HAWKE'S BAY REGIONAL COUNCIL

Tukituki Choices

A discussion of choices and opportunities
for land and water management

Foreword

The Hawke's Bay Regional Council knows how important the Tukituki River Catchment is to our region.

That's why over the last few years we've invested a lot of time and money to better understand the quality and quantity of the water that flows down the Tukituki River, as well as the current and potential economic value of the water, and what it may mean for our communities.

We're ready to share some possible options with you and get your thoughts. So we've produced Tukituki Choices, a discussion document presenting four different scenarios for land and water management in the catchment.

We would really appreciate well informed written submissions. These will help us shape a land and water management framework for the Tukituki catchment. We will also consider it when making a decision on the next phase of the Ruataniwha Water Storage Project.

Your feedback is an important element of our planning processes, so please take some time to read this document and tell us about your choice.

Cr Fenton Wilson
Chairman, Hawke's Bay Regional Council

The Tukituki Vision

Hawke's Bay Regional Council has an optimistic vision for the Tukituki River catchment

A vision that will create a vibrant economy, a healthy river and a local community that can prosper. It's a vision that will help create a land and water management framework for the catchment that will be sustainable for the next 100 years.

HBRC has been working on a range of solutions for the catchment since 2008, to achieve positive environmental, social, cultural and economic outcomes for the region. The Ruataniwha Water Storage Project is potentially one of those solutions.

Exactly how the region will achieve this has been, and no doubt will be, the source of much debate, challenge and differing points of view.

That's why HBRC has worked intensively with iwi and hapū representatives, farmers, environmental groups and food processing representatives for over three years to drive as much common understanding and agreement as is possible. This is why HBRC has created Tukituki Choices.

Tukituki Choices highlights four scenarios for the future land and water management of the Tukituki catchment. Two include water storage and two do not. Tukituki Choices presents the environmental and economic benefits and costs of each scenario so that the effect of each choice can be clearly understood.

The aim of this discussion document is to give you information on all the options to allow you to be well informed on all the choices so you can provide us with considered written submissions to help guide our decision making.

Hawke's Bay needs to further develop and grow to be a successful and vibrant region in the future. The success of the land and water management framework for the Tukituki River catchment will benefit the whole region, potentially opening up more farm land in the Ruataniwha Plains for agriculture and horticulture, in turn creating more jobs and stronger local communities.

Now is the time for a long term sustainable solution for the good of the entire region.

Contents

This discussion document outlines four choices available to improve the Tukituki River, two with water storage and two without.

As people take information on board in different ways, this document presents the choices in a number of formats.

Tukituki Choices starts with a broad overview and, as you read further, goes into more detail. At the back, there is more technical information about the land and water resources.

What we need from you

We welcome your written comments and we encourage you to use the following questions to guide your feedback on this important work.

If there are a number of you who have the same view, please do not send duplicates of the same comments. We're hoping for comments that reflect a wide range of views and perspectives to help us to make good long-term focused decisions.

1. Which scenario do you think delivers the best outcomes overall? Why?
2. Are there elements of the scenarios that could be combined to deliver a more favourable set of outcomes? If so, which ones? Describe the outcomes that would result.
3. Where would the costs or advantages of that modified scenario fall?

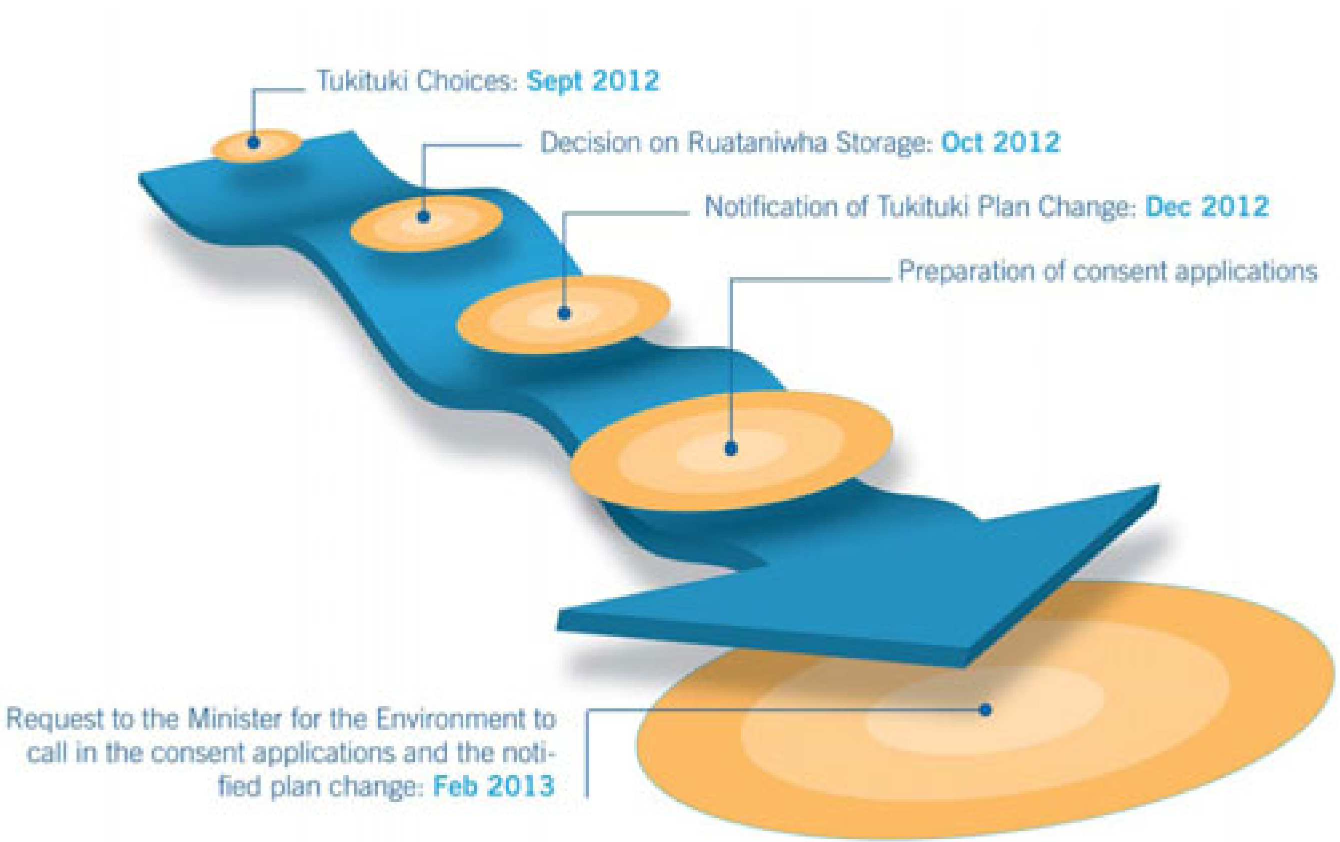
Send your comments by **Friday 5 October 2012** to:

Email: tukituki@hbrc.govt.nz

Fax: 06 835 3601

Post: HBRC, Private Bag 6006 Napier 4140

The Direction Ahead



Note: This diagram assumes a decision to proceed with storage.
If HBRC decides to proceed with the storage project it will need to:

- continue discussions/negotiations with potential investors and lenders;
- continue discussions with key stakeholder groups regarding water uptake;
- tender for the project's construction and operations;
- optimise all aspects of the scheme

If HBRC decides not to proceed with storage, it will proceed with the notification of the Tukituki plan change which would be considered by a Council Hearing Panel.

Introduction


Photo: Peter Scott

Tukituki: Issues In Context

Hawke's Bay Regional Council is committed to improving overall water quality and water security in the Tukituki catchment.

During the last five years HBRC has invested significant time and money to better understand the quality and quantity of water that flows down the Tukituki River. The river flows are not large compared to South Island east coast rivers and the issues in this catchment highlight our collective need to consider new options for water management.

A combination of increasing minimum flows, water storage, on-farm nutrient management, stock exclusion from waterways, wetland enhancement and waste water management are needed to achieve our objectives of environmental improvement, economic growth and community resilience.

National content	Regional content
Fresh Start for Fresh Water As part of Government's 'Fresh Start for Fresh Water' reform, a package of initiatives was launched that recognises the strategic value of fresh water to New Zealand's economy and way of life.	**Hawke's Bay Land and Water Management Strategy** In 2011, a reference group led by HBRC developed the Hawke's Bay Land and Water Management Strategy. It is a non-statutory document and identifies a number of actions that could move the region towards its goals, including setting policy and rules in RMA plans to provide the framework and investigating the provision of water infrastructure.
National Policy Statement for Freshwater Management The National Policy Statement for Freshwater Management came into effect in July 2011. It sets out objectives and policies that direct us to manage water in an integrated and sustainable way, while providing for economic growth within set water quantity and quality limits. The objectives for water quantity and water quality established a clearer bottom-line for freshwater management - to safeguard life-supporting capacity, ecosystems processes and indigenous species and their associated ecosystems. It also looks to maintain or improve the overall quality of freshwater within a region. The scenarios described in the Tukituki Choices all seek overall environmental improvement.	**Regional Policy Statement and Regional Resource Management Plan** HBRC has recently consulted informally on a change to the Regional Policy Statement to incorporate key principles of the Hawke's Bay Land and Water Management Strategy. Notification is due in October 2012. The Tukituki Plan Change will be developed and notified following Tukituki Choices public engagement. It will set water allocation limits, minimum flows and water quality limits, and is consistent with the National Policy Statement - however setting limits alone will not get us to where we need to be. **HBRC's role in a Primary Sector Economy** About 45% of Hawke's Bay's economy is in primary production, associated manufacturing and service industries. This economy is vulnerable to both trading conditions and climate variations. As guardian of the region's water and soil resources, HBRC can help to manage the risks around climatic uncertainty and water security.

Tukituki: Issues In Context (cont)

National content	Regional content
Irrigation Acceleration Fund This fund aims to unlock the economic growth potential of the nation's primary sectors by developing more effective and efficient water infrastructure, such as storage and distribution lines. The Council has been successful in gaining government support from this fund as well as the previous Community Irrigation Fund and the Sustainable Farming Fund for the Ruataniwha Water Storage Project feasibility studies.	**The Investment in Existing Infrastructure** The Tukituki catchment has been heavily modified due to historical vegetation clearance, land drainage and land development. In the 1930s and 40s, HBRC's predecessors built a flood control and drainage scheme - stopbanks and living tree edge protection - for the Upper Tukituki catchment. Gravel extraction occurs in the rivers across the Ruataniwha Plains to maintain channel capacity. After further improvements in the 1980s, stopbanks were also built in the lower part of the Tukituki catchment. The Upper Tukituki Scheme supports today's economic development in the catchment and has a total replacement value of $25.6 million (June 2012). Regional benefits gained from that investment could increase significantly with the availability of secure water for irrigation.

Tukituki: Issues In Context (cont)

Ongoing droughts, drawing water for irrigation, and wastewater discharges all have a negative impact on the river. 83 water take consents in the Tukituki catchment are subject to review and expire in 2013, with another 70 in 2014/15.

The regional community including environmental interest groups have expressed continuing concern since 2003 about the minimum flow levels in the Tukituki River, in addition to high levels of nutrients in the river, relating to algal blooms with potential effects on fish and other river life.

What are the issues?

- Over allocation of surface water based on current allocation limits
- Excessive periphyton growth adversely affecting swimming and fishing, particularly in the lower Tukituki
- Degraded mauri of the Tukituki River and its tributaries
- Lack of understanding of the groundwater system and its surface water interactions
- Inadequacy of existing minimum flows to provide for native fish and trout habitat
- Reduced security of supply for existing irrigators if existing minimum flows need to be higher
- Economic impact of any reduced security of supply for irrigators
- Potential land development hindered by lack of water.

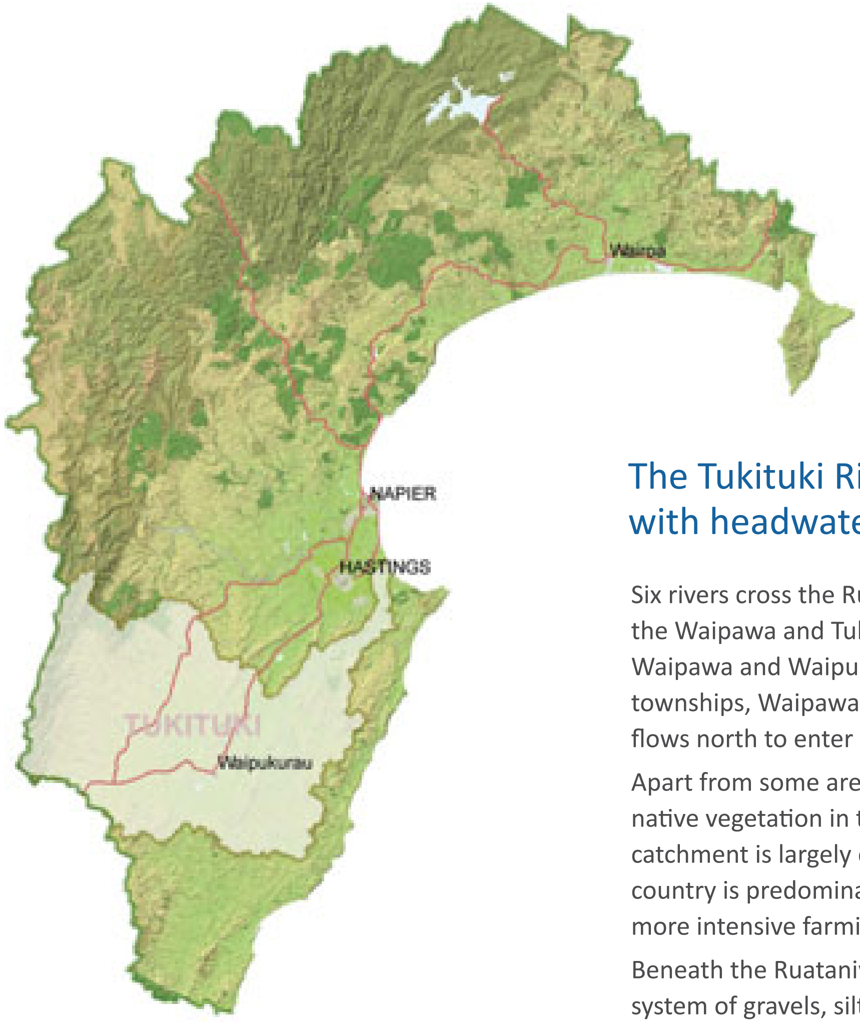
What we have done

- Facilitated Tukituki Liaison Group to develop community led goals and objectives for the catchment
- Developed a groundwater model to better understand and predict groundwater/ surface water interactions, undertaken more intensive water quality monitoring, and reviewed in-stream habitat assessment which underpins the setting of minimum flows ($2.7M over last 5 years)
- Facilitated water user groups to improve efficient use of available water
- Facilitated metering and telemetry to improve knowledge of actual water use
- Investigated feasibility of storage to meet current and future water demand and improve water quality ($5.6M)
- Collaborated with mana whenua to measure, monitor and improve mauri
- Collaborated with Ruataniwha Stakeholder Group on storage feasibility.

How do we move forward?

- Hawke's Bay Land and Water Management Strategy
- Review the Regional Resource Management Plan to set new minimum flow limits, surface water and groundwater limits, water quality limits, and allowable nutrient leaching losses from farms
- Potential Ruataniwha Water Storage Scheme
- Mātauranga Māori tools including Cultural Health Index and State of the Takiwā monitoring

Tukituki: In Brief



The Tukituki River is one of the region's largest catchments, with headwaters in the Ruahine Ranges.

Six rivers cross the Ruataniwha Plains merging into the Waipawa and Tukituki Rivers, sitting west of the Waipawa and Waipukurau townships. East of the townships, Waipawa River joins the Tukituki and flows north to enter Hawke Bay at Haumoana.

Apart from some areas of exotic forestry, and the native vegetation in the Ruahine Forest Park, the catchment is largely deforested. Land use in the hill country is predominantly dry stock farming with more intensive farming on the plains.

Beneath the Ruataniwha Plains, a complex aquifer system of gravels, silts and clays contain water from rainfall and rivers. Water leaves the Ruataniwha Basin through springs, joining the Tukituki and Waipawa Rivers through their river beds.

The lower Tukituki River is part of the iconic landscape of Te Mata Peak and the Kahuranaki range. The river is appreciated for its aesthetic, recreational and cultural values and with the aquifer, is valued for the water it provides for household, stock and public supply, commercial use and irrigation.

Consents in the Tukituki Catchment

Irrigation takes **284**
Potable water supplies **22**
Industrial takes **14**
Discharges to land **142**
Discharges to water **30**

The Story Behind Tukituki: Te Ao Māori

In 2011 and 2012, Te Taiwhenua O Tamatea and Te Taiwhenua O Heretaunga jointly prepared a report to clarify and define Māori environmental values in the context of the Tukituki River catchment. The following are extracts from that report.

The connection between mauri, water and people, is a basic tenet for Māori. When Māori meet for the first time, one is asked, 'Nō wai koe?' (Where are you from? From where do your waters flow?).

The Tukituki awa (river) is a tūpuna (ancestor). It is integral to the web of whakapapa (geneology) connections shared by the different hapū (tribal clan) along its banks. It provides hapū with a sense of identity and interconnectedness.

The awa was once a 'river of villages' and a 'highway' connecting whānau to their mahinga kai and to other whānau.

The name Tukituki refers to both a paddle rhythm and the beating of water to make a splashing noise to herd fish into backwater or channels.

The Tukituki flows from the Ruahines across the Ruataniwha plains converging with the Waipawa River and other tributaries meandering northeast to the mouth of Waipureku to finally meet with Hinemoana, Tangaroa, Te Moananui a Kiwa, the great ocean.

According to Māori legend, the Ruataniwha plains were once covered by a large lake which was the lair of two enormous taniwha (water spirits) who regarded the Māori living around the lake as a source of food.

One day a plump little Māori boy unfortunately fell from a cliff on the eastern side of the lake, near where the Tukituki and Waipawa Rivers now flow. The two taniwha quarrelled and a fierce fight took place between them for this appetising food. The wild lashing of their tails cut through the eastern hills and the lake poured out forming the Waipawa and Tukituki rivers of today.

The kōrero continues: one of the taniwha was Te Awarua o Porirua who was being pursued up and down the country and was finally slain by Tara, a well known ancestor of Ngāti Kahungunu, at Te Roto a Tara.

The surviving taniwha, Te Uma O Pua retreated into its abode (between the golf course and Takapau). The howling noise which you hear when strong winds rise over the Ruahines beyond Rakautatahi is believed to be Te Uma O Pua crying for its mate. The original taniwha hole at Ruataniwha can still be seen from the eastern side of Speedy Road near Takapau and is considered highly tapu.

What Do We Value Here?

We’ve established agreed values for the Tukituki Catchment from our work with these groups and activities:

Tukituki Liaison Group 2008

2010 Water Symposium

Ruataniwha Stakeholder Group 2010-12

Hawke’s Bay Land and Water Management Strategy 2011

Tukituki Catchment Freshwater Values Assessment Report 2012

Tukituki Cultural Values and Uses Report 2012

No Wai, Ko Wai, Ma Wai

The Māori worldview is that everything is connected: water, land and people.

Water is the lifeblood of the whenua, the land, and therefore of tangata whenua, the people. It is integral to who they are (ko wai), where they are from (no wai) and their future (ma wai).

A river is a living being. It has a mauri life force that weaves itself through the people, connecting the people with the river.

Whānau and hapū consider it their right, as tangata whenua, and duty as kaitiaki, to protect mauri.

Refer Key Supporting Reports: Reports 1 and 2

Economic values

- Long term economic growth (including potential)
- Flexibility
- Investment certainty
- Employment opportunities
- Reliable water supplies for commercial, industrial and irrigation
- Tourism

Social values

- Human and stock drinking water needs
- Swimming and fishing
- Passive enjoyment
- Food gathering
- Public access
- Lifestyle

Ecological values

- Healthy ecosystems - life supporting capacity
- Biodiversity
- Native fish habitats
- Trout habitats
- Fish passage

Cultural values

- Mauri - the life force
- Wāhi tapu - sacred places
- Tikanga - protocols
- Kaitiakitanga - guardianship
- Manaakitanga - being good hosts
- Mahinga kai - food gathering places
- Mātauranga Māori - knowledge
- Te Reo - language
- Taonga - highly prized things

What Are Our Objectives for Tukituki River?

We propose the following catchment-wide water management objectives:

- Maintain the life supporting capacity of the water and its ecosystems
- Satisfy needs for human and stock drinking water
- Maintain or enhance mauri
- Safe swimming
- No impediments to fish migration

We also propose these catchment-specific water management objectives:

Lower Tukituki - Zone 1

- Maintain inanga spawning habitat
- Improve physical habitat availability for trout
- Reduce periphyton (algae and slime) growth to improve swimming and fishing

Ruataniwha Basin rivers - Zones 2 and 3

- Provide adult native fish and trout habitat
- Provide native fish and trout spawning habitat

Head water rivers - Zone 4

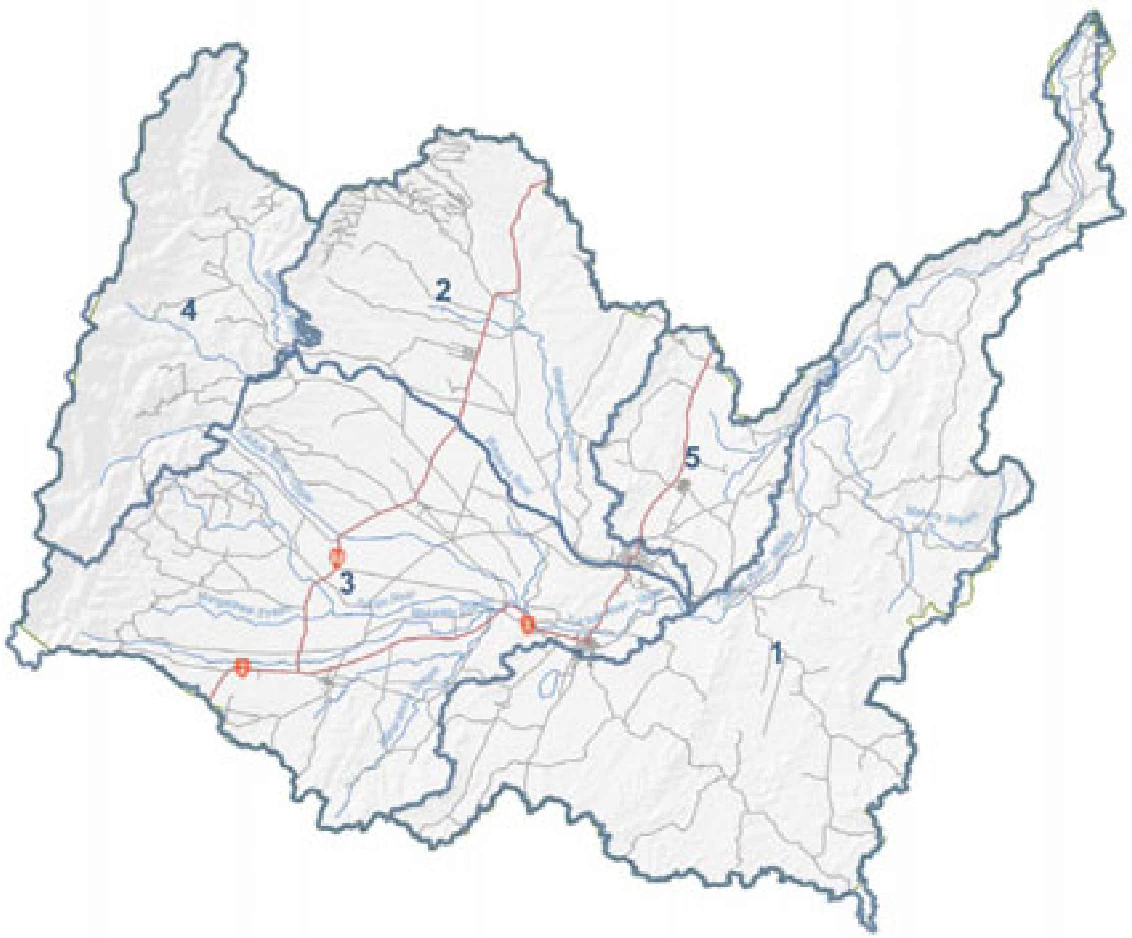
- Provide native fish and trout spawning habitat
- Maintain current biodiversity level, and limit periphyton growth

Papanui-Otane - Zone 5

- Provide native fish habitat

These are the species we use to set minimum flow and water quality limits:

Inanga • Longfin eel • Trout



Land and Water Management Tools

There are a range of tools available to achieve the desired water management objectives.
A single tool can contribute to a number of water management objectives as shown in the matrix.

WATER MANAGEMENT OBJECTIVE	**Planning, regulation and monitoring**	**Surface and groundwater allocation** (quantity)	**Minimum flows**	**Water quality limits** (physical and bacteriological)	**Nutrient limits and loads** (Nitrogen and Phosphorus)	**Stock exclusion from water bodies / Riparian management**	**Water infrastructure**
Maintenance of water and ecosystem capacity to support life							
Maintenance or enhancement of mauri							
Drinking water							
Commercial, industrial and irrigation water							
Unrestricted fish passage							
Improved physical habitat availability for trout and native fish							
Improved swimming, fishing and amenity							
Provision of native fish and trout spawning habitat							
Maintenance of inanga spawning habitat							

Understanding the Tools Used in Tukituki Choices

To help you understand the Tukituki Choices, we have summarised the tools that we have used.

More information is contained in the Technical Information section and in the supporting reports.

Minimum flow

This is the level where consent holders may take no more water from a waterway. The minimum flow is set after assessing the level of water needed to keep important fish and insect species in the river healthy, and considering the impact the flow will have on 'security of supply' for irrigators.

Water allocation limits

This is the total amount of water that can be taken from a water source in a set period. This could be surface water, like a river or lake, or groundwater from underground. Setting a surface water allocation limit avoids the risk of 'flatlining' the flow at the minimum flow level. Setting a groundwater limit can ensure that the aquifer is used sustainably, as well as protecting the values of interconnected surface water resources such as springs.

Water quality limits

Safe swimming and healthy fish come from good quality water. Limits are set to ensure that an acceptable and agreed standard is maintained to meet the water management objective. Different indicators are used depending on what you are managing the water for. E.coli is used as an indicator for swimming and drinking water. Phosphorus is used as an indicator for periphyton growth. Nitrate can be used for protecting fish and invertebrates and it can also be used to control periphyton.

Nutrient loads

If a limit is set for nitrate, this can be converted into an allowable catchment load. This is the amount of nitrogen that can be leached from the land into groundwater and streams and still maintain the water management objective. It can also be allocated across the catchment on a per hectare basis.

Technical Things You May Need to Know

Science has helped our understanding of how the rivers and aquifers are connected and our understanding of the water quality and ecology in the catchment. We have summarised the key scientific findings here. More information is contained in the Technical Information section and in the supporting reports.

Ruataniwha groundwater and surface water interconnection

The Ruataniwha aquifer sits in a contained basin. Water enters it when rain falls on land and through the bed of the rivers. Generally speaking, Waipawa River loses water to the aquifer and the Tukituki River gains water. The groundwater moves in a west-east direction under pressure and all groundwater leaves the basin via springs or through the river bed at the eastern side of the Basin.

Taking groundwater from the aquifer reduces how much water flows back into the river through springs and the river bed over time. Groundwater modelling predicts that groundwater abstraction has the greatest impact on river flows during the summer months and the least impact during the winter.

Impact of groundwater takes on security of supply for surface water takes

The reduction in river flow caused by the groundwater takes has an impact on those surface water users who are subject to a minimum flow condition on their consent. It results in the minimum flow being reached sooner and takes longer to return above the minimum flow. The effect is variable depending on the minimum flow sites but can double the number of days that an irrigator might need to stop taking water.

Impact of groundwater takes on natural flows

The cumulative effect of all the groundwater takes also means that the impact of reduced river flows continues during the low flow period after the minimum flow level is reached. This could reduce the physical habitat for fish over this period by 5-10%. Setting a higher minimum flow is one way to minimise the effect.

Impacts of the Ruataniwha Water Storage Project on river flows

Groundwater modelling has been undertaken to assess the impact of the storage scheme on river flows. It has been modelled based on current surface and groundwater takes continuing and alternatively based on current surface water and groundwater consents taking from storage. This has been compared to the status quo of no storage.

Drivers of Periphyton

Based on our assessment of the available information, the main stem of the Tukituki River is phosphorus limited. This means that reducing the amount of phosphorus in the river will result in a larger environment improvement than reducing nitrogen.

Nitrate Risk for Fish and Invertebrates

Nitrate can have chronic toxicity impacts on fish and invertebrates, so nitrate still needs to be managed. NIWA have reviewed the latest toxicity data, including inanga and mayfly, and have developed a Nitrate Risk Management Framework for the Tukituki catchment. This framework is used in the Choices scenarios.

Refer Key Supporting Reports: Reports 19, 23 and 24

Tukituki Choices

Scenario Description

Choice A

Caps water allocation limits at current consented volumes and sets a high level of protection for longfin eel through higher minimum flows in the Waipawa River at SH 2 and in the Tukituki River at Tapairu Rd. An improvement to moderate protection is provided for trout in the Tukituki River at Red Bridge (Waimarama Rd). This reduces current security of supply for irrigators. Water quality limits for nitrate means that current land use could intensify but it is hindered through a lack of irrigation water.

Choice B

Similarly caps water allocation. This scenario provides high protection for trout in the Lower Tukituki, matching the protection given to longfin eel. River nitrate concentrations are managed to limit periphyton (algae and slime) growth to acceptable levels for most of the time. This means a significant reduction of nitrogen loss through the soils is required, leading to reduced stock numbers and / or changes in land use.

In Choices C and D, the Ruataniwha Water Storage Scheme is in place.

Choice C

Existing surface and groundwater irrigators choose to stay with their existing water supplies. Allocation limits and minimum flows are the same as Choice B. Water quality limits are the same as Choice A but with irrigation water available from storage, further development of land can occur. The impact of the storage scheme in operation and the continued abstraction from the river and groundwater does not improve summer low flows.

Choice D

All existing surface and groundwater irrigators migrate to storage. Water quality limits are the same as for Choices A and C. Like Choice C, land development can proceed with certainty under irrigation. Waipawa River is impacted more directly from the operation of the same but not as much as with Choice C. With existing irrigators no longer taking from groundwater and surface water, the flows in the Tukituki River are significantly enhanced over the mid to low flow range.

How do I read Tukituki Choices from here?

Each scenario is based on key assumptions and two water management tools: minimum flows and water quality limits.

We first provide a summary of outcomes for all scenarios and then each scenario is described showing:

- The situation as it is
- A story putting that scenario into context
- What outcomes would be achieved

A Sunday Drive in 10 Years Time

Each scenario is described through the eyes of Mark, a 70 year old farmer and his passenger. Mark is of Ngāti Kahungunu descent and he's a keen trout fisher. He drives from his home in Ongaonga, past his old farm on SH50 before heading down the river valley.

Outcomes

Each choice is described using environmental, economic, social and cultural outcomes as a guide.

More information

More information can be found in the Technical Information section along with a list of reports that support Tukituki Choices.

Scenario Assumptions

Surface Water Allocation Limits

Surface water allocation limit by zone	Minimum flow site	Maximum take rate (l/sec)	Annual allocation (cubic metres x 10^3)
Zone 1	Tukituki at Red Bridge	1068	4688
Zone 2	Waipawa at SH2	908	7298
Zone 3	Tukituki at Tapairu Rd	1128	8371

Groundwater Allocation Limits

Groundwater allocation limit by zone	Aquifer	Annual Allocation (cubic metres x 10^3)
Zone 1	Otane Basin	2,553
Zone2	Ruataniwha Basin north of Waipawa River	5,278
Zone 3	Ruataniwha Basin south of Waipawa River	16,167

Managing Phosphorus

Managing phosphorus in the catchment includes:

Stock Exclusion Rule

Evaluation presumes a rule will be contained in the regional plan that requires the exclusion of stock from waterways. Details of how this rule might be targeted are on page 76

Waipukurau and Waipawa Oxidation Pond Discharges

A significant reduction in phosphorus will be achieved when these discharges meet the requirements of the current consent. Compliance with the required date of September 2014 is taken as a given.

Nutrient Management Plans

Through permitted activity rule conditions or via conditions of any consent for the Ruataniwha Water Storage Scheme, nutrient management and mitigation plans for managing nitrogen and phosphorus would be required, as a minimum.

Managing Nitrogen

The regulatory framework for managing nitrogen in the catchment is detailed in pp 77-80. In summary it includes:

- Setting a Nitrate concentration limit and Maximum Allowable Zone Load (MAZL) for each Nitrate Management Area
- Allocating part of the MAZL across the zone as a permitted activity
- Providing access to additional nitrogen through resource consent
- Setting a trigger value as the MAZL or concentration limit is approached where the level of regulation is stepped up
- Nutrient management and mitigation plans will be necessary tools for all farmers to develop as part of this regulatory framework.

Tukituki Choices at a Glance: Environmental Outcomes

	Choice A No storage	Choice B No storage	Choice C Storage - no existing uptake	Choice D Storage - full existing uptake
Inanga spawning in Lower Tukituki (nitrate limit)	Very Good	Very Good	Very Good	Very Good
Trout and native fish habitat in streams of the Ruataniwha Plains (nitrate limit)	Good Overall	Very Good	Good Overall	Good Overall
Native fish and trout spawning in headwaters (nitrate limit)	Excellent	Excellent	Excellent	Excellent
Maintain biodiversity and limit periphyton in headwaters (nitrate limit)	Excellent	Excellent	Excellent	Excellent
Habitat retention for trout (minimum flow)	Good	Very Good	Very Good	Excellent
Habitat retention for longfin eel (minimum flow)	Very Good	Very Good	Very Good	Very Good
Reduce periphyton growth	Fair	Good	Fair	Fair

Note 1: The scores are based on a comparison against the current situation

Note 2: The scores are based on management classification for habitat and species protection relating to minimum flows and nitrate risk. There is no comparable management classification for periphyton so the score provided is based on an assessment relative to the current situation, where Fair is equivalent to the current situation.

Tukituki Choices at a Glance: Economic and Social Outcomes

	Choice A No storage	Choice B No storage	Choice C Storage - no existing uptake	Choice D Storage - full existing uptake
Growth Opportunities	Poor	Very Poor	Excellent	Very Good
Security of Supply for Irrigators	Poor (surface water takes)	Poor (surface water takes)	Poor (surface water takes)	Poor to Fair (surface water takes outside the scheme area)
	Good (groundwater takes)	Good (groundwater takes)	Good (groundwater takes)	Good (groundwater takes outside scheme area)
			Excellent on storage	Excellent on storage
Nitrogen Availability	Good	Poor	Good	Good
Regional Economic Impacts	Fair	Poor	Excellent	Very Good
Social wellbeing	Fair	Very Poor	Excellent	Very Good
Threats	Continued stress on water allocation. A stagnant local economy accompanied by a decrease in social wellbeing	Continued stress on water allocation. A shrinking economy accompanied by a significant decrease in social wellbeing	Slow uptake of storage water by new irrigators and consequently slower economic/social improvements	Slow uptake of storage water by new irrigators and consequently slower economic/social improvements

A Look at River Values from a Māori perspective

Indicators and Values to Uphold Mauri of the River	**Choice A** No storage	**Choice B** No storage	**Choice C** Storage - no existing uptake	**Choice D** Storage - full existing uptake	**Explanation**
Water depth, minimum flow	Good	Very Good	Very Good	Very Good	In A, the minimum flow in the lower Tukituki will not be as high as in B, C and D.
Mahinga kai quality and availability	Very Good	Very Good	Very Good	Very Good	Mahinga kai is supported by minimum flows which provide habitat for different species. All scenarios provide 90% habitat for longfin eel.
In-stream nutrient levels	Very Good	Excellent	Very Good	Very Good	In-stream nitrate levels are lowest in B. Phosphorus levels in the lower Tukituki will reduce significantly with the upgrade of CHB wastewater treatment.
Taonga fish species	Very Good	Excellent	Very Good	Very Good	Overall provision for native fish species based on nitrogen toxicity thresholds is best in B while very good in A, C and D
Natural flow and flow variability	Very Good	Very Good	Good	Very Good	Damming the Makaroro will affect the natural flow, however the ceasing of surface and groundwater abstraction in D will mean the Tukituki will be able to run its natural course more often.
Health of waipuna (springs) and aquifers (quantity)	Good	Good	Good	Excellent	Impacts on waipuna will remain as per status quo in A, B, C. In D, waipuna associated with the Ruataniwha aquifer, will return to their natural state as groundwater abstraction is ceased.
Health of waipuna (springs) and aquifers (quality)	Very good	Excellent	Good	Very Good	B is best with very low levels of nitrate leaching. Because of the combination of increased irrigation and nitrate leaching and continued groundwater abstraction in C, nitrate concentrations in the aquifer may rise.
Repo raupo (wetlands) protection	Good	Good	Good	Very Good	Wetlands on the eastern edge of the Ruataniwha basin are affected by the level of the water table. With the removal of groundwater abstraction in D, the water table will rise and the health of wetlands is likely to improve.
Overall mauri score	**Good / VG**	**Very Good**	**Good / VG**	**Very Good**	Overall mauri scores are derived from averaging the indicators and values to uphold mauri.

The landscape in Choice A reflects moderate environmental improvement, with no stored water

The Situation:

Minimum flows increase, reducing security of supply for irrigators

No additional surface water or groundwater available for allocation

On-farm storage may be possible

Land use intensification could occur but likely to be limited by lack of water

Choice A

Choice A: A Sunday Drive in 10 Years Time

Mark reflects on a landscape with some environmental improvement, without water storage

We pull out of the driveway. Mark takes the long way to his daughter's, past the old place he farmed for 30 years. With his wife away, his daughter is cooking a Sunday roast, so we can take our time. It should be interesting to see what's happened. I was last out here 15 years ago before Mark sold the farm. His daughter wasn't interested in taking it on, neither his son-in law – the way it goes these days.

Central Hawke's Bay looks much the same - beaut rolling golden hills, with pockets of bright green pasture and crops where irrigators spray in the mid morning sun. Mark was an irrigator early on, converting his sheep and beef herds to a dairy farm. He got a loan from the bank to drill a deep bore and at the time it seemed there was plenty of water.

"The new owner still runs it for dairy but the water supply is not that secure now," he tells me, and then gets really annoyed. "You know he told me that when the consent came up for renewal, he needed more info on the link between the deep bore I'd used and the Waipawa River. They found out that the groundwater bore was connected to the river. Blow me, he has to stop pumping now when the river gets down. And no use going deeper, 'cos there's no more water to be had."

Mark shakes his head. I agree. It's mad, that these days a farm with so much potential can't produce any more than it did back then.

"Still," says Mark as we cross Waipawa River going north, "the new minimum flows mean more water for trout and eels, so they grow bigger and fatter. Should we go eeling again while you're here? We could smoke some... ka pai te kai."

He laughs and it's easy to see that he still sees both sides as he always did. We travel the plains to Waipawa. The landscape looks the same as it did when he sold the farm.

"No change then, no progress?" I ask him.

"You want progress? Let's take a look at progress then." A bit further down the valley, Mark pulls into a spot by the Tukituki river. "It was never worth fishing here – slimy and smelly a lot of the time. But since they improved the sewage ponds, the fishing is much better and the trout are fatter. That green slime still takes over sometimes, but I guess you can't have everything."

I point to some long lines of fencing near the river. "Are they to keep stock out?"

"Yep, some new rules the council brought in and it seems to be helping. Some streams are being planted up and are really looking a picture. The Council helps with some money for planting which is good."

We drive over Red Bridge on Waimarama Road and see kids playing in the Tukituki - just like the old days.

"On the radio last Friday, council said that the river was under its low flow just here, so all the river takes for irrigation stopped. This must be close to natural flow now. But all those irrigators you saw have to find other supplies for when the minimum flow cuts in. It's expensive for some of them."

Mark sighs.

"So they did improve the environment, there is some progress?" I ask.

"Maybe, but you've got to wonder whether it was worth it. There's not much progress when you look from the ranges to the coast, just the same blocks of land, the same crops, the same stock. C'mon, we'd better get on. Can't be late for lunch, or she'll chew my ear off. "

Scenario Settings

RIVER FLOWS	Minimum Flow (l/sec)	Level of Habitat / Species Protection
Tukituki at Red Bridge	4300	80% / trout
Waipawa at SH2	2500	90% / longfin eel
Tukituki at Tapairu Rd	2300	90% / longfin eel

WATER QUALITY Management Classification Nitrate Concentration (mg/l)	Annual Median Limit (current)	Chronic Maxima 95th percentile Limit (current)	Annual Average Limit (current)
Zone 4 Waipawa at SH50 (Maintain biodiversity)	-	-	0.14 (0.148)
Zone 4 Tukituki at SH50 (Maintain biodiversity)	-	-	0.14 (0.134)
Zone 2 Waipawa at SH2 (Good - 90%)	3.6 (0.719)	5.1 (1.3)	
Zone 3 Tukituki at SH2 (Good - 90%)	3.6 (1.3)	5.1 (2.4)	
Zone 1 Tukituki at Shag Rock (Very Good - 95%)	2.3 (0.925)	3.6 (2.050)	
Zone 1 Tukituki at Red Bridge (Very good - 95%)	2.3 (0.673)	3.6 (1.705)	

Choice A

Choice A: Future Outcomes

What would our future look like with some environmental improvement and no access to stored water?

Environmental

Excellent conditions are maintained for native fish and trout spawning in the headwater catchments. Current biodiversity is maintained. Very good conditions are available for inanga spawning in the Lower Tukituki River.

Water quality conditions in streams across the Ruataniwha Plains overall will provide sufficient habitat to support adult trout and native fish and spawning habitat.

There is enough water in the rivers and streams to support most adult native fish and trout populations. Habitat for trout in the lower Tukituki provides a moderate improvement.

Water quality is generally improved through the stock exclusion rule, contributing to reduced periphyton growth and improved amenity.

Economic

Reduced water security for those consent holders subject to minimum flows and seasonal volumes, especially for consent holders tied to the Red Bridge site. Without alternative water supplies, this reduction in available water is estimated to have a total on-farm impact of $2 million per annum in operating profit (after interest).

The on farm losses have flow on regional impacts and are assessed using input output (I/O) models. The total regional impact of lower levels of reliability amount to $2m per annum in GDP.

These effects are distributed throughout a range of sectors in the local economy but will be particularly affect the agricultural servicing sectors of the economy. However the regional impacts are not likely to be severely felt.

Regional impacts include:

- $1million/annum reduction in household income
- 15 Full Time Equivalent (FTE) reduction in employment

This scenario will result in a relatively stagnant local economy with slow growth at best and few opportunities to increase or diversify primary production.

Without water, the productive capacity of the high quality land across the Ruataniwha Plains will not be realised, even though additional nitrogen can be leached without compromising identified in-stream values. This scenario will generate $330 million less in regional GDP and 2600 fewer FTEs than Choice C.

No new water available unless through on farm or smaller community storage supplies. These storages are generally less reliable and more expensive than off farm storage.

Social

Limited employment opportunities in Central Hawke's Bay continues to threaten the region's resilience.

Increasing numbers of bad climatic years continue to create stress on farmers, farm families and farm service providers. Some farms may not be economic leading to a reduction in population and number of farms.

Employment in plants involved with processing current farm production may see some reduction.

A slowly declining population and low economic growth gradually increases social-economic polarisation and erodes vitality and resilience across the district for youth, families and the elderly

Slowly declining participation in community and social activities caused by the declining population and availability of social services.

Continued social issues and conflict based on economic disparity.

Cultural

Increases in minimum flows will improve the habitat availability for taonga species including longfin eel , koaro and bluegill bully over the summer months.

Refer Key Supporting Reports: Reports 4, 5, 8 , 9, 16, 17, 23 and 32

Choice A: Future Outcomes

What would our future look like with some environmental improvement and no access to stored water?

In-stream nitrate concentrations will support inanga spawning and migratory native fish including taonga species.

Whānau hauora enhanced through improvements to mauri, mahinga kai and water quality for swimming.

Groundwater abstraction will continue to have an impact on waipuna (freshwater springs) and wetlands

A stagnant primary sector, manufacturing and processing activity likely to have an accentuated effect on Māori due to predominance of Māori involvement in these sectors in Central Hawke's Bay.

The landscape in Choice B reflects significant environmental improvement, with no stored water

The Situation:

Minimum flows increase, reducing security of supply for irrigators

No additional surface water or groundwater available for allocation

On-farm storage may be possible

Eventually, periphyton growth will be at levels which support healthy ecosystems for most of the time

Land use and land management practices will need to change significantly to reduce nitrogen losses

Choice B

Choice B: A Sunday Drive in 10 Years Time

Mark reflects on a landscape with significant environmental improvement, without water storage

We wave to Mark's neighbour who's steering her ride-on mower carefully around her gate on the grass verge as we drive away.

"She's a good neighbour and we keep in touch as there's only the two of us living on this road now. Not like twenty years ago when there were at least ten families down here. Most of them left the district to find work. Just us retired old codgers now."

As we drive past his old farm, he points to the tree plantations that have replaced some of the farms. He tells me about the community's decision to give more protection to the river, the fish and the habitat, for swimming and fishing, but he reckons we also need jobs to give families enough to live on, enough to grow a good farming business.

"I guess those trees are good for climate change but there must be another way. The soul of the awa is in good heart but at the expense of what we can do on the land?"

Mark had retired from farming by the time the decision was made, but he felt for his neighbours who had to farm a more complicated system. A few winners and many losers.

"We'd talk it over in the pub and the looks on their faces when they'd said what it meant for their business to halve the nitrogen getting into groundwater and the rivers from their farms. The amount that was allowed had to be divvied up across the Plains! Well, soon after that, land was bought up for its nitrogen allocation and used for more intensive operations, and we started seeing the pine plantations grow."

"Lots of farmers must have sold up? Business would have been too difficult," I say.

"Yeah, some of them simply lost heart. As I said, there must be a better way."

We leave the plains behind and drive along beside the river. Mark points out where farmers have had to be innovative to keep on farming within the tighter limits.

"It's good to improve things," I say.

"But it's not easy, there's a cost ..."

He pulls in beside the river to show me his favourite fishing spot. Not just his favourite either, judging by the number of anglers sprinkled along the river bank.

"The trout are well fed and have the space they need to grow big, thanks to better flows in the river over the summer. There've been some record catches this year. What bothers me is it's the farmers and irrigators paying to boost fishing. Yes more tourists come here to fish but the productive sector is doing it tough with more cost. How can that be good for the place long term?"

We drive over Red Bridge where the river looks healthy and sparkles in the sunshine. Kids are splashing in the water, pretending to fish, making towers with rocks and skimming stones. It's a picture of paradise which looks great through the eyes of our international visitors.

"So what does this postcard picture cost the country as a whole?" I ask him.

"A pretty penny, that's what. I wonder if we're going to get trout for lunch again."

Scenario Settings

RIVER FLOWS	Minimum Flow (l/sec)	Level of Habitat / Species Protection
Tukituki at Red Bridge	5200	90% / trout
Waipawa at SH2	2500	90% / longfin eel
Tukituki at Tapairu Rd	2300	90% / longfin eel

WATER QUALITY Management Classification Nitrate Concentration (mg/l)	Annual Average Limit (current)
Zone 4 Waipawa at SH50 (Maintain biodiversity)	0.14 (0.148)
Zone 4 Tukituki at SH50 (Maintain biodiversity)	0.14 (0.134)
Zone 2 Waipawa at SH2 (Good - 90%)	0.3 (0.712)
Zone 3 Tukituki at SH2 (Good - 90%)	0.3 (1.349)
Zone 1 Tukituki at Shag Rock (Very Good - 95%)	0.3 (1.007)
Zone 1 Tukituki at Red Bridge (Very good - 95%)	0.3 (0.729)

Choice B

Choice B: Future Outcomes

What would our future look like with significant environmental improvement and no access to stored water?

Environmental

Current levels of biodiversity are maintained in the headwaters, as well as maintaining excellent habitat native fish and trout spawning.

Throughout the rest of the catchment, the nitrate levels will be sufficiently low to limit periphyton growth, most of the time, to levels that support healthy ecosystems, and provide a plentiful food source for fish and invertebrates which graze on algae and slime. This also provides a high level of protection for spawning habitat.

Due to the groundwater travel times, the improvements in periphyton levels would not be achieved for at least two decades.

After that time, excessive periphyton growth may still occur in places during extended periods of low flows.

Water quality is generally improved through the stock exclusion rule, contributing to reduced periphyton growth and improved amenity.

There is enough water in the rivers and streams to support most adult native fish and trout populations. Habitat for trout in the Lower Tukituki is significantly improved.

Economic

The nitrogen limits will result in a reduction in current levels of land intensification and substitution of forestry for pastoral land uses. Intensive land uses will need to undertake mitigation to reduce their losses. This would result in the productive capacity of the high quality land being under-utilised.

The change in land use and management results in a $40 million/year reduction in profit (after interest), and a $20 million reduction in regional GDP relative to current. This scenario will have an opportunity cost relative to Choice C of $60 million in on farm profit and
$340 m per annum in regional GDP.

Reduced water security for those consent holders subject to minimum flows but the reduction in irrigated area is likely to mean that any remaining irrigators will have opportunities to maintain their reliability.

These effects are distributed throughout a range of sectors in the local economy but will be particularly affect the rural servicing sectors of the economy, including those directly servicing the agricultural sector, but also the wider rural community as population decreases and the viability of business in small towns is threatened.

It is likely that the decline in demand for goods and services will exted to major towns of Hastings and Napier, but will be most concentrated in agricultural service sector, manufacturing, construction, and other services, particularly those based in Waipukurau and Waipawa.

Regional impacts include a $10 million reduction in household income, although a significant shift in the nature of employment to forestry related activities. There will be $160 m less in regional household income and 2700 FTEs fewer than in Choice C.

These impacts will result in a declining local economy, which will be particularly acute between the time when forests are initially developed and their harvest.

Demand for water decreases and this will result in an increased focus on use of the water in high value, low nitrate leaching land uses, particularly permanent horticulture and viticulture.

Social

Very limited employment opportunities in Central Hawke's Bay threatens the region's resilience.

A major change in land use with likely replacement of family farms with corporate forestry, leading to a reduction in population and number of farms.

A lack of incentive for farmers and businesses in traditional activities to undertake retraining

Refer Key Supporting Reports: Reports 4, 5, 8 , 9, 16, 17, 23 and 32

Choice B: Future Outcomes

What would our future look like with significant environmental improvement and no access to stored water?

Greatly reduced employment in plants involved with processing current farm production.

Increased unemployment among farm workers and supporting sectors but more employment in the forestry sector.

A change in the composition of the population with less children and consequent decreases in school rolls.

Reduced participation in sport, recreation and community activities.

The Waipukurau and Waipawa towns may also see a decline in some housing neighbourhoods and amenity through the lack of economic opportunity.

Significant implications in the changing nature and location of employment. There will be a move from farm work to forestry work, with forestry gangs located in towns, including the major centres, with a resulting decline in the rural population. Existing workers will lose their jobs and will need to relocate.

Increased social issues and conflict based in economic disparity and shifts in employment.

A declining population and low economic growth increases social-economic polarisation and erodes vitality and resilience across the district for youth, families and the elderly.

Slowly declining participation in community and social activities caused by the declining population, leadership and availability of social services.

An increasing risk of a reduction in the availability of health services in rural areas.

Cultural

Increases in minimum flows will improve the habitat availability for taonga species including longfin eel, koaro and bluegill bully over the summer months.

Low in-stream nitrate concentrations will provide excellent conditions (high protection level from nitrate toxicity) for native fish species throughout the catchment.

Groundwater abstraction will continue to have an impact on waipuna (freshwater springs) and wetlands.

Whānau hauora enhanced through significant improvements to mauri, mahinga kai and water quality for contact recreation.

Declining primary sector, manufacturing and processing activity likely to have an accentuated effect on Māori due to predominance of Māori involvement in these sectors in Central Hawke's Bay.

Photo: Peter Scott

The first two scenarios do not include water storage.
This gives a basis for comparison against the current situation.

The following two scenarios assume the Ruataniwha Water Storage project has gone ahead.

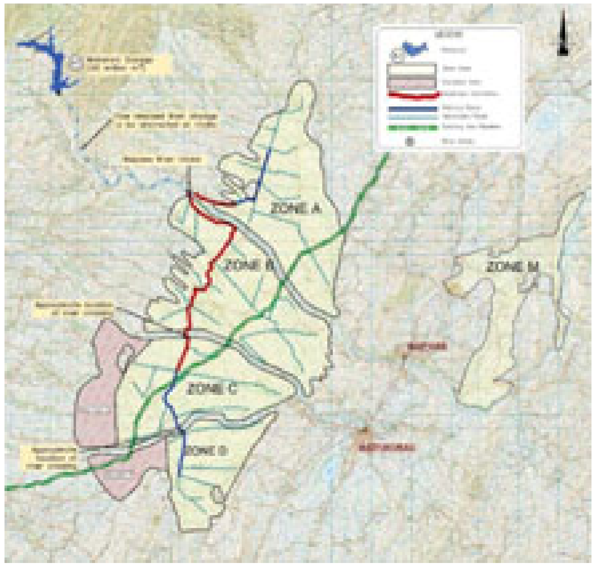
Ruataniwha Water Storage Project

Ruataniwha Water Storage

The Ruataniwha Water Storage project is a potential long-term sustainable water supply solution for Central Hawke's Bay

If approved, the storage reservoir with a potential capacity of 91 million cubic metres, will be an important foundation for future economic growth in the region, providing certainty of supply for irrigators and other water users. It also seeks to improve the health of the ecosystems through maintaining higher flows through the summer periods. This would be possible if all existing irrigation moved to storage.

This project is led by Hawke's Bay Regional Council and has been supported by central government funding.



Fast Facts

Dam type:

A concrete-faced rock fill dam

Dam height:

80 metres

Reservoir length:

7 kilometres

Storage volume:

91 million cubic metres

Surface area:

372 hectares

Operating draw down range:

10-26 metres

Irrigation footprint:

Approx 25,000 hectares

Area of Influence:

Irrigation footprint increases the productivity of another 17,000 hectares of farm land

Potential Electricity Generation:

6.5 MW

Ruataniwha Water Storage

The journey so far

The journey started with a "Pre-feasibility Study of Water Augmentation Opportunities". The objective was to determine, in broad terms, whether surplus water falling in the Ruahine Ranges and flowing in the rivers during the wetter times of the year could be captured or stored for use in the drier times. The study, completed in 2009, determined that this is possible.

From 20+ sites to six

The pre-feasibility study identified 6 potential storage sites, having looked at over 20 potential sites within the catchment. We started with the principle that the storage reservoir would ideally be off river and that there should be multiple sites so that construction could be staged with demand.

A full feasibility study for these water harvesting sites got underway in 2010. Geotechnical mapping and seismic assessments on the 6 water storage sites showed that none of them were suitable due to instability and seismic activity.

And from 2 to only 1

Two alternative sites were then investigated on the Makaroro River and the Makaretu River, both potentially large reservoirs. However further geotechnical investigations revealed the dam construction at the Makaretu River site would not be financially feasible.

Fortunately, the Makaroro water storage site, while still geotechnically complex, has been determined to be technically feasible. This shows that it's not easy finding a good storage site in this area.

Single reservoir benefits

A single water storage site means only one tributary of nine tributaries will be directly affected, which simplifies the assessment of environmental effects. There are also economies of scale in relation to construction costs which in turn may improve on-farm economics.

Where to after Feasibility?

Over the last two years, more than 30 key studies have been undertaken to determine whether the Ruataniwha Water Storage project is:

- Technically feasible
- Environmentally acceptable
- Affordable to irrigators, and
- Represents a sound financial and commercial investment decision.

A final report is being presented to HBRC to consider in September with a final decision to be made at the October 2012 Council meeting.

Stakeholder Engagement

Ruataniwha Stakeholder Group is independently chaired and has met every six weeks since May 2010.

Membership

- Landowners / irrigators
- Te Taiwhenua o Tamatea
- Department of Conservation
- Fish and Game Hawke's Bay
- Royal Forest and Bird Protection Society
- Central Hawke's Bay District Council
- HBRC Councillors

Over the last 3-4 years, senior HBRC staff have attended numerous meetings of community groups such as Hāpu, Rotary, Fish and Game, Forest and Bird, Chamber of Commerce, Business Hawke's Bay, Property Institute, Federated Farmers and other agribusiness groups, to talk about this project and how it fits with the strategy of improving water quality and water security and future proofing the region's economic well-being.

Ruataniwha Water Storage

Investigations

Extensive investigations into the feasibility of water storage have been carried out over the last 18 months. The results of these investigations are available on HBRC's website, including:

- Groundwater / Surface Water Flows Modelling
- Modelling of Land Use Intensification Effects
- Aquatic and Terrestrial Ecology Assessments
- Cultural Impact Assessment
- Social and Recreational Assessments
- Historic Heritage / Archaeology Assessment
- Traffic, Road Access and Noise Assessments
- Review of Farm Profitability
- Regional and National Economic Impact Assessments.

Environmental effects, mitigation and benefits

With the dam in place we would expect to see an increase in flows at the low flow end of the range by maintaining a residual flow from the dam.

This mitigation method is aimed at maintaining 90% of the Mean Annual Low Flow. Modelling indicates that if all existing irrigators move to storage, the magnitude of the increase is significantly higher than if they continue to take from groundwater and rivers.

The harvesting of winter flows will change (reduce) the flow regime over the mid to high range flows.

Flushing flows are included in the design and operating procedure to maintain flow variability and assist in periphyton flushing

Land use intensification scenarios indicate that existing nitrogen losses from current land use may increase by 25% but nitrate concentrations in the rivers present very low risk to aquatic species. Some elevation of nitrate concentrations in the groundwater will need to be managed.

The reservoir will inundate a small area of mixed native bush and farmland adjacent to a pine plantation and the Ruahine Forest Park. Restoration and enhancement programmes around the dam, downstream of the dam and around the spring fed streams on the eastern side of the Plains are proposed, as well as on farm riparian management.

The reservoir will result in the loss of a spawning river for native fish and trout, however the Tukituki is not short on suitable spawning sites.

Social and economic effects, mitigation and benefits

Total regional economic benefits (GDP) increase by approximately $320 million annually. Employment is expected to increase by 2,600 full time equivalents (FTEs) associated with increased farming activity and its flow-on impacts.

The combined effects of both on and off farm investment, upwards of $600 million, leads to a additional increase in total regional GDP of $350 million with an additional 3,800 job years of work.

These impacts will likely be focussed around the early years of the storage scheme when dam construction and most on-farm investment would occur.

Flow-on effect in growth and numbers employed in processing plants associated with new and increased farm outputs.

Irrigators joining the scheme will enjoy a secure water supply and increased business certainty.

Over time, the community profile and ownership will change. A social management plan will be required to ensure that community needs, both existing and new, are catered for.

The average age of farmers will reduce.

New families will come into the area, including overseas workers.

There will be a turnaround from negligible growth in population, evident in the district over recent years.

The composition of the population will change, with an increase in younger families and children and the consequent rises in school rolls.

Increased participation in sport, recreation and community activities will occur.

Greater demand can be expected for social services, including health services.

Refer Key Supporting Reports: Reports 25-33

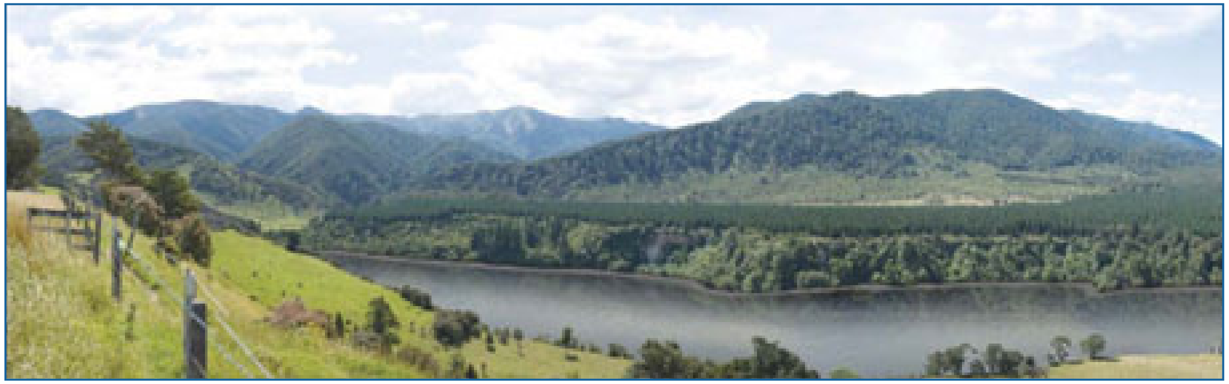
Proposed management practices for farms supplied by the Ruataniwha Water Storage Scheme include:

- Fenced and destocked waterways
- Marginal buffer strip of vegetation.
- No fertiliser spread in waterways.
- Nitrogen applied at a rate that can be taken up by pastures and crops.
- Fertiliser application according to nutrient budget such as Overseer.
- Careful cultivation to minimise soil loss by erosion and reduce breakdown of organic matter (N loss)
- Careful grazing management to minimise pugging and runoff.
- Irrigation management to maintain the soil moisture in tight band between wilting point and field capacity in order to maintain growth but minimise leaching.

RUATANIWHA
Water Storage

Makaroro River: before Ruataniwha Water Storage

Makaroro River: after Ruataniwha Water Storage



The Value of Water Storage

HBRC and BNZ Advisory are currently completing a financial feasibility study to determine the optimal structure to deliver reliable water in a cost effective and affordable manner.

This phase is critical in the context of the overall approach to management of water in the catchment as the cost of secure water on farm must be economic on farm and in turn provide a return to those parties that invest in the storage infrastructure.

Storage and Irrigation scheme ownership

The financing of a storage scheme will likely favour some combination of both public and private investment, in that there is early stage risk but the life of the asset is potentially 100 years plus.

There are variations of public-private partnerships that may be applied in this instance. In particular, considerations include ensuring the scheme is grounded in the Hawke's Bay community, has compatible investors with aligned value sets, fairly reflects returns to both the public and private sectors and in particular acknowledges those investors taking early risk.

HBRC has signalled the possibility of being an investor in the project through the Long Term Plan.

Early stage risk

The Tukituki plan change alone cannot force existing irrigators to join the scheme, even though modelling indicates that if they did, the Tukituki River would be better off.

The time of largest financial risk for the storage and irrigation project is in the first 10 years.

There is an incentive to maximise revenue early through strongly encouraging early uptake of stored water, maximising electricity generation, and ensuring the food processing sectors integrate planning and investment with increased reliable production.

The business proposition

While irrigators joining the scheme will face new costs, the irrigation scheme can :

Provide reliable water at least 19 years in 20, noting that this level of reliability dramatically improves on farm certainty , value and profitability.

Reduce power costs for many properties especially those on ground water

Improve certainty through longer term consents and therefore remove uncertainty associated with individual consent processes

Be priced on a per cubic metre basis so it is accommodates a range of farming enterprises, coupled with price stability mechanisms.

Incentive based transition arrangements for existing irrigators from surface and ground water takes to stored water are being assessed.

Assessment of on farm economics

A number of farming systems have been assessed as being feasible in a study undertaken by MacFarlane Rural Business Ltd. In particular, these include sheep & beef intensive, intensive arable, dairy light soil and mixed arable dairy support. Material improvement in horticultural and viticultural prices may in turn open up opportunities in these sectors.

Value of stored water for the river flow regime

Given that a plan change alone cannot deliver 'naturalised' flow regimes during the water-short summer months, the quicker irrigators migrate to stored water the better - in terms of flow regimes for other river users.

The landscape in Choice C reflects moderate environmental improvement with stored water

The Situation:

Minimum flows increase, reducing security of supply for irrigators

No additional surface water or groundwater available for allocation

Existing irrigators choose to stay with current surface and groundwater supplies

On-farm storage may be possible

Ruataniwha Water Storage Scheme available to new irrigators

Land use intensification can occur

Choice C

Choice C: A Sunday Drive in 10 Years Time

Mark reflects on a landscape with some environmental improvement and access to stored water

Mark calls his grandson to hurry up as we get in the car. We are dropping the boy at the turnoff to the new lake. With warmer days, spring winds and the lake being full, it's the best time for sailing.

I'm interested to see the changes since the storage scheme went in. As we head over the plains, we drive beside the new irrigation canal that moves the water across the plains. I say 'new', but Mark reminds me it was finished 5 years ago.

"It's a shame the canal's empty at the moment. Once the irrigation season starts, it's quite a sight, a flow of good, clean water."

He talks about the speed of water storage and irrigation becoming reality for the Ruataniwha Plains over these past 10 years.

"The Council said we could get more reliable water for irrigation with better summer flows and cleaner water. They also said it was a way to grow the district and the region. The government got on board as well as private investors. It wasn't a project for the faint-hearted, or investors wanting a quick return," he chuckles.

We get to the drop off point on the road to the lake where cars are waiting full of restless kids eager to sail. "See you back here at four, granddad!" the lad calls as he races off to meet his mates.

We turn and make our way across the Waipawa river. The river flows lower than it used to during the winter when the reservoir is filling.

"You can't make an omelette without breaking eggs," says Mark. "This is one of the drawbacks of storing winter flows. But there's plenty of benefits. Heck, some of this land had no water at all and now look at it , over 25,000 hectares worth!"

"There's a great sense of energy about the place," I say, as we pass paddocks being worked by tractors, with signs of new crops that I haven't seen in Central Hawke's Bay before.

"Yes, the storage scheme has certainly done that! But for me and others like me, we had a hard decision to make. I was already irrigating from groundwater. We knew we'd get a better flow in the rivers and we'd avoid the summer low flow restrictions if we moved to storage completely but many of us had sunk a lot of money into irrigation systems and weren't ready to give it up if we didn't have to. We liked our independence"

"It can't have been an easy decision to make, at your age," I smile.

"Too right! And for the first time we faced a minimum flow cut-off ! Less water for irrigating right when I need it most. But I sorted it out with the irrigation company, and now we carry on taking from the bore. But when the bans come into force we get a top up from the irrigation scheme."

"That must cost a bit?"

"The price of a cubic metre is higher than it would be if we got all the water from the scheme. Other farmers with no minimum flow cut-offs generally had enough water for their operations at the time but couldn't expand. For some, this was an important part of their business decision."

As we cross the plains to Waipawa, I can see fences keeping stock out of the river and in some places new stands of native trees.

"Scheme irrigators have a supply agreement in place and stock farmers need to keep management plans to show how sediment, nitrogen and phosphorus is being controlled.

"Nitrogen loading had an interesting solution. The load was large enough for the development expected under the irrigation scheme. They gave us a permitted allocation to cover existing farming activities but some of the more intensive operations needed to apply for a consent to leach more. The storage scheme got their allocation that way too."

"Seems reasonable," I say.

"There are still pockets in the catchment where nutrient levels get high, so sometimes there's algae and slime in the river. But water quality is better overall and there's more whitebait in the lower part of the Tukituki."

"So that's what we're having for lunch?" I grin hopefully.

Scenario Settings

RIVER FLOWS	Minimum Flow (l/sec)	Level of Habitat / Species Protection
Tukituki at Red Bridge	5200	90% / trout
Waipawa at SH2	2500	90% / longfin eel
Tukituki at Tapairu Rd	2300	90% / longfin eel

WATER QUALITY Management Classification Nitrate Concentration (mg/L)	Annual Median Limit (current)	Chronic Maxima 95th percentile Limit (current)	Annual Average Limit (current)
Zone 4 Waipawa at SH50 (Maintain biodiversity)	-	-	0.14 (0.148)
Zone 4 Tukituki at SH50 (Maintain biodiversity)	-	-	0.14 (0.134)
Zone 2 Waipawa at SH2 (Good - 90%)	3.6 (0.719)	5.1 (1.3)	
Zone 3 Tukituki at SH2 (Good - 90%)	3.6 (1.3)	5.1 (2.4)	
Zone 1 Tukituki at Shag Rock (Very Good - 95%)	2.3 (0.925)	3.6 (2.050)	
Zone 1 Tukituki at Red Bridge (Very good - 95%)	2.3 (0.673)	3.6 (1.705)	

Choice C

Choice C: Future Outcomes

What would our future look like with some environmental improvement and access to stored water?

Environmental

Upper Tukituki and Waipawa rivers support high quality spawning habitat and maintain biodiversity.

There is a loss of spawning habitat in the Makaroro River and other biophysical effects downstream of the reservoir to the distribution intake that cannot be practicably avoided.

Restoration and enhancement initiatives around the storage reservoir, riparian enhancement downstream and stream enhancement and phosphorus mitigation in the spring-fed stream that drain the eastern edge of the plains will enhance aquatic ecology.

Other streams across the Ruataniwha Plains provide suitable habitat to support adult trout and native fish and spawning habitat through suitable nitrate and minimum flow levels.

Very good conditions for inanga spawning in the Lower Tukituki are available.

The risk of effect from nitrate toxicity will be:

- No more than very low for juvenile trout, and negligible for all other aquatic species in the Ruataniwha Plains streams;
- Negligible for all aquatic species in the rest of the catchment.

Elevated concentrations of nitrate in the shallow groundwater near the eastern edge of the basin and around Takapau Plains are likely under more intensive land uses.

Periphyton growth will be reduced compared to the current situation, but less than in scenarios without the water storage in place. Excluding stock from waterways will also improve water quality and habitat. Phosphorus mitigation on farms with irrigation water from the scheme will minimise farm losses.

Seven migratory native fish species will require fish passage above the dam to continue to sustain populations. If fish passage is not provided, the loss of these populations as a result of the dam is not expected to increase the threat of extinction from elsewhere in the catchment.

With storage in operation and none of the existing irrigators taking from storage, downstream flows are altered:

- Flows in the Tukituki at Tapairu Rd increase slightly over the full range of flows.
- Flows in the Waipawa River at SH2 reduce by 16-25% over mid range flows and the Q99 flow increases by 13%. This is the flow that the river will be above, 99% of the time. The Mean Annual Low Flow is reduced slightly.
- Flows in the Tukituki at Red Bridge reduce slightly in the mid range flows and the Q99 flow increases by 7%. The Mean Annual low flow is slightly reduced.
- The number of days the flow will be below the proposed minimum flow Waipawa at SH2 and Tukituki at Red Bridge increases by an average 7 and 3 days respectively.

Economic

Reliable water 19 years in 20 for new irrigated enterprises. This level of reliability provides new irrigators with the certainty and confidence to convert to more intensive farm systems. This certainty allows these farmers to avoid wastage by moving from “just in case” to” “just in time” watering.

Minimum flow bans are still relevant for some existing irrigators as are tightened allocation limits.

Under this scenario, the losses of production due to minimum flow requirements will be slightly more than experienced under Choice A (due to the impact of the storage scheme on low flows and higher minimum flows) with on farm impacts are estimated to be $1.3 million per annum (after interest). The seasonal volume limitations will cost irrigators a further $1 million per annum (after interest).

With the storage in place, despite the reduction in

Refer Key Supporting Reports: Reports 4, 5, 8, 9, 16, 17, 23, and 25-33

Choice C: Future Outcomes

What would our future look like with some environmental improvement and access to stored water?

reliability for existing irrigators, the overall on farm productivity gains translate into improved farm profit (after interest) of approximately $20 million per annum.

The on-farm impacts are magnified at the regional level. There is a very significant gain from the new irrigation, which is only slightly offset by the impacts of reduced reliability. In total regional GDP is expected to increase by $320 million in this scenario from the current situation.

The flow on impacts to household income is expected to increase by $160 million, and employment is expected to increase by 2600 FTEs associated with increased farming activity and its flow on impacts.

During construction the combined effect of both on and off farm investment (approx $600+ m) contributes approximately $350m to GDP and an additional 3,800 job years of work. These impacts will likely be focussed around the early years of the scheme when the dam construction and most on farm investment is expected to take place.

Any new processing operation, such as milk or vegetable processing is likely to have a positive effect on the centre in which it is located

It is very likely that workers constructing the dam, headworks and on-farm works will be a combination of those already living in the district and those commuting from further afield. The effect of the increase in employment and economic activity will be noticeable as it flows into towns that are currently struggling with people leaving town, businesses failing and schools with falling rolls.

A boost to the district and regional economy with an increase in economic activity relating to farming and some diversification of the economic base with greater robustness in the face of periodic droughts.

An increased demand for retail, veterinary and farm services in Waipukurau and Waipawa.

An increase in local transport firms in this district and decentralisation of services.

Increased impetus to broadband development through land use intensification and economic activity.

Increased costs of maintaining local roads.

Social

Reduced average age of farmers

New families coming into the area

Land use changes will have the effect of increasing the number of farmers, farm managers, farm workers and people working in farm contracting.

Strengthening determinates of health particularly through reduced unemployment and increased opportunities for youth.

Reduced dependence on benefits amongst working families

Some loss in amenity values in flooded valley but the gain of new amenity values for reservoir lake.

Some risk of reduced values for surface water if there is poor nutrient management

Successive ownership and land use changes occurring in waves after the introduction of irrigation and occurring over an extended period of time (perhaps a generation).

Turnaround from negligible growth evident in the district over recent years

Sports and community organisations get a boost from new members and provide a basis for building community attachment and support

Potential for enhanced agricultural and horticultural training in support of land use change with irrigation.

Opportunities to add career options for high school students and youth, including disadvantaged youth.

Change in the composition of the population with younger families and children and consequent rises in school rolls.

Increased participation in sport and recreation and community activities.

Choice C: Future Outcomes

What would our future look like with some environmental improvement and access to stored water?

A greater demand for social services, including health services.

Opportunities for technology transfer on farms around new farming systems, water and nutrient management and environmental management.

Opportunities for local business training and support.

A social management plan is needed to ensure opportunities from this major infrastructural investment are realised (social impact report).

Flow-on effect in growth of numbers employed in any new processing plant associated with increased farm outputs.

Increased health and safety risks from intensified production and increased road traffic.

General improvement in housing and neighbourhoods over time with the flow on from employment and higher incomes.

An increase in population based funding and services including schools.

Boost to community participation, leadership and engagement.

The landscape in Choice D reflects significant environmental improvement with stored water

The Situation:

Minimum flows increase but irrelevant to existing irrigators moving to storage

Surface water and groundwater allocation limits lowered as existing irrigators migrate to storage. New limits set to meet reasonable public and industrial water demand

Ruataniwha Water Storage Scheme available to new irrigators

Land use intensification can occur

Choice D

Choice D: A Sunday Drive in 10 Years Time

Mark reflects on a landscape with some environmental improvement and access to stored water

It's good to be driving with the aircon on full. It's your typical Hawke's Bay summer day; the heat haze distorts the distant fields. But the place looks different. The pasture is green and fresh, not the usual burnt gold, and tractors are busy sowing the second round of process crops.

"Now that we have water year round instead of worrying about what a couple of dry seasons can do, they can plan ahead with their business and run different types of farming," he explains. "Over 25,000 hectares irrigated now, compared to the 6,000 odd before the scheme."

On the other side of SH50, Mark points out where prime lambs are being finished ready for export. His old farm is now part of a large farm enterprise which includes arable cropping.

"Central Hawke's Bay lamb is an international brand now, isn't that something! It's different from the old days when I went into dairying, where the money was then."

"The water storage investors - the council, the government and others – were smart and came up with a great package for existing irrigators. It was a good solution for me at that stage of my life, with no one to pass the farm onto. I leased the farm out to someone to take it into the next era."

Mark waves to the guy moving stock in the paddock.

"So what are you doing with all your spare time? It can't be easy giving up farming," I ask cautiously.

"Me? I'm just as busy. I help out at the Ongaonga community centre giving practical advice to newcomers. It's great! I keep in touch and I'll tell ya, even though I'm not actually farming, it feels good to give back to this community and be part of its future," Mark says.

He explains the master plan put together by the social agencies, Hāpu groups and the local district council. "It was a real challenge at the beginning - the community wasn't used to change. Many adapted, some moved on, and lots of new families came. We had to work hard to help the community make the most of new opportunities for work, housing, services and the like."

"You know, there's all the stuff that you don't normally think about until a community booms! The chance to get secure water for irrigation was so good that inside of five years, all us irrigators had done it. And the Council acted fair by sinking the lid on the allocation caps behind us so no-one else could apply for the water that we gave up.

The old minimum flows are obsolete on the plains now. With no irrigation out of the rivers or groundwater, and the flow out of the reservoir being maintained all year round, river flows are higher in summer than they've been for decades. That's been good for lots of other reasons."

Mark heads his wagon away from the irrigation scheme area towards Waipawa.

"You'll be interested in what's happening in the lower Tukituki valley. Higher summer flows have been a big bonus for the irrigators here too. They still face tough limits at the Red Bridge monitoring site, but the higher river flows means they can irrigate for longer in these hot dry summer months. So business is better."

Mark stops at his favourite fishing spot, but it's too hot and bright to fish now. We slip off our shoes and step into the cool water. Downstream, a group of teenagers show off at a clear, deep water hole near a new stand of native trees.

"The dam may have flooded some pretty nice bush upstream but we've made up for that and improved the whole river, I reckon. Trampers still go up into the hills to enjoy the Ruahine Forest Park, but now there's views across the new lake, and the sailing and kayaking we never had before." Mark splashes his face and brushes his hands dry on his pants.

"It's quite an achievement all round," I say.

"Yep, the storage dam looked like a difficult balance, but she's a good one to my mind...ka pai. C'mon... we'd better get out of this heat before we fry. And we don't want my daughter telling us off being late. She promised me prize-winning Hawke's Bay lamb and trout."

"Prize-winning?" I say, as we scramble up the bank.

Scenario Settings

RIVER FLOWS	Minimum Flow (l/sec)	Level of Habitat / Species Protection
Tukituki at Red Bridge	5200	90% / trout
Waipawa at SH2	2500	90% / longfin eel
Tukituki at Tapairu Rd	2300	90% / longfin eel

WATER QUALITY Management Classification Nitrate Concentration (mg/L)	Annual Median Limit (current)	Chronic Maxima 95th percentile Limit (current)	Annual Average Limit (current)
Zone 4 Waipawa at SH50 (Maintain biodiversity)	-	-	0.14 (0.148)
Zone 4 Tukituki at SH50 (Maintain biodiversity)	-	-	0.14 (0.134)
Zone 2 Waipawa at SH2 (Good - 90%)	3.6 (0.719)	5.1 (1.3)	
Zone 3 Tukituki at SH2 (Good - 90%)	3.6 (1.3)	5.1 (2.4)	
Zone 1 Tukituki at Shag Rock (Very Good - 95%)	2.3 (0.925)	3.6 (2.050)	
Zone 1 Tukituki at Red Bridge (Very good - 95%)	2.3 (0.673)	3.6 (1.705)	

Choice D

Choice D: Future Outcomes

What would our future look like with significant environmental improvement and access to stored water?

Environmental

Upper Tukituki and Waipawa rivers support high quality spawning habitat and maintain biodiversity.

There is a loss of spawning habitat in the Makaroro River and other biophysical effects downstream of the reservoir to the distribution intake that cannot be practicably avoided.

Restoration and enhancement initiatives around the storage reservoir, riparian enhancement downstream and stream enhancement and phosphorus mitigation in the spring-fed stream that drain the eastern edge of the plains will enhance aquatic ecology.

Other streams across the Ruataniwha Plains provide suitable habitat to support adult trout and native fish and spawning habitat through suitable nitrate and minimum flow levels.

Very good conditions for inanga spawning in the Lower Tukituki are available.

The risk of effect from nitrate toxicity will be:

- No more than very low for juvenile trout, and negligible for all other aquatic species in the Ruataniwha Plains streams;
- Negligible for all aquatic species in the rest of the catchment.

Elevated concentrations of nitrate in the shallow groundwater near the eastern edge of the basin and around Takapau Plains are likely under more intensive land uses.

Seven migratory native fish species will require fish passage above the dam to continue to sustain populations.

If fish passage is not provided, the loss of these populations as a result of the dam is not expected to increase the threat of extinction from elsewhere in the catchment.

With storage in operation and all existing irrigators taking from storage, downstream flows have improved overall:

- Flows in the Tukituki at Tapairu Rd increase over the full range of flows.
- Flows in the Waipawa River at SH2 reduce by 14-22% over mid range flows and increase by up to 24% over the low flow range.
- Flows in the Tukituki at Red Bridge reduce slightly in the mid range flows but significantly increase flows over the low flow range.
- The number of days the flow will be below the proposed minimum flow of 5200 l/sec at Red Bridge reduces from an average of 26 days to 15 days

Economic

Reliable water 19 years in 20 for new irrigated enterprises. This level of reliability provides both new irrigators and existing irrigators within the scheme service area with the certainty and confidence to convert to more intensive farm systems. This certainty allows these farmers to avoid wastage by moving from "just in case" to" "just in time" watering.

The on farm productivity gains translate into improved farm profit (after interest) of approx $20 million per annum.

Minimum flow bans are still relevant for some existing irrigators located outside the irrigation scheme service area, as are tightened allocation limits. The improved flows resulting from existing irrigators converting to storage does not quite offset the higher minimum flows, with reliability for irrigators similar to Choice A and worse than current.

Without alternative water supplies, existing irrigators located in Zone 1 will face a small decline production and profit outcomes (but less than under Choice B or C). The potential on farm impacts attributed to this decline are estimated to be $0.5 million/annum (after interest).

The on-farm impacts are magnified at the regional level after the economic multiplier effect is considered. Total regional impacts attributed to the

Refer Key Supporting Reports: Reports 4, 5, 8, 9, 16, 17, 23, and 25-33

Choice D: Future Outcomes

What would our future look like with significant environmental improvement and access to stored water?

new and existing irrigators (using storage) is +$270 m in GDP throughout the regional economy.

Improved household income of $130m and increased employment of 2100 FTEs.

Possible employment opportunities during the construction phase of the dam. It is very likely that workers constructing the dam , headworks and on-farm works will be a combination of those already living in the district and those commuting from further afield. Expenditure on project construction, including the workforce will have a positive flow on effect into local businesses, and the district and regional economies.

More intensive land uses and increased farm viability and on farm employment typically leads to an increase in employment off farm through employment in farm services and indirect and induced employment in other sectors. The effect of the increase in employment and economic activity will be noticeable as it flows into towns that are currently struggling with people leaving town, businesses failing and schools with falling rolls.

During construction the combined effect of both on and off farm investment (approx $600+ m) contributes approximately $350m to GDP and an additional 3,800 job years of work. These impacts will likely be focussed around the early years of the scheme when the dam construction and most on farm investment is expected to take place.

Any new processing operation, such as milk or vegetable processing is likely to have a positive effect on the centre in which it is located.

A boost to the district and regional economy with an increase in economic activity relating to farming and some diversification of the economic base with greater robustness in the face of periodic droughts.

An increased demand for retail, veterinary and farm services in Waipukurau and Waipawa. An increase in local transport firms in this district and decentralisation of services. Increased impetus to broadband development through land use intensification and economic activity.

Increased costs of maintaining local roads.

Social

Reduced age of farmers

New families coming into the area

Land use changes will have the effect of increasing the number of farmers, farm managers, farm workers and people working in farm contracting.

Strengthening determinates of health particularly through reduced unemployment and increased opportunities for youth.

Reduced dependence on benefits amongst working families.

Some loss in amenity values in flooded valley but the gain of new amenity values for reservoir lake.

Some risk of reduced values for surface water if there is poor nutrient management

Successive ownership and land use changes occurring in waves after the introduction of irrigation and occurring over an extended period of time (perhaps a generation).

Quicker turnaround from negligible growth evident in the district over recent years.

Sports and community organisations get a boost from new members and provide a basis for building community attachment and support.

Potential for enhanced agricultural and horticultural training in support of land use change with irrigation.

Opportunities to add career options for high school students and youth, including disadvantaged youth.

Change in the composition of the population with younger families and children and consequent rises in school rolls.

Increased participation in sport and recreation and community activities

A greater demand for social services, including

Choice D: Future Outcomes

What would our future look like with significant environmental improvement and access to stored water?

health services

Opportunities for technology transfer on farms around new farming systems, water and nutrient management and environmental management.

Opportunities for local business training and support.

A social management plan is needed to ensure opportunities from this major infrastructural investment are realised.

Flow on effect in growth of numbers employed in any new processing plant associated with increased farm outputs.

Increased health and safety risks from intensified production and increased road traffic.

General improvement in housing and neighbourhoods over time with the flow on from employment and higher incomes.

An increase in population based funding and services including schools.

Boost to the participation, leadership and community engagement.

Cultural

Increases in minimum flows will improve the habitat availability for taonga species including longfin eel, koaro and bluegill bully over the summer months.

Summer flows are further enhanced as a result of the flow regime produced by storage and no water being taken for irrigation from groundwater and surface water. The ceased groundwater abstraction will also have positive impacts on wetlands and waipuna (freshwater springs), returning them to natural flows.

The storage will have capacity for up to four flushing flows to maintain natural flow variability and also to help remove any periphyton growths in the Makaroro and Waipawa.

In-stream nitrate concentrations will support inanga spawning and migratory native fish including taonga species.

Storage and irrigation scheme infrastructure is potential investment for tangata whenua/iwi.

Employment opportunities associated with the storage and irrigation scheme are likely to have accentuated benefits for Māori in Central Hawke's Bay due to high Māori involvement in primary sectors including manufacturing and processing activities.

How Do They Rate?

We would appreciate your comments

Many of you will have heard presentations made on the Ruataniwha Water Storage project and the Tukituki Strategy through community group meetings, stakeholder group meetings, two water symposiums, Annual Plan and Long Term Plan processes, consent holder newsletters and one-on-one meetings. Some of the information contained in this discussion document and the supporting reports will be familiar to you, some will be new. There is a lot to take on board.

Many factors need to be balanced to make the right choice for the region's future. We have described four 'Choices' to consider. We value your assessment of the choices and how you would balance the factors to achieve the best outcome for our region.

Our Analysis

	Choice A	Choice B	Choice C	Choice D
Environmental	Good	Very Good	Good	Very Good
Economic	Fair	Poor	Excellent	Very Good
Social	Fair	Very Poor	Excellent	Very Good
Cultural	Good	Very Good	Good	Very Good

Your Analysis

	Choice A	Choice B	Choice C	Choice D
Environmental				
Economic				
Social				
Cultural				

The information contained in this report is derived from many technical reports and from Council's databases. Key reports are listed and numbered at the end of the document.

Key reports are referenced at the bottom of the page.

More information on:

Hydrology

Groundwater resources

Groundwater quality

Surface water quality and ecology

Soils and Land use

Assessment of Mauri

Surface Water Allocation Limits

Surface Water Allocation Limits

Minimum Flows

Groundwater Impacts on River Flows

Water Quality limits

Managing Periphyton

Phosphorus management

Stock Exclusions from Water

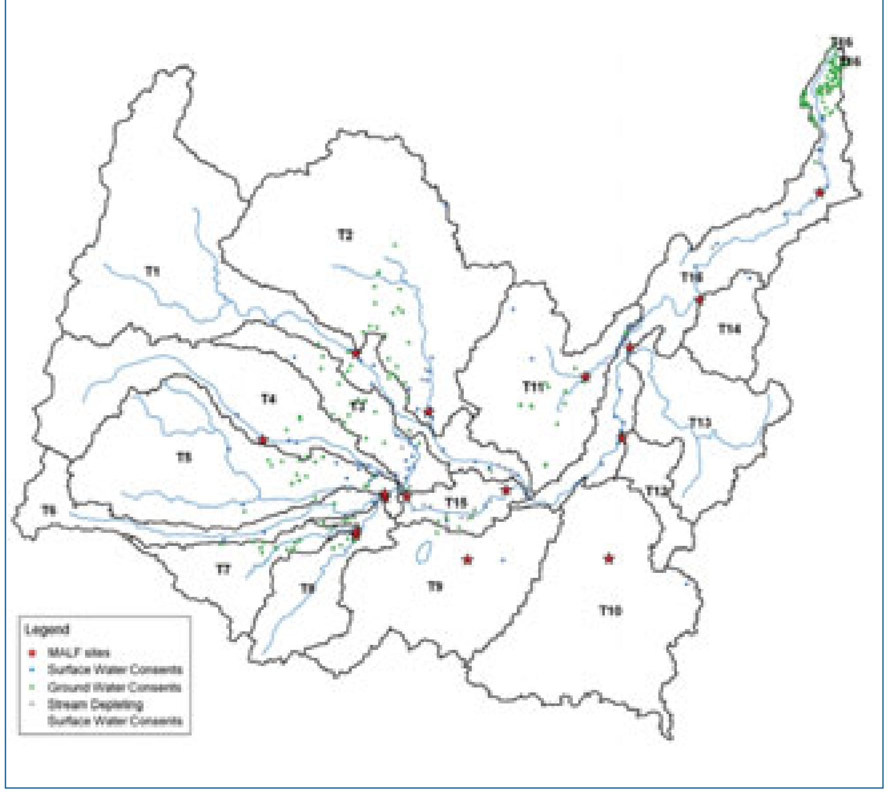
Nitrogen Management

Technical Information

Tukituki Hydrology

The Catchment

The Tukituki River Catchment is made up of 17 sub-catchments with different stream types. The headwaters originate in the Ruahine Ranges to the west which are wet (receiving more than 2 metres of rain per year) compared with the drier Hill Country sub-catchments to the east (which receive less than 1 metre of rain per year).



The Numbers

SITE	Mean Annual Low Flow (7 Day) (l/sec)		Long-term Mean Flow (l/sec)	
	Natural [1]	Recorded [2]	Natural [1]	Recorded [2]
Waipawa River at RD5 / SH2	3009	2839	14970	14949
Tukituki River at Tapairu Rd	2865	2534	15830	15150
Tukituki River at Red Bridge	6258	5902	44505	44544

Note 1: 'Natural' means that the hydrological statistic was determined based on flow data that has been 'naturalised'; that is, estimated abstractions during the time of measurement are added back in. It is as if there had been no abstractions.

Note 2: 'Recorded' means that it is the flow series as recorded at the date of measurement with the effect of any abstractions.

During low flows, about three quarters of the Tukituki River flow originates from the Ruahine Ranges.

Refer Key Supporting Reports: Report 16

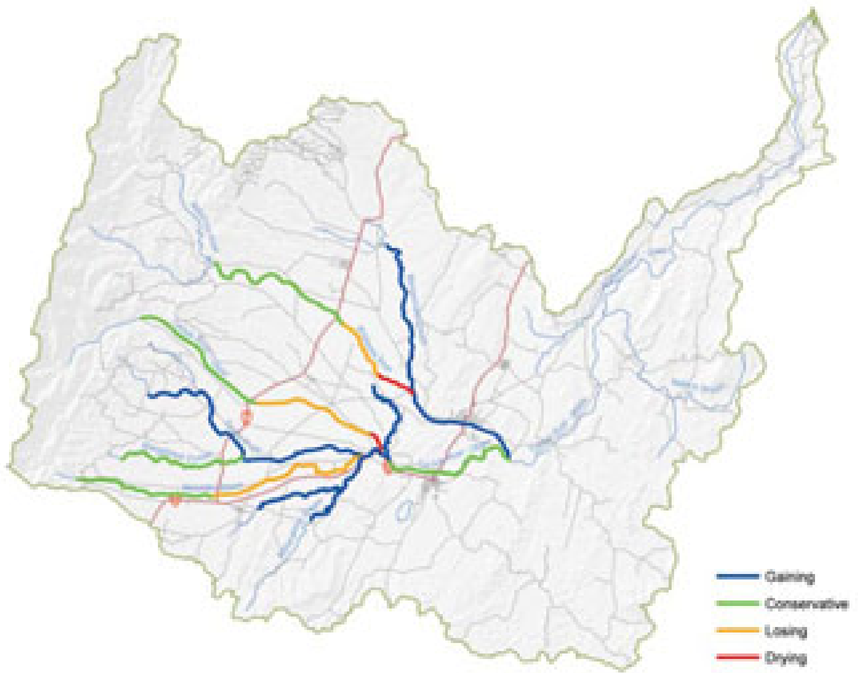
Tukituki Hydrology

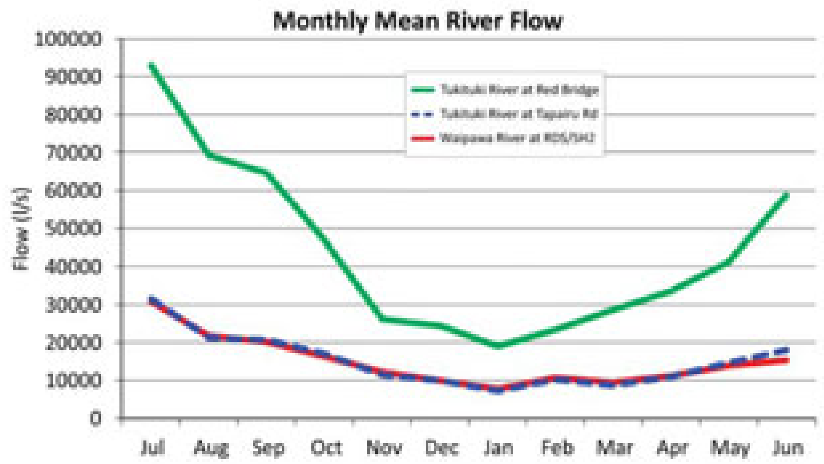
Stream Types

Gravel streams are sourced from the Ruahine Ranges with some reaches running dry where the river loses water to the Ruataniwha Aquifer. Hill country streams experience rapid floods and little baseflow, whereas groundwater fed streams flowing over the Ruataniwha Plains commonly have gaining reaches and a more reliable baseflow.

Seasonality

More rain in the winter combined with less evaporation produces higher winter river flows. Lower flows are typically experienced during November to May.





Groundwater and Aquifers

There are two main productive aquifers in the Tukituki Catchment, the Ruataniwha Basin and the Otane Basin.

There is a third aquifer system at the lower end of the catchment where the river intersects with the Heretaunga Plains system. This lower Tukituki aquifer system is not considered to have a significant influence on the management of the overall Tukituki catchment.

The Ruataniwha Aquifer

The Ruataniwha aquifer sits in a contained basin. Water enters the aquifer when rain falls on land and through losses in some parts of the rivers that cross the plains. Groundwater is generally moving in a west-east direction under pressure and all water leaves or discharges the basin, entering the Tukituki and Waipawa Rivers via springs or through the river bed. The rate of discharge depends on the pressure in the aquifer system.

Pumping groundwater can lower the pressure in the aquifer and this can reduce the rate of discharge into the river system.

The Lower Tukituki Aquifer system

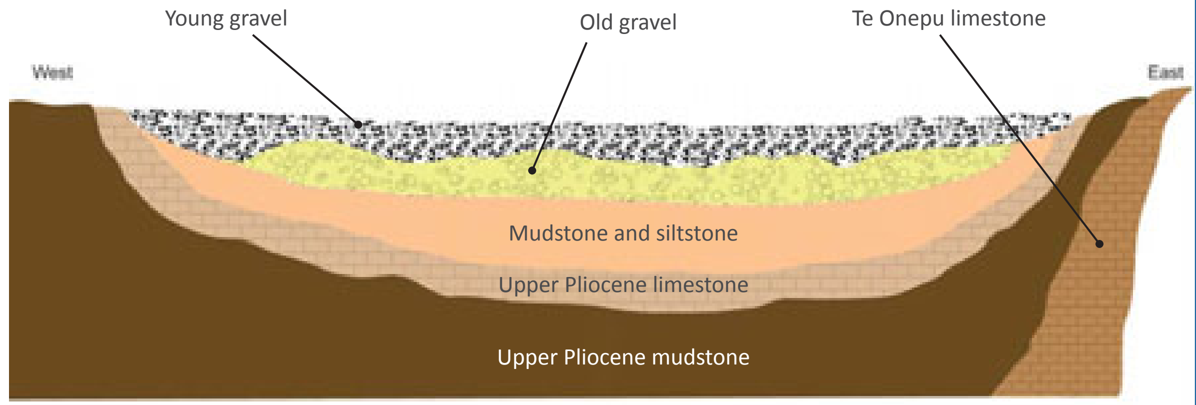
There are a number of domestic and irrigation bores tapping into the aquifer system near the mouth of the Tukituki River. It also appears to merge here with the gravel layers of the Heretaunga Basin aquifer system. There is little quantitative information about this aquifer system.

The majority of consents in Haumoana - Mangateretere area expire in 2022-25. Unless a current consent is linked to the Red Bridge minimum flow site, the groundwater consent is not included in the Tukituki groundwater allocation.

The Otane Basin

Groundwater can be found in most geological formations within the Papanui Catchment; however the most productive aquifer system appears to be within gravels located beneath both the old Waipawa River bed and the Papanui Stream. Well depths indicate the aquifer system is deeper at the southern end of the catchment near the middle of the old Waipawa River bed; in this area, wells penetrate gravels up to 50 metres deep. Further north, along the Papanui Stream, well lithology suggests alluvium is up to 30 metres thick. Toward the west, along Drumpeel Road in the middle of the catchment, the aquifer system grades into swampy deposits from the Quaternary. The general flow of groundwater within the aquifer is unknown but thought to move with the topographical gradient from southwest to northeast along the old Waipawa River bed.

Geological Cross-section of the Ruataniwha Basin



Groundwater Quality

Hawke's Bay Regional Council measures water quality in 42 monitoring wells in the major aquifer systems in the region on quarterly basis.

The samples are analysed for major physical, chemical and microbiological parameters. Nitrate-nitrogen (NO_3-N) and bacteria (Escherichia coli or E.coli.) are key indicators of the state of groundwater quality.

The New Zealand drinking-water standards have defined a maximum acceptable value (MAV) for Nitrate-Nitrogen of 11.3 mg/L. Half MAV is used as a threshold for nitrate (5.65 mg/L).

Shallow unconfined aquifers and other recharge areas are vulnerable to contaminants from activities that occur on the land surface. For primary production activities, those contaminants include bacteria and pathogens from animal wastes, nitrogen and phosphorus from fertilisers.

Monitoring in 2008 indicated that the mean nitrate concentration of the shallow monitoring bores sampled from the Ruataniwha aquifer was 3.05 mg/L. This is part of a 5 yearly monitoring programme.

Results from 2011 monitoring of bores taking water from a range of depths within the Ruataniwha aquifer system indicated the annual median concentration for nitrate was 1.55 mg/L. This is part of the State of the Environment monitoring programme.

Bacteria monitoring in 2011 showed no indication of bacterial contamination in the Ruataniwha aquifer except for one site which had an elevated concentration.

Surface Water Quality & Ecology

Monitoring indicates that the microbiological water quality and water clarity is generally good across the catchment.

Both are better than national median values for comparable systems (www.landandwater.co.nz) - and improving over time. This indicates a low health risk to river users from pathogens of faecal origin.

Nutrient enrichment and associated periphyton growth is the largest issue in the Tukituki Catchment resulting in a general degradation from upstream to downstream in the catchment. The hydrology of the catchment means there can be extremely long periods of periphyton accrual. This means that there will always be elevated growths at times, even if nutrient levels are low.

Macroinvertebrate communities show a similar pattern of degradation going down the catchment although high summer water temperatures in the lower Tukituki would go some way to explain this pattern, as aquatic animals with low tolerance to high water temperatures would be lost from the river during these periods.

Nutrient concentration ratios indicate that the main river corridor is generally phosphorus limited, although periods of co-limitation or N-limitation are possible at some sites during low flows.

The upper Tukipo Stream above SH50 does not have as good water quality as the other upper catchment sites and significant long-term increases in phosphorus and nitrogen have been detected. However in most recent years (2004-2011) the status has slightly improved with phosphorus levels decreasing by 6% and nitrate levels not showing a significant increasing or decreasing trend.

Both the Mangatarata Stream and the Papanui Stream have very high levels of phosphorus although flows from the Mangatarata Stream over summer are very low. In the case of the Mangatarata Stream the phosphorus appears to originate largely from Lake Whatuma (Hatuma).

Soil & Land Use

Soils are a vital resource for Hawke's Bay.

They store and filter water, recycle nutrients and provide the medium in which to grow the crops, pastures, vineyards and plantations which drive the region's economy.

Like water, high-quality soils are finite resources which need to be well-managed to ensure their productive capacity is maintained.

The soils of the Tukituki catchment support, and are suited to, a wide range of land uses, from the extensive sheep and beef farms of the eastern hill country, to the intensive grazing, cropping and horticulture on the Ruataniwha Plains.

The Land Use Capability Classification illustrates versatility of land from highly versatile Class I, to the limited versatility of Class VIII.

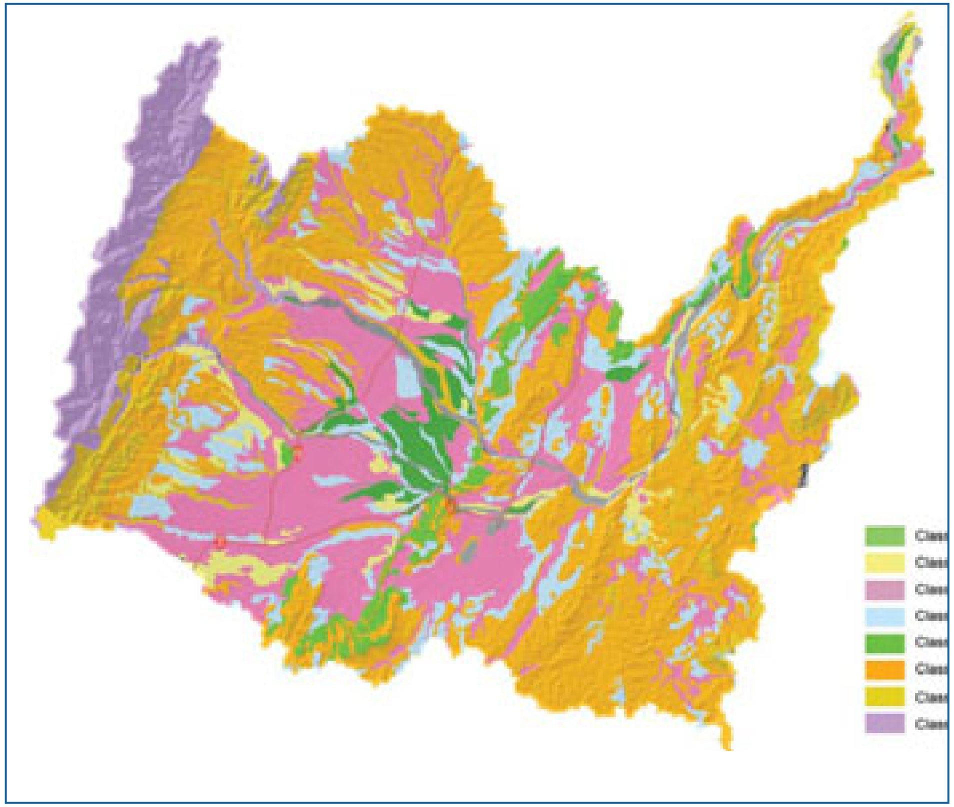
The Ruataniwha Plains comprises of a diverse patchwork of soils formed from alluvium, loess and colluvium of different properties, ages and depths. Many of these soils are highly productive. Elsewhere soil potential is limited by waterlogging, or insufficient water for crops and pastures.

Careful management is required to ensure that:

- nutrient application does not exceed plant requirements
- land use is closely matched to the productive properties of soil type
- stock are kept out of waterways
- soil loss through erosion is minimised, and
- on farm practices which prevent nutrient loss to waterways are adopted

In areas where soils are susceptible to wind erosion, practices like no-tillage cultivation and grazing management, which ensure soil groundcover is maintained, need to occur.

Land Use Capability Classes of the Tukituki River Catchment



Assessment of Mauri

One of the recommendations from the Cultural Values and Uses report is the restoration of the mauri of the waterways.

The mauri, vitality or inner life-force of the waterways in the Tukituki catchment is inseparable from the vitality and life-force of the tangata whenua. It is the duty of mana whenua, as kaitiaki (guardians), to honour that which their Tūpuna (ancestors) left in their care, and to protect the mauri.

As well as spiritual elements, mauri also relies on appropriate river flow, good water quality, availability of mahinga kai (food gathering places) and whether taonga (highly prized) species are present.

Attribute of mauri	How mauri can be improved
Water depth, minimum flow	Increase minimum flow
Mahinga kai quality and availability	Improve habitat for species such as longfin eel
In-stream nutrients	Reduce nutrient load from point source and non-point source discharges
Native fish species presence	Ensure in-stream water quality parameters, particularly nitrate toxicity ,allow native species to thrive
Natural flow and flow variability	Ensure water takes do not significantly alter river flows and improve flow variability by reducing the length of time flows are at or near minimum flow
Health of waipuna (freshwater springs) and aquifer quantity and quality	Ensure groundwater abstraction is sustainable and mitigations are implemented to minimise nutrient leaching
Wetland health	Ensure water takes do not drop the water table too low as to adversely affect wetlands

Mauri health can therefore be considered in terms of waterway health.

In 2011 and 2012, Ngā Taiwhenua o Heretaunga raua ko Tamatea assessed the mauri of the Tukituki River. They found that:

- Flows are well below what is sustainable for tuna and other taonga to survive and thrive
- There has been a decline in mahinga kai quality and loss of taonga species
- Tuna / Eel habitat is significantly degraded
- River banks and margins have been degraded by stock
- The mauri of the river is severely impacted by effluent from the Central Hawke's Bay oxidation ponds
- Wetlands are degraded by introduced species (e.g. willows) and low water levels caused by water abstraction.

Maintaining or improving mauri is a key evaluation criteria for the Tukituki Choices scenarios. The attributes of mauri and how they can be addressed are shown in the table.

Surface Water Allocation Limits

Setting a Surface Water Allocation limit

Setting a surface water allocation limit reduces the risk of 'flatlining' the river at the minimum flow for extended periods. There is no national standard for setting allocation limits although some guidance has been provided by the Ministry for the Environment who suggest a default allocation limit based on 50% of the mean annual low flow (MALF) for rivers with a mean flow of over 5000 litres per second. The current level of allocation for surface water takes is close to 50% MALF.

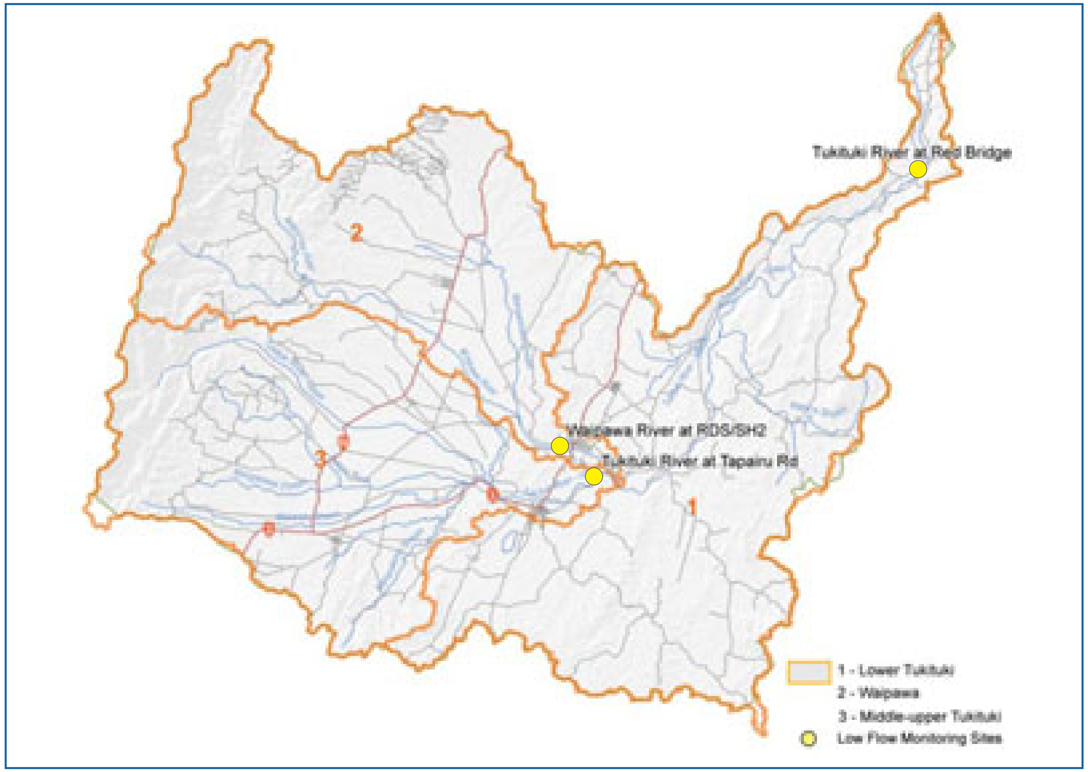
Surface Water Allocation in the Choices

The surface water allocation limit will be the same in each Choice except that it will reduce in Choice D as existing irrigators move to storage.

Allocation limits have been based on current consented surface water take allocation adjusted to a seasonal allocation. Surface water allocation includes river takes and any groundwater takes which impact on river flows within a short period of time ('immediate effect' groundwater takes, also referred to as direct stream depleting groundwater takes).

Irrigators indicated through previous planning processes that they need water security for 9 years in every 10. Current irrigators do not have that level of security of supply from surface water and connected groundwater supplies.

For irrigation takes, it is proposed that consents will specify a monthly (or 4 weekly) limit and seasonal limit as a condition of consent.



Surface water allocation limit by zone	Minimum flow site	Maximum take rate (l/sec)	Annual allocation (cubic metres x 10^3)
Zone 1	Tukituki @ Red Bridge	1068	4688
Zone 2	Waipawa @ SH2	908	7298
Zone 3	Tukituki @ Tapairu Rd	1128	8371

Refer Key Supporting Reports: Report 18

Groundwater Allocation Limits

Setting a Groundwater Allocation Limit

Where groundwater is connected to surface water as is the case in the Ruataniwha Basin, the management objectives for the river will influence the groundwater allocation limit and the need to set a water level /pressure threshold to meet those objectives.

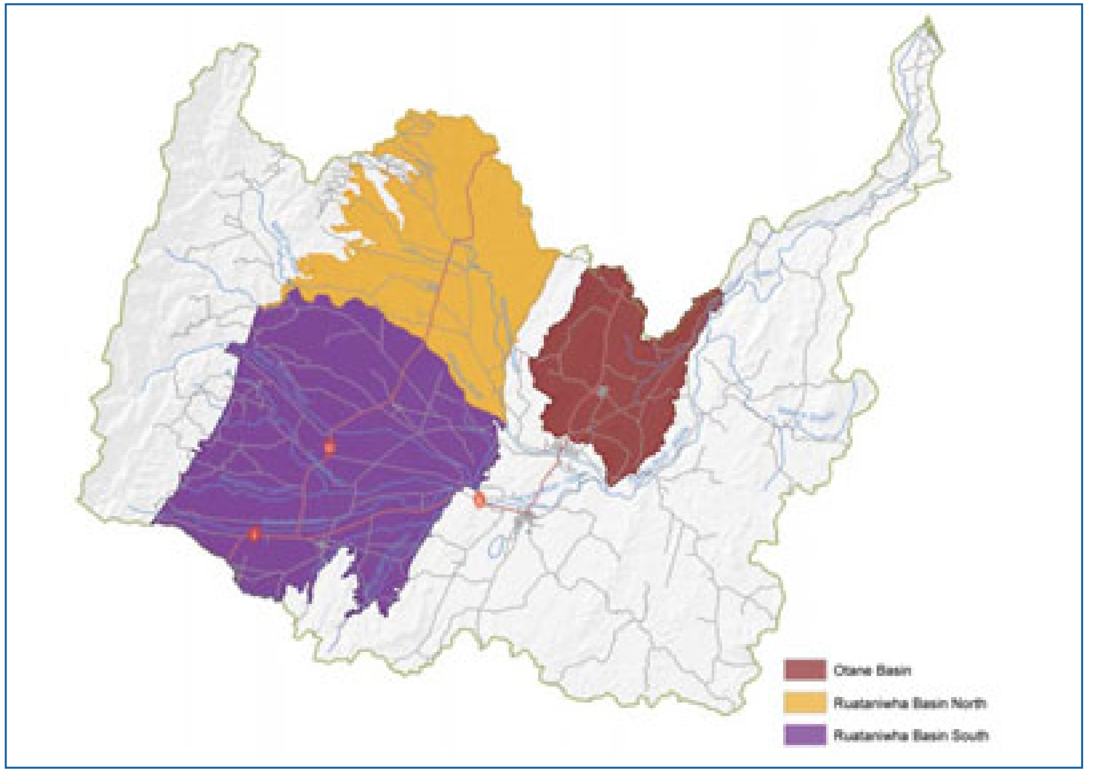
The effect of the current groundwater takes on the river have been modelled. Higher minimum flows are likely to be warranted to minimise the impact of the effects over the low flow period.

Groundwater Allocation in the Choices

The groundwater allocation limit for each zone will be the same in each scenario.

Allocation limits have been based on current consented groundwater take allocation adjusted to a seasonal allocation. We know that taking groundwater from the Ruataniwha Basin reduces the river flow. Groundwater takes are defined as 'delayed effect' groundwater takes (also refered to as indirect stream depleting groundwater takes).

For irrigation takes, it is proposed that consents will specify a monthly (or 4 weekly) limit and seasonal limit as a condition of consent.



Surface water allocation limit by zone	Aquifer	Annual allocation (cubic metres x 10^3)
Zone 1	Otane Basin	2,553
Zone 2	Ruataniwha Basin north of Waipawa River	5,278
Zone 3	Ruataniwha Basin south of Waipawa River	16,167

Minimum Flows

Setting a Minimum Flow

The starting point for setting a minimum flow is to identify the critical fish species that the river is to be managed for, and to assess how much flow is required in order to maintain enough area for the fish to live in (physical habitat).

Physical in-stream habitat assessments have been undertaken for a number of species in the Tukituki River Catchment. Trout and longfin eel were identified as the critical species requiring protection. A high value fishery would warrant setting a minimum flow to achieve a high level of habitat availability. For a lower value fishery, a lower level of habitat availability, i.e., a lower minimum flow, might be acceptable.

Minimum Flows in the Choices

For all Choices, the minimum flow is set at 90% habitat protection except for Choice A, where the minimum flow for Tukituki River at Red Bridge is set at 80% habitat protection, as shown in the table.

Based on the latest in-stream habitat assessment methodology, it is clear that the existing minimum flow at Red Bridge is inadequate to support the trout fishery. Retaining the current minimum flow, or reducing the current minimum flow further is not acceptable, if adequate habitat is to be ensured. As a consequence, Choices A-D all consider an increase in minimum flow threshold.

Minimum flow as a management tool

The minimum flow is the flow at which irrigators, being the largest users by volume, would be required to stop taking water. Minimum flows impact on the security of supply for irrigators – this impact needs to be considered when setting minimum flows. The impact of the proposed minimum flows compared to the current minimum flows is shown in the lower table below. The impact is considered in terms of frequency of occurrence of the flow being less than the minimum flow for more than 10 consecutive days, over the January-February period.

Flow Management Site	Critical Species	Current	Choice A	Choice B, C and D
Tukituki @ Red Bridge	Trout	3500	4300	5200
Waipawa @ SH2	Longfin eel	2300	2500	2500
Tukituki @ Tapairu Rd	Longfin eel	1900	2300	2300

Impact of minimum flow limits on water security	Current Minimum flow l/sec	Frequency of year with a period where flow less than minimum flow for more than 10 consecutive days (Jan-Feb)	Proposed minimum flows in Choices (l/sec)	Frequency of year with a period where flow less than Minimum flow for more than 10 consecutive days (Jan-Feb)
Tukituki at Red Bridge	3500	1 in 13	4300	1 in 7.8
Tukituki at Red Bridge	3500	1 in 13	5200	1 in 3
Waipawa at SH2	2300	1 in 4.3	2500	1 in 3
Tukituki at Tapairu Rd	1900	1 in 3	2300	1 in 2

Note: Frequency data is based on flow series impacted by groundwater takes.

Refer Key Supporting Reports: Reports 16, 17 and 19

Groundwater Impacts on River Flows

Any water pumped from groundwater in the Ruataniwha Basin will affect the volume and rate of water that leaves the Basin. This means that all groundwater takes affect river flows, some to a greater extent than others. Groundwater modelling predicts that groundwater abstraction has the greatest impact on river flows during the summer months and the least impact during the winter.

Groundwater takes with a more immediate impact on river flows are considered part of the surface water allocation and are generally linked to a minimum flow condition. Groundwater takes with a delayed longer term impact are not. These are often taking deeper groundwater and/or are some distance from the river. Minimum flows are not an appropriate management tool for the 'delayed effect' groundwater takes.

Because of the delayed effect, the impact of reduced flows continues after pumping from groundwater stops.

This has two flow-on effects:

- The impact of the 'delayed effect' groundwater takes on the security of supply for surface water takes
- The impact of the 'delayed effect' groundwater takes on natural flows below the minimum flow cut-off (after surface water takes have stopped).

Impact of 'delayed effect' groundwater takes of security of supply for surface water takes

The table below shows the impact of groundwater takes on the average number of days the river would be below the minimum flow (current and proposed) when compared to the river flow if there were no groundwater takes. This equates to the average number of days that surface water takes would need to stop irrigating.

The reduction in river flow caused by the 'delayed' groundwater takes results in the minimum flow being reached sooner and takes longer to return above the minimum flow. The effect ranges between 1.4 – 6.7 additional days on average for current minimum flows to between 2.3 – 5.2 for the proposed minimum flows. Note that these are not necessarily consecutive days.

Impact of 'delayed effect' groundwater takes on flows below minimum flow

The impact of 'delayed effect' groundwater takes on natural flows when they are below the minimum flow cut-off can further reduce the amount of physical habitat available to fish. This impact has been assessed as being in the order of a 5-10% reduction. In a prolonged low flow period this reduction could lead to adverse biological responses in fish species but it can be buffered by setting a higher minimum flow.

		Groundwater Abstractions Off	Groundwater Abstractions On
Site	Minimum Flow (MF) (l/sec)	Average no. of days per year flow less than or equal to MF (Jan-Feb)	Average no. of days per year flow less than or equal to MF (Jan-Feb)
Waipawa River at RDS/SH2	2300 (Current)	3.8	7.1
	2500 (Proposed)	6.5	9.6
Tukituki River at Tapairu Rd	1900 (Current)	3.1	9.8
	2300 (Proposed)	8.2	13.4
Tukituki River at Red Bridge	3500 (Current)	0.3	1.7
	4300 (Proposed)	2.1	4.4
	5200 (Proposed)	5.9	10.3

Water Quality Limits

Water Quality Guidelines

Water Quality Guidelines are commonly used for setting water quality limits for different management purposes. Examples include:

Australian and New Zealand Guidelines for Fresh and Marine Water Quality guidelines (ANZECC 2000 guidelines)

Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas 2002

New Zealand Periphyton Guidelines: Detection, Monitoring and Managing Enrichment of Streams (Biggs, 2000)

In 2009, NIWA undertook a literature review of the nitrate toxicity research and prepared a set of guidelines for Ecosystem protection based on the methodology contained in the ANZECC guidelines for Canterbury Regional Council. In 2012, HBRC engaged NIWA to undertake nitrate toxicity research on two New Zealand species to improve the robustness of the Nitrate-nitrogen toxicity guidelines for New Zealand freshwater ecosystems and to support the development of site-specific guidelines for the Tukituki catchment.

Application of the Guidelines in the Tukituki Catchment

When determining relevant water quality limits for the water management objectives in the Tukituki Catchment, each guideline is considered.

The Recreational Water Quality Guidelines for Marine and Freshwater Recreational Areas will be used to ensure that we can engage in contact recreation without unacceptable health risk.

The ANZECC guidelines will be used for many of the standard physico-chemical variables associated with maintaining the life-supporting capacity of the ecosystem and for amenity purposes such as pH, dissolved oxygen concentration and visual clarity.

Managing excessive periphyton growth also allows contact recreation, amenity and ecosystem objectives to be met. This requires managing the concentrations of nutrients which promote plant growth – nitrogen and phosphorus. Application of the periphyton guidelines is explored in Tukituki Choices.

The site –specific nitrate guidelines developed by NIWA for the Tukituki Catchment for the protection of aquatic species will be used in Tukituki Choices.

Water Quality Limits and Point Source Discharges

Point source discharges include discharges from wastewater treatment plants, industrial processing plants, farm dairy effluent discharges, reticulated urban stormwater systems and on-site domestic wastewater systems. These are largely managed through resource consents. Water quality limits provide a structure whereby the impacts of discharges to land and water may be assessed and managed.

Water Quality Limits and Non-point Source Discharges

Non-point source discharges include runoff from agricultural land, leaching of contaminants through the soil into groundwater that finds its way into surface water, and reticulated urban stormwater systems. Main contaminants of non-point source discharges include:

- Bacteria and pathogens - from animal and birds
- Soil – from bare land, stream banks on farms
- Nitrogen – in the form of nitrate and ammonia from farms
- Phosphorus – in the form of soluble reactive phosphorus from farms

Contaminants from non-point source discharges are best managed at source (on the land), to keep them out of water. Strategies include keeping stock out of water ways, repairing stream bank erosion, maintaining and enhancing riparian vegetation, establishing buffer strips between cropped land and streams, crop rotations, managing the amount and timing of fertiliser inputs.

Water quality limits provide a measure to monitor the efficiency of on-farm management strategies.

Refer Key Supporting Reports: Reports 23 and 24

Managing Periphyton

Periphyton is the slime and algae found on the bed of streams and rivers

While this group of organisms is essential for ecosystem functioning , excessive growth can degrade aesthetic, recreational and biodiversity values.

Factors controlling periphyton growth include the length of time available for growth before a flushing flow occurs, the amount of light reaching the streambed, temperature, substrate type, invertebrate grazing and nutrient concentrations. It is important to identify the nutrient that is limiting periphyton growth and to have a thorough understanding of the background nutrient concentrations and the temporal dynamics. This allows us to identify the nutrients that regulates or limits periphyton growth.

The limiting nutrient

Based on our assessment of the available information, the main stem of the Tukituki River is phosphorus limited. If the phosphorus concentration is reduced in water (therefore not available for plant growth), excessive growth of slime and algae may be reduced.

In some sub-catchments, such as the Papanui Stream, periphyton growth may be nitrogen limited. This situation exists because the phosphorus concentrations are very high and available at saturating levels. In the Tukituki, reducing phosphorus concentration is the most effective way to reduce periphyton growth to acceptable levels. This should be accompanied by measures aimed at ensuring that nitrate concentrations are suitable for aquatic fish and invertebrates.

Sources of Phosphorus

The wastewater oxidation ponds for Waipawa and Waipukurau contribute 20% of the total annual load, about 50% of the total catchment load over the summer months and up to 70% of the load over the low flow period. Modelling has indicated that improving the wastewater treatment to meet new wastewater discharge standards (as required by the current consent by September 2014), will significantly reduce in-stream concentrations of phosphorus.

The bulk of the remaining phosphorus load comes from diffuse sources such as sediment that enters the water through runoff, and stream bank erosion.

What if the Tukituki was largely N limited?

The current estimated nitrogen load in the catchment is approximately 2500 tonnes per year resulting in in-stream nitrogen concentrations which range from 0.13 mg/L to 1.35 mg/L. To limit periphyton growth, the annual average nitrogen concentration must be less than 0.3 mg/L. To achieve the nitrogen concentration *(cont)*

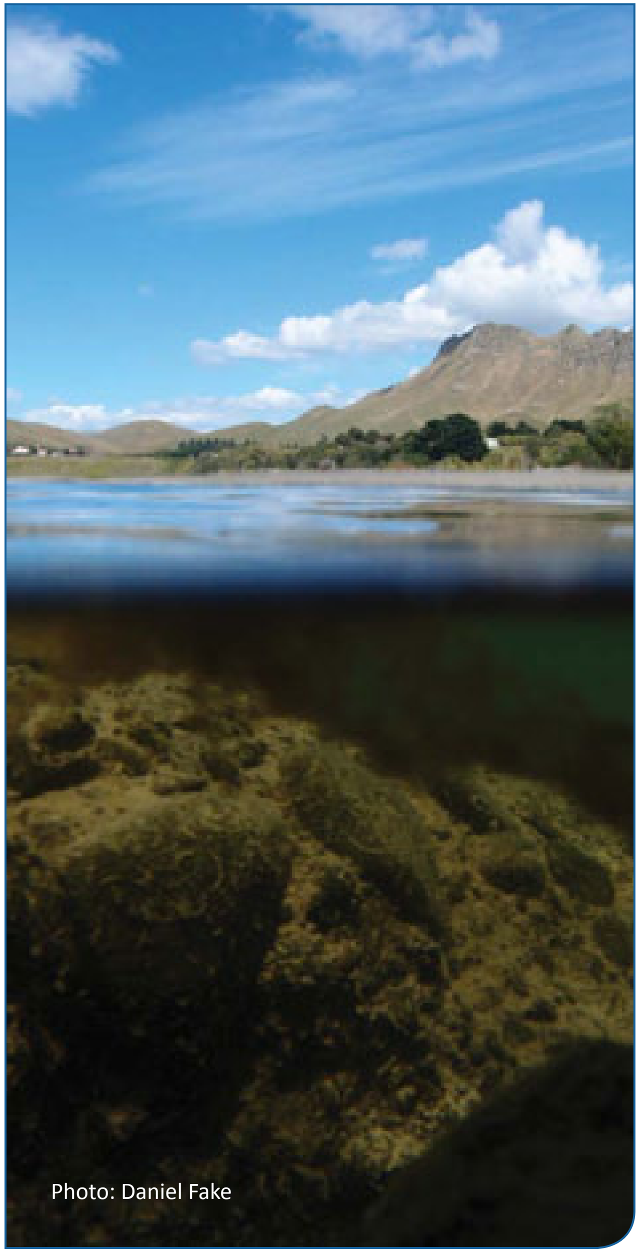


Photo: Daniel Fake

Managing Periphyton

threshold, the nitrogen load from the catchment would need to be reduced to below 1341 tonnes per year. This is evaluated as Choice B.

This would impact on all farmers in the catchment except for those in the headwaters of the Tukituki and Waipawa Rivers. The reduction required would require significant and costly mitigation measures such as herd homes, and probable changes in land use, all associated with significant economic impacts. While we do not consider it realistic to manage periphyton through significant nitrogen reductions, this approach needs to be presented to enable informed debate.

Nevertheless, managing nitrogen for periphyton growth to maintain current biodiversity values and limit periphyton growth is appropriate in the headwaters of the catchment where concentrations are currently well within the limit of 0.3 mg/L.

Other ways to manage periphyton include:

- Riparian shading
- Soil conservation measures
- Artificial flushing of flows to slough off the algae and remove slime
- Keeping stock out of waterways
- Further improving the treatment of point source discharges

Phosphorus Management

Much of the phosphorus in the rivers is a result of soil erosion, inappropriate fertiliser use, livestock acessing waterways and human sewage discharges.

Some geology in the Tukituki Catchment is also naturally enriched in phosphate.

Phosphorus attaches to soil and a large proportion of the annual catchment load is transported to the rivers through surface runoff and stream bank erosion. A key management strategy is therefore to minimise the amount of soil entering streams, and to keep livestock away from stream banks.

Excessive periphyton growth may be managed by setting phosphorus concentration limits for an entire catchment, or specific sub-catchments. However, the high variability of phosphorus sources across the landscape and over time means management of phosphorus is unsuited to a land allocation strategy.

Modelling will be used to determine a concentration and load that will provide acceptable extent and duration of aquatic plant growth in the Tukituki River downstream of Waipukurau and Waipawa.

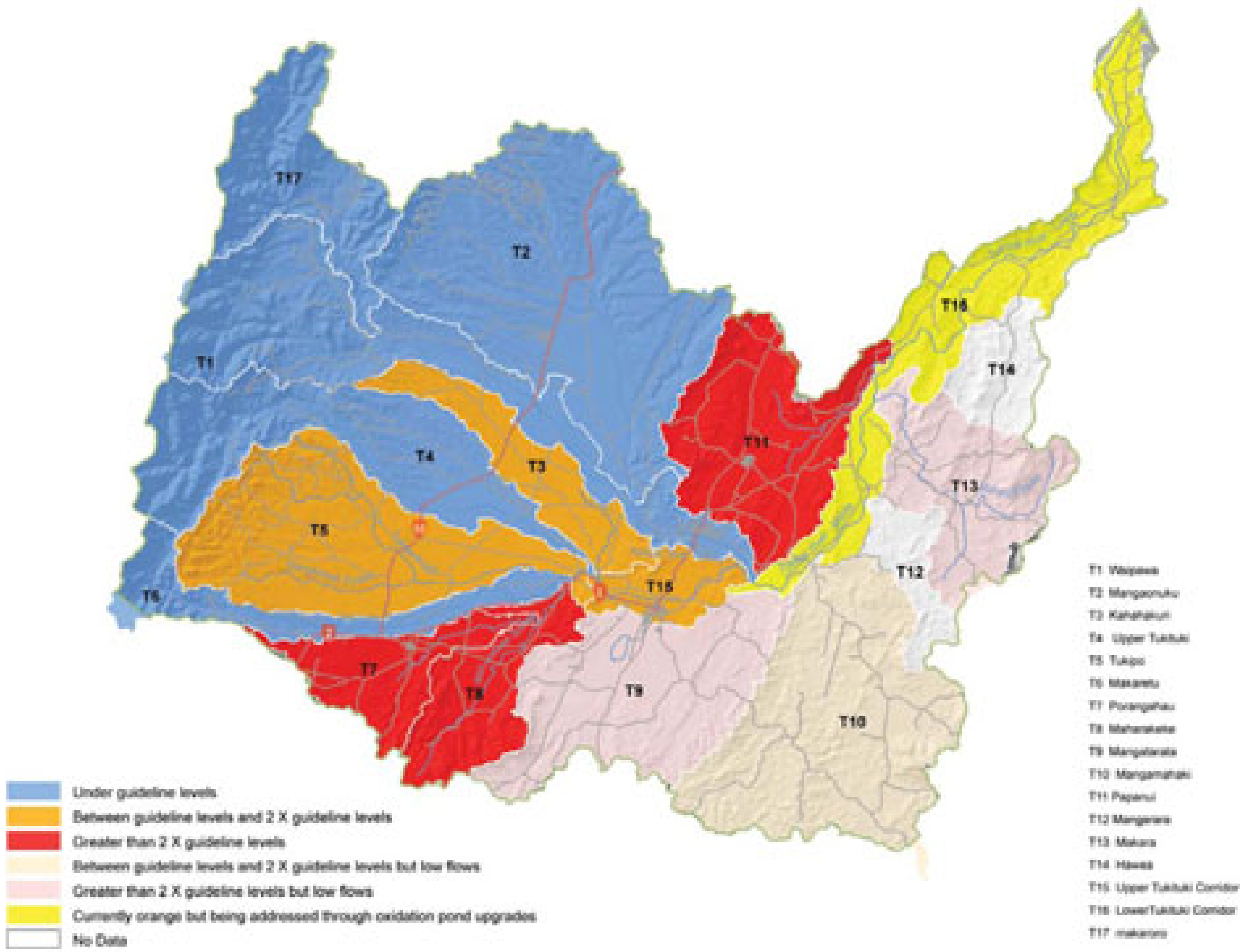
In the meantime, limits are proposed in the table opposite for comparison purposes. The 0.015 mg/L value is the current guideline in the Regional Resource Management Plan and the other two values in the table are limits that have been applied in the Manawatu-Whanganui region.

The map opposite shows the status of the sub-catchments within the Tukituki catchment in relation to the comparative limits. HBRC will prioritise its land management advisory activity within red and orange zones across the Ruataniwha Plains and Otane area. These zones have elevated phosphorus and contribute a significant amount of flow to the main river. By contrast, the shaded zones to the south and east, despite having elevated phosphorus levels, have a lower contribution of flow to the river and do not influence in-stream phosphorus to the same extent. Primary sector industries have an important role. Sub-catchment, community based groups will be encouraged and tasked with developing catchment management plans that will be implemented at farm and catchment level to help to improve the quality of the water. The limits provide a benchmark for the community in those zones.

The yellow zone is impacted by the Waipukurau and Waipawa oxidation pond discharges, which contribute up to 70% of the summer phosphorus load. Meeting the current consent conditions is non-negotiable and is the key method in this zone for reducing phosphorus loads in the catchment.

Refer Key Supporting Reports: Report 11

Phosphorus Management



Soluble Reactive Phosphorus (Annual Average)	Current measured (mg/L)	Proposed limit (mg/L)
Waipawa at SH50	0.004	0.006
Tukituki at SH50	0.004	0.006
Waipawa at SH2	0.012	0.015
Tukituki at SH2	0.014	0.015
Tukituki at Shag Rock	0.019	0.010
Tukituki at Red Bridge	0.014	0.010

Stock Exclusion

Excluding stock from water is a key mitigation measure for phosphorus, while also reducing the amount of sediment, bacteria and pathogens entering the water.

Stock can damage stream banks and the margins of lakes, releasing soil into the water. During rain, soil can also be washed off from the disturbed stream banks.

There are many ways to achieve stock exclusion including:

- Fencing – either permanent or temporary. Fencing off gullies can also reduce stock losses as well as reduce the time that is otherwise spent managing the often steep and marginal land within gully systems
- Riparian planting - to provide a buffer of vegetation that discourages stock from accessing the waterway. Riparian planting can also provide other benefits such as improving terrestrial and aquatic habitats and potentially enhancing biodiversity
- Changing stock behaviour - by providing shelter, shade and water troughs / ponds in the paddock, thus removing the need to cool off in the creeks, streams or rivers and to drink directly from them.

Fonterra is requiring stock exclusion from waterways as part of its milk supply agreements and other primary production sectors recognise the need to exclude stock from waterways.

Stock exclusion measures can be expensive so any stock exclusion rule to be included in a regional plan needs to be appropriately targeted in areas where it will have the most benefit. Farmers also need time to put the stock exclusion measures in place.

Which waterways are to be targeted?

The rule will apply to all lakes, wetlands, permanently and intermittently flowing rivers, streams and creeks. An intermittently flowing river, stream or creek is defined as one having an active bed which is predominantly unvegetated and comprises sand, gravel, boulders or similar material.

What stock are to be targeted?

All stock are being targeted. Large, heavy stock can cause the most damage, particularly where the density of stocking is high. Mob stocking of sheep along a riparian margin, for example, can also cause significant damage. However, sheep at normal stocking rates generally do not like to stand in water as cattle do so this behaviour is considered an effective stock exclusion strategy for sheep.

Stock Exclusion– Proposed Regulatory Framework

The following table outlines the proposed regulatory framework for stock exclusion in the Tukituki Catchment. It is also appropriate to consider it applying to the whole region. The Land Use Capability Classification system has been used to define the flatter and more intensively used land from the hill country where stock are more likely to be farmed at lower stocking rates.

The conditions associated with stock exclusion will be drafted into a permitted activity rule which will provide for the use of land for primary production subject to conditions requiring stock exclusion as outlined in the table. Methods of stock exclusion are not prescribed, however farmers will need to demonstrate how they are achieving compliance through the preparation and implementation of farm management plans.

Refer Key Supporting Reports: Report 11

Stock Exclusion

Stock exclusion from water ways	All land with Land Use Capability Class I - IV		All land with Land Use Capability Class V - VIII	
	Exclusion from lakes, wetlands, permanently flowing rivers	Exclusion from intermittently flowing rivers	Exclusion from lakes, wetlands, permanently flowing rivers	Exclusion from intermittently flowing rivers
Applies to	All stock within 5 years	All stock within 10 years	All stock at a rate of 18 stock units / ha (paddock level) or more within 5 years	All stock at a rate of 18 stock units / ha (paddock level) or more within 10 years
Conditions	Preparation of farm management plan			
Exceptions	Stock being used for vegetation control within fenced riparian areas as described in an approved farm management plan. Where stock exclusion is impractical and other mitigation or offset action is taken to minimise effects as described in an approved farm management plan			

Nitrogen Management: Objectives and Limits

Framework for Managing Nitrate Toxicity Risk for Aquatic Species

NIWA has developed a nitrate toxicity risk management framework for the Tukituki catchment (see top table). This includes a review of the trigger values based on available data, including new toxicity data for two New Zealand species, inanga and mayfly.

This framework has been applied to the Tukituki catchment, as shown in the table to the right. This table also shows current nitrate-nitrogen concentrations.

Management Classification (ANZECC protection threshold)	Nitrate concentration (mg/L)	Chronic Maxima Nitrate concentration (mg/L)	Description of Management Class
Excellent (99%)	1.1	2.0	Pristine environment with high biodiversity and conservation values.
Very Good (95%)	2.3	3.6	Environments which are subject to a range of disturbances from human activities, but with minor effects.
Good (90%)	3.6	5.1	Environments which have naturally seasonally elevated concentrations for significant periods of the year (1-3 months).
Fair (80%)	6.3	8.7	Environment which are measurably degraded and which have seasonally elevated concentrations for significant periods of the year (1-3 months).
Method of comparison	Annual median	95th percentile	

Nitrate Toxicity Protection Levels for Tukituki Catchment

Management Classification and Nitrate concentration limits (mg/L) and current concentrations	Choices A, C and D		Choice B
	Annual Median Limit (current/measured)	Chronic Maxima 95th percentile Limit (current/measured)	Annual Average Limit (current/measured)
Zone 4 Waipawa at SH50 (Maintain biodiversity)	0.14 (0.148)	0.14 (0.148)	0.14 (0.148)
Zone 4 Tukituki at SH50 (Maintain biodiversity)	0.14 (0.134)	0.14 (0.134)	0.14 (0.134)
Zone 2 Waipawa at SH2 (Good-90%)	3.6 (0.719)	5.1 (1.3)	0.3 (0.712)
Zone 3 Tukituki at SH2 (Good - 90%)	3.6 (1.3)	5.1 (2.4)	0.3 (1.349)
Zone 1 at Shag Rock (Very good - 95%)	2.3 (0.925)	3.6 (2.050)	0.3 (1.007)
Zone 1 Tukituki at Red Bridge (Very good - 95%)	2.3 (0.673)	3.6 (1.705)	0.3 (0.729)

Refer Key Supporting Reports: Reports 23 and 24

Nitrogen Management: Determination of Zone Load

Having determined the nitrate concentration limit for each nitrate management zone, the next step is to calculate the load of nitrate for that zone. This is the Maximum Allowable Zone Load (MAZL) measured in tonnes N/year. It defines the mass of N that may be lost below the root zone.

Determining Nitrogen Loads

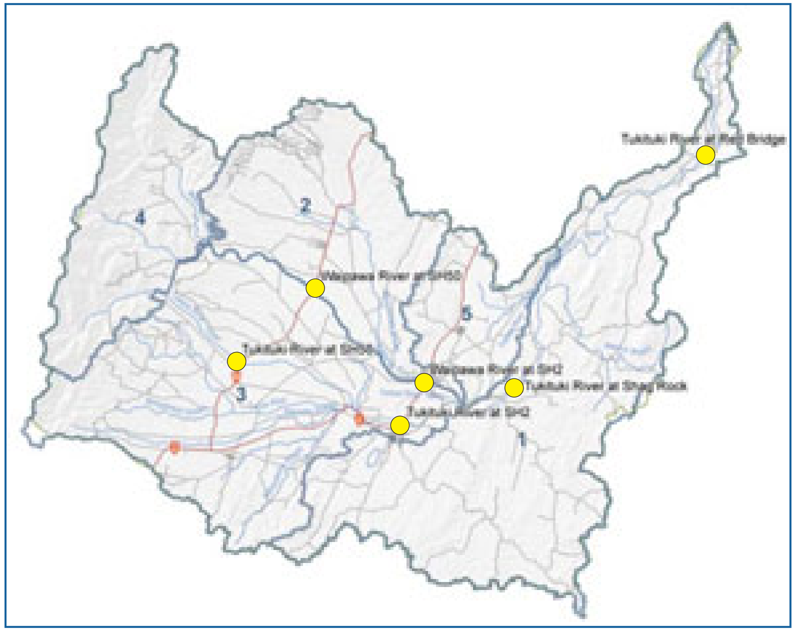
Step 1: Using a relationship that has been determined between in-stream concentration and catchment yield, the yield for a land parcel (kg/ha/yr) can be determined for each Nitrate Concentration Limit.

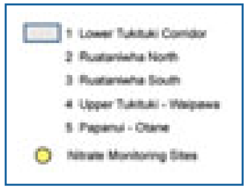
Step 2: The yield is multiplied by the total hectares in the Nitrate Management Zone which drains to that point to get the allowable in-stream Load (measured in tonnes N/year).

Step 3: The in-stream Load is divided by an attenuation coefficient to get the Maximum Allowable Zone Load. This coefficient recognises that some Nitrate-nitrogen is taken up by physical and biological processes before it reaches the sampling point. For these calculations, a 50% attenuation rate has been used for Zones 1, 4 and 5, and a 30% attenuation rate for Zones 2 and 3.

Maximum Allowable Zone Load for each Choice is shown in the table, along with a comparison with the estimated Current Root Zone Load, based on the measured in-stream load. The Current Root Zone Load is the load that would maintain current measured concentrations.

Nitrate Management Zone	Hectares	Choice A, C, D	Choice B	Status Quo
		Maximum Allowable Zone Load (tonnes per year)	Maximum Allowable Zone Load (tonnes per year)	Current Root Zone Load (based on measured in-stream load)
1 - Lower Tukituki / 5 - Papanui	103,169	2585	642	896
2 - Ruataniwha Plains North	41,401	919	197	367
3 - Ruataniwha Plains South	72,404	1607	345	1011
4 - Upper Tukituki / Waipawa rivers	33,535	157	157	198





Nitrogen Management: Allocation of Allowable Nitrogen Load

Nitrogen Allocation Principles

Key principles of Nitrogen allocation are:

- Land is a finite resource that should be used efficiently
- The same type of land should be treated the same across the zone, unless there is good reason for any differences.
- Use of good agricultural practices are assumed

Given these principles, it is proposed to allocate nitrogen across the zones using the 'natural capital' approach. This allows allocated leaching rates to vary spatially across the zones, with the variation linked to the underlying Land Use Capability (LUC). A leaching rate for each LUC class has been derived using the potential animal stocking rate information that is relevant to Hawke's Bay from the extended legend of the Land Resource Inventory.

	LUC Class							
	I	II	III	IV	V	VI	VII	VII
Natural Capital Nitrogen Leaching rate Kg/ha/yr	30.1	27.1	24.8	20.7	20	17	11.6	3

Nitrogen Leaching Models

Models such as OVERSEER have been developed to assess the average N losses from the root zone under pastoral farming systems. Other models are being developed to quantify N losses from cropping and arable farming systems. Whatever model is used, it must be used consistently to enable comparison between each assessment. Model outputs may vary even when using the same inputs if a model is upgraded or changed, therefore there is a need to run the same data in both models to enable a comparison between them.

Allocation Methodology

The Maximum Allowable Zone Loads for Zones, 1, 2, 3 and 5 in Choices A, C and D are considerably larger that the estimated current loads in those zones.

Land use intensification is largely governed by the availability of irrigation water and irrigation will not occur on every LUC class. To allocate all the MAZL across the zone would mean that it would not necessarily be available where irrigation is most likely to occur.

Instead it is proposed to allocate the estimated Current Root Zone Load (as determined from the measured in-stream load) using appropriately scaled 'natural capital' leaching rates plus a 'buffer' of 30% to take into account the accuracy margins associated with current leaching assessment models such as OVERSEER. These figures are shown in the table below.

This provides flexibility to existing farming enterprises (recognising that the 'natural capital' approach to nitrogen allocation is only a proxy system). A farm enterprise would then aggregate the allocated leaching losses within the farm to arrive at a single Nitrogen Discharge Allowance (kgN/year).

	LUC Class							
Allocated Leaching Loss (kgN/ha/yr)	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VII**
Zones 1, 2, 4 and 5	19.5	17.6	16.1	13.5	13	11.1	7.5	3
Zone 3	27.4	24.6	22.5	18.8	18.2	15.5	10	3

Refer Key Supporting Reports: Report 11

Nitrogen Management: Proposed Regulatory Framework

This table outlines the proposed Regulatory Framework for managing Nitrogen within the Maximum Allowable Zone Load (MAZL). This approach means that in Choice A, C and D, current farmers will have 5 years to demonstrate that they are operating within their Nitrogen Discharge Allowance (as determined by OVERSEER or other approved model) and to take mitigation action to reduce their nitrogen discharge within the amount permitted by the rule.

A more intensive farming operation might need a higher allocation which it could access through a controlled activity consent. While the operation would still need to implement good agricultural practice, provided the MAZL is not exceeded it would be granted consent. For Choice C and D, this approach would enable an irrigation company to apply for a N allocation for land within the scheme area. The irrigator would also be subject to ensuring that good agricultural practices are followed.

Use of land for primary production purposes	**Measured in-stream concentration less than 80% of Nitrate limit** **Or** **Assessed leaching losses for a Zone is less than 80% of the MAZL**	**Measured in-stream concentration is greater than 80%, but less than 100% of Nitrate limit** **Or** **Assessed leaching losses for a Zone is greater than 80% of the MAZL, but less than 100% of the MAZL**	**Measured in-stream concentration greater than 100% of Nitrate limit** **Or** **Assessed leaching losses for a Zone is greater than 100% of the MAZL**
Permitted	Any farm discharging Nitrogen within its allocated Nitrogen Discharge Allowance. Demonstrate compliance 5 yearly using OVERSEER or other approved model		
Controlled	Any farm discharging Nitrogen above its allocated Nitrogen Discharge Allowance Lock in implementation of Good Agricultural Practices as described in an approved Nutrient Management Plan. Demonstrate compliance annually using OVERSEER or other approved model	All farms within the Nitrate Management Zone (Would require a transition to manage consent administration) Lock in implementation of Good Agricultural Practices as described in an approved Nutrient Management Plan. Demonstrate compliance annually using OVERSEER or other approved model	
Non-complying or Prohibited			Any new landuse or point source discharge that would cause the Limit to be exceeded

Key Supporting Reports

Tukituki General

1. Hawke's Bay Regional Council (Mar 2012). 'Tukituki Catchment Freshwater Values Assessment' HBRC Plan# 4296.
2. Hawke's Bay Regional Council (Mar 2012). 'Tukituki River Catchment: Identifying the Native Fish Values' HBRC Plan #4303.
3. Hawke's Bay Regional Council (July 2012). 'Papanui Catchment; an Environmental Characterisation' HBRC Plan #4372.
4. Te Manaaki Taiao & Te Taiwhenua o Heretaunga (2012). 'Cultural Values and Uses of the Tukituki Catchment'.
5. Wakefield, Apatu, Hape, Maaka, Maaka, Moffatt, Wakefield & Whitiwhiti (2012). 'Tukituki River Catchment Cultural Values and Uses Report'.
6. Hawke's Bay Regional Council (2012). 'Tukituki Catchment: Water Management Objectives' HBRC Plan #4407.
7. Hawke's Bay Regional Council (Mar 2012) 'Tukituki Choices Scenario Construction Report' HBRC Plan #4394.
8. Harris Consulting Ltd (August 2012). 'Tukituki River Catchment: Economic Impact of Minimum Flow Proposals'.
9. Harris Consulting Ltd (August 2012). 'Economic Impacts of Future Scenarios for the Tukituki River'.

Land

10. Hawke's Bay Regional Council (Dec 2011). 'Tukituki Catchment Terrestrial Ecology Characterisation' HBRC Plan #4294
11. Hawke's Bay Regional Council (2012). 'Nutrient Management Approaches for the Tukituki Catchment' HBRC Plan #4344.

Water Quantity

12. Hawke's Bay Regional Council (2003). 'Ruataniwha Plains Water Resource Investigations' HBRC Plan #3254.
13. Hawke's Bay Regional Council (Sep 2010). 'Ruataniwha Basin Transient Groundwater Surface Water Flow Model' HBRC Plan #4234.
14. Hawke's Bay Regional Council (June 2011). 'Ruataniwha Basin Groundwater/ Surface Water Predictive Modelling' HBRC Plan #4264.
15. Hawke's Bay Regional Council (Aug 2012). 'Hydrology of the Tukituki Catchment' HBRC Plan #4405.
16. Hawke's Bay Regional Council (Dec 2010). 'Tukituki Catchment Instream Flow Assessment' HBRC Plan # 4248.
17. Hawke's Bay Regional Council (June 2012). 'Tukituki Catchment Instream Assessment. Addendum Report' HBRC Plan #4363.
18. Hawke's Bay Regional Council (July 2012). 'Consented Water Allocation: Ruataniwha Basin Groundwater and Tukituki River Stream Management Zone' HBRC Plan #4411.
19. Hawke's Bay Regional Council (Aug 2012). 'Tukituki Catchment: Modelling the Impacts of Groundwater and Surface Water Abstraction' HBRC Plan #4410.

Water Quality

20. Aussiel, O (2008). 'Water Quality in the Tukituki Catchment - State, Trends and Contaminant Loads' Aquanet Consulting Ltd.
21. Hawke's Bay Regional Council (Aug 2012). 'Ruataniwha Plains Groundwater Quality State and Trends' HBRC Plan #4399.
22. Hawke's Bay Regional Council (Aug 2012). 'Assessment of Nitrate and E.coli Groundwater Quality in the Hawke's Bay Region (2008)' HBRC Plan #4204,
23. Hawke's Bay Regional Council (2012). 'Water Quality Limits Setting for Nitrate Toxicity and Nitrogen Load Calculations -Technical Memorandum' (draft).
24. NIWA (Aug 2012). 'Site-specific nitrate guidelines for Hawke's Bay' (draft).

Key Supporting Reports

Water Storage

25. Young et al (2012). 'Ruataniwha Water Storage Project - Aquatic Ecology Assessment of Effects'.
26. Gibbs et al (July 2012). 'Ruataniwha Plains Water Storage Project: Characterisation of Reservoir Water Quality'.
27. Hawke's Bay Regional Council (June 2012). 'Ruataniwha Water Storage Project: Tukituki River Catchment Assessment of Potential Effects on Groundwater and Surface Water Resources' HBRC Plan #4370.
28. Coubrough et al (June 2012). 'Ruataniwha Water Storage Project: Proposed Integrated Mitigation and Offset Approach'.
29. Kessels et al (2012). 'Hawke's Bay Regional Council Ruataniwha Water Storage Project: Terrestrial Ecology Study Assessment of Ecological Effects'.
30. Morgan & Frey (2012). 'Ruataniwha Water Storage Project Recreation Assessment'.
31. Rutherford et al (2012). 'Modelling the Effects of Land Use on Nutrients Entering the Tukituki River, Hawke's Bay'.
32. Taylor (2012). 'Ruataniwha Water Storage Project Social Impact Assessment'.
33. Wakefield et al (2010). 'Tukituki River Catchment: Cultural Values and Uses' (section 5.2).

Regional

34. Beagle Consultancy Limited (Oct 2011). 'Land River Us: Hawke's Bay 2050'
35. Fluent Environmental (Dec 2010). 'Hawke's Bay Regional Water Symposium 2010 Event Report' HBRC Plan #4245.
36. Hawke's Bay Regional Council (Aug 2006). 'Hawke's Bay Regional Resource Management Plan'.
37. Hawke's Bay Regional Council (2011). 'Regional Resource Management Plan: Plan Effectiveness Report for Water Quality and Ecology' HBRC Plan # 4271.
38. Hawke's Bay Regional Council (Oct 2011). 'Strategic Plan' HBRC Plan # 4282.
39. Hawke's Bay Regional Council (Nov 2011). 'Hawke's Bay Land and Water Management Strategy' HBRC Plan #4287.
40. Hawke's Bay Regional Council (Dec 2011). 'Hawke's Bay Regional Land and Water Symposium 2011 Event Report' HBRC Plan# 4296.
41. Hawke's Bay Regional Council (June 2012). 'Hawke's Bay Regional Council Long Term Plan 2012-2022'.
42. Hawke's Bay Regional Council (July 2012). 'Recreational Water Quality Report 2011-2012' HBRC Plan # 4383.

Glossary

ANZECC: Australia New Zealand Environment and Conservation Council.

Aquifer: An underground deposit of water-bearing sand, gravel or rock capable of yielding supplies of water.

Attenuation coefficient (nitrogen): The proportion of nitrogen taken up by physical and biological processes after leaving the root zone of a catchment or management zone and reaching a sampling point in a river or stream downstream of the catchment or management zone. The nitrogen attenuation coefficient identified in the Tukituki Choices is the difference between the mass of nitrogen leaving the root-zone and the mass of nitrate-nitrogen measured at a sampling point downstream of the zone. The attenuation coefficient includes such processes as assimilation and uptake, denitrification and conversion of inorganic nitrogen to organic nitrogen.

Catchment: The total area draining into a river, reservoir or other body of water.

Chronic toxicity: Effects caused by long-term exposure to a toxicant; often for periods from several weeks to years. Chronic exposure typically includes a biological response of relatively slow progress and long continuance such as a reduction in weight gain.

Controlled activity: An activity for which a resource consent is required. The Council cannot decline consent, but can impose conditions with which the activity must comply.

Discretionary activity: An activity where a resource consent must be obtained before the activity can occur. The Council may decline consent, or grant consent with or without conditions.

Ecosystem: A system formed by all plants, animals, and micro-organisms in a particular area interacting with the non-living physical environment as a functional unit.

Farm management plan: A plan to integrate the farm business within the physical capability of the farms land and water resources. May include separate policies on the management of irrigation, effluent, fertiliser, riparian and soils.

Good Agricultural Practice (GAP): a quality assurance programme that provides a traceable, accountable system from crop to customer. In the context of this document, GAP refers to the practicable and affordable on farm management practices that are designed to minimise the amount of nutrient losses and sediment and fecal discharges.

Hapū: clan or tribal social order.

High flow range: flows that are typically associated with floods or flushing flows.

Inanga: native fish species (Galaxias maculatus), commonly referred to as whitebait.

Input-output model (I/O): a model of the regional economy that quantifies linkages between different sectors and demonstrates how changes in one sector can influence others.

Intermittently flowing river: Rivers that do not flow all year, whose bed is predominantly un-vegetated with terrestrial grasses and comprise sand, silt, gravel, boulders or similar material.

Kai: food.

Kaitiakitanga: guardianship or caretaker role (in particular, of natural resources).

Land Use Capability Classification (LUC): National classification of discrete units of land that have differential capability and limitations where class 1 has the highest level of versatility and class 8 the least.

Low flow range: the range of flows close to the MALF that typically occur during dry summer months. Includes flows equal to or less than the minimum flow.

Mahinga kai: food gathering places, cultivated gardens.

Mana whenua: those who descend through a hapū or ancestor who hold the tikangā or customary rights over a specific area.

Mātauranga Māori: Māori knowledge originating from Māori practices, observations, science, ancestors, including the Māori worldview.

Mauri: The inner life-force or essence, for example, of a river.

Glossary

Maximum Allowable Zone Load (MAZL): the amount of nitrogen that can be lost below the root zone within a defined water management zone as determined by the in-stream nitrate load limit (adjusted for attenuation).

MCI: Macro Invertebrate Community Index: An index of the proportion of sensitive to tolerant species (in relation to the quality of a water body), among the community of benthic invertebrates that can be seen with the naked eye.

Mean Annual Low Flow (MALF): the average of the lowest flow recorded in each year over a range of years.

Mid flow range: the range of flows occurring around the mean or median of a flow record.

Minimum flow: Limits the amount of abstraction during low river flows. A minimum flow determines when consent holders have to reduce, and ultimately stop, abstracting.

Multiplier: determines the extent to which changes in one sector of the economy influence indicators of regional economic performance.

N: Nitrogen.

Natural Capital: Inherent capability of a unit of landscape to provide an ecological service, for example, food production, freshwater, or biodiversity.

Nitrate toxicity: Nitrate itself is not overly toxic, however when nitrate is reduced to nitrite in the digestive system of animals it becomes toxic. Nitrites oxidize the iron atoms in haemoglobin affecting its capacity to carry oxygen.

Nitrogen Discharge Allowance (NDA): LUC-based leaching allowances within individual farms.

Non-complying activity: An activity that must be authorised by a resource consent. The Council may decline consent, or grant consent with or without conditions. A consent for a non-complying activity cannot be granted unless the effects of the activity are minor or not contrary to objectives and policies of the relevant plan.

Nutrient limitation: The capacity of nitrogen and/or phosphorus to limit plant or algae growth.

Nutrient load: The mass of nutrients lost from the land surface or leaving a catchment or management zone. Nutrient load is often expressed as tonnes per year (t/yr).

Nutrient yield: The mass of nutrients leaving a catchment or management zone standardised by catchment or management zone surface area. Nutrient yield is often expressed as kilograms per hectare per year (kg/ha/yr).

Nutrient management plan: Written plan that describes how the major plant nutrients (nitrogen, phosphorus, sulphur, and potassium, and any others of importance to specialist crops) will be managed annually on a particular property. The plan will be implemented to optimise productivity, to reduce nutrient losses, and to avoid, remedy or mitigate adverse effects on the environment.

OVERSEER: Agricultural management tool which assists farmers and advisors to examine nutrient use and movements within a farm to optimise production and environmental outcomes.

P: Phosphorus.

Periphyton: A group of organisms in aquatic environments adapted to living on inert stable surfaces such as rocks, cobbles and logs. Organisms include fungi, bacteria, protozoa and algae.

Permitted activity: An activity that does not require a resource consent, provided it complies with any conditions and standards of the relevant rule that permits the activity.

Prohibited activity: An activity that is not allowed in any circumstance. A resource consent for a prohibited activity cannot be applied for and so cannot be granted.

Rāhui: a temporary ritual prohibition on natural resources, for example on a waterway or fishery; traditionally a rāhui is placed on an area, resource or stretch of water as a conservation measure or if the area is affected by tapu.

Resilience: The ability to withstand and recover quickly from difficult or challenging conditions or circumstances.

Glossary

Restricted discretionary activity: the same as a discretionary activity, except that when assessing a resource consent application, the Council may only consider a restricted range of matters specified in the regional plan rules.

Riparian management: The planting of vegetation along riparian margins to provide shade for waterbodies, thereby reducing algal growth and maintaining cool water temperatures, which are generally more favourable for aquatic fauna. Riparian vegetation also reduces bank erosion and intercepts sediment and other contaminants before they enter a waterbody.

Soil conservation: The protection of soil from erosion and other types of deterioration.

Stock exclusion: Any method or activity that prevents farmed animals from having direct access to a stream or its margins.

Sustainability: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Takiwā: catchment or region.

Tangata whenua: in relation to a particular area, means the iwi or hapū that holds manu whenua over that area.

Taniwha: water spirit or monster often regarded as guardians by the people who live in their territory.

Taonga: treasure, anything highly prized.

Tikanga: customary right, rule, plan, method.

Tūpuna: ancestors.

Uptake: rate of adoption of, for example, a technology or scheme. In the context of this document, it refers to the uptake of the Ruataniwha water storage scheme.

Wāhi tapu: Sacred site, as defined locally by the hapū which are the kaitiaki for the wāhi tapu.

Water allocation limits: The amount of water available to be extracted from a water source for use (e.g. for public supply, irrigation etc). The total allocation is limited to protect instream values and provide security of supply to water users.

Water quality: The chemical and physical attributes of water such as turbidity, phosphorus and nitrogen concentration, temperature, dissolved oxygen and major ion concentrations.

Water quality limit: A limit identified for a particular water quality variable or attribute to meet a specific management objective.

Wetland: Permanently or intermittently wet land, shallow water and land-water margins. Wetlands may be fresh, brackish or saline and are characterised in their natural state by plants and or animals that are adapted to living in wet conditions. Wetland functions include nutrient filtering, sediment trapping, preventing flooding, carbon sequestration, habitats, recreation, education, cultural value. A wetland does not include:

- wet pasture land
- artificial wetlands used for waste water or storm water treatment
- farm dams and detention dams
- land drainage canals and drains
- reservoirs for fire fighting, domestic or municipal supply
- Temporary ponded rainfall
- artificial wetlands.

Whakapapa: genealogy.

Whānau hauora: cultural health/wellbeing.

Tukituki Choices

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HAWKE'S BAY
REGIONAL COUNCIL