

Living lake, changing catchment:
Te Waihora/Lake Ellesmere integrated catchment symposium,
Lincoln University 7/8 November 2013

Setting the scene

Clive Howard-Williams and Scott Larned

Thanks to Ned Norton and Ken Taylor
for many discussions



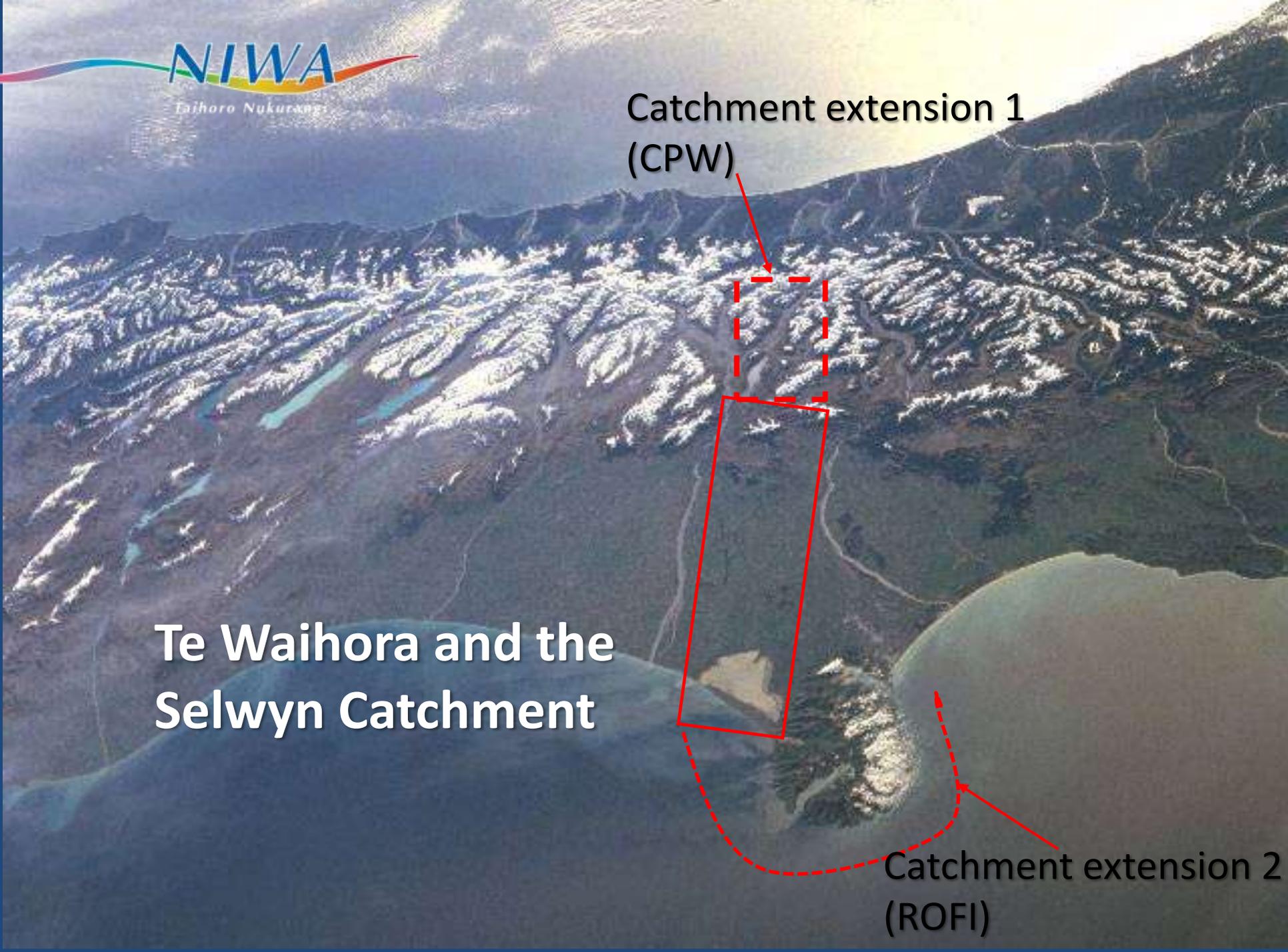
This Talk

- Introduction – extended catchments
- Recap on past symposia (2007, 2009, 2011)
- Recent Regional Policy Framework
- Focus on the issue of lowland streams (What are they? What are the issues)?
- Are there any solutions to better manage quantity/quality of lake inflows?
- Take-home messages

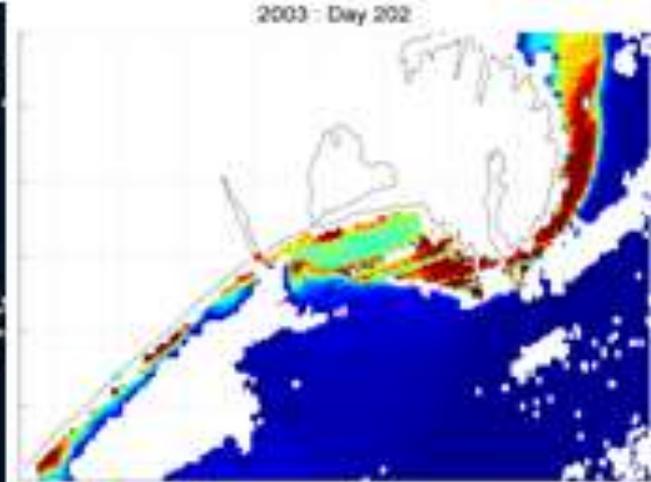
Catchment extension 1
(CPW)

Te Waihora and the
Selwyn Catchment

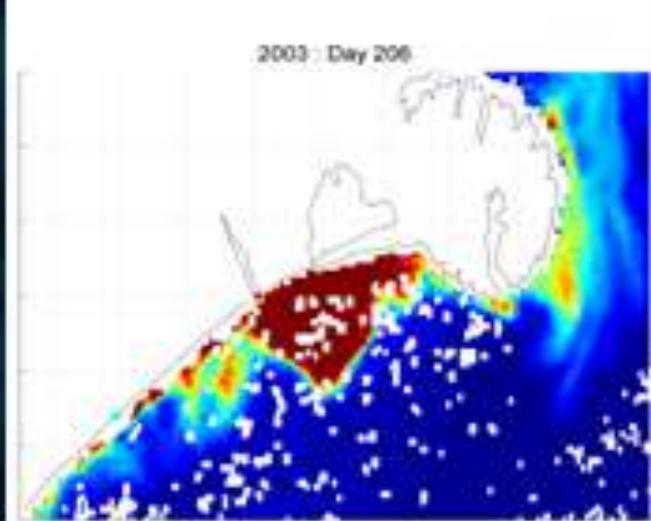
Catchment extension 2
(ROFI)



21 Jul 2003



25 Jul 2003



- Top: S or SW Winds - coastal freshwater band moves quickly (days) NE around Banks Peninsula to Pegasus Bay.
- Bottom: W or NW winds - water from Te Waihora, recorded NE and SW of the source up to 33 km from coast.

Recap on past symposia



2007 Symposium- Focus on state of the lake:
addressed the question: *“Is the lake dead, and if not, how
alive is it?”*

On the basis of discussions on:

Ngai Tahu Values;

Catchment hydrology;

Water quality of tributaries and lake;

Vegetation;

Fisheries;

Wildlife; Recreation.....

the conclusion was that the lake was in an overall ‘Bad’ state

Implications:

- Led to more informed debates around the state and future of the lake which in turn:
 - Fed into discussions on importance of a range of values
 - Fed into CWMS targets

2009 Symposium – Focus on lake opening

Potential lake level management scenarios considered.

Clarified ways forward, e.g.:

- higher lake opening trigger levels come with costs but few obvious gains;
- higher average lake level can occur without raising the trigger level, but by incorporating other decision criteria;
- targeted openings around September and/or October have potentially great benefits for fisheries management;
- lake openings recognised as one of a linked complex of lake management issues



Implications from 2009 :

- Lake's future tied to more than the lake level management regime.
- Concept of multiple values and multiple solutions...
- Riparian management (willow control, stream edge planting, and stream side fencing) necessary and now underway.
- Fed into 2011 Water Conservation Order particularly on timings of openings
- Fed into CWMS implementation

2011 Symposium: - Focus on an integrated catchment perspective. (Messages – Jenkins & Taylor)

1. CONNECTEDNESS

- Coleridge to Waihora – a larger catchment!
- “Ki uta ki tai” – Mountains to sea - must appreciate the links between all components of the system -

2. NEW THINKING / NEW SOLUTIONS

- Storage by managed aquifer recharge
- Improved farm management
- Tailor-made openings
- “Whole new game” not “Business as usual”
- Good decision making informed by good science

3. ENCOURAGING PROGRESS

Retention of collaborative approach with community, tangata whenua, government and industry involvement and,

Shift from:

“Comparison of the past”	to	“predictions of the future”
“Looking for actions”	to	“restoration activities”
“Focus on the lake”	to	“focus on the catchment”

4. CHANGES IN STATUTORY FRAMEWORK

- Statutory backing of CWMS
- NPS for Freshwater Management
- WCO for lake openings
- Land and water quality management (audited self management)
- Zone Implementation Programme



Implications from 2011 :

- 1. Focus groups of the Zone committee (Volunteers)**
 - Fed into Zone Implementation Programme
 - Solutions package to Sub- Regional L&W plan.

2. Development of Whakaora Te Waihora

Joint programme between Ngai Tahu, ECAN and MfE with commitment to restoration and rejuvenation of the mauri and ecosystem health of Te Waihora to:

- Accelerate the restoration of ecosystem health
- Begin restoring and enhancing cultural sites and mahinga kai
- Protect and restore lake margin wetland habitats....and lowland tributary streams and riparian habitats
- Improve lake and catchment management practices
- Establish a robust monitoring and investigations programme

Summary time line of Symposia

2007 State of the lake – how bad is it?

2009 Managing lake openings within a complex ecosystem - multiple values

2011 Integrated catchment perspective

2013 State of the lake – measure to manage, how good are interventions?

The challenges continue

Recent Policy frameworks





More decisions in the last two years than in the last 2 decades?

Changes at National level

- Land and Water Forum's Final reports 2011-12
- National Policy Statement on Freshwater Management 2011 (2013 Amendments)
 - Limit setting now accelerating
- Water Reforms - 2013 and beyond (April 2013)
 - Collaborative Planning
 - National Objectives Framework

(New announcement today from Minister Adams)
- Environmental Reporting Bill (to be introduced this year)



Two new regional policy frameworks

1. **Selwyn/Waihora Zone Implementation Programme (ZIP) Addendum** (Accepted at ECAN Council Meeting Sept. 2013).

“a solutions package for Te Waihora/Lake Ellesmere that has taken three years to develop and represents a broad vision of how the lake can be restored,”

2. **Variation 1 to Proposed Canterbury Land & Water Regional Plan: Sub region -Selwyn Waihora** (One of the first regional Plans that is putting into effect limits under the 2011 NPS)

The overall vision:

‘To restore the mauri of Te Waihora while maintaining the prosperous land-based economy and thriving communities.’

1. Selwyn Waihora Zone Implementation Programme (ZIP)

Addendum notes:

- Agriculture a significant contributor to local and regional economies;
- Reliable water supply for irrigation underpins agricultural prosperity;
- Water use, irrigated area and intensive land use has substantially increased in last 20 years;
- Flows in lowland streams and Selwyn River decreased 15-20%;
- High nitrate concentrations occur in shallow groundwater and lowland streams;
- Phosphorus accumulation in lake-bed sediments of Te Waihora;
- Health of Te Waihora has decreased;
- Lag in groundwater system of 10-30 years - some environmental, cultural and social outcomes will decline further.

It notes: CPW irrigation development consented

Key pathways and actions proposed by the Zone Committee are:

1. Water quantity

- Water allocation limits set to first provide for ecological and cultural flows in waterways.
- Alpine water (CPW) provides additional water to meet current demand and for augmenting stream flows
- Combined surface water and groundwater allocation limits;
- Allocation limits reduced by 35%
- Requirement for efficient and justified water use included in audited farm environment plans.
- Water storage is required but needs to take particular regard to “red flags” identified in preliminary assessment of potential water storage areas.

2. Water quality

- Restrict nitrogen load from catchment (agriculture and point source)
- Manage the agricultural N load target at the property level by:
 - a. Ensuring intensification does not result in discharges > 15 kg N/ha/yr;
 - b. Providing a N load to CPW to allow for intensification from 30,000 ha new irrigation
 - c. All rural properties (>20 ha) to prepare audited farm environment plans to improve soil, nutrient, irrigation, wetland, riparian and cultural health management;
- Reduce phosphorus and microbial contaminants from catchment by:
 - a. Stock exclusion from streams, rivers, wetlands and lakes;
 - b. Effective riparian margins on a significant length of the lowland streams;
 - c. Enhancing and constructing wetlands to improve water quality;
 - d. Managing sediment including via detention and targeted in-stream sediment removal.

3. Lake interventions (see also Whakaora Te Waihora)

include:

- Improved lake-level and lake-margin management (including lake opening)
- Addressing the legacy phosphorus from historical land use
- Restoring macrophyte beds
- Constructing floating wetlands and enhancing lake-margin wetlands.

2. Variation 1 to Proposed Canterbury Land & Water Regional Plan: Sub region - Selwyn Waihora

The plan vision means:

- Rehabilitating Te Waihora and other water bodies in its catchment to support a range and abundance of mahinga kai... and which is culturally fit for consumption.
- Good water quality, healthy flows and ecological communities in the hill-fed rivers and improved flows in spring-fed streams.
- Providing for recreational opportunities and amenity values and farming profitably within limits.
- Both regulatory and non-regulatory actions need to work together.

The **Key Actions** included are:

- Alpine water to enable additional irrigation development, replace groundwater takes and enable stream augmentation;
- Water allocation limits, to deliver ecological and cultural flows. New takes are prohibited and volume of water allocated is reduced;
- Reducing legacy phosphorus in Te Waihora by 50% and improved management of lake-level and opening;
- Restricting the agricultural nitrogen load from the catchment;
- A 50% reduction in catchment phosphorus load;
- Requiring all farming activities to operate at good management practice then make further improvements over time in managing nitrogen.

Where and how will this take place?

The rise of the lowland stream



At risk of environmental degradation

Lowland groundwater dominated streams - Critical points between the catchment and the lake (see also *Te Waihora/Lake Ellesmere State of the lake 2013*)



What are lowland streams?

Lowland streams in our area generally refer to:

- Low-elevation – (e.g., < 200 m a.s.l.)
- Usually coastal,
- Low-gradient
- Surface water is derived primarily from regional groundwater



In Selwyn/Te Waihora we mean:

Low-Elevation Low-Gradient Groundwater-Dominated-Streams

The quality of the groundwater has a major influence on the quality of the stream

Why are we concerned about lowland streams?

Historical management

- Riparian vegetation removal
- Willow planting and spread
- Channel straightening
- Alterations of channel network
- Stock access
- Surface and groundwater abstraction
- Aquatic weed management

Multiple stressors

- ***High nutrient concentrations***
- Low dissolved oxygen
- High-amplitude pH fluctuations
- Invasive macrophytes
- Non-native fish
- Biocides, hydrocarbons and metals

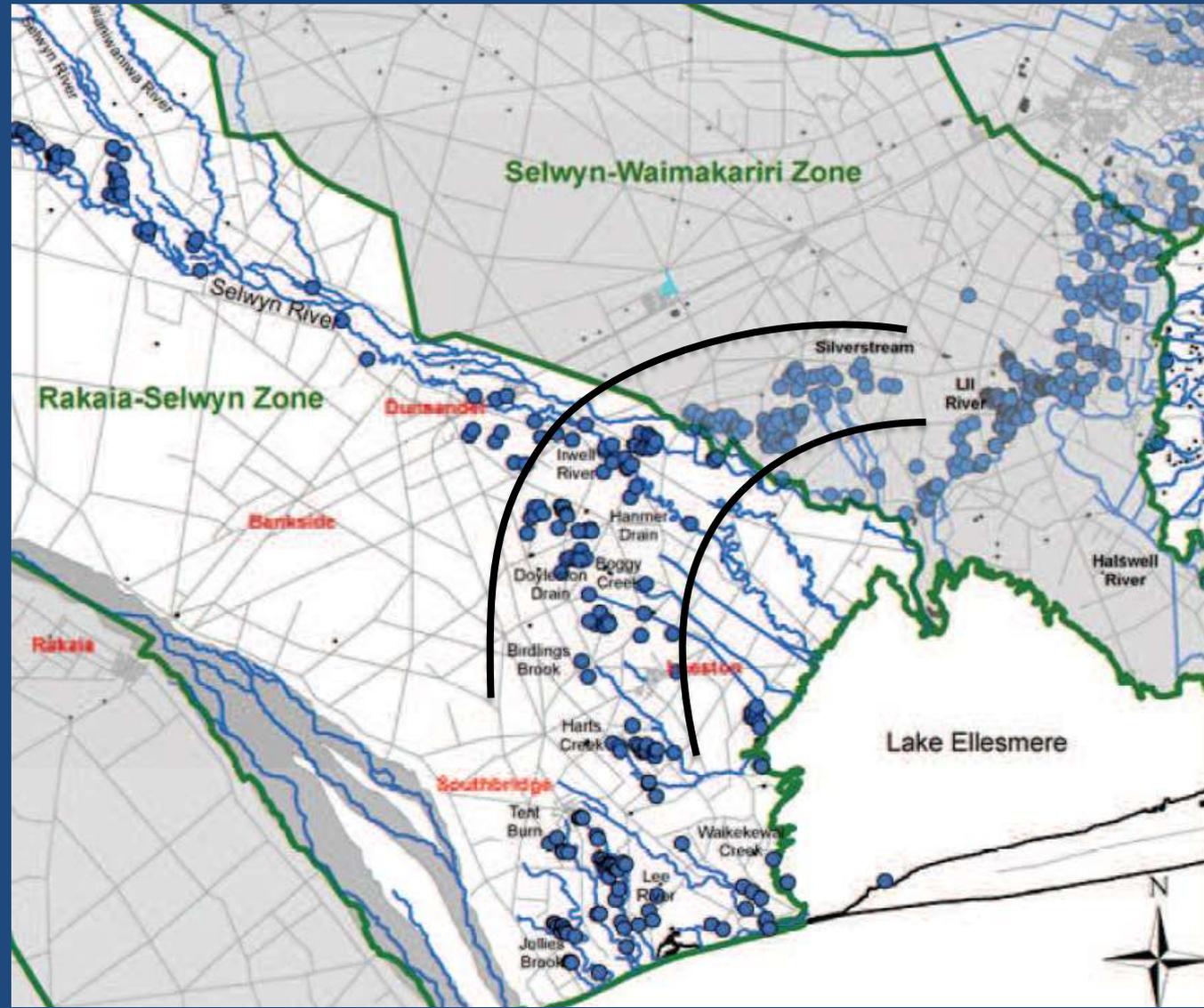
Legacy effects associated with inflow from regional aquifers

Multiple values

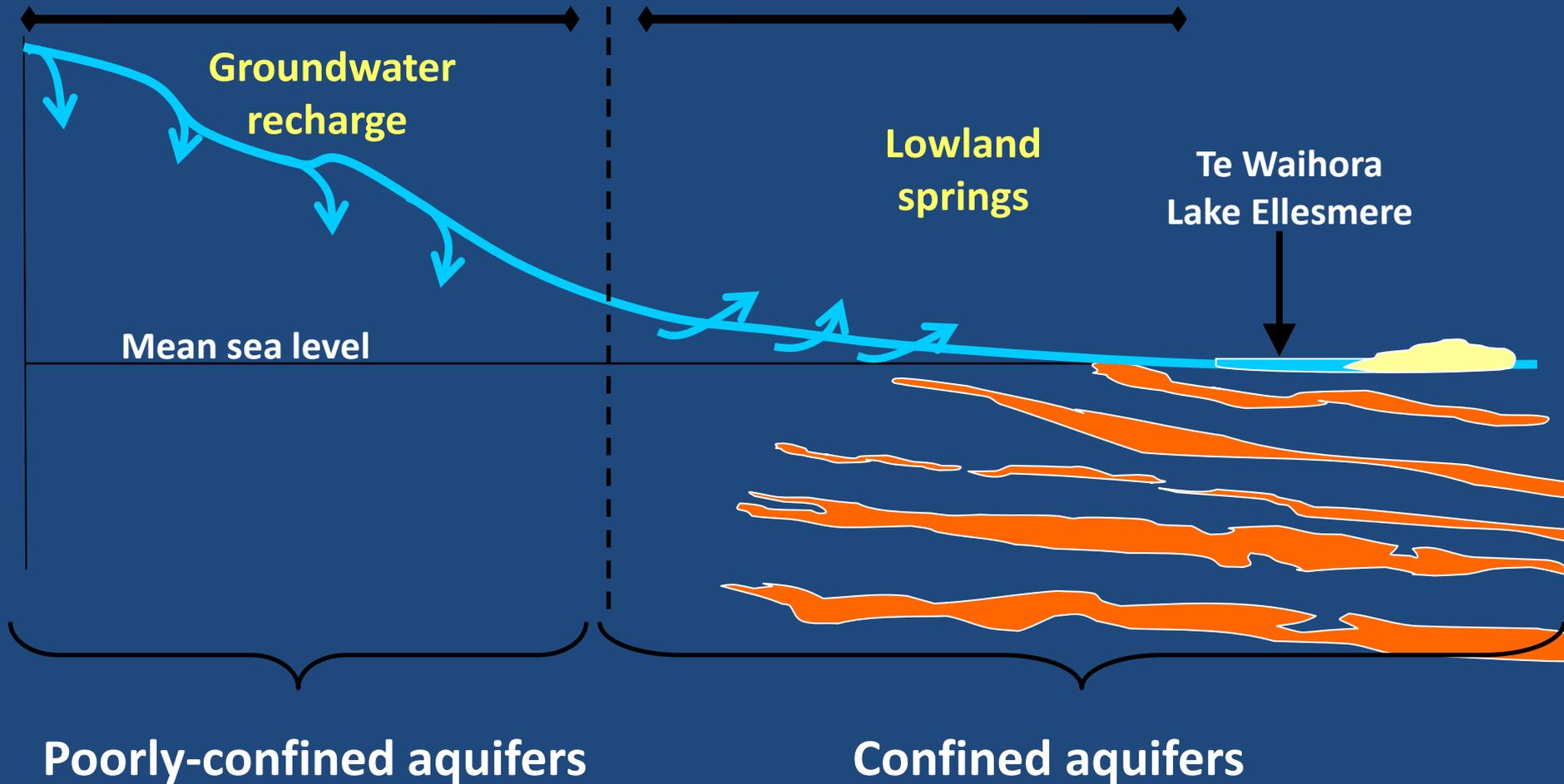
- Biodiversity
- Spawning grounds
- Migration routes
- Mahinga kai
- Recreation
- Water supply

Lowland groundwater dominated streams in Te Waihora catchment

Begin with discrete springs along a boundary zone corresponding to past inter-glacial high sea levels



Distribution of springs and lowland streams



Some Canterbury streams are groundwater dominated for their entire length.

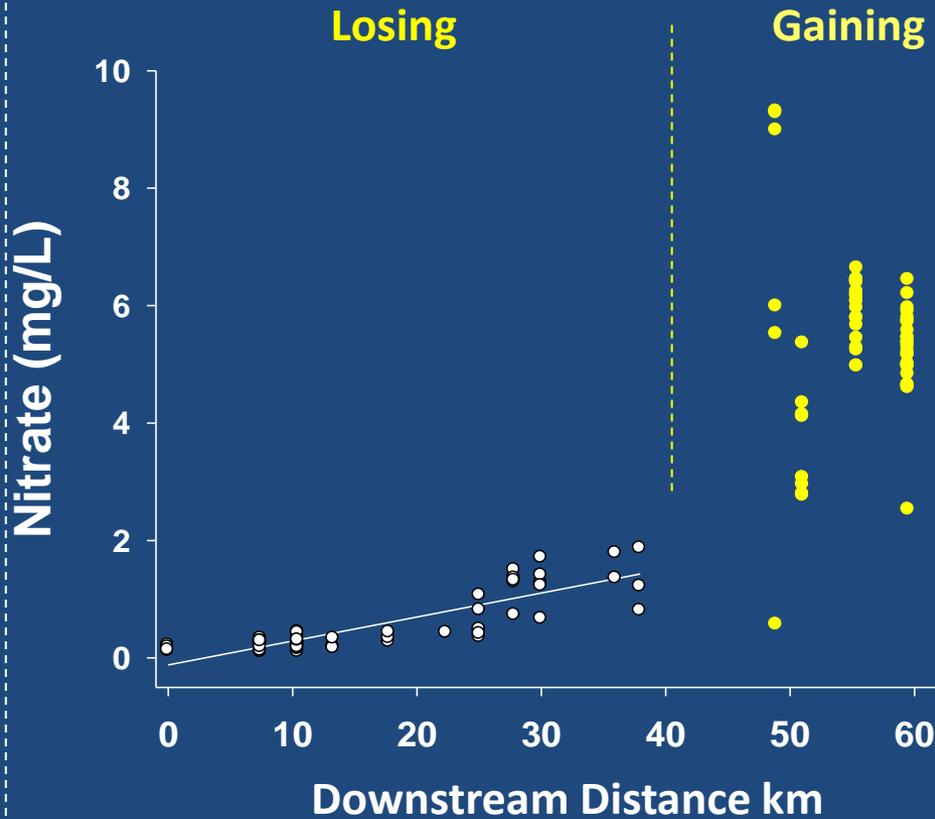


Hart's Creek

Others shift from runoff-dominated in the upper reaches to groundwater-dominated in the lowland reaches...



Orari River



Selwyn River

In groundwater-fed gaining section: nitrate is 10 x and DRP 2.3 x higher than in run-off fed losing section.

Where does the water come from?

Chemical signals in the lower reaches indicate that water is a mixture of regional groundwater and tributary inflows. Who is responsible for quality?

Nitrogen & phosphorus concentrations in lowland streams:

As groundwater moves east, fertiliser nutrients and effluent are leaching through soil to water table so concentrations increase. When it emerges at springs it is enriched.

Stream	TN	TP
Selwyn River - Coes Ford	4.7	0.03
L-2 River	3.4	0.06
Halswell River	3.5	0.06
Hamner Road Drain	2.6	0.08
Doyleston Drain	4	0.08
Harts Creek	4.5	0.02
Irwell River	1.4	0.11
Boggy Creek	5.8	0.06
Average	3.7	0.06
ANZECC Guidelines	0.61	0.03

Legacy effect created by farming years to decades ago.

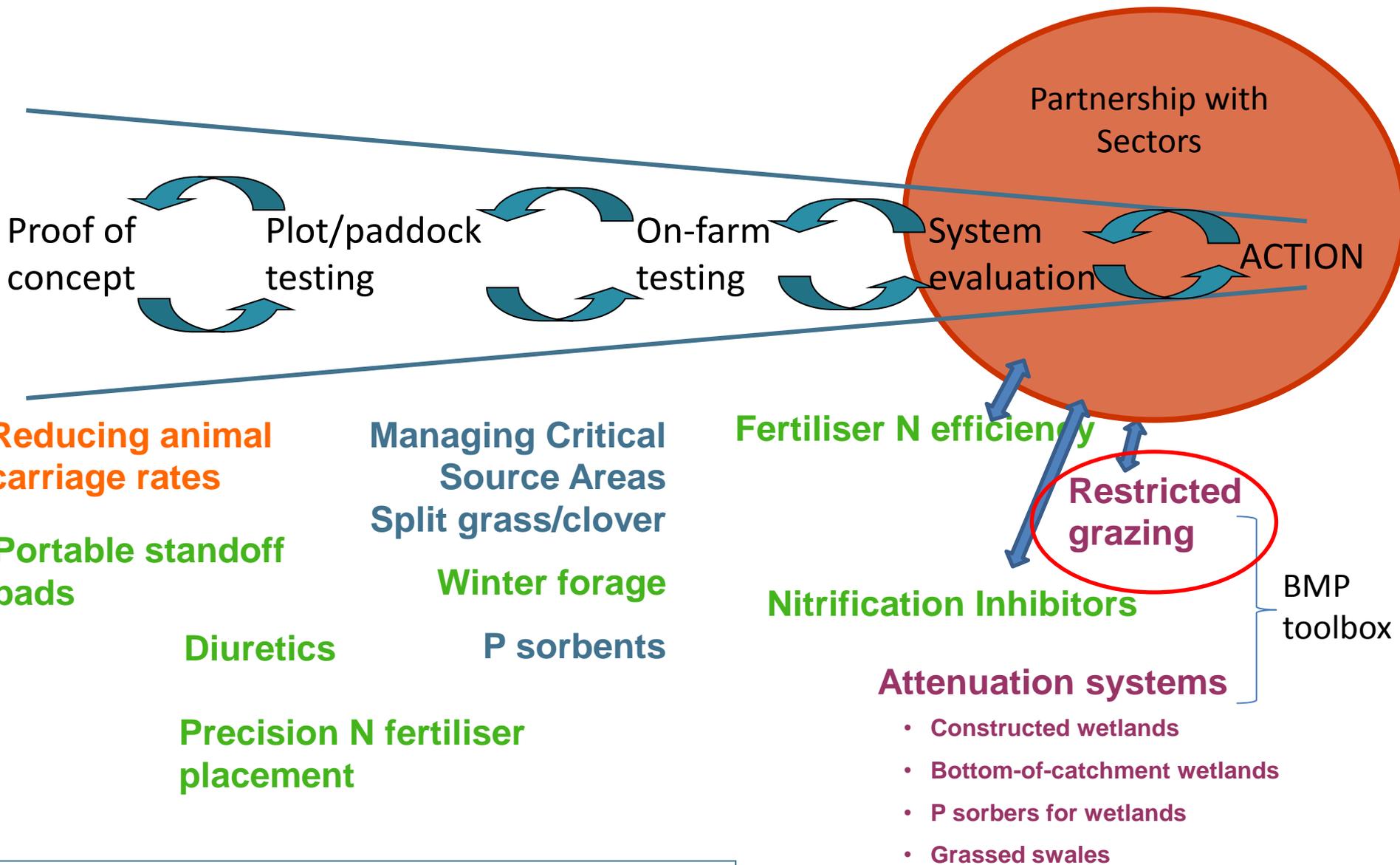
Solutions

*Variation 1 to Proposed Canterbury Land & Water Regional Plan:
Sub region - Selwyn Waihora* calls for :

-
-
-
- Restricting the agricultural nitrogen load from the catchment;
- Reducing catchment phosphorus
- Requiring all farming activities to improve nitrogen management

How can these be achieved??

Technology pipeline



Legend: **Microbes**, phosphorus, **nitrogen**, combination

Assessment of Strategies to Mitigate the Impact or Loss of Contaminants from Agricultural Land to Fresh Waters

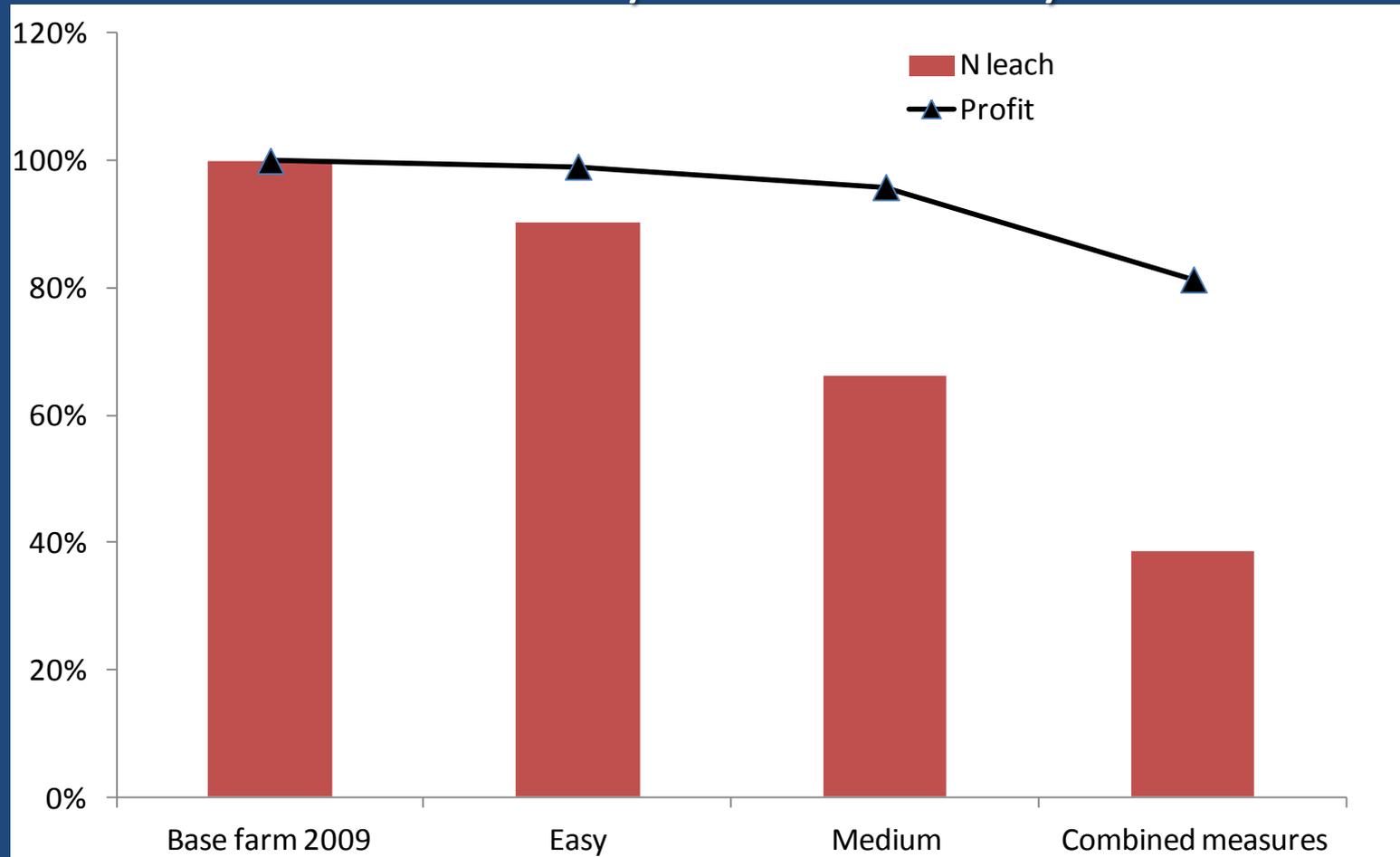
RE500/2013/066

June 2013

Rich. W. McDowell (AgResearch),
Bob Wilcock (NIWA)
David P. Hamilton (Univ. of Waikato)

Target	Nitrogen, Phosphorus, SS. E.coli
Dairy	Restricted grazing and off pasture animal confinement systems
Description	Minimising N, P, sediment and E. coli losses needs to avoid deposition of urine and faeces or soil disturbance during periods of high loss risk by either removing the animals from pasture at certain times or by extending the existing housing period. Measurement and modelling of these “restricted grazing” strategies have been shown to decrease N leaching losses and surface runoff losses of P, E. coli and sediment. The size of these decreases depends on the duration and timing of the restricted grazing period. Greater benefits were observed if grazing was restricted shortly preceding or during periods when losses were likely. Stand-off pads (preferably covered), herd shelters and wintering barns are some of the infrastructure options that are required for an off-pasture animal confinement system to work effectively.
Lead Agency	AgResearch, Massey University, DairyNZ
Effectiveness	High [N]; Medium [P]; Low [SS]
Cost	Medium [N]; Medium [P]; Very high [SS]
Variability	Costs vary due to variations in soil type and climate, and on the frequency of use of a restricted grazing strategy. For farms on heavy soil types and in wet locations where standing animals off-paddock is desirable, a small or nil net cost might be assumed. For dairy farms on well-drained soil types with minimal risk of soil treading damage, significant cost might be incurred.
Limitations to uptake	High capital and operational costs and increased management complexity; immature design criteria and management systems that meet animal welfare and manure management requirements; and some risk of ‘pollution swapping’ by increasing NH3 or N2O emissions from the collected effluent and manures
Co-benefits	Decreased soil and pasture damage caused by animal treading will help increase pasture yields and decrease N2O emissions and denitrification rates

The effects of cumulative management changes on N leaching and farm profit: Southland dairy farm case study



**Progressive implementation
of measures:**

**Improved nutrient &
effluent management**

**+ N inhibitor
(DCD)**

**+ Herd
Shelters
+ wetlands**

Mitigation Technologies: P

Strategy

Effluent pond storage / low rate application

Optimum soil test P

Low water soluble P

Restricted grazing

Tile drain

Aluminium sulphate to pasture / cropland

Stream fencing

Sorbents in and near streams

Irrigation water use and recycling

Natural and constructed wetlands

Source
management

In-field
amendment

Edge of field

Mean cost-benefit decreases away from source (or as scale increases.)

Catchment –scale: Downstream technologies in receiving waters – Advantages may be rapid improvement in water quality but major risks are on-going operational costs

Intervention	
Sediment capping	Lake Okaro (30 ha) zeolite application c. \$75,000 p.a. over 3 years
Phosphorus inactivation	Lake Rotorua alum dosing \$1M p.a.
Dredging	Very expensive although costs will vary considerably depending on circumstances
Oxygenation/destratification	Destratification trial in lake Rotoehu (790 ha): \$524,000
Hypolimnetic withdrawal	Limited application so far in NZ but proven to be “low cost” in Europe and USA.
Weed harvesting	Hornwort harvesting in Lake Rotoehu (790 ha): \$52,800 p.a. \$22/kg N and \$165/kg P
Diversions	Ohau Channel wall in Lake Rotoiti (124 ha): \$10 million

Conclusions on Catchment management for waterway protection

- Technologies are currently available for a variety of circumstances from paddock to catchment scale and
- Future technologies are under development.
- Effectively adopted technologies should be sufficient in most places (to meet desired standards and/or create headroom).
- Uptake of effective technology is dependent on the willingness and motivation and skill base of stakeholders (eg farmers) at the source end; and community understanding at the receptor end.
- Science is informing community processes at the catchment scale, and
- Regional Council is (has) developing relevant networks to enable a cross sectoral/policy/science approach to rehabilitate Te Waihora.

Take home messages:

1. New recognitions

Very significant advances in both national and regional policies relating to water management

System complexity and management of multiple values

The programme of work to restore the lake will be measured in decades rather than years.

Legacy issues such as phosphorus in lake sediments and nitrogen in slow moving groundwater. This will be a ‘load to come’

The biggest single hurdle is getting parties to agree that everything they want may not be possible

Take home messages:

2 . Knowledge gaps

- Quantitative relationships between ecology and flow (eg. how much water do spring-fed streams need?)
- Canterbury's alluvial plains rivers are controlled by groundwater-surface water interactions
- Effects of agricultural groundwater use on river flow and water quality. Definition of nutrient sources.
- The nutrient thresholds above which the lake will be affected.
- Links of science to policy

Take home messages:

3. Issues for 2015 *(to be addressed at this Symposium?)*

- Whakaora Te Waihora
- Lowland streams - Values and what do we manage these for?
- Community decision making and specific solutions
- Interface of Maatauranga and Science
- Measure to manage - What do we have to do
- Responsibility for measurement and analysis
- Responsibility for enforcement



END

