

How getting the 'demand side' right, by empowering community led initiatives, is leading to sustainable management of freshwater in New Zealand

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Abstract

Freshwater resource management in New Zealand is governed by the Resource Management Act (1991). This empowering legislation established the framework for the National Policy Statement on Fresh Water Management (2011), under which lies regional policies and plans, and then resource consents (for particular activities, e.g., hydro dams and irrigation water extraction). Although this framework appears logical, integrated and robust it has resulted in a very unsatisfactory 'first-in first-served' system of water resource management, and has resulted in severe degradation to many lowland streams and lakes in terms of water quality and quantity. In response to dissatisfaction amongst almost all parties and in the region with the most potentially irrigable land, the local regional and district councils developed the Canterbury Water Management Strategy 2009 (CWMS). The Environment Canterbury (Temporary Commissioners and Improved Water Management) Act, passed by government in 2010, gives statutory weight to the CWMS, requiring that all decisions in respect of water have regard to the vision and principles of that Strategy. The CWMS is being implemented by Canterbury Water, essentially a partnership of the regional council and district councils, but housed in Environment Canterbury. Implementing the strategy involves a complex tiered system of bottom up local 'collaboratively based' implementers (largely audited self management groups), 10 local zone committees (each responsible for drafting an integrated 'zone implementation programme' – their 'ZIP') and a regional committee (responsible for the regional 'plumbing' and overall integration – their 'RIP'); all of this complemented by statutory plans (the rules). In this paper I outline how the ZIP and statutory regional planning process have clashed regarding water quality, and how environmental (including indigenous peoples interests) and development interests have clashed over water storage options – I then analyse how the Zone Committee has attempted to work through the issues in a collaborative way and how this promises to lead to a win for society, a win for the economy, a partial (or 'not such a big loss') win for the environment, and a win for cultural interests. In New Zealand we call this the Quadruple Bottom Line. The promise shown by these initiatives has not been without pain but could provide impetus for other similar initiatives in New Zealand and potentially elsewhere.

1. Introduction

New Zealand, somewhat like Australia, could well be described as a 'lucky country'. It has bountiful natural resources, magnificent scenery, a small population and a generally enviable climate – little wonder then it is often also described as being 'clean and green'. It is within this context, and on a global scale, that New Zealand is considered to be a water rich country. This water drives much of its very large renewable hydro electricity industry, supplies water to very large scale irrigation schemes, yet while in-river is internationally regarded for its recreational fishing, white water kayaking, and nature conservation values. Given that the spatial and temporal distribution of the resource, and

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demands thereon are often mismatched, it is perhaps not surprising that debate around the allocation and management of water is one of the country's most pressing economic and environmental (and also cultural²) issues. This debate is not new but continues to become more pressing, especially as development pressures grow while demands to retain, and moreover restore, the country's 'clean and green' image also mount.

Over the decades, and certainly since 1967, a variety of legislative and other policy mechanisms, and general institutional reorganisation, has been a feature of New Zealand's efforts to promote sustainable water resource management. In this paper I first outline the key steps in these processes, I then briefly evaluate the responses to these initiatives, and finally because of ongoing policy failure to achieve the desired environmental and cultural outcomes I outline and consider the latest set of reforms and their prospects for success.

2. Water resource management in New Zealand – some context

Some historical context

To help understand New Zealand it is important to appreciate its cultural genesis. Indigenous Maori first inhabited the country around 1200 AD. New Zealand was then 'rediscovered' by Abel Tasman in 1642, and then by James Cook in 1769. Following Cook came a period of 'unmanaged' 're'colonisation mainly by whalers and sealers. During this time Maori tikanga (roughly meaning traditional ways of managing resources and doing things) was maintained. However, during the early to mid 1900s the rate of 'largely' European colonisation increased and pressure on Maori, land ownership, etc., grew to unprecedented levels; indeed, to such an extent that 'land wars' occurred. In response the British government (the Crown) negotiated and alongside many (but not all) Maori leaders signed the Treaty of Waitangi in 1840. This Treaty has become a founding document of New Zealand and effectively promised Maori that they could retain ownership and control of key resources in ways consistent with their cultural practices. By implication for freshwater this meant community ownership (now referred to as Crown ownership) and is characterised by Maori seeking to maintain traditional food resources, Mauri (the life force of the water), etc.

The rate of European colonisation grew rapidly and was heavily linked to fishing, gold mining and farming. Trade was and remains all important. As land was increasingly alienated from Maori ownership so the focus moved slowly to freshwater. This interest grew in the 20th century when the drier eastern side of the South Island recognised the potential to increase production through the development of irrigation – the first major schemes being built in the 1930s. Also during this period the South Island's major rivers were being explored and increasingly developed for hydro electric power development.

Development plans first began to pique public concern in the 1960s and 1970s as a growing awareness of environmental and conservation issues first arose significantly in New Zealand. This convergence of interest was first expressed in the 'Save Manapouri' campaign, a battle to protect one of the country's most scenic lakes. The result of this campaign was an environmental awakening,

² New Zealand's Local Government Act (2002) requires local government to develop Long Term Plans (LTPs). These plans are required to consider the Quadruple Bottom Line of Economic, Environmental, Social and Cultural issues. The latter is typically taken to mean the obligations to and expressed needs of New Zealand's indigenous Maori as mandated under the Treaty of Waitangi signed between the Crown and Maori in 1840.

even though the lake was developed (at last partially) for its enormous hydro energy potential. The collision of the growth and environmental paradigms dominated the water debates of the 70s and 80s, but was then added to by the indigenous Maori reawakening of the 1980s and beyond. No longer was it development vs environment; frequently it became development being balanced against environmental and cultural forces. It is this picture, with the addition of social on the economic side of the debate which is the dominant feature of much New Zealand's contemporary water discourse. And, it is this picture which perhaps best explains why there is a divide between private and public rights, and the public good.

Institutional and legislative change

The Crown retains right of 'ownership' of freshwater in New Zealand³. In 1967 the Water and Soil Conservation Act heralded the first attempt at promoting sustainable water resource development and management in New Zealand. This legislation was accompanied by the setting up of river authorities and regional councils specifically mandated to manage water, supported by a strong central government Ministry of Works and Development (and its Water and Soil Division). The Act's shortcomings, especially in the environmental area, were soon exposed and it was amended in 1981 to include provision for the protection of nationally important water bodies (via National Water Conservation Orders) and other more 'triple bottom line' components.

But, while aspects of water resource management were seemingly improving (e.g., the water conservation order process was protecting key rivers and sending clear signals about sustainable development prospects – see Hughey et al. in prep.), other issues including the overall health of the New Zealand economy were coming under pressure. Such was the severity of these pressures that from the mid 1980s to the early 1990s the economic and institutional framework around which resources were managed and development promoted was changed hugely. Along with a shift to free market principles (the New Right) and practices was a radical change to environmental legislation. The Resource Management Act (RMA, 1991) heralded an era of integrated (vertically) effects based management, essentially development being permitted unless there was likely to be significant adverse effects on the environment in which case the requirement to avoid, remedy or mitigate these impacts was instituted.

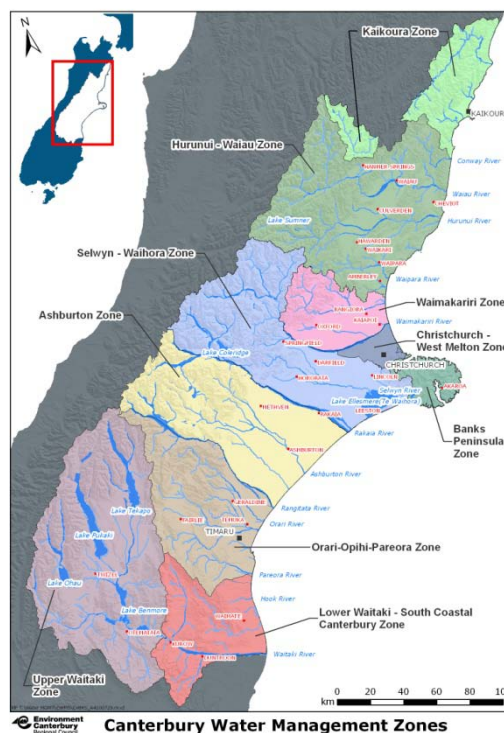
But the RMA is not just about water – essentially, apart from marine fisheries, it is about integrated management of all natural resources in New Zealand. The Act has been accompanied also by central and local government reform. Nationally, the Ministry for the Environment is responsible for national policies and standards and for monitoring the Act's effectiveness; other government agencies have advocacy powers they can use with regard to the Act's implementation (e.g., the Department of Conservation for environmental and conservation matters, and the Ministry of Agriculture and Fisheries for development interests). For local government, a tiered system of geographically large regional councils (responsible for freshwater, coastal, air, transport) develops regional policies and plans; these in turn are complemented by typically smaller district (and city) councils (responsible for land management, community services, etc). The tiered layers of councils produce 10 year Long Term Plans (under the Local Government Act 2002). These LTPs express the community visions for the future consistent with the Quadruple Bottom Line rubric.

³ Although debate continues, legally and politically about what 'ownership' means in a bicultural society where concepts of co-governance and co-management are increasingly being promoted.

However, despite all these reforms there has been growing and widespread local, regional and national level dissatisfaction with matters freshwater (see Cullen et al. 2006, Hughey et al. 2007, 2010 for example). And perhaps nowhere has this concern been more intense than in the Canterbury region (Figure 1).

Canterbury is New Zealand’s largest regional council by area, has a population of around 560,000, and has around 800,000ha of potentially irrigable land (currently over 500,000 irrigated). The region is also traversed by several large rivers (mean annual flows in the order of 100-400m³s⁻¹) which are of national and international importance for their recreational angling, boating and birdlife conservation values. Between these rivers and the sea are many lowland and mostly spring fed streams that contain important recreational and cultural values, especially for native fish, and also lowland lakes (one such, Te Waihora/Lake Ellesmere, is of international importance (see Hughey and Taylor (Eds) 2009)). While the larger rivers have been subject to large scale development (hydro and irrigation) they retain (mostly) adequate environmental flows and have high water quality. By contrast the lowland streams and lakes are typically hugely impacted by reduced flows and water pollution linked mostly to intensive agriculture development (see Cullen et al. 2006). Given that New Zealand’s economic growth forecasts and future prosperity (unlike almost any other ‘developed’ country) appear closely linked to agriculture and its development, yet New Zealanders’ value highly their clean and green image and high quality rivers and lakes, it is little wonder that questions are being asked about how ‘real’ sustainable development can proceed (see Hughey et al. 2007). It is within this context that the ‘new’ Canterbury Water Management Strategy initiative needs to be introduced and considered.

Figure 1. The Canterbury region and its water management zones



3. The Canterbury Water Management Strategy – a new way forward?

The empowering legislation, the RMA (1991), sets the framework for freshwater resource management in New Zealand – namely the National Policy Statement on Fresh Water Management (2011), under which lies regional policies and plans, and then resource consents (for particular activities, e.g., hydro dams and irrigation water extraction and discharges into water bodies). Unfortunately while the system appears vertically integrated and logical it has resulted in a very unsatisfactory ‘first-in first-served’ system of water resource management, which in turn has resulted in over allocation of water and pollution, especially of lowland rivers and lakes. In response to this and the growing environmental and cultural concerns, and growing dissatisfaction amongst almost all parties and in the region with the most potentially irrigable land, the local regional and district councils developed the Canterbury Water Management Strategy 2009 (CWMS). The process of developing the CWMS was multi staged, long and collaborative (Table 1).

Table 2. The Five Stages of the Canterbury Water Management Strategy

Stage	Time line	Coverage
1: Future Water Availability	1999 - 2002	Increasing demand for water in Canterbury meant increasing conflict over the allocation of water for abstraction and for the maintenance or improvement of instream values. In addition, there was concern that ad hoc decisions by one group might foreclose on protection or development options that provide greater benefits to the wider community. Needed fundamental information on: <ul style="list-style-type: none"> • The potential long-term requirement for water; • The capacity of the region to meet these requirements; • The water resources that would come under the most stress; • The reliability, over the long term, of water supplied from natural systems for abstractive uses.
2: Major Storage Options	2003 - 2005	Determination of whether it is practical to meet environmental needs and potential water demands through the use of storage as a core component of integrated management of surface water and groundwater in the Canterbury region.
3: Multi-Stakeholder Evaluation of Storage Options	2005 - 2007	Three phases: (i) formation and work of the regional reference group (ii) core reference group members joined consecutively by north, south and mid Canterbury representatives in staged meetings of locality-based reference groups to evaluate storage options in their subregion, and (iii) consultation with north, south and mid Canterbury interest groups based on the findings of the reference group evaluations.
4: Formulation of the Canterbury Water Management Strategy	2008 - 2009	Five key elements (i) stakeholder and community engagement on option development (ii) definition of strategic options (iii) community consultation on option preferences (iv) strategic investigations of outcomes (v) sustainability appraisal of options
5: Implementation of the CWMS	2010 -	Establishment of zone committees and regional committee; production of Zone Implementation Plans; integration of ZIPs into statutory planning and other implementation approaches. Ongoing community engagement at all levels

(Source: Adapted from B. Jenkins *et al.* in prep.)

However, even while the Canterbury Regional Council and district councils were developing the CWMS political dissatisfaction with political infighting and management failures of the same council led the national government in 2010 to 'sack' the democratically elected council and replace it with appointed commissioners. Thus, The Environment Canterbury (Temporary Commissioners and Improved Water Management) Act, passed by government in 2010, gives statutory weight to the CWMS, requiring that all decisions in respect of water have regard to the vision and principles of that Strategy (ECan 2009), namely:

Vision: "To enable present and future generations to gain the greatest social, economic, recreational and cultural benefits from our water resources within an environmentally sustainable framework" (ECan 2009: 6).

Within the CWMS (ECan 2009: 8) the priorities and "Principles that must be met:

First order priorities: environment, customary use, community supplies and stock water.

Second order priorities: irrigation, renewable electricity generation, recreation and amenity.

Primary principles – sustainable management, regional approach, and tangata whenua

Supporting principles – natural character, indigenous biodiversity, access, quality drinking water, recreational opportunities, and community and commercial use.

These are designed to ensure that our water resource is managed sustainably".

Underneath these all encompassing requirements is a set of 10 target areas, namely:

1. Ecosystem health/biodiversity
2. Natural character of braided rivers
3. Kaitiakitanga
4. Drinking water
5. Recreational and amenity opportunities
6. Water-use efficiency
7. Irrigated land area
8. Energy security and efficiency
9. Regional and national economies
10. Environmental limits

These targets will all be met in the region over a staggered time period, i.e., 2010, 2015, 2020 and 2040 (see Appendix 1 for examples). This staggered time period is important as it reflects:

- 'Rome wasn't built in a day' – transition periods are necessary
- Some of the targets may at first glance appear mutually exclusive but over time and space can be made to work
- There are insufficient resources – dollars and people – to do it all now
- Planning and sometimes new tools will be required
- New resources flowing from early investment will be required into the future.

The targets reflect the QBL and reflect a desire for balance, but only consistent with the Vision and Principles, thus environmental and cultural needs outweigh economic and social but over time all will be achieved.

Implementation of the CWMS is coordinated by Canterbury Water, essentially a partnership of the regional council and district councils, but housed in Environment Canterbury. Implementing the strategy involves a complex tiered system of local 'collaboratively based' implementers (largely

audited self management groups), 10 local zone committees (each responsible for drafting an integrated 'zone implementation programme' – their 'ZIP') and a regional committee (responsible for the regional 'plumbing' and overall integration – their 'RIP'). The composition and working mode of the zone committees is important:

- Each zone committee is appointed by the local District and the Regional Council
- Both of the above have a representative on the Committee
- The tangata whenua have as many representatives as there are tribal or sub tribal groupings in the zone (in Canterbury this ranges from 1-6 per zone)
- Community representatives, at least 7, are then appointed. Nominations are called for, applications made, presentations given, and appointments made. Typically the community representatives live in or near the zone; alternatively they have a close association with a zone (in my case my family is from the zone and I fish and kayak and undertake research in the zone)
- The zone committee is a statutory committee of both councils under the LGA – it has secretarial support from the District Council; it has a professional facilitator from the Regional Council
- Zone committees each produce a Zone Implementation Plan – an integrated document that covers all things freshwater. This non statutory plan then forms the basis from which statutory plans and further community initiatives are then undertaken.
- Committees meet as often as is necessary – the Hurunui Waiau Committee met every 3 weeks for around 6 hours (plus travel of 2-4hrs per meeting) for a year to produce its plan. It had numerous other meetings in the zone and multiple field trips.

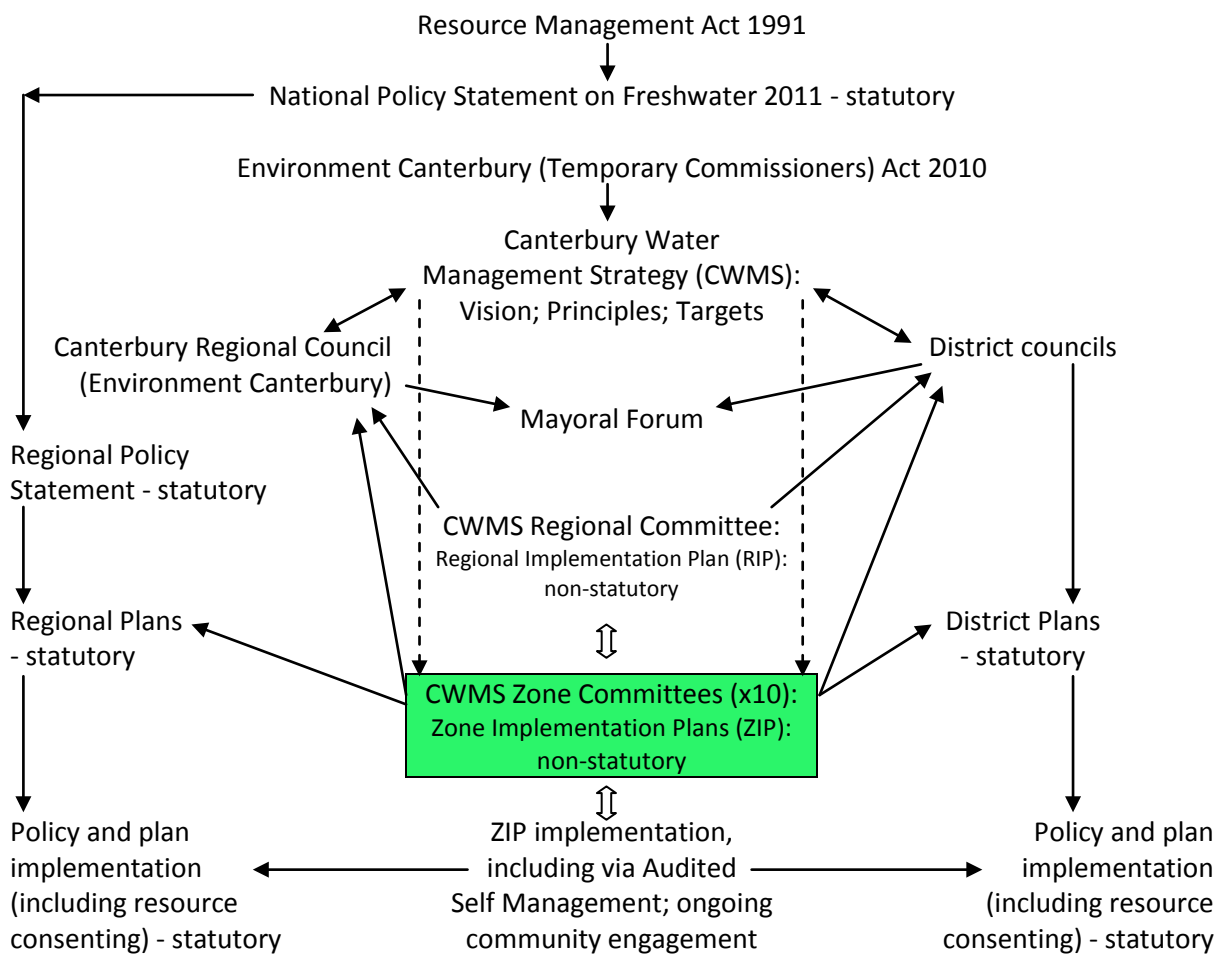
These collaboratively developed documents in turn are 'used' by regional and district councils as the foundation for their statutory plans (containing policies, objectives and rules) (Figure 2). The first of the 10 zone committees, Hurunui-Waiiau, was established in July 2010; concurrently the national government approved moratoria regarding further water resource development on the two biggest rivers in the zone (the Hurunui and Waiiau) for a period of one year to give the committee time to develop an integrated zone implementation plan. This plan (as shown in part in Appendix 1) covers:

- Tangata whenua issues
- Potable water supplies
- Every river and lake in the zone
- Environmental requirements – amount and quality of water needed for the life supporting capacity of water bodies, including the needs for safeguarding native birdlife, native fish, etc
- Recreational requirements – amount and quality of water for white water kayaking, recreational angling, jet boating, swimming, etc
- Irrigation demand
- Complementary hydro development (but only where it supports irrigation development).

The programme is integrated and can perhaps best be described as 'demand driven', i.e., the community has defined its needs (demands) and these now have to be met (supplies). This philosophy has changed the 'playing field' for developers. It is no longer their job to invent the supply side – it is their job to work collaboratively with the community to meet the demands. It is this philosophy that is already resulting in some interesting 'developer behaviour'. Hydro developers

can now only operate in the zone if they are adding value to irrigation development (e.g., by storage) and are not in conflict with environmental and recreational demands (e.g., off river storage rather than main stem dams; flow stabilisation from hydro dam discharges to protect fisheries rather than diurnal hydro-peaking). And, perhaps not surprisingly they are beginning to work with the zone committee and its constituent supporters, the farmers, the fishers, the nature conservation interests. This sort of behaviour appears likely to lead to a range of superior multiple use type outcomes, borne out of the collaborative process.

Figure 2. The relationship between the statutory and non-statutory components of the Canterbury Water Management Strategy implementation framework



The vexed issue of water quality

Of all the issues faced to date (and going forward), and perhaps the hardest to deal with not surprisingly, is water quality. Despite a 'cap and trade' system recently being introduced for the iconic Lake Taupo catchment (Rutherford and Cox 2009), no similar system is as yet contemplated for the Canterbury region (although some preliminary discussions have been occurring within at least one water zone committee). Typically in New Zealand point source discharges are consented and managed (relatively) appropriately. But, as with many countries, the existing and looming larger challenge is that from intensive agriculture and non-point source pollution (N, P and *E. coli* in particular). Already, and despite the country's 'clean and green' image we have grossly polluted

rivers (e.g., the Manawatu in the North Island) and lowland lakes (e.g., Te Waihora/Lake Ellesmere in Canterbury, South Island). As a result there is a need to protect what remains in 'good' condition, and a need to restore what is already damaged, while concurrently providing for new and more intensive development.

Unfortunately non-point source pollution is challenging to manage. In order to meet this challenge Canterbury Water engaged with a range of partners (e.g., DairyNZ, NIWA, AgResearch, Lincoln University, HortNZ, Fish and Game NZ, Royal Forest and Bird Protection Society) at a governance level, and with an on-the-ground collaborative project involving farmers, recreationists, tangata whenua, council staff, scientists, etc., to develop the Land Use and Water Quality Project with an initial pilot focused on the central Hurunui River catchment. The study area has several advantages:

- a) The water flowing into it from the Upper Hurunui can be measured for its quality at a Gorge measuring site; and
- b) The water flow out of it can be measured at a further downstream Gorge site; and
- c) As a result of the above the difference between a) and b) is calculated as being caused largely by agricultural intensification – there is little or no 'real' debate about this point; and
- d) On the north side of this central catchment there is considerable irrigation development mostly now associated with dairying but applied via spray and border dyke flood systems, and the south side where farming is currently dryland (sheep and beef) dominant.

As part of the project the researchers identified the relative nutrient loads in various parts of the catchment, the source of these loads, and the impact of these loads on a range of river values (e.g., in some years when high N and P coincide there is a high incidence of nuisance periphyton occurrences). As a consequence the researchers were able to model the likely changes that would result to these loads over a range of different intensification/development scenarios. Ultimately this led to develop an impact assessment matrix (Appendix 2) which allowed consideration of the likelihood of adverse and unacceptably risky events occurring. The conclusion from this work was that if current N concentrations were maintained and P reduced (which is relatively simple as it mostly comes from surface runoff from border tyke flood irrigation systems which are progressively being converted to spray irrigation systems) then the 4 out of 5 year periphyton target would probably be met; this was an acceptable position for the zone committee, although it was signalling it wanted further improvement in water quality over time.

Ultimately the zone committee published the above as an 'at or about' target within its ZIP. It was then the task of the Canterbury Regional Council to convert this target into policies, objectives and rules within its proposed Hurunui Waiau Regional Plan. At this point two 'senior' members of the zone committee took it upon themselves to question this target and to raise their concerns with the Council and others without a full opportunity for the Zone Committee to once again discuss the issue. As a result, ultimately, the notified regional plan was published and contained a new target which allowed for a 20% 'N-head room' to be applied to new developments in the area. Some members of the zone committee were alarmed, not so much by the change itself, but the process which involved very limited consultation and which was undertaken without the same degree of engagement that had characterised the ZIP development. Concern was also expressed in the media and higher level policy circles, about process. These concerns led the Regional Council Commissioners to make a 'bizarre' decision – they threw the issue back to the Zone Committee and invited them to come up with a consensus agreement (remember there already was one, in the ZIP)

which they would then submit on behalf of the Council to the Council's independent panel hearing submissions about the Council's own notified plan. Ultimately, the zone committee has come up with such a consensus, and indeed in my view a position which is vastly superior to that in the notified plan, and also superior in many respects to that in the ZIP. But, the decision is now in the lap of the independent hearing panel which will convene in 2012 and which has to finalise the plan in the same year. This is a pivotal issue for water management in the zone, in Canterbury and in New Zealand – the outcome is likely to be precedent setting.

So, what are the lessons from the consideration of water quality? The main issue concerns process, not surprisingly, informed by good science. If the community is going to drive the 'demand' side then it behoves the policy makers and the politicians to have robust community inspired processes which are resilient to change to pressures. These processes and their outcomes should be subject to review but that review itself needs to engage with the community and not marginalise it as occurred here.

4. Conclusions

'The jury is still out' is not a new phrase but it is one that applies, and will apply for some considerable time, to evaluating successful implementation of the Canterbury Water Management Strategy. There are however 'runs on the board':

- The community is more engaged and probably more unified than it has ever been (a social capital outcome)
- plans and policies (outputs) have been developed or are in the process of development
- Developers are working with the zone committee and individuals on the committee to develop innovative solutions to match the 'demands' expressed in the ZIP (an output)
- Upper sections of rivers have, at least for the moment, been 'barred' from hydro development (an outcome)
- Restoration projects have already occurred (an outcome).

All of these successes (outcomes and outputs) have occurred within a <18 month period, amazing for a 'wicked' environmental problem like this. So, there is much promise, but will the ZIP and its implementation over time deliver on:

- Desired water quality outcomes
- Maintaining the dam prohibition on the upper rivers
- Maintaining and enhancing recreational requirements
- Maintaining and enhancing biodiversity
- Restoring tangata whenua aspirations
- Protecting and improving lowland river flows
- Providing potable water
- Leading to significant economic and social growth in the area?

The fact that the community is 'demand'ing these outcomes is perhaps a source of reassurance, as too is the collaborative engagement process. The Hurunui Waiau community is very strongly agriculturally based but is complemented by wider local and regional environmental and cultural communities of interest. This combination of interests appears committed to ensuring the supply side more than matches these demands. Having said this it is also clear the 'jury is still out' and may

well be asking these questions for at least the next 10-20 years before they receive sufficient information to allow them to make an informed and hopefully consensual decision.

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Appendix 1. Examples of region wide and zone specific targets over time for the CWMS region wide and specifically for the Hurunui Waiau Zone

Target area	Times	Canterbury WMS regional example targets	Hurunui Waiau target examples from Zone Implementation Plan
Ecosystem health and biodiversity	2010 2015 2020 2040	Prevent further loss of area of naturally occurring wetlands Protected all and restored at least two significant wetlands in each zone Protected all existing wetlands Protected all existing wetlands	By 2012: Set a target for wetland protection in the Zone (taking into account the CWMS target/goals) and identify how this target would be achieved Target Immediate Steps Biodiversity Funding for 2011/12 through 2014/15 to some or all of the following priority areas: 1. North Pegasus Bay coastal wetlands 2. Lower Waitohi wetlands 3. Conway Flat to Waiau River mouth; 4. Braided River Ecosystems 5. Sumner Lakes complex
Natural character, processes and ecological health of braided rivers	2010 2015 2020 2040	Implement actions to correct the decline in useable braided river bird habitat Enhanced and protected of breeding population of indigenous braided river birds Protected significant habitat for a full range of indigenous braided river flora and fauna Increase habitat area usable by all species of braided river indigenous birds	2011: The Hurunui Waiau Regional Plan must include minimum flows and flow variability for Waiau River that provide for: <ul style="list-style-type: none"> • in-stream river ecology (including native fish and invertebrates); • protection of river-nesting birds during breeding season
Kaitiakitanga	2010 2015 2020 2040	Increase understanding in each zone of the customary values and uses associated with specific water-bodies or parts of water-bodies All degraded wahi taonga and mahinga kai waterways nominated by Ngai Tahu have an active restoration programme in place that responds to cultural priorities Increased the abundance of, access to and use of mahinga kai Kaitiakitanga is a normalised and an integrated practice of water management	By Nov 2011: The Hurunui Waiau Regional Plan will recognize and provide for all wāhi tapu and wāhi taonga within the Hurunui and Waiau catchments (e.g. spawning grounds and key habitats for native fish species are protected and maintained or enhanced to ensure the ongoing health and vitality of those species).
Drinking water	2010	Prevent further decline in source water quality for those communities that currently have to treat drinking-water, such that this requires increased level of treatment or monitoring requirements	By 2011: The Hurunui Waiau Regional Plan must give priority to takes for community drinking water and stock water schemes By 2011: The Hurunui Waiau Regional Plan must include provision of water availability to meet future demand for community water supplies in volume, quality and location to align with existing schemes as identified by Hurunui District Council By 2011: Provision of secure community drinking water (and stockwater) of a quality capable of being treated to New Zealand Drinking Water Standard should be part of an integrated "more water" project and developers will partner with Hurunui District Council to deliver this outcome

	2015 2020 2040	Set catchment load limits for nitrate consistent with drinking water quality targets for each zone, identified priority areas where targets are not met and implemented actions to ensure there is no further enrichment A demonstrable decrease in nitrate concentrations in shallow groundwater in priority areas is achieved Nitrate levels in community drinking wells are below the maximum allowable value of drinking water	in their proposals and plans
Recreational and amenity opportunities	2010 2015 2020 2040	Maintain the existing diversity and quality of water-based recreational sites, opportunities and experiences At least 80% of river bathing sites graded as suitable for contact recreation A positive trend in the availability and/or quality of recreational opportunities Restored fishing opportunities in most lowland streams	By 2011: The Hurunui Waiau Regional Plan must include minimum flows and flow variability for Hurunui River that provide for: <ul style="list-style-type: none"> • the needs for salmon and trout fisheries (including fishability); • maintenance of in-stream recreation opportunities (particularly whitewater kayaking and jet-boating (including commercial jetboating))
Water use efficiency	2010 2015 2020 2040	Initiate the development of models/benchmarks of reasonable and efficient use of water in irrigation 60% of water used for irrigation is operating according to best practice water use 80% of water used for irrigation and stockwater is operating according to best practice water use Implemented best practice water use on all irrigation, stockwater and industrial/commercial use in Canterbury	Nov 2011: The Hurunui Waiau Regional Plan will ensure new irrigation includes efficient distribution and irrigation systems and that water-use efficiency continues to improve in current irrigation 2010 on: The Zone Committee will work with Amuri Irrigation Company and Irrigation New Zealand to identify and then support activities to improve water-use efficiency amongst current irrigators in the Zone
Irrigated land area	2010 2015 2020	No reduction in irrigated land area in Canterbury or in overall reliability A system of regionally distributed rural water infrastructure for the storage and distribution of water that provides reliable water to all irrigated land has been designed, timetabled, costed and staged Started construction of regional storage and improved reliability of supply for at least 50% of irrigated land Improved reliability of supply for all irrigated land	Nov 2011: The Hurunui Waiau Regional Plan should ensure water would be available (including through storage) to irrigate the approximately 100,000ha (net) irrigable area in the Zone.
Energy security and efficiency	2010 2015 2020	Maintain Canterbury's existing contribution to New Zealand's security of electricity supply Started projects to generate electricity from existing irrigation infrastructure Increased the productivity per unit of electricity – per hectare consumption for irrigation sector and equivalent measures in other sectors	The Hurunui Waiau Regional Plan should give priority to allocation for irrigation development (particularly for integrated irrigation and hydro-generation projects) rather than allocation just for hydro-generation

	2040	Generate at least 40-45% of the power used by irrigation in Canterbury from irrigation infrastructure (including multi-use hydro and irrigation systems)	
Indicators of regional and national economies	2010 2015 2020 2040	No decline in the contribution water makes to Canterbury economy “as measured through value added” (economic impact) Increased the “value added” and employment per unit of water Increased production through the direct application of water to agriculture contributes an additional \$0.4 billion per annum value-added to the Canterbury economy Increased production through the direct application of water to agriculture contributes an additional \$1.7 billion per annum value-added to the Canterbury economy	The Hurunui Waiau Regional Plan should ensure water would be available (including through storage) to irrigate the approximately 100,000ha (net) irrigable area in the Zone.
Environmental limits	2015 2020 2040	Set catchment load limits for nutrients for each water management zone that are consistent with the fundamental principles of the CWMS and that: - are consistent with ecosystem health, drinking water and biodiversity targets - afford protection to instream values identified in Ngāi Tahu policies - are consistent with the recreational uses of the water body; and - consider all the target areas of this strategy Review of environmental flows and catchment load limits in response to changing monitoring information, new understanding and technologies, and if requested by regional and zone committees Environmental flow and catchment load limits achieved in all waterbodies	Water quality outcomes for mainstem of Hurunui and Waiau Rivers: <ul style="list-style-type: none"> • Achieve in most years periphyton limits as identified in NRRP (that is, 4 years in every 5); • Safe for contact recreation; • Maintain or enhance the mauri of the river; • Toxin producing cyanobacteria shall not render the river unsuitable for recreation or animal drinking water; • Nutrients (particularly nitrate and phosphorous) will decrease over time at sufficient rate and to a level such that additional irrigation development can occur without compromising water quality outcomes for the river (i.e. reduce current loads to create “headroom” for new irrigation development).

Appendix 2. Example water quality assessment matrices for various values versus different development scenarios for the Hurunui River, New Zealand, and key tributaries (Source: N. Norton, NIWA, pers. comm., 2011)

a) Hurunui River upstream of Mandamus

VALUES AND ASSESSMENT CRITERIA ACHIEVED FOR EACH SCENARIO...	SCENARIOS				
	A (Conservative modelled)	B (1990-1995 data)	1 (Current - 2005-2009 data)	2 (Business as usual)	3 (Extensive irrigation)
NRRP periphyton objective (50 mg/m ²)	Almost certainly	Almost certainly	Probably	Probably	Probably
Visual aesthetic values (<10% algae cover)	Almost certainly	Almost certainly	Probably	Probably	Probably
Visual water clarity	Almost certainly	Almost certainly	Almost certainly	Probably	Probably
Recreation values (safety, microbiological health)	Almost certainly	Almost certainly	Probably	Probably	Probably
Benthic biodiversity (invertebrates QMCI, EPT response to algae)	Almost certainly	Almost certainly	Probably	Possibly?	Possibly?
Trout habitat & angling (based on NZ periphyton guidelines)	Almost certainly	Almost certainly	Probably	Probably	Probably
Nitrate toxicity criteria to protect 95% aquatic species biodiversity (~1.7 mg/L)	Almost certainly	Almost certainly	Almost certainly	Almost certainly	Almost certainly
Nitrate toxicity criteria to protect human drinking quality (~11.3 mg/L)	Almost certainly	Almost certainly	Almost certainly	Almost certainly	Almost certainly
Riverbed birds (with respect to maintaining aquatic food supplies only)	Almost certainly	Almost certainly	Probably	Probably	Probably
¹Ngai Tahu eco-cultural values	?	?	?	?	?

b) Hurunui River at State Highway 1

VALUES AND ASSESSMENT CRITERIA ACHIEVED FOR EACH SCENARIO...	SCENARIOS				
	A (Conservative modelled)	B (1990-1995 data)	1 (Current - 2005-2009 data)	2 (Business as usual)	3 (Extensive irrigation)
NRRP periphyton objective (120 mg/m ²)	Almost certainly	Almost certainly	Probably	Possibly?	Possibly?
Visual aesthetic values (<20% algae cover)	Almost certainly	Almost certainly	Probably	Possibly?	Possibly?
Visual water clarity	Almost certainly	Almost certainly	Almost certainly	Probably	Probably
Recreation values (safety, microbiological health)	Almost certainly	Almost certainly	Probably	Possibly?	Possibly?
Benthic biodiversity (invertebrates QMCI, EPT response to algae)	Almost certainly	Almost certainly	Probably	Possibly?	Possibly?
Trout habitat & angling (based on NZ periphyton guidelines)	Almost certainly	Almost certainly	Probably	Possibly?	Possibly?
Nitrate toxicity criteria to protect 95% aquatic species biodiversity (~1.7 mg/L)	Almost certainly	Almost certainly	Almost certainly	Almost certainly	Almost certainly
Nitrate toxicity criteria to protect human drinking quality (~11.3 mg/L)	Almost certainly	Almost certainly	Almost certainly	Almost certainly	Almost certainly
Riverbed birds (with respect to maintaining aquatic food supplies only)	Almost certainly	Almost certainly	Probably	Possibly?	Possibly?
¹ Ngai Tahu eco-cultural values	?	?	?	?	?

Note: 1 = An assessment of Ngai Tahu eco-cultural values is in progress. An agreed process for integrating an assessment of scenario implications for Ngai Tahu values has not been finalised, however it is likely to include Cultural Monitoring in the Hurunui case study area in early 2011 and associated predictions for cultural health across the five scenarios.

Lower Waitohi River upstream of Hurunui confluence – partially developed tributary

VALUES AND ASSESSMENT CRITERIA ACHIEVED FOR EACH SCENARIO...	Scenarios...				
	A (Conservative modelled)	B (1990-1995 data)	1 (Current - 2005-2009 data)	2 (Business as usual)	3 (Extensive irrigation)
NRRP periphyton objective (200 mg/m ²)	Almost certainly	Probably	Possibly?	Possibly?	Possibly?
Visual aesthetic values (<30% algae cover)	Almost certainly	Possibly?	Possibly?	Possibly?	Unlikely
Visual water clarity	Almost certainly	Probably	Possibly?	Possibly?	Possibly?
Recreation values (safety, microbiological health)	Almost certainly	Possibly?	Possibly?	Possibly?	Unlikely
Benthic biodiversity (invertebrates QMCI, EPT response to algae)	Almost certainly	Possibly?	Possibly?	Possibly?	Unlikely
Trout habitat & angling (based on NZ periphyton guidelines)	Almost certainly	Probably	Possibly?	Possibly?	Unlikely
Nitrate toxicity criteria to protect 95% aquatic species biodiversity (~1.7 mg/L)	Almost certainly	Probably	Almost certainly	Almost certainly	Almost certainly
Nitrate toxicity criteria to protect human drinking quality (~11.3 mg/L)	Almost certainly	Almost certainly	Almost certainly	Almost certainly	Almost certainly
¹Ngai Tahu eco-cultural values	?	?	?	?	?

St Leonards Stream – already developed tributary

VALUES AND ASSESSMENT CRITERIA ACHIEVED FOR EACH SCENARIO...	Scenarios...				
	A (Conservative modelled)	B (1990-1995 data)	1 (Current - 2005-2009 data)	2 (Business as usual)	3 (Extensive irrigation)
NRRP periphyton objective (200 mg/m ²)	Almost certainly	Possibly?	Possibly?	Unlikely	Unlikely
Visual aesthetic values (<30% algae cover)	Almost certainly	Possibly?	Possibly?	Unlikely	Unlikely
Visual water clarity	Almost certainly	Probably	Possibly?	Possibly?	Possibly?
Recreation values (safety, microbiological health)	Almost certainly	Possibly?	Possibly?	Unlikely	Unlikely
Benthic biodiversity (invertebrates QMCI, EPT response to algae)	Almost certainly	Possibly?	Possibly?	Unlikely	Unlikely
Trout habitat & angling (based on NZ periphyton guidelines)	Almost certainly	Possibly?	Possibly?	Unlikely	Unlikely
Nitrate toxicity criteria to protect 95% aquatic species biodiversity (~1.7 mg/L)	Almost certainly	Probably	Unlikely	Unlikely	Unlikely
Nitrate toxicity criteria to protect human drinking quality (~11.3 mg/L)	Almost certainly	Almost certainly	Almost certainly	Almost certainly	Almost certainly
¹ Ngai Tahu eco-cultural values	?	?	?	?	?