Living Lakes Symposium 2

summary notes by key presenters

Presenter: *Philip Grove Environment Canterbury*

Title: *Willow Control Update since 2007*

Contact: philip.grove@ecan.govt.nz

Analysis of data collected during 2007 lake shore vegetation mapping project was used to investigate the state of invasive willows in the shoreline wetlands surrounding Te Waihora (Environment Canterbury Technical Report R09/25). This recent study provided more information on the distribution, extent and density of willow infestations around the lake shore. It also examined what vegetation/habitats the willows are currently growing in, and what vegetation/habitats are threatened by further willow spread.

On the basis of this information, 45 priority willow control sites with a combined area of 32 ha have been recommended, from the total 170 ha of willow infestations around the lake. It is suggested that by targeting initial willow control operations to these priority sites, and keeping clear areas clear, substantial progress could be made in maintaining and restoring Te Waihora's native lake shore freshwater wetland habitats.

Presenter: *Graeme Horrell NIWA*
Title: *Water balance model of Lake Ellesmere (Te Waihora).*
Contact: g.horrell@niwa.co.nz

The water level in Lake Ellesmere (Te Waihora) has been managed by Maori and European Settlers by opening channels through the gravel bar to the sea.

Currently Te Waihora is artificially opened to the sea to prevent flooding to the surrounding farmland. The lake is opened when the lake height reaches 1.13 m above m.s.l between April to July and 1.05 m above m.s.l during the months August to March.

To study lake level management options, a water balance model was developed. This recent analysis provides 38 years of data on the variables listed below which affect the lake level and increases the confidence for management scenarios, which Te Waihora managers may wish to test.

- tributary inflows
- Kaitorete Spit seepage inflows
- groundwater seepage inflows
- artificial opening sea incursion inflows
- rough weather sea incursion inflow
- inflow due to rainfall on the lake
- Kaitorete spit seepage outflow
- evaporation losses expressed as a flow rate
- artificial opening outflows

Opening the lake directly after the trigger level is reached is not simple and can be delayed by the sea conditions, therefore a dataset of sea conditions was developed for the model.

The model when tested reproduces a similar number of artificial openings to those that actually occurred over the 38 year period, this provides confidence for future scenario testing.

The lake inflow and outflow variables are compared to provide an overall lake water balance.

Two examples of model output displays how Te Waihora's water level regime would have been under natural (no artificial openings) and under Maori management.

It can be concluded that: (provided there are no artificially increased tributary inflows)

1/ An increase in lake height opening regime will require less artificial openings, due to increased seepage through the spit, and the increased area will add to the evaporation and will be matched by a small increase in rainfall.

2/ Salt concentrations after an opening will increase, however overall with reduced opening numbers and a longer period for the sill to rebuild there will be less rough weather incursions, resulting in overall less salt water entering the lake.

3/ Today's water is resident in the lake for approx 6 months, while under natural conditions it would reside for up to 17 months.

This water balance model is a key component of John Raffensperger's model for sustainable lake management.

WET, PO Box 198, Tai Tapu 7645

Ph: (03) 353 9712 Cell: 0272942132

Email: admin@wet.org.nz Web: www.wet.org.nz

Presenter: *Don Jellyman, Donna Sutherland, Jeremy Walsh, Mary de Winton (NIWA)*
Title: *A review of the potential to re-establish macrophyte beds in Te Waihora (Lake Ellesmere)*
Contact: d.jellyman@niwa.co.nz

Historically, Te Waihora had an extensive margin of macrophytes, which finally disappeared with the Wahine Storm of 1968. Since then there has been periodic interest in re-establishing these beds and this presentation is taken from a report commissioned by ECan to review prospects and feasibility of achieving this.

A review of yields from the commercial fisheries for eels and flounders showed no change or some improvement from the pre-Wahine Storm situation. While a seed bank still exists within the substrates of the lake, the viability of this seed appears to be low. Results from a wave exposure model indicated that the western shorelines were the areas least exposed to high wave energy, especially the vicinity of Harts Creek to Taumutu. Any attempt at macrophyte restoration should focus on such areas, and use wave baffles or berms to reduce wave fetch and the likelihood of macrophytes being uprooted. Restoration should involve planting of robust propagules or whole macrophytes to supplement any natural germination from existing seeds; some control over black swans would be required to prevent over-grazing of plants. So, while there is some potential to re-establish the macrophytes within selected reaches of the lake, there are also a number of negative effects. A decision will need to be made balancing the perceived benefits against the costs of attempting to establish a viable, self-sustaining area of vegetation and the risk that another extreme weather event could nullify the effort and expenditure involved.

Presenter: *Don Jellyman*
Title: *Te Waihora – using the sustainable lake model to determine an optimal regime for fish*
Contact: d.jellyman@niwa.co.nz

Over 40 species of fish have been recorded from Te Wihora, but the species of customary and commercial importance are shortfin eels, flounders (variously black, sand and yellowbellies), and yelloweye mullet.

Common bullies are the most abundant species in the lake, and make up about 90% of total fish numbers and 40% of total weight (biomass) of fish. Highest densities of all these species are found around the margins of the lake where there is greatest habitat diversity; also species like eels will exploit rises in lake levels to feed on newly inundated pasture.

Eels, flatfish and mullet, are diadromous species, spending their early larval life at sea before recruiting in to the lake in spring; bullies are a mix of diadromous stocks, and another stock that spends all their life in fresh water.

Given this strong relationship with the sea, an opening of the lake in spring is essential to maintain stocks of flounders and very desirable for the other species. As maturing eels endeavour to leave the lake between February to June (actual time vary according to the species and sex of eels), some opening during this period is also required – this would also enable maturing flounders to leave to spawn at sea.

So, important features for fish stocks of any lake model are lake openings in spring and also late summer/autumn, with a high level in summer to reduce the potential for warm water temperatures that can be stressful for fish and promote growth of undesirable blue-green algae.

Presenter: John Raffensberger (Fritz)
Title*: Introducing PLOVER 2k: Planning openings and values for Lake Ellesmere's resilience*
Contact: john.raffensperger@canterbury.ac.nz

The PLOVER model is a deterministic Excel-based simulation of Lake Ellesmere, intended to help choose lake opening regimes. Based on the opening regimes, PLOVER attempts to measure changes in ecological and economic values. In the model, water levels and weather drive water quality, eel and flounder recruitment and migration, and farm values.

Components were selected in a consultation and refereeing process, mainly with scientists.

PLOVER's reliability varies by component. Some components (e.g.,hydrology) are based on causal relationships and considerable data. Some are based on correlative relationships and some data (e.g., water temperature). Some are based on anecdotal data or speculative relationships (a "threat" formula for Nodularia). PLOVER does not forecast, but instead simulatestheperiod1997-2007.

The current opening regime depends mainly on depth. Results from PLOVER suggest the opening regime should depend on depth and date. For example, by seeking openings over 30 days, starting on each of 22 April, 22 July, and 24 September, eel migration could be significantly improved, without significantly reducing other values.

PLOVER could be improved. Eel appears to be the lake's largest economic value; a simulation of eel growth and habitat would be the highest-value research. A detailed Ruppia simulation would guide macrophyte reestablishment. Stochastic reservoir techniques would provide useful conditional regimes, e.g., "don't open if depth is below D in week W."

The larger catchment should be modelled, including water flows, nutrient run-off, and impervious cover. Finally, research would be easier with a consolidated Ellesmere database.

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Presenter: *John Lay*
Title*: Te Waihora /Lake Ellesmere, a farmers view*
Contact: jlay@iagri.com

Have farmed in Ellesmere area for 45 years. Although not immediately adjacent to Te Waihora Lake Ellesmere, or rated for lake management, I do farm in the wider lake catchment.

I am concerned that my farming activities do not contribute to the degradation of the lake and I am as anxious as any other faction or interested party to have a lake in pristine condition surrounded by productive farmlands.

For my sins, I Lectured at Lincoln University for 20 years and have a background in creating Farm Computer software and an association, in a small way, with computer modelling.

Verification? *The action of demonstrating or proving something to be true by evidence or testimony*.
If that is the correct definition - I doubt that I can go as far as verifying the model as my viewing lacks rigour although I can say, in terms of modelling, I am impressed by what I have seen.

The Plover model, accounts for many variables, most of which you have heard about today. Behind each variable are considerable data, some of which are more robust than others.

As Fritz mentioned, the agricultural data are extensive and proven as are the Hydrological data and the GIS information. Some of the data behind other features are a little hazy and qualitative and regression and interpolation of such data has been necessary. This is normal when modelling but needs to be understood and accounted for when interpreting the effects and outcomes of the many what-if scenarios.

It has been stated, in an economic sense, that the model favours farming by a factor of five. I have no way of validating that comment although I have great respect for the objectivity of Dr John Raffensperger who has been superb in stitching this model together.

My assessment of the objectives of the model is that it is designed for “Long Term Planning” and is based on the impact on the many variables affecting the lake’s eco-systems and peripheral farming through the opening of the lake at various lake levels and at various times of the year.

I believe that, in the same way one judges a corporate business by assessing the business acumen of those on the board, so too can we judge a model by looking at the credentials of those involved in its creation. I must say, the credentials of those behind this model are impressive. They are heavyweights in any one's language. Having said that, and despite the "factor of five" one would still need more time to assess the balance between the farming and the environmental emphasis.

It is worth re-iterating that one objective of this model is as a long term planning tool.

A spreadsheet model can become "gee whiz" for an instant of time and then revert to a useless item on a shelf, gathering dust, somewhere in academia, alongside many former "gee whiz" models if one is not careful, and one can be left wondering what all the fuss was about.

If the model is not properly documented, understood, and revised competently and frequently by interested and trained individuals in addition to those who designed the base model, its usefulness will be short.

If the model is going to be used in perpetuity there must be a succession plan involving personnel and clearly defined rules of ownership.

In general, models may not always reflect reality but they do focus attention, promote discussion and, with common sense, contribute to sound decision making.

They can create in a instant scenarios that would take several life times to observe.

Models, if they are to be effective in the long term are always work in progress and constantly require tweeking as new data and empirical observations are noted and incorporated.

Dare I say it, but to be controversial I will, this model lends its self to Linear Programming and the introduction of Risk and Uncertainty i.e what is the probability of another Wahine storm or a Selwyn Flood etc.

The lake's health and well being depends on a lot on factors beyond the immediate area. For instance. What will be the impact of the Canterbury Plains Water scheme and the implications of Nitrification of water inflows into the lake? Where does one stop?

In these matters, perhaps we could learn from the Chesapeake Bay Programme http://www.chesapeakebay.net/

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Their problems have some parallels with the overall situation we are facing.

This programme is a total approach focusing on the broad issues that had reduced the health of the bay to virtually zero. In a "whole community" approach and the help of Environmental Economists, they have set about not only optimizing farming systems and increasing profits on the land in the bay catchment, whilst at the same time optimizing the biota and health of the bay its self.

It's fair to say they haven't been entirely successful in achieving their objectives however it is also fair to say that the health of the Bay is considerably better than when they started and it is still work in progress.

There are many parties vitally interested in the well being of Te Waihora/Lake Ellesmere. I believe all interested parties have similar objectives albeit with different ideas as to how these objectives can be achieved. The model may not result in answers that satisfy all and it is possible that it is weighted towards things ecological.

It is however a brilliant starting point and used wisely, it could help by injecting some objectivity into what is often a debate clouded by emotion.

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Email: admin@wet.org.nz Web: www.wet.org.nz

Presenter: Ross Vesey
Title*: Te Waihora /Lake Ellesmere, a farmers view*
Contact: ross.vesey@ecan.govt.nz

History of Lake openings
- *1875 Bray report (3 options)*
- Use of horse drawn scoops from 1868 to 1904, 1925-1931
- 1904 Dobson's culvert
- 1907 Pannets culvert
- 1931- Ellesmere Drainage Board purchased power scoops
- 1947- North Canterbury Catchment Board took responsibility
- *1975 draft report (2 options)*
- *1981 Morris & Wilson report (3 options)*
- Currently managed by ECan

Previous Structures
- Culvert type structure
- Higher lake level
- Utilised greater head to scour out gravel
- Installed in 1904 but destroyed within 7 months
- Redesigned and upgraded in 1908
- Destroyed by successive storms in 1925
- Failed to alleviate problems associated with fluctuating lake levels

Mechanical Openings
- 1.05m ASL — Summer months August – March inclusive
- 1.13m ASL — Winter months April – July inclusive
- Achieved by making a temporary cut through the beach at Taumutu
  - 1.5-2.0m deep
  - 15m wide up to 300m long.
- Using D9 Bulldozer
  - D7 Bulldozers
  - 22t Dragline
  - 20t Excavator

Factors affecting Openings
- Wind
- Swells and wave action
- Tides and hydraulic gradients
- Beach material
  - unstable, poorly graded gravels.
- Eroding coastline

Future of Openings
- More difficult to find material for sea wall
- Beach monitoring programme doesn't yet show this
- Recession of crest
- Could loose deep pool and feeder channels
- New consent conditions
- Long term sea level rise
- Funding base

Opening Options

Bray report
1. Canal through Halswell to Sumner
2. Connect to Lake Forsyth + tunnel
3. Connect to Rakaia lagoon

Morris & Wilson Report
1. Canal
2. Piped
3. Stopbanking

Previous attempts
1. Dobsons culvert 1904
2. Pannets culvert 1907 (Similar = Waihao box – very narrow beach, higher head)

Previous investigations show option costs significantly higher than mechanical openings
Funding source needed for further investigations

Permanent Opening Objectives
- Reduce fluctuations in lake level
- More control over minimum lake levels
- Fish passage
- Funding/affordability

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