Hekeao/Hinds Water Enhancement Trust

Hekeao/Hinds Managed Aquifer Recharge Scheme

Detailed Business Case

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Role	Name	Review Status
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In a Nutshell

Both historic and, to a lesser degree, current land uses have contributed to making the nitrate levels in the groundwater in the Hekeao/Hinds catchment some of the highest in the country. They are now above safe levels for human and stream health in some locations.

Cemented in the new National Freshwater Policy Statement, *te mana o te wai* places the health of our water above all other priorities.

The regulations in the National Policy Statement for Freshwater (NPS-FM 2020) are placing increasingly stricter controls on water quality, and if real progress isn't made by 2035, then it is certain that these controls will tighten further.

This will significantly impact the agriculture sector, which is the lifeblood of the New Zealand economy. In Hekeao/Hinds where almost the whole district relies on agriculture directly or indirectly, farmers are demonstrating why agriculture is the most productive sector in the country. This is while continually adapting farming practice as our understanding of the links between land use and water quality improve and our community's priorities evolve.

But the national priority given to healthy water, as well as the safety of our drinking water, means that something needs to change. The choice is not to 'do nothing.' The challenge for Hekeao/Hinds is about how to meet the water quality targets as quickly as possible while minimising the cost to the economy and individual farmers.

Modelling undertaken as part of Plan Change 2 to Canterbury's Land and Water Regional Plan (2016) determined that, to achieve the community determined water quality targets by only changing on-farm practices, nitrate leaching on farm would need to reduce by 48%. The cost of implementing the significant on-farm mitigations were forecast to reduce earnings (EBIT), for example by $1,855 per ha for dairy farms (dairy 1) and reduce their asset value by $20,788/ha creating a consequential loss of economic activity and personal hardship.

Hekeao Hinds groundwater age analysis has concluded that much of the groundwater is decades old and some is more than a century old. While it is essential that nitrate leaching on-farm reduces as quickly as possible, these changes will take some time to show up as improvements to groundwater (and connected surface water) ecosystem health.

The Ashburton Zone Committee of the Canterbury Water Management Strategy recognised the importance of a collaborative and multi-pronged approach to the issue and requested the establishment of a Community Governance Group to test the concept of Managed Aquifer Recharge (MAR) for the catchment to work alongside on-farm mitigations. MAR involves soaking already consented but re-purposed river water into the ground to raise the groundwater levels, reduce nutrient concentrations and enhance spring flows. This approach is now codified as Plan Change 2 (PC2) to Canterbury's Land and Water Regional Plan.

The Hekeao Hinds MAR Trial began in 2016 with a single pilot site. At the main monitoring bore down-gradient from this pilot site, nitrate-N concentrations that were approximately 7 mg/l prior to MAR have been maintained at 1.5-3.5 mg/l for the four years of MAR operation. This establishment of proof-of-concept has led to 16 further sites becoming operational to trial different MAR concepts in different parts of the catchment.

In addition to reduced nutrient concentrations and increased groundwater levels, MAR sites and distribution races provide opportunities to improve mahinga kai and biodiversity values across the catchment. To date this comprises a DOC Covenant for lizard habitat, a DOC transfer permit for Kōwaro / Canterbury mudfish, and the first two phases of Kahikatea wetland plantings. Additional biodiversity and mahinga kai are proposed as MAR sites and distribution are confirmed via long term consents.

By using a multipronged approach on-farm mitigations remain a critical component to delivering improved water quality outcomes, with a 36% reduction in nitrate discharge required by 2035. These on-farm actions are supported by the implementation of a MAR scheme, in particular to address the legacy nutrient concentrations as well as supporting groundwater levels and spring flows. This is forecast to deliver the PC2 objectives, which include a median of 6.9 mg/l nitrate-N in shallow groundwater for 80% aquatic species protection and 3.8 mg/l in the lower Hekeao Hinds River for 90% aquatic species protection. Implementation of NPS-FM 2020 may result in an even higher level of protection for aquatic species and groundwater.

Additional forecasting was undertaken which demonstrated an overall benefit to the economy and whilst it was still a significant cost to individual farmers, it was deemed financially viable. Economic modelling forecasts $190 million of additional economic activity including $35 million for the local district. The ratio of benefits over cost when comparing the 'with MAR' and 'without MAR' scenarios is 1.4. The economic modelling also suggests that the activity associated with MAR will support jobs in the farming sector as well as the wider economy to complete the work. Over the long term, MAR will support approximately 23 additional jobs (relative to the without-MAR scenario and per year in Canterbury). This analysis shows that the inclusion of MAR in this multi-pronged approach is a better economic option for the country and the district.

It is proposed that the majority of the capital and operating costs for MAR is raised through a rate levied by Environment Canterbury that is targeted to the landowners that benefit from the scheme. This proposal is subject to Long Term Plan decisions.

Although the reduction in on-farm earnings and capital value of this preferred approach is less than the alternatives (e.g.,EBIT(CV) $545/ha(-$9,810/ha) against 1,855/ha(-$25,970/ha) for dairy 1), the financial impact remains significant and is likely to have an adverse impact on the viability of some farms. As such, it is also recommended that Crown funding is sought for at least $1.4 million (23% of required capital cost) to reflect the economic benefits to New Zealand (past, present and future) as a whole and assist in maintaining the level of employment already present in the district.

It is proposed the Hekeao Hinds Water Enhancement Trust (HHWET) leads the development of the MAR scheme with the practical and financial support of Environment Canterbury via targeted rate funding. Over time, the Trust is envisaged to be developer and owner of the scheme with accountability to the contributing landowners and Environment Canterbury through a Funding Agreement.

Successful realisation of this scheme relies on implementation of the targeted rating scheme, farmer implementation of the on-farm mitigations, and the ability to secure sufficient supply from currently consented Rangitata River water to divert to the MAR systems. The cost of this water supply will have a significant impact on the timeframe for delivery and overall environmental and economic impact.

This business case summarises a decade of work by the community to develop a consensus for the management of water quantity and quality in the Hekeao/Hinds catchment that is effective, affordable and durable. It provides a basis for funding by the benefitting landowners and a rationale for a modest level of Crown support for the project through access to a capital funding contribution.

The Elevator Pitch

Historic land uses and practices have created a long plume of nitrates in the groundwater underlying the Hekeao/Hinds catchment that will take decades to pass through. Current farm practices with more precise irrigation and nutrient management provide benefits through reduced nitrate leaching but also challenges as there is materially less water soaking into the ground.

In order to address these challenges, community representatives (the Ashburton Water Zone Committee) have proposed a reduction in on-farm nutrient discharge of 36% in combination with a Managed Aquifer Recharge Scheme. This is the most cost effective approach, will enable substantial improvement within a generation and will have the least impact on farm economics and property values.

The final matters for resolution before construction can begin is a proposed targeted rate on the benefiting landowners and securing access to the required water at a reasonable price. Crown contribution is sought to reflect national economic benefit (past, present and future) and recognise the significant expenditure already required by farmers for their on-farm improvements. This is proposed to be through a capital contribution.

THE OUTCOME WILL BE A SCHEME THAT GIVES PRIORITY TO WATER HEALTH, SIGNIFICANTLY REDUCING GROUNDWATER NUTRIENT CONCENTRATIONS WHILE ENABLING FARMING TIME TO ADAPT THEIR FARMING SYSTEMS AND TO REMAIN A SUSTAINABLE ECONOMIC DRIVER FOR THE DISTRICT.

Executive Summary

The Proposed Investment

ON-FARM MITIGATION TO REDUCE NITRATE LOSSES TO GROUNDWATER IS THE ESSENTIAL TOOL TO RESOLVING THE HIGH NITRATE LEVELS IN THE GROUNDWATER BELOW THE HEKEAO/HINDS CATCHMENT. TO IMPROVE GROUNDWATER HEALTH MORE QUICKLY, EFFECTIVELY AND AFFORDABLY, IT IS PROPOSED TO BE COMPLEMENTED BY A MANAGED AQUIFER RECHARGE (MAR) SCHEME TARGETED TO FURTHER IMPROVING GROUNDWATER QUALITY (E.G., REDUCING NITRATE CONCENTRATIONS) AND QUANTITY (E.G., SUPPORTING LOWLAND STREAMS) OBJECTIVES.

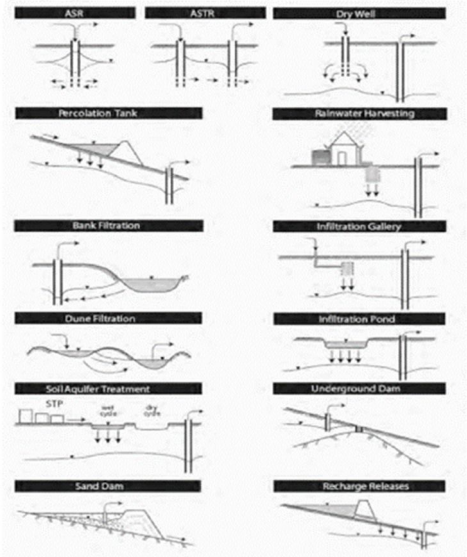
There are several methods of recharging the groundwater such as basins, wells and trenches. The main principle is that surface water from a lake or a river is made to percolate into the underlying geology via porous material to recharge the groundwater.

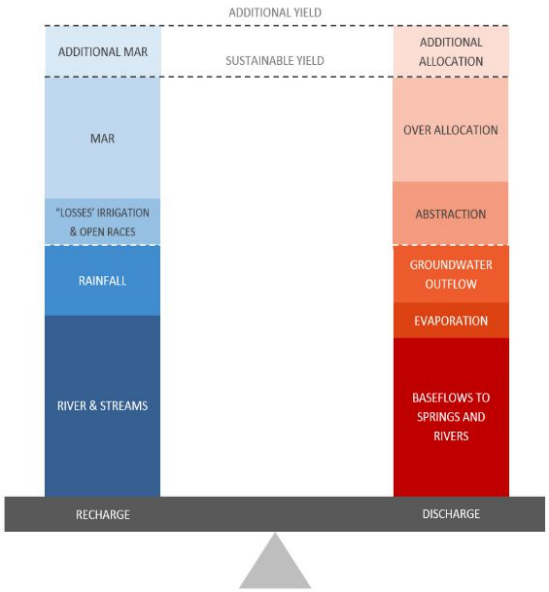
The MAR Scheme volumetric recharge target to reach current catchment objectives set by PC2 is 125 million m^3/year with scheme over-build capacity of 55 million m^3/year. The additional capacity is directly related to seasonal flow variability of likely MAR source water and distribution capacity.

A total of 17 MAR sites are currently operational, with further sites identified adjacent to the RDR, BCI, MHV Water and ADC stock water distribution systems. In addition to reduced nutrient concentrations and increased groundwater levels, additional mahinga kai and biodiversity opportunities are being identified and implemented (e.g., lizard and Kōwaro / mudfish habitat and native plantings).

The scheme has an existing water supply arrangement with Ashburton District Council in place and is seeking agreement for further arrangements relating to use of the Council's stock water system and gravel pits. Additional water supply from an existing RDRML Rangitata River consent is under discussion. This will require successful consenting and commercial arrangement discussions.

The capital cost of the scheme is estimated at $8 million (including $2 million already secured for the current phase) with annual operational costs of between $0.4 million and $1.7 million, depending on the cost of securing the water.



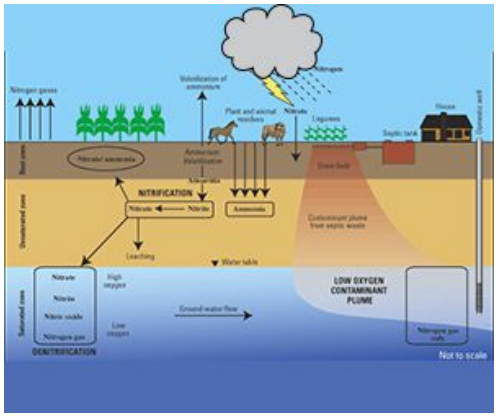


The Strategic Case

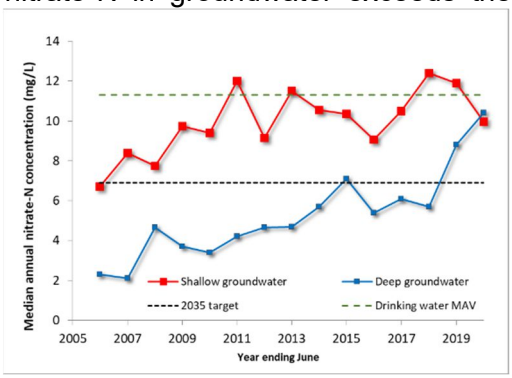
The Strategic Context

Agriculture is an essential part of our economy, and it is the most productive sector in the country. Furthermore, water quality is one of the most important issues for New Zealanders.

Nitrate contamination of groundwater has occurred since agriculture began on the Hekeao Hinds Plains. Lag times in shallow groundwater flows are estimated to range from years to one or more decades, while lag times in deeper groundwater have been measured as decades to more than a century. This means the effects of on-land use changes today that affect nitrate concentrations in the surface and groundwater are not likely to be seen for some time.



Some of the highest nitrate levels in New Zealand groundwater can be found in the Hekeao Hinds catchment. The maximum concentration of nitrate-N in groundwater exceeds the drinking-water standard, and the average concentration exceeds half the standard. This is principally the result of historic farm practices and will take decades to pass through the groundwater system.



The government has a focused action plan to address freshwater issues called the Essential Freshwater Work Programme, which seeks to stop further degradation and loss of freshwater resources, reverse past damage and address allocation issues. MAR is well aligned with this Programme, particularly through its proven ability (at a local scale to date) to address past damage.

A key element of that programme is the recently released National Policy Statement for Freshwater (2020). This strengthens the *Te Mana o te Wai* framework with a specific hierarchy of obligations. The new hierarchy places the health and well-being of bodies of water and freshwater ecosystems above human health and economic activity.

The changes to the farming environment are therefore being reflected in multiple ways:

- A key part of the recommendations in the Ashburton (Hinds Plains) Zone Implementation Programme (ZIP) and ZIP Addendum (ZIPA) are a 'solutions package.' The three main catchment scale actions are on-farm mitigations, Managed Aquifer Recharge (MAR), and management of irrigated area. MAR is designed to complement the other two actions.

- Plan Change Two to Canterbury's Land and Water Regional Plan (PC2) codified the 'solutions package' developed by the Ashburton Zone Committee to achieve outcomes for the Hekeao/Hinds Plains Area. It required all farms to operate at good management practice by 2017, and by requiring farms subject to a resource consent to further reduce nitrogen losses by 15% by 2025, 25% by 2030 and 36% by 2035, or until they reduce to 20kg/N/ha/yr.

- Through writing, implementing and auditing Farm Environmental Plans (FEP's), consent holders are required to demonstrate their level of environmental performance and compliance with resource consent conditions. The completion of a nutrient budget is also a key requirement.

- *Ki uta ki tai* is a Māori philosophy meaning 'mountains to the sea.' This approach takes a holistic system view, including linking special areas together so that, over time, they provide habitat 'corridors' for valued species such as whitebait/inanga, lamprey/kanakana, and eel/tuna.

This Business Case draws on decades of work between all stakeholders to collaboratively develop a robust and feasible strategy to address water quality and quantity issues in the catchment. Meanwhile farmers have got on with adapting their practices to respond to the evolving understanding of land use effects on our groundwater and lowland streams. Farmers in the Hekeao/Hinds catchment are leaders in both milk solid production and winners of environmental awards for their work.

The Problems Defined:

The context above leads to the following problems that could be addressed by an investment in Managed Aquifer Recharge:

- The nitrate levels in the groundwater are excessively high, leading to groundwater eco-system and human health risks from drinking the water. These nitrates will take decades to pass through the system.
- The high nitrate levels in groundwater also adversely affect the eco-system health of connected lowland streams and drains. These lowland waterways enable lower catchment farming as well as provide key mahinga kai, aquatic and riparian habitat opportunities.
- Lower groundwater levels mean that many wells become dry or face increased pumping costs during low rainfall periods.
- Further restrictions on nitrate levels are likely to lead to significant constraints on farming operations and land uses but will not rehabilitate the legacy nutrients in the groundwater system, which will remain for decades to come.

Leading to Investment Objectives to Address These Needs:

Reduce	**Significantly reduce the total discharge of nitrates from the land use on the Hekeao/Hinds Plains to achieve 2035 nitrate-N concentration targets**
Existing Arrangements	The total discharge of nitrates from irrigated properties is estimated to result in a nitrate-N concentration in shallow groundwater of about 14 mg/l. This is well over the toxicity level for most aquatic species and exceeds the New Zealand Drinking Water Standard.

Business Needs	The 2035 nitrate-N concentration target is 6.9 mg/l as an annual median in the PC2 shallow monitoring bores. Modelling showed that the Options Package of on-farm mitigations by itself would only achieve 9.2 mg/l.
ENABLE	**Enable farming activities to be viable and productive, continuing to create economic activities and support the wider community.**
Existing Arrangements	The total irrigated areas in the catchment is as follows:

Irrigation Scheme	Hectares Irrigated
MHV Water Limited	50,000 ha between the Rangitata and Ashburton Rivers
Barrhill Chertsey Irrigation Limited	7,330 ha upper plains
Eiffelton Irrigation Scheme	2,700 ha lower plains
Lynnford Irrigation Scheme	120 ha lower plains
Total Irrigation Scheme	**60,150 ha irrigated land**
Groundwater consents	approx. 48,000 ha irrigated land (with some of this land also supplied by an irrigation scheme)

Business Needs	The new NPS-FM (2020) prioritises environmental health over economic activity (*Te mana o te wai*) and leads to the objective to restore waterways and groundwater within a generation. This means that the quality of the water is prioritised over the economic viability of land uses. Land use in some parts of the catchment have been shown to influence groundwater nutrient concentrations in less than a generation, but lag times over most of the catchment are usually measured in multiple generations. MAR has shown the ability to significantly speed up the rehabilitation of influenced groundwater and connected spring-fed waterways.
RECHARGE	**Recharge groundwater to both mitigate historic effects of nitrate discharges and raise groundwater levels through the discharge of 125,000,000 m^3/annum.**
Existing Arrangements	The national drinking-water standard Maximum Acceptable Value (MAV) for nitrate-N is 11.3 mg/l. In order to meet the drinking-water standard and take into account seasonal and individual well variability, monitoring and analysis are prioritised when monitoring indicates that the average (or median) nitrate-N concentration exceeds half MAV (i.e. 5.6 mg/l) and is showing an upward trend. The median nitrate-N concentration for PC2 shallow monitoring bores in the most recent year (July 2019 – June 2020) is 9.9 mg/l, with a combined median nitrate-N concentration for Regional Council shallow and deep monitoring bores at 10 mg/l. The monitoring and analysis response to these elevated concentrations is to significantly increase the number of monitored wells across the catchment as well as analyse changes over time in wells with a long monitoring record.

	The move to more efficient irrigation practices, reduction in leaky stockwater and irrigation distribution races, and a drying climate are reducing groundwater levels with resulting declines in spring fed flows and increased costs of groundwater abstraction.
Business Needs	Drilling deeper bores to reach lower nitrate has been considered for shallow drinking water bores, with costs estimated to be at least $30,000 per bore. However, with elevated nitrate levels now measured in deeper monitoring bores and longer lag times than shallow bores an alternative mitigation of undersink treatment is being implemented by households across the plains. Approximate installation costs are $1500 - $10,000 plus $150-$800 annual costs. The Hekeao Hinds MAR Scheme is specifically targeting areas of elevated nitrate-N groundwater up-gradient from drinking water supplies. At the main monitoring bore down-gradient from the longest running Hekeao Hinds MAR site, nitrate-N concentrations that were approximately 7 mg/l prior to MAR have been maintained at 1.5-3.5 mg/l for the four years of MAR operation. MAR also raises groundwater levels through a pressure response which radiates in all directions from MAR sites. This improves influenced spring-fed flows and reduces groundwater pumping costs. For spring-fed waterways with high eco-system values, Targeted Stream Augmentation systems (direct augmentation with connected groundwater using solar power) can be added.
RESTORE	**Restore shallow groundwater, lowland drains and streams to improve ecology and support mahinga kai so that annual median nitrate-N concentration does not exceed 6.9 mg/l in shallow groundwater and spring-fed water bodies.**
Existing Arrangements	Groundwater monitoring records back to the mid-1980s in the Hekeao Hinds Plains show elevated nitrate-N concentrations, though it is likely nitrate has leached to groundwater since agriculture began on the plains. The Hekeao/Hinds Plains lowland waterways currently have some of the highest nitrate-N concentrations for surface water in New Zealand, with the maximum concentration of nitrate-N in groundwater exceeding the drinking-water standard, and the average concentration exceeding half the standard. Some of the larger waterways sampled (e.g. Boundary, Blees, Deals drains) have average nitrate-N concentrations equal to that of the shallow groundwater. The lower Hekeao/Hinds River has slightly lower nitrate-N concentrations, which is probably influenced by river recharge further up the catchment.
Business Needs	Canterbury's Land and Water Regional Plan (LWRP) recognises that everything is connected to everything else. Water bodies, whether they are above or below ground, are linked. Actions that affect one water body are likely to affect another. Approaching this catchment as an integrated network that extends from the foothills to the sea is consistent with the concept of K*i uta ki tai*.

	This is further reinforced by the new NPS-FM (2020) which places considerable weight on the health of waterbodies above other outcomes. Analysis of options under the Ashburton (Hinds Plains) ZIPA concluded that managing annual median nitrate-N concentration in spring-fed lowland waterways below 6.9 mg/l to meet nitrate toxicity guidelines was necessary for protection of 80% aquatic biodiversity (including species such as eels and lamprey), plus a target of 3.8 mg/l for protection of 90% aquatic biodiversity in the lower Hinds River. No approach to achieve a significantly lower target (e.g., 2.4 mg/l) in a generational timeframe has been substantiated to date, however as noted above a key MAR-influenced monitoring bore has maintained a range of 1.5-3.5 mg/l nitrate-N for the last 4 years.

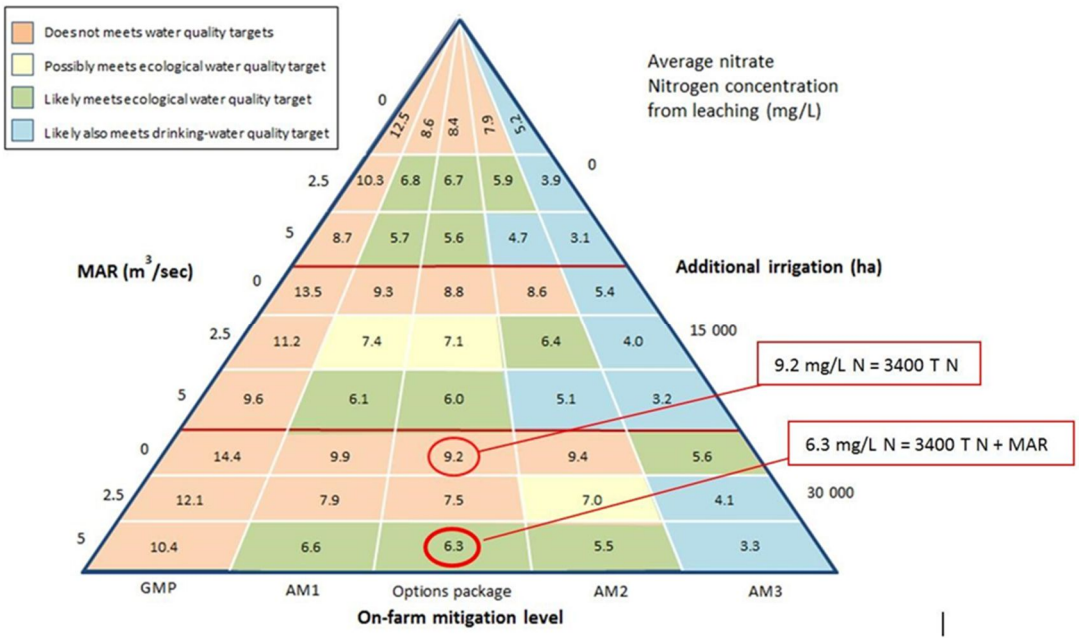
The Economic Case

Shortlist of Options

The shortlist of options for this investment are described in the table below:

Option	Short name	Broad Description
A	Do nothing	Take no action either via MAR or at a property level to mitigate or reduce the discharge of nitrate to the groundwater system.
B	On-farm mitigation only	Employ advanced nitrate mitigation systems on each property to reduce the total nitrate discharge by 48%.
C	On-farm mitigation and MAR	Employ advanced nitrate mitigation systems on each property to reduce the total nitrate discharge by 36% complemented by Managed Aquifer Recharge.

The Dimension of Choice: With or Without MAR



The economic modelling for this Business Case suggests that under the default discount rate (6%[1]), the with-MAR (vs the without-MAR) scenario will return a positive Benefit to Cost Ratio (BCR) of 1.4 and a net position of +$130m. This equals an average annual lift of $6.5m. The BCR moves up or down, depending on the discount rate used but it stays range-bound and above 1.

The economic impacts are estimated as follows:

- **One-off impacts**: These impacts relate to the capital expenditure associated with establishing the MAR Scheme and the on-farm spending related to the land-use change (for the without-MAR situation):
  - Value Added economic impacts are between -$7m and -$10m across NZ with a -$8m mid-point (these figures are negative, so activity is foregone).
  - Concentrated locally (64%) and in Canterbury (22%).
- **Ongoing impacts:**
  - The ongoing impacts (present value @6%) are estimated at between $191m and $221m.
  - Three quarters (75.3%) of the impacts are concentrated in Canterbury and the rest in the wider NZ.
- **Net Impacts:**
  - Summing the one-offs and the ongoing impacts (i.e. subtracting the foregone impacts from the ongoing impacts) shows that the net impacts are estimated to be between $183m and $211m.
  - Most of the impacts are concentrated in Canterbury (60%) with 18% felt locally in Ashburton.

From the analysis, the following observations are made:

[1] 6% is the default rate put forward by NZ Treasury.

- In practice, the option of 'do nothing' is not realistic. The legal and political requirements to take action on water quality means that continuing with the status quo is not an option.

- The alternative to implementation of the multi-pronged approach (on-farm mitigations, MAR and irrigated area constraints) is likely to be significant land use change, with resulting economic and social impacts but unclear environmental benefits in a generational timeframe.

- The multi-pronged approach has a significantly greater benefit to cost ratio and economic value add than any other option and ultimately adds economic value to the district and nation over the alternatives.

- The multi-pronged approach enables farming the time to adapt to the requirement for more sustainable farming systems and to remain viable while meeting reasonable levels of water quality in the groundwater and lowland streams, providing an 80% protection on aquatic organisms.

- While the cost to landowners should not be underestimated, the alternative is more expensive and will cause serious economic challenges for the region.

For these reasons, the analysis has confirmed that the Ashburton (Hinds Plains) ZIPA solutions package is the preferred way forward.

The Commercial Case

The following table sets out the preferred procurement approach to developing and operating the scheme.

Supply	Procurement Approach
Design and Technical Advisors	Panel of pre-qualified providers
Project Manager	Internal or direct commissioned appointment
Physical Works Contractor	Panel of pre-qualified providers with basis for pricing
Operations and Maintenance Contractor	Direct commissioning or service provider secured by open tender

The Financial Case

Cost of delivery

The table below assumes the MAR infrastructure (supplied by largely pre-existing irrigation distribution networks) is built over a six-year period with 20% developed per year for the first four years and the 10% per year for a further two years. The annual cost grows in parallel with the build to reach the eventual amount requiring funding of $2.2 million. This total comprises approximately $6.9m capital infrastructure expenditure plus annual operating costs of $400k and annual water delivery charges of up to $1.3m.

Recommended Local Funding Model

A pragmatic approach is recommended that involves:

- Implement a capital value based rate segmented into three zones (upper, central and lower) as the initial methodology, bearing in mind the stepped imposition of rates increases as the project builds.
- Three-yearly reviews of the methodology in line with the Long Term Plan cycle, with a view to implementing a more specifically targeted process, such as a differential rate or a cap and trade system once technology and monitoring allows.
- Funding through targeted rates levied at differential rates charged to three zones within the catchment.
- If measurable benefits to groundwater abstractors are identified (e.g., increases in groundwater levels that improve supply reliability and/or reduce pumping costs), then relevant targeted rating could be considered.

The economic modelling suggests that approximately 23% of the benefits to the scheme have a national impact and hence can be considered for national funding. Should external (non-rates) funding be secured from the government or any other source, then the impact on rates for the local landowners are forecast as follows:

External contribution		Upper		Lower A		Lower B	
(capital only)		*Year one*	*Year 6*	*Year one*	*Year 6*	*Year one*	*Year 6*
		Rates per ha		Rates per ha		Rates per ha	
Nil	0	$0.41	$1.45	$4.41	$15.43	$3.72	$13.02
23%	$1.4 M	$0.41	$1.41	$4.32	$15.05	$3.65	$12.70
50%	$3.0 M	$0.40	$1.37	$4.22	$14.59	$3.56	$12.31

From a Farmers perspective

The following changes compares the alternative options and shows that the MAR option provides material financial benefits over the counterfactual.

Current Land use	Current Mitigation Level	With/Without MAR	Revised Land Use	Revised Mitigation Level	Change in Rates per Ha	Change in EBIT per Ha excluding MAR	Change in EBIT per Ha including MAR
Dairy 1	AM1	With MAR	Dairy 1	AM1	-$19	-$526	-$545
		Without MAR	Arable 1	AM3	$0	-$1,855	-$1,855
Dairy Support 1	AM1	With MAR	Dairy Support 1	AM1	-$15	-$622	-$637
		Without MAR	Arable 1	AM3	$0	-$2,620	-$2,620
Arable 1	AM1	With MAR	Arable 1	GMP	-$15	$91	$76
		Without MAR	Arable 1	GMP	$0	$91	$91

Scenario	Impact on EBIT/ha	Impact on Capital Value/ha based on P/E ratio of 14	Comparison with MRB analysis (2018) on capital value
With MAR	-$545/ha	-$9,810/ha	-8,270/ha
Without MAR	-$1,855/ha	--25,970/ha	-20,072/ha

The Management Case

Governance and Ownership
The recommended initial governance structure is option B: Council develops, Trust owns and operates as follows.

Funding responsibilities

- Canterbury Regional Council (CRC) to rate for and fund the scheme
- The Trust to seek grant and other funding from the government and other sources
- A Funding Agreement is establishment between the Trust and CRC

Asset Delivery and Ownership responsibilities

- The Trust (through a trust-owned company) holds the resource consents for the scheme on behalf of the community.
- CRC develops the assets in accordance with an implementation plan agreed with the Trust.
- At some stage, the Trust may commence development of the assets. This would be on the basis that CRC are satisfied that a robust management structure is in place. This would be through a grant process to fund development of the scheme. See below for operational grant funding also.
- Alternatively, the Trust could continue to partner with CRC to deliver the works.
- On completion, these assets are vested in the Trust to own and operate.

Operational responsibilities

- The Trust may contract MHV Water, RDRML, BCI, Ashburton District Council and/or other operators to operate the scheme on their behalf.
- Operational funding is passed to the Trust by CRC as it is collected in accordance with the Funding Agreement.
- Annual Statements of Intent (Annual Plans) and Annual Reports are prepared by the Trust as accountability documents for the funding received from CRC and the wider ratepayer base.

Outline Project Plan

Proposed key milestones	Estimated timing
Stage One: Establishment	
Secure initial consents/agreements for water	2020
Commence monitoring programme	2020
Rating Funding Arrangement confirmed	Mid 2021
Confirm initial stages of works	2021

Stage Two: Base	
Commence Stage One MAR	Late 2021
Commence NRR, TSA and ecological works	Late 2021
Secure operational contracts	Mid 2021
Complete base scheme	2024
Secure additional water for extension	2023
Stage Three: Extension	
Commence next stages	2025
Commence NRR, TSA and ecological works	2025
Complete scheme construction	2030

Key Project Risks

Main Risks	Consequence (H/M/L)	Likelihood (H/M/L)	Comments and Risk Management Strategies
MAR not able to recharge groundwater sufficiently due to hydrogeological challenges	Medium	Medium	Will require greater volume of water and further capital and operating input to install more discharge locations
Further changes or regulatory requirements	High	Medium	Further tightening of water quality standards will require either reduced nitrogen leaching and/or increased MAR in order to achieve low water quality concentrations
Not able to get sufficient water to recharge due to cost of water supply	High	Medium	Acquire water from owners at a higher price, leading to higher operating costs and/or increased on-farm mitigation
Farm mitigation not achieved	High	Medium	Leads to increased enforcement. Unlikely to be able to increase MAR as may cause downstream flooding
MAR causes negative downstream effects	Mod	Low	May need additional mitigations or reduction in discharge of MAR in a particular part of the catchment
Insufficient funding secured	High	Mod	Will require offset by increased mitigation by landowners and/or increased rates
Clearly communicating the options and issues to stakeholders, despite their inherent complexity, to allow them to participate in the process in a meaningful way	Medium	Medium	Robust communications and engagement approach

Introduction

What This Business Case Seeks

This detailed business case seeks agreement in principle towards investment in the development of the Hekeao/Hinds Managed Aquifer Recharge Scheme.

The purpose of this business case is to:

- confirm the strategic context and fit of the proposed investment;
- confirm the need to invest and the case for change;
- confirm the preferred way forward for further development of the investment proposal;
- establish the commercial arrangements for procurement;
- propose funding arrangements and forecast the financial needs of the project; and
- outline the management arrangements necessary to deliver the project.

The **scope** of this business case is defined by the key questions that it seeks to answer:

  - Is an investment into the Hekeao/Hinds Managed Aquifer Recharge Scheme worth making?
  - What is the best way to fund and manage the scheme?

How This Business Case is Structured

The business case process is **organised** around a five-case structure designed to systematically ascertain that the investment proposal:

- is supported by a compelling case for change - the 'strategic case'
- optimises value for money - the 'economic case'
- is commercially viable - the 'commercial case'
- is financially affordable - the 'financial case'
- is achievable - the 'management case'

Hekeao Hinds Water Enhancement Trust

For the Canterbury Water Management Strategy, the Ashburton Water Management Zone Committee has recommended evaluation of Managed Aquifer Recharge (MAR) as one of the three complementary primary catchment scale water management options to meet the Hekeao Hinds Plains water management objectives.

Following three initial trial years, the Hekeao Hinds Water Enhancement Trust (HHWET) has been established to develop a catchment-wide MAR scheme for the Hekeao Hinds Plains. The scheme will also incorporate additional MAR concepts such as Near River Recharge (NRR), dry wells and Targeted Stream Augmentation (TSA) where applicable. Goals for the scheme are to:

a. Reduce or maintain groundwater nutrient levels to the community's desired levels, prioritising the enhancement and protection of groundwater drinking water supplies

b. Increase groundwater levels and storage

c. Increase baseflows in the Hekeao/Hinds River and spring-fed streams (drains) for environmental, cultural and recreational values

The Trust also seeks to:

a. Ensure that the MAR Scheme is affordable and cost effective to the community

b. Establish and maintain community acceptance for the MAR Scheme

The Trust comprises a broad membership:

- Rab McDowell: Ashburton District Irrigation companies
- Ian Mackenzie: Environment Canterbury Councillor
- Craig Fleming: Hinds Drainage District
- Anne Marett: Ashburton Community
- Michael McMillan: Arowhenua Rūnanga of Kāi Tahu
- Mayor Neil Brown: Ashburton District Council
- Melanie Brooks: MHV Water Ltd
- Mark Webb: Central South Island Fish and Game Council
- Vince Lobb: Rangitata Diversion Race Management Ltd
- Alister Argyle: Co-opted Trustee
- Peter Lowe (Chair): Mid Canterbury Federated Farmers
- Sir Graeme Harrison: Co-opted Trustee

What is the potential investment?

1.3 The Starting Point[2]

The Hekeao/Hinds Plains area today is highly modified, but it was not always like this with the lower catchment covered by large wetland areas and the upper catchment forested. Tangata whenua traditionally used the different areas as sources of different types of mahinga kai. Over the years, as European-style agriculture began to transform the landscape, cultural and ecological values have changed, and it has become increasingly harder to imagine what the area once looked like.

Drainage of the wetland area near and east of SH1 allowed farming to establish in the 1850s. Drainage remains a primary function of many of the lowland water bodies. The drains and the lower reaches of the Hekeao/Hinds River have been highly-valued habitats for spawning brown trout (Daly, 2004); however, the number of brown trout has decreased in recent years. Some of these drains and water races are the only habitat in the Hekeao/Hinds Plains area suitable for the kōwaro / Canterbury mudfish (*Neochanna burrowsius*), a species with a threat ranking of "nationally critical – conservation dependent." The lowland water bodies are also places where mahinga kai can still be gathered, though with concerns regarding their safe consumption where water quality is degraded.

There are four irrigation schemes in the Hekeao/Hinds Plains area, with water delivered to two by the Rangitata Diversion Race (Table 1). There are also individual surface and groundwater takes throughout the catchment. Groundwater is over-allocated in the Valetta groundwater zone. This means that more than 50% of estimated land surface recharge has been allocated to users by way of water permits. All the water allocated, however, is unlikely to be used in any given year.

Table One: Irrigation Schemes within the Hekeao Hinds Plains Area

Irrigation Scheme	Hectares Irrigated
MHV Water Limited	50,000 ha between the Rangitata and Ashburton Rivers
Barrhill Chertsey Irrigation Scheme	7,330 ha upper plains
Eiffelton Irrigation Scheme	2,700 ha lower plains
Lynnford Irrigation Scheme	120 ha lower plains
Total Irrigation Scheme	**60,150 ha irrigated land**
Groundwater consents	approx. 48,000 ha irrigated land (with some of this land also supplied by an irrigation scheme)

Agriculture now makes up 98% of land use in the Hekeao/Hinds Plains area. Significant changes in land use have taken place since 2000 as dryland farmers and farmers using border dyke irrigation have converted to more efficient spray irrigation systems and facilitated more intensive land uses. In 2011, the economy of Ashburton grew at twice the national average. This was driven largely by irrigation development, which allowed expansion into dairy and expansion into specialist crops in arable farming.

[2] Adapted from the Zone Implementation Programme Addendum (AZC, 2014)

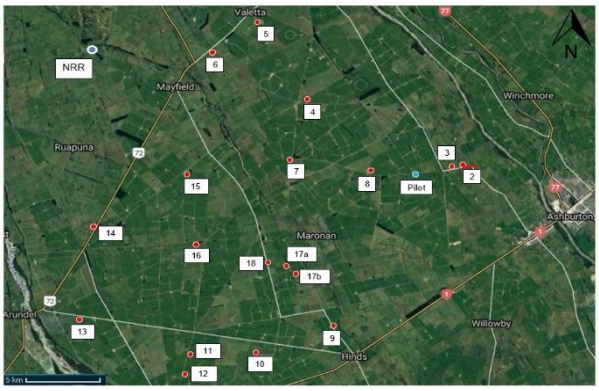
The dairy farms in the Ashburton district produce more milk solids per hectare than any other region in New Zealand. The benefits of this top performance by Ashburton's dairy industry have flowed into many other aspects of the district's economy. Ashburton's growth in GDP, productivity and wages has been faster than nearly all of the 66 territorial authorities in New Zealand over the past decade. Good employment prospects have seen Ashburton's population expand at an average of 1.5%pa, compared with an increase in the national population of 1.2%pa over the last ten years. In addition to the Arable Industry providing NZ with a significant amount of its Milling and Feed grains, many specialised crops are grown, including Bok Choy, about one third of the world's supply of white clover, close to half of the world's hybrid radish, carrot and beet seed, and 60% of seeds for growing pasture underpinning a $9 billion export industry.

Table Two: Land uses in the catchment

Land use	**Est. 2018** Hectare
Sheep, Beef and Deer	36,770
Arable	33,220
Dairy Support	12,320
Dairy	49,110
SUM	**131,410**

Scheme Location

The project area is located on the Canterbury Plains south of Ashburton, between the Rangitata River and Ashburton / Hakatere River, bounded up-gradient by the Canterbury foothills and down-gradient by the Pacific Ocean. The currently consented MAR sites are shown in the Figure right. The Pilot Site, Near River Recharge (NRR) site and most test sites are constructed and operational.

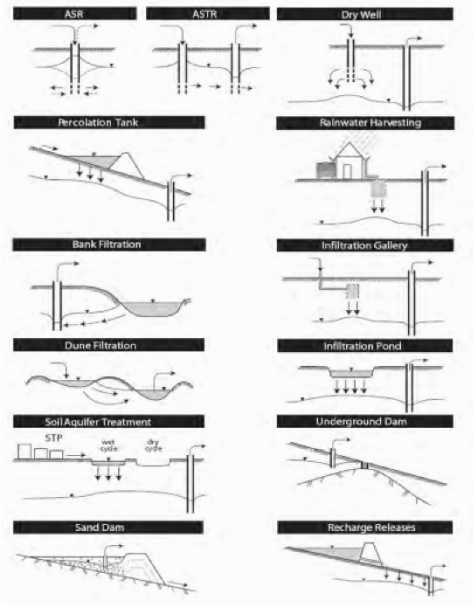


What is Managed Aquifer Recharge and why is it needed?

Managed Aquifer Recharge (MAR) is the targeted recharge of clean water for groundwater quality and quantity objectives. There are several methods of recharging the groundwater such as basins, wells and trenches. The main principle is that clean surface water from a lake or a river is made to percolate into the underlying geology via porous material to recharge the groundwater.

The method is not common in New Zealand, but given the large proportion of agricultural land being situated on alluvial type deposits that are ideally suited to MAR (e.g., Canterbury, Southland, Mackenzie Basin, Otago, Hawkes Bay, Wairarapa, Manawatu, Waikato) and the large population base located near major rivers or significant aquifers, MAR technology has significant potential in New Zealand.

The key MAR water quality objective in the Hekeao Hinds Plains is the reduction in nitrate-N concentrations in groundwater and connected surface water due to historical land use. The very slow travel time for nutrients in this groundwater systems means that only reducing nutrient discharge from current land use will not result in significant nitrate-N concentrations for many years/decades. The key MAR water quantity objective in the Hekeao Hinds Plains is to increase groundwater levels which will increase baseflows in the Hekeao/Hinds River and spring-fed streams (drains) for environmental, cultural and recreational benefit.



Hinds MAR Pilot scheme

Following initial assessments, a Hinds MAR Pilot Trial was developed to demonstrate the potential for MAR within the catchment. Resource consents authorising the Pilot Trial for a period of 5 years were granted by Environment Canterbury and Ashburton District Council (ADC) in 2016. These consents are currently being renewed.

Progress to date is primarily reported on the project website[3]; including the Year 1-4 Annual Reports. The key Year 3 findings are:

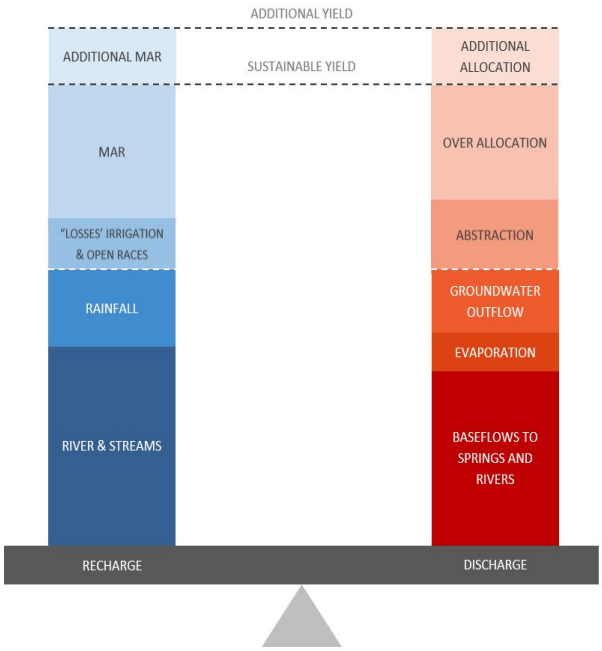
- At the Lagmhor Pilot Site construction of a deep soakage system in combination with sediment removal and higher basin depth operation has increased recharge rates by at least 30%. Monitored groundwater nitrate-nitrogen concentrations down-gradient from the Lagmhor Pilot Site remained low with a summer increase connected to site shutdown during July - September.
- The Hekeao Hinds River Project (HHRP) near river recharge site performed consistently following its commissioning in late September 2018. Recharge site and Hekeao Hinds River flow monitoring shows some recharged water stays in the groundwater system while other water re-emerges in the Hekeao Hinds River before recharging back to groundwater further down river. Above average river flows and groundwater levels, as well as the 5-6 km distance down gradient to monitoring bores, has made the HHRP influence challenging to identify at this distance. However, the cumulative contribution of clean water to this system is measurable and has been positive.
- Proof of concept was established for the trial test sites design, with direct connection to an irrigation pond preferred over stock water race supply for water quality (in particular *E. coli*) and sediment management purposes. Analysis for all test sites has involved recharge potential assessments and identifying ways to maximise their clean water recharge volume through distribution and site upgrades. Consent amendments are in process for enabling implementation of these improvements.

[3] *www.hhwet.org.nz*

Scope of Full Scheme

Objectives

- The MAR Scheme volumetric recharge target set by the Ashburton Zone Committee is 125 million m^3/year (with scheme over-build capacity of 55 million m^3/year). The additional capacity is directly related to seasonal flow variability of likely MAR source water and short 'capture' periods when water will be available for MAR operations (e.g., summer rains).

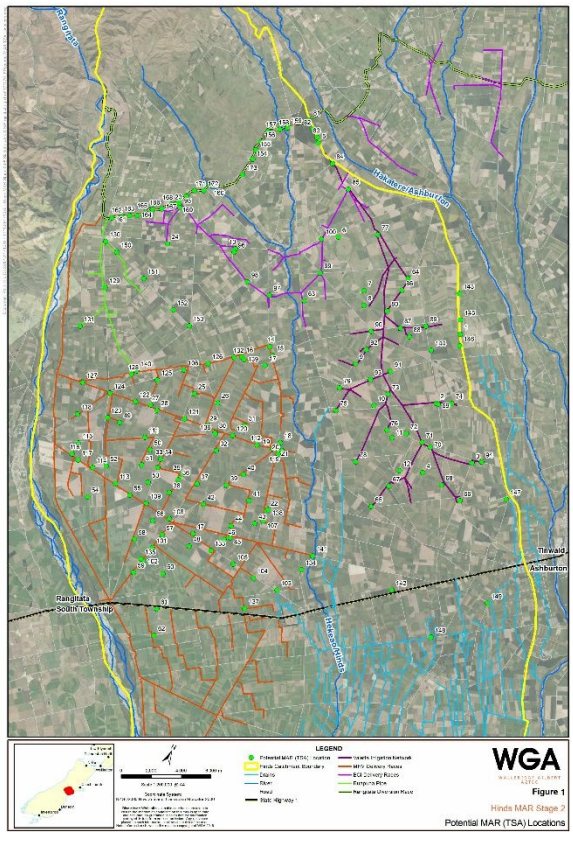


- The timing of full volumetric capacity was requested by the Ashburton Zone Committee to be sufficient to reduce annual median shallow groundwater nitrate-N concentrations from 9.2 mg/l to 6.9 mg/l, and lower Hekeao/Hinds River annual median nitrate-N concentrations to 3.8 mg/l, by 2035. Their assessments assumed full MAR capacity by 2025 to account for groundwater transport lag times.

- Note that no approach to achieve a significantly lower reduced target (e.g., 2.4 mg/l) has been substantiated to date.

Scope of Physical Works

A total of 173 locations have been identified for a total of 180 hypothetical MAR sites, which are situated adjacent to the RDR, BCI, MHV Water and ADC stock water distribution systems (figure right). Existing MAR sites (Lagmhor, Hekeao/Hinds River and the new test sites) are included in this inventory.



Sites chosen were distributed between 89 existing ponds, 45 ADC gravel reserves, 19 private land parcels, one river flood plain and one drain site.

Depending on the performance of the scheme, not all sites are expected to be required. Follow-up site specific assessments and a catchment-scale prioritisation process will be required to determine site locations, capacity and development timeframe. Numerical modelling of the catchment is underway to support this process.

Sourcing the water

The scheme has an existing water supply arrangement with Ashburton District Council in place and is seeking agreement for further arrangements relating to use of the Council's stock water system and gravel pits. Additional water supply from an existing RDRML Rangitata River consent is under discussion. This will require successful consenting and commercial arrangement discussions.

No takes from the Ashburton / Hakatere River are proposed to service the scheme.

Scheme Costs

Scheme costs have been estimated by Wallbridge Gilbert Aztec (WGA)[4] in 2018. This estimated the capital costs at $9.39 million, broken down as follows:

Element	Quantity	Unit rate	Amount
Infiltration Basin (4,000m2)	22	$182,138	$4,007,036
Shallow soakage	34	$27,445	$933,130
Deep soakage	13	$105,380	$1,369,940
ASTR bore	8	$314,243	$2,513,944
Trench	2	$73,830	$147,660
Wetland TSA	4	$101,696	$406,784
Total (ex GST)	**84**		**$9,378,494**

Sensitivity analysis

There is considerable uncertainty in the extent and number of sites requires and the cost of implementation of each site. Each will depend on the nature of the site and the underlying geology and so it is important to allow for the inherent uncertainty in the capital cost estimates.

It can be expected that the capital cost will range between $8 million and $11 million (±20%)

Comparison against recent costs

These have been reviewed against the cost of the pilot schemes works to date and recent projects undertaken by Kerr and Partners. While there is considerable variability in undertaking the works, the cost estimate are within the boundary of accuracy

[4] Hinds/Hekeao MAR Governance Group: Groundwater Replenishment Scheme: MAR Designs, Costings and Social Cost Benefit Analysis Economic Modelling. Job No 171076/Rev 1. 21 December 2018

The Strategic Context

The Strategic Context provides an overview of the key external factors which influence decision-making on this investment.

THE POLITICAL AND ECONOMIC CONTEXT

Agriculture is an essential part of our economy and is the most productive sector in the country.
Accounting for over 40% of total merchandise exports, the agricultural sector plays a key role in the New Zealand economy. Not only is agriculture the primary source of employment in many rural areas, its performance also influences the success of urban regions and its commodities are key inputs to many secondary industries.

From 1996 to 2018, labour productivity growth was highest in the primary sector with an average of 2.3% annual growth compared with 1.5% in the services sector and 0.9% in the goods producing sector. Productivity growth in the services sector is important as the share of employment in this sector grew by 3.4 percentage points between 1996 and 2018. The share of employment in the primary sector and goods producing sector decreased by 4.4 and 3.6 percentage points, respectively (Productivity Commission[5]).

Agriculture is essential to our economic wellbeing.

Water quality is one of the most important issues for New Zealanders.

On behalf of Fish and Game NZ, Colman Brunton asked people how concerned they were about a range of issues, including the cost of living, health system, child poverty and water pollution[6].

Pollution of rivers and lakes was the top concern with 82 percent saying they are extremely or very concerned about the issue. Only four percent said they were not that concerned. The cost of living is New Zealanders' second concern with 80 percent saying they are extremely or very concerned.

We want to swim in our rivers, hear the birdsong and collect our mahinga kai.

The government has a focused action plan to address freshwater issues called the Essential Freshwater work programme.

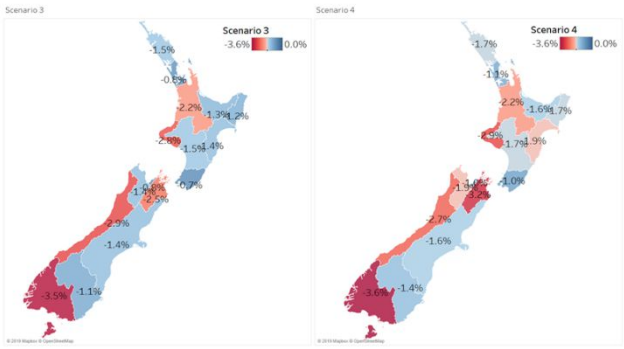
The Essential Freshwater work programme has three main objectives:

[5] Productivity by the Numbers, 2019, Productivity Commission

[6] The poll was conducted for Fish & Game New Zealand by Colmar Brunton from 5-12 December 2018. A thousand New Zealanders were surveyed, and the results are nationally representative for age, gender and region. It has a margin of error of plus or minus 3.1 percent.

1. Stopping further degradation and loss – taking a series of actions now to stop the state of our freshwater resources, waterways and ecosystems getting worse (i.e., to stop adding to their degradation and loss) and to start making immediate improvements so that water quality is materially improving within five years.
2. Reversing past damage – promoting restoration activity to bring our freshwater resources, waterways and ecosystems to a healthy state within a generation, including through a new National Policy Statement for Freshwater Management and other legal instruments.
3. Addressing water allocation issues – working to achieve efficient and fair allocation of freshwater and nutrient discharges, having regard to all interests including Māori, and existing and potential new users.

Improving water quality can have an adverse impact on the economy



DairyNZ[7] initiated three studies into the potential economic effects of the Essential Freshwater proposals. Two of these economic studies are independent and all three have been peer-reviewed.

The economic studies are supported by additional technical research by DairyNZ which analyses the likely water quality improvements. The economic modelling shows that the proposed Essential Freshwater policy package could lead to a $6 billion fall in our GDP by 2050.

Finding the right solutions that enhance water quality and economic activity is critical.

The Canterbury Water Management Strategy provides a collaborative framework to help manage the multiple demands on this precious resource.

The overarching vision of the strategy is 'to gain the greatest cultural, economic, environmental, recreational and social benefits from our water resources within a sustainable framework both now and for future generations.'

This includes managing the flows and levels in any water body, such as the control of taking, using, damming, diverting, and allocating water and control of discharges. Environment Canterbury are a lead agency for this work in collaboration with Ngāi Tahu, territorial authorities, landholders, industry groups, statutory bodies, NGOs and other agencies.

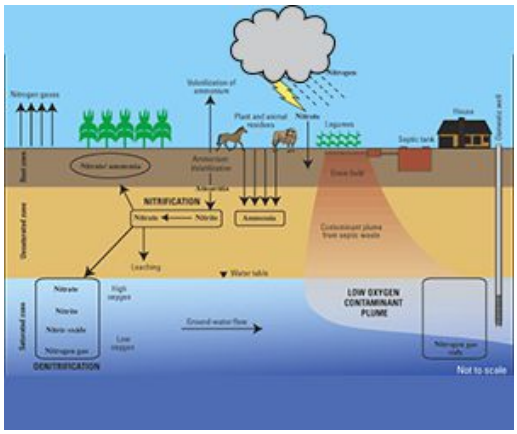
Multi-sector collaboration is the approach taken to resolve these issues in Canterbury.

[7] https://www.dairynz.co.nz/environment/environment-policy-and-leadership/national-freshwater-regulations/

THE ENVIRONMENTAL CONTEXT

Nitrate contamination of groundwater has occurred since agriculture began on the Hekeao Hinds Plains.

In catchments dominated by agriculture, nitrogen, pathogens, phosphorus and sediment are the key contaminants in waterways that can affect the health of aquatic life. They can also accumulate in gathered foods and taint and discolour water.



Nitrogen, pathogens, phosphorus and sediment typically come from fertiliser application, tilling and cultivation, livestock grazing and animal wastes. Although, they can also come from point sources such as leaking animal effluent storage. Other contaminants, such as pesticides or trace metals from fertilisers, may also be derived from agriculture, but there is no evidence from current monitoring that these are having a widespread effect on the water quality of the Hekeao/Hinds Plains area.

Nitrogen (in the form of nitrate) is the best general indicator of cumulative effects on water quality from land use in the Hekeao/Hinds Plains. Nitrate and pathogen concentrations are high in both groundwater and surface water in the Hekeao/Hinds Plains area – sometimes exceeding drinking-water standards and ecological and recreational water guidelines. Nitrate can have serious health effects on bottle-fed infants who may consume high concentrations, and pathogens can be harmful to people and animals. Nitrate can also be toxic to aquatic species even at relatively low concentrations.

Sediment and phosphorus affect the ecological and cultural values of surface waterways by contributing to turbidity and discoloration, nuisance algal growth and loss of habitat. Phosphorus typically binds strongly to sediment which is filtered out during infiltration, so phosphorus and sediment are generally not as problematic in groundwater. Over most of the Hekeao/Hinds Plains phosphorus runoff with sediment is also less of an issue than other areas due to the flat terrain and generally porous soils.

The reasons why nitrate is the most appropriate contaminant to be managed in the lower Hekeao/Hinds catchment are:

- It is highly soluble in water.
- It is released from all types of farming activities, including arable and pastoral.
- It is widely distributed from diffuse sources over the whole of the Hekeao/Hinds Plains area, so it cannot be controlled by local-scale interventions alone.
- Concentrations in surface and groundwater exceed thresholds that impact a range of values.
- Concentrations in surface and groundwater are increasing, and the rate of increase has accelerated.
- Actions to manage nitrate will also control many of the other contaminants from land use.

Point source discharges such as septic tanks, leakage from farm effluent ponds, and farm pits are additional sources of water contaminants, especially of nitrogen, phosphorous and pathogens that need to be managed locally. At present, the Hekeao/Hinds Plains area has no large point source discharges from industries or from centralised sewage treatment plants.

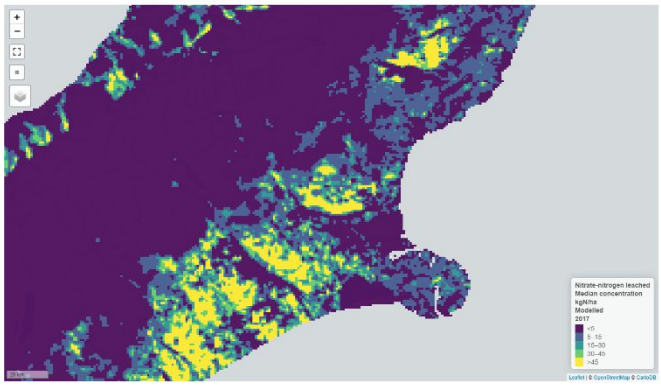
It is estimated that approximately 6 t P/year and 30 t N/year are released from point sources in the Hekeao/Hinds Plains area. This is less than 1% of the current total catchment load for nitrogen (total catchment load for nitrogen approximately 4,500 t N/year). While point sources are still a contributor to overall catchment loads, the most appropriate way to reduce the risk of these contaminants is to continue to require resource consents as set out under the LWRP.

Any new point source discharge of nitrogen will require consent under the LWRP and will need to be accommodated within catchment load limits.

Lag times in groundwater flows are estimated to range from years to decades and in some places more than a century, which means the effects of on-land use today (and the subsequent effect on nitrate concentrations in the surface and groundwater) are not likely to be seen for some time. However, other actions are likely to have more immediate to medium term beneficial effects.

Nitrogen contamination has been caused because we did not understand what the effects of practices at the time were.

Some of the highest nitrate levels in New Zealand groundwater can be found in the Hekeao Hinds catchment.



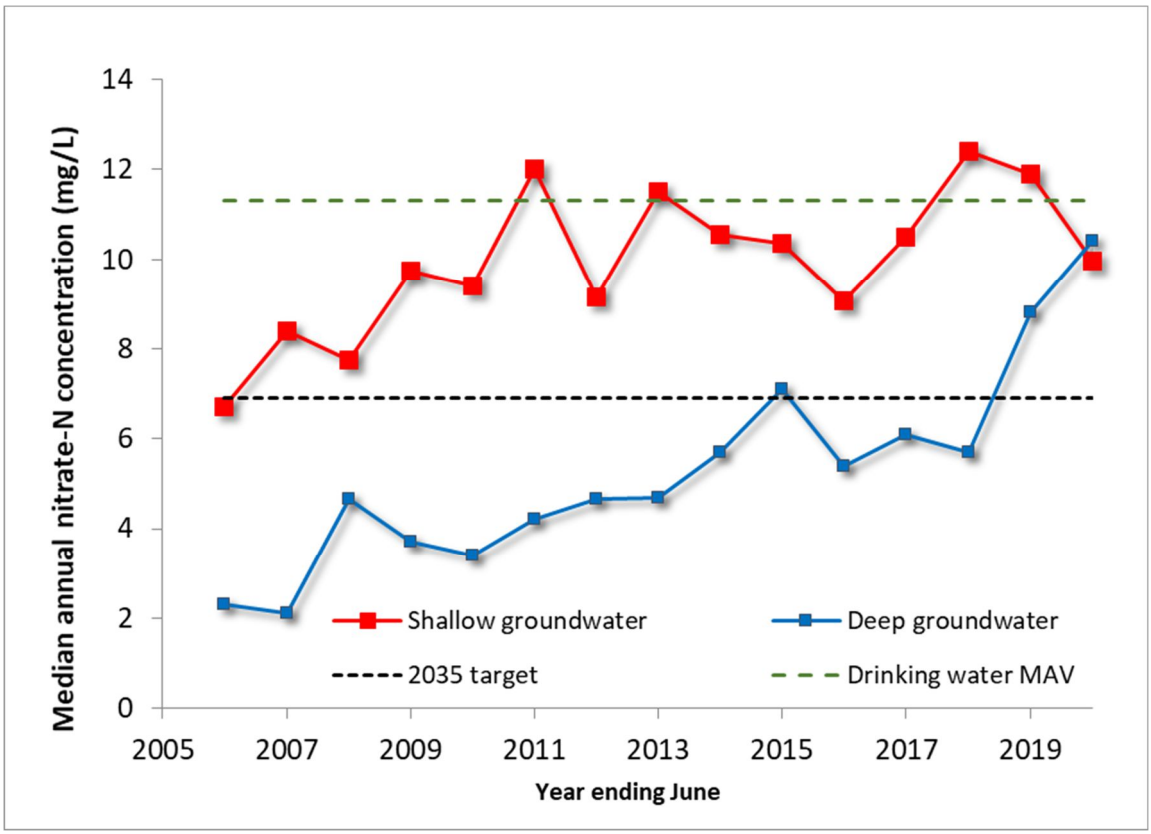
Environment Canterbury manages Hekeao/Hinds groundwater in two Groundwater Allocation Zones: the Mayfield-Hinds GAZ and the Valetta GAZ. Groundwater represents the majority of allocated water in the catchment with 490 consents able to take 249.7 million m^3/yr.

Surface water consents, which are also significantly dependent during the irrigation season on groundwater spring flows, make up 132 consents, totalling 91.5 million m^3/yr assuming continuous pumping for a 150-day irrigation season. The combined total allocated from groundwater is 341.2 million m^3/yr.

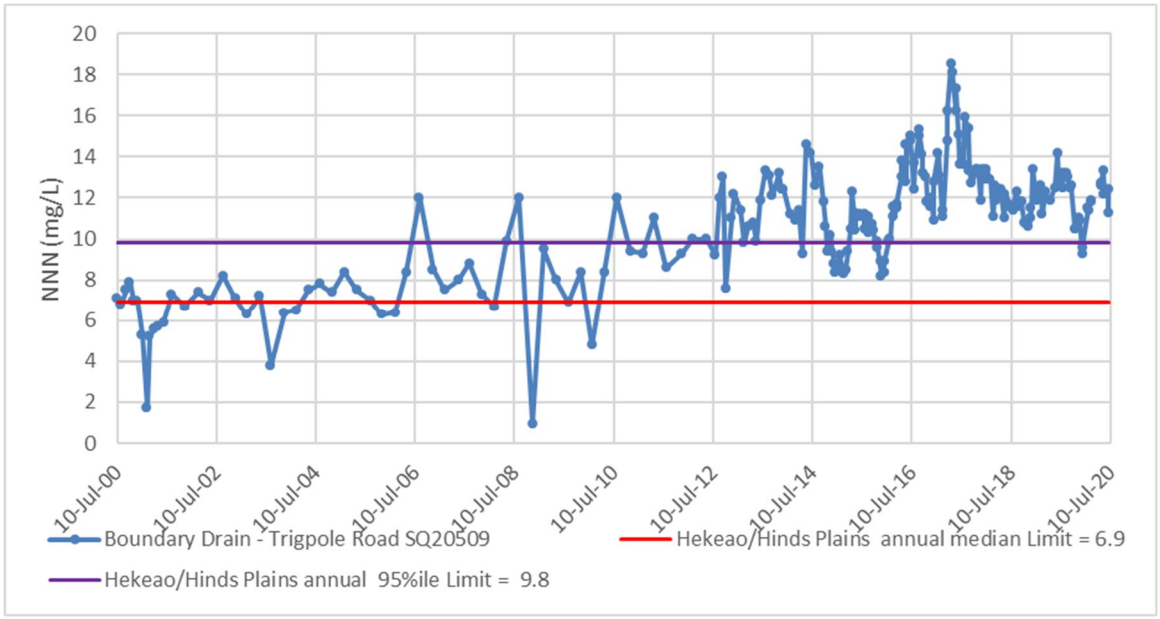
Nitrate-N concentrations are elevated and increasing in the groundwater and the spring-fed waterways. The Hekeao/Hinds Plains waterways have some of the highest nitrate-N concentrations for surface water in New Zealand. The maximum concentration of nitrate-N in groundwater exceeds the drinking-water standard, and the average concentration exceeds half the standard. Groundwater nitrate concentrations vary across the catchment, with increasing monitoring coverage helping to target rehabilitation efforts.

Some of the larger lowland waterways sampled (e.g. Boundary, Blees, Deals Drains) have average nitrate-N concentrations equal to that of the shallow groundwater. The lower Hekeao/Hinds River has slightly lower nitrate-N concentrations, probably influenced by river recharge further up the catchment.

Until 2019, deeper groundwater generally had lower concentrations of nitrate-N than the shallow groundwater; however, CRC monitored deep groundwater median nitrate concentrations reached similar levels to shallow groundwater in 2019/20 and are currently well above the average for deep wells in Canterbury. Deeper groundwater is usually older than shallow groundwater due to longer travel times from the land surface.



Plan Change 2 to Canterbury's Land and Water Regional Plan – Hinds Plains median annual nitrate-nitrogen concentrations



Boundary Drain (lower Hekeao/Hinds Plains) nitrate plus nitrite-N

Nitrates currently present a risk to health and wellbeing of the community and will take decades to pass through the system.

THE REGULATORY CONTEXT

The national and regional statutory planning environment is placing further limitations on activities that impact water quality and particularly nitrate discharge.

Some key changes introduced through the National Policy Statement for Freshwater Management 2020 (NPS-FM) include:

- The *Te Mana o te Wai* framework has been strengthened with a specific hierarchy of obligations. The new hierarchy places the health and wellbeing of water bodies and freshwater ecosystems first.
- Expectations and direction about involving Māori in freshwater decision-making has been strengthened.
- New compulsory values and attributes have been included.
- There is now a requirement for regional councils to map, monitor and manage wetlands and obstacles to fish passage.

Considerable weight must be given to the principles of Te Mana o te Wai, and the requirement to put the health and well-being of freshwater first, then human health, and finally the ability of people and communities to provide for their social, economic and cultural well-being.

Changes are pending to the Land and Water Regional Plan to implement the NPS. In particular, this will mean:

- Resource consents will be required for intensification of land uses and winter grazing unless meeting certain conditions.
- Application of synthetic nitrogen fertiliser to dairy farms will be capped at 190kg N/ha/year from 1 July 2021.
- New attributes are to be included, aimed specifically at providing for ecosystem health. These include fish index of biotic integrity (IBI), sediment, macroinvertebrates (MCI and QMCI), dissolved oxygen, ecosystem metabolism and submerged plants in lakes. Councils will have to develop action plans and/or set limits on resource use to achieve these attributes, including tougher national bottom lines for the ammonia and nitrate toxicity attributes to protect 95% of species from toxic effects (up from 80%).

Regulations are tending towards increasingly stringent water quality standards and controls on land uses and inputs.

The Zone Implementation Programme (and Addendum)

Regional water resource management in Canterbury is being implemented through the Canterbury Water Management Strategy (CWMS): a partnership between local communities, the Regional Council, District Council/s and local Māori.

The Ashburton Zone Committee is a joint committee of Environment Canterbury and the Ashburton District Council. The Committee has been tasked with providing recommendations to Environment Canterbury and the Ashburton District Council on actions to improve the management of water in the Hekeao/Hinds Plains area.

A key part of the recommendations in the Zone Implementation Programme (ZIP) and ZIP Addendum (ZIPA) are a 'solutions package.' There are four main parts to the "Solution Package" (Figure right).

These are:

- Catchment scale actions
- Local scale actions
- Investigations, monitoring and review
- Community engagement

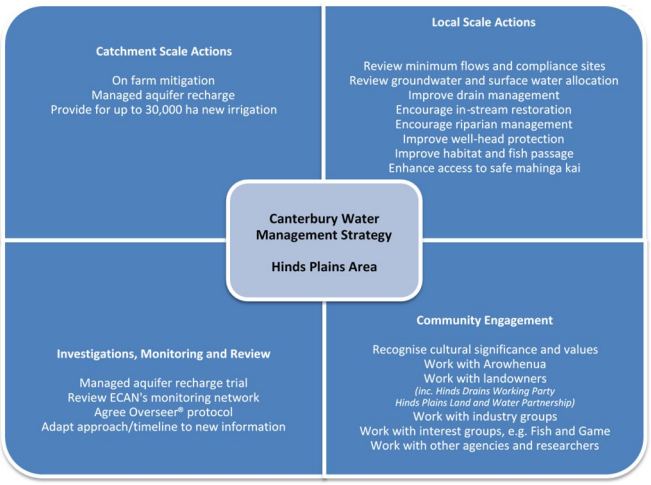


Figure 2: Components of the Hinds Plains Solution Package

The Catchment Scale Actions are large-scale mitigations that are aimed at providing a holistic (whole system) option to manage the large-scale issues in the catchment.

The three main catchment scale actions are on farm mitigations, Managed Aquifer Recharge (MAR), and management of irrigated area.

The collaborative process under the Canterbury Water Management Strategy has produced a strategy to address these issues.

Plan Change Two: Canterbury's Land and Water Regional Plan

With some important amendments, Plan Change Two to Canterbury's Land and Water Regional Plan codified the "solutions package" developed by the Ashburton Zone Committee to achieve outcomes for the Hekeao/Hinds Plains Area.

It required all farms to operate at good management practice by 2017, and by requiring farms subject to a resource consent to further reduce nitrogen losses by 15% by 2025, 25% by 2030 and 36% by 2035, or until they reduce to 20kg/ha/yr.

Farms with nitrogen loss of more than 15kg/ha/yr require a resource consent and must not exceed their nitrogen baseline. Applications for resource consent must be accompanied by a Farm Environment Plan (FEP) and explain how the stepped reductions in nitrogen loss will occur over time (as directed by the policies).

The ability to extend the area of irrigation by 30,000ha (as included in the ZIPA) was set aside in the Plan Change following the decision by the Commissioners because the assurance around the effectiveness of the nitrogen reduction action (on-farm and MAR) could not be relied upon.

Support for MAR is codified in regulation.

THE SOCIAL AND CULTURAL CONTEXT

"Ki uta ki tai" is a Māori holistic philosophy meaning "mountains to the sea." This approach would aim to link special areas together so that, over time, they provide habitat 'corridors' for valued species such as whitebait/inanga, lamprey/kanakana and eel/tuna.

Ngāi Tahu consider that all water policy and plans should be guided by the principle that water is a taonga. This taonga value includes inherent values associated with water itself, resources living in the water, and the resources in the wider environment that are sustained by the water (Ngāi Tahu Freshwater Policy Statement).

Arowhenua has been clear in its position that the taonga status of water is not affected by the degree of modification that may have occurred to a water body. This is in no small part due to the fact that these modified water courses are the only places in the area now available to whānau for practices such as mahinga kai.

Everything is connected and only a system-based solution will work to protect our resources that we value.

Many farmers in the catchment are making significant investments to limit nitrogen and other contaminants entering the groundwater and surface water from their operations. Examples include:

- MHV Water Ltd (MHV) and Ashburton Lyndhurst Irrigation Limited (ALIL) work together to manage nutrient discharges under the terms of the resource consent CRC183851. Compliance audits show an improvement from 35% achieving A Grade audits in 2017 to 65% achieving A Grade audits in 2020.

- All farms with an OVERSEER™ nitrogen discharge greater than 20/ha are required to hold consents to farm, which include independent auditing of their Farm Environment Plans (FEP's). FEPs enable identification of on-farm risks, targeting of objectives which will drive improved environmental performance, and ensuring compliance with resource consent conditions. The completion of a nutrient budget is also a key requirement.

- The Environmental Management Strategy for MHV includes the Audited Self-Management Program, groundwater and surface water monitoring programme, extension and support for farmers and it outlines collaboration with Rūnanga. This enables the scheme to drive improved environmental outcomes.

- Fonterra's Tiaki Sustainable Dairying Programme enables farmers to tap into specialised regional knowledge, expertise and services to support best practice farm management, proactively stay ahead of regulatory requirements, and satisfy evolving consumer and market expectations.

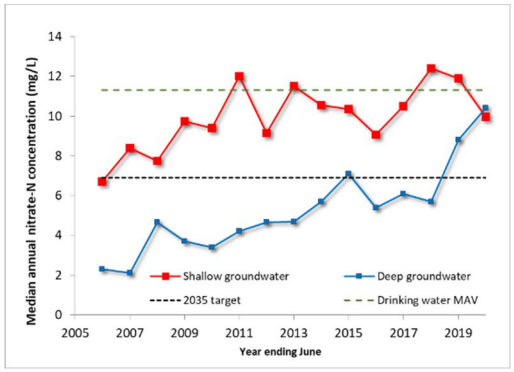
Farmers are working hard to adapt their practices to protect water quality. The challenge is to make those changes while maintaining financial sustainably.

The Strategic Case – Making the Case for Change

This part of the Strategic Case finds a compelling case for change to invest in the development the MAR scheme to address water quality and support economic activity in the catchment.

Existing Arrangements and Business Needs

The nitrate levels in the groundwater are high, leading to potential human health risks from drinking the water and these could take decades to pass through the system.



The nitrate-N concentrations in some parts of the catchment groundwater are high compared with drinking water and ecological guidelines. It is likely that they have been increasing since the advent of agriculture on the plains, with changes in the last few decades (in particular more efficient irrigation, less leakage from water distribution and increased land use intensification) contributing to recent (and potential future) concentration increases.

Over 100 wells were sampled in the Hinds Plains area in the five-year period from mid-2007 to mid-2012. Half of these wells were recorded as drinking-water sources. The average nitrate-N concentration in all of the wells (shallow and deep) tested by Environment Canterbury was 5.6 mg/l, equivalent to half the Maximum Acceptable Value (MAV[8]). An average of half MAV is likely to result in no more than 10% of samples exceeding MAV for drinking-water in a given sample set.

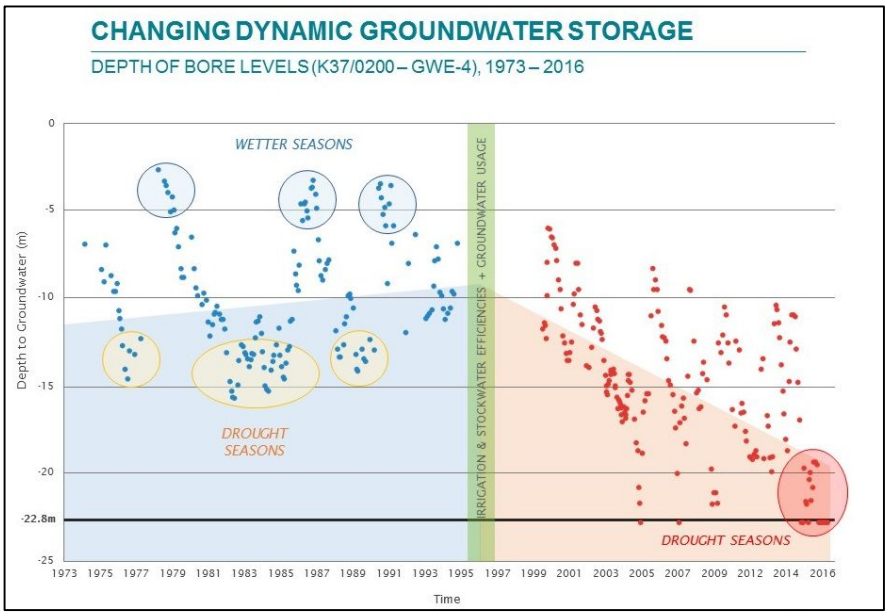
A follow up study by ADC and CDHB in 2015 sampled 50 domestic wells in the Ashburton-Rangitata area, with 25 of these near the town of Tinwald. 54% of these wells had nitrate-N concentrations greater than half the MAV, with 28% greater than the MAV. This led to a targeted drinking water risk awareness campaign by ADC and CDHB.

PC2 models estimated that the average nitrate-N concentration in shallow groundwater could increase to more than 12 mg/l after the time lag for all nitrogen currently leaching from land use to reach the groundwater. Nutrient leaching reductions are occurring as required by PC2, but the long lag times through most of the groundwater system means that these improvements will take a while before the corresponding decrease in monitored groundwater nitrate-N concentrations are measurable.

Any 'at risk' groups – such as pregnant women and formula-fed infants less than six months old – are recommended to only consume other water sources such as bottled water in areas of high nitrate (CDHB).

[8] *Maximum Acceptable Value (MAV) is the non-exceedance standard of nitrate in drinking water as defined in the Drinking Water Standards 2005/2008. This equates to 11.3 mg/L nitrate-nitrogen.*

The high nitrate levels and low flows in springs adversely affect the ecology of the lowland streams and drains.



An annual median[9] nitrate-N concentration of 6.9 mg/l in lowland water bodies is the nationally accepted level for fair protection (80%) of aquatic biodiversity. For 90% biodiversity protection, the annual median recommended is 3.8 mg/l. The level of 6.9 mg/l is expected to provide base levels of protection to maintain populations of eels, lamprey and general native fish species likely to be found waterways in the lower Hekeao/Hinds catchment. The more protective level of 3.8 mg/l was recommended by the ZIPA for the lower Hinds River/Hekeao and tributaries to protect more sensitive species such as whitebait and juvenile trout.

Spring-fed water bodies in the Hekeao/Hinds Plains area are in declining ecological health (ZIPA). Historical changes to improve irrigation efficiency (in particular the change from border dyke to spray irrigation) and increase groundwater pumping (discharge) have resulted in degraded base flow conditions. The ZIPA has recognised that the current allocation has not only negatively affected cultural and ecological values but also reliability of irrigation from groundwater. It therefore seeks to return some of this allocated water to protect cultural and ecological values as part of the mitigation options being proposed in the catchment.

Nitrate from historical land uses has moved through the groundwater system and is now present in spring-fed flows to lowland water bodies. Monitoring of the Hinds Drains has increased since PC2, with most drains in the last few years exceeding the 6.9 mg/l nitrate-N target most of the time.

Noting the new requirement of the NFPS-FM (2020) that places the health and well-being of waterbodies and freshwater ecosystems before human health and economic activity, the current ecological health of spring-fed water bodies in the Hekeao/Hinds Plains area is unacceptable.

The NPS-FM (2020) requirement to develop long-term visions for freshwater in each region and the realisation of those vision within an ambitious but reasonable timeframe (generally

[9] *Note that annual **average** (or mean) nitrate concentrations estimated from modelling are considered comparable to annual **median** concentrations for the purpose of assessing whether toxicity thresholds are likely to be breached.*

considered to be 30 years). This means that these levels of nitrogen concentration will need to be reduced within a generation to enable the mana of the water to be restored.

Lower groundwater levels mean that many wells are dry or face increased pumping costs during low rainfall periods.

The Hekeao/Hinds Plains area contains two groundwater allocation zones separated by the Hekeao/Hinds River. The area north of the Hekeao/Hinds River is called Valetta and the one to the south is called Mayfield-Hinds. In recent years, demand for groundwater has increased substantially with allocation doubling twice in the last 10 years. By 2007, the groundwater in the Valetta zone was classed as over-allocated (138% of the groundwater has been allocated). Additionally, 82% of the groundwater in the Mayfield-Hinds zone is considered allocated. Actual abstraction is usually significantly less than that allocated, but demand (constrained by minimum flows) is greatest during dry periods when groundwater levels are naturally lower.

The sources of recharge to groundwater include rainfall, irrigation water, and surface water from rivers and open channel races. In recent years, improvements in irrigation efficiency through water race maintenance, conversion to efficient spray irrigation and improved management have reduced the amount of irrigation water recharging the groundwater. These, along with changes in rainfall and increasing usage of the groundwater resource, are likely to be the cause of falling groundwater levels, and the drying up of associated springs and surface water bodies in recent years.

Despite the fact that the Mayfield-Hinds groundwater zone is not 100% allocated, the Zone Committee determined that a precautionary approach is needed until monitoring provides some certainty that the system has stabilised and that the measures proposed will halt the decline in the Valetta zone. However, it is currently too difficult to determine whether the system can be rebalanced until the effectiveness of MAR is determined.

Further restrictions on nitrate levels are likely to lead to very significant constraints on farming operations and land uses.

The Hekeao/Hinds Plains area is considered a nutrient management “red zone” under the LWRP, which means there can be no increase in nitrogen leaching relative to the 2009 to 2013 nitrogen baseline. Farms with medium nitrogen loss rates in the red zone (less than 20 kg N/ha/yr) can continue to operate as a permitted activity. Farms with higher nutrient losses (more than 20 kg N/ha/yr) could continue to operate as a permitted activity until 1 January 2017, but a resource consent is now required with a completed Farm Environment Plan.

For the purposes of evaluating the costs of meeting the median nitrate-nitrogen target concentration of 6.9 mg/l in groundwater without the use of MAR, MRB (2018) re-evaluated the OVERSEER® and financial farm models using a target reduction of 48%. The MRB assessment indicated that to achieve a 48% reduction ‘significant changes in land use would be required if other on-farm technologies are not developed.’

In order to provide an economic value to achieve the nutrient reductions (without MAR), MRB has provided an estimate of ‘potential costs’ for achieving a 48% reduction (without MAR). To do this, MRB (2018) selected the greatest emitters (dairy, dairy support and small seed production) and estimated the required increase in lower leaching farm types (Process

Vegetable, Livestock and Grain, and Finishing Livestock). A further assumption was made around additional capital expenditure being invested before undertaking land use change.

If MAR is not available and the community must meet 48% reductions in N loss, MRB forecast that land use must change from high emitting land uses (Small Seed Arable; Dairy; Dairy Support) to lower emitting land uses. The cost of this on-farm is estimated to be -$55/ha NPAT reduction greater than the 36% reductions (-$420/ha NPAT from GMP). The cost reduction in asset value is estimated to be $11,801/ha ($1.551 billion total) de-valuation in land asset value greater than the asset value degradation for 36% reductions.

The cost to the community to achieve 48% reductions, in excess of the costs to achieve 36% reduction targets is estimated to be -$163,141,563 p/a reduction in community spending resulting from lower available income to spend on farm.

Investment Objectives

Based on the problem statements and business needs articulated above, the following MAR investment objectives have been developed to address the problems.

Table Three: Investment Objectives

Reduce	*Reduce groundwater nitrate-N concentrations to mitigate historic effects of nitrate discharges*
Enable	*Enable farming activities to be sustainable, continuing to create economic activities and support the wider community*
Recharge	*Recharge the Hekeao / Hinds groundwater system through 125,000,000 m^3/annum of MAR*
Restore	*Restore the ecosystem health of Hekeao/Hinds groundwater, lowland drains and streams for cultural, environmental and recreational benefit*

Table Four: Summary of the objectives, existing arrangements and business needs

<table>
<tr><td>REDUCE</td><td>Significantly reduce the total discharge of nitrates from the land use on the Hekeao/Hinds Plains to achieve 2035 PC2 nitrate-N concentration targets</td></tr>
<tr><td>Existing Arrangements</td><td>The total discharge of nitrates from irrigated properties is estimated to result in a nitrate-N concentration in shallow groundwater of about 14 mg/l. This is well over the toxicity level for most aquatic species and exceeds the New Zealand Drinking Water Standard.</td></tr>
<tr><td>Business Needs</td><td>The 2035 nitrate-N concentration target is 6.9 mg/l as an annual median in the PC2 shallow monitoring bores. Modelling showed that the Options Package of on-farm mitigations by itself would only achieve 9.2 mg/l.</td></tr>
<tr><td>Potential metrics</td><td>• mg/l for nitrate-N concentration</td></tr>
<tr><td></td><td></td></tr>
<tr><td>ENABLE</td><td>Enable farming activities to be viable and productive, continuing to create economic activities and support the wider community.</td></tr>
<tr><td>Existing Arrangements</td><td>The total irrigated areas in the catchment are as follows:
<table>
<tr><th>Irrigation Scheme</th><th>Hectares Irrigated</th></tr>
<tr><td>MHV Water Limited</td><td>50,000 ha between the Rangitata and Ashburton Rivers</td></tr>
<tr><td>Barrhill Chertsey Irrigation Limited</td><td>7,330 ha upper plains</td></tr>
<tr><td>Eiffelton Irrigation Scheme</td><td>2,700 ha lower plains</td></tr>
<tr><td>Lynnford Irrigation Scheme</td><td>120 ha lower plains</td></tr>
<tr><td>Total Irrigation Scheme</td><td>60,150 ha irrigated land</td></tr>
<tr><td>Groundwater consents</td><td>approx. 48,000 ha irrigated land (with some of this land also supplied by an irrigation scheme)</td></tr>
</table></td></tr>
<tr><td>Business Needs</td><td>The new NPS-FM prioritises environmental health over economic activity (Te mana o te wai) and leads to the objective to restore waterways and groundwater within a generation. This means that the quality of the water is prioritised over the economic viability of land uses.
Land use in some parts of the catchment have been shown to influence groundwater nutrient concentrations in less than a generation, but these time frames over most of the catchment are usually measured in multiple generations. MAR has shown the ability to significantly speed up the restoration of influenced groundwater and connected spring-fed waterways.</td></tr>
<tr><td>Potential Metrics</td><td>• Irrigated land area in catchment (ha)</td></tr>
<tr><td></td><td></td></tr>
<tr><td>RECHARGE</td><td>Recharge groundwater to both mitigate historic effects of nitrate discharges and raise groundwater levels through the discharge of 125,000,000 m^3/annum.</td></tr>
<tr><td>Existing Arrangements</td><td>The national drinking-water standard (Maximum Acceptable Value (MAV)) for nitrate-N is 11.3 mg/l. In order to meet the drinking-water standard and take into account seasonal and individual well variability, concern is raised when monitoring indicates</td></tr>
</table>

	that the average nitrate-N concentration is at half MAV (i.e. 5.6 mg/l) and showing an upward trend. Over 100 wells were sampled in the Hekeao Hinds Plains area in the five-year period from mid-2007 to mid-2012. Half of these wells were recorded as drinking-water sources. The average nitrate-N concentration in all the wells (shallow and deep) was 5.6 mg/l, equivalent to half MAV, with 10% of wells yielding one or more samples exceeding the MAV. The median nitrate-N concentration for PC2 shallow monitoring bores in the most recent year (July 2019 – June 2020) is 9.9 mg/l, with a combined median nitrate-N concentration for Regional Council shallow and deep monitoring bores at 10 mg/l. The move to more efficient irrigation practices, reduction in leaky stockwater and irrigation distribution races, and a drying climate are reducing groundwater levels with resulting declines in spring fed flows and increased costs of groundwater abstraction.
Business Needs	Drilling deeper bores to reach lower nitrate has been considered for shallow drinking water bores, with costs estimated to be at least $30,000 per bore. increasing However, with elevated nitrate levels now measured in deeper monitoring bores and longer lag times than shallow bores an alternative mitigation of undersink treatment is being implemented by households across the plains. Approximate installation costs are $1500 - $10,000 plus $150-$800 annual costs. The Hekeao Hinds MAR Scheme is specifically targeting areas of elevated nitrate-N groundwater up-gradient from drinking water supplies. At the main monitoring bore down-gradient from the longest running Hekeao Hinds MAR site, nitrate-N concentrations that were approximately 7 mg/l prior to MAR have been maintained at 1.5-3.5 mg/l for the four years of MAR operation. MAR also raises groundwater levels through a pressure response which radiates in all directions from MAR sites. This improves influenced spring-fed flows and reduce groundwater pumping costs. For spring-fed waterways with high eco-system values, Targeted Stream Augmentation systems (direct augmentation with connected groundwater using solar power) can be added.
Potential Metrics	• Total managed recharge volume per annum
RESTORE	**Restore shallow groundwater, lowland drains and streams to improve ecology and support mahinga kai so that annual median nitrate-N concentration does not exceed 6.9 mg/l in shallow groundwater and spring-fed water bodies.**
Existing Arrangements	Groundwater monitoring records back to the mid-1980s in the Hekeao Hinds Plains show elevated nitrate-N, though it is likely nitrate has leached to groundwater since agriculture began on the plains. The Hekeao/Hinds Plains lowland waterways currently have some of the highest nitrate-N concentrations for surface water in New Zealand, with the maximum concentration of nitrate-N in groundwater exceeding the drinking-water standard, and the average concentration exceeding half the standard. Some of the larger waterways sampled (e.g. Boundary, Blees, Deals drains) have average nitrate-N concentrations equal to that of the shallow groundwater. The lower

	Hekeao/Hinds River has slightly lower nitrate-N concentrations, which is probably influenced by river recharge further up the catchment.
Business Needs	Canterbury's Land and Water Regional Plan (LWRP) recognises that everything is connected to everything else. Water bodies, whether they are above or below ground, are linked. Actions that affect one water body are likely to affect another. Approaching this catchment as an integrated network that extends from the foothills to the sea is consistent with the concept of Ki Uta Ki Tai. This is further reinforced by the new NPS-FM which places considerable weight on the health of waterbodies above other outcomes. Analysis of options under the ZIPA concluded that managing annual median nitrate concentration in lowland streams of 6.9 mg/l to meet nitrate toxicity guidelines was necessary for protection of 80% aquatic biodiversity (including species such as eels and lamprey). No approach to achieve a significantly lower target (e.g., 2.4 mg/l) in a generational timeframe has been substantiated to date, however as noted above a key MAR-influenced monitoring bore has maintained a range of 1.5-3.5 mg/l nitrate-N for the last 4 years.
Potential Metrics	• mg/l for nitrate-N (or nitrate+nitrite-N) in lowland drains and streams

Potential Business Scope and Key Service Requirements

The potential range of business scope and key service requirements are identified in the table below.

Table Five: Potential business scope and key service requirements

Service Requirements	Scope Assessment			
	Minimum Scope	Intermediate Scope	Maximum Scope	Out of Scope
Additional Irrigation Area	No more irrigation	15,000ha	30,000ha	More irrigation
On-Farm Mitigation	Good Management Practice	AM1	AM3	Regulated land use changes
Groundwater Recharge	nil	2.5 m^3/s	5 m^3/s	Groundwater transfer

Main Benefits

Tables Five and Six summarise the benefits to be gained from investment in MAR scheme:

Table Six: Analysis of potential benefits that can be expressed in monetary terms

Main Benefits	Who Benefits?	Direct or Indirect?	Description
Economic Activity	Wider community	Indirect	Economic impact of increased (and continued) farm output
Financial Sustainability	Landowners	Direct	Property value

Table Seven: Analysis of potential benefits that cannot be reliably expressed in monetary terms

Main Benefits	Who Benefits?	Direct or Indirect?	Quantitative or Qualitative?	Description and Possible Measures
Ecological Health	Wider Community	Indirect	Quantitative	QMCI or similar index in lowland streams
Cultural Values	Mana whenua	Direct	Quantitative	Volume of food gathered/no. of sites and diversity of kai
Human Health	Well owners	Direct	Quantitative	Quality of drinking water

Main Risks

Risks result from uncertain events that either improve or undermine the achievement of benefits. The main risks that might create, enhance, prevent, degrade, accelerate or delay the achievement of the investment objectives are identified and analysed below.

Table Eight: Initial risk analysis

Main Risks	Consequence (H/M/L)	Likelihood (H/M/L)	Comments and Risk Management Strategies
MAR not able to recharge groundwater sufficiently due to hydrogeological challenges	High	Medium	Will require greater volume of water and further capital and operating input to install more discharge locations
Further changes for regulatory requirements	High	Medium	Further tightening of water quality standards will require either reduced nitrogen leaching and/or increased MAR in order to achieve low water quality concentrations
Not able to get sufficient water to recharge due to the cost of the water supply	High	Medium	Acquire water supply at a higher price, leading to higher operating costs and/or increased on-farm mitigation
On- Farm mitigation not achieved	High	Medium	Leads to increased enforcement. Unlikely to be able to increase MAR due to anticipated technical, land access and financial constraints
MAR causes downstream flooding leading to reduction in discharge	Mod	Low	May need additional drainage works or reduction in discharge of MAR in a particular part of the catchment
Insufficient funding secured	High	Mod	Will require offset by increased mitigation by landowners and/or increased rates
Clearly communicating the options and issues to stakeholders, despite their inherent complexity, to allow them to participate in the process in a meaningful way	Medium	Medium	Robust communications and engagement approach
Inability to secure consents for sufficiently long enough to all full impacts of scheme to be realised	Medium	Medium	Secure consents as a key next step

Key Constraints and Dependencies

The proposal is subject to the following constraints and dependencies, which will be carefully monitored during the project.

Table Nine: Key constraints and dependencies

Constraints	Notes
Funding	This is the purpose of this business case
Water availability	The availability of sufficient water from the surface water system is essential to be able to operate the scheme
Dependencies	**Notes and Management Strategies**
On-farm mitigation	This is part of Canterbury's Land and Water Regional Plan and implemented through Farm Environment Plans and consents
Landowner agreements	Land access may need to be secured to accommodate components of the scheme

The Economic Case – Exploring the Preferred Way Forward

The purpose of the economic case is to identify the investment option that optimises value for money. Having determined the strategic context for the investment proposal and established a robust case for change, this part of the economic case:

- Identifies critical success factors
- Generates a list of options
- Assesses the options
- Identifies a preferred way forward

Critical Success Factors

The following critical success factors have been developed:

Table Ten: Critical Success Factors

Critical Success Factors	Broad Description
Meets regulatory requirements	Meets agreed investment objectives, related business needs, and service requirements
Strategic fit	How well the option: • Integrates with other strategies, programmes and projects • Enables alignment with possible future changes in central government mandate • Aligns with national standards and principles for civic accommodation
Value for money	How well the option: • Optimises value for money (i.e., the optimal mix of potential benefits, costs and risks) • Balances the cost of delivery and management with the financial and non-financial benefits
Affordability	How well the option: • Can be met from likely available funding • Matches other funding constraints • Avoids displacing other council priorities
Achievability	How well is the option likely to be delivered: • In the proposed timeframe

	• With the current resources and support • Within the programme's control and influence • With continuity of operation maintained during the construction period

Shortlist of Options

The shortlist of options for this investment have been developed based on the scoped options outlined in the strategic case above. These are described in the table below:

Table Eleven: Shortlisted Options

Option	Short name	Broad Description
A	Do Nothing	Take no action either via MAR or at a property level to mitigate or reduce the discharge of nitrate to the groundwater system. This is not a legal or practical option. Change is required by the regulations and so this option is not advanced.
B	On-Farm Mitigation Only	Employ advanced nitrate mitigation systems on each property to reduce the total nitrate discharge by 48%. This is the principle counterfactual option to the MAR scheme.
C	On-Farm Mitigation complemented by Managed Aquifer Recharge	Employ advanced nitrate mitigation systems on each property to reduce the total nitrate discharge by 36% complemented by a Managed Aquifer Recharge Scheme.

Box: No longlist developed

The nature of the options available for the development of the scheme means that this business case has not developed a longlist/shortlist analysis structure. Instead, the key strategic options have been identified based on an assessment of the Business Scope and Service Needs drawing from the ZIPA.

The options assessment draws heavily on the Ashburton (Hinds Plains) Zone Implementation Programme and Addendum and Canterbury's Land and Water Regional Plan. Without intending to re-litigate the decisions that have informed Canterbury's Land and Water Regional Plan (Plan Change 2), the intent of the economic case is to clearly identify the benefits of the MAR scheme and other components of the solutions package and compare these with the counterfactuals (either do nothing or use only on-farm mitigation).

Shortlist Options Assessment

Decision-making relies on robust analysis of the trade-offs between scarce resources and the extent to which investment objectives and key service requirements of the investment proposal can be achieved.

The shortlist of options outlined above have been assessed as fully, partially, or not meeting each investment objective and critical success factor. Any option that fails to meet any of the critical success factors is automatically dropped and not carried forward.

This analysis is summarised below and detailed in Appendix A.

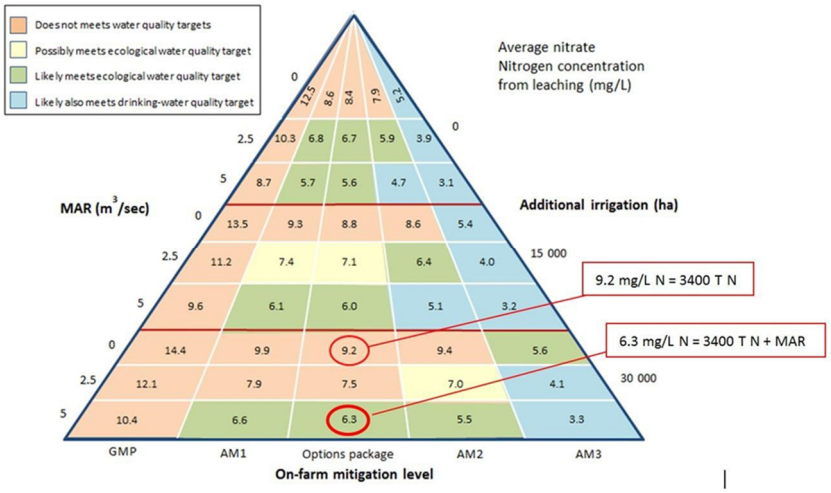
The options

Managing nutrients in the Hekeao Hinds Plains area will involve maximising the interplay between three main factors:

1. The area of new irrigated or intensive land use
2. The level of mitigation used to control nitrogen leaching on farms
3. The volume of clean water used to augment groundwater and reduce nitrate concentrations

Various combinations will achieve the target nitrate-N concentration of 6.9 mg/l. The triangle below was developed to show the interplay between the three main factors and what various combinations could achieve. These are modelled figures.

The package of recommendations contained in the Ashburton (Hinds Plains) ZIP Addendum seeks to reduce the catchment nitrogen load by on-farm mitigation, resulting in a nitrate-N concentration of 9.2 mg/l in lowland water bodies. Further nitrate concentration reduction using up to 5 m^3/s of clean water (managed aquifer recharge) is needed to reach the target concentration of 6.9 mg/l. This is a level consistent with the nitrate toxicity guidelines for protection of 80% aquatic biodiversity.



The target concentration could also be reached by various combinations of the catchment scale factors (i.e., combination of the size of new irrigated land area, amount of MAR and level of on-farm mitigations).

The option for additional irrigation was declined as part of the Land and Water Plan process (Plan Change 2), however this diagram shows the potential opportunities in the future should the combination of MAR and on-farm mitigation be effective implemented.

Economic Modelling and Cost Benefit Analysis

An Economic Impact Assessment has been completed by Market Economics and this is included in Appendix B. This economic assessment considered the options using two tools:

1. A cost-benefit analysis to show the relationship between costs and benefits. The CBA provides an indication of the 'value for money'.
2. An economic impact assessment (EIA) that illustrates how the additional activity flows through the economy, generating Value Added[10] and jobs.

The modelling suggests that under the default discount rate (6%[11]), the with-MAR (vs the without-MAR) will return a positive Benefit to Cost Ratio (BCR) of 1.4 and a net position of +$130m. This equals an average annual lift of $6.5m. The BCR moves up or down, depending on the discount rate used but it stays range-bound and above 1.

Table Twelve: Cost Benefit Analysis

Discount Rate	Costs $'m	Benefits S'm	Total Net $'m	BCR	Annual Net $'m
0%	504.9	663.3	158.4	1.3	7.9
2%	447.4	595.5	148.1	1.3	7.4
4%	401.3	540.0	138.7	1.3	6.9
6%	**363.8**	**493.9**	**130.1**	**1.4**	**6.5**
8%	332.8	455.2	122.4	1.4	6.1

Including non-market values[12] lifts the annual benefit of the MAR by $200,000[13]. Importantly, some of the environmental benefits will also be achieved under the without-MAR scenario because the large land use changes will deliver those improvements.

A sensitivity analysis was completed to reflect uncertainty. It was set-up to reflect the downside and as a way to address optimism bias. The key assumptions were adjusted to reflect a negative position, i.e. up or down 10%. In addition, the assumptions were explored and adjusted using a goal seek approach to identify the movement needed to return the BCR to 1. The outcomes of the sensitivity analysis are (at the 6% default rate):

- Scheme costs 1.4 minimal change,
- Cost of resources used 1.2 lowers the BCR but it stays above 1, and
- Land use change (scale) 1.3 2% downward change.

A pessimistic scenario that combines all the downside settings was assessed. This scenario returns a BCR of 1.2. Under this approach the annual gain is $4.5m. The sensitivity analysis suggests that areas with the least room for movement are the cost of resources used (i.e. farming costs) followed by scale of change. Extending the timeframe by 10 years, lifts the reported results, but the relativities remain constant.

The second part of the analysis estimated the **economic impacts,** and it differentiates the one-off and ongoing impacts. The Value Added (VA[14]) impacts arise as the additional (new)

[10] Value Added is similar to GDP but excludes some taxes.

[11] 6% is the default rate put forward by NZ Treasury.

[12] Like health values and the potential protection of wetland values.

[13] Using conservative positions and settings.

[14] Value added is similar to GDP with minor difference in how tax is treated.

activity that takes place, and then ripples through the economy. The focus is on the backward linkages of the farming sector (as opposed to the backward linkages of dairy processing). The spatial distribution is a function of the supply chains, i.e. the local businesses procuring a portion of goods and services from outside the immediate location. The impacts are estimated as follows:

- **One-off impacts**: These impacts relate to the capital expenditure associated with establishing the MAR and the on-farm spending related to the land-use change (for the without-MAR situation):
    - VA impacts between -$7m and -$10m across NZ with a -$8m mid-point (these figures are negative, so activity is foregone).
    - Concentrated locally (64%) and in Canterbury (22%).
- **Ongoing impacts:**
    - The ongoing impacts (present value @6%) are estimated at between $191m and $221m.
    - Three quarters (75.3%) of the impacts are concentrated in Canterbury and the rest in the wider NZ.
- **Ongoing Impacts:**
    - Summing the one-offs and the ongoing impacts (i.e. subtracting the foregone impacts from the ongoing impacts) shows that the net impacts are estimated to be between $183m and $211m.
    - Most of the impacts are concentrated in Canterbury (60%) with 18% felt locally in Ashburton.

The modelling suggests that the activity associated with the MAR will support jobs in the farming sector as well as the wider economy to complete the work[15]. Over the long term, the MAR will support approximately 23 additional jobs (relative to the without-MAR scenario and per year in Canterbury).

[15] This assumes that there is sufficient capacity in the local market i.e. there are workers available. In reality, business will use technology and other means to address capacity constraints where labour is not available.

Assessment of Shortlisted Options

The following shortlist of options have been identified:

Table Thirteen: Advantages and Disadvantages of the shortlist of options

Option	Name	Capital Cost	Description	Advantages	Disadvantages
A	Do Nothing	nil	Take no action either via MAR or at a property level to mitigate or reduce the discharge of nitrate to the groundwater system. Not considered a realistic option.	• No cost	• Likely to lead to significant enforcement action by Environment Canterbury due to unconsented discharge of nitrates • Consequential environmental effects and health impacts if no enforcement taken.
B	On-farm mitigation only		Employ advanced nitrate mitigation systems on each property to reduce the total nitrate discharge by 48%. This is the principle counterfactual option to the MAR scheme.	• No community MAR scheme and related funding mechanisms required	• High cost for each property owner • Potentially make many farms financially unsustainable • Severe impact on overall economic activity • Potentially not technically viable for all properties/land uses • Decreased groundwater nitrate concentrations are likely to take many decades to show up in monitoring bores.

Option	Name	Capital Cost	Description	Advantages	Disadvantages
C	On-farm mitigation and MAR		Employ advanced nitrate mitigation systems on each property to reduce the total nitrate discharge by 36% complemented by a Managed Aquifer Recharge Scheme.	• Viable farming is able to continue • Increased baseflow to streams and drains • Raise groundwater for well users	• Risks associated with requiring everyone to perform in order to meet the required outcome • Risk of successful implementation of MAR scheme

The Preferred Way Forward

From the analysis included in **Appendix A**, and the summary of advantages and disadvantages above, the following observations are made:

- In practice, the option of 'do nothing' is not realistic. The legal and political requirements to take action on water quality means that continuing with the status quo is not an option.
- The alternative to implementation of the multi-pronged approach (on-farm mitigations, MAR and irrigated area constraints) is likely to be significant land use change, with resulting economic and social impacts but unclear environmental benefits in a generational timeframe.
- The options to implement MAR have a significantly greater benefit to cost ratio and economic value add than any other option and ultimately add economic value to the district and nation over the status quo.
- The multi-pronged approach enables farming the time to adapt to the requirement for more sustainable farming systems and to remain viable while meeting reasonable levels of water quality in the groundwater and lowland streams, providing an 80% protection on aquatic organisms.
- While the cost should not be underestimated, the alternative is more expensive and will cause serious economic challenges for the region.

For these reasons, the analysis has confirmed that the Ashburton (Hinds Plains) ZIPA solutions package is the preferred way forward.

The Commercial Case

This section outlines the proposed deal regarding the preferred way forward outlined in the economic case. Procurement will be required for construction contractors, engineering, design and consulting services, as well as ancillary infrastructure, marketing, promotion and project management.

The commercial case plans for the procurement arrangements needed to implement the preferred solution, prior to issuing requests for proposals. The IBC commercial case considerations are not intended to be as detailed as the strategic or economic cases and include only a high-level analysis of the identified procurement approaches that are likely to be suitable for this project.

Project Characteristics

The project has the following key characteristics:

Simple nature of work: The works are not technically complex and can be undertaken by a wide number of civil contractors.

Undefined full scope: The final full scope of the project will depend on the successful implementation of individual sub-projects with supporting monitoring to determine the location and solution in each area. This will be further influenced by opportunities as they arise.

Progressive implementation: The works will be implemented over an extended period of time to allow the results of earlier stages to be monitored and further stages to be designed based on that evidence.

Daily operations: The scheme will require daily (or near daily) monitoring and operational management to manage water flows, address snags and blockages and resolve issues.

Considering the potential value of procurement and the potential risk to the project, the following concepts apply:

- **Appropriate allocation of risk** – Risks should be allocated to the party best positioned to control or manage these
- **Monitoring and accountability** – Contracts and supplier relationships will be managed in accordance with good contract management practice. Performance measurement may be used where appropriate
- **Integrity** – A transparent approach to procurement in line with both local authorities' procurement policies, rigorous and consistent processes for selection, evaluation, and ongoing management
- **Flexibility**: The ability for the principle to direct the scope and timing of works progressively and in small stages will be essential to allow the scheme to be refined and extended based on the findings of the monitoring.

Required Services

The required works, goods and services will likely require procurement from the following suppliers:

Professional Services

- Technical advisors and groundwater specialists
- Engineers and supporting consultants
- Project management professionals

Physical Works

- Civil construction contractors
- Operators and maintenance contractors

Procurement of Physical Works

There are several options for procurement. Noting that more complex arrangements (such as alliancing or construction management) are unlikely to be suitable, the following three approaches to procurement and delivery are potential solutions to deliver best value for money. Each of these has its own benefits and risks.

Design/Tender/Construct

This is the approach usually employed for a project of this kind. With a traditional approach, the design is completed by a multi-disciplinary design team, which is then used to approach the market for a suitable construction partner. The key benefits of this approach are that the principle maintains control at every stage over the design, quality and standards of construction. There is also the benefit of price certainty if a fixed price-contracting model is used. However, the principle also retains all design risk for any omissions or errors in the documentation that could result in later variations and costs.

This traditional approach often takes the longest, as design, tender and construction are carried out sequentially. In addition, there is no opportunity for the contractor to have input into the final design. This can limit opportunities for innovative approaches to improve the functionality or buildability of the scheme.

The scheme is simple in nature, requires flexibility and will be implemented progressively. This means it is necessary to separate out design from construction and allow a flexible approach to implementation.

Contractor Panel

In addition to the above design/tender/construct model, it may be appropriate to establish a panel of contractors to create a pre-qualified shortlist to allow more flexible contracting arrangements. This could include pre-agreed prices in order to form a basis for negotiated individual stages/packages of work.

The small scale and simpler nature of the works suggest that smaller contactors with lower overheads will be most suited to the works. This means that a panel of pre-

qualified contractors offers potential to provide a cost-efficient and flexible approach to procuring the works.

Design and Construct

This is a project delivery method whereby the contractor takes responsibility for both the design and construction of the project based on a concept and requirements specified by the principle. Also referred to internationally as Design & Build or Turnkey, the latter typically being a more extreme risk transfer model.

The 'Design & Construct' method of project delivery is where the design is completed to concept level and then tendered as a Design & Construct contract based on performance specification documents.

This method allows the principle to establish the key parameters of the project by way of performance design briefs for design implementation by the D&C contractor. Consultant inputs may be required to develop early design brief and concept documentation.

This is likely to be an unwieldly and onerous approach to development of the scheme as the scope of works is both simple and will be spread over time. Therefore, this approach is not recommended.

Early Contractor Involvement

This approach enables the contractor to be selected and contracted prior to the completion of the detailed design work. While this means that the scope of the contractor cannot be completely specified at the outset, making the final pricing uncertain, the balance of the scope can be awarded once the design is finalised and the pricing negotiated.

The main advantages offered by this approach are:

- It is often faster than traditional models as the construction tender process is carried out in parallel with the design work
- Contractor input can improve the buildability of the final design
- It may foster a more collaborative working relationship between the contractor, the consulting/design team and the principle

In terms of this scheme, the need for early contractor involvement appears to be unnecessary and adds complexity that does not provide value. This is because the scope of works is undefined, low risk and not complex. Therefore, this approach is not recommended.

Recommended Procurement Approach for Physical Works

It is recommended that a panel of physical works contractors is established from which quotations for individual packages of work can be procured.

This approach provides flexibility to match the project characteristics but also allows building up of capability, experience and capacity of contractors who are able to add additional value to the scheme through repeated involvement.

Procurement of Professional Services

Because the preferred physical works procurement model involves separating design from contraction services, this leads to a separate range of contracts with professional services providers.

Due to the same reasons that a panel approach is recommended for the physical works contractors, a panel approach to the necessary professional services is also recommended. This proves a flexible approach to procurement, provides some on-going commitment to the consultants but also allows the principle to select the most suitable advisors for the project as it progresses.

Alternative options, which involve seeking fixed prices, are not viable due to the full scope of the project not being fully defined and the need to adapt as the scheme is developed progressively.

The only difference to this is the appointment of a project manager to administer and manage these contracts. A long-term project manager is required to be able to provide continuity to the project. Depending on the policy and approach of the governance agency, this would be an internal or direct commissioned appointment.

Procurement of Operations and Maintenance Services

There are a range of procurement models which span from traditional activity-based contracts (i.e., pay ‘x’ for the contractor to do ‘y’ task) to more performance-based contracts (pay ‘x’ to get ‘y’ outcome).

While it is anticipated that a more performance-based contracting model could become appropriate as a scheme grows, this will not be feasible until the full scheme has been developed and a track record of the work required to operate and maintain the system has been established.

Until then, a partnership approach will be required to be able to experiment and learn from the operation of the scheme, and a negotiated service will be most appropriate in the short term.

Two key options are available:

- Direct commissioning with existing providers (RDRML, MHV Water and BCI)
- Seeking proposals from experienced operators based on a forecast scope of works

Procurement approach summary

Table Fourteen - Procurement Approach Summary

Supply	Procurement Approach
Design and technical advisors	Panel of pre-qualified providers
Project manager	Internal or direct commissioned appointment
Physical works contractor	Panel of pre-qualified providers with basis for pricing
Operations and maintenance contractor	Direct commissioning or panel of local service providers

The Financial Case

The purpose of this section is to set out the funding requirements of the preferred option and demonstrate that it is both affordable and can be funded from available resources and revenue sources.

The purpose of this section is to set out the indicative financial implications of the preferred way forward. This section addresses three key questions:

- What is the expected cost of delivering and managing the scheme?
- What is the recommended allocation of contributions?
- What is the recommended approach to raising local contributions?

Financial Forecasts

The table below assumes the MAR infrastructure is built over a six-year period, 20% per year for the first four years and the 10% per year for a further two years. The annual cost grows in parallel with the build to reach the eventual amount requiring funding of $2.2 million.

Value of work completed to date	$879,797	
Projected future Capital Expenditure	$6,000,000	
	$6,879,797	
Term (years)	33	
Discount rate	0.0%	
Annual repayment to Ecan		$208,479
Operating charges (admin, staff, and maintenance)		$400,000
Water delivery charges (125,000,000 m^3 p.a.)		$1,300,000
Total Annual Cost at completion		**$1,908,479**

Phasing

Year	2021	2022	2023	2024	2025	2026
Cost to date	$879,797					
Annual Capex	$600,000	$1,200,000	$1,200,000	$1,200,000	$1,200,000	$600,000
Future Capex % of Total	10%	20%	20%	20%	20%	10%
Cumulative Capex	$1,479,797	$2,679,797	$3,879,797	$5,079,797	$6,279,797	$6,879,797
Annual Repayment	$44,842	$81,206	$117,570	$153,933	$190,297	$208,479
Annual Operating	*Assume implemented over 4 years*					
Operating charges	$200,000	$300,000	$300,000	$400,000	$400,000	$400,000
Water charges	$300,000	$600,000	$600,000	$1,300,000	$1,300,000	$1,300,000
Total Annual Cost	**$544,842**	**$981,206**	**$1,017,570**	**$1,853,933**	**$1,890,297**	**$1,908,479**

Funding Model Options

Principles for the allocation of costs

Funding decisions are guided by the distribution of future benefits and costs including:

- The funding load is linked to the parties who will benefit from the project. Parties that do not benefit from the project should not be included in the funding calculation.
- The funding is linked to the whole of life costs. Only the direct capital cost may be recovered up-front.
- Over-recovery should be avoided.
- The received funding has to be used for the project (and not used for other projects).
- Funding should be transparent and reasonably fair; sufficient information should be available to demonstrate what the funding is used for and how the shares of costs have been calculated.

The economic analysis identifies the magnitude of the value-added activity accruing to each sector. At the same time, the practicalities and affordability of extracting funding must be taken into account and consideration must be given to potential externalities or perverse outcomes. In other words, does the funding mechanism encourage or discourage improved behaviour?

Suggested Key Characteristics of a Funding Model

Based on these funding principles, the focus is to develop a funding regime that is:

- Simple and transparent
- Affordable and equitable
- Incentivises outcomes sought (without perverse outcomes)
- Future benefits based

Other Considerations

- Current nitrate levels are due, at least in part, to historic inputs, and there is no ability to claw back funding from those who caused it.
- Nitrate levels are rising due to current farming practices.
- Some soil/drainage types are more prone to higher nutrient discharge than others.
- There are a range of economic benefits:
  - Lowers individual cost of nutrient discharge mitigation/maintains productive capability for farmers
  - Farmers who use groundwater will have decreased pumping costs and potentially reduced periods of restrictions
  - Local businesses benefit (including outside the Hekeao/Hinds catchment) from farmer spending
  - Urban households benefit from employment and business opportunities created from the above activity
- There are a range of environmental, social and cultural benefits as a consequence of MAR, including:
  - Improved ecological and mahinga kai values in lowland streams and drains
  - Recreational benefits – e.g., swimming and fishing

Overly complex or arguable funding structures and calculation methodologies should be avoided to reduce the potential for dispute and/or high administration costs.

Potential Funding Contributions

Funding for the scheme will ideally be from a combination of sources based on 'who benefits.' Potential sources are as follows:

Capital Expenditure	• National contribution • Regional rates • Local targeted rates (ADC or ECan) • Benefiting landowners	• Upfront payment for capital expenditure by those who benefit from the scheme seems inappropriate, given that the future benefits are long-term, and the causes are in large part historic. • It would be more appropriate to charge those who benefit the amortised capital costs over the life of the infrastructure. • Grants or loan funding may be available from Crown agencies (e.g., Ministry for the Environment, Department of Conservation or Ministry for Primary Industries).
Operating Costs	• Local targeted rates (ADC or ECan) • Benefiting landowners	• Economic benefits may well flow out from the Hekeao/Hinds catchment to other areas; however, the greatest portion of the financial benefits will accrue to local farmers, who are also collectively responsible for causing the issues. • Therefore, landowners should logically bear most of the costs. The challenge then becomes how to apportion the costs in a fair and reasonable way.

The following table sets out the potential benefits, the parties who benefit and ways they can contribute:

Table Fifteen: Potential funding sources and beneficiaries

Benefits	Who benefits?	How do they benefit?	How can they contribute to funding? What are the options?	
			Capital expenditure	*Operating costs*
A viable (profitable, sustainable) farming sector	Individual farmers	• Reduced nitrate mitigation costs (e.g., lost production due to reduced fertiliser use, lower stocking rates) to help maintain profitability and property values • Improved groundwater reliability for well irrigators	• Targeted rates (capex amortisation) • One off levy	• Direct levy (e.g., based on quantity discharged from Overseer) • Targeted rates (per ha/per rating unit/per valuation) • Cap and trade (nutrient allowance trading scheme) • Use of infrastructure (e.g., free/low cost use of irrigation and stock water scheme resources is an indirect subsidy)
	General economic benefits • National • Regional • District • Catchment	• Farmer direct and in-direct spending	• Central government e.g., MfE/DOC/MPI grants/loans • Local authority grants/loans • Infrastructure (e.g., retired council gravel pits and farmland as MAR locations, free / low cost use of irrigation and stock water distribution infrastructure)	• General rates (ADC or ECan) • Targeted rates (per ha/per rating unit/per valuation)
Improved ecological and mahinga kai values in lowland streams and drains	Mana whenua	• Cultural • Food gathering	• General rates (ADC or ECan)	
	Residents (i.e., community benefits)	• Recreational use • Environmental quality	• General rates (ADC or ECan)	• General rates (ADC or ECan) • Targeted rates (per ha/per rating unit/per valuation)
	National	• Biodiversity	• Central government e.g. MfE/DOC Grants/loans	
Healthy drinking water	Residents (i.e., community benefits)	• Lower nitrate levels – health benefits	• General rates (ADC or ECan)	• Targeted rates (per rating unit/per valuation)

Local and Landowner Contributions

Options

Regardless of the proportion of capital investment from outside the local area, there will be a material portion that is funded by way of contributions from the local district. The options are:

A. Community apportionment and hectare-based farmer charges
B. Capital value based rate
C. Community apportionment and capital value based rate
D. Land value based rate
E. Nitrogen cap and trade

Options Evaluation

A weighted attribute assessment has been undertaken on these options, and this is set out in Appendix C:

A cap and trade system is better but not currently viable. The fairest regime would differentiate between high and low benefit/causality, such as with a cap and trade "carrot and stick" regime or other differentiating methodology that incentivises good practice. Unfortunately, current monitoring and measurement systems do not provide sufficiently robust information to be able to assess this fairly.

The only tool available to measure farm specific nitrate performance is OVERSEER® software. However, OVERSEER® was created for a different purpose (fertiliser management) and is not trusted as a leaching contribution indicator.

The more nuanced charging methods all have weaknesses. None fully adjust for nitrate leaching potential, and/or the technology and systems that fairly and accurately measure impact are not available. In time, new technology may allow for improved and more transparent performance measurement, which would potentially make options, such as cap and trade, more viable. However, cap and trade would be more appropriate as part of an integrated nitrate mitigation regime across a wider region. Here, farmers can vary factors within their direct control.

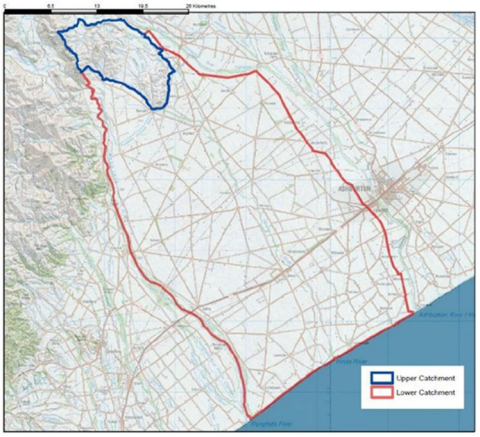
The highest scoring feasible option is Capital Value Based (CV). Of the options considered that are currently feasible, a Capital Value based rate scores the highest. The Capital Value approach benefits from being simple and transparent as it is based on the generally used rating methodology. The downside is that it does not incentivise better practice, nor does it recognise the inherent advantages of some soil types or land uses.

The conventional ratings basis of Capital Value is well understood, reflects affordability (i.e., higher value farms generally have relatively higher incomes), and usually corelates with more intensive farming systems. Capital value is for many farmers a key measure of success and is the factor that is most at risk if more regulatory limits are imposed.

Neither land value nor rating based on land area reflect the level of intensification, which is a key factor in nitrate leaching. Land area (unless used in conjunction with differentiated rates) would skew the cost towards larger farms, irrespective of productive capacity.

Differential rating against nitrate loss potential: Lower impact farming systems or lower leaching drainage profile land contributes less nitrate to groundwater, and there is a basis for a differentiation in charges across soil vulnerability levels or land use.

The ECan rating system is capable of charging differential rates, such as by mapped areas. There are multiple variables that contribute to nitrate leaching, such as climate, soils, and farm management (including land use and intensification). The available soils data (S-Map) is also known to miss the significant soil/hydrogeological variability that can be found on many farms, (for example, where they overlie old river channels).



The ECan system is not currently capable of identifying well users, nor is it able to categorise them by depth of well. On that basis, a well-user charge is not currently feasible. As no differential rates methodology is capable of accounting for all variables, a simple three or four zone option is recommended following the Upper Catchment and Lower Catchment zones identified in the Ashburton (Hinds Plains) ZIP Addendum.

Recommended Local Funding Model

A pragmatic approach is recommended. This involves:

- Implement a Capital Value based rate segmented into three zones (Upper, Central and Lower) as the initial methodology, bearing in mind the stepped imposition of rates increases as the project builds.
- Three-yearly reviews of the methodology in line with the Regional Council Long Term Plan cycle, with a view to implementing a more specifically targeted process, such as a differential rate or a cap and trade system, once technology and monitoring allows.
- The examples on the next page compare a uniform rate (the same rate charged per Capital Value across all farms in the catchment) with differential rates charged to three zones within the catchment as per the table below.

Table Seventeen: Differential rating

Rate relative to Lower Catchment	Differential Rate 1	Differential Rate 2
Upper Catchment	25%	25%
Lower Catchment - A	100%	100%
Lower Catchment - B (Drainage Area)	100%	75%

Using two to three examples from each of the three zones, the resulting rates increases are as follows. Examples are shown in more detail in Appendix D.

Table Eighteen: Impact on Rates

	Increases Year 1	Increases Year 6	$ per $000 CV Current	$ per $000 CV Year 6
Uniform Rate				
Upper	6.86-7.32%	24.01-25.64%	$1.3506-1.3882	$1.7050-1.7366
Lower A	6.19-7.11%	21.68-24,92%	$1.3321-1.5416	$1.6865-1.8960
Lower B	3.73-3.99%	13.07-13.96%	$1.4785-1.6520	$1.8329-2.0064
Differential Rate 1 (two levels)				
Upper	1.75-1.87%	6.14-6.56%	$1.3506-1.3882	$1.4413-1.4729
Lower A	6.34-7.28%	22.19-25.50%	$1.3321-1.5416	$1.6948-1.9044
Lower B	3.82-4.08%	13.38-14.29%	$1.4785-1.6520	$1.8412-2.0148
Differential Rate 2 (three levels)				
Upper	1.87-1.99%	6.54-6.98%	$1.3506-1.3882	$1.4471-1.4787
Lower A	5.81-7.74%	20.35-27.13%	$1.3321-1.5416	$1.7179-1.9275
Lower B	3.05-3.25%	10.68-11.40%	$1.4785-1.6520	$1.7678-1.9414

Table Nineteen: Rates Summary

Assuming:	Area (approx. ha)	CV/ha (estimated)	Total Capital Value ($)
Upper Catchment	11,000	15,000	165,000,000
Lower Catchment - A	99,000	40,000	3,960,000,000
Lower Catchment - B (Drainage Area)	28,000	45,000	1,260,000,000
TOTAL	138,000	39,022	5,385,000,000

Uniform Rate

Assumes rural only and all properties charged the same rate per CV

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Rate per $000 CV	$0.101178	$0.182211	$0.188964	$0.344277	$0.351030	$0.354406
Total Targeted Rates	$544,842	$981,206	$1,017,570	$1,853,933	$1,890,297	$1,908,479

Differentiated Rate 1 - Two levels

Assumes rural only and Upper Catchment charged at at a lower rate

Rate relative to Lower Catchment - A	
Upper Catchment	25%
Lower Catchment - A	100%
Lower Catchment - B (Drainage Area)	100%

Rate per $000 CV	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Upper Catchment	$0.025889	$0.046624	$0.048352	$0.088094	$0.089822	$0.090686
Lower Catchment - A	$0.103558	$0.186497	$0.193408	$0.352375	$0.359287	$0.362742
Lower Catchment - B	$0.103558	$0.186497	$0.193408	$0.352375	$0.359287	$0.362742
TOTAL						

Total Targeted Rates	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Upper Catchment	$4,272	$7,693	$7,978	$14,535	$14,821	$14,963
Lower Catchment - A	$410,088	$738,527	$765,897	$1,395,405	$1,422,775	$1,436,460
Lower Catchment - B	$130,483	$234,986	$243,695	$443,993	$452,701	$457,055
TOTAL	$544,842	$981,206	$1,017,570	$1,853,933	$1,890,297	$1,908,479

Differentiated Rate 2 - Three levels

Assumes rural only and properties charged depending on location

Rate relative to Lower Catchment - A	
Upper Catchment	25%
Lower Catchment - A	100%
Lower Catchment - B (Drainage Area)	75%

Rate per $000 CV	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Upper Catchment	$0.027538	$0.049593	$0.051431	$0.093704	$0.095542	$0.096461
Lower Catchment - A	$0.110153	$0.198374	$0.205725	$0.374816	$0.382168	$0.385844
Lower Catchment - B	$0.082614	$0.148780	$0.154294	$0.281112	$0.286626	$0.289383
TOTAL						

Total Targeted Rates	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Upper Catchment	$4,544	$8,183	$8,486	$15,461	$15,764	$15,916
Lower Catchment - A	$436,204	$785,560	$814,673	$1,484,271	$1,513,384	$1,527,940
Lower Catchment - B	$104,094	$187,463	$194,411	$354,201	$361,148	$364,622
TOTAL	$544,842	$981,206	$1,017,570	$1,853,933	$1,890,297	$1,908,479

External Funding Scenarios

The Economic assessment developed by Market Economic (Appendix B) has identified the share of economic activity created by the scheme across the country. This is summarised in the table below

Table Twenty: Regional Economic Impacts

		$m		
		4%	**6%**	**8%**
One-offs	Ashburton	(6)	**(5)**	(5)
	Rest of Canterbury	(2)	**(2)**	(2)
	Rest of NZ	(1)	**(1)**	(1)
	SUM	(10)	**(8)**	(7)
Ongoing	Ashburton	43	**40**	37
	Rest of Canterbury	129	**119**	110
	Rest of NZ	48	**46**	43
	SUM	221	**205**	191
OVERAL L	Ashburton	37	**35**	33
	Rest of Canterbury	127	**117**	108
	Rest of NZ	47	**45**	42
	SUM	211	**196**	183

This suggests that 23% of the benefits to the scheme have a national impact and hence can be considered for national funding. Should external (non-rates) funding be secured from the government or any other source, then the impact on rates for the local landowners are forecast as follows:

Table Twenty-one: External Funding Impacts

External contribution	**Upper**		**Lower A**		**Lower B**	
(capital only)	*Year one*	*Year 6*	*Year one*	*Year 6*	*Year one*	*Year 6*
	Rates per ha		Rates per ha		Rates per ha	
Nil	$0.41	$1.45	$4.41	$15.43	$3.72	$13.02
23%	$0.41	$1.41	$4.32	$15.05	$3.65	$12.70
50%	$0.40	$1.37	$4.22	$14.59	$3.56	$12.31

This translates to a modest saving for landowners.

From a Farmers perspective

With MAR

The following on-farm mitigation changes to farmers perspective will result from the 'with MAR' option:

- Implementing on-farm mitigations and additional advanced mitigation practices on new irrigation areas (in line with compliance with PC2),
- Advanced mitigation practices for different land uses (e.g. dairy and dairy support farms), and
- All existing dairy and dairy support farms to adopt advanced mitigation practices from 2025 and move to higher mitigations by 2035.
- Additional NPS-FM 2020 requirements such as application of synthetic nitrogen fertiliser to dairy farms capped at 190kg N/ha/year from 1 July 2021.

Without MAR

The without-MAR scenario is based on the MRB (2018) analysis showing the required land use change and the farm systems that are needed to reduce N-losses by an estimated 48%. This scenario used a high level of land use change as estimated with a 48% reduction in N-losses. The level of change associated with this shift is estimated at:

- 33% reduction in dairy farm area,
- 33% reduction in dairy support farm area,
- 33% reduction in arable 2 (small seed production) area,
- 194% increase in arable 1 (process vegetables) area,
- 83% increase in arable 4 (livestock and grain) area,
- 53% increase in sheep, beef and deer (finishing livestock) area.

Based the land use change, and shifts towards AM3, the farming economics profile shifts towards other farming activities – away from dairying and dairy support towards arable, and sheep, beef and deer farming. These farming types have different revenue and cost profiles, driving additional shifts in the economic effects of the land use change.

Forecast Financial Implications

As such, the financial perspective for an individual farmer for the with and without MAR scenarios are forecast as follows for:

Table Twenty-two: Financial Impacts on farm earnings

Current Land use	Current Mitigation Level	With/Without MAR	Revised Land Use	Revised Mitigation Level	Change in Rates per Ha	Change in EBIT per Ha excluding MAR	Change in EBIT per Ha including MAR
Dairy 1	AM1	With MAR	Dairy 1	AM1	-$19	-$526	-$545
		Without MAR	Arable 1	AM3	$0	-$1,855	-$1,855
Dairy Support 1	AM1	With MAR	Dairy Support 1	AM1	-$15	-$622	-$637
		Without MAR	Dairy Support 1	AM3	$0	-$2,620	-$2,620
Arable 1	AM1	With MAR	Arable 1	GMP	-$15	$91	$76
		Without MAR	Arable 1	GMP	$0	$91	$91

Table Twenty-three: Forecast Impact on capital value for dairy

The following table forecast the impact on capital value of the with- and without MAR options against the current capital value of the farm properties. It is based on amn average P/E ratio of 14 based on long term averages calculated by the Reserve Bank , however this will vary over time[16].

Scenario	Impact on EBIT/ha	Impact on capital Value/ha based on P/E ratio of 14	Comparison with MRB analysis (2018)
With MAR	-$545/ha	-$9,810/ha	-8,270/ha
Without MAR	-$1,855/ha	--25,970/ha	-20,072/ha

16 https://www.rbnz.govt.nz/financial-stability/financial-stability-report/fsr-may-2016/dairy-farm-land-valuation-an-examination-based-on-price-multiples

The Management Case

The management case addresses the achievability of this proposal, setting out the planning required to ensure successful delivery, effectively coordinate change and manage project risks. This section considers the arrangements necessary to realise benefits and allocates project governance, ownership, roles and responsibilities.

Governance and Ownership

What is to be governed, managed, owned and operated?

The key activities to deliver and manage the scheme are as follows:

Table Twenty-four: Scope of governance

Matter
Development Phase • Consenting and funding • Design and construction of scheme • Financial and contract management (capital) • Loan security and fundraising **Operations Phase** • Asset management and maintenance • Operation of scheme • Financial and contract management (opex) **Governance and Oversight** • Depreciation, insurance and related asset ownership obligations • Strategic planning and risk management • Financial oversight, audit and corporate responsibilities • Funding mechanisms and non-council fundraising

Current Situation

The Hekeao Hinds Water Enhancement Trust (HHWET) has been established for the purposes of driving the realisation of the MAR scheme. HHWET is the sponsor of this business case. HHWET was formed to take over the task of implementing the Managed Aquifer Recharge (MAR) project in the Hinds Plains from the previous unincorporated MAR Governance Group.

This section establishes the assessment criteria, outlines the options available for governance and ownership of the scheme and then assesses which is the preferred option.

Lessons From Other Scenarios

A range of other community-based schemes and ownership arrangements exist throughout the country, ranging from irrigation companies to environmental enhancement projects to parklands, commercial/public projects and cycle trails. There is a range of published literature that summarises these arrangements with an applicable summary of lessons set out in a recent publication examining relevant case studies for the Ōtākaro Avon River Corridor (Residential Red Zone). These lessons are summarised in Appendix E and have been used to assist development of the following assessment criteria:

Assessment Criteria

The criteria to assess the options for governance and ownership are set out below:

1. The durability of the entity
2. Degree of partnership with Mana whenua
3. Diversity of skills and experience
4. Security of commitment
5. Accountability to community
6. Ability to balance multiple competing outcomes
7. Ability to raise funding
8. Flexibility to change over time

Options

Preamble

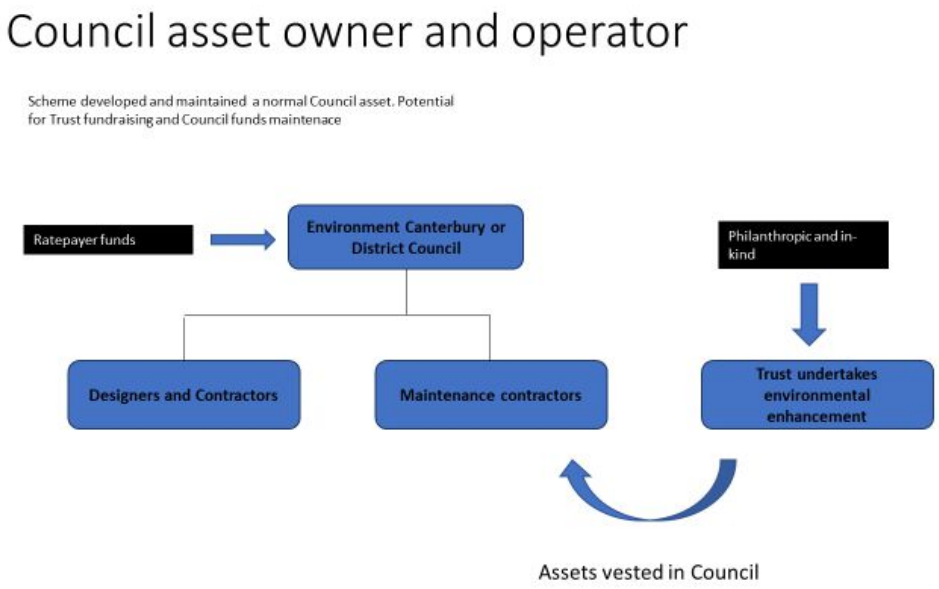
The key options for governance, management, ownership and operation are a mix of local authority and Trust ownership with the potential for contracting of responsibilities to new or existing entities from either of these agencies.

HHWET has been established as a representative group with the purpose of promoting the MAR scheme. As such, it is the natural independent community Trust for governance, management and ownership roles.

In terms of local authorities, there are two options: District Council or Regional Council. A significant portion of the funding is recommended to be sourced via targeted rates by the Regional Council as set out in the financial case (at least in the short term). This means that ECan will be the natural entity as the Council in these options.

MHV Water (along with RDRML) brings significant operational expertise, and when combined with existing operations, the potential for efficiencies and economies of scale. There are also other options in the region that could perform some of these services.

Option A: Council develops, owns and operates

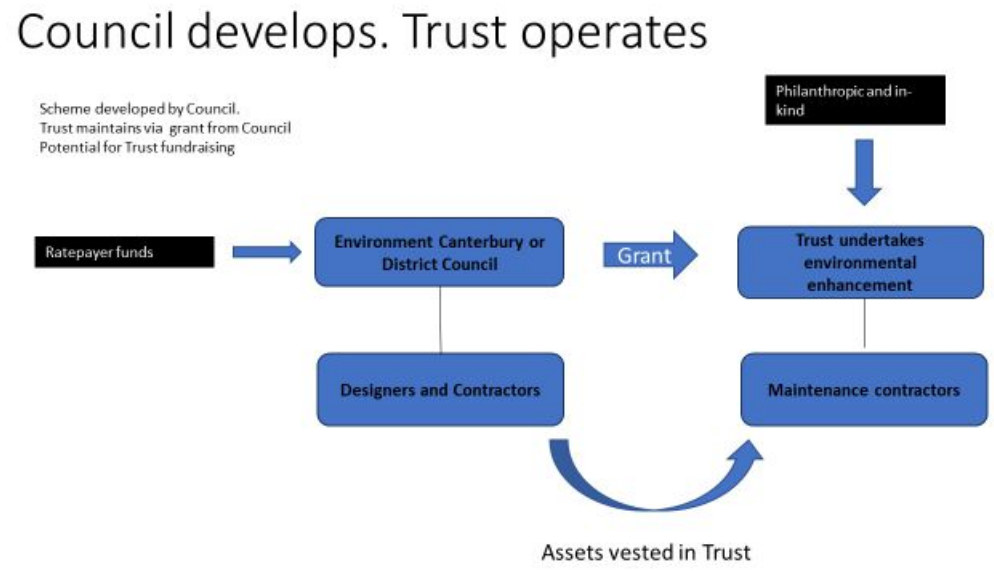


The predominate operating model for similar schemes is for assets to be owned and maintained by Council (typically via contracted services).

Council ownership and maintenance means that the scheme is primarily funded by rates with reduced ability to raise non-rates sourced funds.

Some capital or maintenance may be provided through fundraising, either in-kind support or voluntary contributions from the community or corporate groups. This could be focused towards environmental and mahinga kai projects.

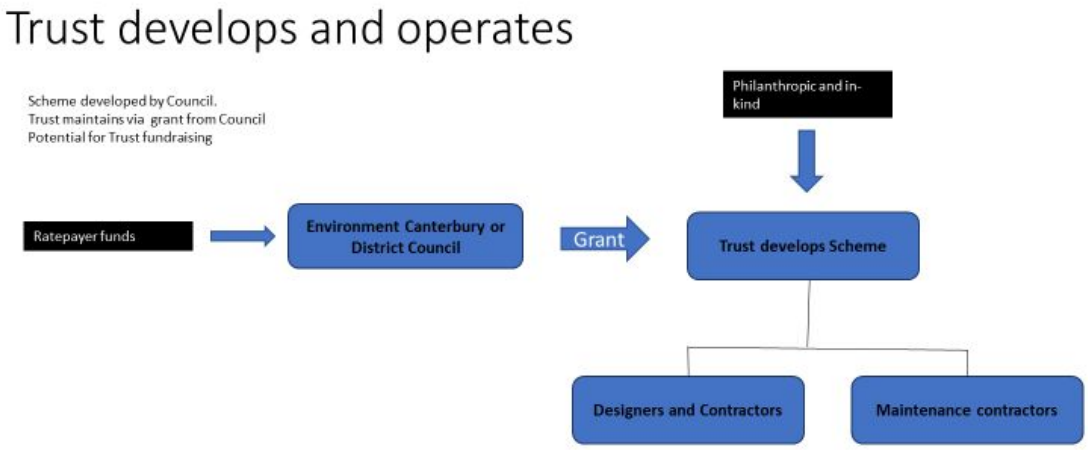
Option B: Council develops, Trust owns and operates



A Trust (such as HHWET) owns and maintains the assets after development by ECan and/or ADC. The assets are vested in the Trust by ECan/ADC and the annual maintenance

costs are passed to the Trust via a grant to operate the scheme. The Trust may raise additional non-Council funding to further develop the scheme.

Option C Council funds, Trust develops and operates



This option involves the Trust developing and operating the scheme. Funding is provided via an annual grant from Council and any other funds that the Trust may be able to secure.

This option would involve the Trust either contracting out or employing management services during both construction and then ongoing operation.

Assessment of Options

The table below assesses each option against the criteria set out above.

Table Twenty-five: Governance options assessment

	A	B	C
	Council develops, owns and operates	**Council develops, Trust owns and operates**	**Council funds, Trust develops and operates**
The durability of entity	Strongly supports	Slight adverse	Slight adverse
Degree of partnership with Mana whenua	Slight adverse	Supports	Supports
Diversity of skills and experience	Slight adverse	Supports	Strongly Supports
Security of commitment from public sector	Supports	Supports	Supports
Accountability to community	Supports	Strongly supports	Strongly supports
Ability to balance multiple competing outcomes	Supports	Supports	Supports
Ability to raise funding	Slight adverse	Supports	Supports
Flexibility to change over time	Slight adverse	Supports	Supports

Recommended model

All three principal options provide a good basis for managing and delivering the scheme. Key observations in determining the preferred model include:

- The two options which favour a deeper Trust involvement provide a more directly responsive governance to the local community. This includes mana whenua and the key financial contributors to the scheme (the landowners), which is generally preferred.
- However, the Trust is separated from the rating of the landowner for the scheme. This can be seen as an overall benefit as it insulates the challenging decisions on rating with on-the-ground implementation and management. Although, this is a normal situation for Councils.
- The Trust model is generally able to attract a wider variety of funding sources, noting that the security provided by Local Authority support is also important to provide assurance to the potential funders.
- This includes the robust project management and procurement process required by local authorities and the existing systems and processes in place to ensure financial accountability. This means that local authorities are often best placed to deliver the capital works and manage operational contracts notwithstanding that this is able to be done by a well-managed Trust.
- There are also a range of environmental and mahinga kai focused projects that support the scheme that would be ideally funded and driven by the Trust.
- The benefits of the scheme are a mix of environmental, cultural, social and financial as well as wider economic benefits. However, they are primarily focussed locally and require consideration of the balance between outcomes within the financial constraints. This suggests that the Trust may be well-positioned to make those balanced decisions provided that the Trustees are appropriately diverse and experienced.
- A key benefit of the scheme is the ability for local farming to continue, provided that there are the necessary mitigation measures adopted. If the scheme is not implemented, then this will lead to regulatory constraints on the farmers. Environment Canterbury will be the enforcement agency.
- It is noted that both councils are able to develop and operate the scheme. Careful management to separate compliance with scheme governance and rating is required, but this is not insurmountable and normal practice. The Ashburton District Council may be affected by the three waters reforms if the scope enlarges beyond potable water supply and wastewater.
- Ultimately, the preference is for Trust ownership and management, provided that the Trust is able to demonstrate that it is managed appropriately. This can be achieved through an annual Statement of Intent and annual reporting back to ECan as an obligation of any Funding Agreement.

Recommended Governance and Ownership Model

Based on the above analysis and observations, the recommended initial governance structure is option B: Council develops, Trust owns and operates as follows:

Funding responsibilities

- ECan to rate for and fund the scheme
- The Trust to seek grant and other funding from the government and other sources
- A funding agreement is establishment between the Trust and ECan

Asset delivery and ownership responsibilities

- The Trust (through a trust-owned company) holds the resource consents for the scheme on behalf of the community.
- ECan develops the assets in accordance with an implementation plan agreed with the Trust.
- At some stage, the Trust may commence development of the assets. This would be on the basis that ECan are satisfied that a robust management structure is in place. This would be through a grant process to fund development of the scheme. See below for operational grant funding also.
- Alternatively, the Trust could continue to partner with ECan to deliver the works.
- On completion, these assets are vested in the Trust to own and operate.

Operational responsibilities

- The Trust may contract MHV Water, RDRML, BCI, Ashburton District Council and/or other operators to operate the scheme on their behalf.
- Operational funding is passed to the Trust by ECan as it is collected in accordance with the funding agreement.
- Annual Statements of Intent (Annual Plans) and Annual Reports are prepared by the Trust as accountability documents for the funding they received from ECan and the wider ratepayer base.

Strategic Delivery Roadmap

Refer to the next page for a roadmap for delivery of the project.

HEKEAO HINDS MANAGED AQUIFER RECHARGE SCHEME: STRATEGIC ROADMAP

Inputs and considerations

- **Plan Change 2 Land and Water Regional Plan (PC2 LWRP)**
- **Essential Freshwater 2020**
- **Zone Implementation Programme and Addendum**
- **Trust Deed**
- **Canterbury Water Management Strategy**

Stage One: Establishment

15 million m^3 per annum

Outcome sought:

Establish scheme on strong foundations of governance, funding and stakeholder support

Proof of concept

- Develop pilot schemes to prove concept
- Establish broad monitoring framework

Stakeholder engagement

- Continuous presence and communication campaign
- Funding engagement

Funding arrangements

- Prepare Business Case
- Councils Long Term Plan
- Seek external funding

Governance and agreements

- Establish Trust
- Formal agreements with local authorities
- Secure water rights

Scheme design

- Develop staged implementation plan
- Identify priority sites
- Commence land negotiation
- Secure consents

Stage Two: Base

85 million m^3 per annum

Outcome sought:

Build core of scheme and begin to see water quality improvements

Infiltration systems

- Construction of core of scheme at scale
- Technical programme for future locations
- Water and land access arrangements

Conveyance systems

- Strengthen conveyance system (stock water races and other channels)

Ecological and mahinga kai improvements

- Additional, NRR, TSA and other local projects

Operations

- Monitoring programme
- Daily operations
- Silt removal and refresh programme
- Landowner engagement

Stage Three: Extension

125 million m^3 per annum

Outcome sought:

Extend scheme to seek additional improvements in water quality as per PC2 LWRP

Infiltration systems

- Construction of core of scheme at scale

Conveyance systems

- Strengthen conveyance system (stock water races and other channels)

Ecological and mahinga kai improvements

- Additional NRR, TSA and other local projects

Operations

- Monitoring programme
- Daily operations
- Silt removal and refresh programme
- Landowner engagement

Outline Project Plan

The key aspects of the project plan are shown in the following table:

Table twenty-six: Project milestones

Proposed key milestones	Estimated timing
Stage One: Establishment	
Secure initial consents/agreements for water	2020
Commence monitoring programme	2020
Rate funding arrangement confirmed	2021
Confirm initial stages of works	2021
Stage Two: Base	
Commence Stage One MAR	2021
Commence NRR, TSA and ecological works	2021
Secure operational contracts	2021
Complete base scheme	2024
Secure additional water for extension	2023
Stage Three: Extension	
Commence next stages	2025
Commence NRR, TSA and ecological works	2025
Complete scheme construction	2030

Communications and Stakeholder Management

A detailed communication and engagement strategy will be prepared that will focus on council, stakeholders, farmers and other financial contributors as well as the wider community.

Risk Management and Project Assurance

The project manager shall hold the risk register and be supported by monthly all team formal risk identification meetings and weekly risk review. All mitigation measures will be included in the weekly action register.

This investment proposal has been assessed as LOW risk using the State Services Commission (SSC) Gateway Risk Profile Assessment tool. Based on this risk assessment, it is recommended that normal project assurance processes be put in place.

Benefits Management Planning

Tracking and monitoring the realisation of expected benefits is critical to ensure that the project is successful in achieving its intended objectives. A successful investment in change can result in both winners and losers. It can also be affected by external factors and can result in gains that may not be measurable.

At a high level, the framework for benefits management has four phases:

- **Identification** – identifies and defines measures and identifies owners of benefits
- **Analysis** –quantifies the scale of benefits, compares options, assesses attribution, proves identified measurements will work
- **Planning** – schedules how much of the benefits will be realised, by whom, and by when
- **Realisation & Reporting** – tracks, monitors, reports on and optimally realises planned benefits, including:
    - Reports on both benefit realisation and risks to benefits not being realised
    - Lessons learned (ensuring any lessons are actively incorporated into benefits realisation and as inputs to future benefits analysis to increase accuracy)
    - A feedback loop to inform the benefits management performance system and its strategy when this is refreshed

Appendices

Appendix A – Options Analysis

Hekeao/Hinds Managed Aquifer Recharge

Hekeao/Hinds Water Enhancement Trust

	Response options		
	Option A	**Option B**	**Option C**
Investment Objecfives	**Do Nothing**	**On-Farm Mitigation Only**	**On-Farm Mitigation complemented by Managed Aquifer Recharge**
Significantly reduce the total discharge of nitrates from the land use on the Hekeao/Hinds Plains to achieve 2035 PC2 nitrate-N concentration targets	Does not meet	Partially meets	Meets
Enable farming activities to be viable and productive, continuing to create economic activities and support the wider community.	Does not meet	Does not meet	Meets
Recharge groundwater to both mitigate historic effects of nitrate discharges and raise groundwater levels through the discharge of 125,000,000	Does not meet	Does not meet	Meets
Restore shallow groundwater, lowland drains and streams to improve ecology and support mahinga kai so that annual median nitrate-N concentration does not exceed 6.9 mg/l in shallow groundwater and spring-fed water bodies.	Does not meet	Partially meets	Meets
Critical Success Factors			
Meets business needs	Does not meet	Does not meet	Meets
Strategic fit	Does not meet	Partially meets	Meets
Value for money	Does not meet	Partially meets	Meets
Affordability	Does not meet	Partially meets	Meets
Achievability	Does not meet	Partially meets	Meets

			Response options		
Benefits			**Option A**	**Option B**	**Option C**
			Do Nothing	On-Farm Mitigation Only	On-Farm Mitigation complemented by Managed Aquifer Recharge
Percentage of full benefit to be delivered			**0.0%**	**48.0%**	**84.0%**
Benefit 1	Economic Impact	20%	0.0%	20.0%	100.0%
Benefit 2	Farm financial sustainability	20%	0.0%	20.0%	80.0%
Benefit 3	Ecological health	20%	0.0%	80.0%	80.0%
Benefit 4	Cultural and Human Health	40%	0.0%	60.0%	80.0%

Risk and uncertainty			
Risk 1 : Water supply	Nil	Nil	Medium
Risk 2: Regulatory changes	Extreme	High	High
Risk 3: Effectivess re water quality	Extreme	High	Medium
Cost			
Financial impact on landowners	**not able to calculate**	**-$1,855 EBIT**	**-$545 EBIT**
Costs and Benefits	**not able to calculate**	**0.1 CBR**	**1.4 BCR**
Ranking			
1-3	**3**	**2**	**1**

Appendix B – Economic Analysis

Hekeao-Hinds Business Case

Managed Aquifer Recharge

Economic assessment for the business case

November 2020

m.e consulting

Prepared for

Environment Canterbury

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Summary

Water quality and management are key issues. Improving local nutrient management has been identified as one way to help to reduce pollution. The Hekeao-Hinds Managed Aquifer Recharge Scheme (MAR) is an instrument that is being pursued to lift water quality while at the same time increasing groundwater storage and baseflows to the catchment's river and streams. This economic assessment considered the MAR using two tools:

1. A cost-benefit analysis to show the relationship between costs and benefits. The CBA provides an indication of the 'value for money'.
2. An economic impact assessment (EIA) that illustrates how the additional activity flows through the economy, generating Value Added[1] and jobs.

Crucially, economic impacts (VA or GDP) are not benefits and are not used in CBAs. This assessment addresses several issues[2] identified in earlier assessments. The main differences being, including the cost of (economic) resources used in the production process, and not treating VA (or GDP) as a benefit. Our assessment approach is consistent with the New Zealand Treasury[3] CBA and Better Business Case approaches. The analysis builds on earlier work, and uses it to inform the settings, baseline and assumed development pathway. Uncertainty is dealt with by way of a sensitivity analysis.

The analysis uses the current (2018) land-use patterns and apply assumptions about the change going forward. The 'Solutions Package' mentioned in the Preliminary Business Case is viewed as part of the MAR and the changes associated with it are modelled. We have assumed that the with-MAR scenario will see land use remain stable with a shift in farming systems (i.e. moving towards higher levels of advanced mitigations). The shift in land use applied in the without-MAR scenario, to reflect the envisaged changes. The advanced mitigation financial information was rebased to 2019/20 values.

Supporting environmental improvements and delivering potential health effects, are seen as potential benefits are also considered, and commented on separately.

<u>Results</u>

The analysis period mirrors the timeframes from earlier work, with initial activities taking place in the current year. There is likely to be some delays and rescheduling that will impact the temporal distribution. Such shifts will impact the results, but only very large changes will have a meaningful impact on the results.

The modelling suggests that under the default discount rate (6%[4]), the with-MAR (vs the without-MAR) will return a positive BCR of 1.4 and a net position of +$130m. This equals an average annual lift of $6.5m. The BCR moves up or down, depending on the discount rate used but it stays range-bound and above 1. Including non-market values[5] lift the annual benefit of the MAR by $200,000[6]. Importantly, some of the environmental benefits will also be achieved under the without-MAR scenario because the large land use changes will deliver those improvements.

A sensitivity analysis was completed to reflect uncertainty. It was set-up to reflect the downside and as a way to address optimism bias. The key assumptions were adjusted to reflect a negative position, i.e. up or

[1] Value Added is similar to GDP but excludes some taxes.
[2] A peer review was outside the scope of this commission, but several material issues were identified in the earlier CBAs.
[3] Treasury New Zealand (2017) Guide to Social Cost Benefit Analysis.
[4] 6% is the default rate put forward by NZ Treasury.
[5] Like health values and the potential protection of wetland values.
[6] Using conservative positions and settings.

down 10%. In addition, the assumptions were explored and adjusted using a goal seek approach to identify the movement needed to return the BCR to 1. The outcomes of the sensitivity analysis are (at the 6% default rate):

- Scheme costs 1.4 minimal change,
- Cost of resources used 1.2 lowers the BCR but it stays above 1, and
- Land use change (scale) 1.3 2% downward change.

A pessimistic scenario that combines all the downside settings was assessed. This scenario returns a BCR of 1.2. Under this approach the annual gain is $4.5m. The sensitivity analysis suggests that areas with the least room for movement are the cost of resources used (i.e. farming costs) followed by scale of change. Extending the timeframe by 10 years, lifts the reported results, but the relativities remain constant.

The second part of the analysis estimated the **economic impacts,** and it differentiates the one-off and ongoing impacts. The Value Added (VA[7]) impacts arise as the additional (new) activity that takes place, and then ripples through the economy. The focus is on the backward linkages of the farming sector (as oppose to the backward linkages of dairy processing). The spatial distribution is a function of the supply chains, i.e. the local businesses procuring a portion of goods and services from outside the immediate location. The impacts are estimated as follows:

- One-off impacts: These impacts relate to the capital expenditure associated with establishing the MAR and the on-farm spending related to the land-use change (for the without-MAR situation):
  - VA impacts between -$7m and -$10m across NZ with a -$8m mid-point (these figures are negative, so activity is foregone).
  - Concentrated locally (64%) and in Canterbury (22%).
- Ongoing impacts:
  - The ongoing impacts (present value @6%) are estimated at between $191m and $221m.
  - Three quarters (75.3%) of the impacts are concentrated in Canterbury and the rest in the wider NZ.
- Ongoing Impacts:
  - Summing the one-offs and the ongoing impacts (i.e. subtracting the foregone impacts from the ongoing impacts) shows that the net impacts are estimated to be between $183m and $211m.
  - Most of the impacts are concentrated in Canterbury (60%) with 18% felt locally in Ashburton.

The modelling suggests that the activity associated with the MAR will support jobs in the farming sector as well as the wider economy to complete the work[8]. Over the long term, the MAR will support around 23 jobs (relative to the without-MAR scenario and per year in Canterbury).

Financial considerations

How the MAR is funded is important because it has implications for who-pays. The funding load can be distributed using different philosophies, like a user-pays or benefit-basis, or an approach where the costs are paid for by the parties that create the need for that infrastructure. The specific approach followed to

[7] Value added is similar to GDP with minor difference in how tax is treated.
[8] This assumes that there is sufficient capacity in the local market i.e. there are workers available. In reality, business will use technology and other means to address capacity constraints where labour is not available.

estimate where the funding load falls is influenced by the overarching philosophy. Estimating the relative distribution needs to consider the growth projections, infrastructure expenditure (current and future) and the financial settings (interest rates, terms, depreciation, WACC[9] and so forth). In turn, these influence the allocation methodology and how the funding load is shared between existing and future (growth) users.

[9] Weighted Average Cost of Capital – WACC).

1 Introduction

Water quality and management are key issues in New Zealand and globally. Ongoing nutrient management is important because it assists in reducing contamination. Without proper management, nutrients can dissolve in soil water and go into surface or ground water through leaching or runoff. The Hekeao-Hinds Managed Aquifer Recharge Scheme (MAR) is being pursued with the aim of reaching a recharge target of 125 million cubic metres (Mm^3) per year to:

- improve water quality, and
- increase both groundwater storage and baseflows to the catchment's river and streams.

This report summarises the outcomes of an economic assessment of the MAR relative to a without-MAR scenario. The findings will inform a wider business case process. Crucially, the assessment uses available information about the scheme and development timelines and makes a series of assumptions to enable the analysis. The assessment uses two different tools:

- Cost benefit analysis (CBA), and
- Economic impact assessment (EIA).

These two different tools are used because, while based on the same information, they illuminate different aspects:

1. The CBA sheds light on the relationship between costs and benefits. The CBA provides an indication of the 'value for money'.
2. The EIA illustrates how the new activity will flow through the economy, generating Value Added (VA, and similar to GDP) and jobs.

Crucially, economic impacts (VA or GDP) are not benefits and are not used in CBAs. Value Added includes items like salaries and wages. A salary, or a wage, is a gain to the worker but a cost to the business employing that person. The initial capital investment (e.g. constructing a building) generates economic activity and so it delivers a VA impact. But, from a CBA perspective, this capital investment is a cost because a resource is used, and an opportunity cost is incurred[10].

This assessment differs from earlier economic impact assessments insofar as separating out the EIA-part from CBA. It addresses several issues[11] with the historic approaches. The main differences being:

- Including costs that were not captured in the earlier assessments, like the cost of (economic) resources used in the production process.
- Not treating GDP (or VA) as a benefit because this is inappropriate.
- Completing the analysis in real terms (today's values and not inflating only selected parts).
- Using a lower discount rate to reflect the long-term nature of the improvements and the economy operating in a low-inflation environment.

[10] The funding cannot be used for another purpose.
[11] A peer review was outside the scope of this commission, but several material issues were identified in the earlier CBAs.

1.1 Project objectives and approach

The approach followed during this assessment is consistent with the New Zealand Treasury[12] CBA and the Better Business Case approach. We considered the costs and benefits and the analysis focused on the main (largest) items. The CBA (and EIA) framework is well defined in economics and the key steps are as follows:

- Define **the project and the counterfactual:** correctly defining the project, including the counterfactual, is important because it impacts the range of costs and benefits examined and the quantum (size) of effects. Generally, the counterfactual is defined as the 'do nothing', 'do minimum' or even a 'business-as-usual' approach. While this step may seem relatively uncontroversial, it is critical because it sets the benchmark against which change is assessed. This is important for EIA and CBA processes.
- **Identify the costs and benefits:** in an economic analysis it is common practice to develop a complete list of all the costs and benefits that may arise. This helps to frame subsequent steps. It ensures that researchers do not omit, or double count, costs and benefits that may be hard to quantify. The assessment should extend to include non-market impacts, including externalities and public goods.
- **Valuing the costs and benefits (over time):** usually the most difficult step in any economic assessment is valuing or quantifying the costs and benefits. NZ Treasury considers that "*Valuation of costs and benefits, however, is usually more difficult. But this is not a reason not to make an attempt. Even a rough, back-of-the-envelope attempt will convey some useful information to decision-makers. In fact, just identifying the main costs and benefits, and summarising them in a table on one page, often reveals surprisingly useful information*".[13]
- **Sensitivity Analysis:** a core step in a CBA and economic modelling is to test the sensitivity of outcomes to changes in key assumptions. This shows the direction and scale of change under different conditions. The sensitivity analysis is useful in reflecting uncertainty.

As mentioned, the assessment used a two-pronged approach – a CBA structure, supplemented with an Economic Impact Assessment. The EIA reports the total value of the economic transactions associated with the (new) spending and how it flows through the economy.

1.2 Limitations and Caveats

This analysis is based on the information received from the project team and forms the basis for the assessment. The CBA reflects the potential costs and benefits of implementing the MAR. The assessment will need to be updated if new research/information becomes available and as the implementation process unfolds to reflect more recent information about the effects of the MAR, and the cost of delivering it.

The following limitations and caveats apply to the analysis:

- **Capex and opex estimates:** The capex and opex figures were sourced from a range of sources. We have used these estimates without any structural/material adjustments. This information is assumed to be accurate and robust. Changes in these inputs will affect the results.

[12] Treasury New Zealand (2017) Guide to Social Cost Benefit Analysis.
[13] Ibid p16.

- **Scenarios and pathways:** The scenarios and development pathways are based on different documents and an interpretation of them. The assessment relies on these pathways as the basis for assessing the MAR. We have assumed that the development pathways outlined in earlier reports still hold.
- **Non-market Values:** This assessment did not include primary research. So, it was not possible to accurately[14] estimate the non-market values associated with the MAR. Examples of such values include the potential environmental gains from improved water quality. These benefits (and the potential costs) are dealt with through high-level commentary and then linked to the CBA to illustrate the likely direction and magnitude of the effect.
- **Uncertainty/Future:** Inherently there is always uncertainty associated with future estimates and economic assessments. The analysis covers more than 20 years, which is likely to result in a significant range of potential outcomes. A targeted sensitivity analysis was conducted to reflect uncertainty, to explicitly capture optimism bias and to identify the aspects with the greatest influence on the results
- **CBA/LSF:** This report applies commonly adopted methods for assessing the merits of the options (CBA), however the Treasury Living Standards Framework is acknowledged. The LSF is a method for assessing policies/projects. This assessment has not attempted to provide an analysis that matches this new LSF because of data issues. Nevertheless, the approach aligns with the principles of the LSF.
- **Other:** Several assumptions underpin the analysis. These are based on the current understanding of the variables and parameters. The team has used the best available data and/or applied conservative assumptions. Regardless, the assumptions will change as more research is completed and new information becomes available. This report is likely to underestimate some benefits and overestimate some costs. A conservative approach is maintained throughout the analysis.

1.3 Information sources

A range of data and information sources were consulted in undertaking the analysis, including:

- Hekeao/Hinds Groundwater Replenishment Scheme – Preliminary Business Case. 19 December 2018.
- Environment Canterbury Reports:
  - Economic impact of the Hinds Water quantity and quality limit setting process. Report No: R14/82.
  - Hinds catchment nutrient and on-farm economic modelling. Report No: R13/109.
- Ashburton Multi-Regional Input Output Tables (see Appendix 1 for a brief discussion of Input-Output modelling).
- Several reports by MacFarlane Rural Business.
- Official information and data sources from StatsNZ:
  - Annual Enterprise Survey,
  - Business Demography Survey,
  - Supply-Use Tables,
  - StatsNZ published price inflators.

[14] That is, Ashburton specific.

1.4 Report Structure

This report is structured into four sections, as follows:

- Section Two provides a description of the key assumptions and processes followed.
- Section Three summarises the results of the cost benefit analysis, economic impacts and the sensitivities. Commentary on the non-market values, and how they add to the CBA, are presented in this section.
- Section Four concludes the report with commentary around the wider considerations, e.g. funding arrangements.

2 Assumptions and processes

The assessment is based on several assumptions covering the roll-out and implementation of the MAR. The activity it supports and the changes it enables/avoids are reflected in the modelling through assumptions and different metrics. This section summarises the key assumptions, but it is not an in-depth discussion of all the technical considerations.

Most assumptions are sourced from, or informed by, earlier reports on the MAR and these have been updated to 2019/20 values by applying price inflators. The assumptions are also informed by discussions with Environment Canterbury representatives. Minor adjustments were made to reflect our understanding of different processes, e.g. land use changes were distributed over a longer timeframe than those used in earlier analyses. The assumptions take a conservative view across the board, taking a cautious approach i.e. the high(er) cost options, and low(er) benefit options are used.

The economic impacts are reported separately, with the one-off capital expenditures and the ongoing/operational spending modelled individually.

The assessment considers the spatial distribution of the economic impact assessment as well as a cost benefit analysis. The (overall) CBA reflects a NZ-wide situation but most of the effects will have a distinct local effect, linked to Ashburton and the farming community. In contrast, the economic linkages (supply chains) are considerably wider, distributed to Christchurch and the rest of Canterbury and the rest of New Zealand.

The main assumptions are summarised below.

2.1 Base positions

The analysis uses the existing land-use patterns, and assumptions about the change going forward. Table 2-1 reports the current (2018) land use by main category.

Table 2-1: Estimated Land Use (2018)

Land use	Est. 2018 Hectare
Sheep, Beef and Deer	36,770
Arable	33,220
Dairy Support	12,320
Dairy	49,110
SUM	**131,410**

The outlook (change in land use) is based on the growth pathways described in earlier work (e.g. MRB reports), as is the change in the farming systems. Implementing the MAR will deliver a range of effects, and these are assessed against a without-MAR scenario. The without-MAR scenario forms the basis against which the MAR is assessed. The without-MAR scenario is based on the MRB analysis showing the required land use change and the farm systems that are needed to reduce N-losses by an estimated 48%. We understand that there is considerable uncertainty around likelihood that the land use, and farm system change, will actually deliver the required nitrate reduction by 2035. If this does not happen, more stringent

measures could be implemented but the nature of the stricter rules is unknown and therefore we have assumed that the without-MAR scenario will achieve the required reductions.

The 'with-MAR' scenario is compared against the without-MAR. The most obvious and direct effect, of the MAR is that it enables ongoing farming across the current land uses while at the same time moving towards more advanced mitigation measures. The following changes are included:

- Implementing on-farm mitigations and additional advanced mitigation practices on new irrigation areas (in line with compliance with PC2),
- Putting forward conditions for advanced mitigation practices for different land uses (e.g. dairy and dairy support farms), and
- All existing dairy and dairy support farms are required to adopt advanced mitigation practices from 2025 and move to higher mitigations by 2035.

The land use estimates (Table 2-1) were reconciled against the those used in the 2014 study, and provide an updated starting point for the modelling. The change in land use observed between 2014 and 2018 was included in the model. For the without-MAR scenario, the conversions were re-calibrated to align with the data in the MRB report. The change was estimated on a straight-line basis and the total land area was then rebased to retain the total area. The land use shifts are consistent with the patterns outlined in the initial assessment but with the additional refinement of smoothing out the transitions over three years.

Several minor adjustments are applied to balance the conversions over time to remove the effects of over/undershooting transitions. A by-product of this is that the conversion process takes slightly longer (+2 years) to complete when compared against the original analysis.

Table 2-2 references the financial information (Earnings Before Interest and Tax - EBIT) for the different advanced mitigation practices. The earlier estimates have been updated to reflect 2019/20 $-values by using factors ranging between -9% and +44%.

Table 2-2: Earnings ($-EBIT) per Hectare (2019/20) per land use and per farm practice ($/ha)

	GMP	AM1	AM2	AM3
S&BD 1	712	537	537	-
S&BD 2	494	471	823	-
Arable 1	2,344	2,260	2,341	2,351
Arable 2	2,262	2,283	2,387	2,351
Arable 3	1,274	1,107	1,536	1,182
Arable 4	663	590	415	474
Arable 5	1,636	1,560	1,670	1,589
Dairy Support 1	4,610	4,971	4,971	4,349
Dairy Support 2	4,000	3,988	4,707	4,266
Dairy support 3	5,619	5,794	6,153	4,308
Dairy 1	3,900	4,206	4,206	3,680
Dairy 2	3,384	3,374	3,982	3,610
Dairy 3	4,414	4,047	4,351	3,902
Other	2,344	2,283	2,387	2,351

M.E calculation based on MRB Report (2018)

The earnings (EBIT) information is used to estimate additional business activity (sales) that is supported by the MAR and the without-MAR scenario.

Without-MAR scenario

The without-MAR scenario, a separate scenario was modelled to estimate the costs and benefits and it is seen as the counterfactual. This scenario used a high level of land use change as estimated with a 48% reduction in N-losses. The level of change associated with this shift is estimated at:

- 33% reduction in dairy farm area,
- 33% reduction in dairy support farm area,
- 33% reduction in arable 2 (small seed production) area,
- 194% increase in arable 1 (process vegetables) area,
- 83% increase in arable 4 (livestock and grain) area,
- 53% increase in sheep, beef and deer (finishing livestock) area.

Based the land use change, and shifts towards AM3, the farming economics profile shifts towards other farming activities – away from dairying and dairy support towards arable, and sheep, beef and deer farming. These farming type have different revenue and cost profiles, driving additional shifts in the economic effects of the land use change. In addition to the ongoing effects, there are costs associated with converting land use between farming types. While the initial investment (cost) is not as large as shifting to dairying, there are still cost. The literature about the cost of converting away from dairying suggests that in some instances, there could be a surplus (i.e. a profit) once converted. This arises from the sale of the dairy cattle. The cost to convert away from dairying used in this assessment is $2,500. The land use change is assumed to occur over 10-years.

The following two sections outline the costs and benefits that are included in the analysis.

2.2 Costs

When completing an economic assessment like a CBA or EIA, it is important to reflect the anticipated change that is associated with the project. Any change that would have occurred regardless of the intervention (e.g. policy or change), has to be excluded. Similarly, this means that the cost associated with the intervention (direct costs) as well as other costs that are incurred by other parties, due to the intervention, have to be included. In the context of the MAR, such secondary costs include the economic resources used during farming. The secondary costs are also included in the without-MAR scenario, and reflects capital expenditure associated with activities like converting between land uses.

The costs[15] associated with the MAR and the facilitated activities are summarised below.

- The MAR scheme costs outlined in the Preliminary Business Case are used. The values are in 2018 $-terms and have been updated to 2019/20 using published price deflators. A range of items are included:
    - Consent costs are put at $172,000 per round, and three rounds are planned.
    - The capex for the scheme is estimated at $8.4m over three cycles. This excludes an allowance of $2.2m for staff costs.
    - The operational activities will start off with an annual cost of around $70,000, before scaling up to $194,000 as the scheme expands and becomes fully operational. An annual cost of $246,000 is added to allow for operational staff.

[15] The figures are rounded.

  - The project profile (timelines) mirrors the one outlined in the Preliminary Business Case (Figure 7. GRS implementation timeline with associated costs, as presented in the Preliminary Business Case) with adjusting the values to 2019/20 $-terms.
- As part of the without-MAR scenario, land use change will take place. This is mostly away from dairying, dairy support and arable activities. The shifts are listed in the preceding section.
- Earlier analysis did not reflect the costs associated with land use conversion, or the value of the economic resources used by the different land uses. For the non-MAR scenario, the total conversion costs are relatively low because the land-use shifts away from dairying, and this tends to be relatively less costly (vs converting to dairying). For converting away from dairying, an average cost of $2,500 is used[16]. The variability and uncertainty around these costs are acknowledged. The sensitivity analysis is used to reflect the uncertainty and to shed light on how critical these matters are to the overall BCR.
- An often-neglected part of a CBA is the cost of economic resources used in the economy if production levels change. If land use shifts from one activity to another, then the value of economic goods used to produce the new output has to be included. The value associated with the current (pre-conversion) activity is included in the assessment to ensure that the net change is considered. The share of total activity that reflects the resources used is an important variable. We considered a range of data sources, including StatsNZ data, the Ashburton MRIO and the Financial and Production Summaries for the different farm systems. Costs as a share of production range between 67% and 84%, with the range reflects different farm types (arable, dairy etc) and farming practices.
- The value of labour is included in the analysis and has been adjusted for displacement and opportunity costs and in line with Treasury guidelines.
- How a project is funded can introduce other costs. Most costs are associated with the change in resource use (discussed earlier). But additional costs arise if a project is funded through rates or taxes. Taxation distorts spending patterns, introducing deadweight costs (sometimes called deadweight losses). For simplicity, we have assumed that MAR costs (capex and opex) are both rates funded and have applied the 20% deadweight cost loading. This is a conservative position because it increases the cost.
- A finance change is included to reflect the interest payment on the capex component of the MAR. A 5% interest rate with a 10-year period is used.

2.3 Benefits

The benefits of the MAR arise from several channels and these are associated with shifts in the nutrient loads and water use. These include:

- Enabling/maintaining land use,
- Lifting water security,
- Potential health effects,
- Environmental effects.

[16] We note that there is considerable uncertainty around this. In some instances, there could be a surplus (so no cost to convert) because of gains associated with selling milking animals.

2.3.1 Land-use change

Changing/maintaining the land use aspect drives the benefits because it is through the land use shifts that nutrients are better managed. By enabling the land use, the level of economic activity that can be undertaken is supported and maintained. Importantly, the costs structures associated with the land-use shifts also move (as mentioned in the earlier sector). The benefits are valued in different ways.

The land use enables goods that can be produced for the export market and associated sectors. The value of farming activity is compared against the baseline situation i.e. the without-MAR scheme and the change in land use. The value of business activity is estimated using the 'Financial and Production Summaries' and rebasing these to 2019/20 $-values. The estimates maintain consistency with other data sources and reported ratios (e.g. EBIT/Ha, NPAT/Ha). The production activity is often expressed on a kilogram Milk Solid (MS) basis and this can have considerable variation over different years. Our approach is conservative but maintains the important relativities. The value of production per ha varies across the farming types and the mitigation activities applied. It ranges from $2,300/ha to $12,320/ha.

Earlier assessments include asset value shifts as a benefit (or cost) of the MAR and related activity. The asset value is a function of production activity (MS/kg) and expenses. Since both of these aspects are already included in the BCR, including asset value shifts in the calculation would double count the effects.

2.3.2 Water security of supply and reliability

Another benefit of the MAR is that it is expected to lift the productivity of a portion of farms due to improving water reliability. We applied the improvement ratios to the relevant areas and increased the production by the same proportion as implied in the earlier studies. There is some uncertainty around the contribution of this issue to the overall, total level of benefit. Regardless, the potential size of the benefit is integrated into the analysis. On a per hectare basis, improving water reliability is expected to lift the relative productivity.

2.3.3 Health and environmental effects

For the health and environmental effects, the values used in the earlier assessments are updated and the input parameters are refined. This maintains high level consistency with the logic but improves the insights delivered.

2.3.4 Labour benefits

A portion of the capex and opex spending is on staff (salaries and wages). In addition, changes in the land use will flow through altering employment levels. Care is needed before labour market effects are counted as benefits and should be adjusted. Only a portion of the employment gains is seen as a benefit because the change has two components – opportunity costs and displacement effects:

- *Opportunity cost* accounts for the fact that a person going into a job does not necessarily see their welfare increase by their income. While unemployed, a person can utilise their time and gain satisfaction from this.
- The *displacement effects* account for the intervention moving an individual from one job to another or changes the timing of when effects (like jobs) occur.

The approach followed to estimate these two effects are based on the NZ Treasury's guidelines.[17] This assumes that the labour value (wages and salary) are costs, and only a portion of it presents a (net) benefit to society.[18] These costs[19] are included under the 'cost heading' and the benefits are recorded as described.

2.4 Other considerations

The assessment considers the potential effects of establishing the MAR. Once established, the operations will drive demand for transport (vs the no-MAR scenario). This includes moving inputs to/from farms to processors and then shipping the goods offshore. The externalities associated with the wider transport are not reflected in this assessment. The traffic movements also add to the burden on transport infrastructure and change accident risk profiles on the routes used. The costs associated with these wider effects are not included in the assessment. Other costs, like emissions, are not considered.

The analysis does not reflect the potential cost of staff injuries (or fatalities). If this is included then the BCR is expected to change somewhat but including it would need an analysis of risk profiles, matched to the operational risks and the cost of injuries (e.g. using ACC costs).

The next section summarises the results.

[17] Treasury New Zealand (2017) Guide to Social Cost Benefit Analysis.
[18] Treasury New Zealand (2018) CBAx Tool User Guidance and CBAx Tool.
[19] The cost side includes 100% of the salary and wage cost.

3 Results

This section summarises the results of the assessment. The CBA is dealt with first, followed by the EIA results. Several different discount rates are used to translate future cash flows (positive and negative) into present values. Selecting a discount rate is important because it can impact the results. A high discount rate reduces the 'value' of future benefits/costs. This means that more weight is placed on the short term. Discounted Cash Flow analysis (DCF) is used to translate future costs and benefits into a single value, i.e. how much is the future costs/benefits worth today. A range of discount rates are used to:

- Show the values using a low discount rate. This is consistent with approaches where environmental projects are considered. This is because the timeframes associated with such projects tend to be very long and using a low discount rate reduces the 'weight' of future values.
- The default discount rate (6%) is used (together with 4% and 8% to show the range). However, in light of the current low interest rate and inflation, environment using a too high discount rate will reduce the values too much.

A full set of discount rates are used to show the range of outcomes. These are all interpreted to show the spread of results.

3.1 Costs and Benefits

The analysis covers the period to 2040 and it mirrors the capex and opex of the MAR roll-out, with initial activities taking place in the current year (assumed to be 2020). In reality, there is likely to be some delays and rescheduling that will impact the temporal distribution. Such shifts will impact the results, but only large changes will have a meaningful impact on the results. Table 3-1 summarises the results.

Table 3-1: CBA – Results

Discount Rate	Costs $'m	Benefits $'m	Total Net $'m	BCR	Annual Net $'m
0%	504.9	663.3	158.4	1.3	7.9
2%	447.4	595.5	148.1	1.3	7.4
4%	401.3	540.0	138.7	1.3	6.9
6%	**363.8**	**493.9**	**130.1**	**1.4**	**6.5**
8%	332.8	455.2	122.4	1.4	6.1

Based on the assumptions, the MAR will deliver a positive net position under different discount rates (when compared against the without-MAR situation). Under the 6% discount rate (default rate[20]), the net benefit position is +$130.1m. This equals an annual surplus[21] of $6.5m when averaged out over the assessment period. The overall benefit associated with the MAR is estimated at $493.9m, with a cost of $363.8m. The BCR is esimated at 1.4 suggesting that the benefits outweigh the costs.

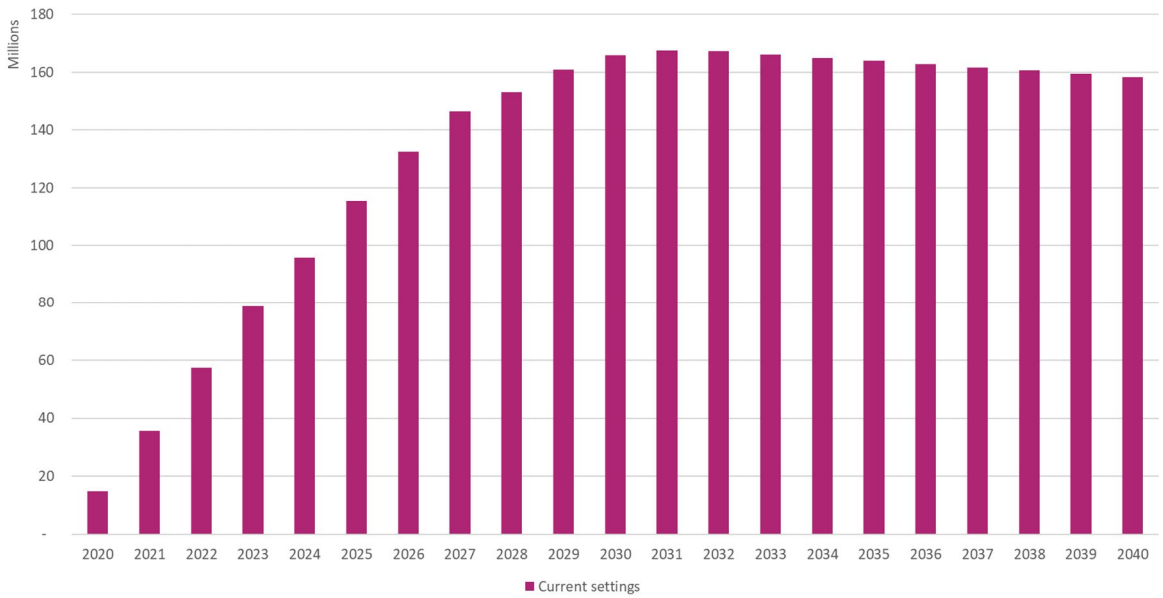
[20] 6% is the default rate put forward by NZ Treasury.
[21] When compared against the without-MAR scenario.

The other discount rates show that even using higher discount rates, which reduces the relative weight of future costs and benefits, a positive BCR (>1) is still returned. Under the high discount rate (8%), the net position is $122.4m and the annual average gain is $6.1m. In light of the total additional benefit of around $455.2m and the cost of $332.8m, the gain is similar to the 6% discount rate.

The robustness of the net position is explored using a sensitivity analysis but the fact that the results under the different discount rates are similar suggests that a large portion of the net benefits are experienced early in the assessment period, before tapering off. This is consistent with the patterns observed across the two scenarios (with-MAR and without-MAR). Under the without-MAR scenario, large-scale land-use shifts are expected with additional costs front-loaded onto those areas that convert. Under the with-MAR scenario, these conversion costs are avoided, and the total value of activity is higher than the without-MAR scenario. Further, over time the relationship between the activity (revenue) and costs change as land uses move towards more advanced mititgation – the relative output per hectare reduces and the cost per hectare increases. Combined, these changes deliver net benefits in the short to medium term.

Figure 3-1 shows the cumulative position of the with-MAR scenario as measured against the without-MAR scenario.

Figure 3-1: Cumulative Position (Benefits less costs over time)



The figure illustrates that the cumulative net benefit over time. The with-MAR scenario will deliver ongoing benefits over the first decade, reflecting the avoided costs associated with converting land to other uses, as well as the shift in type of activity. On a cumulative basis, the point at which the with-MAR scenario delivers the greatest overall position is around year 2029. This specific point is a function of the assumptions around the speed at which land use change takes place (for the without MAR situation). The gradual decline in the cumulative position points to the shift in the overall value delivered by activity after the land use change has been completed (that is, the changing relationship between the sales and operating costs).

As mentioned, the analysis does not consider the potential environmental costs or other externalities. But, based on the analysis, the environmental costs and externalities would need to be greater than the annual values for the BCR to fall below one. For the assessment period, this is over $6.5m/year. But, in light of the anticipated outcomes of improved nutrient management, and less nutrients entering the receiving environment, an improvement in the BCR is expected.

3.2 Sensitivities

The CBA suggests that the MAR will deliver positive gains to the district with the effects arising from the farming activity that is maintained, and the costs that are avoided. This positive BCR is despite upward shifts in the costs associated with the different land uses i.e. increasing the economic resources used to produce the goods. As with any economic modelling, the results must be considered in a way that reflects uncertainty and optimism bias. A sensitivity analysis enables such consideration.

The core input assumptions were explored and adjusted using a goal seek approach. The aim was to identify the overall movement needed to return the BCR to 1 i.e. the point where benefits equal costs. The different assumptions are also increased/decreased by 10% to assess the effects on the BCR. The sensitivity analysis considers the downside situation, and the following assumptions were assessed:

- Scheme costs (capex),
- Cost of resources used,
- Land use change – scale,
- Land use change – costs.

Table 3-2 summarises the outcomes of the sensitivity analysis using 6% discount rate.

Table 3-2: Sensitivity analysis – Results (NPV at 6%)

+/-10%	Net Position	BCR	Annual Value	BCR Shift (% of original)	Net Annual (% of original)	Change needed to return BCR of 1
Scheme cost	128.6	1.4	6.4	99.6%	98.8%	950%
Cost of resources used	93.3	1.2	4.7	90.8%	71.7%	+40%
Land use change – costs	127.8	1.3	6.4	99.4%	98.2%	-460%
Combined	89.5	1.2	4.5	89.9%	68.7%	+30%

The sensitivity analysis suggests that the BCR remains at least one (1) across the four settings. The combined setting is seen as the downside situation with all variables adjusted by 10% (in a negative direction). Under this situation, the net annual position of the with-MAR is $4.5m and the BCR remains above 1 meaning that the benefits outweigh the costs. The other settings reduce the BCR and net annual position, but it remains positive.

The sensitivity analysis estimated the degree to which the difference assumptions have to shift (up or down) before the BCR is reduced below 1. It suggests that there is some room for the different parameters

(and settings) to move before the BCR comes down to 1. The areas with the least room for movement the cost of resources used (i.e. farming costs), followed by scale of change. Not surprising, the scheme costs can increase by a considerable margin because it is relatively small when compared against the wider effects associated with the MAR.

The assessment timeframe uses a 20-year period to maintain consistency with the preliminary business case. Extending the timeframe by another 10-years lifts the results above those reported above, but the relativities remain constant.

3.3 Other considerations

Earlier work includes other dimensions outside the main BCR. These are considered to provide a full picture, and include commentary around:

- Health effects,
- Environmental values, and
- Additional water security,

The earlier reports reflected the economic value of clean water (low nitrates) using two approaches. Firstly, the cost associated with using alternative water (e.g. bottled water) was used to estimate the costs of increasing nitrates. The second approach reflected increasing the depth of local wells that are used for household use. We focus on the first approach and apply the same logic, but with updated variables.

The estimate of the cost of water for women who are pregnant or breastfeeding within the Hinds catchment is based on two key inputs, the number of females aged between 15 and 44 years old and the cost of drinking water. Based on StatsNZ information, there are 1,970 individuals in the Hinds catchment falling into these age cohorts. In terms of the cost of water, a high-level scan of retail prices suggests that the price per litre is around $0.8/l but a high value of $1/l is applied. Using these two parameters and re-estimating the health costs suggests that the avoided direct costs (to expecting households) is in the order of $1.4m, ranging between $1.6m to $1.2m, under the 4% and 8% discount rates respectively.

With reference to the environmental values of the MAR, the same methodology and parameters as outlined in *Study of the Canterbury Region* (Tait *et al* 2011). This is the same study used by AgResearch in the earlier work. This study of Canterbury estimated the total value of water improvements for the entire Canterbury region over five years.

Notwithstanding the issues with previous assessments as mentioned earlier, base information was used from these studies to estimate the benefits of clean rivers and streams. AgResearch points out this is '*derived from considering the peoples willingness to maintain clean rivers and streams in their vicinity*' and are therefore, not necessarily indicative values of the real services (ecosystem services) provided by rivers and streams.

It is acknowledged that allocating the regional value estimated by Tait et al (2011) of clean rivers and streams pro rata according to geographic area[22], is a crude measure. Nevertheless, it is beyond the scope of this project to re-evaluate these metrics. The values are updated to 2020 values (from 2013) using different price deflators.

[22] The Hinds catchments makes up around 21% of the Ashburton District, which makes up 14% of the Canterbury Region. This suggests 2.9% of the regional value is in the catchment.

The total value of cleaner rivers and streams over 20 years, is estimated to be between $8.4m and $19.3m ($$_{2020}$). Using Treasury's default discount rate of 6%, implies an annual value of between $0.69m and $1.59m.

Wetlands are among the world's most productive natural ecosystems and the benefits they provide to communities both locally and at a global scale, are well documented. Several valuation methodologies have been applied over time to value the ecosystem services provided by wetlands. Following the approach used by Tait et al 2011, we updated the relevant metrics to reflect the current (2020) values. Table 3-3 show the estimated wetlands value in the Ashburton District.

Table 3-3: Wetlands value in the Ashburton District

	NZ$/ha/year ($$_{2020}$)	NZ$'m/year ($$_{2020}$)*	NPV 20 year @6%
Minimum	5,553	0.39	4.5m
Average	47,247	3.35	38.5m
Maximum	193,028	13.70	157.2m

**based on 71 ha of wetland*

The MAR is expected to prevent environmental degradation and the avoided damaged is seen as a benefit. The above estimates are based on 71 hectares of wetlands within the Hinds catchment and assumes that that all (100%) of these wetlands are at risk without a MAR-scheme. The scale and timing of the MAR's impacts on the wetlands are unknown. Therefore, a conservative approach is taken, using the minimum values, and illustrating the potential benefits for 10%, 25% and 50% of the area (@6% discount rate). **The estimates are linear:**

- **10% $450,000,**
- **25% $1.13m, and**
- **50% $2.25m.**

Importantly, the with-MAR and the without-MAR scenarios both deliver improved environmental outcomes, specifically nutrient reduction. Therefore, care should be taken when treating these benefits as a purely with-MAR outcome.

Adding the health effects and the value of saved wetlands, increases the net gains. In light of the large costs and benefits associated with the farming activity, these values do not have a large effect on the overall BCR. Nevertheless, they are important in the local context and the valuation approach does not necessarily reflect the 'true values' that some segments of the community put on those parts. That is, the non-market values of the MAR are important, and they should not be ignored.

3.4 Economic impacts

The second part of the analysis estimated the economic impacts that the MAR could unlock. This includes both the construction and one-off activity as well as ongoing activity. The economic impacts are estimated

using the Ashburton Multi-Regional Input-Output model with 3 regions[23] and 106 sectors. The model reflects the supply chain effects[24].

The VA impacts arise as the additional (new) activity takes place, and then ripples through the economy. We estimate different impact types:

- 'Direct and indirect impacts' – when a visitor (or business) spends (new) money in the local economy, then the economy responds by firstly increasing (or decreasing) activities supplying the goods and services, needed to address that initial demand. This is the direct effect. All firms supplying the businesses responding to the initial spending, adjust their outputs, stimulating further rounds of impacts, and so forth. Further (flow on) rounds of activity are needed to meet the extra demand and these rounds are called the indirect impacts.
- The induced impacts: As businesses respond to the economic change (the direct and indirect impacts explained above), they use additional workers (by increasing staffing hours, employing more people, or staff working overtime). This leads to a lift in salary and wage payments to households i.e. more salaries and wages paid to workers in return for their labour. Businesses also take additional profits as operating surpluses increase – this is partially returned to households through dividends paid to business owners or investors. As households spend their returns or earnings, another round of effects is created (i.e. household spending). These are termed induced impacts.
- The 'total impact' reflects the sum of the direct, indirect and induced impacts.

In this analysis, the focus is on the backward linkages of the farming sector (vs the backward linkages of dairy processing). Some impacts are one-offs and others are ongoing. The spatial distribution of impacts is shown. The spatial distribution is a function of the supply chains, i.e. the local businesses producing a portion of goods and services from outside the immediate location. Table 3-4 summarises the results.

The one-off VA impacts are estimated to be between -$7m and -$10m across NZ with a -$8m mid-point. These impacts are negative i.e. the VA impacts will not be felt under a MAR. The VA added impacts of the one-off (e.g. construction) activities are less under the with-MAR that under the without-MAR scenario. This is because under the without-MAR scenario, a large degree of land use change (conversion) is required, and this activity will generate VA-impacts. Under the with-MAR scenario, this conversion is not needed and consequently the conversion activity is not needed. Spatially, the foregone VA activity is distributed relatively evenly across the district, region and NZ.

As expected, the impacts associated with the ongoing (operational) activity are substantially larger. This is despite the operational activity only ramping up and reaching scale towards the middle of the assessment period. The ongoing impacts (present value of the VA) are estimated at between $191m and $221m, with the midpoint being $205m.

Regionally, a large share of the VA effects is associated with the rest of Canterbury (58%), with around 20% in Ashburton and the rest of NZ, respectively (20% and 22%).

[23] Ashburton, Rest of Canterbury and Rest of NZ.
[24] Sometimes referred to as multiplier effects; we do not use multiplier to estimate the impacts as this can mis-represent the impacts.

Table 3-4: VA Impacts

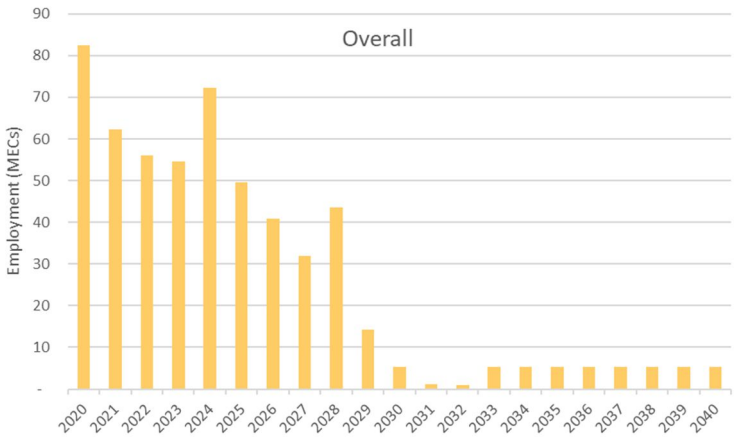
		$m		
		4%	**6%**	**8%**
One-offs	Ashburton	(6)	**(5)**	(5)
	Rest of Canterbury	(2)	**(2)**	(2)
	Rest of NZ	(1)	**(1)**	(1)
	SUM	(10)	**(8)**	(7)
Ongoing	Ashburton	43	**40**	37
	Rest of Canterbury	129	**119**	110
	Rest of NZ	48	**46**	43
	SUM	221	**205**	191
OVERALL	Ashburton	37	**35**	33
	Rest of Canterbury	127	**117**	108
	Rest of NZ	47	**45**	42
	SUM	211	**196**	183

Overall, the ongoing effects are considerably larger than the foregone one-offs. Accounting for the foregone effects reduces the overall VA impacts to between $183m and $211m, with $196m being the mid-point.

The MAR will support ongoing business activity and providing employment opportunities[25]. Using the relationships between economic output and employment, the job numbers associated with flow-on impacts of the MAR are estimated based on 'Modified Employee Counts' (MECs) as a metric of employment. Figure 3-3 illustrates the employment impacts over time.

Starting at a total number of jobs (82), the with-MAR scenario will deliver greater employment opportunities going forward. The difference in employment (without-MAR vs with-MAR) shows that the with MAR scenario will, over the long term, deliver slightly higher employment levels (+16 across NZ and per year). The total number of jobs supported declines over time because only the difference between the two scenarios are shown. The employment levels are also related

Figure 3-2: Employment Impacts (Ashburton)



[25] This assumes that there is sufficient capacity in the local market i.e. there are workers available. Business will use technology and other means to address capacity constraints where labour is not available.

to the cost structures (i.e. moving to different AM-levels[26]) for the farming systems.

3.5 Who-pays considerations

How the MAR is funded is important because it has implications for who-pays. The funding load can be distributed using different philosophies, like a user-pays or benefit-basis, or an approach where the costs are paid for by the parties that create the need for that infrastructure. The specific approach to estimate where the funding load falls is influenced by the overarching philosophy. Often, the funding approach uses a mix of funding tools to address different aspects:

- How to treat any additional capacity that is added in future (e.g. the optional recharge capacity to 180M m^3 in 2028 as per Preliminary Business Case).
- How to link the MAR to future growth/decline in users.
- How to spread risk and the timing of payments (e.g. interest payments).

Estimating the relative distribution of the funding loads, and addressing the above aspects, need to concentrate on:

- Growth projections: this shows the change in users, or parties benefitting, over time by different spatial areas. This is key to evaluating different growth pathways and the financial implications of alternatives.
- Infrastructure expenditure: the total costs (capex) of the project parts, and the timing of the costs, are needed. In effect, this shows the demand for the project as agreed by the representatives. The spending is then linked to (or aligned with) the growth projections to establish the demand factors[27] that drive the requirement for the project.
- Financial Settings. the financial settings are important and need to reflect the range of potential financial settings that could be adopted. This includes the interest charges (e.g. Weighted Average Cost of Capital (WACC)) and financing terms. The CBA includes a finance charge based on a 10-year table loan, at a 5% interest rate that is structured to align with the timelines in the Preliminary Business Case. The financial settings include the temporal distribution. It will be necessary to decide how to treat depreciation. In accounting terms, depreciation allows for an asset to be 'used up' over time and this cost to be reflected in the income statements. The main issues are:
    a. The allocation methodology, by which costs of capital expenditure are apportioned between the current and future communities, including division of expenditure among 'additional capacity', 'improved level of service' and 'renewal'.
    b. The 'Double Dip' and 'Counter Double Dip' issues. The double dip can arise because Growth payers will pay directly for "their" assets through the original payments, but may then also pay (through ongoing payments) a share of costs for capex for existing payers.
    c. The counter or reverse double dip can arise where existing payers contribute more towards the depreciation on new assets for growth, than the incoming payers contribute to depreciation on assets for existing.

[26] The employment estimates are informed by the scale of economic activity and sales is used as a proxy.
[27] Based on the philosophy e.g. user-pays, exacerbator pays or another.

Evaluating different approaches and the relative distribution of funding load must also consider the base[28].

3.6 Conclusion

The analysis shows that the MAR will enable the ongoing farming activity, even with shifts towards advanced mitigation approaches, with higher costs and lower revenues. Relative to the without-MAR, the MAR scenario provides for ongoing activity and higher value land uses.

The non-market values add to the benefit-side of the equation and will lift the BCR further above one (benefits outweigh the costs). There is some uncertainty around the specific input parameters and settings, but the sensitivity analysis showed that the BCR remains reasonably robust at above 1 for most settings. The economic impact assessment shows that the lift in economic activity enabled by the MAR will add to the district and regional economies.

[28] Like, the property value, number of subscribers and so forth.

Appendix 1: Introduction to IO modelling

One of the assets of Input-Output modelling is that the results it provides are easy to interpret and digest, and relatively easy to use once Input-Output tables are available for a particular region. However, IO analysis is not without limitations, despite being widely applied in New Zealand and globally. The most common limitations relate to the historical nature of IO Tables. We have updated the tables using recent data and calibrated these back to official information. We use IO tables derived from the 2006/7 Supply and Use Tables with subsequent updates using partial data from SNZ.

With reference the IO modelling in general, a key assumption is that input structures of all industries (i.e. technical relationships) are fixed. In the real world, however, technical relationships do change over time. These changes are driven by new technologies, relative price shifts, product substitutions and the emergence of new industries. For this reason, IO analysis is generally regarded as suitable for short-run analysis, where economic structures are unlikely to change greatly from the initial snapshot of data used to generate the base IO tables. In addition to the 'fixed structure' assumption, other important assumptions (and limitations) of IO models are:

- Constant return to scale: This means that the same quantity of inputs is needed per unit of output, regardless of the level of production. In other words, if output increases by 10 per cent, input requirements will also increase by 10 per cent.
- No supply constraints: IO assumes there are no restrictions to inputs requirements and assumes there is enough to produce an unlimited product.
- The model is static: No price changes are built in meaning that dynamic feedbacks between price and quantity (e.g. substitution between labour and capital) are not captured.

The following indicators are used to measure economic impact:

- Value added measures all payments to factors of production (land, labour and capital), and excludes all purchases of intermediate inputs. It broadly equates with gross domestic product (GDP) as a measure of economic activity on the national level, and gross regional product on the regional level. Components of value added include compensation of employees (salary and wages), operating surplus (company profits), consumption of fixed capital (depreciation), and subsidies.
- Employment is measured in Modified Employee Count years (MECs). This is the number of full-time and part-time employees as well as working proprietors on an annual basis. This provides a measure of the labour demand associated with the estimate level of economic activity. Note that additional MEC-years do not necessarily require that additional persons be employed. It may mean existing employees or proprietors work longer hours to complete the additional work.

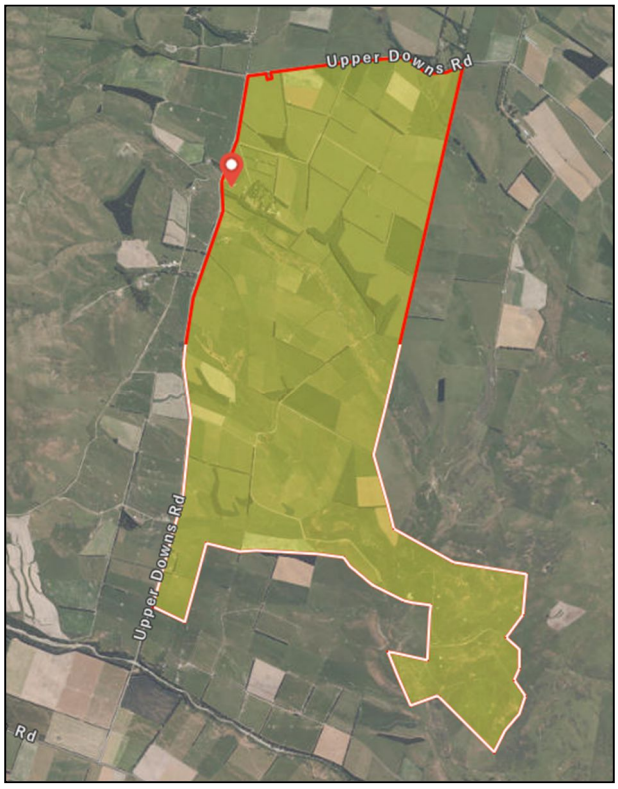
Appendix C – Local Funding Options analysis

Option	Criteria rating*							Comments
	Simple	Transparent	Affordable	Equitable	Incentivises outcomes sought	Future benefits based	**Weighted Average Score**	
A. Community apportionment, land area and well usage farmer charges	1	1	2	2	0	2	**1.30**	• Designed to attribute most cost to those most affected. • Per hectare rate seen as less equitable than valuation based. • Arbitrary apportionment (e.g. High/Low leaching areas) may be contentious.
B. Capital Value (CV) based rate	3	3	2	1	1	1	**1.95**	• Simple and transparent (rate payers familiar with methodology). • Cost only aligned with benefit/causality to the extent that this is reflected in value. • Capital value seen as better reflection of landowner incentives than land value.
C. Community apportionment, CV and well usage farmer charges	0	1	2	2	0	2	**1.10**	• Designed to attribute most cost to those most affected. • Valuation based rate seen as more equitable than per hectare based. • Arbitrary apportionment (e.g. High/Low leaching areas) may contentious.
D. Land Value based rate	3	3	2	1	0	0	**1.65**	• Simple, but capital value seen as better reflection of landowner incentives. • Cost only aligned with benefit/causality to the extent that this is reflected in value.
E. Nitrogen Cap and Trade - Current	**Not currently feasible**							• Rewards good farming practice • Relatively complex and requires more administration at Trust/ECan and farm level • OVERSEER® is not suitable to monitor performance • Potential for "gaming"
F. Nitrogen Cap and Trade - if appropriate tools available	1	2	2	3	3	3	**2.25**	• Rewards good farming practice • Relatively complex and requires more administration (at trust/ECan and farm level) • Transparent if tools were available
Weighting	20%	20%	15%	15%	15%	15%	**100%**	

Appendix D – Examples of rating impacts

UPPER CATCHMENT EXAMPLES

Property Location	**518 Upper Downs Road, Surrey Hills**					
Catchment Zone	Upper Catchment		as per ZIP Adddendum			
MAR Zone (Suggested)	**Upper Catchment**					
Valuation						
Capital Value	15,610,000					
Land Value	14,000,000					
Area (ha)	787					
CV/ha	$19,825					
Current Rates			Future Rates (Year 6)			
District	$14,456.72			Uniform	Differential	
Regional	$7,119.53				1	2
Total	$21,576.25		Total	$27,108.53	$22,991.85	$23,082.00
per ha	*$27.40*		*per ha*	*$34.43*	*$29.20*	*$29.32*
per $000 CV	*$1.3822*		*per $000 CV*	*$1.7366*	*$1.4729*	*$1.4787*
Uniform Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$1,579.39	$2,844.31	$2,949.72	$5,374.17	$5,479.58	$5,532.28
Increase over current	7.32%	13.18%	13.67%	24.91%	25.40%	25.64%
Differential Rate 1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$404.13	$727.80	$754.78	$1,375.14	$1,402.12	$1,415.60
Increase over current	1.87%	3.37%	3.50%	6.37%	6.50%	6.56%
Differential Rate 2	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$429.87	$774.15	$802.84	$1,462.72	$1,491.41	$1,505.75
Increase over current	1.99%	3.59%	3.72%	6.78%	6.91%	6.98%



Property Location	**405 Upper Downs Road, Surrey Hills**					
Catchment Zone	Upper Catchment					
MAR Zone (Suggested)	**Upper Catchment**					
Valuation						
Capital Value	14,620,000					
Land Value	12,400,000					
Area (ha)	1,466					
CV/ha	$9,976					
Current Rates			Future Rates (Year 6)			
District	$13,059.04			Uniform	Differential	
Regional	$6,686.76				1	2
Total	$19,745.80		Total	$24,927.22	$21,071.62	$21,156.06
per ha	*$13.47*		*per ha*	*$17.01*	*$14.38*	*$14.44*
per $000 CV	*$1.3506*		*per $000 CV*	*$1.7050*	*$1.4413*	*$1.4471*
Uniform Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$1,479.22	$2,663.92	$2,762.65	$5,033.33	$5,132.06	$5,181.42
Increase over current	6.86%	12.35%	12.80%	23.33%	23.79%	24.01%
Differential Rate 1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$378.50	$681.65	$706.91	$1,287.93	$1,313.19	$1,325.82
Increase over current	1.75%	3.16%	3.28%	5.97%	6.09%	6.14%
Differential Rate 2	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$402.61	$725.06	$751.93	$1,369.95	$1,396.82	$1,410.26
Increase over current	1.87%	3.36%	3.48%	6.35%	6.47%	6.54%

LOWER CATCHMENT (A) EXAMPLES

Property Location	**1509 Maronan Valetta Road, Valetta**					
Catchment Zone	Lower Catchment					
MAR Zone (Suggested)	**Lower Catchment - A**					
Valuation						
Capital Value	13,200,000					
Land Value	11,500,000					
Area (ha)	347					
CV/ha	$38,052					
Current Rates			Future Rates (Year 6)			
District	$14,580.28			Uniform	Differential	
Regional	$5,769.19				1	2
Total	$20,349.47		Total	$25,027.64	$25,137.67	$25,442.60
per ha	*$58.66*		*per ha*	*$72.15*	*$72.47*	*$73.34*
per $000 CV	*$1.5416*		*per $000 CV*	*$1.8960*	*$1.9044*	*$1.9275*
Uniform Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$1,335.55	$2,405.18	$2,494.32	$4,544.46	$4,633.60	$4,678.17
Increase over current	6.19%	11.15%	11.56%	21.06%	21.48%	21.68%
Differential Rate 1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$1,366.96	$2,461.76	$2,552.99	$4,651.35	$4,742.58	$4,788.20
Increase over current	6.34%	11.41%	11.83%	21.56%	21.98%	22.19%
Differential Rate 2	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$1,454.01	$2,618.53	$2,715.58	$4,947.57	$5,044.61	$5,093.13
Increase over current	6.74%	12.14%	12.59%	22.93%	23.38%	23.61%

This property has a relatively high current rate due to a $3,268 p.a. stockwater race charge

Property Location	**1491 Hinds Arundel Road, Ealing**					
Catchment Zone	Lower Catchment					
MAR Zone (Suggested)	**Lower Catchment - A**					
Valuation						
Capital Value	14,000,000					
Land Value	11,700,000					
Area (ha)	349					
CV/ha	$40,111					
Current Rates			Future Rates (Year 6)			
District	$12,555.60			Uniform	Differential	
Regional	$6,093.67				1	2
Total	$18,649.27		Total	$23,610.96	$23,727.66	$24,051.08
per ha	*$53.43*		*per ha*	*$67.65*	*$67.98*	*$68.91*
per $000 CV	*$1.3321*		*per $000 CV*	*$1.6865*	*$1.6948*	*$1.7179*
Uniform Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$1,416.49	$2,550.95	$2,645.49	$4,819.88	$4,914.42	$4,961.69
Increase over current	6.57%	11.82%	12.26%	22.34%	22.78%	23.00%
Differential Rate 1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$1,449.81	$2,610.95	$2,707.72	$4,933.25	$5,030.01	$5,078.39
Increase over current	6.72%	12.10%	12.55%	22.86%	23.31%	23.54%
Differential Rate 2	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$1,542.14	$2,777.23	$2,880.16	$5,247.42	$5,350.35	$5,401.81
Increase over current	7.15%	12.87%	13.35%	24.32%	24.80%	25.04%

Property Location	**500 Coldstream Road, Hinds**
Catchment Zone	Lower Catchment
MAR Zone (Suggested)	**Lower Catchment - A**

Valuation

Capital Value	15,170,000
Land Value	12,400,000
Area (ha)	313
CV/ha	$48,435

Current Rates		Future Rates (Year 6)			
			Uniform	Differential	
				1	2
District	$14,099.44				
Regional	$6,579.74				
Total	$20,679.18	Total	$26,055.53	$26,181.98	$26,532.43
per ha	*$66.02*	*per ha*	*$83.19*	*$83.59*	*$84.71*
per $000 CV	*$1.3632*	*per $000 CV*	*$1.7176*	*$1.7259*	*$1.7490*

Uniform Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$1,534.87	$2,764.14	$2,866.58	$5,222.69	$5,325.13	$5,376.35
Increase over current	7.11%	12.81%	13.29%	24.21%	24.68%	24.92%

Differential Rate 1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$1,570.97	$2,829.16	$2,934.00	$5,345.53	$5,450.38	$5,502.80
Increase over current	7.28%	13.11%	13.60%	24.78%	25.26%	25.50%

Differential Rate 2	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$1,671.02	$3,009.33	$3,120.86	$5,685.96	$5,797.48	$5,853.25
Increase over current	7.74%	13.95%	14.46%	26.35%	26.87%	27.13%

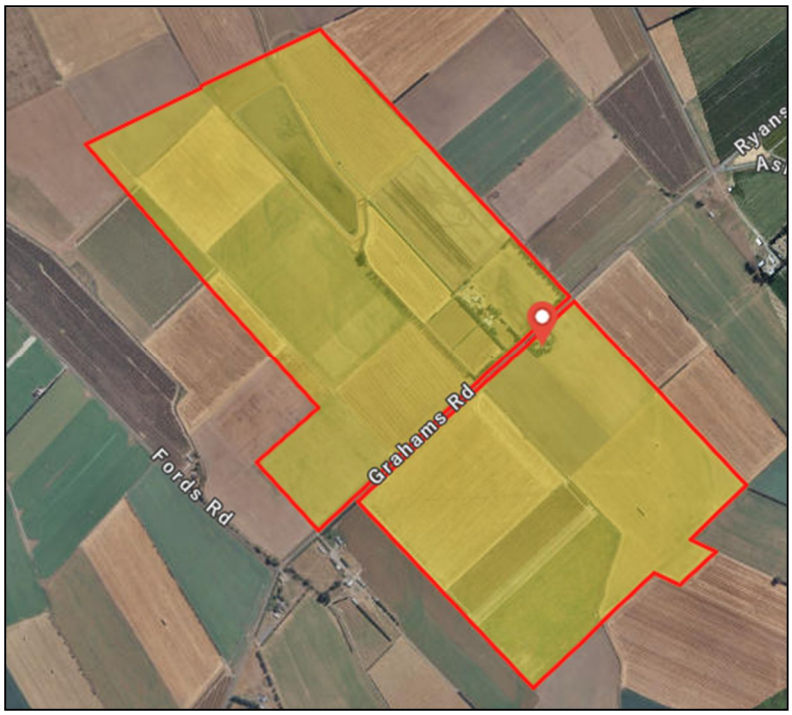
LOWER CATCHMENT (B – DRAINAGE AREA) EXAMPLES

Property Location	**315 Mclennons Road, Eiffelton**					
Catchment Zone	Lower Catchment					
MAR Zone (Suggested)	**Lower Catchment - B - Hinds Drainage Area**					
Valuation						
Capital Value	7,960,000					
Land Value	7,200,000					
Area (ha)	192					
CV/ha	$41,373					
Current Rates			Future Rates (Year 6)			
District	$7,057.32			Uniform	Differential	
Regional	$6,092.85				1	2
Total	$13,150.17		Total	$15,971.25	$16,037.60	$15,453.66
per ha	*$68.35*		*per ha*	*$83.01*	*$83.36*	*$80.32*
per $000 CV	*$1.6520*		*per $000 CV*	*$2.0064*	*$2.0148*	*$1.9414*
Uniform Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$805.38	$1,450.40	$1,504.15	$2,740.45	$2,794.20	$2,821.08
Increase over current	3.73%	6.72%	6.97%	12.70%	12.95%	13.07%
Differential Rate 1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$824.32	$1,484.51	$1,539.53	$2,804.91	$2,859.92	$2,887.43
Increase over current	3.82%	6.88%	7.14%	13.00%	13.25%	13.38%
Differential Rate 2	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$657.61	$1,184.29	$1,228.18	$2,237.65	$2,281.54	$2,303.49
Increase over current	3.05%	5.49%	5.69%	10.37%	10.57%	10.68%

Regional Council rates of $2,595p.a. are currently included for Hinds Drainage (A) and Lower Hinds Catchment Works.

Property Location	**1472 Grahams Road**					
Catchment Zone	Lower Catchment					
MAR Zone (Suggested)	**Lower Catchment - B - Hinds Drainage Area**					
Valuation						
Capital Value	8,500,000					
Land Value	6,900,000					
Area (ha)	188					
CV/ha	$45,292					
Current Rates			Future Rates (Year 6)			
District	$7,495.80			Uniform	Differential	
Regional	$5,071.09				1	2
Total	$12,566.89		Total	$15,579.34	$15,650.20	$15,026.64
per ha	*$66.96*		*per ha*	*$83.01*	*$83.39*	*$80.07*
per $000 CV	*$1.4785*		*per $000 CV*	*$1.8329*	*$1.8412*	*$1.7678*
Uniform Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$860.01	$1,548.79	$1,606.19	$2,926.36	$2,983.76	$3,012.45
Increase over current	3.99%	7.18%	7.44%	13.56%	13.83%	13.96%
Differential Rate 1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$880.24	$1,585.22	$1,643.97	$2,995.19	$3,053.94	$3,083.31
Increase over current	4.08%	7.35%	7.62%	13.88%	14.15%	14.29%
Differential Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual MAR Rate	$702.22	$1,264.63	$1,311.50	$2,389.45	$2,436.32	$2,459.75
Increase over current	3.25%	5.86%	6.08%	11.07%	11.29%	11.40%

Regional Council rates of $1,463.48p.a. are currently included for Hinds Drainage (B) and Ashburton River Catchment Works.



Appendix E – Governance lessons learnt

Objectives are more likely to be achieved when governance gives form to a strong vision that is specified clearly in bespoke legislation or a trust deed

Collectively, the case studies demonstrate that successful examples operate under a legal document that defines, in clear language, their objects, functions and modus operandi: either an Act of Parliament (Te Kōhaka o Tūhaitara Trust, Arts Centre of Christchurch Trust, Waikato River Authority and Centennial Parklands) or a Deed of Trust (Queenstown Trails Trust and Cornwall Park Trust). These founding documents secure in perpetuity both the vision and the mandate for the governance entity; and align partners' strategic plans to achieve that vision.

Clear articulation of the objectives of the entity in a legal document is a necessary condition for a successful organisation, but on its own, it is not a sufficient condition.

Since form follows function, the entities studied understandably vary in shape and include different kinds of council-controlled organisations under the Local Government Act 2002, specific entities set up under legislation, and charitable trusts.

From the multiple public and community stakeholders in the Queenstown Trails Trust, the co-governance models of Te Kōhaka o Tūhaitara Trust, the Waikato River Authority and Maungakiekie/One Tree Hill, among other examples, to the Central Plains Water Trust's partnership with neighbouring Councils, the case studies show that projects most akin to MAR established partnerships with mana whenua and with multiple groups.

1. Co-governance with mana whenua is a proven and essential model in the post-Treaty settlement era

Several case studies exhibit effective co-governance structures where the Treaty partnership, which is given expression in Treaty settlements between the Crown and iwi (tribes) across the country since the 1990s, is manifested through structural arrangements. Wellington's Whaitua Te Whanganui-a-Tara Committee and the Waikato River Authority are examples of how co-governance can work patiently and how the values and principles of mana whenua are integrated into the management of an asset from which the whole community benefits.

These cases also show how locally developed principles that give effect to Māori philosophies and concerns suggest a model for applying Ngāi Tahu principles for a holistic approach to environmental resource management.

2. There is a pattern of governance whereby entities select members with a diverse range of skills and experience rather than on the basis of representation. The process for appointment is defined and transparent.

It is noteworthy that the Arts Centre of Christchurch Trust moved from a representative to a skills-based Trust Board after the earthquakes of 2010-2011 with the process for selection set out in an Act. This change arose from a stalemate about the future direction of the Trust and conflicts of interest. The Queenstown Trails Trust offers another example where appointments to the Board of Trustees are based on the diversity, skills and networks of governance members.

3. Sustained support from local or central government independent of changing political priorities

Several case studies demonstrate the important role that local or central government played in the success of these projects, especially during the early stages. A long-term and sustained funding stream was essential for the Queenstown Trails Trust, Te Kōhaka o Tūhaitara Trust and others. Without such seed and operational funding, these cases would have been unable to achieve their set objectives.

Even the privately-endowed Cornwall Park Trust – the oldest Trust examined –suffered from the withdrawal of promised government support in its foundational phase. Likewise, the Hamilton River Plan lies dormant as a result of changing political priorities.

While Central Plains Water Limited received grants from local and central government in the establishment phase, it is now independent of government funding. The Central Plains Water Trust relies on funding from the company and from continued interest from local government through a joint committee of Christchurch City Council and Selwyn District Council, which, for example, appoints trustees.

As initial landowner and funders, Environment Canterbury and Ashburton District Council are likely to play a key role, including in governance, in the project's foreseeable future. A central question will concern the form and durability of each council's commitment. Attraction of other funding sources will depend on confidence in the durability of this commitment.

4. Accountability and responsiveness to the community and the Council

Community representation and engagement was expected and demonstrated in the development of the ZIPA. Such representation and ongoing engagement are features of some case studies. One example is the Community Committee mandated under the Act that established the Centennial Parklands Trust. Similarly, the community involvement achieved by Te Kōhaka o Tūhaitara Trust through the Friends of Tūhaitara Park shows how a dedicated focus can enhance both levels of participation and accountability.

Accountability to the community and to stakeholders may be achieved through a range of tools such as Statements of Intent for council-controlled organisations, long-term strategic plans that are subject to the sponsoring agency's approval, and through annual reports and annual general meetings.

Given the identified pattern of expected regular, public accountability, careful thought will be necessary about how to meet that expectation in the governance of the scheme without stifling the governance entity's role to make decisions about how best to balance financial constraints, commercial needs and environmental outcomes.

5. Balancing broader environmental and social goals

Most of the entities studied were established to achieve broader environmental and social goals. Thereby, they develop or maintain public assets for the public good, in perpetuity, but draw on a broad range of private, public and philanthropic sources of funding. Such goals oblige governance entities to operate within the broader context of their city or region.

An example is the Central Plains Water Trust which is required to have 'an appropriate balance of the benefits of agricultural development with the enhancement of the ecological, social and recreational values in the Central Plains area.' In addition, the Trust acknowledges that the effects of the scheme go beyond the scheme boundaries and has established a Te Waihora Environmental Management Fund, Te Waihora is outside the scheme area but functionally connected with it.

These case studies, however, also show how long-term planning as well as routine operations and maintenance may be constrained by financial resources. A sober warning is offered by the case study of Wellington Waterfront where the initial objective to self-finance the delivery of public assets and space – that were acknowledged to be of national importance – through returns from commercial development imposed an emphasis on financial return at the expense of the desired public benefits.

This approach generated public protest and led to a new framework for the governance entity as well as a significant injection of ratepayer funding. Striking the right balance between such competing tensions is a core role of governance; and a lesson learnt from Wellington's waterfront experience is that the sponsoring entity needs to be confident that this balance can be achieved.

6. Innovative funding approaches are critical to realise a bold vision; and this suggests that it is advisable for the governance entity to be at arm's length from central and local government.

Just as the case studies demonstrate how there are multiple ways to achieve similar ends, they also reveal that the most successful entities are self-financing at least to some extent by various means. Positioned at arm's length from local government, the Arts Centre of Christchurch Trust and Centennial Parklands Trust have been able to access funding and attract investment not readily available to local government, and thus strike an appropriate balance between commercial revenue and public benefit.

In the case of Central Plains Water, independence was secured through a two-tiered structure that separates the public sector-sponsored Central Plains Water Trust from Central Plains Water Limited, a commercial company owned by the Trust that is charged with the irrigation scheme's development and operation. This example provides evidence of how a two-tiered arrangement distinguishes responsibilities. A local government, mana whenua and community interests are exercised through the Trust while the company has the power to operate commercially.

In contrast, the Mackenzie Country Trust, Hamilton River Plan and Whaitua Te Whanganui-a-Tara Committee provide evidence of inability to employ resources to further their mandate. Notably, the Hamilton City Plan and Te Kōhaka o Tūhaitara Trust are reliant on ratepayer funding, which leaves them exposed to the inherent uncertainties of the political process.

There is a tension between having an entity at arm's length from local government but dependent on its continued support and funding. In such cases, a council-controlled organisation with an innovative structure that complies with the requirements of the Local Government Act may be able to resolve this.

7. There needs to be flexibility in the governance model to allow the form of governance and implementation plans to adapt over time.

The different experiences of Wellington Waterfront and the Arts Centre of Christchurch Trust show that the appropriate structure will likely change over time as the development of the area matures and the vision for the river corridor is realised.

Flexibility to adapt to changing circumstances through the life cycle of the scheme is essential to enable the governance entity to remain fit for purpose. Adaptation will be shaped by, for example, new approaches to managing catchments, climate change and rising sea levels, change in surrounding communities, and legislative and policy changes.