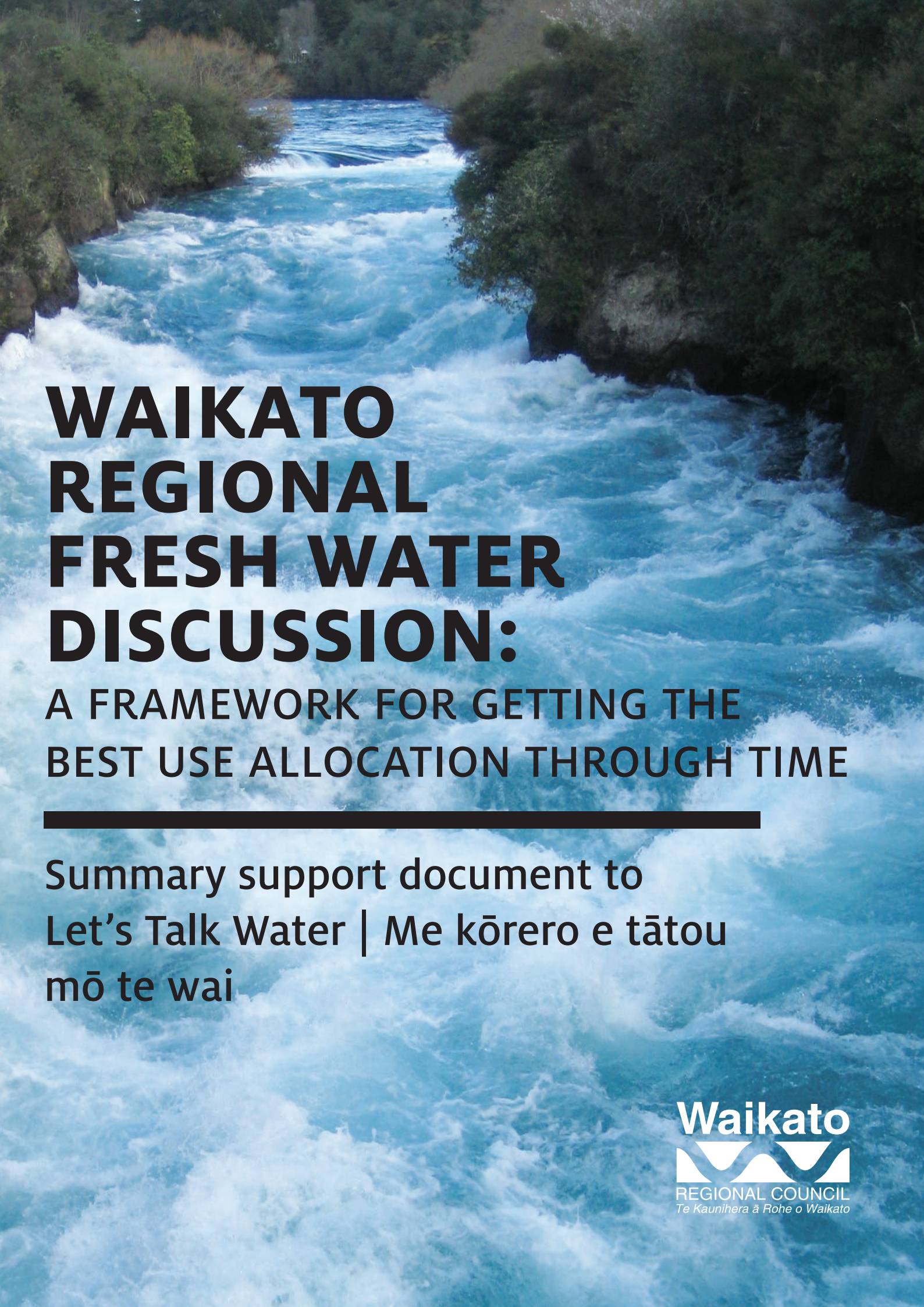

WAIKATO REGIONAL FRESH WATER DISCUSSION:

A FRAMEWORK FOR GETTING THE BEST USE ALLOCATION THROUGH TIME

Summary support document to Let's Talk Water | Me kōrero e tātou mō te wai

Waikato Regional Council
Te Kaunihera ā Rohe o Waikato

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The author would also like to acknowledge the valued assistance of other council staff in the preparation of this document, in particular Ed Brown, Blair Keenan, Bruce McAuliffe, Tracey May, Katie Mayes, Derek Phyn and Wendy Valois.

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SECTION 1 Executive summary

Executive summary

Water is New Zealand's foremost strategic asset. In its simplest terms, the New Zealand economy is primarily engaged in turning our rainwater into exports and experiences for visitors. In this way, Waikato water is critical to the interests of the wider regional community and the nation as a whole.

Regional councils and their predecessors have been charged with managing and allocating fresh water on a regional scale for the last 50 years. During that time the emphasis has changed from the direct regulation of discharges and takes to and from regional water bodies to the realisation that surrounding catchment use must also be managed to achieve community and iwi expectation for water.

While the regulatory tools have served well and point source discharges have either been eliminated or substantially cleaned up, the current management framework is nearing the limit of its effectiveness and new tools are needed. In particular, tools that are designed to change behaviour of landowners regarding their effects on the region's water resources. These can be characterised as incentives and information to complement the current rule framework.

It is reasoned that a wider range of targeted policy instruments will overcome the problems of trying to fit everything within a regulatory framework, speed up decision making and allow water to be allocated to its highest value when needed and when available.

This project looks 30 to 50 years into the future and although it cannot predict the future, it identifies some trends that could drive and support change to the way water resources are used. It recognises the regional framework is appropriate and that there will be changes and opportunities available in the future.

Changes will not be limited to the Waikato region and the region cannot be isolated from the national and global situation. The changes in water availability, global population growth and global shift in rainfall patterns, as well as over exploitation of groundwater will increase the relative value of water from the region and presumably the value of exports that contain water unobtainable cheaply elsewhere.

Changes can be expected with water supply and demand due to the projected effects of climate change. In general there will be more meteorological extremes with more frequent drought conditions in the north and the east of the region, and more intense storms elsewhere. Of particular relevance is the projected rise in sea level which will have dramatic influence on the low-lying northern plains of the region. It is in these areas that the fresh water resource will be reduced into the future and overtaken by estuarine conditions.

Technology change will almost certainly change the way we use and value water and will allow us to understand the regional resource better than ever. Information will in the future not just be limited to those with the resources to go out and take samples – but sensors can be expected to be cheap and will be ubiquitous, and so the use and effects of water use will be available to all. The regional council will have a role in ensuring quality information is freely available to all. These conditions are also expected to herald an increase in citizen science with active participation by community groups, industry and iwi.

Iwi expectations on rights and interests with respect to fresh water have been interpreted and included in a section to reflect the change in management environment into the future. The section is included in full recognition that this is not definitive and that the current negotiations between iwi and the Crown are an ongoing backdrop to all future work.

The project recognises that much of our economic success is dependent upon access to and ability to use water, but we have no way of knowing this and of measuring it. As a result, the development of a set of regional water accounts is proposed that will allow a wider understanding of the impacts of water management decisions on the wider regional and national economy.

A key tenant of the work is the recognition that water quality and water quantity are not separate but related dimensions of the same resource. We must recognise the interactions between the different phases and the link that river systems play in integrating the activities occurring on land with effects in the coastal marine area. All things being equal (and they are not because of different land use, geology, topography, climate, season, use etc), the higher the volume of water in a water body, the more contaminants (either from land or direct discharge) that the water body can assimilate without causing detrimental environmental effects (sustainability). The corollary is that the more water that is allocated for use outside the water body, the more sensitive it is likely to become to water quality degradation.

Once the region is clear on its social, economic and environmental objectives we need to ensure that we have a water allocation that will achieve these. We have no way of achieving that without investment in relationships with other parties and the development of the information management and modelling package so that new policy instruments can be explored and applied.

The report identifies a recommended programme of work for the regional council consisting of a mix of:

- Advocacy for:
    - new policy tools including incentives such as economic instruments, like pricing for volume of take and strength of discharges to facilitate real time trading
    - increased efficiency for that water which is taken
    - storage for use during times of scarcity
    - land use change that positively contributes to water availability in the future.

- Continued support for efforts to reduce the time and costs of policy and plan making that will contribute to increased plan agility.
- Recognition for and acceptance of ways to quantify the embodied water content of water in the products and services from the Waikato region.
- Recognition of the role water plays in the products and services provided by the Waikato region and to seek a consistent methodology for quantifying such a contribution.
- Settle on the appropriate spatial scales for policy making, spatial management scales, data acquisition, information management, modelling and applied actions.
- Develop a water accounts database and organise current and future water related information to match it.
- Actively explore opportunities for environmental engineering solutions to existing and emerging water management issues such as storage, wetland construction, instream structures to mitigate the effects of historic use and the projected change in meteorological conditions.

Recommendations are also made for consideration of other parties to work in concert with the regional council for the future management of the region's water resources.

SECTION 2 Introduction

Introduction

Water is New Zealand's foremost strategic asset.[1] In its simplest terms the New Zealand economy is primarily engaged in turning our rainwater into exports and experiences for visitors. In this way Waikato water is critical to the interests of the wider regional community, which includes iwi partners, recreational users, farmers, households (both within the region and outside), and industrial and other economic stakeholders, as well as Waikato Regional Council and local government organisations. Within these users there are a myriad of competing uses for the water – some of these are extractive but many are not; for example hydroelectricity, recreation and the assimilation of discharges.

Pressure on fresh water resources has increased significantly in recent years, resulting in increasing efforts to regulate use and the condition (quality) of fresh water. There are many actors and agencies in the Waikato region concerned with the use and condition of the regional water resources. Each has a position and in many cases is also engaged in work programmes actively seeking individual outcomes. These range from ensuring the sustainability of the resource to others directed towards securing access for specific uses.

The present management of natural and physical resources under the Resource Management Act has been summarised as the management of externalities, or the consequences of particular activities. This is at best a tactical response and may not allow for the optimal use of water to achieve regional environmental, social, cultural and economic objectives. The current approach is reactive and is relegated to avoiding, remedying or mitigating the negative effects of particular activities. It was developed during a perceived time of plenty with little regard to the limits on fresh water we now face as a society. Moreover, the allocation was and continues to be on a 'first in, first served' basis with legal requirements to favour existing uses at times of review and renewal of consent[2].

Despite visionary work in the past by government ministries[3] and the New Zealand Business Council for Sustainable Development,[4] little has been done in the water management area apart from incremental adjustments to the current regulatory regime using the existing legislative framework. The need to address water management is more critical than ever before. A more strategic approach is required that recognises the increasing pressures on the freshwater resources, and for that, a clear understanding of the resource, its value to society and interactions with other resources is required.

Water quality and quantity issues are interlinked and display the characteristics of a common pool resource. That is, the use of water by one party affects the availability of water for use by another party and it is difficult or costly to control the use of water by different parties for the same or for different purposes.

Issues around fresh water management have been referred to in the literature as a 'wicked' problem. This is because water is neither a private good nor is it a public good. As a result neither market-based instruments nor government intervention alone are applicable to solve the issues around the allocation and use of water. It therefore follows that an allocation regime that uses a combination of regulatory and market based instruments will be required.

1 *http://blog.nature.org/conservancy/2016/01/20/from-davos-water-is-a-valuable-asset-lets-treat-it-like-one/?post=47886#./*

2 *See Resource Management Act 1991 sections 104(2A) & 124B*

3 *Ministry for the Environment 2004 Technical Working Paper Water Programme of Action – Water Allocation and Use*

4 *A Best use solution for New Zealand's Water problems 2008*

Water quality and quantity

For a number of reasons, water quality and water quantity are managed separately and differently, yet these are characteristics of the same resource. This is rational from a direct use viewpoint but less so when from an integrated management perspective. The primary consideration for managing an abstraction application is: Will there be enough water to fulfil expected needs? This is a consideration of quantity and requires an understanding of catchment yields and physics, and typically is the domain of the hydrologist. A secondary consideration may be the degree to which the taken water needs to be treated (if at all) for the anticipated use.

In contrast, the primary concern for managing a discharge application is: What condition does the discharge need to be treated to (if at all) so as not to place excessive demand on the receiving water? This is typically seen as a quality issue and is often the role of a water chemist or biologist or perhaps an ecologist. The training, experience, knowledge and skills are different, yet the resource is the same – water. The ability for a receiving water body to assimilate a discharge is a use and requires a volume of water to dilute the effect of the discharge. Unless the concentration of contaminants in the discharge is the same as the receiving water body (e.g. hydroelectricity discharge), assimilation of a discharge is an – in situ use that requires a volume of water for the dilution of contaminants.

Water quality is a dimension of quantity as it is the allocation of a volume to assimilate the impact of the discharge and the two should be managed in an integrated manner, yet this is rarely the case. Not only are these dimensions studied by different disciplines, the policy treatment is different as evidenced by the different objectives and policies in the National Policy Statement for Freshwater Management[5] – section A for water quality and section B for quantity.

All things being equal (and they are not because of different land use, geology, topography, climate, season, use etc), the higher the volume of water in a water body, the more contaminants (either from land or direct discharge) that the water body can assimilate without causing detrimental environmental effects (sustainability). The corollary is that the more water that is allocated for use outside the water body, the more sensitive it is likely to become to water quality degradation.

Links between water quality and water quantity

5 *http://www.mfe.govt.nz/publications/fresh-water/national-policy-statement-freshwater-management-2014*

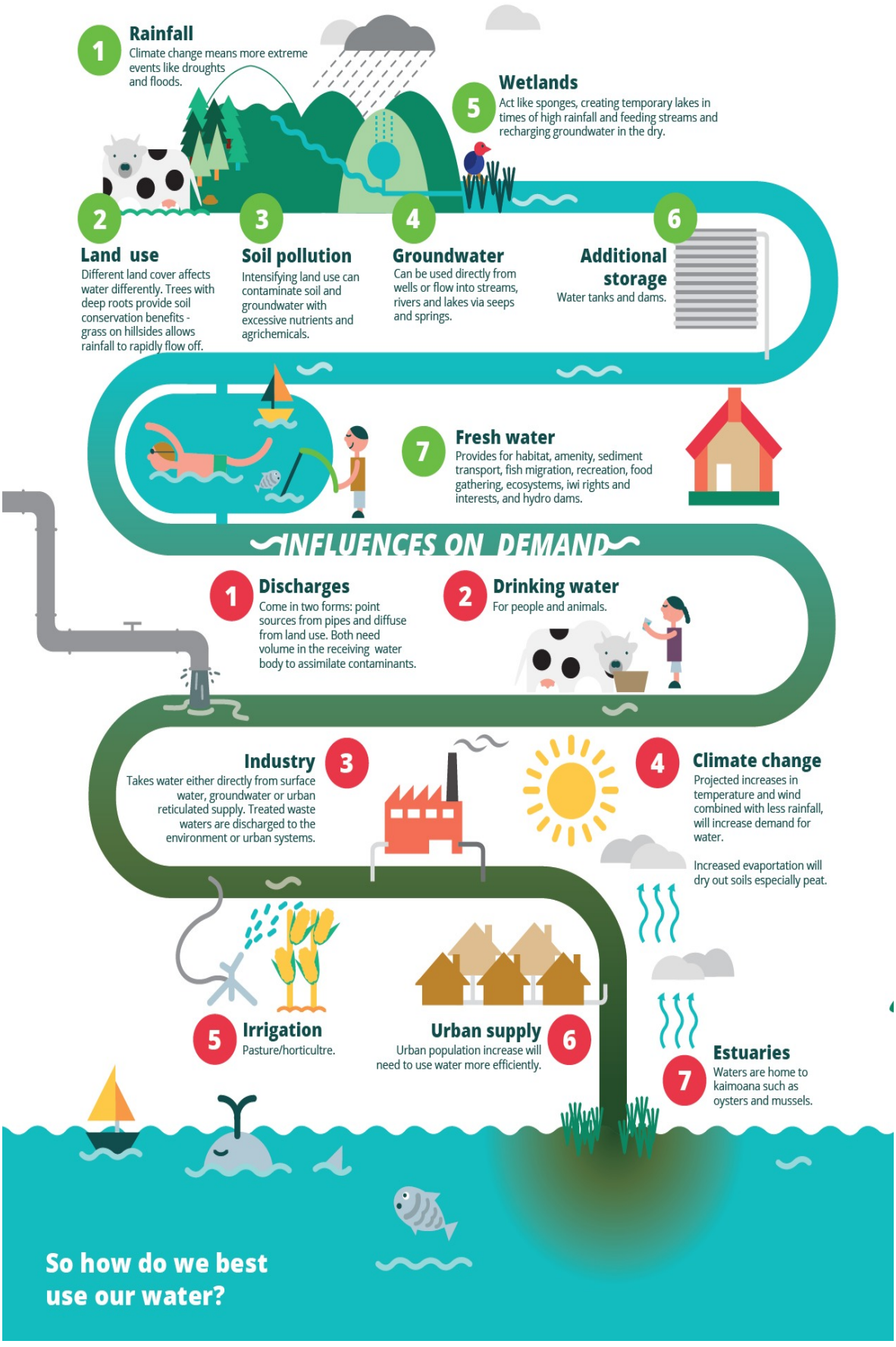
All water is connected

The management of regional water resources is further disjointed with the understanding of groundwater being the specialist role of hydrogeologists. Our understanding of groundwater and the relationships with surface water is much less well understood but this is a significant conduit for joining up activities on land and the transport of contaminants (typically nutrients) to surface water during times of low flows. This is the connection between land use and the resultant water quality of surface water bodies. In this way there is no difference between the need for instream volume to assimilate the impacts of diffuse groundwater transported contaminants as there is to assimilate the effects of a regulated direct discharge.

Figure 1 on the next page is a stylised representation of a typical water catchment. It integrates the supply and demand elements of water management and summarises the impacts of all on the resource. Of note is the role that fresh water plays in the integration of land use effects on the marine receiving environment.

INFLUENCES ON WATER

Freshwater is our region's greatest asset. Climate change and other factors are putting increasing pressue on both supply and demand.



Water is important

Waikato Regional Council has been consistently surveying the opinions of the regional community since 1998. This has established a comparable database that allows tracking the attitudes and concerns of the regional community and partners over time. Three separate surveys have recently provided a clear understanding of the views of the regional community with respect to current and future values of water. Since 2000, water pollution has also been reported as the most important environmental issue facing the Waikato region in five years time.[()]

The citizens, businesses and communities of the Waikato region are directly interested in Waikato Regional Council's management of the region's natural resources and it is appropriate to seek their views.[6] When asked:

What is the single most important environmental issue facing the Waikato region today?

The most frequently mentioned response was water quality, and it is a continuing and growing concern. Second was water availability or quantity followed by concern on agricultural impacts to water.[7]

Changes over time

The following table shows a steady increase in concerns by the regional community over time. The large jump between 2006 and 2013 reflects the increased interval between surveys.

Year	1998	2000	2003	2006	2013
Water pollution/quality	25%	30%	26%	18%	41%
Water availability/quantity	8%	9%	3%	13%	10%
Agricultural impacts on water			6%	7%	8.5%
Other water related matters			9%	4%	7.5%
Total	**33%**	**39%**	**45%**	**43%**	**67%**

Table 1: Waikato region's single most important environmental issue 1998-2013

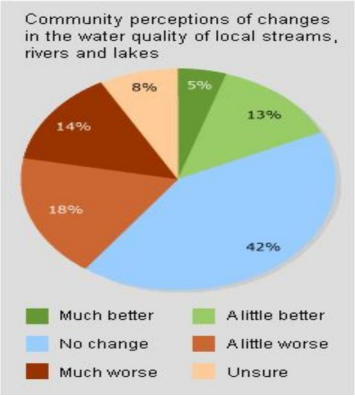


Figure 2: Waikato citizen's perception of water

Perception of change

In a separate survey, when asked about the state of water quality of their local waterways (streams, rivers and lakes) 74 per cent of regional respondents considered the state of water quality of local waterways had either stayed the same or got worse. The breakdown of responses can be seen from the accompanying pie diagram.

One big question

In 2013, as part of a new work initiative[8] in response to the regional council's increasing role in regional development, a single question was posed to regional ratepayers. It was billed as "One big question". It was:

What do you think are the biggest issues likely to face the Waikato region over the next 20 years?

The response was overwhelmingly consistent with previous surveys, reflecting a growing concern in the state of the region's water resources.

"Water quality is seen as the primary issue facing the Waikato region over the next 20 years. It is currently viewed as being in decline and likely to have a hugely negative impact on the cultural, social and economic wellbeing of the region if not addressed."[9]

6 *85% of the regional council's funding comes directly from the region in the form of rates, fees and charges.*

7 *Waikato Regional Council Technical report 2013/41 Environmental awareness, attitudes and actions and new ecological paradigm combined survey: A survey of residents in the Waikato region*

8 *Waikato Means Business*

9 *One Great QuestionTM Business DNATM*

Summary of key points

1. New Zealand's economy revolves around turning rainwater into exports. This is particularly relevant for the Waikato region.
2. Water quantity and quality are linked with management being either an allocation of volume outside a water body for use or an allocation of volume in situ for assimilation of contaminants.
3. All water resources are connected but are measured and managed separately according to water body type e.g. surface water (rivers, lakes, estuaries) or groundwater.
4. There are multiple influences on the supply and demand side of the water use equation. Not all are able to be controlled or influenced by regional actions. Some will need to be accommodated.
5. Water condition and availability for use is currently the biggest concern of the regional population.
6. Water quality is seen as the primary issue facing the region in the next 20 years.

SECTION 3 Context

Global situation

Of all the water in the world only 2.5 per cent is fresh water and of that, almost all of it is locked up in polar ice sheets and in the ground. Only 1.3 per cent of all fresh water is surface water such as lakes and rivers, and other water such as swamps and marshes, the atmosphere and in living things. It is that 2.5 per cent that contributes to the water cycle and which serves most of terrestrial life's needs. Only 0.46 per cent of surface fresh water is found in rivers, and rivers are where humans get a large portion of their water.[10]

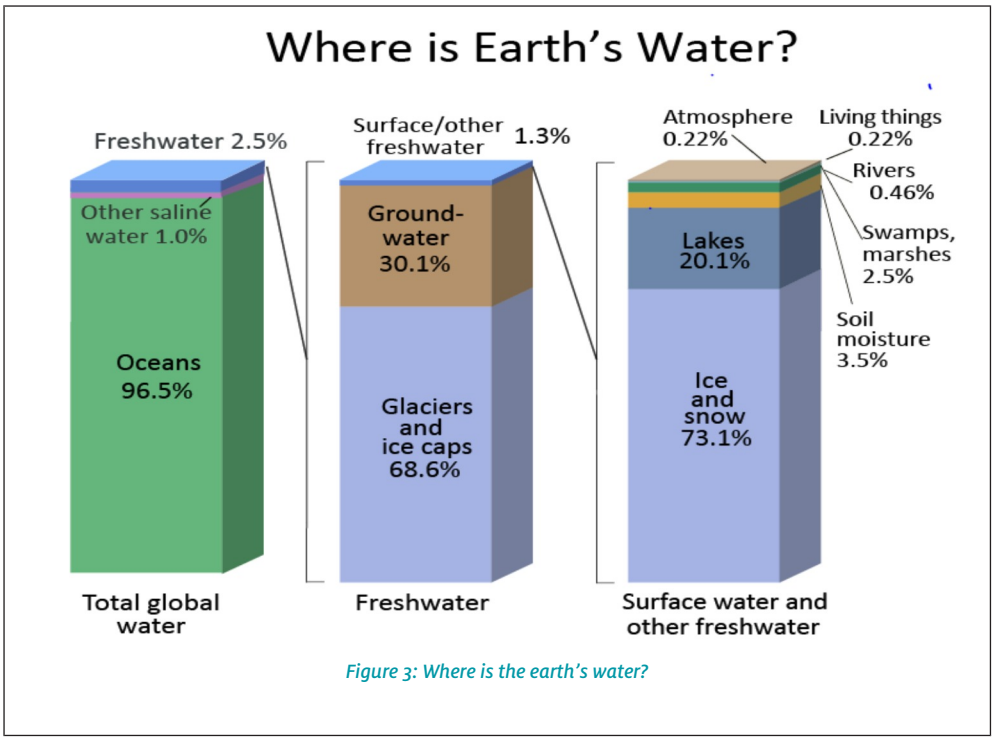


Figure 3: Where is the earth's water?

Access to water is not distributed evenly around the world and contributes to each nation's competitive advantage. According to the CIA World Fact Book,[11] which estimates the long term average water availability for a country in cubic kilometres, New Zealand is well endowed with water resources per head of population. The estimates include precipitation, recharged groundwater, and surface inflows from surrounding countries. The values have been adjusted to account for overlap resulting from surface flow recharge of groundwater sources. Although the estimates are averages and do not accurately reflect the total available in any given year, they are useful in providing a relative comparison and bear no relationship to the land area or population supported.

New Zealand is an island archipelago spanning 1600km (latitudes of 34 to 47 degrees south) across the roaring 40s. Its oceanic situation and mountainous terrain creates the conditions for a nationally wet climate. The same factors of topography and location also act to create subnational variations in rainfall and other meteorological conditions such that a regional/catchment scale approach to water management is required. This supports the devolved management of the nation's water resources to subnational/catchment scale.

A national comparison of available water shows the New Zealand situation compared to some selected other nations. Table 2 clearly demonstrates that either from a population or a land area comparison, at a global level, New Zealand is very well endowed with fresh water.

10 "Water in crisis : A Guide to the World's Freshwater Resources 1993. http://water.usgs.gov/edu/gallery/watercyclekids/earth-water-distribution.html

11 https://www.cia.gov/library/publications/the-world-factbook/fields/2201.html

Nation	Available water (km^3/y)[12]	Population (millions)[13]	Available water per capita (m^3)	Land area (km^2)[14]	Water per land area (m^3/km^2)
United States	3069	325.1	9440	9,147,420	335,504
China	2840	1,401.5	2026	9,388,211	302,507
India	1911	1,282.4	1490	3,287,590	581,277
Australia	492	23.9	20,586	769,024	639,772
Mexico	457	125.2	3650	1,964,375	232,644
New Zealand	327	4.5	72,667	269,190	1,214,755
France	211	64.9	3251	675,417	312,310
Germany	154	82.5	1867	357,021	431,347
United Kingdom	147	63.8	2304	243,610	603,424
Netherlands	91	16.8	5417	41,526	2,191,398
Ireland	52	4.7	11,064	70,273	739,971
Syria	16	22.3	717	85,180	187,838
Saudi Arabia	2	29.9	66.9	2,149,690	930

Table 2: International comparison of available water

There is increasing concern that the world is facing a water crisis. This is in part driven by there being no substitute for water for most uses and empirical reporting of conflicts based upon water. Of particular concern is the emerging understanding (only made possible using satellite measurements of gravity) that one third of the world's groundwater aquifers are being drawn down faster than they are able to be recharged.[15][16] It is estimated that approximately two billion people rely on water supplied from underground aquifers as their main source of fresh water. Groundwater is also used for farming, especially during times of drought.

Areas where groundwater is being rapidly depleted are in: the Middle East, North Africa and Central Asia. The aquifer under California's drought-stricken Central Valley is also being overused.[17]

The World Economic Forum in its 2015 survey of global risks[18] concluded that water crises are likely to have the biggest impacts on economies around the world. The potential for the world's water to be the driver of global conflict is increasing as fresh water supplies in large areas of the earth fail to keep up with increasing global population. Already, over one billion people – one in seven individuals – lack access to safe drinking water.[19]

The Pacific Institute (a US think tank) compiles a web-based water conflict map[20] that maps reported instances of violence or conflict originating from a wide range of stressors. It identifies incidents as development disputes (state and non-state actors) where water resources or water systems are a major source of contention and dispute in the context of economic and social development. In many instances conflicts have been driven by an underlying base cause of prolonged drought. There is no evidence to suggest that the relationship between resource scarcity and global conflict will change in the future.

14 https://simple.wikipedia.org/wiki/List_of_countries_by_area
13 http://statisticstimes.com/population/countries-by-population.php
12 ibid
15 http://www.npr.org/sections/thetwo-way/2015/06/17/415206378/nasa-satellites-show-worlds-thirst-for-groundwater
16 http://www.wri.org/blog/2015/06/nasa-satellite-data-help-show-where-groundwater-%E2%80%93-and-where-it-isn%E2%80%99t
17 Felicity Barringer, World's Aquifers Losing Replenishment Race, Researchers Say: Science 25 June 2015
18 http://reports.weforum.org/global-risks-2015/#frame/20ad6
19 Robin McKie, Why freshwater shortages will cause the next great global crisis; The Observer
20 http://www2.worldwater.org/conflict/map/

Water is necessary for all life and has been linked to oil as a strategic resource, yet there are many differences. As with oil it is not distributed evenly, but unlike oil there are no alternatives,[21] and it is much harder to transport than oil. In many ways the global trade in water occurs but it is masked as the embedded water in products, primarily agricultural (see section 4 on 'Water footprinting' and 'Hidden water' in this report).

For coastal areas the value of water will increasingly be linked to the price of energy and infrastructure that is needed to desalinate sea water and reticulate to consumers. It is anticipated that as increasing numbers of people are living in coastal cities this will primarily affect the world's urban populations.

21 *Hidden Waters - We consume a lot more water than we can even imagine, and our water footprints extend far beyond our own nation's boundary. A briefing 2007*

Climate change projections

New Zealand is projected to be less affected by climate change than many other countries as it is buffered by the surrounding Tasman Sea on the west and Pacific Ocean to the east. However, it will still be affected relative to the past conditions which we understand and have records for. For this reason, it is no longer sensible to assume that our past understanding of the frequency of weather events (often described as 'return periods') will continue into the future. Modelled projections show a change in projected rainfall with time, geography and seasonality. In summary we can expect more severe extremes with more frequent dryer (drought) conditions in the north and east and higher intensity rainfall events in the south and west.

Irrespective of the regional impacts the economic success of the Waikato region will also depend upon the international value of water and this will change due to projected changes in regions that produce similar produce to that of the Waikato.[22]

Climate change projections for the region come from work updated using the Intergovernmental Panel on Climate Change's Fifth Assessment Report (AR5) information. A broad assessment of the physical effects of climate change in the Waikato region have been calculated over three time horizons: short (2030), medium (2070) and long term (2100). Eight climatic indices were used to represent the major climate change-induced effects. They are:

- average temperature
- peak temperatures
- average and extreme precipitation
- peak stream flow
- potential evapotranspiration deficit
- temperature-humidity index
- growing degree days
- extreme wind.

Projected climate changes are spatially and seasonally variable over time. An increase in the plant growing season can be anticipated in the northern districts and will be lowest in the Taupō district with increased stress for livestock in the Hauraki and Matamata-Piako districts by mid-century and later on in Ōtorohanga district. Projected changes for the Thames-Coromandel, Hauraki and North Waikato include:

- greater than New Zealand average sea level rise
- increased extreme daily precipitation and a slight decrease in the annual average rainfall
- increased peak stream flow in the Kauaeranga and Waihou rivers.

The Thames-Coromandel, Hauraki, North Waikato and Matamata-Piako districts can expect decreased soil moisture levels which will increase demand for irrigation and can be expected to drive efficiency.

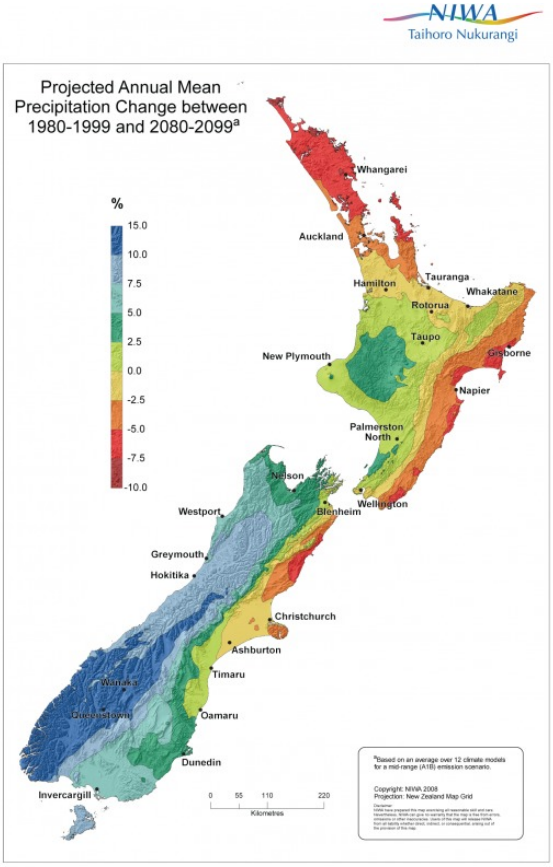


Figure 4: Projected changes in mean annual rainfall over the coming century

Even average precipitation is projected to change over the coming century.[23] The implications of climate projections to water management in the Waikato region are that we can expect more frequent drought conditions in the north and eastern areas of the region, and more intensive rain events in the south-western areas that will contribute to the Waikato River catchment through Lake Taupō and the Waipa sub-catchment.

22 *Climate changes the water rules: How water managers can cope with today's climate variability and tomorrow's climate change. Dialogue on Water and climate 2003 Ed. Brian Aplpleton.*

23 https://www.niwa.co.nz/our-science/climate/information-and-resources/clivar/scenarios

Present water allocation framework

Background

The allocation of water is controlled by the Resource Management Act 1991 (RMA). Common law rights to access water were extinguished by the Water and Soil Conservation Act 1967. Under section 21 of that Act, the Crown reserved for itself the sole right to take and use natural water. The Water and Soil Conservation Act 1967 was repealed along with 77 other Acts and replaced by the RMA, but the Crown's existing rights to resources continued under section 354.[24]

The Crown allows use of water through the RMA either directly under section 14(3) or through regional plans prepared by regional councils. Regional plans authorise activities and not necessarily uses by classifying the use as a permitted activity or as a use that requires consent and there are grades of those.

The position taken by the Crown on allocation means the question of ownership of water in a natural water body is avoided.[25]

The RMA was accompanied by a conscious change to the naming of the relevant permits for water use. Previously, under the Water and Soil Conservation Act, multiple use was promoted and permits were referred to as 'water rights'. The advent of the RMA resulted in a change to recognise the public nature of water and the need to manage it and use it with respect to the public interest. Permits became 'resource consents'.

A comparison of the two Acts respective 'Long Title' and 'Purpose' sections reveals significant differences in the approach to water management.

Water and Soil Conservation Act 1967	Resource Management Act 1991
Long Title "An Act to promote a national policy in respect of natural water, and to make better provision for the conservation, allocation, use and quality of natural water, and for promoting soil conservation and preventing damage by flood and erosion, and for promoting and controlling multiple uses of natural water and the drainage of land, and for ensuring that adequate account is taken of the needs of primary and secondary industry [community water supplies, all forms of water-based recreation, fisheries, and wildlife habitats, and of the preservation and protection of wild, scenic, and other natural characteristics of rivers, streams, and lakes."[26]	**Section 5 Purpose** "(1) The purpose of this Act is to promote the sustainable management of natural and physical resources. (2) In this Act, **sustainable management** means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while— (a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and (b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and (c) avoiding, remedying, or mitigating any adverse effects of activities on the environment."[27]

The difference is that the 1967 Water and Soil Conservation Act targeted multiple uses whereas the 1991 RMA does not 'pick winners', rather it focuses on the sustainability of the resource and its ability to provide for uses.

The emphasis can be considered to have shifted at that time from one where elements of sustainability were subject to trade-offs to the recognition that there is no substitutability for some natural resources such as water and that the social, cultural and economic dimensions of modern life occur within a nested relationship with natural resources. In short there is no sustainable economy without a foundation of good quality natural resources to support it over the long term. The RMA makes the resource the focus while the preceding Water and Soil Conservation Act made the use of the resource the focus. The current allocation system therefore reflects this and is use neutral.

This change in focus occurred during the review instituted by incoming Minister for the Environment Simon Upton when there was a shift from balancing economic and environmental objectives, to that of economic objectives being "constrained"

24 *Legal rights to minerals in geothermal fluids: Barry Barton February 2015 Research Report: Centre for Environmental, Resources and Energy law. University of Waikato*

25 *Ibid.*

26 *Long Title: Water and Soil Conservation Act 1967*

27 *http://www.legislation.govt.nz/act/public/1991/0069/latest/DLM230265.html*

by environmental ones. The shift was termed sustainable management and was different to the concept of sustainable development,[28] which had been coined a few years earlier.[29]

One area that did not change was the locus of management. Under both Acts, management was devolved subnationally, initially to regional water boards under existing catchment authorities and following local government restructuring in 1989, to the new regional councils and unitary authorities.

Resource Management Act 1991

The New Zealand Government has the sole right to allocate water and has done so since the enactment of the Water and Soil Conservation Act 1967. Section 14 of the RMA allows some legislated uses and section 30 provides regional councils with the delegated authority to allocate water and assimilative capacity of natural waters – discharges by resource consent and permitted activity in regional plans. Section 30 also charges regional councils with the role of controlling land use for the effects on water quality and quantity.

Thus, regional councils have the sole delegated role for managing the nation's water resources. They do so in response to the capacity and the priorities of their respective communities and although there is extensive cooperation between councils, this has not always resulted in a consistent national effort. The only policy lever provided to regional councils by the RMA has been that of regulation – setting objectives and enforcing the achievement of these with rules and consent conditions. At times this has been undermined by central government policy using economic instruments to affect policy outcomes in other spheres of public policy, see example of the effect of the New Zealand Emissions Trading Scheme on land use change in the upper Waikato catchment.

The RMA sets up a strict hierarchy for the management of natural resources which consists of a system of legislation, subordinate national policy instruments and then council developed policy statements and plans. In the Waikato region, legislation supporting the Treaty of Waitangi settlement between the Crown and Waikato-Tainui sets aspirational objectives and provides access to water allocation tools by creating a policy instrument (Te Ture Whaimana o Te Awa o Waikato – the Vision and Strategy for the Waikato River) that overrides all future national policy statements for water. Due to the hierarchical design of the policy framework it naturally trumps regional and local policy as well.

Figure 5: Hierarchical relationship between policy and plans under the RMA 1991

28 *1987 Bruntland Report*

29 *http://envirohistorynz.com/2010/03/20/resource-management-law-in-nz-a-potted-history/*

The RMA prohibits unauthorised taking, damming and diversion of water unless there are rules in a plan stating otherwise. However, section 14(3)(b) allows a person to take water for their reasonable domestic needs and the reasonable needs of an individual's[30] animals for drinking water without resource consent provided the taking does not, or is not likely to have an adverse effect on the environment. Conversely, a rule may allocate water as long as the allocation does not affect the ability of a person to take water for their reasonable domestic needs and the reasonable needs of an individual's animal drinking water.

Regional council functions include the establishment of rules in a regional plan to allocate natural resources including water (other than open coastal water). The RMA gives regional councils the role[31] of:

- The control of the taking, use, damming, and diversion of water, and the control of the quantity, level, and flow of water in any water body, including –

(i) The setting of any maximum or minimum levels or flows of water:

(ii) The control of the range, or rate of change, of levels or flows of water:

(iii) The control of the taking or use of geothermal energy:

- The control of discharges of contaminants into or onto land, air, or water and discharges of water into water.
- If appropriate, the establishment of rules in a regional plan to allocate any of the following:

(i) the taking or use of water (other than open coastal water):

(ii) the taking or use of heat or energy from water (other than open coastal water):

(iii) the taking or use of heat or energy from the material surrounding geothermal water:

(iv) the capacity of air or water to assimilate a discharge of a contaminant.

It is the last role that links water quantity to quality, but the ability to act is limited to rules and as a consequence is more appropriate for the management of point source discharges into water bodies. In this regard the record of the Waikato Regional Council and of regional councils in general has been good. Rules are not proving to be the most appropriate way of managing diffuse sources of contaminants e.g. those coming from historic and current land use. These sources by definition involve an intrusion into actual or perceived private property rights which are difficult to regulate.

The current allocation system is considered to no longer be fit for purpose. It relies solely on regulatory tools and as a consequence is 'clunky' to the point of being static. Allocation through regional plans (for permitted activities) and resource consent for the remainder of uses does confer certainty but at the expense of flexibility. A new way of allocation from the 'first in, first served' is required.

A regional plan can allocate resources amongst competing activities. However, it may include rules that reallocate a resource that is subject to existing resource consents. These rules will not have affect until the consent is renewed or expires. Resource consents are a bankable certainty for holders confirming they have a right to use water subject to conditions.

This does not affect council's powers to set minimum or maximum flows. Plans are not required to allocate the relevant resource in the way that reflects existing consents and plans do not have to anticipate applications for new consents to replace expiring ones. Therefore, plans can set rules that provide for reallocation of the resource when existing consents expire. However, a regional council must also ensure that the grant of any future permits will not derogate from an existing consent holder's allocation.[32]

The RMA directs all persons exercising functions under the RMA to recognise and provide for the relationship of Māori and their culture and their traditions with their ancestral lands, water, sites, wāhi tapu (sacred sites) and other taonga (treasures). In achieving the purpose of the RMA councils must also take account of the principles of the Treaty of Waitangi and have particular regard to kaitiakitanga (the exercise of guardianship by Māori).

National Policy Statement for Freshwater Management

In an effort to address concerns over water management and to achieve national consistency the Government prepared a National Policy Statement in 2011 (updated in 2014) for freshwater management. The provisions require all regional councils to achieve a common standard of performance and to take a strategic approach to the allocation of water by requiring the consideration of future stressors on the water resource, specifically climate change, before any water objectives may be set for water quality or any flows and levels can be set for water quantity. The objectives of the National Policy Statement for Freshwater Management are still expected to be achieved through regulatory mechanisms.

The National Policy Statement for Freshwater Management separates objectives and policies for water quality and water flows and levels in water bodies but has similar policy requirements for both so this is not really an issue. For example, when setting freshwater quality objectives Under Policy A1 and setting flows or levels under Policy B1, regard must be had to at least the following:

30 *The Government proposes a change to 'a person's animals' as part of the 2015 RMA reforms.*

31 *Resource Management Act 1991, section 30.*

32 *See also Resource Management Act 1991 sections 104(2A) & 124B*

a. The reasonably foreseeable impacts of climate change;
b. The connection between water bodies; and
c. The connections between freshwater bodies and coastal water.

In all other aspects the autonomy of regional councils to determine the type and spatial extent of freshwater management units and the type and degree of monitoring and accounting within freshwater management units (other than for the nationally compulsory attributes) is confirmed.

The National Policy Statement for Freshwater Management is to be reviewed periodically. The next review is this year (2016), and new water quality attributes are expected.

Te Ture Whaimana o Te Awa o Waikato – the Vision and Strategy for the Waikato River

The Vision and Strategy only covers that part of the region from Huka Falls in the south to the mouth at Port Waikato, but it is a significant and influential element of the region's water resources.

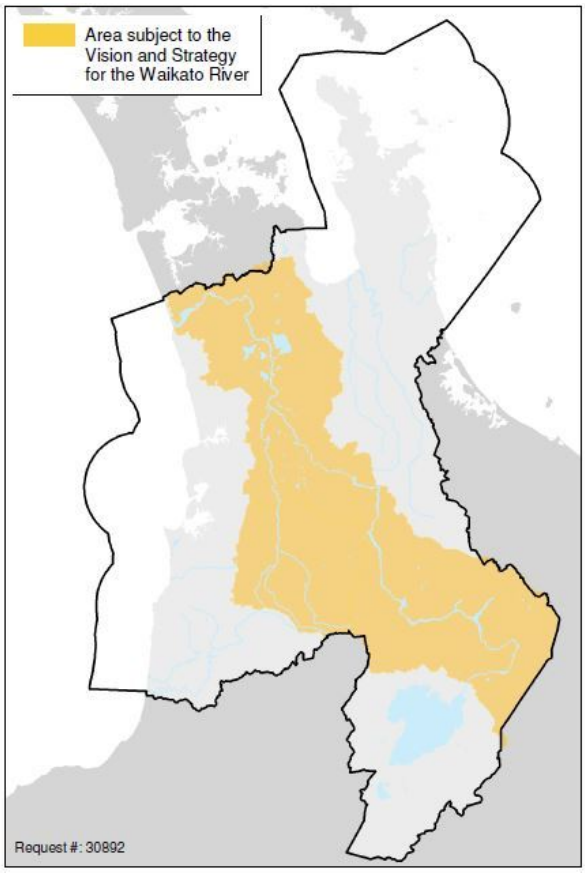


Figure 6: Area covered by Te Ture o Te Awa o Waikato – the Vision and Strategy for the Waikato River

Some uses for water in the Waikato River catchment have already been determined through legislation supporting the five recently negotiated and agreed Treaty of Waitangi and co-management settlements. The first to be enacted in legislation was the Waikato Raupatu Claims (Waikato River) Settlement Act.[33] This gave effect to the 2009 Deed of Settlement in respect of raupatu claims of Waikato-Tainui over the Waikato River. One of the provisions of the Act was to deem Te Ture Whaimana o te Awa o Waikato – the Vision and Strategy for the Waikato River into the Waikato Regional Policy Statement without the need for public consultation.

Although affecting less than half of the region, Te Ture Whaimana o te Waikato overrides the present and any future national policy statements with respect to the management of the Waikato River and its tributaries. With its legislative support, Waikato Regional Council has found this method to present a clear mechanism for the partial recognition of iwi rights and interests with respect to the waters of the Waikato River catchment.

Other Acts covering co-management settlements of the remaining river iwi are outlined in the following section on *Māori dimensions to water management*.

Regional Policy Statement

The Waikato region's second generation Regional Policy Statement was proposed in November 2012,[34] following the review of the operative policy statement. The Waikato Regional Policy Statement is a mandatory document that provides:

- an overview of the resource management issues of the region
- the ways in which integrated management of the region's natural and physical resources will be achieved.

A regional policy statement sets the direction for management of a region's natural and physical resources and can have a considerable impact on resource management decision making within the region. In recognition of the multi-decade time delay for resource management processes, the intergenerational element of sustainable management and the design life of some infrastructure elements, the Waikato policy statement takes a 100 year planning horizon with reviews not more than 10 years apart.

The Waikato Regional Policy Statement provides an overview of resource management issues in the Waikato region. It provides policies and a range of methods to achieve integrated management of natural and physical resources across resources, jurisdictional boundaries and agency functions. It also guides the development of sub-ordinate plans (regional as well as district) and the consideration of resource consents.

The framework the current policy statement provides for resource use enables the regional community to achieve its social and economic aspirations within the capacity of the environment. Where resource quality is high, it is the intention of objectives and policies to retain high resource quality. Where resource quality has been degraded through inappropriate use, the quality of such resources is intended to be improved over time.

33 *Waikato Raupatu Claims (Waikato River) Settlement Act was passed on 07 May 2010.*

34 *http://www.waikatoregion.govt.nz/Council/Policy-and-plans/Regional-Policy-Statement/*

The previous objective of a net improvement of water quality across the region was found to be unworkable in practice as it was not possible to measure the value or impact of trade-offs between water quality variables in different water bodies. This was also found to be incompatible with the requirement under the RMA to maintain and enhance.

The objectives for water use are identified in Appendix 1 of this report.

Waikato Regional Plan

The Waikato Regional Plan covers the entire region above that part deemed to be part of the coastal marine area. It contains objectives, policies and rules to allocate water quantity and to manage water quality. The water allocation policy was designed to achieve the following objectives:

- Give effect to the Vision and Strategy to restore and protect the health and wellbeing of the Waikato River.
- To ensure the availability of water to meet reasonably justified domestic or municipal supply.
- Ensure the efficient allocation and the efficient use of water in line with the objectives of the National Policy Statement for Freshwater Management.
- Protect water used for the generation of electricity from renewable energy resources. In terms of the hydro dams on the Waikato River, the water for these dams is included in the minimum flow. For dams on other rivers, like King Country Energy dams on the Mokau River, there are resource consents for a set amount of water for the take, dam, diversion and discharge of water.
- Protect the availability of water for cooling Huntly Power Station as an important part of New Zealand's energy infrastructure.
- Recognise that existing takes contribute to social and economic wellbeing, and specifically provide for these takes.
- Ensure sufficient water is retained (through the setting of minimum flows) to safeguard the life supporting capacity of water bodies, including aquatic life and their associated ecosytems.
- Ensure that allocation decisions avoid further degradation of water quality.
- Set allocation limits and minimum flows.
- Recognise the importance of the availability of water to meet future social, economic and cultural needs of individuals and communities.

The design and implementation of the regional plan water allocation module is summarised in Appendix 2 of this report.

The Waikato Regional Plan is being reviewed in stages with the ultimate aim of combining the terrestrially focused plan with the mandatory plan for the coastal marine area. This will bring all resources across the region from the catchment ridgelines to the limit of the territorial sea into the same document and make seamless management across the land sea interface a reality. This is a major undertaking and very resource intensive. It is also not practicable to pursue this in one step, so a staged approach has been adopted.

The first stage, known as Healthy Rivers: Plan for Change/Wai Ora: He Rautaki Whakapaipai, is limited to the water quality of the Waikato River catchments below the Huka Falls – the area covered by Te Ture Whaimana o Te Awa o Waikato – the Vision and Strategy for the Waikato River.

Healthy Rivers: Plan for Change/Wai Ora: He Rautaki Whakapaipai

There are four key drivers for the Healthy Rivers/Wai Ora project.[35] They are:

- legal requirements
- water quality monitoring results
- policy effectiveness reviews
- stakeholder and community expectations.

The project responds to these four drivers by focusing on management solutions to help reduce nutrients (nitrogen and phosphorus), sediment and bacteria (which are primarily influenced by land use activities) entering water bodies, including groundwater.

To do this, it is engaging in a comprehensive collaborative stakeholder process to develop changes to the Waikato Regional Plan.

Hauraki Gulf Marine Park Act 2000 and Sea Change – Tai Timu Tai Pari project

The Hauraki Gulf Marine Park Act 2000 was enacted to address a number of integration concerns regarding the management of Tikapa Moana (the Hauraki Gulf). This largely arose out of concern from communities in the Auckland region over the reduced national profile for the gulf following the replacement of the Hauraki Gulf Maritime Park with the institutions and instruments that came out of the local government reform of 1989 and 1991 resource management reform.[36]

The Act recognised the Hauraki Gulf as a single management unit and sought alignment on a number of levels, including:

- recognition of iwi interests with that of the wider community
- recognition of catchment influences on the coastal marine area
- alignment of management effort between the Auckland and Waikato regions
- alignment of management effort between local government authorities within each region
- alignment of management effort between central government agencies (particularly the Department of

35 http://www.waikatoregion.govt.nz/Council/Policy-and-plans/Plans-under-development/Healthy-Rivers---Plan-for-Change/Drivers-for-change/

36 *Hauraki Gulf Marine Park Act 2000: What is it, what does it do and what does it mean for you? Blair Dickie and Jim Milne, RMLA Journal November 2001*

Conservation and Ministry of Fisheries (now Ministry for Primary Industries) and local government agencies.

In contrast to Healthy Rivers: Plan for Change/Wai Ora: He Rautaki Whakapaipai, which is developing changes to the regional plan that will have regulatory effect, Sea Change – Tai Timu Tai Pari is a non-statutory, multi-stakeholder project that will inform the review of the Waikato Regional Plan.

The relevance of Sea Change – Tai Timu Tai Pari to this project is the inclusion of fresh water catchments in seeking management solutions to water quality issues in the coastal marine area of the Hauraki Gulf. The areas covered by the project include a substantial part of the Waikato region (see figure 7).

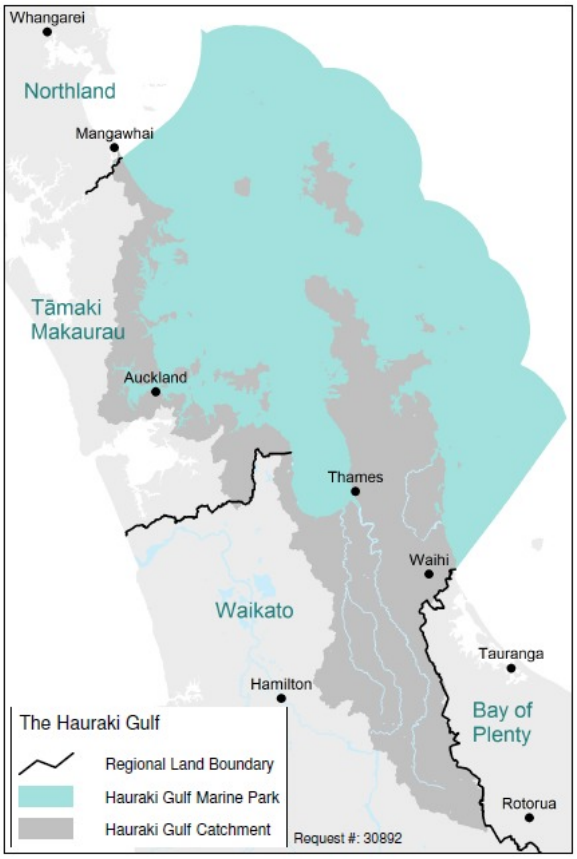


Figure 7: Area covered by the Hauraki Gulf Marine Park Act 2000

Sea Change – Tai Timu Tai Pari is a clear example of the role of the region's rivers in linking catchment activities and activities in, on, under or over major rivers to the coastal marine area.

Land and Water Forum

The Land and Water Forum[37] is a multi-stakeholder collaborative advisory body to central government with the objective of developing a shared vision and common way forward for the management of fresh water resources. It was first constituted in 2009 and has prepared four reports – the latest in November 2015. It is responsible to, and instructed by two cabinet ministers (Minister for the Environment and Minister for Primary Industries).

In their joint letter and Terms of Reference (April 2015)[38] for the third phase of the Land and Water Forum, the ministers requested the forum provide advice to the Government on:

- maximising the economic benefit of fresh water while managing within limits (allocation)
- further attributes for adding to the National Objectives Framework
- further refinements to the Water Management System.

In so doing, iwi/hapū rights and interests were to be taken into account, but the forum was specifically instructed to exclude addressing iwi/hapū rights and interests directly as this is a matter for iwi and the Crown. As a result, a level of uncertainty is perpetuated with respect to some of the forum's findings.

There are 60 recommendations from the latest report. The recommendations cover maximising the economic benefit of fresh water while managing within limits and typically build upon the existing regulatory mechanisms. They also include topics such as:

- integrated catchment management
- stock exclusions
- water quality
- water quantity
- reducing over allocations.

The default management scale is catchment based and there are specific recommendations covering the need for data to support decision making. While there is much commonality with the findings of this report, the Land and Water Forum have constrained their recommendations to changes to the present regulatory system.

The Government has historically implemented only some of the forum's previous recommendations.[39] Given the possibility that not all of the 60 recommendations from the Land and Water Forum's latest report[40] will be picked up by the Government there is a need to ensure the forum's thinking is fully optimised for Waikato communities.

37 http://www.landandwater.org.nz/

38 http://www.landandwater.org.nz/Site/Resources.aspx

39 *The first three reports contain 158 recommendations (53 in First report, 38 in Second report and 67 in the Third report) with the First recommendation of the Fourth report being: "The government should complete implementing the Forum's recommendations from its three previous reports as soon as possible. Unless otherwise explicitly stated in this report, those earlier recommendations remain unchanged".*

40 http://www.landandwater.org.nz/

Local Government New Zealand

In August 2015 Local Government New Zealand (LGNZ) signed a Memorandum of Understanding (MOU) with the Freshwater Iwi Leaders Group, on behalf of the Iwi Chairs Forum,[41] to establish a structural and operational relationship between the Iwi Chairs Forum and LGNZ, and to further support and encourage strong relationships between councils and iwi.

The MOU does not contain policy, but includes a set of working principles. Of particular interest is that it foresees the need for additional relationship documents and specifically anticipates the Regional Sector Group will have a relationship with the Freshwater Iwi Leaders Group centred on matters specific to regional councils (in particular the management of freshwater).

41 http://www.lgnz.co.nz/home/nzs-local-government/council-ma/

Māori dimension to water management

Uncertainty surrounding the recognition of iwi rights and interests with respect to fresh water has led to the matter becoming a significant issue in the ability to move forward as a nation with a water allocation system that reflects the interests and expectations of historical as well as currently authorised users.

The issue, when raised in the context of Treaty of Waitangi settlement processes has not been able to be dealt with comprehensively in the absence of an agreed position from both parties. Instead, matters regarding rights and interests to fresh water have often been left for discussion and resolution for some time in the future. This matter rose to national interest in 2012 when the Government was implementing its policy to partially privatise the three electricity generating state-owned enterprises of Mighty River Power, Meridian Energy and Genesis Energy.

The value of each relies to some extent upon access to and use of fresh water for hydroelectric generation and access to cooling water for heat dissipation.

At the time a case was brought before the Waitangi Tribunal by the New Zealand Māori Council to determine the nature of iwi/hapū rights and has resulted in an acknowledgement by the Government that such rights and interests do exist, but that these are not clear. As a further consequence the Government continues to work with the Freshwater Iwi Leaders Group to develop a position.

In practice, successive governments have recognised iwi/hapū do have rights and interests with respect to fresh water. These are undefined but have been variously described as having elements of conservation and development. The mechanism for expression of these rights and interests has not been fully described although there is recognition that these could involve geographic differences.

Arguably, partial recognition of iwi/hapū interests in fresh water has already been negotiated as part of Treaty of Waitangi settlements and in some situations legislated for over and above Part 2 RMA obligations. For example, Te Ture Whaimana o te Waikato – the Vision and Strategy for the Waikato River defines water quality objectives such that the water body is safe to swim in and to collect kai from.

Central government's position with respect to iwi rights and interests with respect to water was argued in 2012 before the Waitangi Tribunal in the matter of the National Freshwater and Geothermal Resources Inquiry (WAI 2358). It has subsequently been refined to five elements following consideration of the Tribunal's interim decision and was reflected in a cabinet paper in early 2015. The five points are:

1. No one owns fresh water, including the Crown.
2. There will be no generic share of fresh water resources provided for iwi.
3. There will be no national settlement of iwi/hapū claims to fresh water resources.
4. Fresh.water resources need to be managed locally on a catchment-by-catchment basis within the national fresh.water management framework.
5. The next stage of fresh water reform will include national-level tools to provide for iwi/hapū rights and interests.

The cabinet paper also identifies that it is the Minister for the Environment's preliminary view that the most effective approach will be to develop tools at a national level that can then be applied locally. These tools may include criteria for establishing the need to provide preferential access for iwi in catchment based processes, and requirements or guidelines for regional councils when choosing or implementing allocation approaches or reviews of existing allocations.

Treaty settlements with a fresh water interest

The Waikato Raupatu Claims (Waikato River) Settlement Act[42] gave effect to the 2009 Deed of Settlement in respect of raupatu claims of Waikato-Tainui over the Waikato River. Three other Acts cover the co-management settlements of other river iwi and provide apologies from the Crown and cultural redress. These are:

1. Ngāti Raukawa, Ngāti Tūwharetoa and Te Arawa with rohe in the south of the catchment, which came into force in 2010.
2. Ngāti Maniapoto, predominantly covering the river and catchment of the Waipā River (the largest tributary to the Waikato system), in 2012.
3. Ngāti Koroki Kahukura to the south of Cambridge with respect to:

- The Waikato River in the vicinity of lakes Karapiro and Arapuni
- Maungatautari.

Ngāti Koroki Kahukura will be involved in co-management of the Waikato River within their area of interest through Waikato-Tainui.

42 *Waikato Raupatu Claims (Waikato River) Settlement Act was passed on 07 May 2010.*

Hauraki/Coromandel rohe

Negotiations between the Crown and iwi (the Hauraki Collective) that have interests over fresh waters in the eastern part of the region are ongoing. They follow the Hauraki Iwi Framework Agreement,[43] which was signed on 1 October 2010 and although non-binding does give an idea of future direction with respect to the management of large river systems and fresh waters in general.

Other Treaty of Waitangi settlements

There are other settlements that at first approach may not appear to have a Waikato regional element. One is the Te Arawa Lakes Deed of Settlement which predominantly applies to 14 lakes found in and around the Rotorua area. However, three of these lakes to the south of the rohe[44] – lakes Ngahewa, Ngapouri and Tutaeinanga – are in the Waikato region.

Another key settlement is that of Whanganui Iwi in respect of the Whanganui River (Ruruku Whakatupua – the Whanganui River Deed of Settlement). Unlike the previously mentioned Te Arawa Lakes settlement there are no areas in the Waikato region, but the Tongariro Power Scheme authorised in 1958 by Crown Order in Council provided for the diversion of water from the Whanganui River and other rivers into the proposed Tongariro Power Scheme and subsequently into Lake Taupō.

The Crown did not consult with Whanganui Iwi about this decision or the diversions before they started in 1971. Whanganui Iwi have consistently opposed the Tongariro Power Scheme and maintained their view that the diversions and reduced flows have damaged the health and wellbeing of the Whanganui River and adversely affected their cultural and spiritual values.[45]

43 http://haurakicollective.maori.nz/framework/

44 https://www.govt.nz/treaty-settlement-documents/te-arawa-lakes/

45 https://www.govt.nz/treaty-settlement-documents/whanganui-iwi/whanganui-iwi-whanganui-river-deed-of-settlement-summary-5-aug-2014/ruruku-whakatupua-te-mana-o-te-awa-tupua/

Iwi rights and interests with respect to water

In recognition of central government's position that a subnational resolution of iwi rights and interests with respect to fresh water is preferred, it is appropriate that an attempt is made to include an iwi view in this report. The following section is advanced as Waikato Regional Council's understanding of iwi rights and interests with respect to fresh water.

An understanding of iwi rights and interests to fresh water

Water sustains all living things and creates life. There is no substitute for water, which is why iwi, hapū and marae regard water with the greatest respect.

The rights and interests of iwi, hapū and marae in the protection, use, management and preservation of natural resources is built on generations of experience under the guidance of tikanga and kawa for each respective iwi. Over the past two centuries the rights of iwi to carry out their rights were removed or diminished through land confiscation, legislation and disposition.

To iwi, hapū and marae, their rights and interests to fresh water is inclusive of environmental, social, cultural, spiritual and economic values. In the context of this strategy, an allocation of fresh water for iwi, hapū and marae is one significant component to addressing their range of rights and interests.

National discussion

Many iwi are currently engaged in national and regional discussions in relation to securing iwi rights and interests across the nation. Currently the Iwi Chairs Forum (ICF) is in discussion with the Government to recognise a set of iwi rights. The ICF is a collective representation of iwi authorities to discuss matters of importance to iwi and the nation. The ICF is very clear in its mandate that it does not represent all iwi, nor does it usurp the mana of iwi in the progression of their own matters with the Government. However, in the determination of rights and interests to fresh water the ICF demonstrate these in the diagrammatic expression of 'Ngaa Matapono ki te Wai'.

This discussion is occurring alongside the Waitangi Tribunal Freshwater and Geothermal Inquiry WAI2358 lodged by the New Zealand Māori Council. This hearing has been adjourned until February 2016. However a key finding by the Waitangi Tribunal during the first hearing of the Inquiry in 2012 was:

"Our generic finding is that Māori had rights and interests in their water bodies for which the closest English equivalent in 1840 was ownership rights, and that such rights were confirmed, guaranteed, and protected by the Treaty of Waitangi (sic).....we say that the nature and extent of the proprietary right was the exclusive right to control, access to and use of water while it was in their rohe."

Also, many iwi are still working through their treaty settlement negotiations with the Office of Treaty Settlements. Whatever the outcome may be for each engagement iwi recognise that the implementation of any outcome for natural resources will occur through local authorities. It is therefore pertinent that the rights and interests of iwi within the Waikato region are discussed in depth with the relevant local authorities.

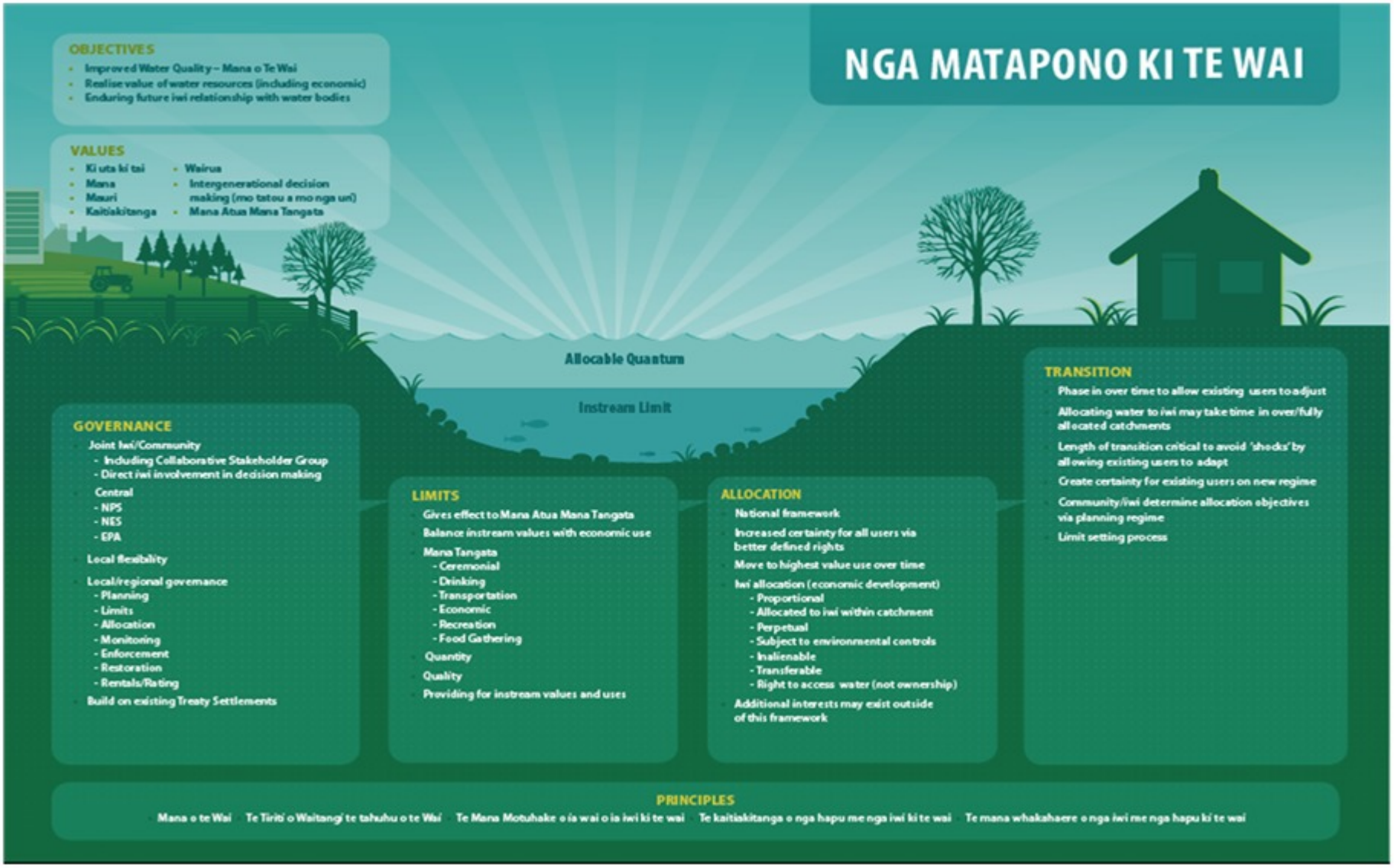


Figure 8: Nga Matapono Ki Te Wai

Resource Management Act 1991

The RMA was enacted in 1991 and is the key legislative instrument for the management of natural resources. Many of the rights to access and use resources were distributed under that legislation prior to many of the current treaty settlements we see today. While that legislation allowed for regulators and local authorities to provide some recognition of the rights and interests of iwi in fresh water, such recognition has not been forthcoming. The 'first in, first served' approach to acquiring a consent has not supported the majority of iwi. Therefore, iwi and hapū seek to restore those rights through treaty settlements and regional solutions, whilst recognising that the health and wellbeing of all water bodies is paramount to sustain the future of the environment and people. As noted in the Sapere Reports[46][47] (2014-2015), a more equitable solution for iwi, hapū and marae may be a market based model. Whatever solutions are determined in future, iwi, hapū and marae must be an integral partner of any proposed developments.

Regional settlements

The Waikato region has seen the implementation of historic co-management settlements that have focused on improved iwi management of natural resources, in particular the Waikato and Waipā rivers. These settlements were a feature of their time and set the tone for other iwi claims throughout the country. However, as it is with every negotiation, they were not perfect in the eyes of iwi, or the environment. It was explicit in each of these settlements that the rights and interests of each iwi with respect to the waters of these rivers were not settled with the Government. These settlements are stepping stones to implementing a relationship with iwi as an equal partner that was confirmed, guaranteed and protected under Te Tiriti o Waitangi.

Whilst some treaty claims and co-management arrangements have been agreed within the Waikato region, in particular the treaty claims to some water bodies and lands, there are many settlements currently in progress. Still to be resolved are the Hauraki claims, Te Rohe Pootae Inquiry, West Coast Harbours claims and various hapū claims. It is highly likely that these settlements will result in resolving some rights and interests to our natural resources. This section on 'An understanding of iwi rights and interests to fresh water' does not in any way presume the aspirations and outcomes of each respective iwi and hapū in the resolution of their claims.

Te Mana o Te Wai

The health and wellbeing of our fresh water resources is integrally connected to the health of our whenua and our health and wellbeing as a community. Te Mana o Te Wai represents the holistic health and wellbeing of a water body by capturing the full range of iwi and community values in a water body including environmental, social, cultural and economic values. It represents the overall wellbeing of a water body (mauri) and its ability to provide for te hauora o te tangata (the health of the people), te hauora o te taiao (health of the environment) and te hauora o te wai (health of the water body). Recognising and providing for Te Mana o Te Wai requires all water users and managers to place water quality at the centre of providing for the range of values the iwi and community hold for a water body, and as the primary consideration when managing and providing for the full range of iwi and community values in a water body.

Te Mana o Te Wai is a recognition and acknowledgement that water has rights, has mana and, in turn, often is a representative of the mana of iwi. Historically, Te Mana o Te Wai was such that it would provide all manner of sustenance to iwi including physical and spiritual nourishment that has, over generations, maintained the quality and integrity of iwi, hapū and marae. Their relationship with their waterways, and their respect for it, gives rise to their responsibilities to protect Te Mana o Te Wai and to exercise their kaitiakitanga in accordance with their long established tikanga. Although it is a kaitiaki responsibility to iwi, hapū and marae, it is a responsibility on all people to provide for its sustainability by gifting better quality water to future generations. The health and wellbeing of water for future generations must be assured.

Relationship and significance of water

All iwi, hapū and marae have an intricate relationship with all water bodies in their catchments. This is reflected in tongi (prophetic sayings), naming of waters, waiata (songs), whakapapa (genealogy), tikanga and kawa (practices, procedures and protocols). Iwi, hapū and marae seek to strengthen that relationship. The relationship and practices should be permitted without undue restriction.

Having the ability to preserve and enhance the relationship between iwi, hapū and marae with water and their environments is significant to their way of life. This relationship allows them to provide kai (food) to manuwhiri (visitors) which in turn upholds their mana. To deny the marae the function of feeding people, is to deny values passed through the generations of manaakitanga, kotahitanga and whanaungatanga.

All marae were built next to, or near, a fresh water body to sustain the health of its people. Rivers generate energy, provide kai, and sustain ecological and human communities. Many of the iwi taniwha (spiritual guardians) live in rivers and water bodies. Streams provide habitat for fisheries and significant flora flowing into and feeding the rivers.

Many of the puna (springs) within the Waikato region are used for cleansing, healing and general sustenance of marae and papakaainga (settlements). Significant aquifers feed many of the puna, playing a significant role in recharging the puna.

46 *Kieran Murray, Marcus Sin, Sally Wyatt. December 2014 The costs and benefits of an allocation of freshwater to iwi. Report prepared for the Iwi Advisors Group. Sapere Research Group.*

47 *Kieran Murray and Sally Wyatt, March 2015 The incentives to accept or reject a rights regime for fresh water. Report prepared for the Iwi Advisors Group. Sapere Research Group.*

Wetlands are recognised as the kidneys or natural cleansers of water prior to the waters reaching our rivers. The Whangamarino and Kopuatai wetlands are recognised internationally as RAMSAR sites. The soils of wetlands have special functions, such as to dye, preserve and harden taonga (treasures).

Rights and interests for iwi, hapū and marae

Iwi, hapū and marae have social, cultural, spiritual, environmental and economic aspirations for the use of fresh water. The discussions need to focus on providing for the rights of iwi to satisfy iwi interests and aspirations. Iwi, hapū and marae interests in water range from the innate responsibility to care for their water bodies, through to aspirations to generate revenue through the use of water. During discussions in relation to an allocation of water, a key barrier to progress is the provision for an 'iwi allocation' to achieve iwi, hapū and marae aspirations.

Iwi, hapū and marae are not just 'environmentalists', they are entrepreneurs, commercial operators, farmers, tourism operators, forestry managers and resource users. There is a range of mechanisms that could be used to provide iwi with access to water and resolve the nature of rights and interests in water.

Iwi acknowledge that there are existing rights for current consent holders, and do not seek to have those existing rights removed. But iwi do not support that the right be perpetual or expected to be held in such a manner.

Timing to provide an allocation of water to iwi, hapū and marae is likely to be the biggest concern, along with the perceived costs to existing right holders. They are happy to discuss this with all sectors that use natural resources. It is the view of iwi that the following gains would arise for existing resource consent holders following the resolution of rights and interests for iwi, hapū and marae:

1. Reduced uncertainty for existing consent holders.
2. Reduced conflict around the nature of rights for all users.
3. Increased ability to transfer to higher value use.
4. Improved investment opportunities.
5. Potential for longer term consents.
6. Easier capital formation.

Iwi, hapū and marae also understand that the Waikato region is limited in the amount of water available for extraction and use. They are supportive of seeking new ways to generate 'new water' and create 'headroom' that will allow iwi, hapū and marae to unlock the potential economic gains from their lands, including holding an allocation of water for use. As long as the health and wellbeing of water is provided for first, and that everyone (all users) contribute to that goal, then they will consider new ways to access water.

What do iwi, hapū and marae seek?

Iwi, hapū and marae seek the following to enhance their relationship with water and provide for some recognition of their rights and interests:

1. Recognising and providing for the health and wellbeing of all water bodies.
2. Fulfilling their role as kaitiaki through the support of appropriate tools, bylaws, regulations and other legislation.
3. Holding governance roles on council, sub-committees and catchment services.
4. Supporting councils to advocate local solutions with central government.
5. Having priority access to water, fisheries, flora and fauna for customary and contemporary purposes and that these activities are classified as permitted activities, subject to any reasonable mutually agreed regulation of such activities.
6. Providing clean water to marae and papakāinga.
7. Protecting waterways of significance (including wāhi tapu associated with them).
8. Returning the title of waterways to iwi and hapū.
9. Supporting their capacity building to engage in local policy and committees.

Iwi also seek the following to enhance their ability to derive an economic benefit with water:

1. An allocation of water for use as determined by iwi, hapū and marae.
2. An allocation that provides for nutrient discharge to water.
3. The ability to trade, transfer, store, hold and use the water rights as determined by respective iwi, hapū and marae (in relation to the above two points).
4. Engagement in the development of policy to achieve 'headroom' and create 'new water' for iwi.
5. To be a priority partner in regional infrastructure development.

In the Waikato region we have moved in a positive fashion towards achieving some of the above. For example, we have seen the introduction of co-management arrangements, fisheries bylaws, implementation of iwi management plans, iwi commissioners and inclusion of iwi, hapū and marae values into policy development. In this sense, the Waikato region and iwi are pioneers in this space. There was great opposition to these arrangements at that time, but iwi and council believe that the co-management arrangements have created benefit. Iwi, hapū and marae believe in creating their own destiny, instead of relying on central government to provide direction. Solutions can be created locally.

Iwi, hapū and marae look forward to finding these solutions alongside the community, business sectors and local government.

Technologies affecting water management

Within the 30 to 50 year time horizon of this project there will be technological changes in all fields that have the potential to affect the way we use and manage our regional water resources. We are unable to predict the future, but we do have some understanding of current and emergent technologies that with development and adoption could be very disruptive and have significant effects on the regional economy as well as state of our future water resources.

One area where there is a degree of certainty is from the adoption and development of emerging technology. In the information technology area we have experienced exponential changes in the storage of information and the connectivity that links the entire planet through the World Wide Web. This has increased our outlook to a global scale and resulted in a democratisation of information that is available personally wherever we are on the planet. Changes in other technologies such as biomedical, distributed renewable energy, nanotechnology and food technology are also evolving or changing rapidly. The one common characteristic of these is not that change is occurring but that the rate of change is accelerating. An increasing and unpredictable trend involves the combining of technologies and application in non-traditional areas.

There are existing technologies that if widely adopted could change the way we use and manage water. Many, but not all, fall into the information technology area. Examples include:

- Water conservation technologies, including low flow domestic and industrial valves, taps and showerheads.
- Low impact urban design (residential, commercial and industrial) incorporating water sensitive development like stormwater capture and infiltration and green roofs to ameliorate the effects of hard surfaces.
- Low impact rural design such as creation of artificial wetlands (see section 8, *Management options*).
- Wastewater/process water reclamation technologies and the development of closed cycle processes which would reduce water consumption.
- Remote sensing either in the ground, the air (drones) or from satellites that allow a better understanding of seasonal variations in water availability and loss from irrigation infrastructure.
- Precision farming – using in-ground sensors to determine the precise water requirements of crops, horticulture[48] and pasture.
- Software development connected to smart sensors connected to the internet, and by optimising the use of water – making every drop count.
- Real time kinematic satellite positioning of aerial drone delivery platforms to allow accurate water, fertiliser, tillage, sowing and pesticide applications to land.
- Rapid growth aeroponic technologies to allow plants to grow in urban settings with no soil and far less water than traditional methods.[49]
- Nanotechnology for filtration and sensors, particularly n the fields of desalination, reclamation of process water, water purification and wastewater treatment.
- Biotech food technologies.[50] The development of synthetic beef[51] and synthetic milk[52] may not directly affect the crops grown in the Waikato but they could reduce the current concentration on bulk commodity grown products, enabling regional growers to concentrate on high end products that allow verified provenance with respect to carbon, water and animal welfare to command top prices in markets.
- Probabilistic modelling will not overtake the need for accurate field measurements but will provide an opportunity to link social and economic outcomes to natural resource conditions (particularly water), and coupled with the explosion in interdisciplinary research,[53] could indicate the costs and benefits of policy choices and decisions regarding water management.

Many of these technologies may not be directly applicable or used within the Waikato region in the near future, but they are available and will be of interest to water managers and water users around the world. The relative value of fresh water from the Waikato region and by implication the success of regional products and services can be expected to be linked to global practice and expectations. In this area we can expect the value of fresh water from the Waikato to increase whether that is as embodied water in export products or water remaining in the system providing services to ecosystems from the assimilation of land use effects, habitat, tourism experiences and achievement of cultural and wider social expectations.

48 *New gear from Senteck technologies is making every drop of water count;*

49 *NASA 2006 Progressive plant growing has business booming*

50 *http://www.scientificamerican.com/article/inside-the-meat-lab/*

51 *https://www.washingtonpost.com/news/wonk/wp/2015/05/20/meet-the-future-of-meat-a-10-lab-grown-hamburger-that-tastes-as-good-as-the-real-thing/*

52 *http://www.stuff.co.nz/business/farming/dairy/10258565/Milk-made-in-laboratories-to-hit-shelves*

53 *Cosgrove E. And Cosgrove William J. The Dynamics of Global water futures Driving Forces 2011 – 2050 Global World Futures 2050 UNESCO 2012*

These examples of technologies are becoming cheaper and if not already, will very quickly be available to community groups and individuals. This will have revolutionary implications for those with an interest in their surroundings and has the potential to enhance the democratisation of environmental information. In the future much of our knowledge about the Waikato region and its water resources could come from citizen groups with their own monitoring networks of internet connected sensors and freely available sophisticated analytical packages.

Changing technologies will have significant implications for the way water resources could be used and managed. Typically there will be early adopters in society and there will be laggards with the majority of people adopting once the benefits are clear and initial problems addressed. The regional council as manager of the water resource will need to be mindful of the implications and should move to adopt new technology when the risks are obvious, mitigation strategies are known, some staff have a familiarity with the technologies and have ideas about its use, and the market price has fallen.[54]

54 *SOLGM 2015: Technologies for the 21st Century - Fit for the Digital Future*

Summary of key points

7. Globally, water is a finite resource. Only 2.5per cent is fresh water and of that only 1.3 per cent is available surface water. Available surface waters are distributed unevenly.

8. Global fresh water supplies are drying up through over exploitation of groundwater aquifers and pollution of groundwater and surface water.

9. New Zealand is well endowed with water, either on a per capita or a land area basis. However, it is also unevenly distributed between and within regions.

10. As clean fresh water becomes scarcer, its value will increase and we can expect access to be more keenly contested.

11. Fresh water allocation (for direct use outside water bodies and within water bodies for assimilation of contaminants) has been devolved to regional authorities for nearly 50 years. This was originally to regional water boards and from 1991 to regional councils and unitary authorities.

12. Regional authorities have the sole delegated role for managing the nation's water resources.

13. Central government has provided regional authorities with regulatory tools (initially water rights changing to resource consents) to undertake this task.

14. The current allocation system is limited and although it has achieved positive changes to direct discharges and takes it is considered no longer fit for purpose.

15. Central government influences national water management in three ways:

    - changes to the legislation
    - national policy and standards
    - Treaty of Waitangi settlement legislation.

    This is interpreted regionally and in accordance with the capacity and resourcing of each region.

16. Regional management of water resources is limited to regulatory processes – regional policy statements, plans and resource consents.

17. The present 'first in, first served' convention for water allocation and duration of resource consent authorisations advantages present users and creates barriers to new entrants who may have more efficient or more economically valuable uses with less effects from accessing the resource.

18. At the time of writing, interpretation of the Treaty of Waitangi on iwi rights and interests with respect to fresh water is unresolved and is promoting a sub-regional resolution.

19. In the future, technological changes will determine the way we use, measure and manage our water resources. Such changes are not limited to information technologies, but also production efficiencies, water recovery and treatment, and biotechnologies.

20. New technologies could be disruptive to existing uses of land and by implication water use, and if prevented from accessing water may economically disadvantage the region's economic or ecological prospects.

21. The changes are important and so is the rate of change which puts pressure on the current regulatory system of plan development preparation to respond. A more agile system is required.

SECTION 4 A fresh way to look at fresh water

Water footprinting

Water footprinting is a relatively recent (last decade) way of understanding the absolute and therefore the relative contribution of fresh water in the growing and processing of food, manufacturing of products, and the supply of services. It builds upon the concepts of life cycle analysis and derives from an accepted measure for comparison – that of an ecological footprint and of a carbon footprint but is much more complex. It is emerging as a useful way for businesses to quantify their exposure and as a result their corporate risk to changing water availability. This is particularly the case with respect to global businesses with extended and complex supply chains that rely on a secure water supply. Failure to address risks associated with water use can result in risks to operations, supply chains and to reputations. In this context it is often referred to as embodied water, virtual water or hidden water.

Water footprinting is not limited to the analysis of business risks, it can also be used as a management tool at the catchment level, as well as providing an estimate of the embodied water contained in food and manufactured products traded internationally.

For the purposes of determining the embodied water in products, the 'type' of water is important as is the location. It is this later factor that lends the analysis of water footprinting useful in the catchment management context.

Water can be divided into three 'types', which have been given the following colours: blue, green and grey.

Blue water is the easiest to recognise because it is the water we can see in streams, rivers, lakes and in groundwater aquifers. It can be accessed relatively easily and with technology and infrastructure can be piped and distributed. In most places it must be paid for. It is this water type that is the focus of management effort. Location is important as is seasonality and although indices are under development there are no agreed protocols for between catchment comparisons to account for climate influences.

Of all the rain that falls on the planet annually only about 40 per cent makes its way to groundwater aquifers, lakes and rivers. The remaining 60 per cent becomes locked up in soils as 'moisture' and although technically it is groundwater it is inaccessible to extraction by anything other than plants. It is hidden, unrecognised and responsible for 85 per cent of the world's crops. As it is hidden it generally goes unrecognised and is not monetised. This is green water and it is completely free. Green water cannot be piped or harvested yet if it were absent there would not be sufficient blue water in lakes, rivers and aquifers to irrigate all food and fibre crops.

There is a third water type – grey water – which is the volume of water required to assimilate (dilute) the pollution caused by contaminants such as excess nutrients and pesticides based on ambient water quality standards. It is this definition that links water quality (concentrations) to the common water quantity measure of a volume and to location as it will be apparent that the higher the water quality standards are the higher the grey water component of the footprint will be compared to the same product from a different catchment. This has implications for between catchment and international comparisons but does not materially affect within catchment comparisons.

The water footprint of products also must recognise the life cycle components of elements in the supply chain, but this may not be as relevant in the context of catchment level comparisons as some of these may occur overseas. Supply chain allocations are typically referred to as 'hidden water'.

It is not inconceivable that as global water scarcity becomes more acute consumers will want to know and understand the implication of their purchasing choices. Indeed it is not inconceivable that producers of products with low water footprints may seek a competitive market advantage over those with higher footprints or even those of unknown water content. For this reason, it is important that internationally agreed protocols that allow for comparisons are developed.

The possibility of quantifying the embodied water contained in export products coming from the region within the time horizon of this work (30-50 years) is high. The concept can also be useful for catchment scale management and is already being used as a communications tool to allow a location specific understanding of the use of water.

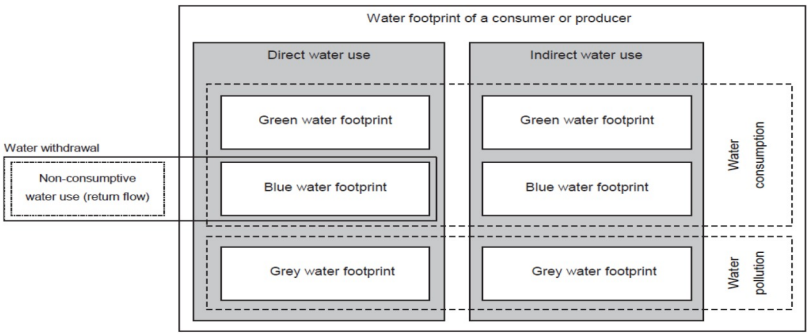


Figure 1.1 Schematic representation of the components of a water footprint. It shows that the non-consumptive part of water withdrawals (the return flow) is not part of the water footprint. It also shows that, contrary to the measure of 'water withdrawal', the 'water footprint' includes green and grey water and the indirect water-use component

Figure 9: Water footprint elements in products and services

The schematic representation (figure 9) from Hoestra *et al* [55] identifies the components of embodied water contained in a product or service. It shows that the non-consumptive part of water withdrawals (the return flow) is not part of the water footprint of the product or service as it is available for others. It also clearly reflects the fact that the 'water footprint' is the sum of green, blue and grey waters from direct and indirect use.

Water footprinting can also be used to describe catchment activities as in the following diagram (figure 10).

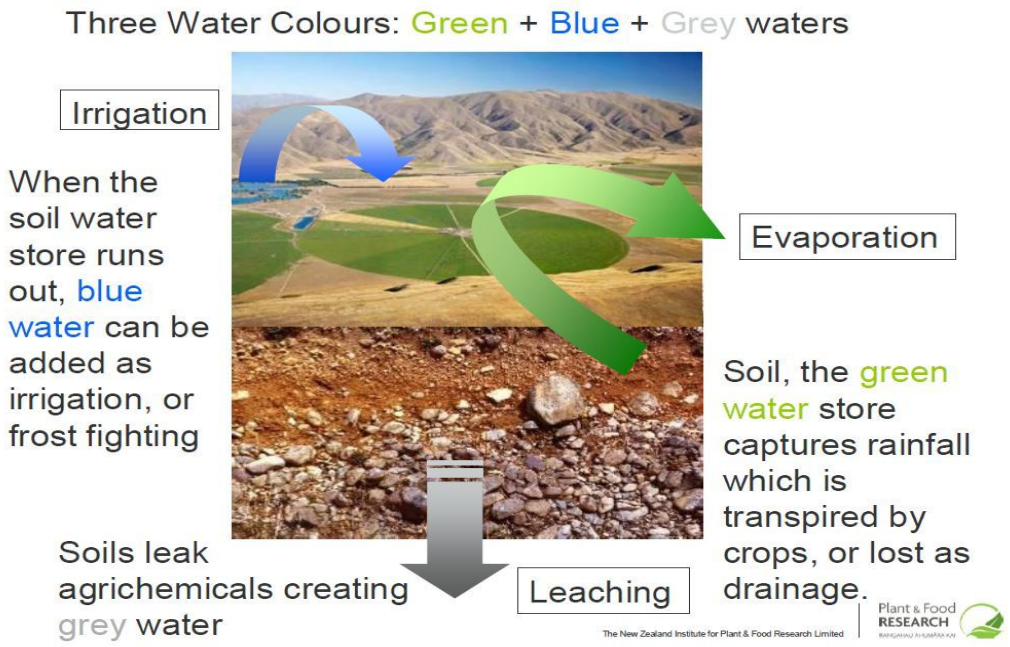


Figure 10: Catchment scale water footprint elements. Source: NZ Institute for Plant and Food Research Limited

To date, businesses that have drawn upon this nascent idea have predominantly been those associated with beverages such as soft drink and breweries. They have typically focused on the immediate corporate activity (e.g. that of brewing or bottling) and have not extended to the supply chains (e.g. the growing of the parent crop such as barley, hops, apples, grapes etc).

The study of embedded water is relatively new and has to date mostly been applied to agricultural products to any degree. As mentioned, location is important as well as this will affect the type of water that is contained in the product. Unfortunately there have been few studies done on the embedded water of New Zealand export products and only

55 *The Water footprint Assessment manual – Setting the global standard: Arjen y. Hoestra, Ashok K. Chapagain , Maite M. Aldaya and Mesfin M. Mekonnen. Earthscan Publishing 2011. ISBN: 978-1-84971-279-8*

one from the Waikato region – a comparison of a green water driven dairy in the Waikato with an irrigated (blue and green) dairy in Canterbury.[56]

An understanding of the total fresh water component of regionally grown and manufactured products is critical in allowing optimisation of the water that falls as rain on the region and enters through transfer of 'blue' water from the Whanganui River catchment. Blue water can be easily quantified and managed and this is presently covered under the RMA through the Waikato Regional Plan. Green water on the other hand cannot be managed to the same extent as the options are more limited and are essentially reduced to land use. The water can either be used for natural vegetation (ecological functions) or it can be harnessed for agriculture.

Blue water is scarcer than green water and its withdrawal often has greater negative social and ecological impacts than the use of green water. Nations can conserve their blue water reserves by importing products that have high green water components.

The embedded water in export products from the Waikato is valuable to other nations. Although there is no trade in embedded water (this occurs behind the scenes as part of the trade in commodities like beef, wheat, dairy etc) it is not inconceivable that once accounting protocols are standardised this may feature as a consideration in international trade. Already some Middle Eastern countries (Israel, Jordan and Egypt) and South Africa have consciously reduced the export of water intensive products and instead moved towards importing such products. For example, by importing wheat Egypt frees up 4km^3 of domestic water for other uses.[57] The Australian government also recently announced plans to start a register of foreign ownership of water rights.[58]

One possible strategy is for the Waikato region to maximise the value from its green water resources in the recognition that these may not exist in their current state into the future and may need to be topped up with blue water from storage. An understanding of the water components of products and services in adjoining regions may also inform decisions on the value of blue water exported to Auckland (see section 6 on *Water exports*).

National and international comparisons of embedded water and water footprints are fraught, and beyond providing a greater understanding of the role climate plays in the selection of produce grown and interdependence of nations through the global trade of products with embedded water, may be limited. However, it is not unreasonable to suggest that over the 30-50 year time horizon of this strategy, an understanding of the importance of water in trade will develop, particularly with respect to the proportions of direct (blue) and embedded (green) components. This may extend to consumer demand for information on the embedded water in products that we buy. This could be achieved similarly to current nutritional information.

The 'grey water' component of products is catchment specific as it will depend on the ambient water quality standards established for particular water bodies. This is likely to be the situation for New Zealand and particularly the Waikato River catchment as the 2008 Treaty of Waitangi settlement between the Crown and Waikato-Tainui iwi and the 2009 legislation that supports it, enshrined ambitious water quality objectives that effectively require large amounts of water to remain in the river so that the high ambient water quality standards of swim ability and the safe collection of kai, (river sourced food) can be achieved. This can be seen as a legislated transfer of what was allocable water to the river such that it can now be accounted for as the grey water components of products derived from this catchment.

56 *Life cycle assessment – a tool for evaluating resource and environmental efficiency of agricultural products and systems from pasture to plate S.F. Ledgard, M. Lieffering, M.A. Zonderland-Thomassen and M. Boyes. Proceedings of the New Zealand Society of Animal Production 2011. Vol 71: 139-148*

57 *Hidden Waters - We consume a lot more water than we can even imagine, and our water footprints extend far beyond our own nation's boundary. A briefing 2007*

58 http://planetark.org/wen/74177

Summary of key points

22. Water footprinting allows an understanding of the embodied water in products and services coming from any particular region.

23. It is an accounting tool that links product supply chains and environmental effects to determine the overall water content and water demand of a product.

24. Not only does water footprinting link water quantity and water quality dimensions of catchment wide activities, it can make the link between point and non-point (diffuse) inputs.

25. As global pressures on water resources increase, the need for an understanding of the embodied water content of regional products and services will become more relevant.

26. A consistent and agreed methodology is needed to quantify the embodied water in products and services in order to provide an evidential comparison between products, catchments and regions.

SECTION 5 Water availability (supply)

Surface water

The Waikato region has very diverse and extremely significant surface water resources consisting of lakes, rivers and wetlands. Of the over 100 lakes in the region, most are found in the Waikato/Waipā river catchment, including the largest lake in the country – Lake Taupō at 612km^2 in the south – and many smaller peat dune and riverine lakes in the north-western areas. All of these lakes provide essential habitat to indigenous fish and birds and respond differently to activities in, on, under and over their waters and in their respective catchments.

Demand for farmland and urban development close to water has meant that most of the region's lakes are now much smaller and shallower than in the early 1900s and some have been completely drained and turned into pasture. Lakes tend to collect pollutants over time because their waters are still, unlike rivers where moving waters transport pollutants into the coastal ecosystem. More intensive use of land in lake catchments means many lakes now receive more nutrient and sediment loads than in the past. This encourages nuisance plant growth which has a negative effect on indigenous biodiversity as well as aesthetic values.

There are three major river systems in the region:

- The Waikato River is the nation's longest river at 440km. It is also the most complex with eight hydro dams and a major flood control scheme in the lower reaches. The Waipā River sub-catchment is part of this system.
- The Hauraki plains feature the Waihou system, spring fed from the Mamaku plateau in the south and draining Kaimai and Coromandel ranges in the east.
- The pastoral farming area of the Hauraki Plains is drained by the Piako/Waitoa river system. Both the Waihou and Piako systems feature significant flood management infrastructure in their lower reaches.

Other catchments also feature flood management infrastructure at smaller scales e.g. Mokau River.

The condition of the region's water resources are inextricably linked to the catchment characteristics. That is the underlying geology, topography, climate and land use. The major geographic features of the Waikato, including landforms that influence water conditions are identified in figure 11.

Figure 11 also identifies the major river systems that connect land use influences to the coastal marine area. The Waihou and Piako rivers in the north and the Waikato and Mokau river systems to the west can be considered as significant point source discharges into coastal waters with the associated estuaries forming unique mixing zones. It is important that these areas are recognised in water management policy and actions.

The influence of Lake Taupō cannot be underestimated or understated. By virtue of its location at the head of the catchment it has a large influence on the Waikato River. It is also projected to play an even greater part in the balancing and attenuation of flows from projected episodic increases in volume as a result of climate change. The 30 years of soil conservation activity and the creation of a nitrogen market in the catchment mean that Lake Taupō is in the ideal place both physically and from a management view to contribute to the long term management of the Waikato River system.

Figure 11: Key regional hydrological and topographical features

Regular monitoring of the water quality of surface waters allows an indication of catchment responses to the past and current uses, and of the success of the present water management regime. The results are not encouraging and highlight the need for a change in the way water is managed, and by implication, the way land is used throughout the region.

The following figures (12, 13 and 14) show region wide trends in the concentrations of three key surface water quality variables over 20 years until 2013. All three are critical variables associated with ecosystem health and typically originate from land use/catchment influences. They are:

- turbidity or water clarity (figure 12)
- phosphorus[59] (figure 13), nitrogen[60] (figure 14).

In all cases a blue colour shows an overall improvement over the 20 year sampling period. An open circle shows no significant change and a red colour shows a decrease in the quality with an increase of the variable being measured.

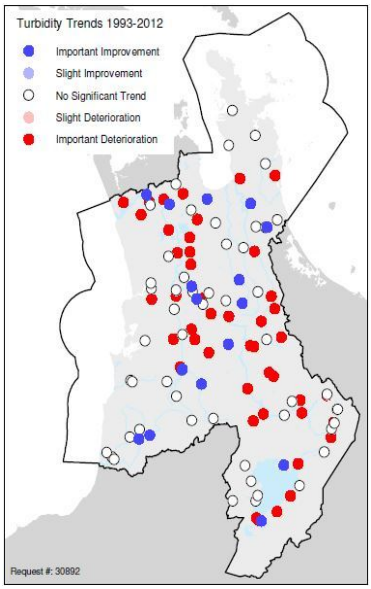


Figure 12: Turbidity Figure

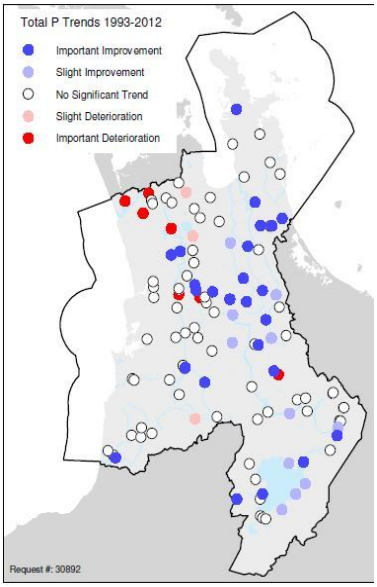


Figure 13: Total phosporus

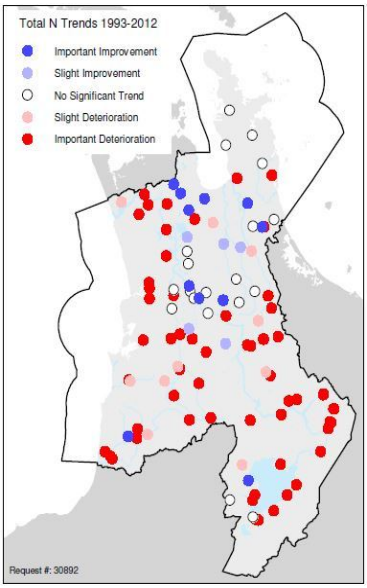


Figure 14 : Total nitrogen

Turbidity, typically measured in arbitrary units (nephelometric turbidity units), is an indication of water clarity which has ecological as well as aesthetic implications. Highly turbid waters can be an indication of enrichment and this is either a result of nutrients in sufficient concentration to promote algal growth or may be caused by the suspended products of soil erosion. In either event it detracts from the enjoyment of the water body for contact recreation, and can interfere with the ability of visual predators such as trout. The results show the turbidity of regional surface waters has increased in more places in the region over the last 20 years than it has decreased. The inverse is applicable, that the water clarity has declined in those places showing an increase in turbidity. The results do not say why this has happened.

Total phosphorus (figure 13) is a plant nutrient common in agricultural fertilisers and in organic wastewaters including sewage effluents. It can enter waterways though groundwater but more commonly via surface run off transporting eroded soil particles, either from stream banks or from catchment soil disturbance, with associated adsorbed phosphorus. The map shows no change or a decrease in the concentration of total phosphorus in most parts of the region over the 20 study period. The exception is the main stem of the Waikato River downstream of major population centres (e.g. the Hamilton Basin). Phosphorous is a common component of detergents and sewage therefore can be high in treated wastewater discharges.

It is relevant to note that the rural areas in the south of the region around Lake Taupō, the upper Waikato catchment, the Mamaku Plateau, and in the Waipa catchment have historically been the site of significant investment in soil conservation activities designed to enhance catchment security by keeping productive soils in situ and out of waterways. The data suggests this may have had a positive effect. The data may also reflect the transport mechanism in that adsorbed phosphorus would

59 *Phosphorus and nitrogen enter the water in different ways.*

60 *Phosphorus and nitrogen enter the water in different ways.*

tend to enter and be transported in rivers during high flow events rather than the common flow conditions, post wetland clearance and drainage.

Total nitrogen (figure 14) is also a plant nutrient but in contrast to phosphorus which is typically bound to sediments, nitrogen is a highly mobile nutrient and passes freely through the pumice soils of the volcanic plateau and upper Waikato catchments. Elsewhere in the region land use, geology and topography have varied influences on the amount of nitrogen that remains available to enter surface water bodies, lakes and rivers.

Microbial bacteria found in wetlands play an important role in the nitrogen cycle, including nitrification and denitrification. Denitrification causes nitrogen to be released back into the atmosphere, effectively removing it from solution in water. In some parts of the region where nitrogen concentrations in surface waters have stabilised or have decreased, the catchments have peat soils and/or are where remnant wetlands remain such as the Hauraki Plains. In addition to over application of nitrogen rich fertiliser, nitrogen is concentrated in the urine of cows as ammonia and in many places (especially in the pumice soils in the south of the region) hydraulically overwhelms the ability of soil microbes to make it available to plants and it is lost to the terrestrial system through surface waters, forming a conduit to estuaries and coastal waters.

These worsening surface water conditions, particularly for total nitrogen, indicate that in some catchments our past (and by extension current) water management is not working. This is not because of a lack of ambition, it is because we are now approaching real ecological limits and we are effectively asking more of our fresh water ecosystem services than ever before. The current regulatory approach of the RMA has worked well when managing activities (take and discharges) directly to water. We now need to manage the fresh water resource indirectly by managing land uses. This will require a new approach.

Extra water

Additional water enters the south of the region through the operation of the Tongariro Power Scheme. Using a system of tunnels, aqueducts, natural and artificial lakes, the scheme collects water from four sources before discharging into Lake Taupō at Tokaanu.

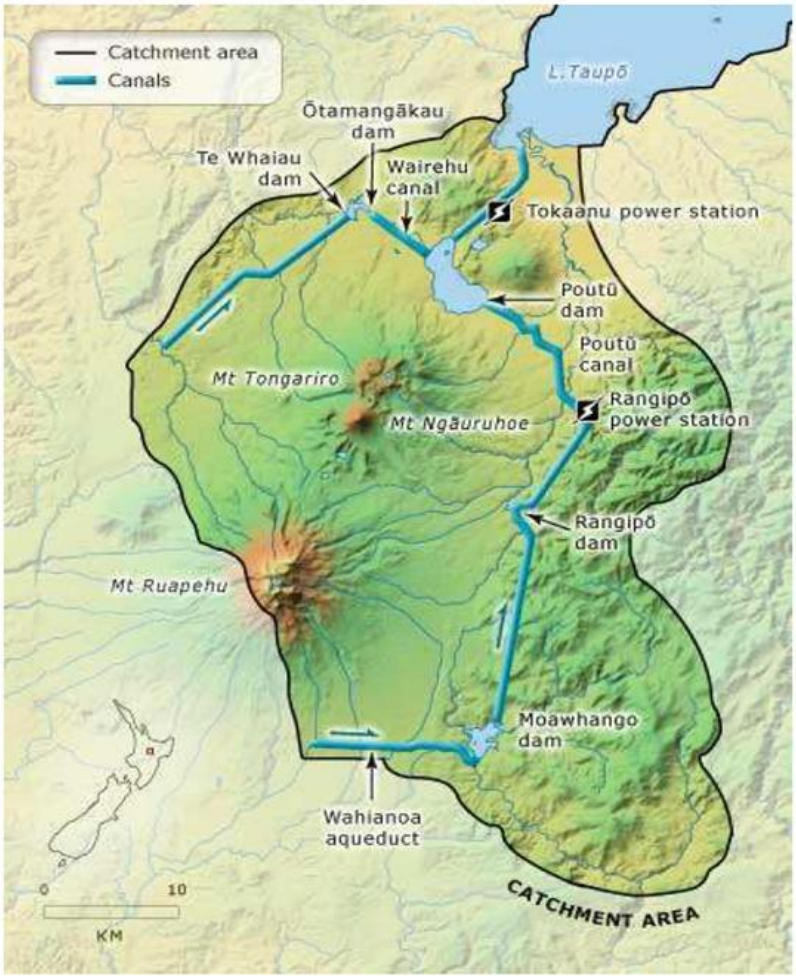


Figure 15: Extent of Tongariro Power Scheme and location of key infrastructure elements. Source: www.teara.govt.nz/en/map/21656/tongariro-power-scheme

The scheme has three hydroelectric generating stations – Tokaanu, Rangipo and Mangaio – with a combined installed capacity of 362MW. It covers 2600km^2 and on average contributes an additional 29m^3/s or an additional 20 per cent[61] of the natural inflow into the lake. The above figure shows the extent of the scheme and the location of key infrastructural elements.

Water is collected from the:

- western side of Ruapehu, Ngaruahoe and Tongariro mountains that originally formed the catchment of the Whanganui river
- southern side of Mt Ruapehu that originally formed part of the Whangaehu catchment
- eastern sides of the three mountains that originally contributed to Tongariro River (this water is the only component that would historically have contributed to the Waikato region)
- western side of the Kaimanawa Ranges that historically drained into the Rangitikei catchment via the Moawhango River and Mangaio Stream.

In addition to the 'hidden' water embodied in the export products from the region, water directly leaves the Waikato River catchment in the north of the region from three consented activities:

- Watercare's take from the Waikato River at Tuakau
- Watercare's dams on the south side of the Hunua Ranges
- Glenbrook Steel Mill's take at Waiuku.

These are discussed in the following section on water demand.

61 *Genesis Energy: Tongariro Power Scheme Annual Environmental Report 2014/15.*

Groundwater

Groundwater is largely derived from rainwater that has travelled through the soil to underground aquifers. It makes up about 90 per cent of the region's fresh water resource. Aquifers are areas of fractured rocks or porous sediments such as sand and gravel. Wells pump groundwater from aquifers. Groundwaters are used for drinking, in industry, agriculture and horticulture. Around half of our region's rural population rely on groundwater for drinking.

Rainfall naturally replaces water that is pumped from aquifers. The amount of water in our aquifers will sustain our needs as long as we don't take too much. When too much groundwater is taken from aquifers:

- the level of groundwater left in aquifers lowers (lowering of the water table)
- there may not be enough water for everyone to use, resulting in competition for water
- less groundwater flows into streams (during extended dry periods most of the water present in a stream may be from groundwater – this is known as base flow).
- land may subside.

Also, in coastal areas, salt water may come into fresh water as the water table drops. This can be expected to be exacerbated as surrounding sea levels rise.

Role of wetlands

About 90 per cent of New Zealand's freshwater wetlands have been lost over the last 150 years, including over 95 per cent of the wetlands in the Waikato region (see figure 16).

Wetlands are often flat areas of land that when drained can become very desirable for farming. As a result, many wetlands in the Waikato region have been drained and turned into pasture. Draining of peat bogs causes loss of peat due to drying and shrinkage, erosion and compaction, as well as cessation of peat formation. It has been estimated that in some areas up to six metres of elevation has been lost from the historic peat lands in the Hauraki Plains.

Historically, the wetlands in the Waikato were a combination of lowland swamps, bogs, fens and marshes as well as small dispersed hillside seeps. While the loss of biodiversity and habitat value due to drainage of large wetlands is relatively well documented and understood, the effects of cumulative losses of wetland seeps on biodiversity and hydrological processes is relatively unknown and little research has been done.

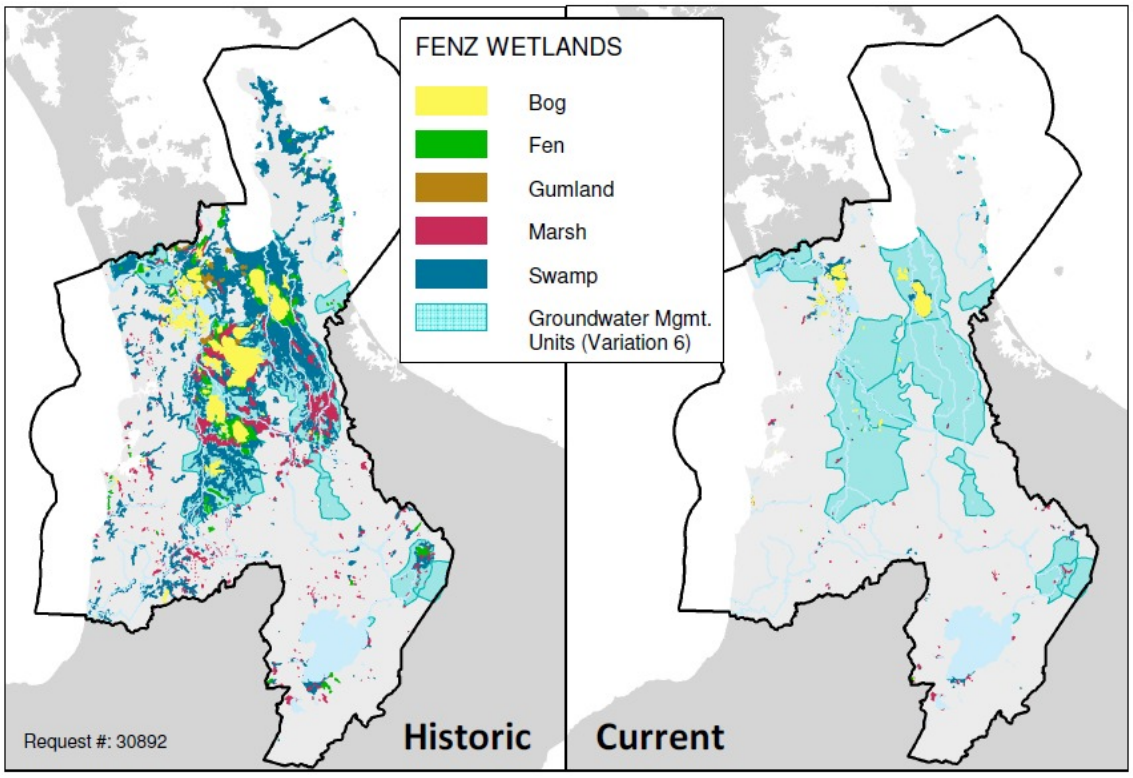


Figure 16: Historic and current wetlands over the 17 groundwater management units of the Waikato Regional Plan

Seepages and small and ephemeral wetlands support unique flora and fauna and provide a range of ecosystem services. These can include:

- denitrification (reducing nitrate levels in surface waters)
- carbon sequestration (via the accumulation of plant matter)
- filtration and storage of particulates from surface flows (including organic and inorganic matter, as well as phosphorus and bacteria)
- attenuation of surface water flows (via direct adsorption from rainfall, and adsorption via interception of surface flows).

The value of these ecosystem services has not yet been quantified for these smaller wetland ecosystems, regionally or nationally, presenting a significant knowledge gap.

Investigating the potential to enhance the benefit of these ecosystem services by protecting and restoring seepages and small and ephemeral wetlands would clarify the role wetland ecosystems may play in sustaining adequate water quantity for all in the Waikato region in years to come.

The current policy emphasis for wetland management has been directed to what is understood and this has focused on areas considered to be 'significant wetlands' –wetlands of large scale and demonstrable habitat for indigenous biodiversity. Individual upper catchment wetlands have been considered to have only local effect. However, the cumulative effect of wetlands in upper catchment valleys may be regionally significant, yet remain unquantified.

When riparian planting is considered as an operational response to water quality issues it has generally been for interception of sediments and prevention of adsorbed contaminants from reaching surface waterways. Any hydraulic delay in reaching surface waters is incidental.

It is not clear if the process of catchment adjustment to land use change has stabilised and reached a new equilibrium or indeed if it is still occurring. What is clear is that catchment land use change takes time to result in the establishment of new hydrological conditions and that this is a continuous process of adjustment in all parts of the region. For this reason we can never go back to the pre-human conditions but we can develop technologies and institute management requirements that ameliorate the negative conditions created by land use change and development.

The ability of small wetlands in the upper reaches of water catchments to delay the release of intercepted and stored water in times of stress (drought) has been inferred from anecdotal observations by landowners.

All these benefits of wetlands contribute to increasing the resilience of catchments to projected climate impacts.

Figure 17: Upper catchment pastoral wetland in Waitetuna catchment. Source: Environment Waikato & Farm Environment Award Trust: Managing Waterways on Farms Whaingaroa Harbour

Effects of climate change on supply

Climate change for the Waikato region is projected to affect the availability of fresh water and its subsequent use.

Sea level rise will increase the area of currently dry land that will either be permanently or periodically inundated by salt water. This is especially so in the lower Hauraki Plains where existing flood protection infrastructure and continual drainage services maintain 250km^2 currently below high tide level. This is projected to double by the end of the century to approximately 500km^2. The situation is also mirrored in the lower Waikato river system but to a lesser extent.

This will have the direct effect of pushing the salt water influence of tidal waters upstream for many kilometres. An associated effect will be an increase in the ground water table and in some areas will result in salinisation of the groundwater.

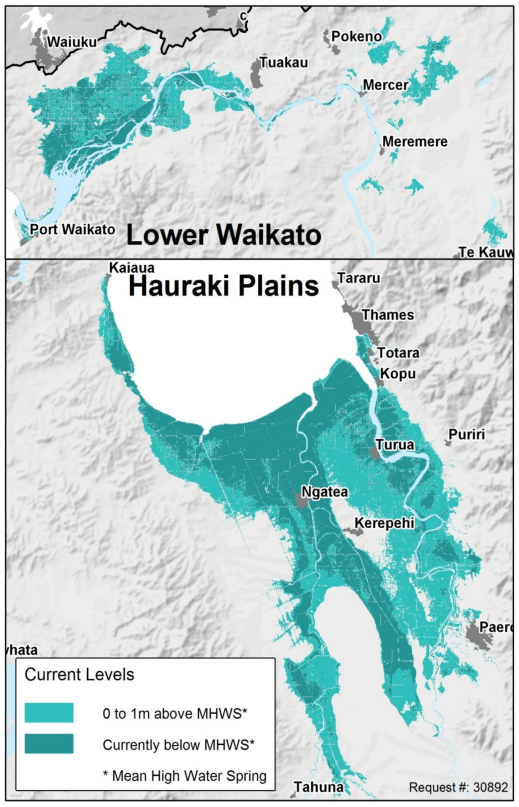


Figure 18: Area of lower Waikato River catchment and Hauraki Plains below current mean high water spring tide and within one metre above mean high water spring tide For a definition of mean high water spring, see www.linz.govt.nz/sea/tides/introduction-tides/definitions-tidal-terms

Both of these conditions will influence the sustainability of current land use that is only permitted through the operation of extensive combined flood protection and drainage infrastructure. These schemes were designed and built for 20th Century conditions and there will come a time when the costs of re-engineering and rebuilding for the 21st Century climate projections compared to overall benefits will need to be considered. The topography of these areas means that the effect can extend many tens of kilometres into the catchment as can be seen in figure 18 (map showing current land below high tide level and land projected to be below high tide level by 2100).

A similar but less extensive situation exists in the lower Waikato River system where there is currently 46km^2 of protected area below high tide level and a 111km^2 projected to be below high tide level by century end.

The current fresh water allocation regimes extend only to the extent of the boundary with the coastal marine area. This boundary is defined legislatively as the line of the mean high water spring tide. Where this crosses a river, the boundary has recognised the dynamic transition inherent in estuaries[62] and has been set at a convenient and agreed place. This has usually been the point of a bridge or causeway crossing. Within the 30-50 year time horizon of this project it is expected that sea level rise will reduce the size of the region's rivers in response to an encroachment of marine influence. The inference is that in the future the regional fresh water resource will be reduced and at the same time the role of rivers as conduits of land use effects on the marine environment and transport of contaminants into coastal waters will continue.

Meteorological extremes will change the distribution of rainfall. A recent report by Climsystems Ltd based on the Intergovernmental Panel on Climate Change's Fifth Assessment Report confirms the understanding that climate changes are spatially and seasonally variable over time.

The water cycle is influenced by physics (meteorology), chemistry (geology and uses) and to a certain extent, biology (land use). For every one degree celsius increase in temperature, the atmosphere can hold 8 per cent more water. This has two very interesting consequences:

- Globally as temperatures increase, the amount of water stored in alpine areas as snow and ice is reduced. This reduces the seasonal buffering of water distribution – as river systems and groundwater are fed by slow release melt waters.
- With temperature increases more water (previously stored as ice) will be stored in the sea and as vapour in the atmosphere where it is available to be released quickly, creating flooding and associated damage before contributing to sea level rises.

62 *River estuaries are always changing with the boundary between marine dominated conditions and freshwater conditions continuously changing according to state of tide, inflows and weather*

The local (Waikato region) situation displays similar characteristics but without the reliance on storage in alpine areas as snow and ice to attenuate water inflows to catchments throughout the year. Other mechanisms are at work. These vary according to location (topography, geology and climate) and include but are not limited to:

- Lakes to buffer storm inputs. The upper reaches of the Waikato catchment features Lake Taupō with an area of 612km^2 and a volume of approximately 60km^3. An artificially controlled outlet creates an operating range that can be used to attenuate peaks and to sustain flows at dry times, thus buffering the natural inputs. This catchment is the only one with any form of alpine influence in the region.
- Forested upper catchments. Whether from plantation forest or ancient native rainforests, the deep roots and high soil carbon impart the ability to buffer rainfall and release it through groundwater seepage in dryer times.
- Wetland areas, naturally distributed throughout the region's rolling catchments, have the ability to fill up and form ephemeral lakes during times of high rainfall and attenuate flows through releasing water into groundwater aquifers and streams to sustain flows during dry periods.

Land use change that reduces the buffering and flow attenuation ability of deeply rooted trees and substitutes that for relatively shallow rooted pasture deprives the remainder of the catchment of resilience to projected changes in climate (both flood and drought events).

Projected climate changes have been modelled on the latest Intergovernmental Panel on Climate Change's Fifth Assessment Report. An increase in the plant growing season can be anticipated in the northern districts and will be lowest in the Taupō district with increased stress for livestock in Hauraki and Matamata-Piako districts by mid-century and later on in Ōtorohanga district. Projected changes for the Thames-Coromandel, Hauraki and North Waikato include an increased extreme daily precipitation and a slight decrease in the annual average rainfall with increased peak stream flow in the Kauaeranga and Waihou rivers. The Thames-Coromandel, Hauraki, North Waikato and Matamata-Piako districts can expect decreased soil moisture levels.

In summary, we can expect less rainfall overall but the rainfall that we do receive will arrive quickly in the south-west of the region (coastal and Lake Taupō catchments) and the eastern Coromandel ranges.

The implications are that we will need to adapt and develop measures that will enable the collection and storage of water when it is plentiful for use during extended dry times when the region's waterways will be stressed and in need of flows to assimilate contaminants from land use and from point source discharges.

Summary of key points

27. Waikato region has a diverse geology and topography and land use that creates spatial differences in water yields.

28. Lake Taupō is a significant natural storage of surface water for the Waikato River catchment. No similar surface water storage influences the Hauraki Plains river systems.

29. Lake Taupō receives an annual 20 per cent increase in flow from the diverted waters of the Whanganui and Rangatikei catchments through the Tongariro Power Scheme.

30. The quality of Waikato region's surface waters have changed over the last 20 years, despite point source discharges being rigorously controlled. Most notable is an increase in total nitrogen from most sites, an indicator of rural intensification.

31. 95 per cent of the region's wetlands have been drained for agriculture, typically these were groundwater discharge zones which would have attenuated catchment responses to high flows and land derived contributions to estuaries and coastal waters.

32. Land use changes have changed catchment response characteristics to rainfall. Catchments now respond faster than would have previously been the case.

33. The interconnections between surface water and groundwater and the role of wetlands across the region are not well understood and require further work to determine spatial implications.

34. Catchment responses to meteorological events have changed and are dynamic. The changes in catchment responses from past land use changes and to intensification of present uses are not likely to have reached equilibrium and the effects are not fully understood. This is compounded by the projected future effects of climate change and the future distribution of rainfall.

35. Climate change projections are expected to change the frequency, location and intensity of rainfall globally, nationally and within the region. This will change the viability (costs and potentially location) of water dependant activities.

36. Climate change projections of sea level rise indicate a decrease in the region's fresh water resources in the lower reaches of major river systems.

37. Sea level rise will place current infrastructure at risk and prompt the inland migration of the coastal marine area. This will require a transition of the boundary between fresh water and the coastal marine area and a spatial reduction of the regional fresh water resource.

38. Projected changes in meteorological conditions include an expectation of less rainfall across the region overall, but the rainfall we do receive will arrive quickly in the south and west of the region and in the Coromandel ranges.

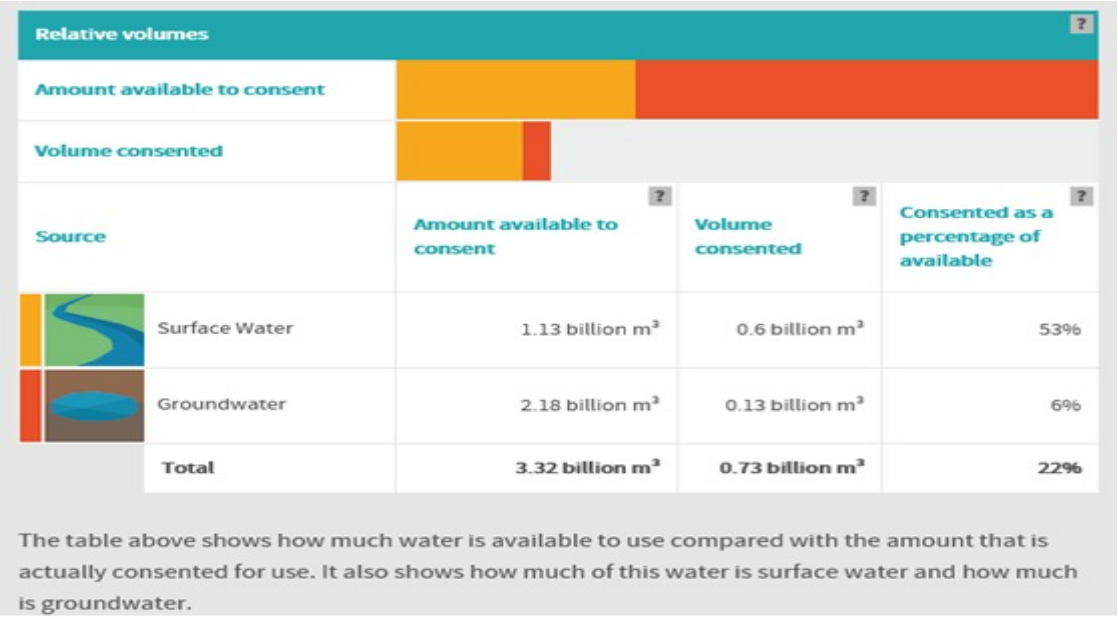
39. Land use change that reduces the buffering and flow attenuation ability of deeply rooted trees and substitutes that for shallow rooted pastures, deprives the remainder of the catchment of resilience to projected changes in climate (both flood and drought events).

SECTION 6 Demands for water

Present allocations

Allocation of water in the Waikato region is presently on a 'first-in, first-served' basis in accordance with established case law. Processing of water resource consents is done under the terms of the operative Waikato Regional Plan. Water allocation limits are in place and are designed to meet a range of social, cultural, economic and environmental needs. The limits are not 'absolute' at present. Waikato Regional Council can allow over-allocation to enable particular needs to be met but it is expected to avoid this where possible.

Data from the Land and Water Aotearoa (LAWA)[63] website (see below) provides a snapshot of the amount of consented water from all surface and groundwater sources.



Source	Amount available to consent	Volume consented	Consented as a percentage of available
Surface Water	1.13 billion m³	0.6 billion m³	53%
Groundwater	2.18 billion m³	0.13 billion m³	6%
Total	**3.32 billion m³**	**0.73 billion m³**	**22%**

The table above shows how much water is available to use compared with the amount that is actually consented for use. It also shows how much of this water is surface water and how much is groundwater.

Table 3: Consented water allocation by source. Waikato region: Consented volumes by source

The inference is that surface water is only 53 per cent used and that there is plenty of scope for future use of groundwater sources. This is likely to be a misleading interpretation and unlikely to be sustainable into the future as there is already considerable pressure on surface water in the region's major rivers at times of low flow. Seasonality is critically important.

In the case of groundwater, which would seem to be more widely available, the recharge-abstraction relationships for groundwater aquifers in the region need to be assessed taking into account changes to land use, land use intensity and subsequent water take pressure. The groundwater/surface water relationships are unable to be accounted for by the national website and these are represented as different resources when in reality they are the same water. If the surface water is at full allocation, and it is fed by groundwater, it is reasoned that this is also at full allocation.

Additionally, projected changes in precipitation patterns with climate change need to be understood to adequately assess the sustainable yields and best use of groundwater resources into the future.

In terms of assessing the region's exposure to water scarcity, the waters of the Waikato region sit in the middle of the Organisation for Economic Co-operation and Development (OECD) defined water scarcity spectrum[64], as described by the characteristics in table 4.

63 http://www.lawa.org.nz/explore-data/waikato-region/water-quantity

64 *OECD (2015) Water Resources Allocation; Sharing Risks and Opportunities OECD Studies on Water - Reference Figure 5.1 Water Scarcity Spectrum.*

Water availability		
No/low scarcity	**Moderate scarcity**	**Severe scarcity**
• General water abundance, low incidence of drought. • Water resource neither over-allocated or over used	• Emerging scarcity, increasing variability, frequency, severity or spatial extent of drought. • Periodic or localised scarcity. • Water resources may be either over-allocated, but not yet over used	• Chronic scarcity, high rainfall variability and incidence of drought. • Water rersource may be either over allocated, overused or both.

Table 4: OECD water scarcity spectrum

Surface water

The total regional surface water use (including irrigation) is 1.7 million m^3 per day. Nearly half of this is for irrigation of pasture and crops.

Use[65]	Quantity m3/day	%
Agriculture	774,479	46
Domestic and municipal water supply	526,067	31
Horticulture/market gardening	93,400	5
Industry	280,032	17
Recreation	13,532	1
Other	4,201	<1
Surface water take (total)	**1,691,711**	**100**

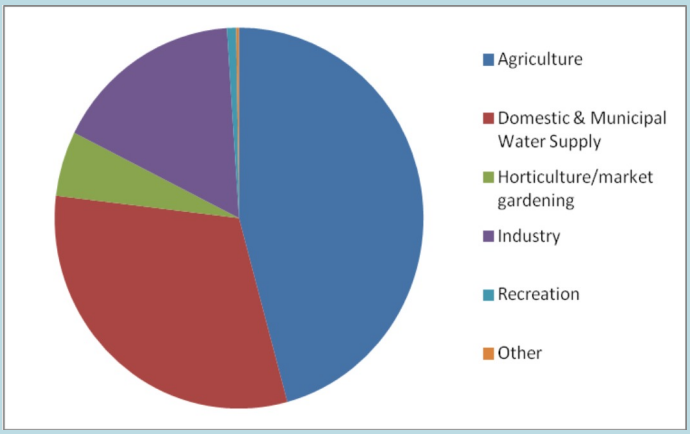


Table 5: Surface water allocation by sector

Waikato Regional Council divides the surface water resources monitored in the region into three categories: low, medium and high stress.

- Low stress areas have less than 70 per cent of available surface water allocated for use.
- Medium stress areas have between 70 and 99 per cent of available surface water allocated for use.
- High stress areas have 100 per cent or more of available surface water allocated for use.

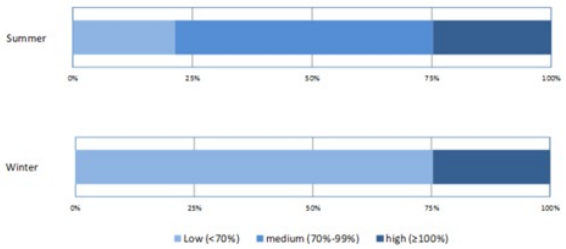


Figure 19 : Season stress for allocation of surface water

Figure 20 shows that most of the monitored surface water areas in our region are under medium to high stress during summer and low stress during winter. The two maps below reinforce the importance of seasonality and place. For example, there is less pressure on surface water in the Waikato/Waipā catchments in winter, but in the Lake Taupō and Hauraki Plains catchments the allocation stress is evident all year round.

65 *WRC Corporate database for resource use IRIS (Integrated Resource Information System)*

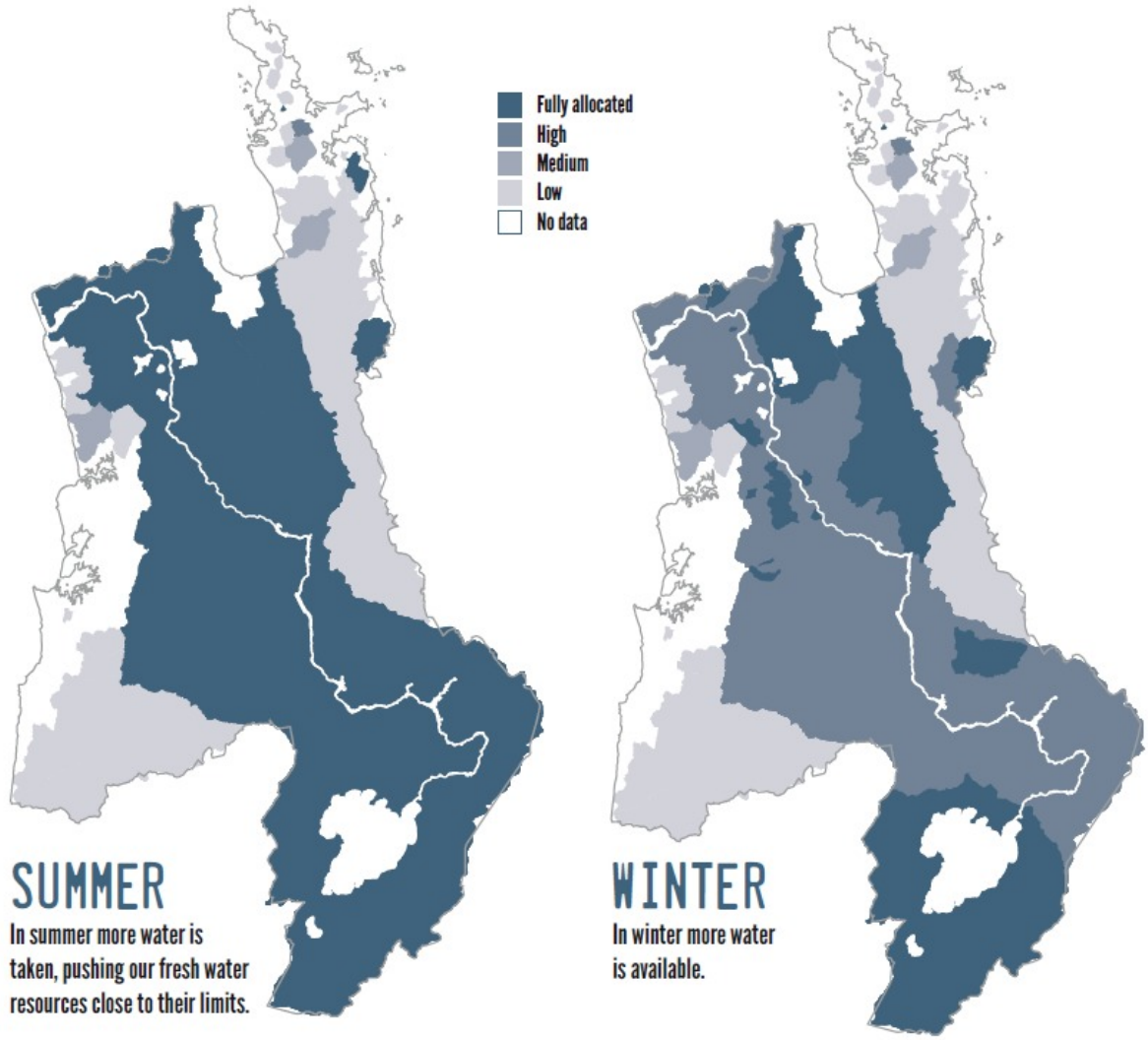


Figure 20: Current (as at January 2016) surface water allocation levels under the operative Waikato Regional Plan showing importance of seasonality

As at May 2014, most of the Waikato River catchment has water take applications in process that, if granted, would see allocation limits exceeded. That is, all the readily available water able to be taken under current regional policies would be allocated.

- 89 per cent of the primary allocable flow above Karapiro is already allocated for summer months. More water is available in winter.
- 87 per cent of the primary allocable flow at the river mouth is already allocated for summer months. Again, there is more water available in winter.
- For both sites, the council has received enough new applications that, if granted, would take allocation levels over limits.

Existing mechanisms for transfers are limited to like for like activities. Transfers between dissimilar uses of water, for instance offsets, are not allowed. An example of the current practice occurs regularly within the industrial cluster at Waitoa on the Hauraki Plains.

There is already evidence through new consent applications that the demand and competition for fresh water particularly surface water is steadily increasing.[66]

66 *Waikato Regional Council Integrated Regional Information System (IRIS) database*

Case study: Waitoa industrial cluster

An application was received by Waikato Regional Council to temporarily transfer a water permit (part permitted allocation) on the Waitoa River upstream from Fonterra to Wallace Corporation on the Waitoa River. The proposed transfer was to allow Wallace Corporation to remain compliant over the summer. The water is primarily used for cooling purposes and returned to the river via the cooling pond discharge. This discharge is consented and there are conditions around this.

The proposal transferred up to 500m^3 per day from the Fonterra Co-operative Group from a total consent allocation of 10,000m^3 per day.

Figure 21: Location of Waitoa Industrial Cluster. Source imagery: Google Earth

Waikato Regional Council water and aquatic life scientists considered that the potential for adverse effects related to the reduction of dissolved oxygen levels below 3ppm or temperature increases that could result in the Waitoa River temperature exceeding 25°C. To enable the transfer and manage the potential water quality issues the transfer was granted but was contingent on Wallace Corporation monitoring dissolved oxygen and water temperature at a point downstream of the mixing zone from the cooling water pond discharge point. Conditions were imposed to stop the transfer if the water quality limits for dissolved oxygen and temperature were not achieved.

This transfer has occurred over three separate summer periods to increase the reliability of the Wallace Corporation water supply during times when there is reduced demand by Fonterra. To date monitoring has not shown adverse effects from the transfer.

Case study: Waitoa industrial cluster

Water exports

In addition to the 'hidden' water embodied in the export products from the region, water directly leaves the Waikato River catchment in the north of the region from three consented activities:

- Watercare's take from the Waikato River at Tuakau
- Watercare's dams on the south side of the Hunua Ranges
- Glenbrook Steel Mill's take at Waiuku.

Sixty per cent of Auckland's water was sourced from the Waikato River catchment in the last year[67] with 37 per cent coming from the dams in the Hunua Ranges and 23 per cent directly from the Waikato River.

Watercare: Waikato River take at Tuakau

The Waikato River has been an integral part of the Auckland water supply network since 2002 with a daily average take last year (2015) of 91,000m^3 per day. The energy costs for pumping over the catchment boundary (Bombay Hills) and for treatment to drinking water standards make the Waikato River component of Auckland's water supply its most expensive source[68]. However, the Waikato River source is also its most reliable and as a consequence tends to be used in preference to the other sources during summer periods. This is precisely the time when the river is at its most critical with respect to flow and ability to assimilate contaminants.

The maximum daily consented take is for 150,000m^3 per day from Tuakau, approximately 40km upstream of the river mouth. An application to take a further 200,000m^3 per day has been made to support projected population growth in the Auckland region. It has been estimated that this would drop the river height by 15 to 22mm compared with a typical water depth of approximately 6m and a daily tidal variation of approximately 0.5m.[69]

Figure 22 records the daily variation of the present Waikato River take in November and December 2015. At this time of year the volume is at the upper end of the allowable range.

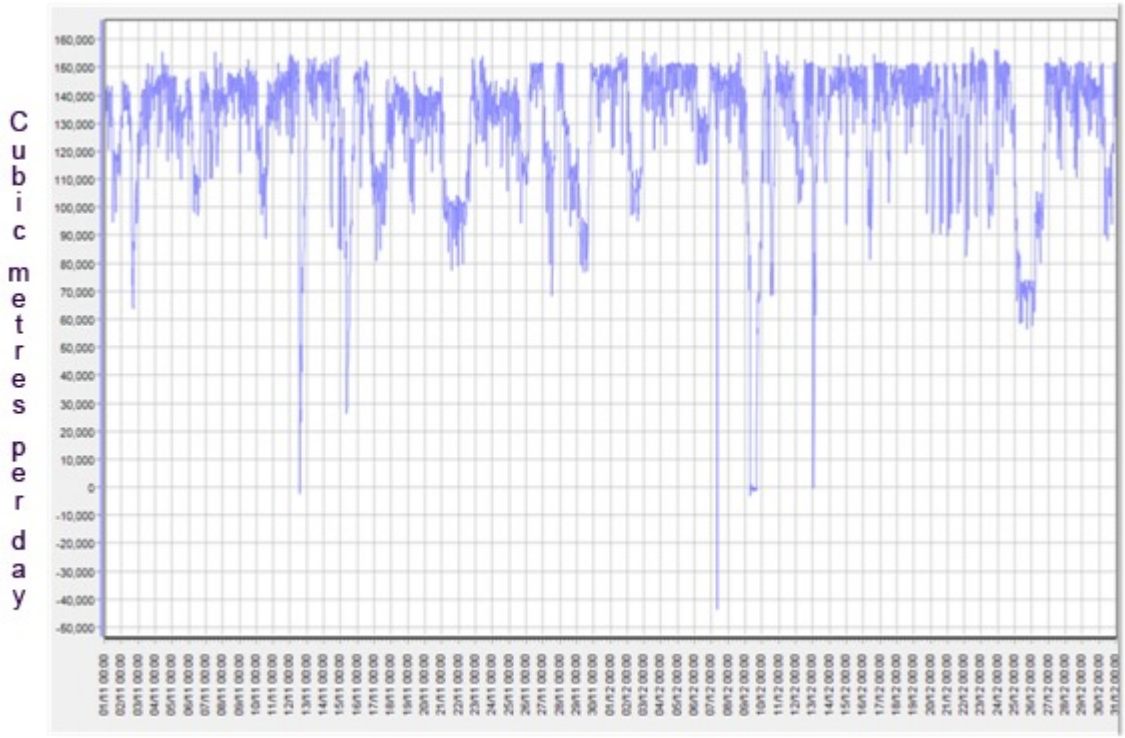


Figure 22: Volume of water taken from Waikato River at Tuakau in summer to supply Auckland

In contrast, less water was taken during the winter months of July to September 2015. During these months the dams are full and there is strong potential for refilling them.

67 *Watercare Headworks, Water Supply Department 2016*

68 *Other sources include dams in the Hunua and Waitakere ranges and groundwater from Onehunga*

69 *https://www.watercare.co.nz/about-watercare/our-services/waikato-river-water/Pages/default.aspx*

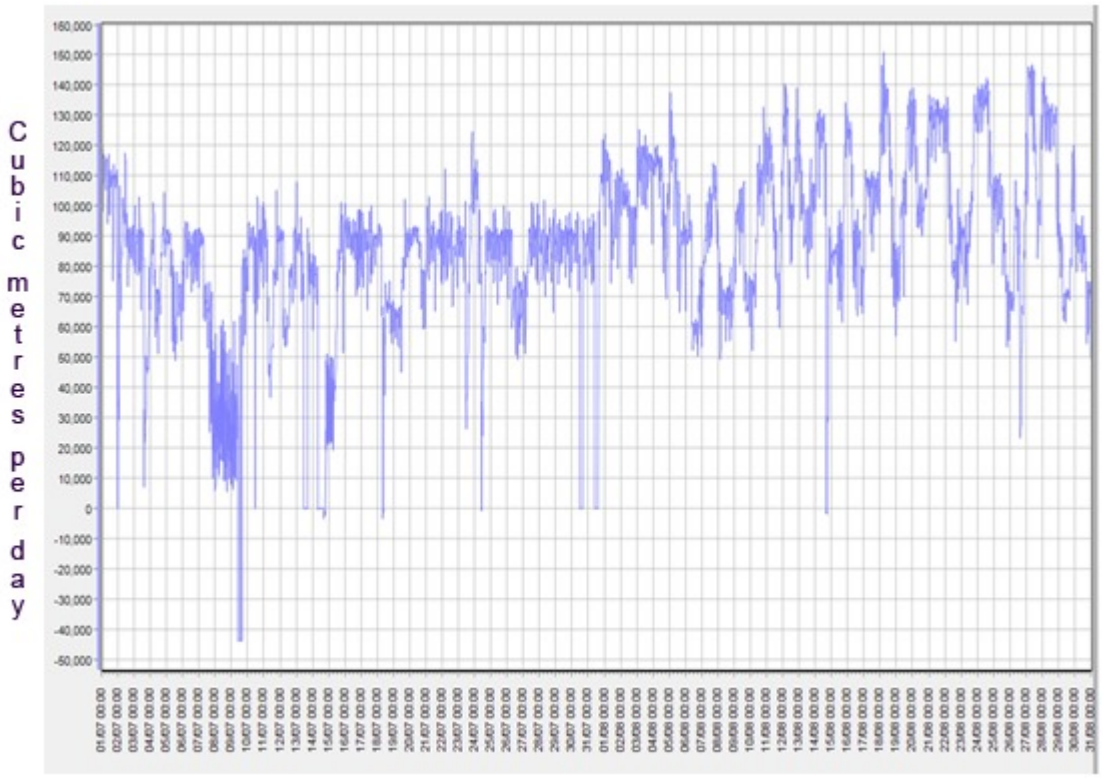


Figure 23: Volume of water taken from Waikato River at Tuakau in winter to supply Auckland

Watercare Hunua dams

Auckland's two largest water supply dams are located in the Waikato region on the southern side of the Hunua Ranges. These dams are on the Mangatangi and Mangatawhiri rivers and are some of the northern most catchments of the Waikato River. A total of 53.7 million m^3 is taken from the Waikato catchment by these dams and supplied to Auckland annually.[70]

Both the Mangatangi and the Mangatawhiri rivers are highly modified by the operation of the dams as these reduce the natural clearing functions of storms with high rainfall events. This is partially offset and the rivers are sustained in a modified capacity by the requirement to release a residual flow at all times. Characteristics of the two dams are outlined in table 6.

	Mangatangi Dam	Mangatawhiri Dam
Lake area	185ha	128.5ha
Capacity	35.3 million m^3	16.2 million m^3
Supplied volume	30.7 million m^3	22.8 million m^3
Residual flow	200l/s (1 December to 30 April) 283l/s (1 May to 30 November)	150l/s

Table 6 : Key characteristics of Waikato catchment water storage dams

Glenbrook Steel Mill (New Zealand Steel)

The other major direct water export from the region is for New Zealand Steel's Glenbrook Steel Mill at Waiuku in the Auckland region.

Wastewaters are treated and discharged into the Manukau Harbour and therefore represent a direct loss to the Waikato River. A take of up to 40,000m^3 per day is authorised by a resource consent which will expire in 2021. In the 2014/15 reporting year the take did not exceed 33,000m^3 per day.

70 *Watercare Headworks, Water Supply Department 2016*

Groundwater

In contrast to surface water, the primary users of groundwater are industry, predominantly in the water short Hauraki Plains, and horticulture in the northern part of the region

Use[71]	Quantity m3/day	%
Agriculture	97,162	20
Domestic and municipal water supply	54,597	11
Horticulture/market gardening	108,283	23
Industry	205,062	43
Recreation	7,405	2
Other	5,455	1
Groundwater take (total)	**477,963**	**100**

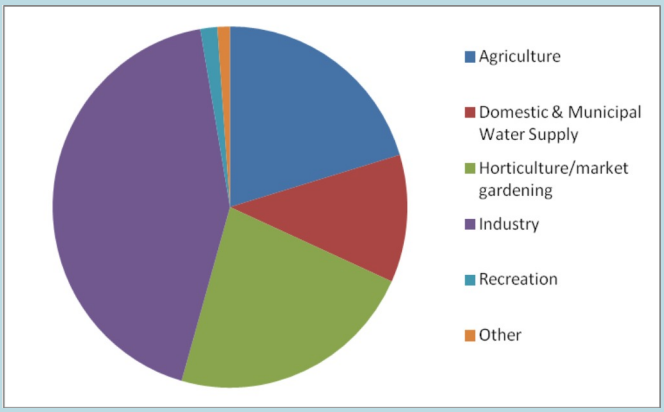


Table 7: Groundwater allocation by sector

The location and amount of groundwater use is shown on the following map with a significant cluster around the Pukekohe market gardening area.

71 *WRC Corporate resource use database IRIS (Integrated Resource Information System)*

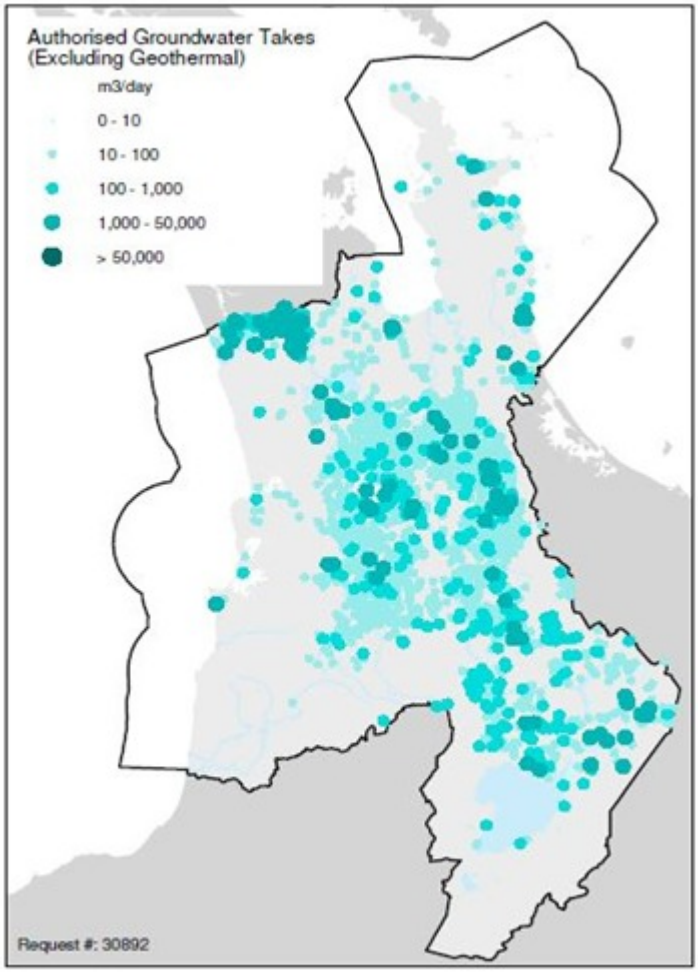


Figure 24: Consented groundwater takes and the amounts of water allocated (as at February 2016)

Land use demand

The change in irrigated area has historically been a reliable indicator of water demand over time. At the end of 2014, there were 25,677ha authorised for irrigation in the Waikato region. Figure 25 shows how the authorised irrigated area has changed over time with a doubling in the last 12 years.

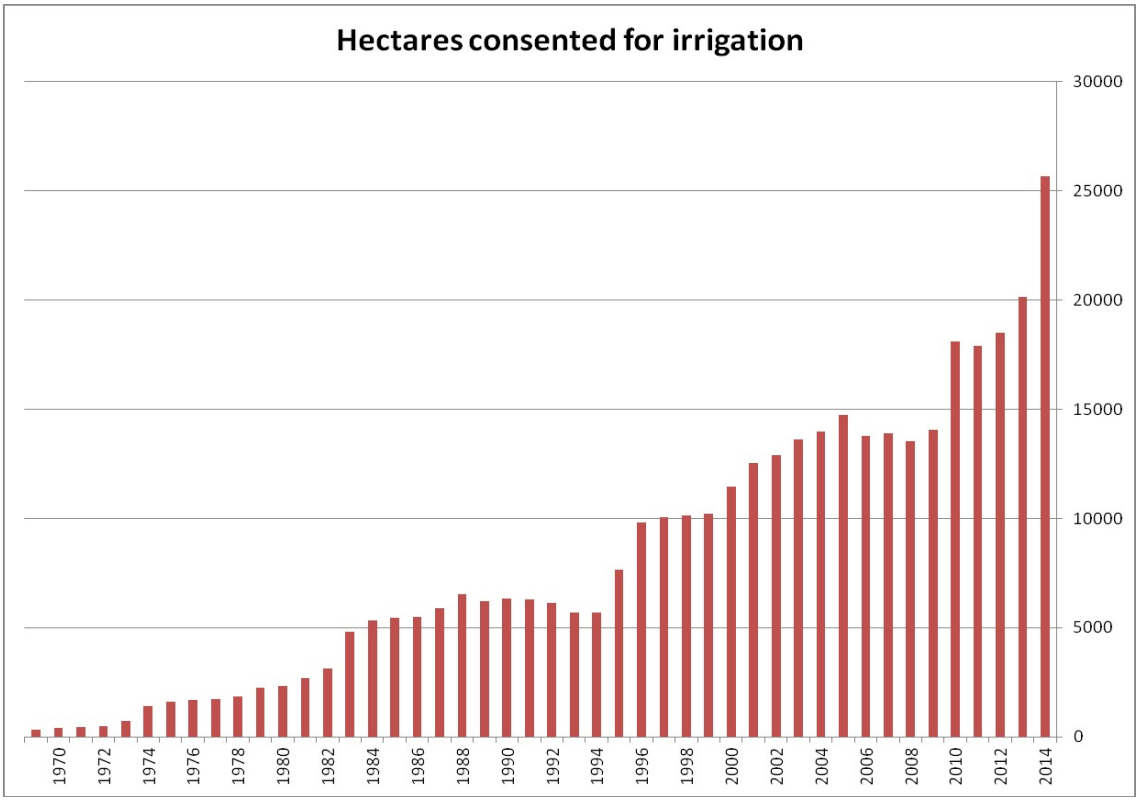


Figure 25 : Regional growth in irrigated land

Seasonality is important – both for irrigation and in situ uses. When working to limits it is important to consider the intra-annual variability and address 'worst-case' situations rather than manage/allocate on the basis of annual averages.

Historic demand (legacy effects)

There is an ongoing requirement for water to be available at times of low flow to provide for the assimilation of diffuse nutrient inputs from historic land use change and land use intensification. The impact and future duration of the demand will need to be modelled geographically in combination with other projected variables such as future precipitation to estimate the extent of this 'locked in' demand.

This historical use will create an ongoing legacy affecting future assimilative capacity.

Not all industries are able to reduce their water demand during times of drought. Some, such as the dairy industry, tend to be linked directly to water availability. For example, when production declines through lack of grass growth so too does processing of product. In contrast, those industries linked to the management of by-products and processing of stock (e.g. abattoirs, rendering works and tanneries) may not be able respond and may need more water at such times. This is because farmers often de-stock in anticipation of drought and water restrictions, and it is the meat processing and waste management industries that need water at the very time it is not available.

Potential demand

Overall, the Waikato region's population is projected to grow by about a third – from 425,000 in 2015 to 572,000 in 2043. About 90 per cent of this growth is expected to occur in northern Waikato (Hamilton, and Waipa and Waikato districts). Assuming behaviours about water use do not change, more water will be required to support this projected growth. This is significant in itself but population of the Auckland region is also expanding[72] and will exert an additional demand. This has been factored into the application by Watercare for an additional 200,000m^3 per day from the Waikato River at Tuakau.

Potential demand for industrial development also continues to grow in the Waikato. The region is well placed to absorb this industrial growth, assuming it can provide water to support businesses. The region has excellent transport links and is well endowed with zoned and serviced industrial land[73] as well as suitable rural land in some areas. For some industry, it makes increasing sense to be close to the source of livestock or produce that is being grown in the Waikato.

Some of this potential demand, particularly in the northern Waikato, is due to population growth in Auckland. This growth has seen Auckland's residential and retail areas spread to an extent that existing industry has lost the space to expand, and "reverse sensitivity" concerns have arisen (e.g. at Pukekohe). It also means it is expensive for new industry to establish, with the cost of land being significantly higher than in regions such as the Waikato. Some Auckland-based businesses are increasingly concerned at the current and future compliance costs associated with operating within Auckland's boundaries.[74]

Water, wastewater, solid waste and property rates are all increasing higher than the rate of inflation. More generally, the cost and difficulty of operating within Auckland's increasingly densely populated urban areas means that businesses are considering whether to relocate from Auckland and invest in the Waikato region where reverse sensitivity issues can be managed more cost effectively.

Other potential demand is from those expanding within the Waikato region or from elsewhere. Within the past year alone, the region has seen:

- The opening of Yashili New Zealand Dairy Company's new infant formula manufacturing plant in Pokeno, which will have an annual production capacity of about 52,000 tonnes of formula product.
- A proposal for Open Country Dairy to build a greenfield processing site at Horotiu, with a decision anticipated in 2016.
- Allied Faxi Food Co begin construction of a factory at Kerepehi in Hauraki, which is expected to produce 10 tonnes of frozen cream and 5-10 tonnes of ice cream each day.
- Ingham Enterprises NZ propose a change to the Matamata-Piako District Plan to allow it to increase production from 160,000 to 250,000 chickens per day at its Waitoa plant. This would include a new water treatment plant and water reservoirs.
- The construction of a new drier at Fonterra's Lichfield site, lifting peak processing capacity from approximately 3.2 to 4.4 million litres of milk per day.
- The commencement of a feasibility study to build, own and operate a large-scale new sawmill, laminated veneer lumber and medium density fibreboard plant in Taupō.

It is likely the region will see more industrial development (and therefore demand for water) from others also looking to benefit from the region's location advantage and proximity to natural inputs such as livestock and produce.

Tourism is one of New Zealand's largest export industries, second only to the dairy industry in terms of foreign exchange earnings. It directly employs 4.7 per cent of the New Zealand workforce and indirectly employs a further 3.1 per cent.[75]

New Zealand brands itself as clean and green. For example, Tourism NZ's long running 100% Pure New Zealand brand campaign. There are others too that leverage this image, like Anchor. To maintain access to high value premium markets we need to maintain an internationally positive perception to New Zealand brands.

A significant risk to accessing premium market segments is the overseas defined perceptions of social and environmental sustainability factors. New Zealand needs to increase its sustainability credentials to maintain market access to premium markets.[76][77]

Taupō Beef in the Lake Taupō catchment is an example of a product currently leveraging its compliance within a strict lower nitrogen farming catchment for access to a premium

72 http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections.aspx#projections

73 *Approximately 4,280ha of industrial land is available for development in the Waikato. Of this, 80 per cent is to be provided prior to 2021, with the completion of the Waikato Expressway triggering the release of much of this land (Upper North Island Freight Story Shared Evidence Base, April 2013).*

74 *Over the past 2-3 years, Waikato Regional Council has received correspondence and met with a number of Auckland based businesses that are interested in information about the Waikato business environment. For example, discussions have been held at the Forestry Liaison Forum and with the Employers and Manufacturers Association (EMA) Northern and constituent businesses.*

75 http://www.tourismnewzealand.com/about/about-the-industry/

76 *Dr Caroline Saunders: edsconference.com/content/docs/2010.../Saunders,%20C.pdf*

77 *AgResearch New Zealand's Provenance: Review and Workshop Report Green Growth Objective 1 May 2013.*

market. They have successfully converted their farming system to protect the waterways and produce high quality beef that demands a premium price.[78] That is, it is focused on environmental effects, and this is new – differing from other types of certification like 'organic' which concentrates on inputs.

The demand for high in situ water quality is often seen as a constraint on pastoral farming. But this need not be the case if the product is high quality and targeted to high value markets. It appears it is more a constraint to high volume commodity production.

78 http://www.stuff.co.nz/business/farming/74301144/Taupo-Beef-wins-top-sustainability-award

Effects of climate change on demand

Demand for water can also be expected to change with a changing climate. This may initially be in the form of businesses seeking to re-establish historic rainfall patterns through make up irrigation.

There may be more pressure on farmers for animal welfare reasons to provide shelter/shade to stock in lieu of allowing access to waterways during times of heat stress. This may extend to more off stream access for drinking water and may require extending the practice of spraying dairy cows with water as they wait for their turn to be milked. Conversely, water demand may decrease in some situations with land use change to less water demanding species (livestock or forage species).

A warming of surface waterways will reduce the ability of these water bodies to assimilate the contaminants from point and non-point discharges in the future. As water temperature increases, the ability to hold dissolved gasses such as oxygen decreases. Dissolved oxygen is vital for breakdown of pollutants and sustaining aquatic life. Any reduction in the concentration of dissolved oxygen will increase the demand for water for this function, thus rendering less available for abstractive uses.

A key response will be the need to shade waterways so that dissolved gasses, especially oxygen is retained by the water body.

The interconnected global economy can also be expected to exert a climate change influence on water demand as the international effects of climate change shift growing zones to different places. As mentioned, New Zealand can expect fewer changes in supply than many other countries and may be at a relative advantage with respect to an ability to grow pasture and crops.

It is recognised that the 'best' use of water will change over time. This will be in response to the changing value of water as the international value of water changes. This is likely to occur in response to an expanding global population, projected negative climate effects in current global food bowl regions which are already stressed through groundwater aquifer drawdown and contamination of source aquifers.

Summary of key points

40 Seasonality is important for water use. Most of the region's surface waters are at or near full allocation during the summer with less allocation stress during the cooler winter months.

41. The Lake Taupō catchment and the Piako/Waitoa catchment surface water systems are fully allocated all year round.

42. Groundwater and surface water are recognised as the same resource. Until a better understanding of the linkages between the two water bodies are known and uncertainty reduced the allocation from groundwater is conservative.

43. The current regulatory allocation regime does allow for transfers of allocated water, but this is bureaucratic and infrequent with the best example coming from the matching of water requirements from the industries clustered at Waitoa.

44 Auckland receives 60 per cent of its annual water supply from the Waikato catchment – 37 per cent from the Mangatangi and Mangatawhiri dams and a further 23 per cent from the Waikato River.

45. If behaviour change for water doesn't change more water will be required to support current and projected population growth in Auckland.

46 Due to the time lag between effects from land use change and current use intensification, there will be a legacy of demand for in situ assimilation capacity into the future. The magnitude of this is unknown.

47. High and increasing costs of doing business in Auckland along with high population growth have created conditions for businesses to investigate relocation to the Waikato region where reverse sensitivity issues can be more cost-effectively managed. Investment will increase demand on water resources.

48 Projected climate change conditions suggest receiving water bodies may be less able to assimilate the effects of contaminants to water bodies in the future as warmer waters hold less dissolved gasses (e.g. oxygen). This may be interpreted as more in situ demand from the water body.

SECTION 7 Strategic issues

Limited policy instruments

There are three classic policy levers. These have often been described as the carrot, the stick and the sermon, which broadly relate to incentives, regulation and education.

We have regulatory tools at our disposal for managing water through the RMA and the ability to provide information, budgeted through the Local Government Act's long term and annual planning cycles, but we have very little access to instruments to incentivise alternative behaviours. In essence, we are short of carrots (incentives).

Regulation has served regional councils well with respect to managing activities directly related to water. That is, the allocation of discharge capacity from point sources and allocation of abstractive takes and diversions. These are activities that directly interact with what is widely regarded as a common resource and where there are obvious public good implications. The management of activities, however, locks in technology and a historical use as this is governed by the 'first in, first served' allocation principle. There is no responsive way to manage the value of the approved use once consent is granted.

As allocated volumes approach the limits of a water body's capacity for use, the emphasis falls to managing the remaining catchment influences on each water body. These are often that of land use impacts. This is a different situation as the water resource now needs to be managed vicariously through land use, yet regulation is the only policy tool provided by the legislation. This is an emerging area of policy failure as it is extremely expensive to create appropriate bespoke regulations that impose constraints on individual private property rights, as when this is attempted the level of technical justification is arguably disproportionate to the benefit.

The current allocation system is considered to no longer be fit for purpose. It relies solely on regulatory tools and as a consequence is 'clunky' to the point of being static. Allocation through regional plans (for permitted activities) and resource consent for the remainder of uses does confer certainty but at the expense of flexibility. A new way of allocation from the 'first in, first served' is required.

The questions then become:

- What are the behaviours and actions we require to address water allocation issues?
- What tools are required and how much science is required to support these?

This gives rise to a further question:

- What behaviours and actions do we want to prevent and how much science is required to justify these?

As the regulation of activities can involve curtailing actual or perceived private property rights it is an expensive process, requiring high levels of scientific justification and legal process to implement. Unfortunately, at this time, it is the only approach available to regional councils through the RMA. This is the core of the issue with respect to plan agility and the costs of plan development. It is possibly also the reason why some of the seemingly intractable water allocation issues have not already been addressed.

No amount of collaboration when developing controls and guidance to do the right thing will achieve the results required without access to a full suite of policy instruments i.e. meaningful economic and financial incentives. This project will consider fresh water management in light of what is needed to support existing tools.

There is clear and recent evidence that policy tools need to work together to effectively deliver on resource management objectives. This comes from two separate but related situations with opposite outcomes. Both examples come from within the Waikato region from the wider Waikato River catchment, and both reflect the influence of the New Zealand Emissions Trading Scheme which placed a price on carbon but which resulted in two different outcomes when compared to the prevailing resource management objectives. Both examples demonstrate the power of economic instruments with respect to land use change.

Regulation and price working together in the Lake Taupō catchment

The first example is where the policy objective was achieved ahead of time. The Lake Taupō Protection Trust was established to purchase the right to discharge 20 per cent (170.3 tonnes) of nitrogen entering the lake from the surrounding catchment. This was to be achieved by 2018. However, the New Zealand Emissions Trading Scheme came into force during the early stages of the project and advanced the achievement of nitrogen reductions. This rate subsequently tapered off, but the initial reductions were instrumental in achieving the target three years in advance of project expectations.

The mechanism was to promote land use change as pasture to forestry conversions not only surrendered nitrogen discharge allocations but also received carbon sequestration credits for a time.

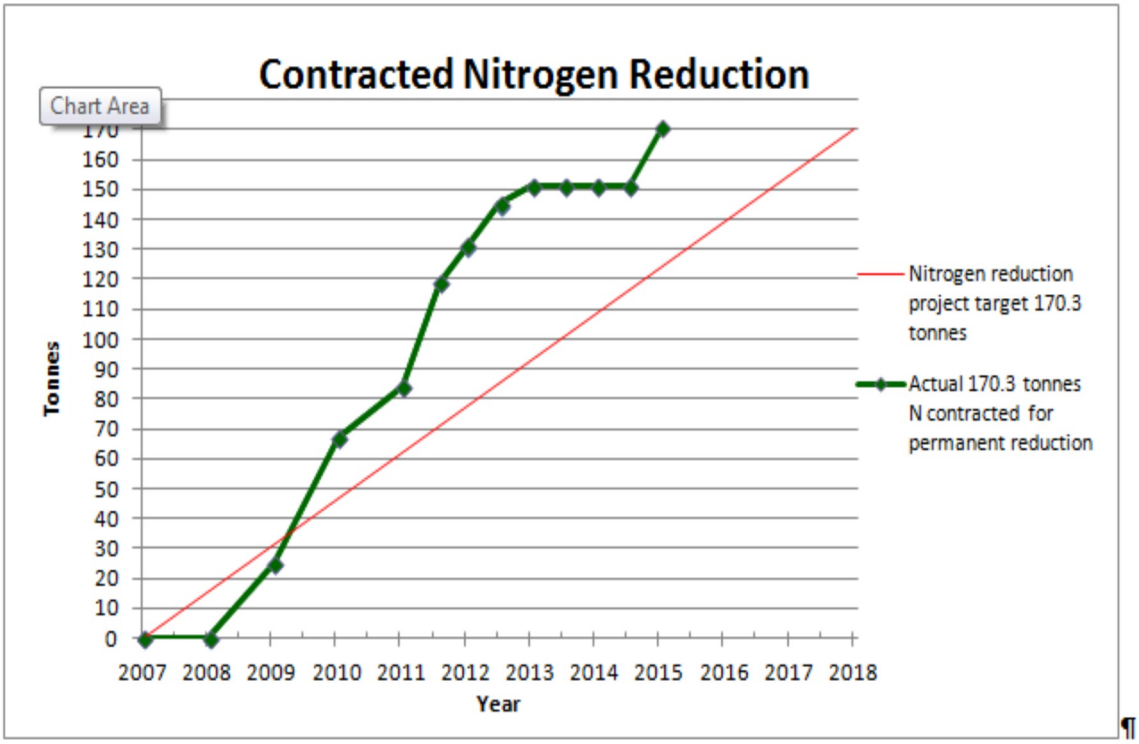


Figure 26: Actual versus planned nitrogen removal from Lake Taupō catchment. Source: http://www.laketaupoprotectiontrust.org.nz/page/lake_7.php

Regulation and price working in opposition in the upper Waikato River catchment

The second example is where a price on carbon had the opposite effect resulting in an outcome that is in opposition to the legislated objectives for the Waikato River and its catchment.

In 2008 two central government policy initiatives came into force. One was the nationwide New Zealand Emissions Trading Scheme and the other was the culmination of the Waikato River Treaty settlement process which resulted in the Te Ture Whaimana o Te Awa o Waikato – the Vision and Strategy for the Waikato River. Among other matters, the Vision and Strategy contains 13 objectives (a-m) and five are particularly relevant in the current example. They are:

e. *The integrated, holistic and co-ordinated approach to management of the natural, physical, cultural, and historic resources of the Waikato River.*

f. The adoption of a precautionary approach towards decisions that may result in significant adverse effects on the Waikato River, and in particular, those effects that threaten serious or irreversible damage to the Waikato River.

g. The recognition and avoidance of adverse cumulative effects, and potential cumulative effects, of activities undertaken both on the Waikato River and within the catchment on the health and wellbeing of the Waikato River.

h. The recognition that the Waikato River is degraded and should not be required to absorb further degradation as a result of human activities.

k. The restoration of water quality within the Waikato River so that it is safe for people to swim in and take food from over its entire length.

The introduction of the New Zealand Emissions Trading Scheme was anticipated as it was the subject of intense political debate and public consultation. The scheme would be the nation's primary policy instrument for achieving Kyoto Protocol obligations for carbon reduction and the first five year commitment period started in 2008. Under the scheme landowners with forests that existed prior to 1990[79] would be required to pay for carbon credits upon any conversion to another land use such as pasture. This effectively locked in forestry as the land use for much of the upper Waikato River catchment.

In order to retain flexibility for future land use some landowners chose to fell their forests before the start of the first commitment period (01 January 2008). The result was a clearance of 20,853ha[80] in the upper Waikato catchment between Huka Falls and Lake Karapiro.

79 *The baseline year under the United Nations Framework Convention on Climate Change (UNFCCC)*

80 *Between 2001 and 2008.*

The Government (elected at the end of 2008), in response to the global financial crisis, amended the New Zealand Emissions Trading Scheme by:

- removing agricultural emissions
- increasing the transitional settings by requiring surrender of one emissions unit for every two units of emissions
- opening up the market to international units which were oversupplied.

The effect was to remove the price restraint on land use conversion for forestry (carbon sinks) to pastoral farming with associated increased nutrient derived water quality effects on the Waikato River. This resulted in the clearance of an additional 21,955ha in the upper Waikato River catchment during the Kyoto Protocol's first commitment period (2008-2012). This clearance totaled 41,926ha in the upper Waikato River catchment.

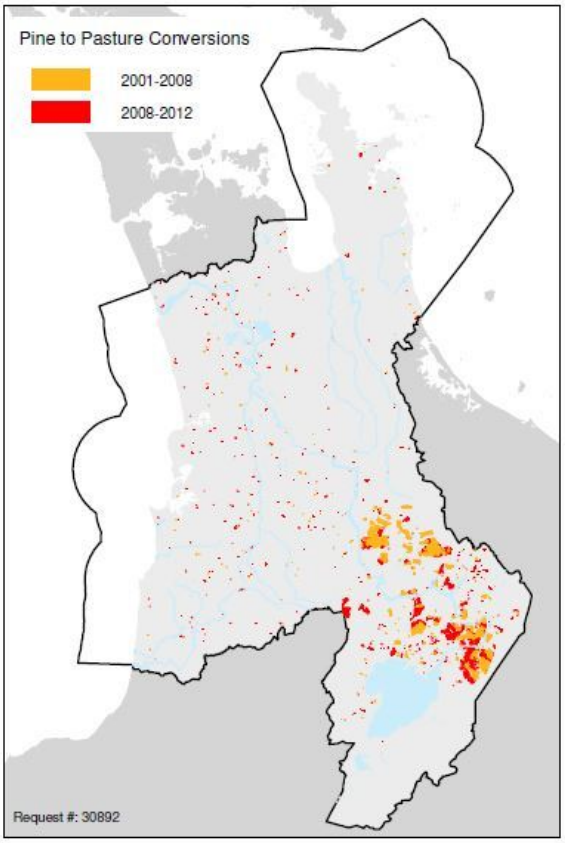


Figure 27: Waikato region forestry to pasture conversions 2001-2012

Arguably the initial (precommitment period) conversion can be viewed as a rational response to the advent of a price on carbon and it preceded the Vision and Strategy for the Waikato River. The conversions that followed the review of the New Zealand Emissions Trading Scheme demonstrate the power of a price signal in the face of regional plan water quality objectives and government policy objectives as agreed in the Vision and Strategy.

Fresh water allocation is currently focused on the effects of activities on the fresh water resource – the take – and not on the economic implications of the allocation i.e. the use. Regulatory approvals in the form of consented activities are 'clunky proxies' for the ability to ensure that water allocation is able to move towards the highest value use. A full suite of policy options would allow the link to be made to allocation and value.

Plan agility

Regional rules that regulate water allocation are linked to regional plans. These are currently very expensive to prepare and change and the costs are increasing as the focus moves from managing discrete takes and discharges of water to managing diffuse influences.

Part of the increasing expense involves the additional time involved to justify changes to rules that affect land use decisions (individual private property rights) either in the Environment Court, and potentially High Court, or in the design of rules during the initial phase.[81]

The high and increasing time as well as the cost of developing and justifying regulatory interventions is seen as the major reason why plans are increasingly unable to respond to the rapidly changing demand for water resources. This is being seen as a lack of plan agility.

Plan agility could be improved if allocation wasn't restricted to regulation (rules) alone and new policy instruments were made available in a two-stage allocation process. A regulatory envelop could be used within a regional plan to establish parameters for allocation within a Freshwater Management Unit (spatial area, objectives to be achieved, quantum available etc). Once set uses within each unit could be managed with more flexible tools such as economic instruments.

81 *Variation 6 - water allocation rules to the Waikato Regional Plan cost the Waikato Regional Council $4,500,000 over nine years. The cost to contributing parties is unknown.*

Reactive management

The current regulatory management served the nation well when the focus was on the cleanup of point source discharges. We have done a credible job using the tools we have been given and these have been successful in addressing point source discharges and abstractions from the region's water bodies.

The values we place on our rivers and other water bodies have changed. For example in the first half of last century the Ohinemuri River, a tributary of the Waihou River, was designated in the New Zealand Gazette as a 'sludge channel'. That is, it was an active decision by the Parliament of New Zealand to identify the use of that river as being for the transportation of industrial waste. Similarly in the 1960s wastewater in Hamilton was not treated. Instead, it was collected, stored and then released at night into the Waikato River when the aesthetic effects were minimised. The situation was repeated in other parts of the country as well with industrial discharges consisting of little more than pipes, a holding tank and a pump. We have come a long way.

We have now entered a new understanding of the role of rivers and their capacity to receive and accept discharges. Direct discharges to waterways are regulated, but indirect discharges (non-point sources) are not. This creates the situation where, as the effect of diffuse discharges from land use increases, the ability to regulate direct activities becomes less and less practical. This is because it becomes very difficult to justify requiring a discharge quality to be better than that of the receiving waters. This is the stage at which the limit of regulation is reached.

The present 'first in, first served' approach to water allocation potentially locks in inefficient and historical allocations. Where there is insufficient water for all demands there is no guarantee that water will be allocated to the greatest environmental, social, cultural and economic values. Additionally, the 'first in, first served' approach can make it difficult to manage the cumulative effects of numerous small water takes and discharges to water bodies.

We need to find a system that will allow water that's already allocated (either directly or its assimilative capacity) to be moved around to meet the short term needs of users.

The current allocation system is also constrained by central government amendments with a case in point being the Resource Management (Discount on Administrative Charges) Regulations 2010 which were part of the Resource Management (Simplifying and Streamlining) Amendment Act 2009. These had the effect of preventing a common expiry date for regulated allocations within sub-catchment management units and review of consented water allocations. The reason is the time it would take to review all the consents in a sub-catchment which would incur costs payable by the community – in effect a subsidy from regional ratepayers.

It is essential to be able to treat each identified water management unit (whatever the spatial scale) as an integrated whole so as to allow supply and demand pressures and surface/groundwater interactions to be matched to monitoring results and future modelling. This has also significantly limited the ability to take account of climate change, one of the bottom line requirements of the National Policy Statement for Freshwater Management.

Spatial scales

The current regional practice of separating water management into activity types[82] to address specific issues has removed the ability to treat water matters in an integrated way. A by-product of this has been the proliferation of a number of different scales for different purposes that perpetuate the problem by preventing easy integration in the future.

Examples of this include:

- Separation of objectives, policies and rules for surface water takes and groundwater takes (water quantity), and for surface water discharges (water quality) and discharges to land.
- Region wide reporting on water quality outcomes from eight water quality zones. This is part of the ongoing State of the Environment reporting responsibilities pursuant to section 35 of the RMA.[83]
- Region wide reporting and allocation from nine sub-regional zones with 79 sub-zones.
- Partial regional coverage for groundwater takes from 17 zones.
- Establishment of eight[84] (four catchment and four lake types) freshwater management units for accounting and management of four water quality attributes.
- Lake Taupō and its catchment are separated for land use and water discharges into a single management zone.

Additionally, catchment related services are provided to eight management zones.

It is rational to have a number of sub-regional management zones as it then allows for an optimised management regime within each zone and the ability to manage the interrelationships between zones. But it is not helpful to have a combination of overlapping management units each developed at different times and covering different matters as it makes it extremely difficult to treat the resource as an integrated entity.

This situation needs to be addressed to allow the development of a set of water accounts that will allow modelling the economic impacts of future management options including the establishment of water trading areas, potentially at a sub-freshwater management unit scale.

82 *E.g. Takes or discharges, groundwater or surface water*

83 *The Waikato Progress Indicator does prove a region-wide water quality indicator – that of "The percentage of unsatisfactory river water samples for ecological water quality in the Waikato Region's rivers and streams, as an average across all sites measured"*

84 *The Healthy Rivers Wai Ora project (Waikato River catchment between Huka Falls and the sea)*

Continuing research

The Waikato region is fortunate to have a number of organisations concerned about water management. These include iwi, the Waikato River Authority, environmental groups, tertiary institutes, Crown Research Institutes (NIWA, Landcare Research, AgResearch), local government, industry sector groups and so on. Some of these groups are involved with using water, some with on the ground change, some with maintaining the regulatory environment, some with supporting others to use water well, and some with researching strategic issues relating to water. This latter group includes the University of Waikato and various Crown Research Institutes. Continuing to have this research capability in the region is critical if we are to understand strategic issues related to water – issues that will continue to be important for the Waikato region and the rest of New Zealand into the future.

As previously stated, the key is to take an inter-disciplinary approach to addressing water issues. This requires an understanding of the inter-relationships between natural, economic, cultural and social dynamics relating to water management. While there are many examples of cross-disciplinary research on water issues occurring at the moment, this is largely ad hoc. Greater gains could be made if pure and applied research involving aspects such as Māori co-governance and tikanga, mātauranga Māori, law, bioengineering, economics, modelling, natural sciences and social sciences were brought to bear in an integrated way to gain a better understanding of the waterways of the region.

Research findings that took such a multi-disciplinary approach would enable communities, iwi, local government, industry and others to apply learnings to help meet social, economic and environmental outcomes as they use water, undertake on the ground action, make regulation, encourage behaviour change, support others and so on.

Use of models

The current system of data collection and storage on water use and of water conditions has resulted in inefficiencies when seeking solutions to present and emerging issues. In the main we manage on the basis of monitored information and make changes after the fact when monitoring shows a change in resource condition. This is reactive.

Often the response is to query a number of databases and files either in print or electronic form to answer specific research or management questions. The results are applicable to the time, location and subject of the enquiry. This will only ever allow policy to be developed on the basis of past performance and has been likened to driving a car while looking through the rear vision mirror. This provides an accurate picture of what has already happened as they are a reflection of past management decisions but very little understanding of the possible future situation.

Figure 28: Present system is akin to driving forward while looking through the rear vision mirror

Through consideration of differing scenarios, models do allow the exploration of different policy tools and settings and allow 'what if' questions to be asked. While there will always be a level of uncertainty with model outputs (they will never have the clarity of hindsight monitoring), these are able to be refined over time with knowledge and increases in the databases that they draw upon.

A number of databases have been developed to store data for various purposes. They are not relational (they have not been designed to communicate easily with each other), which limits their usefulness. Moreover, most do not have the capacity to include climate change projects into the future and are therefore not suitable for strategic work.

With the recent expansion and ongoing reduction in the cost of computing power, it is now feasible to create a mathematical representation (computer model) that mimics the regional uses of water, condition of water bodies and the relationships between them (stocks and flows) over time and with respect to projected climate change. Moreover models can also be used to explore the social and economic dimensions of water management decisions to allow an understanding of the best value use. For example, the changing demand for water from population, industry and farming.

The use of mathematical models to project future scenarios allows decision makers to understand the wider implications on social and economic matters of their decisions on water. It allows a likely or plausible view of the future – although an uncertain one – instead of making decisions solely on evidential support from the past and using a narrow, piecemeal perspective. The last aspect is particularly important as today's increasingly complex issues demand an integrated approach considering all natural resources (e.g. land and waters), socio-economic drivers and impacts, and a geographical (spatial) view (e.g. national regional, catchment).

To ensure the best use of water, a combination of a market based water allocation system bounded by regulation may be an option but will need to be modelled so the implications between environmental and economic outcomes are clearly understood before policy decisions are made and budget committed.

The challenge will be to create a mathematical model that replicates the regional uses using data in the form of accessible databases. Databases for our natural capital, such as water, are being developed nationally by Statistics NZ. However, these water accounts will need to be spatially relevant with geographic components for water management over the whole Waikato region, and be able to be disaggregated to give a sub-regional understanding. This will require a decision on the scale of management unit to be included in the design of the relevant database. The Waikato water account could then be used to quantify and assess current water uses and to model future likely or plausible water uses.

The Waikato Integrated Scenario Explorer (WISE) model has the ability to include such water accounts. WISE is also an integrated and spatially-explicit model which means it includes a number of sub-models such as for population, the economy, climate, hydrology, water quality and land use. It can also simulate future scenarios over the next 30-50 years at a geographical scale of 1ha.

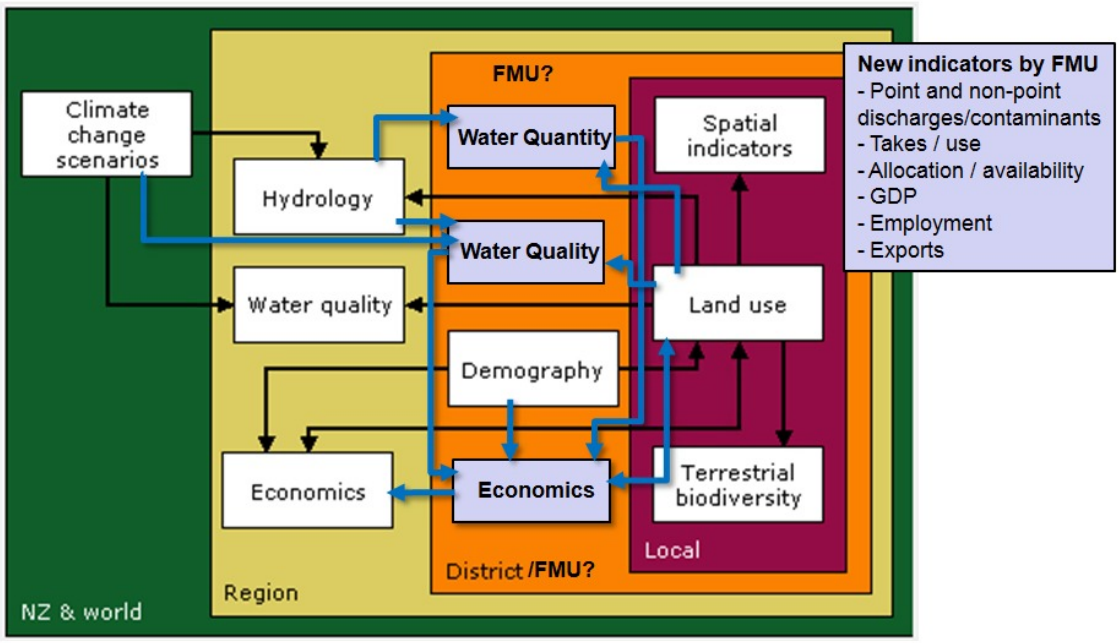


Figure 29: Schematic of WISE sub-models and connections required (in blue) to include water accounts

The WISE model is an example of a type of tool that demonstrates capability in exploring trade-offs but it does not yet have the capability to explore water economy trade-offs. The diagram above shows how WISE might look if it had that capability. It would rely on a water module being developed and existing and future information collected and organised (water accounts database) in such as way as to be accessible to the model.

The proposed water accounts database would need to be structured so as to allow geographic specific management and analysis that has the ability to be aggregated to a regional scale if required. In the first instance, this would require a decision (a priority) on the management scale to be used across the region into the future. It would also need to integrate elements of water quality and quantity, recognise groundwater and surface water interrelationships and be compatible to the land use, demographic and economic spatial databases already in the model.

Healthy Rivers/Wai Ora economic modelling approach

Healthy Rivers: Plan for Change/Wai Ora: He Rautaki Whakapaipai is a project to change the Waikato Regional Plan to set targets and limits for the Waikato and Waipa river catchments in respect of sediment, nutrients and bacterial discharges. To inform it, a modelling framework was developed that determines the least-cost combination of mitigation measures (land management, land use changes and point-source treatments) required to meet the water-quality attribute limits set for each scenario.

The modelling provides information for each water quality scenario about the best possible (i.e. least cost) package of changes to achieve the scenario, and the economic impacts of changes across catchments, sectors, and regional and national economies. Decision makers can use the information produced by the modelling to better understand the magnitude of changes associated with different water quality scenarios and the relative impacts, and weigh this up against other information about the benefits of improving water quality.

Information management and data implications

Information would need to be collected and organised to support:

- the development of a water accounts database that can be used for modelling future scenarios
- real time trading opportunities for allocable water
- monitoring the achievement of objectives, the state of the respective water resources in the region, and the efficiency and effectiveness of water management
- wider community and business access in a live, accurate and at a useful scale.

A thorough analysis of the data and information needs of each purpose listed above would be required to determine the design of data acquisition programmes and how the information should be organised. The spatial scale (of the extent of the freshwater management units) would be a consistent feature of the data acquisition and storage work, and hence would be a priority to be agreed – one of the first matters to be settled.

While transfers of allocation are allowed in the current system and the operative Waikato Regional Plan actively encourages this (see case study for the Waitoa Industrial Cluster), these need refinement. Also, a quick responsive system operating in real time should be available to current and potential water users. This would need appropriate software, which is currently available. But it would also need to be supported by appropriately designed and managed databases.

The many regional stakeholders with an interest in water have some understanding of the amount and condition of water as it affects their particular interests. Many actively invest in better understanding the resource though data collection and analysis to suit each particular need. There is a perception that this has created a variable understanding by different parties of the regional water resource, possibly at the cost of duplication.

It is expected that data collected now will be a fraction of what will be available in the future. New sources will allow mining the internet of things for data coming from sensors in the region and incorporated into the relevant databases. Providing quality assured, freely available data on the regional water resources will allow all interested parties to find out about the regional water conditions and potentially to develop innovative apps to allow them to manage their activities in a future flexible trading environment.

Information on the region's water resources will also be sourced from resource users, citizen science, iwi/hapū community, and come in a variety of forms and structures. Where possible, the integration of this information should be encouraged.

Rural citizens and business operators typically have an acute need to know and understand their water budgets. Leaks are usually found and fixed quickly. This is not always the case in an urban setting, as much of the infrastructure is underground and hidden. Ageing infrastructure means that the likelihood of leaks occurring and being undetected is increasing in many areas is increasing.

Figure 30: Leaking urban water connection discharging potable water to the stormwater system

Individual meters are the most accurate way of measuring water use and the integrity of the distribution system. As well as assisting with the understanding of use they also identify anomalies beyond typical use profiles and obvious indications of leaks – not all are as obvious as the example above.

According to Water NZ, the case for measurement of individual water use is compelling on environmental, economic and social equity grounds.[85] Benefits include but are not limited to:

- customers have an increased awareness of their water use and save money accordingly
- private leaks are managed and fixed promptly
- cutting peak demand
- the ability to defer investment in new treatment works and supply infrastructure in growth areas
- an improvement in asset and water use knowledge
- the community valuing water more.

Another benefit is the better understanding of the economic implications of water use as commercial use and industrial use can sometimes be masked if it occurs within an urban supply environment as opposed to a rural situation. This can confer a competitive advantage to the industry sourcing supply from a supplier with a priority allocation.

85 *Water NZ Policy Statement 2015: Water metering and volumetric charging on domestic dwellings*

Summary of key points

49. Regulations are the only class of policy instrument provided to regional councils under the current legislation to manage water use. They have the advantage of providing certainty to the user for the duration of the consent.

50. Regulations are exact mechanisms and are usually inflexible. Once an allocation is made it is difficult to transfer it to another user.

51. The current system of 'first in, first served' allocation has the potential to be unresponsive to new entrants regardless of the increased value (social, economic or environmental) they may bring.

52. Regulations have in the past been successful in managing abstractions from and point-source discharges to water bodies, but are not as effective for managing diffuse discharges emanating from land use changes and intensification of current land use.

53. New policy tools are required (incentives) to promote behaviour change with respect to land use decisions and seasonal timing of water use.

54. While transfers of allocation are possible (and encouraged) under the current system, the transfer mechanisms are 'clunky' and a quick responsive real time transfer system should be available.

55. Plan agility could be improved if allocation is not restricted to regulation (rules) alone and new instruments were available in a two-stage allocation process.

56. A new system is needed that will allow fresh water that's already allocated (either as an abstractive use or as assimilative capacity) to be moved around to meet the short term needs of users.

57. Policy tools (provision of information, regulations and incentives) need to work together for maximum effect. It is often ineffective and certainly inefficient if these are developed by different agencies.

58. Current policy/plan making processes are failing to keep pace with changes in the environment, technology and community expectations. Unresponsive plans regulations and decision processes themselves have the potential to become part of the problem, potentially contributing to adverse outcomes.

59. New policy tools will require new information and reorganisation of existing information (databases) to support modelling to determine the most appropriate mix of policy classes (provision of information, regulations and incentives).

60. Current data acquisition, analysis and storage systems have been designed to meet the needs of a regulatory management regime. This will need to change to support models able to make the connections with wider social and economic dimensions.

61. Future information systems will need to be designed to support:

    a. The development of a water accounts (database) that can be used for modelling future scenarios.
    b. Real time trading opportunities for allocable water.
    c. Monitoring the achievement of objectives, the state of the water resources of the region, and the efficiency and effectiveness of water management.
    d. Wider community and business access in a live, accurate and at a useful scale.

62. We need to decide on the appropriate spatial scales required for policy making, data acquisition, information management, modelling and applied actions. This will be key in determining freshwater management units for the remainder (outside the of the Te Ture Whaimana o Te Awa o Waikato – the Vision and Strategy for the Waikato River) of the region.

63. As a matter of priority settle on the number and spatial extent of Freshwater Management units across the region to allow development of water accounts within a robust and settled framework.

SECTION 8 Management options

Economic framework

When there is sufficient water to meet all current demands (including environmental 'demand') there is little need to worry about its efficient allocation because all the potential values of water can be achieved. Once limits are reached, different uses of water begin to compete with each other to be able to use it. The management of water resources then becomes a 'constrained optimisation' problem. That is, what is the best way for resource managers to ensure that water is allocated to its 'best' use, so that the welfare of society is maximised.

Initial allocation and 'best use'

Allocation of water resources in the Waikato region is currently determined under the Waikato Regional Plan according to some straightforward priorities. Firstly, environmental flows are provided for, and only the residual flows are *allocable* to other uses. Secondly, some types of allocation receive a higher priority (for example municipal takes receive priority over others). Beyond this priorities are determined on a 'first in, first served' basis. However, there is no reason why the 'first in, first served' allocation of water would result in the 'best' use of water.

The 'first in, first served' approach does not allow resource managers to evaluate the merits of competing uses (even if they did have adequate information to make just judgements). Because there is limited flexibility water allocations and use tend not to change much once allocated.[86] When water allocations are locked in for a period inefficiency will similarly be locked in and there is limited ability for a new entrant, or other user who could use the water more efficiently, to get access to the resource.

However, if water use is able to move around *after* it has been allocated then there is potential to achieve efficient overall use of water even with a 'first in, first served' approach.[87]

86 *Kieran Murray, Peter MacIntyre and Deborah Peterson, 2015. 'Towards more efficient use of freshwater resources in the Waikato Region'. Sapere Research Group.*

87 *It is noted, however, that this does not address any concerns there may be about the equity of initial allocations.*

Options to promote community/business action

Policy options

Resource management frameworks are often a combination of regulatory and market-based tools. Economic instruments provide an opportunity to not only achieve these objectives, but to reduce compliance costs and potentially the costs to the regulator.[88] These instruments comprise a group of policy tools that create an economic incentive, i.e. a price signal to conserve a resource that was previously undervalued or treated as free.[89] Resource managers can create incentives either by affecting the price signals resource users face, by constraining quantities,[90] or by introducing markets where there were none.[91]

Stand alone regulation usually requires all parties to comply regardless of their size, cost structures and location, so there are often no economic incentives to achieve a higher environmental standard than is required by the regulation. Economic instruments can introduce continuous incentives for environmental improvements – more so than traditional regulation.[92] These instruments are most effective when it is recognised that people face different cost structures and have different needs.[93] This allows the market to direct resources to where they are valued the most. The following section provides a brief description of key types of economic instruments.[94]

Taxes, fees and charges

Taxes and charges based on resource use may be used to create an economic incentive. Imposing an additional cost on resource users provides an incentive to adjust behaviour so that they use less of the resource. To achieve a particular limit the tax or charge is set at a rate that provides an incentive for resource users to reduce use to the point where they would be better off paying the tax rather than further reducing use. Those who get the greater value from water use will be able to use more before they reach this point.

A disadvantage of this approach is that the resource manager is unlikely to have good enough and current information to determine what level of tax is required so that there is an aggregate level of use equal to the limit. Also, because flows vary, the appropriate tax rate may vary from year to year (or even within a year). Frequent changes to tax rates to account for this is are likely to impose significant transaction costs. Nevertheless, there are numerous examples of volume-based charging for water having resulted in reductions of water use. A volume-based charge could be used in combination with quantitative limits (e.g. through RMA consenting processes).

Subsidies or payments for services

Subsidies, or positive incentives, involve rewarding those who achieve desirable outcomes or undertake desirable activities.[95] Subsidies can take many different forms such as regular payments, lump sum grants, loans, tax credits or rates remissions.

Tendering is used by natural resource management agencies to distribute public funds to private firms and individuals who engage in activities to improve the environment.[96] Under a tendering approach, contracts are awarded to those who bid the greatest amount of environmental improvement per dollar. This approach can be seen as payments for particular services, but where the market would not otherwise provide the required level of service, they can also be thought of as subsidies. Similarly, the use of auctions is one way of addressing the issue of the demand for public funding (subsidies) exceeding the available supply.[97]

88 *See Keenan and Mackay (2012), Economic instruments for water quality management. Waikato Regional Council Internal Series 2012/11, Waikato Regional Council.*

89 *Sinner J, Salmon G 2003. Creating economic incentives for sustainable development. Report to the New Zealand Business Council for Sustainable Development. Ecologic Foundation.*

90 *Hatton MacDonald D, Connor J, Morrison M 2004. Economic instruments for managing water quality in New Zealand. Final report for the New Zealand Ministry for the Environment. CSIRO Land and Water.*

91 *Denne T 2005. Economic instruments for the environment. Environment Waikato Technical Report 2006/23. Covec Limited.*

92 *Denne T 2005. Economic instruments for the environment. Environment Waikato Technical Report 2006/23. Covec Limited.*

93 *Sinner J, Salmon G 2003. Creating economic incentives for sustainable development. Report to the New Zealand Business Council for Sustainable Development. Ecologic Foundation.*

94 *For a more detailed discussion in respect of water quality objectives, see Keenan and Mackay (2012), Economic instruments for water quality management. Waikato Regional Council Internal Series 2012/11, Waikato Regional Council.*

95 *Denne T 2005. Economic instruments for the environment. Environment Waikato Technical Report 2006/23. Covec Limited.*

96 *Hatton MacDonald D, Connor J, Morrison M 2004. Economic instruments for managing water quality in New Zealand. Final report for the New Zealand Ministry for the Environment. CSIRO Land and Water.*

97 *Denne T 2005. Economic instruments for the environment. Environment Waikato Technical Report 2006/23. Covec Limited.*

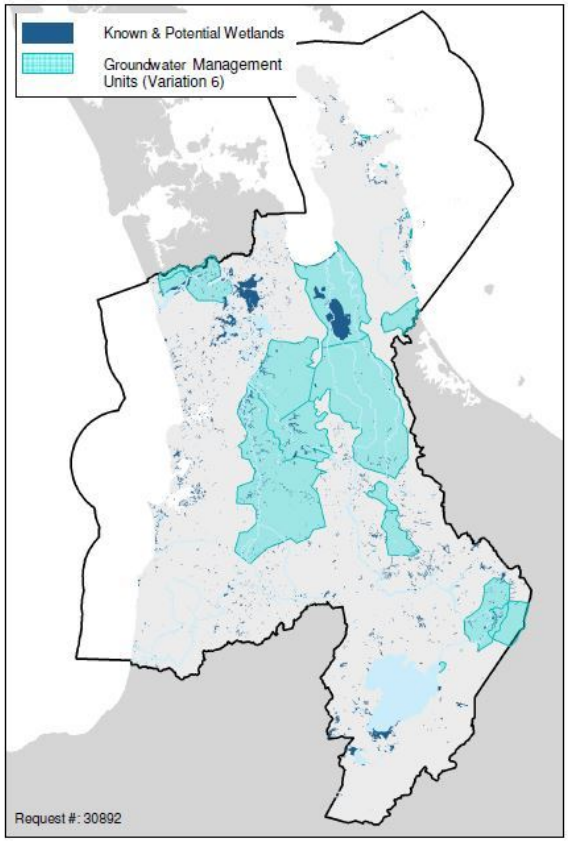


Figure 31: Potential locations for wetland creation/enhancement

It is noted that the regional council need not be the only funder of such activities. Interested groups such as environmental or philanthropic organisations may also seek to achieve their objectives by funding activities to improve water quality. Finding opportunities where the objectives of the council and other stakeholders align have the potential to enable greater improvements than any organisation could do on its own.

An example is the role Waikato Regional Council could play in identifying areas where it is willing to invest for land use change such as potential wetland sites for surface water flow support during low flow periods, as in figure 31.

Examples of these kinds of tools already exist in the Waikato region. For example, the Waipa Catchment Plan provides financial assistance for farmers to undertake soil conservation measures they would not undertake voluntarily. It is commonplace for councils to provide rates remissions for actions that contribute to particular goals.

Resource rentals or royalties

Another form of charge that is sometimes levied on resource users is a resource rental or royalty. These represent a means for government to appropriate a share of the return that private individuals or firms generate through the use of a public resource. In this sense, the primary focus of a resource rental/royalty regime would not typically be to change behaviour or address water quality management issues although it is noted that the funds generated by a royalty could be used to fund water quality management.

The design of a royalty regime should try to take account of externalities and in some circumstances may be able to achieve similar results to other forms of charges. Nevertheless, in principle, charges imposed for different purposes (e.g. generating revenue, obtaining a share of resource rents, or cost recovery) should be separated as far as is consistent with reasonable costs in order to ensure that each charge achieves its own intended purpose.

Royalty regimes in New Zealand currently relate primarily to minerals (under the Crown Minerals Act 1991) and coastal occupation (under the RMA). It is likely that new legislation would be required to enable a royalty regime to be established in respect of the use of fresh water as a waste sink.

Royalty regimes typically relate to the extractive use of resources and are generally set on the basis of:

- units used/extracted (e.g. a fee levied per unit of volume or weight)
- value (calculated as the royalty rate multiplied by the value of the resource extracted/used)
- profit or income (a charge proportional to the returns earned from using the resource).

Unit based royalties have the most direct impact on costs, and therefore production decisions, and are relatively cheap and easy to administer. In contrast, profit based royalties are better able to achieve allocative efficiency, but are typically complex and expensive to administer. In this context allocative efficiency is where resources are allocated to their highest value use and implies the least distorting effect on production decisions. However, if the purpose of the royalty is to affect behaviour to account for unpriced externalities (e.g. water quality outcomes) then the intention is to affect behaviour.

Prioritisation tools

If the council determines that it wishes to incentivise certain activities it will be important to establish processes for determining priorities. For example, it may wish to identify the best places for activities such as afforestation, wetland creation and the like. The Waipa Catchment Plan and the Waikato Lite projects are existing examples of such prioritisation exercises in respect of areas to be targeted to maximise soil conservation benefits.

The Waikato River Authority is also utilising a decision support tool called Inffer™ (the Investment Framework for Environmental Resources)[98], which incorporates a flexible form of cost-benefit analysis to inform priority setting. Similar methods can be adapted as circumstances require.

98 See http://www.inffer.com.au/

Tradeable permits

In general, a system of tradable permits works by permit holders who can get the 'best' value from water use buying permits, as required, from those with relatively low value potential uses. Hence, water is used where it is considered to be most valuable. More trades (and a more effective policy) will result where there are significant differences in cost structures across traders.

There is a great deal of flexibility in the potential design of trading schemes, including: Who is the market open to? Should trading ratios be adopted? What is the appropriate scale of the market? But the key point is that they should enable water to move to its 'best' use.

A permit can be for a fixed quantity or for a fixed proportion of a total allowable limit. In the latter case, the actual entitlement is determined at the beginning of each permit period. Having an entitlement to a proportion of a total limit adds some uncertainty to users, but shares the risk and gives flexibility to the governing body if new information or circumstances necessitate a change in the amount of the resource available. Currently, consents to take water are based on a proportion of low flows, whereas the Lake Taupō nitrogen discharge allowances are for a fixed quantity.

While catchments may be the most appropriate scale for a market, a well-functioning market may require specific legal authority, and regulatory capture by economically powerful interest groups may be more likely.[99] To facilitate market-based approaches changes to the RMA may be needed to:

- enable more clarity and measurability in the context of sustainable management
- strengthen the ability to enforce rules
- create a new avenue (other than the Environment Court) for the public to bring grievances against the market administrator for enforcement failures.[100]

A key advantage of using a market-based approach to allow water to move to its best use is that it reduces the need for the resource manager to obtain costly information to make judgements about the value of water in different uses. The water users, who best know the value water holds for them, reveal this information through their actions in the market.

99 *Greenhalgh S, Walker S, Lee B, Stephens T, Sinclair RJ 2010. Environmental markets for New Zealand: the barriers and opportunities. Landcare Research Science Series No. 40. Manaaki Whenua Press.*

100 *Ibid.*

Actions that could be taken now

Measurement to inform understanding and management

Water supply agencies could make water use information available to consumers. Where water is supplied to urban consumers, without measuring the actual use and providing feedback to consumers, it is difficult for those individuals to see the effects of their activities and to appreciate the impacts of their actions. Where individual water metering has been adopted by water supply agencies and the information received has been made available to consumers, the reduction in use has been dramatic.[101]

Local/water supply authority	Pre-metering	Post-metering	Percentage change
Tauranga City[102]	288 litres/person/day	216 litres/person/day	25%
Nelson City[103]	254 litres/person/day	160 litres/person/day	37%
Kapiti Coast[104]	590 litres/person/day	437 litres/person/day	25%
Central Otago[105]	34,620 m^3/day	26,930 m^3/day	22%

Table 8: Water use, pre/post metering

In Auckland a reduction of 19 per cent in per capita use was measured after the introduction of universal metering in 1988 to just before the 1994 drought.[106] The downward trend in per capita use was continued during the first part of this century following the introduction of volumetric charging in the late 1990s when per capita use dropped from around 320 to 274 litres per person per day.

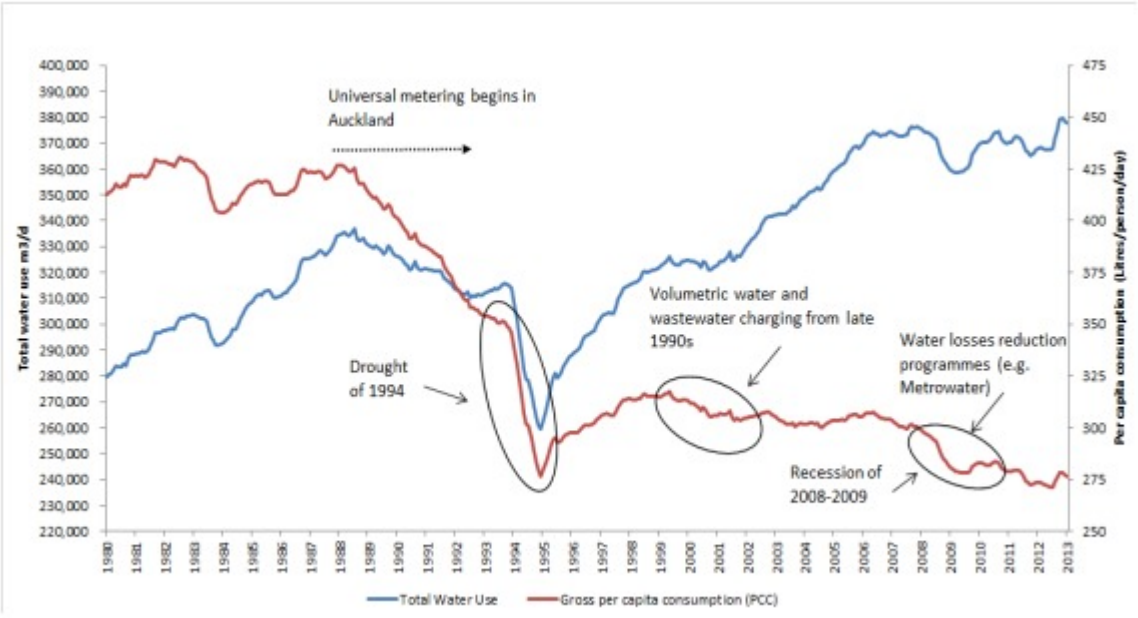


Figure 32: Auckland's historical water use. Ibid.

101 *NZ Water Position Statement on Water Metering and Volumetric Charging on Domestic Dwellings – September 2015*

102 *http://www.beaconpathway.co.nz/further-research/article/case_study_tauranga_city_council*

103 *http://www.beaconpathway.co.nz/further-research/article/case_study_nelson_city_council*

104 *Water New Zealand*
http://www.newsboost.com/newsroom/mediaportal-silvereye-communications/benefits-of-water-meters-spelled-out-at-water-new-zealand-conference

105 *The Value of Water - IPWEA Clyde Branch Meeting 2015*

106 *Watercare Auckland Regional Water Demand Management Plan 2013 - 2016*

Evolution towards a more efficient allocation mechanism

Sapere Research Group was commissioned to report on what a framework might look like that enables water to move to its 'best' uses.[107] Overall, Sapere argue that systems of transfer or exchange are the key to achieving an efficient allocation of resources. Noting that transfers are possible, to some extent, under the existing Waikato Regional Plan, Sapere consider that the council could achieve significant gains in the short to medium term by making greater use of existing RMA tools and by focusing on increasing the ease of transferring water between users once allocated. This would increase clarity and certainty of consents and how they are managed, and decrease transaction costs. The following extract from the report by Sapere provides further detail on these points.

"Ensuring that water permits can be transferred with as much freedom as possible, while still meeting the requirements of the RMA, would appear to provide a significant opportunity to improve the efficiency of water allocation in the short term. If Councils are acting too prescriptively and cautiously in their approach to facilitating transfers, compared to the risks such transfers may represent, they could be materially penalising regional economic activity.

Both the perception and the reality of difficulties in transferring water permits could be deterring water consent holders from transferring their permits. This is likely to be an issue, for example, where the regional plan rules signal that transfer applications are opportunities for the Council to reduce water takes to manage over allocation. Such rules are likely to cause permit holders to be cautious about applying for transfer because it could be viewed as signalling spare capacity that could be cut, either on processing their application, later as part of a catchment review, or on consent expiry.

Councils could address this by explicitly ruling out trimming consents when transfers are processed. They could instead seek to manage over allocation by catchment wide processes that seek to trim all consents proportionately to meet any new environmental flow limits that are set over time. This would improve the clarity, certainty and economic value of water permits and foster transferability which should provide greater access to water for new activities in over allocated catchments over time.

This approach would strengthen the security and exclusivity of consents, and effectively result in a similar situation to where the right to use water is defined as shares of the available resource, as advocated in the literature on economically efficient water allocation schemes. In such circumstances, the quantum of available resource can be reset if needed – for example, for environmental purposes (as occurs with fisheries quota management), resulting in predictable and equitable reductions to water available for use by individual consent holders.

There may also be opportunities to widen the range of permitted transfers. The requirement for both transfers to a new site that involve ground water, and transfers drawing from downstream tributaries, to go through a restricted discretionary procedure, could be examined to see whether the benefits of wider opportunities to transfer might outweigh any environmental costs or risks. Such investigation should take into consideration the impact on the security and value of consented water.

Greater use of catchment groups with voluntary agreements between water users and global consents is another measure by which transfer of water could potentially be improved. This approach can help to better allocate water to its highest value by allowing these groups to develop water exchange processes themselves through private negotiation.

Such approaches could include investigation of using more permissive rules for those within global consents to provide incentives to consent holders to join such groups. These could be designed to result in an overall improvement in managing flows as they approach minimum levels. It is also conceivable that such approaches could be expanded to include other uses such as municipal supplies. However, this may require amendment of the RMA. Such processes could potentially result in more flexible reallocation of water than is possible using existing regulatory methods.

Councils may be able to further simplify and facilitate transfers by ensuring that use and take are fully separated in all resource consenting processes. This would improve the clarity and transferability of water permits. However, this would require scrutiny of all water management methods (such as dealing with over allocation) where the method requires knowledge of the use.

Other measures to improve the number of transfers could be further education and information, reducing the frequency of reviews and allowing longer consent periods, particularly where the economic life of water infrastructure is greater than the duration of resource consents. These measures could help encourage investment over the long term and build clarity and security of water permits.

Councils could also look to free up the ability to transfer takes involving harvesting surface water between holders of consents e.g. hydro operators at times of very high flow, who currently have priority, and allowing farmers to harvest surface water during this period.

Greater transferability of water permits would reduce the opportunity to profit from 'hoarding' or holding unused or rarely used permits. More transfers would give more competitive options to access water for new activities. This should improve security for consent holders and increase options for new entrants. For example, where there is only one existing consent holder willing to transfer in a catchment, that holder would have a much stronger bargaining position than if there were three or more existing consent holders willing to transfer. A

107 *Murray et al, 2015, p2. Framework. Report by Sapere Research Limited for Waikato Regional Council.*

greater number of potential transfers erode dominance by one or a small number of consent holders and make it easier to establish an exchange price.

Volumetric charging could potentially improve the efficiency of water use in the Waikato's main urban areas. Water savings achieved could improve environmental outcomes and/or used for different priorities during times of reduced water availability.

Councils could also help to increase consent transfers by reducing asymmetric information, transaction costs and search and bargaining frictions. Asymmetric information could be addressed by ensuring that both existing consent holders and potential transferees are well apprised of the opportunity to transfer. This would be assisted by ensuring that the time and effort required to find a prospective counterparty, establish a price and conditions and other necessary charges are not unnecessarily high.

There may be opportunities to further harmonise the approach to water allocation across different regional council boundaries to reduce regulatory costs. This would be particularly important with neighbouring regional councils."[108]

108 *Kieran Murray, Peter MacIntyre and Deborah Peterson, 2015. 'Towards more efficient use of freshwater resources in the Waikato Region'. Sapere Research Group.*

Water objectives as a co-benefit

In order to address the impacts of unintended consequences on the region's water resources and therefore the achievement of economic, social and cultural objectives, a thorough and current understanding of the links between fresh water and the region's wider goals is needed. One way of achieving this is to model the impact of central government policy proposals and to advocate either in support of these or for change should the proposals be antagonistic to regional fresh water objectives.

Experience has shown the exposure of fresh water resources to the unintended consequences of central government economic policy (see case study in section 6 of this report). It would be prudent to recognise the potential impacts of non-water related policy decisions and develop evidential methods to quantify these. Where possible, investments should also be directed into areas that have positive outcomes for the achievement of regional water management objectives and targets.

Active engagement and support for policy instruments that will support regional water management co-benefits would multiply the leverage for behavioural changes. Experience in the Lake Taupō catchment has shown that the rapid achievement of policy goals was achieved by the synergies of the high price on carbon under the original New Zealand Emissions Trading Scheme settings and a market for nitrogen supported by regional rules for other activities.

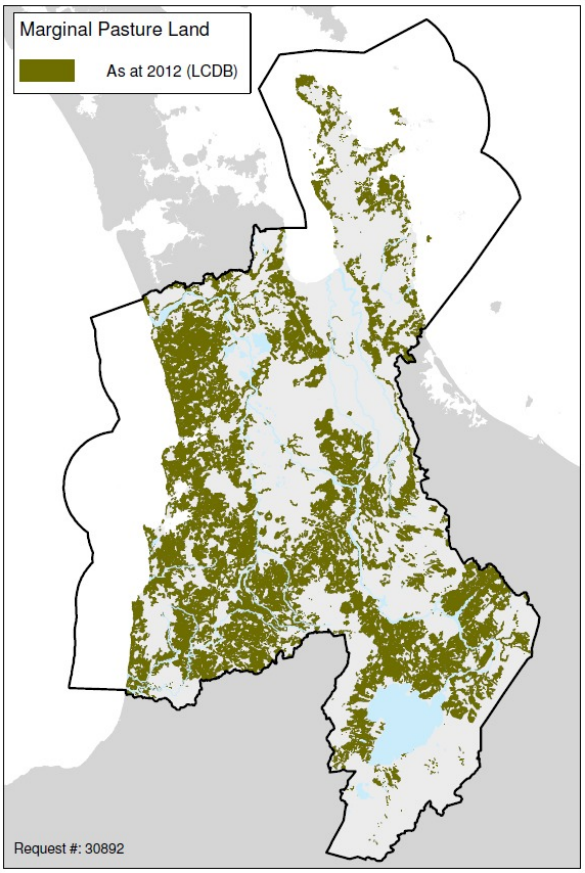


Figure 33 : Marginal land in pasture in 2012

Figure 33 shows the location of 523,000ha of marginal land[109] in the Waikato region that was in pasture in 1990.[110] The inference is that much of this land would not have been cleared and farmed were it not for central government loans and subsidies.

There are multiple effects of land use change from forest cover to pasture in marginal land areas:

- The first is the impact on water quality where catchment security is diminished and resulting soil erosion releases sediment into headwaters and then into river systems during storm events. Coupled with this are the effects of adsorbed contaminants.
- The pastoral land use enabled by the clearance creates the need for downstream flows to assimilate the effects of mobile nutrient contaminants.
- Forest clearance will increase the annual catchment yield and at first this might seem a good thing to assimilate the increase in nutrients, but the increase comes during storm events and high flows, adding to flood peaks. This creates a more actively responsive catchment with little buffering capacity to release water during times of stress.

109 *Land Use Capability (LUC) classes 6e, 7 & 8.*

110 *Based on LCDB 4.1*

Modelling the range and location of catchment responses to afforestation opportunities – for instance in response to an economic instrument that seeks to incentivise the creation of forest sinks – will assist the achievement of water management outcomes by directing investment to areas with the greatest benefit. This will require quality models supported by reliable and up to date information. The areas identified in figure 33 are a basic representation of this – areas with afforestation potential for carbon forestry while at the same time reducing effects on water quality.

Modelling will allow the consideration of mixed catchment land use beyond the uses of today.

It is not a certainty that current industries and land uses will prevail into the future as other land uses become potentially more viable. It is only through knowledge of the nutrient and water requirements of alternative land uses that an understanding of regional impacts (all dimensions) can be gained. For instance, land uses that are tolerant of projected meteorological conditions may be more profitable than a perpetuation of existing uses with high water demands that require expensive solutions e.g. water storage to mimic current conditions.

For this reason, regional water management policy should not 'lock-in' current uses at the expense of flexibility to meet future opportunities. Examples of future land uses with less water demand that could contribute to regional wellbeing alongside carbon farming could be manuka honey or alternative pastoral species such as dairy goats or alternative fibre crops like hemp.

The modelling would need to include a full life cycle analysis to determine the complete picture.

Environmental engineering opportunities

This section considers options for addressing the policy failures identified in the previous sections of this summary.

It is clear that the condition of the region's water resources is deteriorating and that along with increasing demand for services provided by fresh waters, the legacy of existing and locked in land uses and the projected changes in distribution of rainfall in future years means a shift in management emphasis is required.

The traditional approach has been to incrementally make changes to the current regulatory system. This has had the effect of adding more complexity to the creation of plans to the extent that it has the potential to be counterproductive, with more costs and delays making the system less responsive to changes and adding to the problem. Unfortunately, this is the intended track of the current resource management reforms, supported by an incrementalist approach which is also evident in the recent recommendations of the Land and Water Forum in its November 2015 report.

Policy instruments that make the value of water to the region more transparent would also promote engineering solutions to its storage, protection, enhancement and use. Funding of environmental engineering activities could be achieved through the creation of a hypothecated fund from charges on the effects of activities (volumetric charging and strength of effluent charging). For instance, the enhancement of what would have been natural processes to offset the effects of past and current land and water use. The most obvious example is the construction of storage, but it is not immediately apparent at what scale or spatially where in the region this may occur.

Storage

The potential for enhanced storage exists across the region with some areas having more potential than others. There are five types of storage:

- enhancement of natural wetlands and lakes
- artificial created wetlands
- dams (property or utility scale)
- tanks
- groundwater recharge.

Storage allows water to be harvested during times of plenty for use during times of scarcity when the region's water bodies need a minimum flow of water to assimilate the effects of discharges entering as leachate from catchment land use and from direct discharges. This offsets the loss of natural infrastructure such as wetlands in moderating surface flows.

The water allocation module in the current Waikato Regional Plan recognises the benefits of creating property scale water storage and in an effort to encourage this practice has reduced regulation of this activity to a minimum. It has done this by creating a permitted activity for small dams that are less than three metres high and have a storage volume of less than 20,000m^3.

The lower Waikato catchment has been identified over the years as a potential site for additional storage and it must be noted that there are already two large water storage lakes in the north of the region in the lower Waikato river catchment. These are the Mangatangi and Mangatawhiri dams – the two largest water supply dams supplying Auckland (see section 6 of this report).

Waikato Regional Council owns and manages several detention dams within the region. These dams were designed for flood retention and attenuation of flood flows, thereby reducing the peak height of the floods downstream. The dams are operative for short periods of time (high flow events) and are idle most of the year retaining small volumes of water as ponds.

There have been increasing calls from the surrounding community for the regional council to consider using the dams for water storage and irrigation, as demand on water increases. This is in response to increasingly longer, dry summer seasons and higher rainfall in winter. This pattern is projected to continue under current climate change projections.

As the water resource becomes scarce and demand increases multiple uses of dams is becoming more important nationally and internationally.[111] The Waikato region already has a number of multiple use dams on the Waikato River, primarily for hydroelectricity generation. These dams also provide a limited phasing of flood peaks and are important sporting and recreational assets. There are also single purpose dams for water supply[112] and flood protection in the lower Waikato River catchment and Hauraki Plains.

Over the last three years there has been increasing interest from the regional community in relation to using Lake Waikare for flood protection, environmental improvement, recreation storage and irrigation of the surrounding farmland.[113] A

111 http://agriwaterpedia.info/wiki/Multi-purpose_dams

112 *Mangatangi and Mangatawhiri Dams in the Lower Waikato River catchment*

113 *The W2O Trust has been invited to work with stakeholders around the Lake to explore options for a comprehensive scheme where the interests of other stakeholders are also accommodated.*

stakeholder group is currently preparing a catchment management plan for the Waikare and Whangamarino catchment.

Apart from hydroelectricity use, most notably on the Waikato River, dams are infrequently used for community water supplies[114] and there has been no systematic investigation as to the applicability of water storage for irrigation in the remainder of the region.

The Lake Taupō outlet is controlled, and the flow into the Waikato River actively managed, within a 1.4m lake level range (between 355.85m above sea level and 357.25m above sea level) to optimise the profitability of hydroelectric generation[115] from dams along the Waikato River. The storage in Lake Taupō is vast[116] and there is potential that a small change to the lake operation may address some of that catchment's water allocation issues. This could be by enabling additional uses along the Waikato River and at times of scarcity the chance of achieving mandated water quality objectives from the Te Ture Whaimana o Te Awa o Waikato – the Vision and Strategy for the Waikato River.

Storage at a property scale would be a rational response to a price on water and would promote harvesting during times of plenty for use during times of scarcity in either a rural or an urban setting, as long as the price signal was passed onto users.

Physical alteration of waterways

The capacity for flowing waterways to assimilate the effects of land use and of direct discharges can be enhanced with the construction of passive structures that mimic the action of riffles in flowing waters. This would have the benefit of promoting natural aeration of water and maintain their ecological health.

Waterways could be shaded either artificially or more typically with riparian planting to keep them cool and would mitigate the effect of projected temperature increases. This would increase the amount of dissolved gases (particularly oxygen) in the water and assist in the assimilating the effects of land use and of direct discharges.

Rafts of floating artificial wetlands could be deployed on the surface of lakes where it is not practicable to plant fringing wetlands. These are being developed to remove nutrients from natural lakes and may also be deployed on artificial treatment ponds to reduce the strength of discharges.

Figure 34 : Demonstration floating wetland, Baltimore Harbour

The deployment of active or powered structures and devices to provide aeration would mean that less volume is required to assimilate loads of upstream land uses at times of summer stress. This would be an expensive and potentially energy intensive approach and would require maintenance. The design, construction and deployment of active mechanisms would need to have a well supported business case.

Other opportunities

A higher standard of discharge may be required when receiving water bodies are too hot or too small to be able to assimilate the effects of land use and direct discharges.

114 *Morrinsville township is partly supplied by a dam on the Topehaehae stream*

115 *Resource Consent condition 2.1: "The consent holder may at any time operate the Taupo gates to manage the level of Lake Taupō, for the purpose of water storage for hydro electricity generation"*

116 *The entire storage available from Watercare's two biggest Hunua dams combined (Mangatangi and Mangatawhiri) is equal to 83mm change in the level of lake Taupō.*

Choosing a policy instrument

The choice of a policy tool depends on the particular circumstances of the issue that is being addressed. For example, if the aim is to provide an incentive for someone to do something (or stop doing something) then both a subsidy and a tax could provide such an incentive. If the person is creating a public benefit then providing a subsidy may be appropriate. If they are imposing costs on others through their actions then a tax might be the tool to choose.[117]

Property rights also have a bearing on the appropriate policy tool. Work by Sapere Research Group[118],[119] suggests that well-specified property rights are fundamental to the efficient use of water. For example, if someone has the 'right' to take and use water the wider community may be obliged to compensate them if it wishes to reallocate that water. If water is considered to be a 'public resource' it may be argued that private individuals or businesses who make a profit from its use should pay for its use (for example through payment of a volumetric charge or royalty to iwi, Crown or 'the community').

These are just a few hypothetical examples of the issues that need to be considered when making choices about policy instruments. Ideally, a structured and systematic approach should be taken to policy choice. One example is that of the *Policy Choice Framework*[120] which provides a series of decision trees that help policymakers clearly determine the nature of the problem and come up with rational and consistent choices for policies to address it.

So the choice of a policy tool may not be a simple exercise – it is likely to be a situation of 'horses for courses'. Being able to choose the right horse (i.e. policy tool), depends on it being available under current institutional and legislative arrangements.

117 *It should be noted that, while taxes and subsidies can provide the same sort of incentive to individuals, the aggregate effect of these tools might be very different, so careful analysis of the implications is required.*

118 *Kieran Murray, Peter MacIntyre and Deborah Peterson, 2015. ' Towards more efficient use of freshwater resources in the Waikato Region'. Draft report by Sapere Research Group.*

119 *Deborah Peterson and Kieran Murray, 2015. 'Review of selected literature on water allocation'. Draft report by Sapere Research Group.*

120 *Geoff Kaine, 2015 ' A Primer on the Policy Choice Framework'. Geoff Kaine Research.*

Summary of key points

64. The present central government approach of incremental changes to the current regulatory system has resulted in more complexity for plan development and increasing costs for policy and plan preparation decision making and often implementation as well.

65. Market-based instruments can provide a useful complement to regulation to achieve objectives cost-effectively.

66. Economic instruments such as taxes and subsidies that increase or decrease the cost of particular things can provide important incentives to encourage desirable actions or discourage undesirable actions.

67. Systems that enable water to move to its 'best' use are the key to achieving efficient allocation of the resource.

56. Within existing frameworks there may be scope to improve the ease with which water can be transferred (once initially allocated), increase the clarity and certainty of resource consents, and decrease transactions costs.

57. It is important to continue support for efforts to reduce the time and costs of policy and plan making that will contribute to increased plan agility.

58. We need to develop a water accounts database and organise current and future water related information to match it.

59. We need to actively explore opportunities for environmental engineering solutions to existing and emerging water management issues such as storage, wetland construction, instream structures to mitigate the effects of historic use and the projected change in meteorological conditions.

SECTION 9 Next steps

Next steps

The recommended activities identified in the following lists are very preliminary and have yet to be scoped out fully or prioritised against other council commitments. Recommendations are targeted towards Waikato Regional Council and other parties with an interest in fresh water management. This reflects the statutory role of the regional council under the RMA and the Waikato Regional Council's strategic intent of 'working with others' among other things to achieve agreed fresh water objectives.

Recommended work programme for Waikato Regional Council

Advocacy

1. Advocate to central government agencies, ministers and to political parties for reform of the RMA to include an alternative mechanism to the 'first in, first served' approach for initial allocation of fresh water.

2. Advocate to central government agencies, ministers and to political parties for reform (better alignment) of the RMA and/or the Local Government Act to allow the recoupment of fresh water monitoring costs in cross boundary situations. Currently the Local Government Act does not allow the recoupment to include cross-boundary charging. Additionally, the Local Government Act has a sustainable development focus compared to the sustainable management focus of the RMA.

3. Advocate to central government agencies, ministers and to political parties for reform of the RMA to include the ability to use economic instruments for the management of fresh water resources. Reform is required to allow differential charging for volume of water taken and strength of discharges (either point source or diffuse) as this requires an instream assimilative allocation. Economic instruments are required for example to:

    a. provide recognition and financial benefit to those landowners who positively contribute to the seasonal base flow of surface water bodies and the recharge of groundwater aquifers through land use change

    b. incentivise future land use change that positively contributes to seasonal base flow of surface waters and to the recharge of groundwater aquifers

    c. incentivise the taking of water during times of plenty for use in times of scarcity

    d. incentivise the surrender of water allocations during times of scarcity

    e. incentivise the efficient use of water that is taken from either surface water or ground water aquifers.

4. Support the establishment of a National Freshwater Centre of Research Excellence in the Waikato region to provide a multi-disciplinary approach to fresh water management.

5. Seek recognition of the value for, and development of a consistent methodology for, determining the embodied contribution of fresh water in products and services (water footprinting) so as to better understand and quantify the strategic value of the fresh water resource to the region and nation.

6. Continue to work within the regional sector seeking efficient (less resource intensive and cheaper) policy and plan making processes to increase plan agility and responsiveness.

Policy/decision making

7. As a matter of priority develop criteria for identifying freshwater management units of appropriate scale and location to integrate water quality and quantity elements. This should recognise appropriate social and economic spatial units as well as including surface water and groundwater interactions to support water accounts modelling and the regional plan review.

8. Acknowledge the effort of regional parties to the Healthy Rivers/Wai Ora process and progress to a conclusion as part of the review of the Waikato Regional Plan. Recognise the Healthy Rivers/Wai Ora engagement process in the determination of freshwater management units for the Waikato and Waipa river catchments.

9. Decide on the number and location of the region's freshwater management units and design data/information systems to allow fresh water modelling and determine the appropriate freshwater management units for the remainder of the region.

10. Review international examples and establish the market parameters needed (regulatory envelop including checks and balances) and establish the data requirements to support a real time trading market.

11. Ensure that any fresh water trading framework is developed within an understanding of, and provides a benefit towards, iwi rights and interests for fresh water.

12. Recognise the certainty provided by the Te Ture Whaimana o Te Awa o Waikato – the Vision and Strategy for the Waikato River in establishing water quality objectives by using it as a starting point for fresh water objectives in the Waikato Regional Plan review for the reminder of the region. This must recognise the potential for future Treaty of Waitangi settlement processes to modify this.

Information management

13. Continue existing programmes to refine the technical and spatial understanding of surface water and groundwater linkages and interactions to determine the best source for allocation. This requires recognition and understanding of regional variability e.g. differences in responses in karst, peat, pumice and other geologies.

14. Clarify the hydrological role protecting and restoring seepages and small and ephemeral wetland ecosystems may play in sustaining adequate water quantity for all in the Waikato region.

15. Continue and accelerate programmed data acquisition to implement water allocation and water quality provisions of the Waikato Regional Plan.

16. As part of the development of a corporate science plan regionally identify all current and programmed water related science and research activities and determine the gaps in relation to:

    a. current requirements for state of the environment and efficiency and effectiveness of plans

    b. future modelling and trading requirements.

17. Undertake an analysis (potentially through support of targeted academic research) of the regional water footprint to allow an understanding of the contribution of Waikato water to:

    a. the Auckland economy

    b. national exports.

18. Proceed with developing environmental accounts in collaboration with Statistics NZ and the Ministry for the Environment with a priority to construct a regional account database. The water accounts database should be designed to enable integration with spatial integrated modelling (e.g. WISE) to link the water accounts database to locations (regional catchments, freshwater management units, aquifers etc.) and to water demand (population, economy) and efficiency (water use by sector or outputs, such as milk solids or per capita municipal use).

19. Make information available to the public about the state of, and pressures on, fresh water in the region, and of implications for communities meeting desired social and economic outcomes so that everyone can help be part of the change that is needed.

Modelling

20. Refine regional understanding of catchment scale, seasonal fresh water yields under IPCC climate scenarios, particularly for drought projections.

21. Develop a set of water accounts to enable the interactions between water use and economic indicators to be modelled.

22. WISE: Identify useful scenarios of plausible future water availability and use against reference scenarios (how much/where/when) looking at land use change, demographics, industrial/commercial development and climate change. This also needs to be aligned (and be not inconsistent with) any other Waikato Regional Council modelling work, including but not limited to Healthy Rivers/Wai Ora.

Applied solutions

23. Actively seek opportunities for environmental engineering options to assist the region's surface waters to respond to future meteorological conditions, increased primary demand and the legacy effects of current and historic land use. This could extend to the identification of potential fresh water storage locations.

24. Work with interested and affected parties including but not limited to: Ngāti Tuwharetoa, Mighty River Power and Taupō District Council to understand the scope for using Lake Taupō as a natural reservoir to integrate projected enhanced rainfall and as base flow support for the Waikato system to achieve Vision and Strategy objectives.

25. Once consistent methodology has been determined ensure all components of the regional water footprint of products and services are included in catchment water related decision making.

Recommended actions for other parties

1. Research institutes, the University of Waikato, Waikato Regional Council and iwi should support the establishment of a National Freshwater Institute (Centre of Research Excellence) in the Waikato to provide a multi-disciplinary approach to water management.

2. Regional parties interested in the achievement of agreed fresh water outcomes should be encouraged to establish a common fresh water database and contribute to its governance. For maximum effect, the regional fresh water database should be transparent, freely available, and live with accurate quality assured information.

3. All fresh water users that collect data on fresh water resources are encouraged to contribute to a common fresh water database.

4. Citizens, marae, schools and community groups, including landcare groups, should feel encouraged to contribute knowledge and information (volunteer monitoring) about the fresh water resources in their locality/rohe. In so doing this will add to the transparent and freely available knowledge of the region's water resources.

5. Research institutes, schools, marae, community groups and industry are encouraged to develop applications that use available fresh water information to help achieve agreed regional fresh water objectives.

SECTION 10 Appendices

Appendix 1

Regional Policy Statement

Freshwater related Objectives from the second generation Regional Policy Statement.[121]

"Objective 3.3 Health and wellbeing of the Waikato River

The health and wellbeing of the Waikato River is restored and protected and Te Ture Whaimana o Te Awa o Waikato (the Vision and Strategy for the Waikato River) is achieved.

Objective 3.13 Mauri and health of fresh water bodies

Recognise and provide for the mauri and health of **fresh water bodies** by:

a) maintaining the following:

i) natural character and natural function, including flow regime variability;

ii) health and functioning of indigenous biodiversity, ecosystems and habitats;

iia) human relationships with fresh water including:

i. the cultural and traditional relationship of tāngata whenua with fresh water;

ii. availability and suitability of water for domestic or municipal supply;

iii. harvesting of aquatic food species and **mahinga kai** that is safe to eat; and

iv. recreation values including swimming;

b) improving the life supporting capacity of fresh water bodies where they have been degraded as a result of human activities, with demonstrable progress made by 2030; and

c) ensuring that high value fresh water bodies are protected;

d) enabling people and communities to provide for their social, economic and cultural wellbeing and for their health and safety; and

e) managing adverse cumulative effects of land use activities on fresh water bodies.

Objective 3.14 Allocation and use of fresh water

The allocation and use of fresh water is managed to:

a) avoid any new over-allocation of ground and surface waters;

aa) phase out any existing over-allocation of ground and surface water bodies by 31 December 2030;

b) [Deleted]

c) increase efficiency in the allocation and use of

Objective 3.15 Riparian areas and wetlands

The extent and quality of riparian areas (including coastal dunes) and wetlands is increased and these areas are managed to maintain and enhance the following:

a) public access;

b) natural character;

c) amenity values;

d) water quality;

e) indigenous biodiversity;

f) natural hazard risk reduction;

g) cultural values; and

h) riparian habitat quality."

121 *2012 Decisions version http://www.waikatoregion.govt.nz/Council/Policy-and-plans/Regional-Policy-Statement/Regional-Policy-Statement-Review/*

Appendix 2

Waikato Regional Plan: Water allocation

The operative Waikato Regional Plan is an all of region, all resource regional plan above mean high water spring tide level. That is, it covers the entire Waikato region above that part deemed to be part of the coastal marine area. It is modular in design with the relevant water module for water allocation colloquially known as Variation 6: Water Allocation[122] being proposed in 2006 and became operative in 2012. The policy was designed to achieve the following objectives:

- The Variation gives effect to the Vision and Strategy to restore and protect the health and wellbeing of the Waikato River.
- Seeking to ensure the availability of reasonably justified domestic or municipal supply.
- Ensure the efficient allocation and the efficient use of water in line with the objectives of the National Policy Statement for Freshwater Management.
- Protection of water used for the generation of electricity from renewable energy resources. In terms of the hydro dams on the Waikato River, the water for these dams is included in the minimum flow. Dams on other rivers, e.g. King Country Energy dams on the Mokau River, there are resource consents for a set amount of water, for the take, dam, diversion and discharge of water.
- We are seeking to protect the water take for cooling water for Huntly Power Station (HPS). HPS is an important part of New Zealand's energy infrastructure and as such Waikato Regional Council is seeking to ensure the continued operation of this facility through the provision of water for cooling.
- The Variation recognises the importance of existing takes to social and economic wellbeing, and these takes are specifically provided in the Variation.
- Seeking to ensure sufficient water is retained, through the setting of minimum flows, to safeguard the life supporting capacity of water bodies.
- Ensuring that allocation decisions avoid further degradation of water quality.
- The Variation sets allocation limits and minimum flows.
- Protects aquatic life while providing for human use.
- Recognises the importance of the availability of water to meet future social, economic and cultural needs of individuals and communities.

Allocation limits

For surface waters, the Variation sets allocation limits for all rivers in the region. This includes setting minimum flows where takes either cease or are restricted when it is reached and providing for the allocation of water above this minimum. The allocation of water is provided for in three tiers/bands. These are referred to as the primary and secondary allocable flows (listed in table 3-5) and water harvesting flows. Figure 35 provides a diagrammatical illustration of these limits.

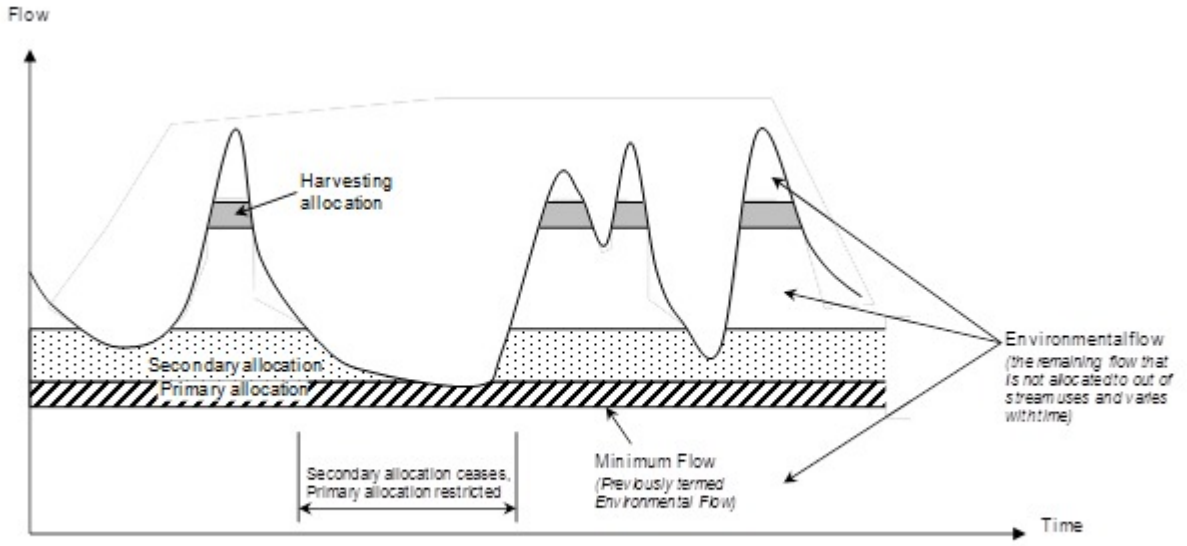


Figure 35: Diagram of hydrograph and were minimum flows, primary and secondary flows and water harvesting flows fit within it.

122 http://www.waikatoregion.govt.nz/Council/Policy-and-plans/Rules-and-regulation/Regional-Plan/Waikato-Regional-Plan/

Waikato Regional Council uses the Q_5 statistic to determine allocable and minimum flows. The Q_5 is the stream flow at any point that has a 20 per cent chance of occurring in any one year. It is calculated from the lowest seven consecutive days of flow in each year.

The primary allocable flow is the difference between the minimum flow and the Q_5 flow which means that on average there will be enough water to meet all of the instream and out-of-stream requirements (within the primary allocation) four years out of every five. Conversely, on average once in every five years is it likely that restrictions on the primary allocable flow would be required to minimise degradation of the minimum flow. This means that in those years abstractions are restricted when the minimum flows are reached in the respective rivers.

The secondary allocable flow is additional to the primary allocable flow, but in combination with the primary allocable flow is equivalent to 30 per cent of the Q_5 flow. For example, if the primary allocable flow was 20 per cent of Q_5 the secondary allocable flow would then be 10 per cent of Q_5. In some catchments the secondary allocable flow is not provided for. In particular, this includes the Waikato River main stem from Lake Taupō to the mouth.

The "environmental flow" in figure 1 is the combination of the minimum flow and that flow that remains instream and provides for sediment transport, natural flushing and flood flows, ecology etc.

Compared to the primary allocable flow which has a staged reduction in abstraction when minimum flows are reached (as per Standard 3.3.4.21), abstraction from the secondary allocable flow ceases completely when the minimum flows in table 3-5 are reached as provided in 3.3.4.21 part a)i).

A band of surface water is available for allocation at higher flows that is in addition to both the primary and secondary allocable flows. This water is available when flows exceed the median flow in the river. This will usually be during the winter months when river flows are typically at their highest. If this water is required for a summer use, the abstractor will require some method of storage.

The amount of water that can be taken for water harvesting is restricted to 10 per cent of the flow in the river at the time. The 10 per cent threshold for abstraction is to ensure only minor modification of the flows, especially if it is taken at the same time as the primary and secondary allocations.

The secondary allocable flow and 'surface water harvesting' provisions do not apply to the Waikato River above the Karapiro Dam as the taking beyond the primary allocable flow in table 3-5 deprives hydroelectricity generation dams of valuable water, which is their only form of fuel.

When establishing or reviewing the primary and secondary allocable flows a number of matters are considered including:

- the Vision and Strategy
- water quality
- flow regime variability
- generation of electricity from renewable energy resources
- the benefits of existing and future takes
- the life supporting capacity of ecosystems
- climate change.

The limit for the Waikato River at Karapiro Dam has been set to protect the level of existing hydroelectricity generation from the dams. Any changes to the limits or any new limits will be added to the plan in consultation with all stakeholders using the RMA First Schedule process.

Initial and replacement allocation

When water is available in either the primary or secondary allocable flows, consents are granted on a 'first in, first served' basis. The consent status (controlled, restricted discretionary, discretionary) will depend on the level of allocation from the water body. The more allocated from a water body the more stringent the consent status.

In those situations where the combined primary and secondary flows are fully allocated new applications for takes will generally be declined. The only exceptions to this are new takes for domestic or municipal supply or for stock water, which are discretionary activities in these circumstances. Other existing takes, including large industrial takes, will be granted replacement consents provided the application is received by the start of 2015 and there is no increase in the amount applied for.

Previously unauthorised existing takes for the purposes of dairy shed wash down and milk cooling are a controlled activity provided an application is received by the beginning of 2015. Council has put in place an implementation programme to ensure that all previously unauthorised takes for this activity obtain resource consent. This water has been provided for in this manner because it is already accounted for in the calculations of the primary and secondary flows and is essential for the ongoing operation of the dairy industry in the Waikato region.

Many of the catchments in the Waikato region are at or nearing full allocation. For example, the Waikato River catchment above Karapiro Dam is fully allocated; when the impacts of recent resource consent applications are added. This means that generally there is no more surface water to be allocated for activities such as pasture irrigation.

Domestic or municipal supply

Variation 6 provides a favourable consent regime for takes for domestic or municipal supply. In legislation Parliament has made clear that a water supply is an essential public good and that local authorities have an overriding obligation to plan for, protect, and to continue to provide high quality water services.

In order for domestic or municipal supply takes to have a favourable activity status the applicant must prepare and present a Water Management Plan (WMP) with an application

for resource consent. If a WMP is not provided, the application will be assessed as a non-complying activity irrespective of the level of allocation from the water body.

WMPs are intended to establish a long term strategy for the water requirements of domestic or municipal water supplier and their communities. It must demonstrate that the volume of water required, including any increase over that previously authorised, has been justified and that the water take will be used efficiently and effectively.

All existing takes for domestic or municipal supply will be treated as controlled activities irrespective of the level of allocation. All new applications will be processed depending on the level of allocation from the water body. However, the most stringent activity status that a take for domestic or municipal supply can have is discretionary activity, provided a WMP is included.

Groundwater allocation

Variation 6 has established a framework for the allocation of groundwater resources. The allocation regime for groundwater is more conservative than the allocation of surface water and this reflects the relative lack of information at a fine spatial scale on groundwater resources within the region.

The Variation provides policies and methods for the establishment of sustainable yields (groundwater limits) for groundwater. When established sustainable yields will be used as a regulatory means to limit groundwater allocation and determine the consent status of an activity. Currently no sustainable yields have been set and a programme of investigation work is being prepared to undertake this work and establish these yields in the Waikato Regional Plan. The policies and methods state how sustainable yields will be set and what matters will be used to determine these levels.

The Variation recognises the linkages between groundwater and surface water. Where linkages occur there are policies to ensure that a groundwater take is assessed as a surface water take to take account of the effects on surface water bodies.

The Variation permits small scale takes from groundwater. One controlled activity is included to provide for takes for existing takes for milk cooling and dairy shed wash down. All other takes are discretionary activities up to the sustainable yield (if listed). If a sustainable yield is listed, any takes which exceeds that level will be assessed as a non-complying activity. If no sustainable yield is listed the take will be assessed as a discretionary activity.

Other methods

The Variation provides for a number of other policies and methods for dealing with water allocation including:

- Detailed consent assessment criteria for takes to guide decision makers particularly in respect to non-complying activities. The guidance is that generally most applications will be declined except in specific situations as specified.
- Consent terms are generally for 15 years. However, longer terms are provided for consents for takes for domestic or municipal supply and capital intensive industrial facilities. The term of 15 years for all other consents for water takes is more than adequate to enable return on investment.
- Requiring water take recording and reporting. The policy is intended to provide a balanced approach to monitoring requirements so the small numbers of users in the region who utilise the majority of the water are required to provide detailed information on their take and use. Goes beyond the RMA s360 regulations on water measurement in specific situations and includes telemetry.
- Specific provision on water shortages will be managed, including setting priorities for which types of consent will be required to shut down first.
- The Variation details how Waikato Regional Council intends to phase out over allocation in line with the requirements of the National Policy Statement.
- Provision for the shared use and management of water.
- Separate rules for the use of water. The “use” of water has been separated from the “take” of water to allow Waikato Regional Council to better provide for the transfer of water permits. The “use” of water is no longer linked to the resource consent for the water take. Transferred water take permits can be used for different purposes. This increases flexibility for all users and means that water take permits can transferred more freely. Generally all uses are permitted activities, with the exclusion of water used for irrigation in specified catchment, including the Waikato River catchment upstream of Karapiro Dam to the Lake Taupō control gates. Where water is used for crop and pasture irrigation a seasonal and monthly irrigation water balance must be used to demonstrate that the amount of irrigation water applied does not exceed the irrigation demand by more than 20 per cent. These conditions ensure water is applied at the correct rate for plant uptake and there is no unnecessary leaching.
- The Variation provides a permitted activity rule for the transfer of permits downstream of the original take. Permits within a hydroelectricity reservoir may also be transferred upstream as a permitted activity. In all other situations resource consent is required to transfer water.
- There are policies and methods requiring efficient use of water. The policy has set minimum requirements for efficient water use for industry, irrigation and domestic or municipal supply.
- There are policies and methods requiring consideration of water conservation measures. Council is also promoting water efficiency and conservation through environmental education, for example the Smart Water Use campaign.

HE TAIAO MAURIORA	HEALTHY ENVIRONMENT
HE ŌHANGA PAKARI	STRONG ECONOMY
HE HAPORI HIHIRI	VIBRANT COMMUNITIES

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