to storage projects and consenting processes were highly contentious and adversarial.

Facilitated by the regional council, the Canterbury Water Management Strategy was led by a multi-stakeholder Steering Group with oversight by the Canterbury Mayoral Forum. There was extensive stakeholder and community engagement on water uses and strategy options.⁹ Strategic investigations of likely options informed the strategy selection process and informed a sustainability appraisal based on environmental, economic, social and cultural criteria.¹⁰

Based on stakeholder input, the Strategy established targets for ten water uses not just water availability. The Strategy demonstrated that improved water-use efficiency of existing users as a more cost-effective and sustainable way of improving water availability compared to storage. Dams on the mainstems of alpine rivers were precluded, and, alternative forms of storage were identified (e.g. off-river storage, managed aquifer recharge) to improve supply reliability for irrigators. Projects aligned with the Strategy were not controversial in the consenting process. Further land use intensification would require

⁵ Jenkins BR (2007) Panarchy. Presentation to Living Lake Symposium, 31 Oct – 2 Nov 2007, Lincoln University; and,

Hughey K, Taylor K and Ward J (2009) Current State and Future Management, Chapter 11 in Hughey K and Taylor K (ed) Te Waihora/Lake Ellesmere: State of the Lake and Future Management, Lincoln University.

⁶ Te Rūnanga o Ngāi Tahu and Environment Canterbury (2011) Whakaora Te Waihora Joint Cultural and Ecological Restoration Plan, <http://tewaihora.org/the-plan-2/>

⁷ Morgan M, Bidwell V, Bright J, McIndoe I, Robb C (2002) Canterbury Strategic Water Study. Lincoln Environmental, Lincoln

⁸ Whitehouse I, Pearce A, McFadden G (2008) Final Report - Canterbury Strategic Water Study Stage 3 Environment Canterbury, Christchurch

⁹ Jenkins B and Henley G (2014) Collaborative Management: Community Engagement as the Decision-Making Process, *The Australasian Journal of Natural Resources Law and Policy*, V 17 (2) pp 135-153.

¹⁰ Jenkins, B.R., Russell, S., Sadler, B., and Ward, M. (2014) Application of Sustainability Appraisal to the Canterbury Water Management Strategy. *Australasian Journal of Environmental Management* v21 n1 pp83-101. <http://dx.doi.org/10.1080/14486563.2014.880383>.

existing users to improve water use efficiency and land use practices, however their existing approvals gave them legal rights to continue current practices.¹¹

MAKING SUSTAINABILITY OPERATIONAL

For making sustainability operational, this paper advocates the need to manage system failure and develop sustainability strategies to manage the processes leading to system failure. This approach is conceptually different from effects-based assessment of development and is needed in advance of development proposals.

For governments, this implies legislative change. It means a strategic front end to impact assessment legislation. It is more than tiered assessment that includes strategic environmental assessment of policies and programmes as in California¹², WA¹³ and the Commonwealth¹⁴. The closest equivalent internationally is the EU Water Framework Directive¹⁵ which requires regional basin management plans for water resources that integrate economic, environmental, social and cultural dimensions. It involves multi-stakeholder collaborative approaches by governments (rather than the RMA approach of government's role as a regulator of the effects of activities). Some of the background papers of the Productivity Commission on the inadequacies of the RMA for dealing with Auckland's planning problems refer to systems approaches like Canterbury's water management strategy approach.¹⁶

For project proponents, it means designing projects to implement sustainability strategies. The existence of a strategy that can guide what development is acceptable removes a significant level of uncertainty in the project design stage (rather than undertaking detailed design before the EIA process provides an indication of what is acceptable).

For NGOs, it means working with government and industry in developing collaborative strategies rather than opposing development through RMA processes. However, this also requires governments to adopt the outcomes of collaborative strategies. The cherry-picking of recommendations by Central Government of the Land and Water Forum recommendations and the Mackenzie Basin Agreement has led to disenchantment and withdrawals from collaborative processes by several NGOs.¹⁷

¹¹ Canterbury Water (2009) Canterbury Water Management Strategy: Strategic Framework. Environment Canterbury, Christchurch

¹² AEP (2016) California Environmental Quality Act (CEQA) Statute and Guidelines http://resources.ca.gov/ceqa/docs/2016_CEQA_Statutes_and_Guidelines.pdf

¹³ Western Australia Government (2017) Environmental Protection Act 1986. <https://www.slp.wa.gov.au/legislation/statutes.nsf/actsif.html>

¹⁴ Australian Government (2017) Environment Protection and Biodiversity and Conservation Act 1999. <https://www.legislation.gov.au/Details/C2016C00777>

¹⁵ European Commission (2000) Directive 2000/60/EC of the European Parliament and of the Council establishing a framework of community action in the field of water policy. Official Journal of the European Communities 43 (L327):1 -73

¹⁶ New Zealand Productivity Commission. (2016). Better Urban Planning Draft Report. www.productivity.govt.nz/inquiry-content/urban-planning

¹⁷ Land and Water Forum (2015) Fourth Report of the Land and Water Forum. Land and Water Trust, Wellington; and

Mitchell C (2015) Historic agreement to protect Mackenzie Basin falters. <http://www.stuff.co.nz/the-press/news/73581719/Historic-agreement-to-protect-Mackenzie-Basin-falters>.

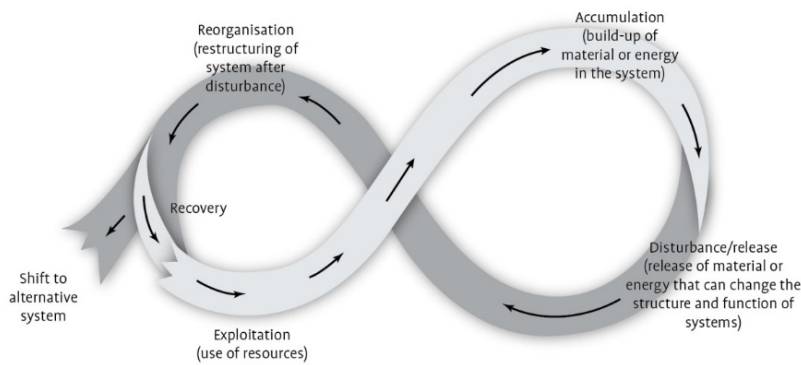
For environmental professionals, this implies developing new skills: (1) resilience analysis and vulnerability assessment of environmental systems (rather than just impact assessment of new development); and (2) the development of proactive strategies for environmental management of vulnerable systems (rather than just reactive mitigation measures for development proposals). It also means providing advice to multi-stakeholder groups on options rather than to proponents on defined proposals.

For EIANZ, it means looking beyond EIA as the main role for environmental practice. It requires a closer examination of the integration of environmental practice with economic, social and cultural development.

Figure 1: Methodological Framework for Sustainability Analysis based on Nested Adaptive Systems

Element 1	the adaptive cycle of exploitation, accumulation, disturbance/release, and reorganisation for describing biophysical and socio-economic systems response to disturbance
Element 2	defining socio-ecological systems as linked adaptive cycles of biophysical and socio-economic systems
Element 3	specifying nested adaptive systems that operate at different spatial and time scales with linkages between the different scales
Element 4	identifying possible failure pathways which can lead to system collapse
Element 5	defining critical variables on possible failure pathways and thresholds associated with system collapse
Element 6	identifying potential management interventions to address failure pathways that could lead to system collapse
Element 7	combining management actions at multiple scales of, and linkages between, biophysical and socio-economic systems into a sustainability strategy

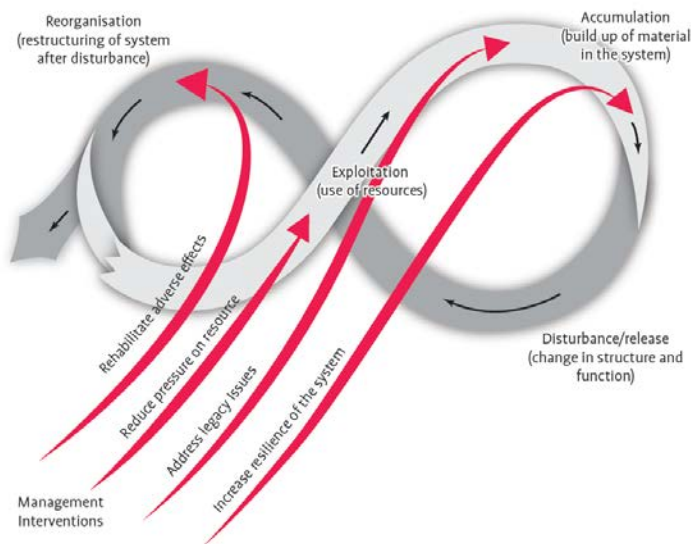
Figure 2: Phases of the adaptive cycle



Source: Adapted from Gunderson and Holling 2002

- Exploitation phase
- use of resources
- Accumulation phase
- build-up of material or energy in the system
- Disturbance/release phase
- release of material or energy that can change the structure and function of the system
- Reorganisation phase
- restructuring of system after disturbance
- either Recovery (system maintained) or Shift to an Alternative System

Figure 3: Management Interventions for each Phase of the Adaptive Cycle



- Reduce pressure on the resource (exploitation phase)
- Address legacy issues (accumulation phase)
- Increase resilience of the system (disturbance/release phase)
- Rehabilitate adverse effects (reorganisation phase)

MAKING SUSTAINABLE MANAGEMENT OPERATIONAL

THE APPLICATION OF FAILURE PATHWAYS AND SUSTAINABILITY STRATEGIES

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Dr Bryan Jenkins

Environmental Planner and Sustainability Strategist

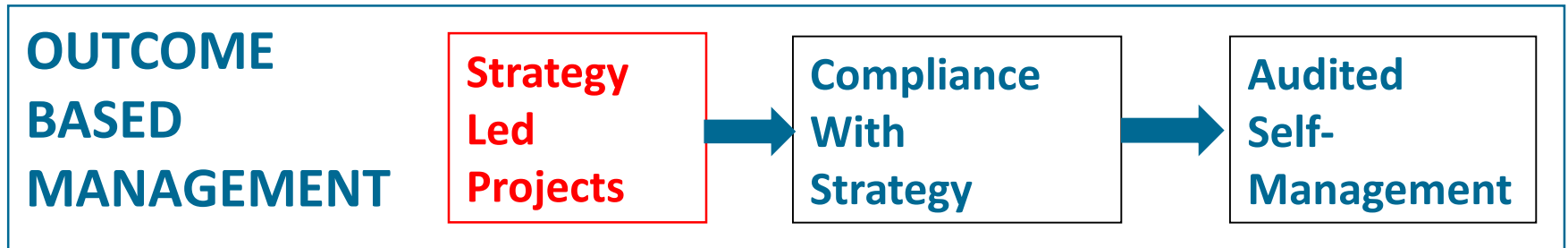
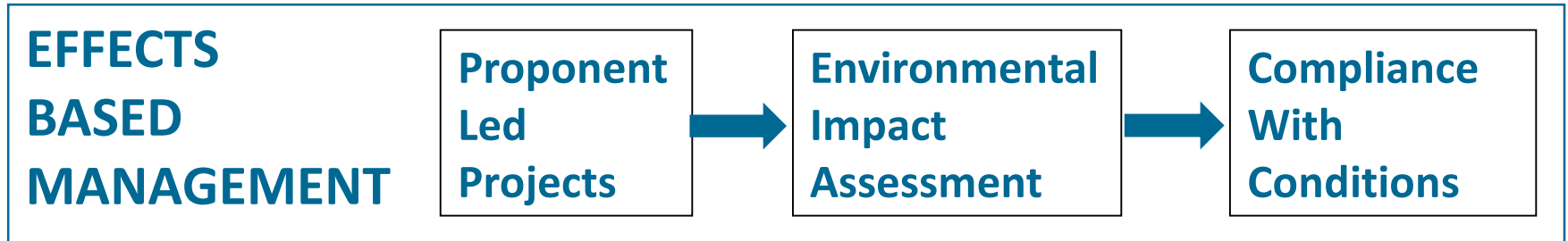


PRESENTATION

- Failure of effects-based approach to address water management at sustainability limits
- Need for a new paradigm: collaborative strategies and systems approach for sustainable outcomes
- Resilience analysis of failure pathways for Te Waihora / Lake Ellesmere
- Collaborative process for Canterbury Water Management Strategy
- Actions to make sustainability operational

EFFECTS BASED AND OUTCOME BASED MANAGEMENT

PROBLEM: Effects-based management is not delivering environmental outcomes



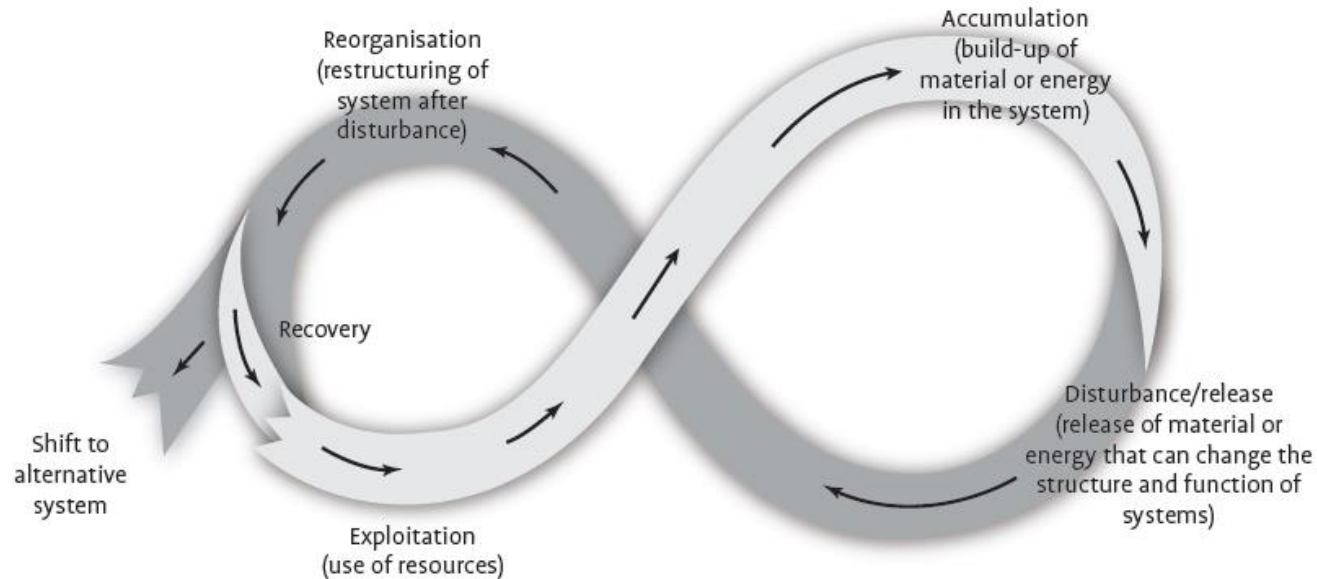
SOLUTION: Output-based management which needs a different approach

SYSTEMS APPROACH FOR SUSTAINABLE OUTCOMES

1. ***Adaptive Cycle***: system response to disturbance
2. ***Linked Biophysical and Socio-economic systems***
3. ***Nested Adaptive Systems***: different spatial and time scales with linkages
4. ***Failure Pathways***: processes that can lead to system collapse
5. ***Critical Variables*** on failure pathways and thresholds leading to collapse
6. ***Management Interventions*** to address failure pathways
7. ***Sustainability Strategy***: combination of interventions to achieve sustainable outcomes

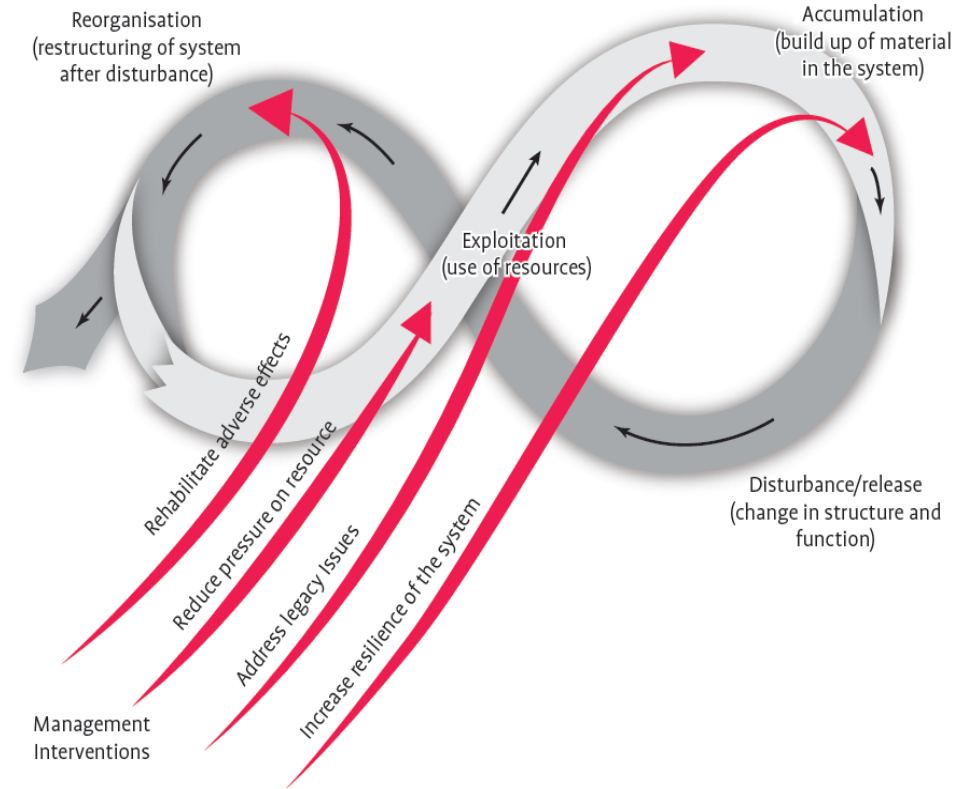
FAILURE PATHWAY ANALYSIS

- Interpret issues as adaptive cycles
- Identify critical variables for potential failure pathways and resilience thresholds



MANAGEMENT INTERVENTIONS TO ADDRESS FAILURE PATHWAYS

- Reduce pressure on resource
- Address legacy issues
- Increase resilience of the system
- Rehabilitate adverse effects



PROBLEMS WITH EFFECTS-BASED ANALYSIS

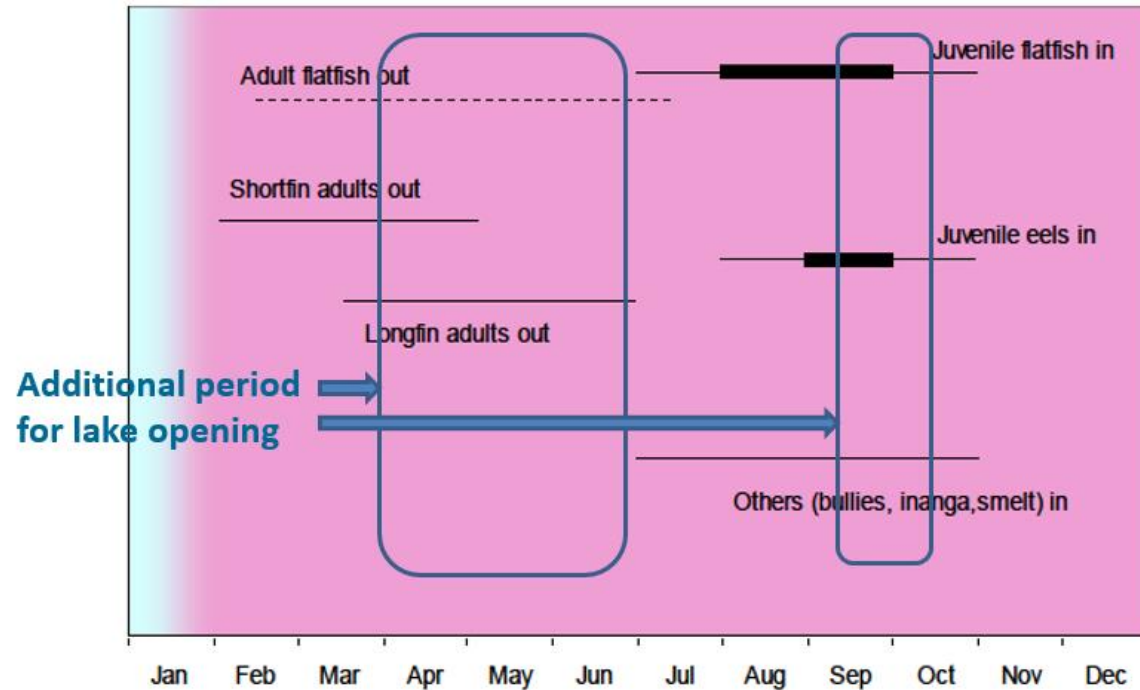
- Te Waihora/Lake Ellesmere
 - highly degraded coastal lake
 - still retains multiple values (wader habitat, fishery, cultural tāonga)
- Multi-criteria effects analysis of lake management
 - evaluation of management options showed mixture of beneficial and detrimental effects on lake values
 - no action taken
- Effects-based assessment of further catchment intensification
 - consents granted despite water quality impacts
 - “overall balancing approach” – requirements for mitigation

ALTERNATIVE PROCESS FOR LAKE MANAGEMENT

- Collaborative forum of statutory agencies, Ngāi Tahu and community trust to coordinate activities and avoid conflict
- Use of resilience analysis to identify priorities for restoration without affecting other values
- Development of models to enable system predictions
- Series of public symposia for all parties to be informed and involved
- Restoration programme agreed and implementation initiated
- Statutory instruments changed and rehabilitation projects underway

RESILIENCE ANALYSIS

- Identified vulnerable components and resilient components
e.g. longfin eel decline, shortfin eel stable
- Tested interventions to improve vulnerable components for effects on other components
e.g. lake level for waders
- Led to rehabilitation strategy of lake improvements
e.g. opening regime for eel migration



PROBLEM WITH DEVELOPMENT APPROACH TO WATER MANAGEMENT

- Concern with water availability in times of drought with increasing irrigation demand
- Irrigation based on run-of-river surface water and groundwater abstraction at sustainability limits
- On annual basis water available but would require storage
- Development of storage on alpine rivers seen as the solution
- Public opposition to effects of land use intensification and storages on alpine rivers
- Consenting process highly contentious and adversarial

COLLABORATIVE PROCESS FOR WATER MANAGEMENT STRATEGY

- Led by multi-stakeholder Steering Group with oversight by Mayoral Forum
- Stakeholder and community engagement on water uses and options
- Steering Group development of strategic options
- Community consultation on option preferences
- Strategic investigations of likely options (cumulative effects)
- Sustainability appraisal of environmental, economic, social and cultural outcomes of options

KEY OUTCOMES OF THE STRATEGY

- Targets for ten water uses not just irrigation water availability
- Cheaper and more sustainable strategy of increasing efficiency of use of water already allocated
- Reduced need for storage; no dams on mainstems of alpine rivers
- Alternative forms of storage: off-river storage, managed aquifer recharge, irrigation scheme storage, on-farm storage
- Further intensification requires existing users to improve efficiency and land use practices; current approvals an impediment to sustainability strategy
- Projects aligned with strategy were not controversial in consenting process

ACTIONS TO MAKE SUSTAINABILITY OPERATIONAL

Process	Manage system failure and develop sustainability strategies
Government	Strategic front end to impact assessment legislation Multi-stakeholder collaborative approaches to strategy development
Project Proponents	Designing projects to implement strategies based on collaboration
NGOs	Working with government and industry to develop collaborative strategies
Environmental Professionals	New skills: resilience analysis; proactive strategies for vulnerable systems Providing advice to multi-stakeholder groups
EIANZ	Integration of environmental practice with economic, social and cultural development