REGIONAL FORUM

People Water and Land – *Te Mana o te Tangata, te Wai, te Whenua*

Regional Forum Recommendations Report to Environment Southland and Te Ao Mārama Inc. Board

Achieving the Community's Aspirations for Freshwater

June 2022

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Achieving the Community's Aspirations for Freshwater

Ki uta, ki tai – mai i te maunga ki te moana – he here tā tēnā, tā tēnā, tā tēna

Ki uta ki tai, from the mountains to the sea - everyone has a part to play

FOREWORD

Murihiku Southland's land use, both urban and rural, has changed significantly during the past 150 years. Across much of Southland, drainage channels have been dug, wetlands have been drained and forests removed, with many rivers straightened or confined within stop-banks to protect growing townships and developed land. More recently, land use has intensified with increasing demand for irrigation and other water supplies. An increase in population and a rich agricultural landscape has resulted which continues to underpin Southland's economic prosperity. However, this has resulted in significant degradation to our freshwater. The current needs of Te Mana o te Wai within Southland are significant.

Following a three-year journey of exploration, learning, consultation, and discussion, this report delivers the key findings and recommendations of Murihiku Southland's Regional Forum to return mauri and hauora to the freshwaters in ways that that align with the values and objectives of Southland's community.

Collectively the Regional Forum members come from all corners of Murihiku Southland and represent a wide cross-section of the Southland community. We are urban dwellers, landowners, business owners, industry and community workers, scientists, tourism operators, and farmers; we are fishermen and women, hunters, swimmers, trampers, photographers, and boaties; we are parents, grandparents, children, and mana whenua; we live, work, raise families, and holiday in Southland. We all connect with this region and recognise that we all connect with each other.

The Regional Forum recognises that changes throughout the catchments have a cumulative effect on our downstream environments such as estuaries and coastal lagoons. It is clear that the challenge is significant, and it will take an all-of-region approach to address Southland's freshwater issues, requiring whole-of-catchment responses supported by a ki uta ki tai (mountains-to-the-sea) perspective.

The Regional Forum's philosophy for sharing the future use of freshwater resources in Murihiku Southland is based on respect for Southlanders and their love of this region, the management of risk (economic, social, cultural, and environmental) across the region, the benefits of collaboration in response to the challenge of more effectively supporting Te Mana o te Wai, and the opportunity for learning and new knowledge.

The gap between the state of our freshwaters now, and where they need to be to sustain ecosystem health and resilience is large. This cannot be overstated. Current and emerging good management practices will not be enough. This report is an integrated suite of measures to create a 'system reset' – a very different way of managing Southland's freshwater resources in the future. This system does not represent business as usual. New ways of thinking, new ways of acting, and new ways of collaborating will be needed in order to secure the freshwater our communities and businesses depend on. Collaborative effort does not demand equal input from every user. Those responsible for activities with a greater environmental impact on freshwater can expect to make a greater contribution towards restoration.

The Regional Forum has recognised the overarching importance of Te Tiriti o Waitangi, including the Treaty principals of partnership, participation, and active protection. The suite of recommendations provided in this

report are intended to give effect to the Treaty principles. We have a genuine belief that within Southland, there is the capacity, given attention and time, for a future partnership of excellence between mana whenua and the Crown, reflecting mutual respect for the mana of each partner. The ongoing development and the embracing of co-governance as a reflection of Treaty Partnership is fundamental to these recommendations.

Everyone has a different relationship to water, but as a community we require a new way of thinking about land and water management practices. Key to our recommendations is the concept of integrated catchment management guided by hauora principals (focussing on the resilience of the waterbody) and co-governance, and through the introduction of hauora management practices at a regional, freshwater management unit (FMU), catchment, and landowner level. At an FMU level, Hauora Plans can be envisaged as a korowai, or a protective cloak, that supports active management and protection of our freshwater. Once established this approach is considered empowering, as it enables something not currently possible for any Southland landowner – management of activities in a manner that responds directly to catchment specific objectives reflecting the environmental risks and opportunities unique and specific to each landholding, catchment and FMU.

An accumulation of many positive actions across the region, ki uta ki tai, will return Southland's freshwater to a state of hauora. A collaborative focus on continual improvement and an investment in the future of Southland, will return the mauri to our waters and return mana to our freshwaters, and the Southland community.

Along with our recommendations, you will also find within this report the foundations to our approach, the concepts, modelling, and the science that shaped our advice, as well as comment on our reflections regarding uncertainty, affordability, funding, and timeframes.

We are proud to present this package of advice that represents the consensus of the Regional Forum members. Regional Forum members that were not able to complete the journey with us are acknowledged. Their unique experiences, energy and time has been invaluable and is hopefully realised in this final report. Ngā mihi nui.

Mo tātou, a, mo ka uri, ā muri ake nei.

For us and our children after us.

Fiona Smith

Regional Forum Chair

Phil Morrison

Regional Forum Deputy-Chair

Regional Forum Members (June 2022)

Sean Bragg	Paul Marshall	Darren Rewi
David Diprose	Phil Morrison	Michelle Roberts
Cain Duncan	Lisa Pearson	Hayden Slee
Kelsi Hayes	Estelle Pera-Leask	Fiona Smith
Bernadette Hunt	Ewen Pirie	Vaughan Templeton

PART ONE - CONTEXT

Introduction

This report delivers the key findings and recommendations of Murihiku Southland's Regional Forum following a three-year journey of exploration, learning, consultation, and discussion. The most significant aspect of this report is the suite of recommendations which reflect an integrated package intended to deliver on the following community vision for freshwater.

> Waterways are respected and managed in an integrated way, ki uta ki tai, that enables a thriving environment, support for our taonga species, and a healthy and prosperous community. People understand and practice their role as kaitiaki and guardians for future generations and enjoy access to waterways for recreation and mahinga kai.

In articulating the recommendations in this report, every attempt has been made to minimise ambiguity and to outline the supporting intent for each recommendation. Yet, acknowledging the uncertainty associated with management of freshwater resources along with the potential for external events that may influence outcomes, the Regional Forum has also tried its best to avoid being unhelpfully prescriptive. This has been an effort in finding an appropriate balance between providing sufficient detail while avoiding rigid, authoritarian guidance that may hinder creativity and innovation in response to the central challenge of managing the region's freshwaters.

Where prescriptive detail is provided, this reflects the Regional Forum's understanding of essential action that must be undertaken to support Te Mana o Te Wai and deliver on freshwater objectives. Where detail is absent, the expectation is that Environment Southland and Te Ao Mārama Inc will continue to apply a co-design approach to implementation. By this we mean mindfully and deliberately involving stakeholders to the greatest practical degree and applying the resource philosophy outlined below.

Regional Forum Allocation Philosophy

The Regional Forum's philosophy for sharing the use of freshwater resources in Murihiku Southland in the future is based on respect for Southlanders and their love of this region, the management of risk across the region, the benefits of collaboration in response to the challenge of more effectively supporting Te Mana o te Wai, and the opportunity for learning and new knowledge.

Respect is reflected in the Regional Forum's intent to transition to a model characterised by increased mutual trust, collaboration, consensus, and community engagement – an approach which affords people the opportunity to increasingly work together to find innovative ways to do the right thing for the water, the land, and the ecology that lives within it. The term "collaborative approach" used here can be considered short-hand for a catchment-centred approach that provides for individual responsibility and flexibility within a framework of increased community collaboration.

Respect is built on a strong foundation of co-governance with mana whenua reflecting Ngāi Tahu principles, particularly ki uta ki tai and kaitiakitanga, and the responsibility of local communities to step up, engage, and support positive freshwater outcomes through Freshwater Management Unit (FMU) hauora plans.

Management of risk is central to freshwater allocation, and it recognises the diversity, connectedness, and complexities of Southland's unique landscapes, as well as the diverse land uses activities that take place within them. The focus on risk seeks to match a broad range of allocation methods (actions and mechanisms) with people, place, and pace. Addressing risk enables the use of risk matrices to guide activities. More broadly, risk recognises the impending challenge of climate change, along with the external influences in the geopolitical environment.

Collaboration is seen as essential to designing and implementing "Southland solutions for Southland challenges" and avoiding 'cookie-cutter' solutions imposed from beyond the region. This is not to suggest that freshwater degradation is unique to Southland nor that Southland communities cannot learn from experiences elsewhere, but rather that there are a number of regionally distinct influences that demand consideration in managing freshwater resources. For the Southland region, actions that are individual, independent, and isolated in character seem very unlikely to achieve the defined objectives for freshwater within required timeframes. In the face of constrained resources, talent, and time, collaboration and coordination amongst the stakeholders and communities of Southland offers the greatest chance of marshalling and leveraging regional energy and resources for best impact.

A collaborative effort with commitment from all also recognises the cumulative effect on freshwater by all users, from the top to the bottom of catchments. Although the largest gap between values for freshwater and current state usually exists in the lower end of catchments, it is only through collaborative effort that cumulative gains throughout entire catchments will be realised. Collaborative effort does not, however, demand equal input from every user. The principle of equity (or fairness) suggests that those responsible for a greater environmental impact on freshwater will be expected to make a greater contribution towards restoring the health and wellbeing of waterbodies. Thus, there is an expected correlation between the level of risk to waterbodies from particular land use activities and landscape settings, and the level of contribution to waterbody health expected from those resource users.

Uncertainty is an inevitable feature of any challenging venture, yet also signals the opportunity for pursuit of learning and new knowledge. It is expected that the approach promoted by the Regional Forum will trigger opportunity for the development of new knowledge, insights and understanding, bringing together western scientific approaches and mātauranga from Ngāi Tahu to accelerate learning. It is the aspiration of the Regional Forum that ways are found to efficiently share what is learned by communities, and that Southlanders approach this learning opportunity with open minds and enthusiasm. This expectation of learning and growth of knowledge also demands that periodic reviews of hauora-led integrated catchment management arrangements are scheduled and enacted. As our knowledge improves it is important to preserve the flexibility and adaptability to act differently for improved hauora outcomes.

The Regional Forum's package of recommendations offers a coherent, integrated set of methods for regional freshwater management. However, it is not possible to anticipate and provide all of the policy advice that will be needed for the next revision of the proposed Southland Water and Land Plan and subsequent planning processes over the next generation (25 years). Where there is silence in this report, the Regional Forum expects this allocation philosophy will continue to provide direction for the future use of our freshwater resources.

Beyond Limits and Methods

From the community engagement undertaken by the Regional Forum, it is evident that there has been a strong interest in the limits and associated methods that will feature within the next Land and Water Plan change. While limits and methods are included within the Regional Forum's recommendations, this is perhaps not the aspect that will deliver the greatest impact to Southland's freshwaters and environment. What this report represents, when all recommendations are considered as an integrated suite of measures, is a system reset – a very different way of managing Southland's freshwater resources in the future.

This system reset, or transition to a more integrated form of catchment management, is considered a necessary response to future-proof our regional resource management systems for the challenges of the 21st century. This system reset does not represent 'business as usual'. New ways of thinking, new ways of acting, and new ways of collaborating will be needed in order to secure the freshwater our communities and businesses depend on for their livelihood. The decisive outcomes that secure the future of that water will not take place in the lakes, rivers, aquifers, estuaries, and wetlands of Southland, but rather in the minds of Southlanders. The very way we think about our freshwaters, and our land uses that influence those waters, will need to change. We simply cannot continue to consider water as an input of production, a commodity, or

an ample un-ending, free resource which we need not concern ourselves with. As it turns out, our waters are far more valuable, vulnerable, and scarce than what many might have previously considered them to be. Further, we now better understand the direct impacts of our land uses on our water. A new-found degree of reverence and respect for our freshwater is called for. We must reconsider and redefine our individual and collective relationships with our freshwaters, ideally in ways that promote a more nurturing and caring approach to how we engage with our water, and in the process, each other. In turn, this might be expected to foster new ways of collectively and collaboratively behaving as we manage our way forward into the middle of the 21st Century and beyond.

Background

Southland's People Water and Land Programme is a partnership between Environment Southland and Te Ao Mārama Inc. (the environmental arm of Ngāi Tahu ki Murihiku). The programme consists of three core workstreams:

1. On-the-Ground Action focusing on providing practical steps to improve our water and land.
2. Values and Objectives engaging Southlanders to define relevant values and objectives.
3. The Regional Forum a temporary community advisory body, advising Governance Group on the options available to achieve the community's values and objectives for freshwater.

Established in April 2019, and undertaking their work in three distinct phases, the Regional Forum's deliberations have been guided by the values and draft objectives defined within the complementary Values and Objectives workstream.

Regional Forum Terms of Reference

As an advisory body, the primary purpose of the Regional Forum is to consider and advise Governance (made up of Regional Council and Te Ao Mārama Board representatives) on the options available to achieve the community's values and objectives for freshwater by considering the impacts, timing, targets, limits[1] (e.g., for water quality and quantity), methods, and policy context.

The Regional Forum's terms of reference directed that the Regional Forum would provide recommendations that consist of:

> "An agreed programme, to update the Southland Water and Land Plan, which will implement the National Policy Statement – Freshwater Management (NPS-FM). The programme will include regulatory and non-regulatory methods to achieve the community's values and objectives for freshwater."

The Regional Forum's terms of reference further directed that in developing the recommendations, the Regional Forum will:

a. "Review and develop proposed methods that are the most efficient, effective, and appropriate, to address the adverse effects of point and non-point discharges to land and water in Southland.
b. Focus on improving water quality over time, taking into account all the influences on it.
c. Consider and recommend water quantity allocation regimes for surface and groundwater systems.
d. Understand the wide range of values associated with Southland's waterbodies, including how values vary in different parts of the region.

[1] The National Policy Statement for Freshwater Management 2020 offers the following interpretation of **limits**:

1.1 **Limit** means either a limit on resource use or a take limit.
2.1 **Limit on resource use** means the maximum amount of a resource use that is permissible while still achieving a relevant target attribute state.
3.1 **Take limit** means a limit on the amount of water that can be taken from an FMU or part of an FMU.

e. Understand the national frameworks and how they potentially impact on the Regional Forum recommendations.
f. Understand and consider the impacts that are anticipated from the recommendations developed by the Regional Forum.
g. Take a strategic approach in considering the future needs of Southlanders and the legacy for generations to come."

Community Vision for Freshwater

From Environment Southland's values and objectives workstream, the Regional Forum developed a community vision to guide analysis of potential options. The following vision was based on conversations with the community, and the community values (including those of Ngāi Tahu ki Murihiku) identified through the two-year Values and Objectives workstream within the Southland People Water and Land Programme.

> "Waterways are respected and managed in an integrated way, ki uta ki tai, that enables a thriving environment, support for our taonga species, and a healthy and prosperous community. People understand and practice their role as kaitiaki and guardians for future generations and enjoy access to waterways for recreation and mahinga kai."

Regional Forum Assessment Criteria

The Regional Forum anticipated that in framing its package of advice, it would be necessary to objectively evaluate and select methods from a wide range of methods considered as potentially suitable for managing Southland's freshwater resources. Thus, at the outset of Phase Three, the Regional Forum defined a set of assessment criteria to support objective evaluation. In broad terms, the assessment criteria prompted evaluation of each potential method by asking:

Does it consider the principles of the Treaty of Waitangi?
Is it effective?
Is it efficient?
How fair is it?

Each of these four assessment criteria questions was supplemented by a set of subordinate questions designed to prompt a more nuanced exploration of each criterion. The complete set of Assessment Criteria questions is listed in Appendix A: Regional Forum Assessment Criteria.

Regional Forum Policy Questions

The Regional Forum was guided by a set of policy questions, (provided by Environment Southland policy staff) in order to assist in ensuring their deliberations were sufficiently comprehensive and thorough to support the design of regional policy necessary for subsequent plan change to the proposed Southland Water and Land Plan. The complete set of policy questions, with summary responses, is listed in Appendix B: Regional Forum Policy Questions.

Treaty of Waitangi / Te Tiriti o Waitangi

In respect of continuing efforts to manage regional natural resources, the Regional Forum recognises the overarching importance of the Treaty of Waitangi, including the Treaty principles of partnership, participation, and active protection. The Regional Forum also recognises the Ngāi Tahu Claims Settlement Act 1998 and the Crown statutory recognition of Ngāi Tahu's special relationship (cultural, spiritual, historical, and traditional association) with particular lands, waters, and species within Murihiku Southland.

Regarding partnerships, it is accepted that to date within our national history the partnership between Crown and mana whenua has not been done well. Despite this experience, the Regional Forum has a genuine belief that within Southland, we have the capacity for a future partnership not only to be 'done well' but, given attention and time, to represent a 'partnership of excellence', reflecting mutual respect for the mana of each partner.

This transition to new and uniquely Southland arrangements for partnership with Ngāi Tahu ki Murihiku in respect of freshwater management should not be considered part of a zero-sum game - one where one partner

must forsake influence in order for another to increase influence. Rather, it should be considered as an inclusive, expansive, win-win situation with the potential to extend the influence and mana of both partners, while generating opportunities previously unattainable to both.

Thus, the Regional Forum recognises the opportunity to give greater effect, substance, and meaning to the Treaty principles of partnership, participation, and active protection at a regional and local level, in ways not previously experienced, via the arrangements established for managing freshwater resources of Murihiku Southland in future. Rather than simply taking the Treaty principles into account, the suite of recommendations provided in this report are intended to give effect to the Treaty principles.

Accordingly, the Regional Forum expects exploration of regionally appropriate co-governance of freshwater resources, likely enabled by, and centred on, Freshwater Management Unit (FMU) Hauora Plans (discussed in greater detail later in this report).

Concepts Foundational to The Regional Forum's Advice

As tangata whenua of Murihiku, Ngāi Tahu share a strong connection to the natural environment. In respect of ongoing management of Southland's freshwater resources, the Regional Forum recognises the significance and importance to Ngāi Tahu ki Murihiku of the following concepts and considerations from Te Ao Māori.

Te Mana o Te Wai

A 2019 Kāhui Wai Māori report to the Minister for the Environment summarised important elements of the concept of Te Mana o Te Wai as follows:

> "Te Mana o te Wai is the national korowai that frames and informs the trajectory for immediate and future policy development, and regional freshwater planning. It is a concept that encompasses the integrated and holistic health and well-being of waters as a continuum from the mountains to the sea."
>
> "Te Mana o te Wai is about a hierarchy of obligations:
>
> - the first obligation is to protect the health and mauri of the water;
> - the second obligation is to provide for essential human health needs, such as drinking water;
> - the third obligation is to enable other consumptive use, provided that such use does not adversely impact the mauri of freshwater."[2]

More recently**,** the National Policy Statement for Freshwater Management 2020 emphasised Te Mana o te Wai as the fundamental concept for management of national freshwater resources, reaffirming the importance of this hierarchy of obligations.

> "Te Mana o te Wai is a concept that refers to the fundamental importance of water and recognises that protecting the health of freshwater protects the health and well-being of the wider environment. It protects the mauri of the wai. Te Mana o te Wai is about restoring and preserving the balance between the water, the wider environment, and the community."[3]

Mauri

Mauri can be translated to mean 'life force' - the life principle or living essence contained in all things, animate and inanimate. The mauri of the water refers to the unique life force of a river or waterbody.

[2] Kāhui Wai Māori (2019). *Te Mana o te Wai: The health of our wai, the health of our nation*, Report to Hon Minister David Parker.
[3] New Zealand Government (2020). *National Policy Statement for Freshwater Management 2020.* Ministry for the Environment.

Ki uta ki tai

The phrase, ki uta ki tai, originates from Ngāi Tahu understanding of the environment and is now referenced in national direction for freshwater management and regional planning. Ki uta ki tai is commonly referred to as 'mountains to the sea' and is about standing on the land and knowing the effects, both positive and negative, in every direction. This ethos reflects the mātauranga (Māori knowledge) that all environmental elements are interconnected and must be managed as such. At a framework level, ki uta ki tai is similar to the RMA term 'integrated management' and, thus, aligns very closely with the concept of Integrated Catchment Management (ICM).

Hauora

Hauora may be simply translated as meaning 'health', but equally can be considered to describe something as vigorous, resilient, or robust. This speaks to the idea of a hauora continuum, which implies varying levels of vigour, resilience or health, and the potential for hauora to change, for better or worse, over time. Just as humans can be considered to display varying degrees of health and resilience, so to can waterbodies be considered to display varying degrees of hauora, or health and resilience. Like healthy people, waterbodies with good levels of hauora can withstand a setback and recover quickly. Waterbodies with poor levels of hauora are more susceptible to setbacks, and less likely to rebound from such impacts.

Kaitiakitanga

Kaitiakitanga can be described as the obligation to nurture and care for the mauri of a taonga; an ethic of guardianship and protection. While the concept of kaitiakitanga is similar in meaning to stewardship or guardianship, in some ways it carries additional nuance and obligations as a result of the core principles of whanaungatanga (kinship) and utu (reciprocity in the pursuit of balance) which Māori consider to extend across the natural world.

Taonga

Taonga might be translated as "that which is valued"; a treasured possession, including property, resources, and abstract concepts such as language, cultural knowledge, and relationships. Specific naturally occurring sources of food and materials within the Southland region are considered taonga by Ngāi Tahu ki Murihiku.

Mahinga kai

Mahinga kai literally means 'working the food' but is more commonly translated as the gathering and harvesting of food and resources. Mahinga kai is central to the Ngāi Tahu ki Murihiku way of life and sense of cultural identity. Where opportunities for traditional mahinga kai practices are compromised, the transfer of intergenerational knowledge, and thus maintenance of cultural identity, are both placed at risk. For Ngāi Tahu ki Murihiku this inability to pass on knowledge from generation to generation, and the associated risk to cultural identity is a key driver for pursing gains in the hauora of waterways and associated ecosystems within the space of a single generation. For Ngāi Tahu ki Murihiku there is a strong sense of urgency in this respect.

Draft Objectives for Freshwater

The 2020 report, 'Draft Murihiku Southland freshwater objectives: Providing for hauora, the health and well-being of waterbodies in Murihiku Southland'[4], identifies options for draft freshwater objectives that reflect qualities that come together to support hauora, or healthy resilience, within waterbodies and by association the environment and communities, in the context of national and regional direction for freshwater management.

The options for draft freshwater objectives were developed within the People Water and Land Programme in a workstream separate to and independent of the Regional Forum workstream. In November 2020

[4] Bartlett, M., Kitson, J., Norton, N., & Wilson, K. (2020). ***Draft Murihiku Southland freshwater objectives: Providing for hauora, the health and well-being of waterbodies in Murihiku Southland***. Environment Southland, Invercargill, NZ. 143 pp

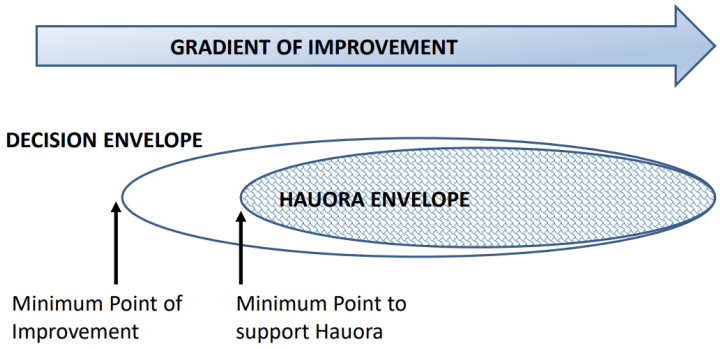
Environment Southland's Council and the Te Ao Mārama Inc board approved in principle to proceed with the option for draft freshwater objectives identified as the minimum to provide for hauora, the health and well-being of waterbodies[5].

Identification of the qualities of hauora were informed by values and objectives of the Murihiku Southland community, including Ngāi Tahu ki Murihiku. Ngāi Tahu ki Murihiku values and objectives are associated with the specific whakapapa of waterbodies, their origins and characteristics, and intergenerational cultural connections.

The process and methodologies used to derive draft freshwater objectives involved the interaction of environmental science with mātauranga (a Ngāi Tahu ki Murihiku knowledge system in this context), particularly Ngāi Tahu ki Murihiku Indicators of Health. This is a novel approach to collaboration between Environment Southland and Ngāi Tahu ki Murihiku in the context of freshwater management in the region.

The Regional Forum recognises that:

1. The package of recommendations represents results particular to Murihiku Southland, and which are unique nationally.
2. The resulting hauora principles (refer to Appendix F: Hauora Principles) require consideration of a combination of waterbody attributes that provide for hauora, understanding that nationally directed attributes on their own do not provide a holistic picture of the health and well-being of waterbodies.
3. The report presents the options for freshwater objectives as two overlapping envelopes:
    a. A decision envelope – the bottom of which is the minimum required point of improvement for waterbodies that are degraded below that point, referencing previous decisions in regional planning instruments and national direction to maintain or improve the state of waterbodies.
    b. A hauora envelope - within which the region is expected to be able to, over time, address the health and well-being impacts arising from degradation of waterbodies.
4. There are some differences in the minimum states between the two envelopes. The differences in the hauora envelope represent further points of improvement, to reach a state of hauora, beyond the minimum step signalled by the bottom of the decision envelope.
5. Draft numeric objectives are outlined for groundwater, rivers and streams, lakes, estuaries, wetlands, and open coast waters.
6. Draft narrative objectives are provided for springs, groundwater, wetlands, rivers and streams, lakes, estuaries, and open coast waters to the extent that they are influenced by freshwater. These draft narrative objectives are designed to reference all relevant qualities of waterbodies that provide for hauora in combination, not all of which are covered by draft numeric objectives.
7. The intention in providing these two envelopes is that decision-makers can consider timeframes and methods that will enable progress towards a state of hauora from a degraded state for affected waterbodies, recognising that there is a gradient between degraded and hauora, and further, that hauora is dependent upon multiple attributes in combination (refer to Figure 1).



[5] *Strategy and Policy Committee Agenda - 2020 November 25.pdf (es.govt.nz)*

Figure 1. Relationship of Freshwater Objectives Decision Envelope and Hauora Envelope

Natural State of Waterbodies

Consideration of the natural state of waterbodies provides a reference point for understanding and evaluating the relative state of hauora of similar waterbodies. Thus, 'natural state' can be considered synonymous with 'reference state'. Consideration and discussion of the natural state of waterbodies does not imply the pursuit of a wholesale return of Southland waterbodies to pre-European settlement conditions. Rather, it informs the assessment and evaluation of the hauora, or healthy resilience of a waterbody, and thus, supports decision making in respect of managing waterbodies.

Mahinga Kai

The Regional Forum members are cognisant that mahinga kai is central to Ngāi Tahu identity and recognise the critical importance of intergenerational knowledge transfer to enable continuation of mahinga kai practices.

Mahinga kai is explained in the Ngāi Tahu ki Murihiku iwi management plan as being:

> "…places, ways of doings things, and resources that sustain the people. It includes the work that is done (and the fuel/energy that is used) in the gathering of all-natural resources (plants, animals, water, sea life, pounamu) to sustain well-being. This includes the ability to clothe, feed and provide shelter." [6]

Kaumātua (respected tribal elders), mahinga kai practitioners, and researchers have shared their experiences of declining access to safe places for harvest, degradation of shellfish beds, loss of habitat for diadromous species that move between the sea and rivers, streams, and lakes. Stories of degradation and decline feature prominently in the history of the tribe, particularly over the colonial period, as recorded during the Ngāi Tahu claim process, and continue into the present. Recent changes are observed at the level of individual streams, small catchments, and at the scale of expanding "dead zones" in New River Estuary for example.

Reports prepared for the Regional Forum highlighted Treaty of Waitangi protection for Ngāi Tahu fisheries and features of the Ngāi Tahu settlement that addressed mahinga kai. Ngāi Tahu have described mahinga kai as the "Ninth Tall Tree" of Te Kēreme, the Ngāi Tahu claim, alongside the eight large scale land purchases, recording that denial of access to mahinga kai accentuated the effects of landlessness and economic deprivation[7]. Activities to restore mahinga kai have long been a focus for tribal members, such as establishment of the first freshwater mātaitai in the country on the Matāura River and ongoing work to improve kanakana (lamprey) populations.

The Regional Forum approach to addressing mahinga kai needs of Ngāi Tahu is encompassed in the recommendation for a co-governance model to be developed and applied in each FMU and for hauora-led integrated catchment management to drive improvements. This reflects Regional Forum understanding that the concept of hauora represents the antithesis of degradation and deprivation, and is inclusive of the needs of the Southland community as a whole, including Ngāi Tahu ki Murihiku. Through these mechanisms, and the combined package of Regional Forum recommendations, mahinga kai habitats and populations are expected to be protected and supported to improve over the coming generation. This time period is recognised as particularly important in the face of additional challenges to mahinga kai species from projected climate change impacts.

[6] Te Tangi a Tauira, 2008.

[7] Ngāi Tahu Report 1991, Wai 27, Waitangi Tribunal, pages xiv – 5, 149-165

The Scientific Dimensions of Southland's Freshwater

Scientific and economic modelling has informed the Regional Forum's consideration of advice.

Science models were used to test out various scenarios to get an indication of the relative utility of different types of potential interventions in contributing to the reduction of the major contaminants. A summary of the focus of each science scenario is provided in Appendix I: Science Scenario Modelling in Support of the Regional Forum.

As the members of the Regional Forum have grappled with understanding the interplay of different contaminant loads within and across the region's FMUs, and the notion of over-allocated or over-loaded water bodies, a useful conceptual metaphor has emerged - that of the 'water quality bucket'. Figure 2captures the sentiment that our regional water bodies are currently over-allocated and carrying too many contaminants. Thus, the challenge becomes lowering the level of contaminant loading in the bucket to levels that represent resource use within limits (in this case defined by the draft numeric and narrative freshwater objectives that reflect the qualities that come together to support hauora, or healthy resilience).

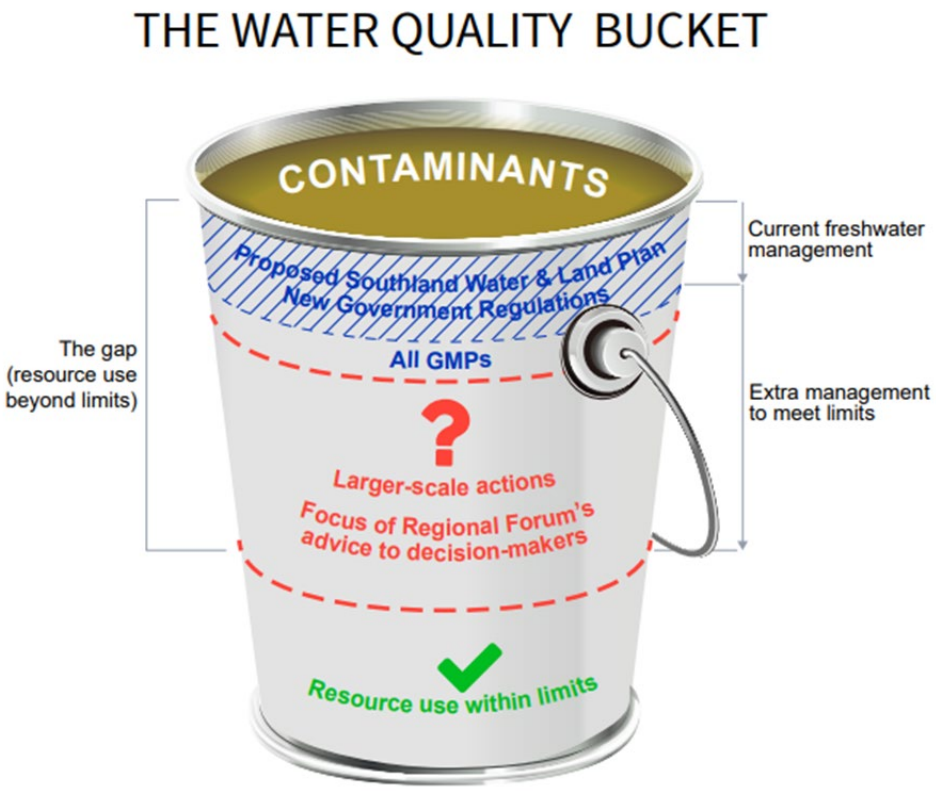


Figure 2. Water quality bucket metaphor diagram (note that GMP is "good management practices")

The Economic Dimensions of Southland's Freshwater

"The economy is a wholly owned subsidiary of the environment, not the reverse"

Emeritus Professor Herman E. Daly, University of Maryland

The 'Southland Economic Project'[8] highlights that, relative to other regions of New Zealand, Southland has a small, narrow-based economy, with a heavy reliance on primary industry, particularly agriculture.

> "Southland's economy has two main features that single it out from most other regional economies around New Zealand. First, it is a considerable distance from New Zealand's three main urban centres: Auckland, Wellington, and Christchurch. Second, it is almost completely reliant on the use of natural resources, either directly or indirectly, particularly water. These two features both constrain Southland's economy and provide opportunities."[9]

An economic model was used to test the same, or very similar, scenarios used in the (biophysical) science models. The outputs of both models have informed the Regional Forum's consideration of advice. A summary of the focus of each economic scenario is provided in Appendix J: Economic Scenario Modelling in Support of the Regional Forum.

Key Modelling Takeaways

All modelling systems have inherent limitations. One obvious limitation of the economic modelling is worth noting here. Within the economic scenario modelling provided to the Regional Forum, there was no capability to account for innovation gains over time. Southland's history reflects a strong tradition of innovation, within and beyond our primary sector. It is anticipated that innovation will remain a positive regional driving force over the next generation and beyond.

Regardless, the economic modelling, combined with the scientific modelling, helped build understanding and provide an indication of the broad magnitude, trajectory, and relative merit of certain types of responses, and thus broadly signposted both the risks and opportunities that needed to be accounted for within the Regional Forum's package of advice (and the subsequent detailed policy design work that will follow). Such risks and opportunities relate to the relative magnitude of investment or costs associated with certain types of interventions, and how those investments might be spread over time, over landscapes, and over communities within Southland. In more simple terms, the scenarios presented demanded that the Regional Forum respond with the question: "So, what?" Or, in more detail, "So, what is the implication for future policy design that we can provide recommendation on?"

The economic scenario modelling provided to the Regional Forum has been both informative and thought provoking, especially when considered alongside the science scenario modelling. In considering the implications and reflecting on the function of the modelling efforts, the Regional Forum collectively have determined not to become fixated on the numbers, understanding that Environment Southland and Te Ao

[8] The Southland Economic Project was a joint initiative between DairyNZ, Beef + Lamb New Zealand, Department of Conservation, Ministry for the Environment, Ministry for Primary Industries, Southland Chamber of Commerce, Te Ao Mārama, and Environment Southland. The Southland Economic Project was set up to develop robust tools to help us understand the impacts of achieving environmental 'limits' set under the National Policy Statement for Freshwater Management.

[9] Moran, E., Pearson, L., Couldrey, M., and Eyre, K. (2017). *The Southland Economic Project: Agriculture and Forestry.* Technical Report. Publication no. 2019-04. Environment Southland, Invercargill, New Zealand. 340pp. https://www.es.govt.nz/environment/economy

Mārama Inc will undertake further economic modelling to inform and refine policy design ahead of the plan change to the proposed Southland Water and Land Plan.

From consideration of both the economic and science scenario modelling, a number of key insights emerged for the Regional Forum. These include the following:

1. The current needs of Te Mana o te Wai within Southland are significant.
2. A series of ad hoc and piecemeal responses is very unlikely to deliver on the freshwater objectives identified within a generation.
3. A collaborative, "Southland-Inc" (multi-entity) response will be needed to leverage available knowledge, resources, and energy to the greatest degree possible to deliver on the freshwater objectives identified within a generation.
4. Given the sense of urgency driven both by climate change effects and the intergenerational knowledge-transfer needs of Ngāi Tahu ki Murihiku, a degree of 'campaign planning' will be needed to sequence and synchronise actions and investment across time, across landscapes, and across communities to deliver on the freshwater objectives.
5. Innovative and entrepreneurial approaches should be broadly encouraged and supported at all levels (from region, through FMU, to paddock-scale) in pursuit of the freshwater objectives.
6. Given the unusually high regional economic dependence on the natural environment, efforts to build regional natural capital and/or further diversify the regional economy (in directions less dependent on natural capital) will contribute to enhanced social resilience.
7. The campaign for Southland's freshwater resources ultimately represents an investment in the future of Southland.

Uncertainty

The Regional Forum accepts that there is inherent uncertainty in environmental decision making, and that this remains the case in respect of Murihiku Southland's freshwater resources. Within public discussion and debates on water quality issues it is common to hear calls for greater certainty and more research before committing to a specific decision or course of action ("Let's wait until the science is settled"). The irony of such calls is that at no time in human history have we enjoyed the benefits of so much scientific research and such a well-developed understanding of water quality as we do today.

This is not to suggest that our understanding is complete, nor that there is no room for further research. It is expected that continued research, monitoring, and practical experience will further extend our knowledge and understanding. Indeed, it is the remaining uncertainty that serves as a stimulus that both drives future research while prompting us to adopt a precautionary stance where certainty remains elusive.

In respect of managing Murihiku Southland's freshwaters there are three types or sources of uncertainty[10].

1. Natural variability refers to the natural variations in many aspects of the environment that we measure. For example, flows and contaminant concentrations in a river vary in time, and contaminant leaching rates vary in space. This variation is an inherent part of the environment and cannot be reduced by collecting more information. Climate change effects are expected to increase natural variations over time.
2. Model and parameter uncertainty includes uncertainty due to the limited scientific knowledge about the nature of models that link causes, environmental effects and mitigation actions, as well as uncertainty about model parameters. There may be disagreements about the model, such as which model is most appropriate for the purpose at hand, which variables should be included, the model's functional form (e.g., whether the relationship being modelled is linear, exponential or some other

[10] Ministry for the Environment. (2018). ***A guide to communicating and managing uncertainty when implementing the National Policy Statement for Freshwater Management 2014.*** Retrieved from https://environment.govt.nz/assets/Publications/Files/fresh-water-guidance-on-uncertainty.pdf

form), and how much data collected in another context can be generalised to the problem at hand. Model and parameter uncertainty can sometimes be quantified and reduced through technical effort.

3. Deep uncertainty is uncertainty about the fundamental processes or assumptions underlying an assessment, which is not likely to be reduced by additional technical work within the time period in which decisions must be made. Typically, deep uncertainty is present when:
   a. underlying environmental processes are not understood
   b. there is lack of consensus among scientists about the nature of an environmental process
   c. methods are not available to characterise the process

   Deep uncertainty also applies to future unknown changes in the social, economic, and technological context of any decision

The Regional Forum recognises these sources of uncertainty, and that where possible, Environment Southland will continue to work with stakeholders to reduce uncertainty. It is also recognised that it takes time, investment, and talent to do this, and that such efforts will continue to run in parallel with practical management actions triggered by the pending plan change.

The suite of recommendations presented within this report are framed with this uncertainty in mind - at times recommending precautionary approaches, at times recommending investment in monitoring, research, and capability building, and at times recommending periodic review to account for new knowledge, insights, or technology. This approach is consistent with the allocation philosophy outlined above.

Affordability

Implementation of the recommendations made within this report will come at significant financial cost, collectively and individually. There is always a temptation to say, "We can't afford it" and to advocate for delay until a time which is more suitable. But the reality is that every delay will increase both the cost to the environment and the effort and investment required to fix it. So, the Regional Forum's challenge to the province is, "If not now, when?"

The Regional Forum's intent is that significant work commences immediately and progresses with a strong sense of urgency. However, priorities and timeframes will need to be regularly reassessed, considering affordability to avoid deepening poverty and/or a population drain. It may be that Three Waters reform and other unknown advances may see funds inserted into the region that will help bear some of the big costs. Equally however, there are many challenges being faced on a provincial, national, and global scale that may influence the ability to invest to the extent required.

The Regional Forum believes that the co-governed structure recommended for FMU hauora planning will be well placed to balance environmental, cultural, economic, and social considerations as plans are developed.

Funding

Funding the suite of initiatives required will need to be an ongoing piece of work to ensure that the region can pursue its goals as rapidly as possible.

At a regional scale a model will need to be developed to value voluntary contributions (such as land, manpower and funds) towards initiatives that have a wider community benefit; and to gather funds from those who are not making a direct or voluntary contribution but are benefitting from the mitigation of the impacts of other's activities, in conjunction with the scale of their impact.

Beyond the regional funding model, pursuit of funds into innovations, developments and improvements will need to be a constant piece of work. Seeking investment from outside of the region will be crucial to ensure the scale of work required can be achieved. This may be in the form of grants for research and development, environmental stewardship, or other endeavours; commercial investment for work that may be innovative

with potential to be leveraged nationally or internationally; through philanthropic sources; or through other means.

Timeframes for Change

With respect to resourcing the programme of change the needs of our waters demand, time can be viewed as one of our critical resources and key inputs. The wider community may take inspiration from the Ngāi Tahu Ki Murihiku philosophy that this challenge is one that must be responded to, to the greatest degree possible, within the space of a generation, as it is simply not fair to pass this problem onto the next generation to fix.

The timeframes for action outlined within this report (and reflected in the suite of recommendations) do impose an obligation on the current generation to commit to action with a strong sense of urgency. Urgency does not suggest undue haste, however. What is needed in greater measure is an initial investment in increasing our regional capacity for collaboration, a mindful and deliberate analysis of the specific challenges and opportunities, followed by a whole-hearted commitment to decisive actions.

Yet, within such an approach, undue delay is to be avoided, not only for reasons of intergenerational equity, but also for very practical considerations of cost. The increasing effects of climate change are predicted to make the challenge more demanding and more costly as each year passes. The science suggests there is an immediate window of opportunity for investment and gains this decade, exploiting the current positive phase of the Interdecadal Pacific Oscillation (discussed in more detail further below).

Immediate investment in capacity building and enabling projects (such as deploying Environmental Management Plans, and establishment of a wetlands task force, for example) is considered both possible and desirable. Investing in human capital and building regional knowledge and talent is considered a sound investment in securing our capability to manage freshwater resources in a more collaborative manner in future.

Some will ask if the change needed is even possible within a generation. One response may be that until we try, we can never know. That said, it is accepted that there are certain specific remediation needs of our waterbodies that most likely lie beyond our grasp within the space of a single generation. For example, the remediation needs of the New River Estuary might be considered a longer-term project for the region. Where such conditions are identified, this does not suggest that remediation work does not commence, but rather that work is undertaken with a clear understanding of the practical time constraints and limits of progress.

Elsewhere, positively, the environment of Southland offers potential for greater progress, when our communities commit to action. To realise such progress, a collective commitment and collaborative action will be needed. Within such an approach, it will be important to understand that:

1. Timelines and priorities may differ for each FMU, reflecting the different hauora needs of each.
2. Some recommendations will need to be prioritised for action ahead of others as they inform and enable subsequent decision-making, practical action, and monitoring of progress.
3. Local government, businesses (urban and rural), not-for-profit organisations, communities (urban and rural), and individuals will need to make an effort and contribute early.
4. Wherever possible recognition and incentives for early action should be explored and promoted.

PART TWO - CATCHMENT MANAGEMENT

Southland's Freshwater Management Units

The National Policy Statement for Freshwater Management 2020 provides the following definition of freshwater management units (FMUs):

> "Freshwater management unit, or FMU, means all or any part of a water body or water bodies, and their related catchments, that a regional council determines an appropriate unit for freshwater management and accounting purposes; and part of an FMU means any part of an FMU including, but not limited to, a specific site, river reach, water body, or part of a water body."

By definition FMUs are made up of freshwater bodies. The FMU concept establishes a spatial scale at which management activities can be undertaken, including freshwater accounting, and setting freshwater objectives and limits. Southland's five freshwater management units are illustrated in Figure 3. It should be noted that the Waituna Lagoon is currently included within the Matāura FMU. However, it is anticipated that the Waituna will be designated a separate FMU when the proposed Southland Water and Land Plan becomes operative, as a result of an interim decision of the Environment Court recorded in December 2019.

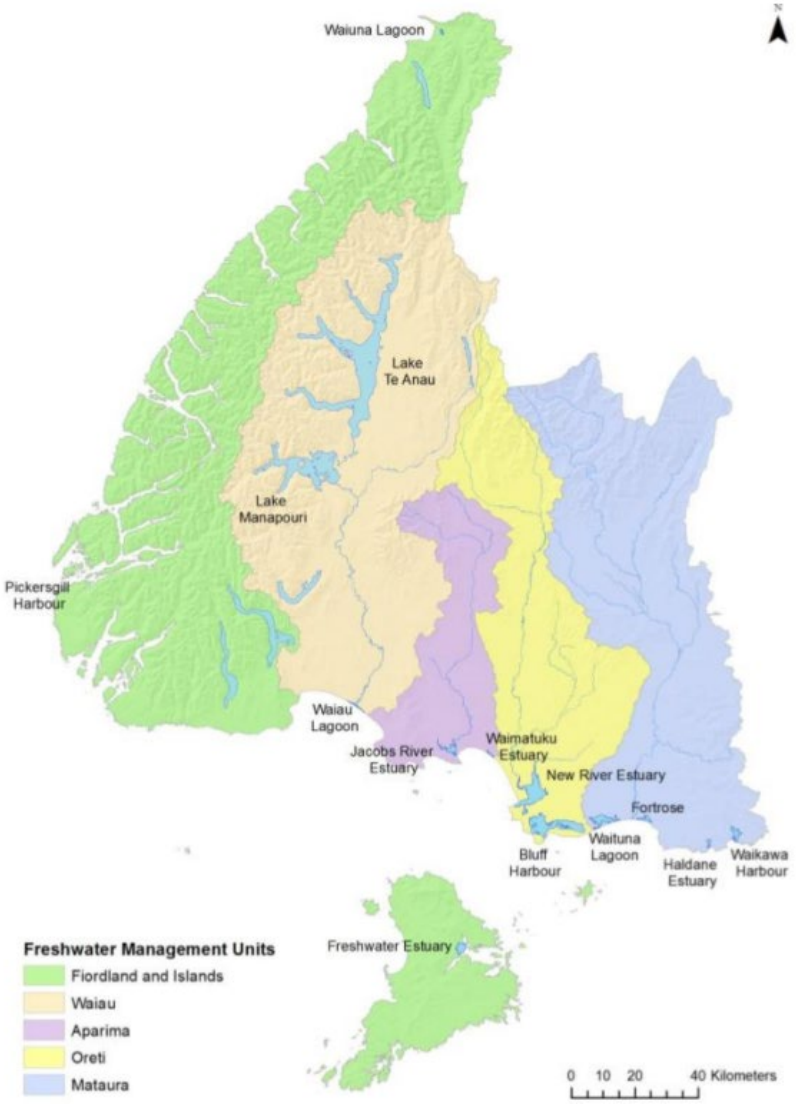


Figure 3. Boundaries of the five FMUs in Southland

Land Management

Good Management Practice

Good management practice (GMP), also sometimes referred to as best management practice, remains an important set of concepts and behaviours in efforts to manage freshwater quality and quantity within Southland. Some GMP are well established, while additional mitigation options and practices continue to evolve and emerge.

In 2021, New Zealand researchers conducted a high-level desktop analysis of farm typologies to establish the theoretical levels of gain that might be made in respect of losses to water of nitrogen (N) and phosphorus (P) based on full implementation of sets of established and developing pastoral farm mitigation options across dairy and sheep/beef farms[11]. This national level analysis considered what gains might have been theoretically achievable based on established mitigation options, as at 2015, and what gains might be theoretically achievable based on both established and developing mitigation options anticipated by 2035. The established and developing mitigation actions considered are summarised in Appendix K: Established (2015) and Developing (2035) Pastoral Farm Mitigations.

Subsequently, in a separate study by Cox et al. (2021), these sets of farm mitigations were modelled for the various FMUs of Southland, for the same two time periods of 2015 and 2035. This more specific, Southland-focused study concluded:

> "Model simulations of pastoral farm nutrient mitigation options reveal the potential for significant water quality gains from the implementation of known and projected (i.e., 2035) on-farm nutrient management strategies. However, simulated nutrient load and concentration reductions from these published mitigations likely represent only part of the reductions required in the region to achieve long-term nutrient targets. That said, the on-farm mitigation actions simulated here will surely need to be a key feature of any comprehensive regional nutrient management strategy." [12]

In essence, known and emerging mitigation options, by themselves, will not deliver the nutrient loss reduction targets anticipated for Southland FMUs, but will remain an essential element in pursuit of those targets.

It is important to note that the Regional Forum does not advocate that each and every mitigation measure identified in this study be applied wholesale across Southland landscapes. Rather they are included in Appendix K to provide increased transparency and context, and to support further understanding and exploration of the role of pastoral farming mitigation actions.

Hauora Management Practices

In future, Southland land-users might consider a different way of thinking about land and water management practices, using the term hauora management practices (HMP). Hauora management practices might be considered management practices that respond to the specific hauora needs of a Southland FMU or catchment. Such practices would be more tightly tailored and targeted to catchment-specific risks and needs, more directly aligning and connecting land-use practices to FMU objectives and targets.

Integrated Catchment Management

The concept of Integrated Catchment Management (ICM) is well-established concept, yet in practice can mean different things to different people, and across New Zealand ICM varies in its design and implementation depending on a wide range of factors.

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[11] Richard W. McDowell, R. M. M., Chris Smith, Andrew Manderson, Les Basher, David F. Burger, Seth Laurenson, Peter Pletnyakov, Raphael Spiekermann & Craig Depree (2021). *"Quantifying contaminant losses to water from pastoral land uses in New Zealand III. What could be achieved by 2035?"* New Zealand Journal of Agricultural Research 64(3): 390-410.

[12] Tim Cox, T. S., Tim Kerr (2021). *Technical memorandum: OLW farm mitigation solutions.*

Helpful to the task of designing a Southland-centric system of ICM are the findings of a 2010 report, prepared by researchers for the Ministry for the Environment, 'Integrated Catchment Management: A Review of Literature and Practice'[13]. This report observed that even among the self-identified ICM programmes in New Zealand, there is little consistency about what 'integrated' means.

The report highlighted that the fundamental component of catchment management is the integrated management of the effects of land use on water. The report advises to:

> "Ask not how integrated is the catchment management, but how is the catchment management integrated?"

Helpfully, the report summarised the key elements of best practice ICM, which are included in Appendix H: Key Elements of Best Practice ICM.

FMU Hauora Planning

FMU Hauora Planning is seen as a powerful approach to integrated management of Murihiku Southland's freshwater resources – an approach to ICM that is led and guided by the concept of hauora and emphases Te Mana o te Wai.

Using the Aparima FMU as an example, Figure 4 illustrates the cascading and nested nature of Hauora planning from FMU scale (macro level), to catchment/sub-catchment scale (meso level), to property scale (micro level). It demonstrates a cascading and nested approach to ICM at three levels. In this example the macro level is the Aparima freshwater management unit hauora plan, the meso level is the Waimatuku catchment, and micro level consists of individual environmental management plans for all properties within the Waimatuku catchment.

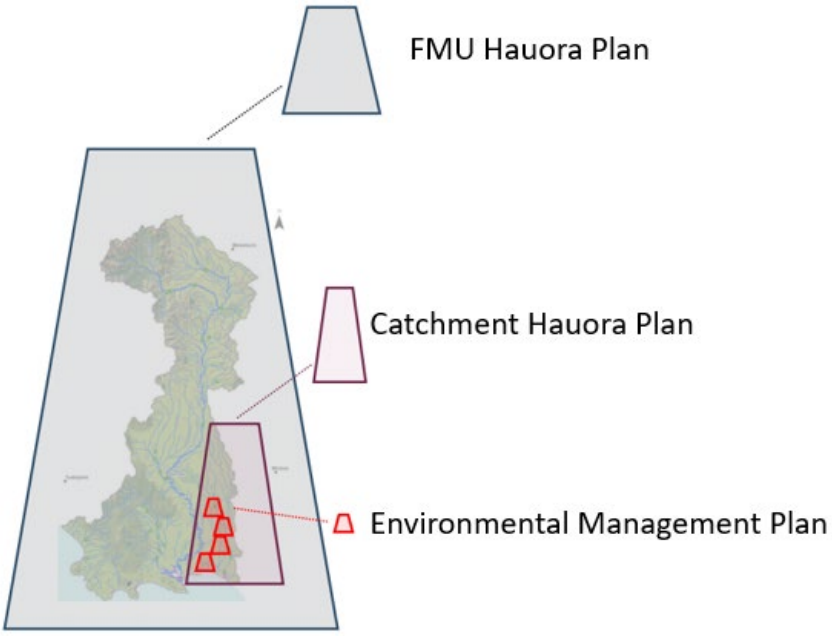


Figure 4. Concept graphic showing FMU planning layers

The concept calls for an overarching FMU Hauora Plan which establishes FMU-specific objectives, policies, rules and limits, methods, and expectations of FMU stakeholders. One way of describing the concept of an FMU Hauora Plan is that it becomes "the operating manual for the FMU."

[13] Clare Feeney, W. A., Annette Lees, Maree Drury. (2010). *Integrated Catchment Management: A review of literature and practice*. Retrieved from https://environment.govt.nz/publications/integrated-catchment-management-a-review-of-literature-and-practice/

Alternatively, from a Te Ao Māori perspective, just as the concept of Te Mana o te Wai is considered as "the national korowai" for freshwater planning, the FMU Hauora Plan can be conceived as the FMU korowai, or protective cloak that supports active management (and active protection) of the mauri of the water.

Subordinate and aligned to the FMU Hauora Plan, Catchment/Sub Catchment Hauora Plans would translate the intent of the FMU Hauora Plan to catchment level, providing more specific guidance on the catchment specific risks and opportunities in respect of hauora, outlining the specific methods to be applied in managing for hauora, and coordinating action amongst stakeholders to achieve the objectives specified in the FMU Hauora Plan. Such an approach allows for identification and prioritisation of actions within the catchment, responding to opportunities that might be considered "low hanging fruit", along with actions that address specific high-risk issues and hot spots.

It is envisioned that Catchment Hauora Plans would be structured with a 25-year time horizon (a generation) but reviewed and revised on a five-year cycle with revision certification at FMU level. The five-year period for revision cycle relates to the minimum period for scientific trend analysis, which is relevant given that monitoring programmes would be expected to inform and guide hauora planning updates.

Once FMU Hauora Plans and Catchment/Sub-Catchment Hauora Plans are established and published, there is an expectation that Environmental Management Plans would be amended and updated to reflect and align with the expectations and requirements of the Catchment/Sub-Catchment Hauora Plans. In this way food and fibre producers, property managers, and landowners can plan for and manage property-scale activities in a manner that supports catchment and FMU hauora outcomes, reflecting HMP.

This is considered an empowering approach, as it enables something that is currently not possible for Southland farmers, property managers, and landowners – management (and demonstration) of activities in a manner that responds directly (and transparently) to well-defined catchment-specific hauora objectives reflecting the environmental risks and opportunities unique and specific to each catchment and FMU.

As a central and enabling feature of the ICM approach recommended by this report, much hinges on the development and deployment of effective FMU Hauora Plans. It is expected their development will present both technical and social complexity. It is certainly expected they will be reviewed, adjusted, and refined over time, informed by monitoring insights, research, and community experience. Development of Hauora Plans is flagged as one of the highest priority tasks emerging from the Regional Forum's recommendations. It is expected the first version of FMU Hauora Plans will be designed and published by December 2023.

Hauora Risk Analysis

At the heart of FMU Hauora Planning is the assessment of hauora risk. Risk to hauora can be conceptualised resulting from the dynamic relationships between:

1. landscape susceptibility,
2. land use pressure, and
3. freshwater ecosystem vulnerability.

Refer to Figure 5.

The assessment of hauora risk will thus require an analysis of risk by FMU, catchment and sub-catchment, underpinned by an increased recognition and appreciation of landscape susceptibility. It is expected that hauora risk assessment will be dynamic, taking account of mitigation actions, land use changes, monitoring results, and climate change effects to inform adjustments to limits and management priorities over time.

Suggested actions for a broadly coordinated approach to implementing Hauora-Led Integrated Catchment Management across the region are provided in Appendix D: Murihiku Southland Integrated Catchment Management – Implementation Matrix.

Figure 6 illustrates the broad concept for FMU Hauora-Led Integrated Catchment Management to be enabled by the suite of recommendations which follow in Part 3 of this report.

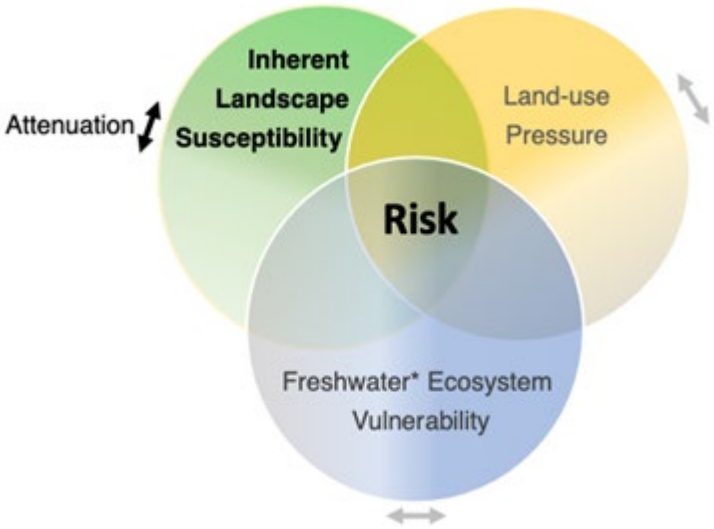


Figure 5. Diagram showing the concept for the assessment hauora risk[14]

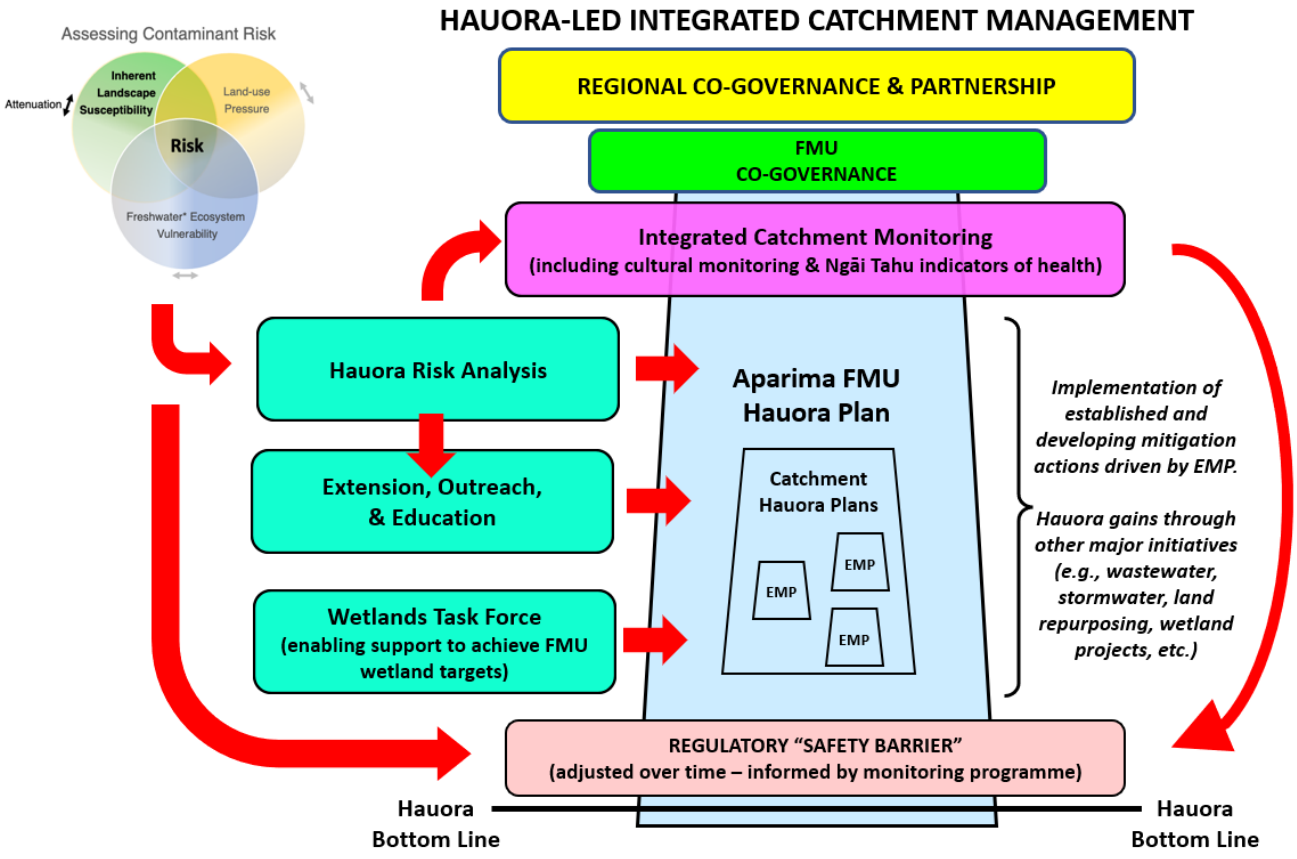


Figure 6. Concept for FMU Hauora-Led ICM

[14] Baisden, W.T., Pearson, L.K., & Rissmann, C.W.F., (2021). ***A source-to-sink contaminant risk framework to support water quality policy across scales***. Presentation to the New Zealand Hydrological Society Conference 2021, Wellington.

PART THREE - RECOMMENDATIONS

Integrated Catchment Management, Monitoring, Modelling, and Learning

Within a system of hauora-led Integrated Catchment Management the Regional Forum recognises the very important role of monitoring and modelling to support continuous learning and adaptive responses. Monitoring programmes will be essential to the task of evaluating the relative cumulative impact of various interventions on our regional freshwater resources and supporting future cycles of decision-making within a co-governance model. The open sharing of stories of success along with stories of failure will be important in supporting Southland communities to 'learn their way forward'.

The Regional Forum expects FMU hauora monitoring programmes will be redesigned and resourced to incorporate Ngāi Tahu indicators of health and cultural monitoring to complement existing monitoring methodologies.

Recommendations

1.1 Environment Southland and Te Ao Mārama Inc implement Integrated Catchment Management by applying an FMU Hauora Planning framework at Freshwater Management Unit (FMU), catchment, and sub-catchment scale, and resource it for success. It is expected the first version of FMU Hauora Plans will be designed and published by December 2023.

1.2 Environment Southland introduce Freshwater Management Unit (FMU) hauora rules to guide regional planning and management of freshwater resources.

1.3 Freshwater Management Unit (FMU), catchment, and sub-catchment Hauora Plans be structured with a 25-year time horizon. These cascading and nested sets of plans should be reviewed, and if need be, revised on a five yearly basis, informed by FMU monitoring, updates in scientific knowledge pertaining to catchment dynamics, and evaluation of regional impacts of climate change.

1.4 Environment Southland and Te Ao Mārama Inc continue to use the Southland Economic Project to anticipate risks, identify opportunities, and manage impacts, by FMU, as Hauora planning evolves.

1.5 FMU integrated catchment management is supported by integrated catchment monitoring which includes hauora monitoring programmes designed and resourced to incorporate Ngāi Tahu indicators of health and cultural monitoring.

Note that a summary of all recommendations, including those above, is provided Appendix C: Summary of Recommendations.

Co-Governance of FMU Hauora Planning and Management

> *"'Co-governance' has become a term that people don't understand. They think it means co-government. People who are frightened by co-governance think they'll be locked out of access to our natural resources, for example. When what it really means is that involving iwi in a myriad of decisions can actually result in a better country."*
>
> Chris Finlayson, Minister for Treaty of Waitangi Negotiations 2008 to 2017, May 2022

Some people feel threatened by the term 'co-governance'. Yet, Southlanders have been exercising effective co-governance of natural resources for some time. Co-governance arrangements are well established with Ngāi Tahu for the management of Whenua Hou (Codfish Island) for more than twenty years, and the existing

relationship between Environment Southland and Te Ao Mārama Inc reflects an excellent foundation from which to extend co-governance in a manner that better serves the needs of Murihiku Southland.

The proposed FMU Hauora Planning framework requires an appropriate form of governance to sustain, guide, and assure the framework. As intimated above, the Regional Forum expects that an appropriate co-governance arrangement with Ngāi Tahu ki Murihiku (as mana whenua) will be established for each FMU, reflecting an authentic commitment to the Tiriti principle of partnership.

It is expected that the co-governance arrangement for each FMU may differ, reflecting FMU specific characteristics, attributes, and existing arrangements (for example, the Guardians of the Lakes may have a specific role to play within the Waiau FMU). Regardless of the specific FMU co-governance arrangements that emerge, the expectation is that for Southland this does not necessarily equate to "equal numbers" at the governance table, but certainly should reflect "equal impact and influence at the governance table" – an approach which, over time, will be seen to anchor the collaborative approach proposed.

It is acknowledged that aspirations for co-governance may be constrained (at least initially) by capacity constraints. It is thus accepted that co-governance models might initially rely on a more centralised form of representation, while subsequently evolving and develop over time to a more distributed (less-centralised) form of representation as capacity building efforts allow.

Such a co-governance arrangement should be co-designed to allow for engagement and contribution by other stakeholders and entities with an interest in management of resources and hauora outcomes within an FMU. A key expectation is that the resulting co-governance arrangements will reflect the needs and character of Murihiku Southland, representing a uniquely regional approach and not prejudiced by co-governance arrangements elsewhere in New Zealand.

Consideration of existing community engagement arrangements, such as River Liaison Committees should be considered within the co-design process for co-governance. The resulting co-governance arrangements may see fit to continue, modify, or retire such entities and arrangements in order to best serve the needs of FMU hauora-led integrated catchment management. Recognition of the knowledge, experience, and insights of those who have been actively sustaining community engagement should be taken into account through the co-design process.

Within co-governance models, it is expected Ngāi Tahu ki Murihiku will take a more active role contributing to FMU hauora monitoring programmes, adding cultural assessment to reinforce and strengthen existing monitoring efforts.

Recommendations

2.1 Environment Southland and Te Ao Mārama Inc co-design Freshwater Management Unit (FMU), co-governance arrangements that support implementation and management of FMU Hauora Planning (hauora-led Integrated Catchment Management). It is expected that co-governance arrangements provide for genuine community representation and diversity, are appropriately resourced to function effectively, and are fully supported with all necessary information relevant to the concerns of hauora planning and management.

2.2 Environment Southland and Te Ao Mārama Inc collaborate to support and deliver a programme of co-governance talent development in order to secure future regional capability for co-governance of FMU Hauora Planning and Management.

2.3 Environment Southland and Te Ao Mārama Inc implement FMU Hauora co-monitoring across all regional FMU, incorporating Ngāi Tahu indicators of health to complement existing monitoring programmes.

Climate Change

Acknowledging the challenge that climate change will pose to the communities and businesses of Southland, the Regional Forum emphasizes the need to take account of anticipated climate change effects, risks, and opportunities in respect of any decision, project or initiative relating to management of freshwater resources.

The Regional Forum believes that any and all initiatives considered for enhancing the hauora of waterbodies should be balanced against the considerations of climate change mitigation and resilience.

The Regional Forum understands there are certain initiatives that might be explored within an Integrated Catchment Management approach that respond to both the needs of Te Mana o te Wai, as well as climate change resilience. Investment in wetland development and repurposing selected land-areas for increased ecological services might be considered examples of such climate-complementary initiatives.

The Regional Forum would flag the recent NIWA research which suggests that, "For rainfall, the fact that we may have recently moved into a positive phase of the Interdecadal Pacific Oscillation may depress the impacts of anthropogenic climate change over the next decade or so."[15] If this were the case, the next decade may be considered to represent a window of opportunity to invest in gains in water quality, quantity and habitat, ahead of a more challenging period when the next negative phase of the IPO amplifies the effects of climate change induced rainfall patterns.

Regardless, it is expected that over time, as climate change effects increase, the magnitude of the challenge of improving regional freshwater resources will increase. A 'mitigation dollar' invested today is expected to return significantly greater benefits than the same inflation-adjusted investment in 10 or indeed 20 years' time. This 'escalating challenge' effect also supports the concept of acting earlier rather than later, adding to the sense of urgency but also creating a sense of current opportunity in respect of more effectively managing regional freshwater resources.

Finally, recognising the anticipated dynamic influence of climate change, the need for monitoring, learning, and adaption all emerge as highly desirable attributes of Southland's continuing response to management of freshwater resources. Accordingly, Integrated Catchment Management arrangements for the FMU and catchments of Southland should ensure a healthy degree of system flexibility and adaptability, allowing for mindful adaptation in response to learning and insight that result as climate change trajectories and effects become more evident, as adaptations are trialled, and as additional monitoring and research offers enhanced understanding of the forces at play.

A summary of the key regional climate change effects predicted by NIWA's 2018 'Southland Climate Change Impact Assessment' is provided in Appendix G: Climate Change Effects in Southland.

Recommendations

3.1 Within the FMU Hauora Planning framework, anticipated regional climate change effects, risks, and opportunities are accounted for in planning and implementing freshwater management initiatives and projects, in order to balance hauora outcomes against climate-change resilience outcomes, including protection of food production systems.

3.2 Within the FMU Hauora Planning framework, prioritise initiatives and projects that are complementary to both hauora outcomes and climate-change resilience outcomes, including water security and biodiversity.

[15] Zammit, C., Pearce, P., Mullan, B., Sood, A., Collins, D., Stephens, S., ... Wadhwa, S. (2018). ***Southland climate change impact assessment***. NIWA. Wellington, NZ.

3.3 Within the FMU Hauora Planning framework, identify risks to hauora from legacy sites (for example, known retired dumps and/or contaminated sites), and undertake a thorough investigation and co-analysis of management and mitigation options for implementation. It is expected that risk assessment, factoring in climate change effects, will inform prioritisation of interventions to manage such legacy sites within each FMU.

Regulatory Expectations

The aspiration of the FMU Hauora Planning framework is to create and support an ICM approach which allows for maximum stakeholder participation, maximum innovation in pursuit of hauora outcomes, while preserving the agency of community and catchment groups, and empowering community action. This aspiration reflects an evolution to a collaborative approach to integrated freshwater management. Such a collaborative approach (reflecting increased mutual trust, community engagement, collaboration, and consensus) might not be immediately possible within each FMU. It cannot be expected that stakeholders within each FMU and catchment/sub-catchment will immediately embrace, nor have both the will and capacity to respond to the concept of hauora-led ICM. Rather, it may require both time and active nurturing to establish hauora-led ICM within each FMU (potentially at different rates of establishment).

In the interim, there remains an imperative to guide and coordinate regional freshwater management efforts in pursuit of both community values and national policy outcomes. In light of this fact, it is considered necessary to regulate for foundational FMU hauora rules to guide centralised planning and management at FMU level. It is envisioned such FMU hauora rules will underpin regional freshwater management efforts until conditions are set for each FMU to transition to an effective co-governance arrangement which is sufficiently robust to guide and sustain development of targeted community led FMU hauora rules.

Another way of conceiving of these rules is to consider them a "safety barrier" designed to capture and arrest any land and water use activities with potential to compromise the hauora of waterbodies before any significant damage is inflicted. Individuals, communities, businesses, and industry groups would be guided and protected by the clarity and certainty provided by the FMU hauora rules. The FMU hauora rules themselves would be designed and established to provide ecological buffers for each FMU, accommodating the uncertainty remaining within the scientific monitoring and modelling available. The FMU hauora rules would thus reflect a precautionary approach to preserving and promoting hauora within the limits of our understanding at the time they are established. Over time, with monitoring efforts, additional research, and increased understanding of the dynamics of FMU hauora, it is expected these hauora rules would be adjusted to reflect that improved understanding. Any such adjustments would be expected to reflect the broad need for future regional resource management arrangements to remain flexible, adaptive, and responsive to emerging regional climate change impacts.

The Regional Forum envisages that these foundational FMU hauora rules (the "safety barrier") will be established by Environment Southland and Te Ao Mārama, for each FMU, and will involve a combination of risk management tools, Environmental Management Plans (EMP), appropriately set limits, benchmarking and reporting, and adequate resourcing to assist compliance and enforcement. The recommendations which follow below in this section provide for this architecture.

Environmental Management Plans (EMP)

The government's national Essential Freshwater policies and regulations introduce Freshwater Farm Plans, as a practical aid for farmers to meet freshwater outcomes. The expectation is that the requirement for certified Freshwater Farm Plans will be phased in from early 2023, region by region. The Regional Forum has identified that all Southland land-users and businesses (not only farmers) with the potential to influence freshwater hauora outcomes should be expected to prepare an appropriate plan, identifying risks to freshwater hauora, along with appropriate risk treatment and mitigation actions. The term suggested for such a plan to be used by regional land-users is an Environmental Management Plan (EMP).

It is expected that the EMP format developed for use across Murihiku Southland will:

1. incorporate and satisfy the expectations of a certifiable Freshwater Farm Plan.
2. be tailorable to specific industry and sector needs (e.g., dairy farming, horticulture, industrial manufacturing, golf courses, lifestyle blocks, etc).
3. explicitly reference relevant Landscape Susceptibility Schedules and demonstrate alignment to relevant regional FMU Hauora Plans.
4. will be subject to review, certification, and audit at appropriately designated frequencies and occasions.

It is expected that certified EMPs are a working document, reviewed and updated by their owner at least annually. The requirement to review, update and recertify could also be triggered:

1. in response to audit results; or
2. where there is a material change to the farming/business activity not currently addressed by the existing EMP.

It is expected that implementation of EMP will:

1. Align timing requirements with implementation of freshwater farm plans as much as possible, so that the process is more efficient overall (with EMP also functioning as the freshwater farm plans and, thus, meeting both sets of requirements).
2. Require frequent (likely annual) review, to ensure that the environmental management plans are maintained and updated (and not gathering dust in storage).
3. Require regular re-certification (for example, every three years as a standard expectation) regardless of whether the farming/business system has materially changed, to ensure that the plan is being updated and that the content is appropriate.
4. Require re-certification and audit frequency determined and adjusted based on performance history.
5. Potentially include a random "spot-check" audit of a small percent of EMP annually.

The Role of Limits

Within the wider set of rules and arrangements for managing FMU hauora, there is a role for limits and limit setting. Figure 7 conceptualises the way in which different businesses both influence, and are influenced by, environmental limits over time.

Input Versus Output-based Limits

The Regional Forum has considered at length the merits of input versus output-based limits. The Regional Forum has a philosophical preference for output-based methods/limits/constraints as they are considered to enable greater freedom of action and, thus, support innovation to a greater degree than input-based methods/limits/constraints. Yet there remains a mix of technical uncertainties associated with setting precise numbers, and some very practical challenges in administering and enforcing compliance with output-based methods/limits/constraints. Thus, the Regional Forum has found it very difficult to recommend output-based limits at this time.

The Regional Forum observes this difficulty is being felt throughout New Zealand, with recent attention on reviews of the use of 'OverseerFM' and possible revised or alternative tools being currently investigated nationally. In broad terms, it is expected that continued investment in research along with technology advances will, over time, expand the potential for greater use of output-based methods/limits/constraints.

The Regional Forum endorses continued effort to explore and use output-based methods wherever possible in the future. However, at this time the Regional Forum has found it necessary to recommend a suite of input-based methods to provide the level of simplicity, practicality, enforceability, and timely direction of change needed. In doing so it is recognised that future shifts in land use and technology may drive unforeseen adverse effects. It will be necessary to remain alert for such developments and to be prepared in response, at appropriate intervals, to consider adjusting methods/limits/constraints.

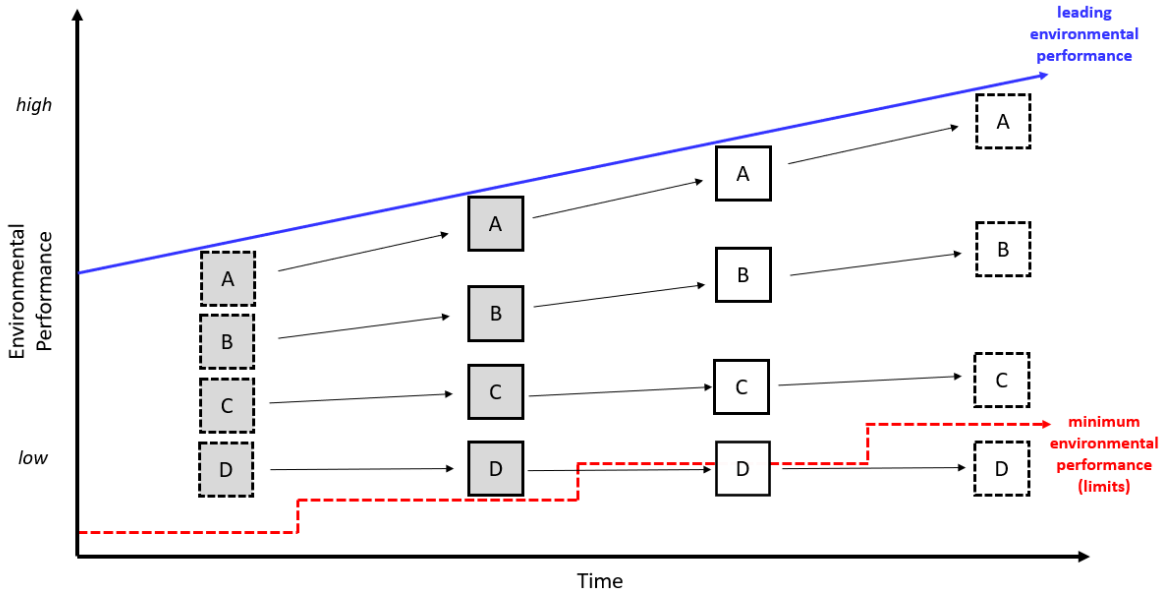


Figure 7. The influence of limits on environmental performance over time. This figure conceptualises the way in which different businesses both influence, and are influenced by, environmental limits over time.
Business types A: lead by defining the possibilities and the frontier of excellent environmental performance (and influences societal expectations in the process).
Business types B: are inspired by, learn from, and follow leaders in the field (often motivated by premiums to be gained in market).
Business types C: make minor gains in environmental performance over time to maintain market access and social licence, and to ensure regulatory compliance.
Business types D: make no environmental performance gains over time and are overtaken by shifting societal expectations of what represents minimum acceptable environmental performance (and in the process threaten the maintenance of social license for all businesses).

Compliance and Enforcement

Compliance and enforcement are seen as critical capability components of the transition to, and maintenance of, the collaborative approach proposed. Those who commit to, and support the collaborative approach need to trust that Environment Southland will ensure compliance, and if need be, enforcement, where specific individuals clearly breach regulatory expectations. Failure to ensure compliance, and failure to follow through with enforcement will place the transition to the desired collaborative approach at risk. Environment Southland must demonstrate both the will and the means to enforce regulations, ensuring sufficient investment in the specific talent and capabilities required. In practical terms, an immediate priority focus for compliance and enforcement efforts must be afforded to protecting existing wetlands from drainage and degradation within current regulations.

Recommendations

Landscape Susceptibility Risks

4.1 For each FMU, develop a landscape susceptibility risk matrix to define key landscape risks to freshwater. Landscape susceptibility risk matrices are to be informed by the best available technology (for example, physiographics, radiometrics, and/or lidar). An illustrative prototype of a landscape susceptibility risk matrix is included in Appendix E: Illustrative Prototype of a Landscape Susceptibility Risk Matrix.

4.2 For each FMU, landscape susceptibility risks to freshwater are to be defined and published as FMU Landscape Susceptibility Schedules, and specified risks are to be responded to within Environmental Management Plans within each FMU.

Environmental Management Plans and Resource Consents

4.3 Environment Southland requires Environmental Management Plans for all land and water uses likely to influence FMU hauora outcomes. Environmental Management Plans will be expected to explicitly reference relevant Landscape Susceptibility Schedules and demonstrate alignment to relevant regional FMU Hauora Plans.

4.4 Environment Southland develop a specific “mini” Environmental Management Plan template for land uses which do not exceed the threshold to be categorized as commercial farming or business operations. For example, lifestyle blocks, and landholding less than 20 hectares in rural zones. It is anticipated that a checklist approach will be most useful in triggering landowner actions that contribute to improved freshwater management.

4.5 Environment Southland develop checklists (or decision-trees), by FMU, that define land-use and water-use activities that require:

a. resource consent,
b. an environmental management plan,
c. a mini environmental management plan

4.6 Environmental Management Plans are informed, guided, and constrained by FMU Landscape Susceptibility Schedules, developed from FMU Landscape Susceptibility Risk Matrices.

Livestock Intensity

4.7 As part of managing key landscape susceptibility risks to freshwater by FMU, Environment Southland define farm stock-carrying capacity thresholds that require either resource consent or a specific response within a farm environmental management plan.

4.8 As part of managing key landscape susceptibility risks to freshwater by FMU, Environment Southland define intensive winter grazing thresholds that require either resource consent or a specific response within a farm environmental management plan.

Nutrient Management

4.9 As part of managing key landscape susceptibility risks to freshwater, Environment Southland defines a cap on the annual application of nitrogen (synthetic and organic), that to exceed requires either resource consent or a specific response within a farm environmental management plan.

4.10 As part of managing key landscape susceptibility risks to freshwater by FMU, Environment Southland define available phosphorous (Olsen P soil test) thresholds that require either resource consent or a specific response within a farm environmental management plan.

4.11 Environment Southland restricts the application of soluble phosphate and nitrogen when local soil temperatures and soil moisture conditions are not appropriate. It is expected that the Environment Southland soil monitoring network, or some other suitable regional monitoring network, or installed meters, or hand-held meters will be used to determine when soil conditions are appropriate. Environmental Management Plans may be used to provide flexibility and environmental protection in cases where application may be justified outside of usual parameters.

4.12 Environment Southland require that Environmental Management Plans must include an annual nutrient budget (planned application), and require that proof of nitrogen and phosphorous application (actual application) is recorded annually with inclusion of application trace maps.

4.13 Environment Southland implement a farm soil testing protocol which defines frequency and intensity of soil testing required of land-users, when this is required as a resource consent condition. It is expected this soil testing protocol is guided both by FMU landscape susceptibility risk matrices, and by the key indicators of soil health. (This protocol might be promoted amongst the wider community as representative of sound “hauora management practice”, influencing soil management practices where resource consent is not required).

Early Adoption, and Mitigation Reporting

4.14 Environment Southland includes provision within Environmental Management Plans for land users to record early-adoption investment, initiatives, and projects undertaken from 2010 (the year the regional plan first became operative) onwards in order to better understand and recognise the scale of existing early-adoption investment.

4.15 Environment Southland and Te Ao Mārama Inc collaborate to map and stocktake known examples of "early adoption" of land-use change and major mitigation investments since 2010 in order to recognise and acknowledge the positive contribution to freshwater outcomes. Examples could include transition to less intensive farming systems, development of major wetlands, re-forestation efforts, and conservation initiatives.

4.16 Environment Southland and Te Ao Mārama Inc collaborate to maintain a register of land-use change and major mitigation investments from when the Southland Water and Plan change becomes operative in order to track, record, report and recognise gains to freshwater outcomes.

Benchmarking

4.17 Environment Southland embed a "risk and mitigation scorecard" within environmental management plans to:

a. to enable benchmarking, at a regional and FMU level, by land users; and
b. to enable targeted extension, and monitoring of businesses considered to represent a high risk to freshwater hauora outcomes.

Compliance and Enforcement

4.18 Environment Southland maintains sufficient effective compliance and enforcement capabilities, sustaining investment in key compliance capability areas.

4.19 Environment Southland demonstrates a consistent willingness to act in firm and predictable ways in response to infringements and serious breaches of regulations.

4.20 Environment Southland gives an immediate priority focus for compliance and enforcement efforts to protecting existing wetlands from drainage and degradation within current regulations.

Repurposing Land

Repurposing vs Retirement

The Regional Forum has very mindfully and deliberately chosen to describe the conversion of land use as "repurposing" rather than "retiring". This choice reflects the understanding that land converted from commercial production purposes to uses that intensify ecological services for improved freshwater outcomes will continue to deliver value, albeit in a different form than direct production gains and profit. In addition, ecological intensification is expected to support a form of cultural rebalancing and cultural enrichment, returning increased opportunities for Ngāi Tahu Ki Murihiku to exercise customary practices within the region's waterbodies and landscapes, supporting the important function of intergenerational knowledge transfer. Outdoor recreational opportunities for the wider community might also be expected to expand.

In contrast to "repurposing", the concept of "retirement" carries connotations of latent potential and unrealised value. "Repurposing" suggests that value is being delivered via alternate means, and also acknowledges the potential for complementary land-use diversification which might deliver economic value in diverse ways (for example, from agritourism, to marketing advantages, to securing social licence). It is expected that, over time, financial and banking systems will adapt further to more effectively recognise and value investment in land repurposing initiatives that intensify ecological services for improved freshwater outcomes.

Public Land

Within the construct of hauora-led ICM, the Regional Forum considers there is both an opportunity and a moral imperative to repurpose public land for increased ecosystem services. Within the Southland region there are parcels of land controlled and managed by government agencies. It seems entirely appropriate that if private landowners are expected to explore changes to management systems that intensify ecological services for improved freshwater outcomes, then owners of public land should not be excluded from a similar obligation.

The total quantum of public land potentially available for repurposing represents less than 3% of the Southland land area, and not all of this land may immediately lend itself to repurposing. Thus, the overall impact on freshwater quality and contribution to hauora outcomes is likely to be limited. Yet, as a matter of principle, repurposing (where possible) is seen as "the right thing to do".

Environment Southland, as one entity with public land holdings, has an opportunity to not only lead by example in this respect by role-modelling land repurposing, but also to promote education and learning from repurposing projects, such that other property owners and managers might be both inspired and informed to initiate their own land re-purposing initiatives. Further, opportunity to role- model, demonstrate, promote, share learning, and facilitate different ways indigenous biodiversity can be integrated within repurposing projects is considered highly complementary.

Additionally, Environment Southland might actively engage with other managers of public land to promote, explore, and support opportunities for land re-purposing that supports improved ecological outcomes. Department of Conservation, Land Information New Zealand and Southland's territorial authorities represent the entities with a stake in this approach.

A further approach which might be considered is the public acquisition of private land in order to repurpose and manage it for the collective good.

Private Land

Opportunities for the repurposing of privately owned land, at various scales, should also be supported by Environment Southland and Te Ao Mārama Inc. This will be dependent upon owners of private land demonstrating an interest and willingness to consider repurposing land from production to ecosystem services. Sharing information that might inspire and enable land repurposing is considered helpful. Such information should include:

1. Results of FMU analysis indicating land that might be considered suitable and/or a priority for repurposing.
2. Stories and information of other successful land repurposing projects within different FMUs across the region.
3. Information on support and resources available to landowners and managers undertaking land repurposing projects.

Recommendations

5.1 Environment Southland repurpose, where appropriate, its own public land for increased ecosystem services that align with FMU Hauora objectives.

5.2 Environment Southland role-models land repurposing for increased ecosystem services, sharing information, knowledge, and insights from land repurposing projects to inspire and inform other regional landowners and managers to initiate land re-purposing initiatives.

5.3 Environment Southland and Te Ao Mārama Inc actively engage with other regional managers of public land (Territorial Authorities, DOC, LINZ) to promote, explore, and support opportunities for land re-purposing that supports improved ecological outcomes that align with FMU Hauora objectives.

5.4 Environment Southland undertake or sponsor a thorough geospatial and physiographic analysis, by FMU, to identify locations and areas most suited to repurposing for increased environmental services aligned with FMU Hauora Objectives (for example, steep farmland in FMU headwater areas), ensuring the resulting analysis is available to all regional landowners and users.

5.5 Environment Southland and Te Ao Mārama Inc collaboratively promote and support indigenous forest planting and indigenous re-forestation projects, including wetland and tussock land projects.

Wetland Protection, Restoration, and Development

Wetlands were once a dominant feature of the Southland landscape but significant loss over time, including over 2700 hectares in the last quarter century, have created a deficit in the natural system that is negatively impacting the health of waterbodies in the region. Between 1996 and 2018 Southland recorded the biggest loss of freshwater wetlands of any region, contributing to almost half (46 percent) of the total loss of freshwater wetlands in New Zealand with a reduction of 2,665 hectares[16].

Ngāi Tahu ki Murihiku have an explicit aspiration for wetland extent lost since 1995 to be restored to the same extent[17] by 2035. Moving beyond this aspiration, the Regional Forum believes there is significant potential and value in a more extensive, long-term programme of wetland development and restoration.

The scientific and economic scenario modelling, when considered together, suggest that the reestablishment of wetlands at scale, potentially up to 5% of modified land, represents a strategic investment in the campaign for the region's freshwater resources. The science scenario modelling indicates that wetland development has the potential to deliver significant reductions in contaminants across all FMU with the comprehensive implementation of combined mitigation packages at a large spatial scale. In particular, modelling simulations show the greatest potential water quality benefits associated with on-farm wetland construction and with the implementation of a suite of land management options and known (or developing) pastoral farm mitigation controls.

The economic scenario modelling indicates that there is likely to be significant costs incurred in implementing wetland redevelopment projects at scale. The expense of such wetland development efforts is driven by the need for carefully design, well-engineered, well-placed wetland infrastructure which optimises water residency times for best treatment outcomes. In simple terms, this suggests significant gains but at significant cost, with a dependency upon access to specialist knowledge and capabilities. Thus, the emerging notion of the need to consider wetland development as a strategic endeavour for the region.

The Regional Forum have identified that the term wetland means different things to different people and encompasses a wide range of types, from highly engineered constructed systems to natural bogs, swamps, fens, and marshes, to duck ponds, farm dams, and sediment detention ponds. These will each have different values associated with them, such as mahinga kai and biodiversity values, and a range of freshwater objectives that they support, such as nutrient treatment or supporting natural hydrology by slowing down and storing water. Their differences need to be considered within the governing rule framework for the region. A key principle endorsed by the Regional Forum is that the 'right wetland in the right place' will be most effective to achieve desired outcomes.

When considering where effort is needed and where costs fall, the Regional Forum have also identified a core principle of fairness that must be applied to requirements for and funding of wetland development and restoration. It will be important to reward those who act, or have acted, early to develop or restore wetlands and who protect remaining wetlands on their property, recognising wetlands as a natural asset. There needs to be a direct relationship between higher impact or higher emitting farms and businesses (with reference to risk matrix) and requirements for wetland restoration or development, whether on the source property or externally in the most effective location using supporting mechanisms.

Peatland Protection and Restoration

Of significance when considering the management of regional wetland resources is the more specific task of protecting and restoring peatlands, or locations with Organic (peat) soils. Peat forms from the build-up of partially rotted plant material in wet environments over extensive periods. Peatlands represent unique hydrological and ecological environments which also absorb and store carbon. Yet peat is also a highly productive growing medium, and when developed for farming purposes carries the risk of subsidence and

[16] https://www.stats.govt.nz/indicators/wetland-area

[17] The use of the term "same extent" is understood to mean an area equivalent to that which existed in 1995, but not necessarily the same exact locations where wetlands existed in 1995.

carbon dioxide (CO2) loss to the atmosphere. Protecting remaining peatlands, and restoring peatland where possible, is considered a high priority within the wider wetland management effort. Such efforts might include:

1. Increasing public awareness of the sensitivity and significance of peatland resources, both as carbon sinks and as unique hydrological and ecological environments, in order to inspire protection and restoration efforts.
2. Encouraging (and possibly incentivising) early action (pre-task force) to minimise the use of peat (Organic soils), which were often marginal land when developed for primary production.
3. Encouraging (and possibly incentivising) farm-scale protection and restoration efforts where small patches or pockets of peatland occur on individual properties.
4. Application of improved technology (LiDAR and radiometric surveys) to map developed peatlands (for example, peatlands now in pasture).

Wetlands Task Force

In light of this strategic nature of wetlands, there is potential to take a new and innovative approach to promoting, supporting, and facilitating wetland development across the FMUs of the region and establish Southland as a leader in wetland restoration and development. It is suggested that Environment Southland form a regional wetlands task force, encouraging a multi-agency approach to planning and managing a regional programme of wetland development. The establishment of such a multi-agency task force would represent a co-investment approach by involved stakeholders, seeking to de-risk investment by spreading and sharing in the costs. At the same time this collaborative approach would seek to leverage expertise and knowledge, specialist resources and capabilities, energy, learning and innovation to enable operations at scale in accelerating wetland re-establishment. In essence, a key focus for a wetlands task force would be to pursue innovative approaches in driving down the cost of wetland development, while simultaneously facilitating innovative approaches to delivering wetlands efficiently at scale.

Such a wetlands task force would best be established and managed applying the principle of "centralised control - decentralised execution" to ensure effective and efficient application of the specialist knowledge and resources needed across all FMUs of Southland in accordance with hauora-led priorities. In essence this means that while priorities for wetland protection, restoration, and development will be established for each FMU, the support provided by the wetlands task force to each FMU will be guided by the regional wetland priorities established by Environment Southland and Te Ao Mārama Inc through the co-governance process. Thus, it is not expected that the wetlands task force will provide equal support across all FMUs, at all times. Rather, efforts of the wetlands task force will be concentrated for specific designated periods and specific designated projects in support of specific FMU wetland priorities. This concentration of effort by the task force will make best use of limited resources to deliver wetland outcomes where the need is considered greatest, and where resources can be brought to bear most efficiently and effectively.

Once established, a wetlands task force might respond to wetland redevelopment opportunities concurrently in different modes, potentially:

1. accepting a leading role in implementing a wetland project;
2. working in equal collaboration with a like-minded partner agency on a wetland project;
3. working in a supporting role, facilitating the efforts of another lead agency to implement a wetland project; or
4. enabling a self-help approach by landowners for small wetland projects.

It is expected that the regional "knowledge advantage" gained through the activities of the wetlands task force will be leveraged to the greatest degree possible, sharing information and data as widely as possible, by different channels, to both inspire and enable "on the ground" action in support of wetland outcomes. Thus, it is expected an outreach and extension function will be key part of the wetlands task force mission.

Recommendations

6.1 By 2025 Environment Southland is to undertake an analysis and stocktake by FMU, including use of physiographics and radiometrics, to identify:

a. The specific loss of wetlands, by FMU, since 1995, in order to support and quantify the Ngāi Tahu Ki Murihiku aspiration for wetland land cover extent lost since 1995 to be restored to the same extent by 2035.
b. Wetlands needed to address water quality issues.
c. Locations and areas most suited to wetland restoration or development, ensuring the resulting analysis informs hauora plans and is available to landowners and users. Consideration of urban and industrial wetland priorities should be included.

6.2 Environment Southland lead the formation of a regional wetlands task force, encouraging a multi-agency approach, to plan and manage a regional programme of wetland development. The wetlands task force purpose is to leverage collaborative energy, innovation, and co-investment in enabling capabilities, and operations at scale to accelerate wetland re-establishment across all FMUs, in support of FMU Hauora Objectives. In particular the wetland task force will:

a. Involve territorial authorities, Ngāi Tahu, experts in wetland implementation and land management, and a range of partners.
b. Explore and implement a variety of funding models, mechanisms, and sources, incorporating the core principle of fairness and recognising the value of wetlands (e.g., as assets, as essential infrastructure, through rates or tax incentives).
c. Co-ordinate efforts to deliver on priorities and targets established through hauora plans and enable strategic wetland placement to ensure the 'right wetland in the right place'.
d. Build capacity for delivery and knowledge of wetland development and maintenance methods across the region.
e. Support landowners and communities seeking to establish and maintain wetlands, whether small scale or large scale.
f. Support implementation of the suite of Regional Forum recommendations.

6.3 Ensure that when developing wetlands for water treatment and water quality purposes:

a. Pollutants are treated at source or as close as possible to source.
b. Intensive land users develop highly constructed wetlands equivalent to 5% of area of the intensive land use, either on the property or in the best location off property using supporting mechanisms, for addressing nitrogen.
c. Extensive land users develop simpler wetlands and sediment traps designed for addressing sediment and nutrients.
d. Associated flow regimes in permanently flowing waterbodies assist treatment with sufficient flow.

6.4 Environment Southland and Te Ao Mārama Inc collaboratively establish targets, by FMU, for the amount and quality of wetland restoration or development expected at five-year increments as part of hauora planning.

6.5 Environment Southland develop permitted activities and streamlined consenting processes for wetland restoration and development, including "farm-gate approvals" for small-scale wetland projects, as a high priority initiative.

6.6 In concert with the wetlands task force, Environment Southland provide targeted facilitation support to large-scale wetland restoration and development projects.

6.7 Ensure tougher enforcement for non-compliance with current regulations that prevent wetland drainage.

6.8 Recognising the sensitivity and significance of Organic (peat soils), utilise the recommended risk matrix approach to determine appropriate land use on Organic (peat) soils, and support landowners to protect and restore them as wetlands where it is feasible to do so, especially where significant catchment hauora gains are probable.

6.9 Incentivise early action, recognising there is no time to waste and ramping up effort through the wetlands task force will take time.

6.10 Provide credit and recognition for early adopters and those who have retained existing wetlands, whilst increasing pressure on land users delaying action or with higher impact activities.

6.11 Prioritise wetland restoration and development in FMUs with greatest degree of economic buffering and consider targeted support for local communities that have disproportionate economic impacts.

Waiau FMU

The Waiau FMU is unique within Southland and New Zealand. No other New Zealand FMU supports such a highly extractive hydroelectricity generation system. Up to 95% of the Waiau River flow is able to be diverted and because of the natural size of the river this allocation of water represents around two thirds of allocated water in the country, a massive allocation.

Lakes Te Anau and Manapōuri, and the Waiau River are recorded in statute for their cultural significance to Ngāi Tahu and embedded in pūrākau, the stories of Ngāi Tahu, including mahinga kai practices associated with the lakes, river and coast. The Regional Forum understands that there are legacy effects in the catchment and coastal waters as a result of the damming of the river, resulting in loss of mana of the river. Applying a ki uta ki tai lens, the diversion of water from the FMU has distinct downstream impacts on water quality and environmental health, evident as far as Te Waewae Bay and Foveaux Strait. There are a number of parties working to restore te mana o te Waiau. The Regional Forum recognises the interconnected nature of natural systems and their interaction with the hydroelectric power scheme control structures.

The Regional Forum understands that there will need to be an increase in flows in the lower Waiau to restore te mana o te Waiau. By enabling more of the lake water to flow down the river the 'life blood' will come back into this natural system. The waters of the Mararoa tributary are naturally high in sediment, with some additional contribution due to human induced changes in land cover. The waters of the Mararoa tributary significantly change the quality of the river in the absence of lake flow contribution. Flushing flows[18] are recognised as critically important to help mitigate the build-up of sediments, and for management of periphyton biomass.

The Regional Forum acknowledges that the Meridian owned and operated Manapōuri hydroelectric power scheme represents a strategic asset to New Zealand, particularly as we continue to reduce the nation's dependence on fossil fuels and meet our international commitments to reduce greenhouse gas emissions. Climate change effects are predicted that will also affect the catchment and the hydroelectricity scheme, such as reduced snowfall, rising snow lines, and increased dry periods.

The Regional Forum recognises the multiple environmental, cultural, social, and economic interdependencies at play in the Waiau FMU. In light of these interdependencies and the need for more mindful stewardship of the natural resources of the Waiau, the Regional Forum promotes a future approach that:

1. is based on co-governance,
2. addresses legacy issues,
3. more effectively incorporates various stakeholder interests and influences,
4. increases investment in science and monitoring, and

[18] Developed as part of a consent condition, there is an existing protocol with Meridian for the provision of voluntary supplementary flows to control periphyton biomass in the Lower Waiau River - the Lower Waiau River Voluntary Supplementary Flows Protocol.

5. is iterative and adaptive in response to new knowledge and insights.

Recognizing the unique nature of the Waiau river and control structures associated with the hydroelectricity generation system, the Waiau river might be considered to be of significant interest to science and research endeavours which seek to better understand the drivers of hauora within New Zealand river systems. There is potential for significant knowledge gains over time from research focused on the Waiau FMU. Beyond the immediate utility of the science programme to establish appropriate flow regimes for the lower Waiau (recommended below), a longitudinal research programme offers potential insights that cannot be gained from any comparable river setting in NZ. An ongoing and integrated research programme of the Waiau river promises knowledge that supports efforts to manage hauora in other river systems of New Zealand, while also supporting positive outcomes for the Waiau FMU in the face of future climate change impacts.

Recommendations

Waiau River Classification

7.1 For the purpose of hauora-led integrated catchment management of the Waiau FMU, the Waiau river should be classified as lake-fed, in accordance with its original state. Such a classification will allow for management of freshwater objectives against reference state conditions, and importantly, culturally, represents recognition of the whakapapa (lineage) of the Waiau river.

Establishing Hauora-Led Flow Regimes

7.2 Mandatory flushing flows must be instituted as soon as possible and remain in place while more comprehensive changes to the lower Waiau flow regime are developed, and are to:

a. be a minimum of five flushing flows annually,
b. be undertaken at times and intervals most conducive to the ecological health of the lower Waiau, and
c. incorporate gradual increase and decrease of flow rates for the benefit of river health (for example, giving consideration to riverbank erosion effects).

7.3 The flow regime for the lower Waiau must be revisited by the time of the next plan change and an approach developed that will guide the reconsenting of the Manapōuri scheme upon expiry of existing consents, based on:

a. improving the life supporting capacity of the river,
b. a synthesis of available science,
c. the potential for staged implementation,
d. understanding the impact on national electricity supply and options for security of supply,
e. exploration of management options including storage or 'banking' of flows, variable flows, and increased minimum flows, and
f. consideration of lake levels and water temperature.

Science Programme

7.4 In order to support establishment, and review, of a new flow regime and other actions that help restore te mana o te Waiau, undertake a programme of additional science that is:

a. funded by ES, with support from Meridian,
b. established in partnership with Ngāi Tahu and community stakeholders,
c. informed by a gap analysis of existing science,
d. on-going,
e. able to support intergenerational understanding of the river, and
f. addresses predicted climate change effects.

Waiau Catchment Hauora Planning

7.5 Support an integrated ki uta ki tai approach in the Waiau catchment by relying on a hauora plan for the catchment in its entirety, and by:

a. managing contaminant load reductions in the tributaries of the Waiau guided by periphyton objectives; and
b. reviewing and undertaking further modelling and analysis of FMU contaminant load reduction targets needed to meet freshwater objectives once the revised flow regime for the lower Waiau is confirmed.

Urban and Industrial Wastewater

The overarching intent with respect to regional management of urban and industrial wastewater is to end all direct-to-water wastewater discharges by 2045.

For Ngāi Tahu Ki Murihiku, the discharge of wastewater direct to waterbodies is considered highly offensive, and a practice which compromises the mana of the water. As mana whenua (Treaty partner), the Ngāi Tahu Ki Murihiku aspiration is that this culturally unacceptable practice is terminated within a generation (no later than 2045). This sense of offence is carried by many others within the Southland community and is by no means unique to mana whenua.

The Regional Forum recognises that to achieve this aim will require significant analysis, effort, and investment. As such, ending direct-to-water wastewater discharges by 2045 is considered one of the core challenges to achieve the communities' aspirations for freshwater. A very deliberate, measured, focused, and collaborative effort will be required to achieve this outcome. The co-analysis approach introduced in recommendations below represents an important element in driving collaboration on this issue for positive hauora and community outcomes.

Three Waters Reform

It is acknowledged that the wider national government three-waters reform programme is expected to establish new publicly owned water service entities by July 2024. The recommendations below are considered agnostic in respect of the entity responsible for managing water services. The expectation is that Territorial Authorities will serve their ratepayers by commencing this recommended programme of work, handing over responsibility at the appropriate point in time, and for this work to continue undisrupted.

Phases and Timeframes for Wastewater System Upgrades

The recommendations below for wastewater system upgrades are framed against Southland urban and industrial wastewater upgrades being managed using the following phased approach and timeframes:

Phase 1 - 2024 to 2026: Investigation and co-analysis of alternate wastewater treatment and disposal options.
Phase 2 - 2026 to 2027: Implementation planning.
Phase 3 - 2027 to 2032: Stage 1 implementation management.
Phase 4 - 2033 to 2037: Stage 2 implementation management.
Phase 5 - 2038 to 2045: Stage 3 implementation management.

These phases have been very mindfully and deliberately identified to align planning and implementation efforts for wastewater systems with local and regional government Long-Term Plan (LTP) three-yearly update cycles. In particular, the LTP update anticipated for 2027 looms as an important milestone. It is projected that this LTP update cycle will be the first opportunity to make meaningful forward investment provisions for wastewater system upgrades; those investment provisions having been informed by the process of investigation and co-analysis outlined in recommendations below.

Evaluation and Learning

The four-step approach, outlined in recommendations below, for responding to the challenge of removing wastewater discharge to Southland waterbodies is likely to be somewhat unique and, thus, of interest to other communities grappling with similar challenges (within New Zealand and abroad). A programme of evaluation is recommended in order to facilitate learning that may be of significant to future regional efforts, and of interest to communities beyond Southland.

Recommendations

Investigation of Alternate Treatment and Disposal Options

8.1 Environment Southland and Te Ao Mārama Inc co-invest with the region's three Territorial Authorities in a study of established and emerging alternate treatment and disposal options in order to inform and catalyse detailed investigation of future wastewater management options for Southland. Study results are expected to encompass urban and industrial contexts, and it is expected that study results will be shared with regional commercial entities with a stake in wastewater management.

8.2 For every existing consented wastewater discharge a thorough, extensive, and detailed investigation is undertaken to identify the range of potential and possible options that will provide for wastewater treatment and disposal without direct discharge to water.

8.3 The terms of reference for each discharge-specific investigation are to be developed in conjunction with Environment Southland and Te Ao Mārama Inc to ensure the integrity and transparency of each investigation for all key stakeholders.

8.4 Investigations are to be commissioned and complete within three years of notification of the plan change (thus, anticipated to be complete no later than December 2026).

Co-Analysis of the Investigation Implications

8.5 Consideration and analysis of the findings from each site-specific investigation is to be undertaken in conjunction with Environment Southland and Te Ao Mārama Inc, applying a "co-analysis" process which further ensures the integrity and transparency in respect of the resulting investment decisions that follow.

8.6 Environment Southland and Te Ao Mārama Inc are to develop the supporting "co-analysis" concept in detail, and communicate this concept to affected stakeholders (regional Territorial Authorities and commercial entities) no later than 30 March 2024, in order to manage expectations of the co-analysis process. It is expected that an outline of the co-analysis approach to be adopted will be appended to the Terms of Reference for each site-specific investigation.

Implementation Planning

8.7 Following the co-analysis of each site-specific investigation findings, an investment and implementation plan is to be developed by Territorial Authorities (for urban wastewater) and by commercial entities (for industrial wastewater), outlining the planned treatment and disposal system upgrades necessary.

8.8 Territorial Authorities will make investment provision for the resulting wastewater system upgrades within their 2027 - 2037 Long Term Plan, indicating when specific wastewater system infrastructure will be upgraded.

8.9 Where it is determined that specific wastewater infrastructure will not be upgraded within the 10-year period to 2037, Territorial Authorities will outline their strategic intent for remaining specific system upgrade investments in the period to 2045.

8.10 Commercial entities will be expected to register their strategic intent and investment provisions for planned wastewater system upgrades with Environment Southland no later than December 2027, in order to provide transparency for the purpose of co-governance decision making.

8.11 Respective FMU and Catchment Hauora Plans are to be updated to reflect the resulting planned wastewater system upgrades.

8.12 Over the period 2024 to 2028, FMU and Catchment Hauora Monitoring Plans will establish hauora baselines for each catchment where consented discharge of wastewater to waterbodies currently occurs in order to subsequently quantify and articulate hauora changes resulting from wastewater infrastructure upgrades.

Implementation Management

8.13 Territorial Authorities and commercial entities are to work closely with Environment Southland and Te Ao Mārama Inc to ensure implementation of specific wastewater system upgrades occur within scheduled timeframes.

8.14 Industrial dischargers must provide and apply an environmental management plan aligning to relevant FMU Hauora Plans to renew consents.

8.15 At Environment Southland's discretion, existing discharge consents may be reviewed both to reflect the stated wastewater system upgrade investment intent, and to incentivise investment in system upgrade implementation.

8.16 Respective FMU and Catchment Hauora Plans are to be updated to reflect the resulting implemented wastewater system upgrades.

8.17 FMU and Catchment Hauora Monitoring Plans will report annually on changes to waterbody hauora seeking to establish direct or indirect relationships between wastewater infrastructure upgrades and waterbody hauora outcomes.

Evaluation and Learning

8.18 It is recommended that a programme of evaluation be designed to determine the efficacy of the process, and progressively capture insights that will:

a. Facilitate learning amongst key stakeholders to support process improvement within each phase.
b. Be of potential interest to other communities, nationally and internationally, which may be considering best-practice options as they manage their own waste-water treatment and disposal challenges.

8.19 This programme of evaluation might be considered as a form of longitudinal research. Consideration should be given to engaging an external research partner from the outset to support the design and implementation of the programme of evaluation.

Localised Wastewater Systems

Across Southland, there is a wide variety of localised wastewater systems, septic tanks representing the most common type. Such systems are very common in rural settings, particularly in remote rural settings where it is not feasible to connect to urban wastewater systems. Such systems are prevalent and concentrated in many semi-rural areas, for example, on the many lifestyle blocks on the outskirts of Invercargill. Such systems, if obsolete, poorly installed, or poorly maintained, have the potential to contribute to catchment contaminant loads. Composting toilets and other alternate forms of local, non-networked toilet systems are likely to increase in prevalence in future in appropriate settings.

In the absence of reliable data, it remains difficult to quantify the risk presented by localised wastewater systems, and thus, difficult to manage associated negative effects. The recommendations below are focused in establishing a more reliable data set in respect of localised wastewater systems, encouraging correct installation and maintenance of such systems, encourage innovation, and enabling improved analysis and management of contamination risks from localised systems.

Recommendations

9.1 Implement a programme to register and certify septic tank and other alternative non-networked toilet systems, to inform FMU hauora planning and monitoring. Registration should include information such

as geolocation, age/installation date, capacity, outlet description, and ownership. Registration might be efficiently managed within the Environmental Management Plan for many Southland properties.

9.2 Implement a certification programme for septic tanks and alternative toilet systems, that as a minimum considers:

a. system maintenance,
b. bypass pipes or overland flow paths to surface water,
c. the operation and performance of the disposal field (if applicable), and
d. the suitability/environmental risk of the system, considering the environmental setting it is installed in.

9.3 Where existing septic tank or alternative toilet systems do not meet certification requirements, they must be repaired, retired, upgraded, or replaced with a system that complies with current building/environmental regulations.

9.4 The time frame for undertaking repairs, upgrades, replacements, or retirements will be determined by Environment Southland, taking into account the risks posed to water quality and the extent and cost of work required.

9.5 In order to facilitate and incentivise innovation in managing localised wastewater systems, consent new technology trials with enabling provisions in the plan and consenting framework.

9.6 Permit the use of alternate technologies for localised wastewater systems in appropriate settings (for example, composting toilets).

Stormwater Management

The Ministry for the Environment National Planning Standards[19] define stormwater as:

> "run-off that has been intercepted, channelled, diverted, intensified or accelerated by human modification of a land surface, or run-off from the surface of any structure, as a result of precipitation and includes any contaminants contained within."

Examples of the risks associated with stormwater are that it:

1. Can contribute to flooding and erosion.
2. Can contribute to sediment transport and increased deposition of sediments.
3. Contains contaminants and has the potential to affect the ecological health of our waterways and coastal waters (acutely following precipitation events, or chronically due to accumulation over time), as well as on the economic, social, and cultural value of these environments.
4. Can be costly to operate and maintain reticulated networks within urban networks costing millions of dollars each year, including upgrades and additions to the stormwater network.

In the context of stormwater, the discussion that follows uses the terms "filtered" and "unfiltered" (rather than "treated" or "untreated", which often carries an association with chemical treatment) in a broad and inclusive sense. Thus, in the context of stormwater, the concept of filtration is intended to include an understanding of the need for both physical and cultural filtration of stormwater. From a Ngāi Tahu ki Murihiku perspective, stormwater is appropriately filtered through contact with the whenua (land) before entering a waterbody, and thus, the mana whenua preference will always lie with land-based filtration systems. For illustrative purposes, a range of practical stormwater management devices that both filter and slow stormwater across the landscape are shown in Appendix L: Stormwater Management Devices in the Auckland Region.

[19] Ministry for the Environment. November 2019. ***National Planning Standards***. Wellington: Ministry for the Environment.

Currently, the majority of stormwater that enters an urban reticulated network is unfiltered, with no delineation between low-risk stormwater such as that from roofs or park space and high-risk stormwater such as that from roading and industrial areas. These different forms of stormwater are collected and mixed together before being discharges into a nearby waterbody.

The level of risk inherent in stormwater management is site and context specific, reflecting the dynamic intersection of ecosystem vulnerability, and stormwater quantities and character. A risk gradient (lower risk to higher risk) can be defined against which to evaluate each instance of stormwater occurrence within specific FMU settings. Where stormwater discharges are already subject to resource consent, this indicates they have already been assessed as carrying a higher degree of risk to ecosystem health.

Management of consented stormwater discharges is closely connected to the issue of wastewater management (discussed above). The overarching intent with respect to regional management of consented stormwater discharges is to end the discharge of unfiltered, high-risk stormwater into stormwater networks and subsequently the practice of directly discharging unfiltered, contaminated stormwater direct to water by 2045.

In a similar fashion to wastewater management, for Ngāi Tahu Ki Murihiku, the consented discharge of unfiltered, contaminated stormwater direct to waterbodies is considered offensive, and a practice which compromises the mana of the water. As mana whenua (Treaty partner), the Ngāi Tahu Ki Murihiku aspiration is that this culturally unacceptable practice is terminated within a generation (no later than 2045).

It is important to note that Ngāi Tahu Ki Murihiku prioritise the termination of wastewater discharges direct to waterbodies. However, given the relationship and connections between management of both wastewater and stormwater, it makes a great deal of sense to at least consider and analyse future management options in an integrated manner, if not manage them in an a more integrated manner in future. Accordingly, the recommendations below are structured and presented in a way that mirrors or parallels the recommendations provided for transitioning to improved systems for wastewater management (investigation of alternate treatment and disposal options, co-analysis of the investigation implications, implementation planning, implementation management, and evaluation and learning).

The Regional Forum recognises the potential for improved management of consented stormwater discharges in support of improved hauora outcomes. The Regional Forum accepts that in regard to contaminant loading both higher risk (e.g., urban, trade, and industrial sites, roads) and lower risk (e.g., rainfall from roof capture, snow melt) stormwater exists. It is expected that effort is made to evaluate stormwater risk, prioritising mitigation, treatment, and management where risk is assessed to threaten the hauora of waterbodies.

It is recognised that the improvements in urban and industrial wastewater treatment and disposal recommended (above) within this report will contribute to improved management of storm water. There is opportunity for improved treatment and mitigation of stormwater through infrastructure investment at household level, and more widely within housing and industrial development projects. Further, there is opportunity for improved treatment and mitigation of stormwater of runoff from roads into urban waterways, like the Waihopai River for example. Floating wetlands, sediment traps, infiltration zones, large scale riparian planting, and other types of retrofitted mitigations offer potential for hauora gains in such urban waterway settings.

Recommendations

Investigation of Alternate Treatment and Disposal Options

10.1 Environment Southland co-invest with the region's three Territorial Authorities in a study of established and emerging alternate treatment and disposal options in order to inform and catalyse detailed investigation of future stormwater management options for Southland. Study results are expected to encompass urban and industrial contexts, and it is expected that study results will be shared with regional commercial entities with a stake in stormwater management.

10.2 For every existing consented stormwater discharge a thorough, extensive, and detailed investigation is undertaken to identify the range of potential and possible options to filter high risk stormwater from roading, industrial sites, and other sources prior to it entering a stormwater network and to identify the range of potential and possible options for filtering urban stormwater prior to its discharge into a waterbody.

10.3 The terms of reference for each discharge-specific investigation are to be developed in conjunction with Environment Southland and Te Ao Mārama Inc to ensure the integrity and transparency of each investigation for all key stakeholders.

10.4 Investigations are to be commissioned and complete within three years of notification of the plan change (thus, anticipated to be complete no later than December 2026).

Co-Analysis of the Investigation Implications

10.5. Consideration and analysis of the findings from each discharge-specific investigation is to be undertaken in conjunction with Environment Southland and Te Ao Mārama Inc, applying a "co-analysis" process which further ensures the integrity and transparency in respect of the resulting investment decisions that follow.

10.6 Environment Southland and Te Ao Mārama Inc are to develop the supporting "co-analysis" concept in detail and communicate this concept to affected stakeholders (regional Territorial Authorities and commercial entities) no later than 30 March 2024, in order to manage expectations of the co-analysis process. It is expected that an outline of the co-analysis approach to be adopted will be appended to the Terms of Reference for each discharge-specific investigation.

Implementation Planning

10.7 Following the co-analysis of each discharge-specific investigation findings, an investment and implementation plan is to be developed by Territorial Authorities (for urban stormwater) and by commercial entities (where any existing consented industrial stormwater discharge exists), outlining the planned treatment and disposal system upgrades necessary.

10.8 Territorial Authorities will make investment provision for the resulting stormwater system upgrades within their 2027 - 2037 Long Term Plan, indicating when specific stormwater system infrastructure will be upgraded.

10.9 Where it is determined that specific stormwater infrastructure will not be upgraded within the 10-year period to 2037, Territorial Authorities will outline their strategic intent for remaining specific system upgrade investments in the period to 2045.

10.11 Commercial entities (where any existing consented industrial stormwater discharge exists) will be expected to register their strategic intent and investment provisions for planned stormwater system upgrades with Environment Southland no later than December 2027, in order to provide transparency for the purpose of co-governance decision making.

10.12 Respective FMU and Catchment Hauora Plans are to be updated to reflect the resulting planned stormwater system upgrades.

10.13 Over the period 2024 to 2028, FMU and Catchment Hauora Monitoring Plans will establish hauora baselines for each catchment where consented discharge of stormwater to waterbodies currently occurs in order to subsequently quantify and articulate hauora changes resulting from stormwater infrastructure upgrades.

Implementation Management

10.14 Territorial Authorities and commercial entities are to work closely with Environment Southland and Te Ao Mārama Inc to ensure implementation of specific stormwater system upgrades occur within scheduled timeframes.

10.15 Industrial dischargers must provide and apply an environmental management plan aligning to relevant FMU Hauora Plans to renew consents.

10.16 At Environment Southland's discretion, existing discharge consents may be reviewed both to reflect the stated stormwater system upgrade investment intent, and to incentivise investment in system upgrade implementation.

10.17 Respective FMU and Catchment Hauora Plans are to be updated to reflect the resulting implemented stormwater system upgrades.

10.18 FMU and Catchment Hauora Monitoring Plans will report annually on changes to waterbody hauora seeking to establish direct or indirect relationships between stormwater infrastructure upgrades and waterbody hauora outcomes.

10.19 From the earliest opportunity, work with Territorial Authorities to run a fixed-term amnesty programme incentivising people to declare illegal stormwater discharges and cross-connections, and to support them in getting them appropriately resolved (making it as easy as possible to do the right thing).

10.20 In conjunction with Territorial Authorities, continue to monitor, explore, and address the source of wastewater and stormwater cross-contamination.

10.21 Integrate dedicated stormwater filtration areas into new developments and retrofit stormwater filtration into existing high-risk infrastructure such as urban roading and industrial areas, prior to stormwater from these areas entering a stormwater network.

10.22 Environment Southland develops a standard defining minimum treatment requirements for stormwater that will apply from 2035.

10.23 Environment Southland does not grant any new resource consents for unfiltered storm-water discharges to water, and from 2035 any filtered stormwater discharges that don't meet the standards developed in response to recommendation 10.22.

10.24 Consider the following initiatives in respect of future stormwater planning and management measures.

a. For future developments:
    i. Limit the amount of stormwater increases from new connections
    ii. Regulate for minimum percentage of area as treatment for stormwater, or provision of permeability, to slow water across landscapes.
    iii. Mandate minimum requirements for on-site stormwater storage and/or primary treatment (by swales, etc). It is expected this measure would support dual outcomes of treating stormwater and slowing water across landscapes during intense rainfall events.
b. For existing sites and households mandate minimum requirements for on-site stormwater storage.

Evaluation and Learning

10.25 In conjunction with evaluation of wastewater planning and management efforts (recommended above), it is recommended that a programme of evaluation be designed to determine the efficacy of the process, and progressively capture insights that will:

a. Facilitate learning amongst key stakeholders to support process improvement within each phase.
b. Be of potential interest to other communities, nationally and internationally, which may be considering best-practice options as they manage their own stormwater treatment and disposal challenges.

10.26 In conjunction with evaluation of wastewater planning and management efforts (recommended above), this programme of evaluation might be considered as a form of longitudinal research. Consideration should be given to engaging an external research partner from the outset to support the design and implementation of the programme of evaluation.

Water Quantity Considerations

The Region Forum acknowledges the strong connection between water quality and water quantity within regional water bodies. The Regional Forum recognises that the proposed Southland Water and Land Plan provides for restrictions on water abstraction in relation to catchment minimum flows.

The Regional Forum accepts that there is inherent uncertainty within the scientific and economic modelling available to date to support decision making, but that this modelling will continue to be refined and improved upon in future, in conjunction with improved monitoring regimes. The Regional Forum also accepts that climate change effects over coming decades may impact regional freshwater resources in unanticipated ways or to unanticipated degrees.

Accordingly, the Regional Forum believes it prudent to review existing arrangements pertaining to water quantity and abstraction limits at ten-year intervals, or more frequently. Additionally, as climate change impacts become more evident, it may be appropriate to consider regional and more localised needs for water security, including projects or initiatives that enhance community water security outcomes.

Recommendations

11.1 Environment Southland review existing water quantity limits every ten years, considering the need to implement revisions due to climate change effects and to continue to meet the needs of Te Mana o te Wai.

11.2 Environment Southland supports and encourages innovations and local projects with potential to improve water quantity resilience and water security, in both rural and urban settings.

Outreach and Education

As Murihiku Southland transitions to a new hauora-led system of integrated catchment management, there is strong need to invest in outreach and education capabilities. Such an investment might be undertaken with the support of like-minded partners, and in some instances a multi-agency approach to outreach and education may carry greater legitimacy.

Outreach and education capability should plan to leverage not just one channel or mode of outreach, but rather a bundle of different channels and modes, tailored for the different information needs and varying characteristics of different regional stakeholders. From face-to-face engagement to the provision of online resources, from targeted one-on-one engagement to larger community group engagement, from solo efforts to multi-agency efforts – outreach and education efforts must have a flexible, dynamic, responsive nature, adapting over time not only to what is considered important by Environment Southland, but also what information needs emerge from within and across regional communities.

Environmental Management Plans

One obvious and immediate need for outreach and education will be in respect of mandatory Environmental Management Plans. While it is acknowledged that environmental management plans are being mandated nationally, there is potential for Southland to tailor environment management plans to reflect specific FMU needs and our unique regional approach. It cannot be assumed that nationally developed and delivered outreach and education efforts will fully meet the specific needs of Southland. Development of regional outreach and education capability and resources will require local investment and management.

Cultural Monitoring

In order to incorporate Ngāi Tahu indicators of health and cultural monitoring within an integrated catchment monitoring programme, there will be need to invest in talent development and education. Those individuals actively contributing to and managing such a programme of integrated catchment monitoring will likely require upskilling in order to meet monitoring expectations. This may require the recruitment or outsourcing of additional talent. Environment Southland staff and councillors seem likely to need some additional upskilling in order to understand and effectively interpret the outcomes of such an integrated monitoring

approach. And information that is available and understandable to the wider public will be needed to ensure the monitoring results are both accessible and understandable to the communities of Southland. An investment in building capacity for delivering, managing, and interpreting the results of cultural monitoring will be necessary.

Land-use Change

External influences (such as international markets and supply chain management needs) will continue to trigger land-use changes within Southland. Additionally, various national and regional policy frameworks, along with advocacy groups, lobby groups, and public pressure also have the potential to trigger land-use changes within the region.

For business operators undertaking due-diligence in respect of potential land-use change choices, the provision of appropriate environmental information is considered both desirable and helpful. Within the Our Land and Water National Science Challenge framework, Lincoln University has developed a multi-criteria decision-making (MCDM) framework to support decision-making in respect of land-use change. There is potential to deploy and apply this multi-criteria decision-making (MCDM) tool within the specific context and needs of Southland, ensuring rural businesses and those that support them are better enabled and informed in respect of land-use choices.

Rural Contractors – Farm Support and Rural Infrastructure

Increasingly, rural businesses and other organisations such as Territorial Authorities routinely rely on contractors for support. Rural contractors as active agents in the rural landscape thus have considerable influence in the way landscapes are managed and modified. This is a particular regional sector with potential to both deliver positive or negative outcomes within their routine activities. From experience, specific risks associated with contractor activity can be identified. An outreach and education channel in respect of such risks across this sector is warranted.

Urban Mitigation

There are many practical measures that urban households can consider in support of improved hauora outcomes. Providing and promoting online information resources for urban households and small businesses can be cost-efficient way of triggering behaviour change across urban stakeholders.

Recommendations

12.1 Environment Southland undertakes a region wide outreach programme to introduce mandatory Environmental Management Plans, with an emphasis on rural users, small business operators, and rural support professionals.

12.2 Environment Southland and Te Ao Mārama Inc co-invest in a programme of education in cultural monitoring in order to secure sufficient talent and capacity for cultural monitoring of waterbodies within hauora-led integrated catchment monitoring.

12.3 Environment Southland work with Lincoln University to explore the potential for regional application of a multi-criteria decision-making (MCDM) framework for supporting decision-making about land-use change (developed through the Our Land and Water National Science Challenge).

12.4 Environment Southland collaborate with Territorial Authorities to ensure infrastructure managers and contractors are aware of, and account for, roadside run-off considerations when maintaining infrastructure such as unsealed roads and associated drainage structures. For example, grader operators might be targeted given their influence in maintaining and modifying rural roading networks. Develop best practice guidelines and checklists for use by contractors in the field (including forestry).

12.5 Develop and publish freshwater “hauora management practice” checklists for urban households and industrial sites, emphasizing both positive ecological outcomes and water security. Note that many Australian cities have extensive existing information resources pertaining to water conservation which may serve as a useful starting point.

12.6 Environment Southland promote information resources available to support farmers to recycle and utilise nutrients more effectively within farming operations.

Technology

It seems very likely that technology solutions that support improved freshwater outcomes will continue to develop and emerge at an accelerating rate over the next 20-year period. A key requirement for technology uptake and application of new technology-based solutions is absorptive capacity. Absorptive capacity can be defined as the ability to recognise the value of new information and technology, assimilate it, and apply it to organisational ends.

In respect of freshwater management in Murihiku Southland, the concept of technological absorptive capacity can be considered relevant at individual, group, organisational, and regional levels. Given Environment Southland's direct interest in effective management of natural resources, the Regional Forum believes there is a role for the Regional Council in contributing to maintenance of regional technological absorptive capacity. One option for doing so is to co-invest with specialist entities in a technology monitoring programme. The aim of such a programme would be to ensure there is regional capacity to evaluate the merits of new technology in the Southland context to inform technology investment decisions.

An important component of technological absorptive capacity is expert talent. One specific area of expertise that it is considered important to ensure Environment Southland has access to is soil science expertise. Soil science capacity within Environment Southland is considered critical to supporting continuing risk analysis and decision-making where physiographics underpins integrated catchment management.

Within the sphere of technology advances, the nation's Predator Free 2050 programme (in concert with like-minded partners such as the NZ Biological Heritage National Science Challenge, Manaaki Whenua, universities, and technology businesses) are making promising advances in respect of predator control. Such advances link to and complement efforts in respect of water quality gains. Effective predator control contributes to the health of the natural environment and supports positive mahinga kai outcomes. Opportunities to promote enhanced regional predator control programmes are thus seen as complementary and supportive of efforts to improve waterbody hauora outcomes.

Recommendations

13.1 Environment Southland invests in a technology monitoring programme to:

a. More effectively understand the potential advantages, costs, and challenges of leveraging emerging technology to promote improved freshwater outcomes.
b. Increase the organisation's capacity to effectively integrate emerging technology when appropriate.
c. Provide guidance to other Southland organisations and entities in respect of potential technology investments relating to water quality monitoring and management.

13.2 In implementing a technology monitoring programme, Environment Southland explores the potential for partnerships with other like-minded organisations to leverage technical knowledge and expertise. Potential technology monitoring partners might include:

a. Other regional councils – Otago Regional Council.
b. Regional training institutes – Southern Institute of Technology.
c. Universities – Otago, Lincoln, or Massey.
d. CRIs - Landcare Research or AgResearch.
e. National Science Challenges – Our Land and Water or NZ Biological Heritage.

13.3 Environment Southland secures access to appropriately qualified, responsive soil science advice to support effective physiographic informed risk analysis and decision-making.

13.4 In order to promote sustainable, resilient, regional farming systems, Environment Southland promote the development and integration of technology to harness the energy potential of farm effluent and other by-products (for example, on-farm bioenergy plants).

13.5 Environment Southland continues to support the application of promising technology in support of regional predator control and eradication programmes.

APPENDICES

Appendix A: Regional Forum Assessment Criteria

Appendix B: Regional Forum Policy Questions

Appendix C: Summary of Recommendations

Appendix D: Murihiku Southland Integrated Catchment Management – Implementation Matrix

Appendix E: Illustrative Prototype of a Landscape Susceptibility Risk Matrix

Appendix F: Hauora Principles

Appendix G: Climate Change Effects in Southland

Appendix H: Key Elements of Best Practice ICM

Appendix I: Science Scenario Modelling in Support of the Regional Forum

Appendix J: Economic Scenario Modelling in Support of the Regional Forum

Appendix K: Established (2015) and Developing (2035) Pastoral Farm Mitigations

Appendix L: Stormwater Management Devices in the Auckland Region

Appendix A: Regional Forum Assessment Criteria

The Regional Forum identified the following assessment criteria at the start of Phase Three of their deliberations, in order to provide an objective criteria set against which to evaluate and select from the range of methods identified as potentially suitable for Southland.

Does it consider the principles of the Treaty of Waitangi?

How is the option (or set of options) likely to:

- Promote cultural equality?
- Give active protection to the taonga of Ngāi Tahu?
- Enable Ngāi Tahu to fulfil their responsibilities as kaitiaki?

Is it effective?

To what extent is the option (or set of options) likely to:

- Achieve the desired outcomes for fresh water (i.e., evidence-based)?
- Be practical to implement?
- Avoid unintended consequences that are reasonably foreseeable?
- Recognise geographic variations?
- Encourage more native aquatic and terrestrial biodiversity to help improve the health of waterbodies?

Is it efficient?

How is the option (or set of options) likely to:

- Recognise the value of different types of assets important to local communities (i.e., people, financial, natural, and built)?
- Optimise resource use for the benefit of local communities (e.g., avoids resource banking)?
- Give everyone more certainty, transparency, and understanding about the future?
- Change (add to or subtract from) the resilience of local communities?
- Give resource users flexibility in their activities and encourage innovation?

How fair is it?

How is the option (or set of options) likely to:

- Result in everyone contributing to better environmental outcomes in ways that are proportional to:
- their ability to contribute to outcomes;
- the benefits they gain from resource use; and
- the effects of their resource use?
- Improve environmental outcomes for all local communities?
- Recognise good environmental performance?
- Recognise there are legacy issues from past generations and minimise them for future generations?
- Support solutions that are generally acceptable to the people of Southland?

Appendix B: Regional Forum Policy Questions

The Regional Forum were guided by the following policy questions, (provided by Environment Southland policy staff) to assist in ensuring their deliberations were sufficiently comprehensive and thorough to support the design of regional policy necessary for subsequent plan change to the proposed Southland Water and Land Plan.

Treaty of Waitangi / Te Tiriti o Waitangi

1. *How would you like to see Treaty Principles taken into account in developing methods for managing freshwater in Southland / Murihiku?*[20]

The Treaty Principles are specifically addressed in the Treaty of Waitangi section of the report. The principles, particularly partnership, participation, and active protection, are embedded in the recommendations, including in relation to co-governance, mātauranga, and taking a holistic hauora-focussed approach. The Ngāi Tahu Claims Settlement Act and statutory acknowledgements, along with the Treaty Principles, form the foundation for co-governance to occur in Murihiku/Southland, and the Regional Forum consider that it is important that the recommendations of this report give effect to the Treaty principles rather than only taking them into account.

In giving effect to the principle of partnership, the Regional Forum consider that co-governance should not be structured around numbers or veto rights, but should be an expression of equality and ensure full participation in order to achieve the best results, with appropriate skills to enable two-way sharing of knowledge and impact at the table.

Integrated Catchment Management

2. *How do you see integrated catchment management working in the future to manage the cumulative effects of all activities across the landscape?*

Integrated Catchment Management forms a key part of the Regional Forum's recommendations, through the hauora planning framework. While the hauora planning framework ties to many of the recommendations, detailed explanation can be found in the FMU Hauora Planning (Hauora-Led Integrated Catchment Management) and Integrated Catchment Monitoring, Modelling, and Learning sections of the report. In the context of this package of advice, the catchment plan should ensure that the water body has what it needs to be able to reach hauora.

Overall, the systems change recommended in this report are substantial, and the Regional Forum anticipate that as the hauora committees are established they would encompass and replace existing systems, including the Catchment Liaison Committees. In doing so, it will be important to ensure that the knowledge gained over the duration of the committees' operation is not lost and is used to inform future decision-making.

Climate Change Impacts

3. *In what ways would you like to see fresh water managed in Southland/Murihiku as part of our response to the impacts of climate change?*

The Climate Change section in the report explains the Regional Forum's thinking in relation to responding to impacts of climate change and provides specific recommendations. The intent of these recommendations is to ensure that actions for water quality do not have perverse outcomes for climate change, and that where possible actions are chosen that also have benefits in the context of climate change. The impacts of climate change have also been considered in the Water Quantity section of the report.

The Regional Forum recognises the New Zealand Government's commitment to the Paris Agreement. Article 2(1)(b) of the Paris Agreement states: "Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not

[20] This question relates specifically to the implementation of the National Objectives Framework.

threaten food production". The Regional Forum is mindful that while the recommendations of this report include systems change and repurposing of land, food production (including different forms of food production) will still be enabled.

Climate change is also relevant to this report's recommendations on timing, as adverse climate events are going to occur more frequently in future. The Climate Change section of the report explains that due to the positive phase of the Interdecadal Pacific Oscillation, there is a window of opportunity over the next ten years to make gains ahead of a more challenging period.

Rates of change

4. *In general terms, what is the rate of change you would like to see over the next generation to achieve environmental outcomes, noting there are many different time lags in the system (e.g., policy, implementation, and environmental)?*

While it is acknowledged that some methods will first require further learning before being implemented, the Regional Forum's general opinion on rate of change is to get going now and drive change early. The Regional Forum considers it important to incentivise early action where it is possible, and prioritise the recommendations that will be critical for guiding other actions, such as identification of appropriate wetland areas through the wetlands task force or identification of alternative options to discharging wastewater to water.

5. *Should the rates of change to be the same or different across the FMUs, given there are variations in the scale of change needed across the region and the activities that occur in each FMU?*

Rather than rates of change, timings should be based on prioritisation. This means that for each FMU, the timing of actions should be based on current state of hauora to prioritise the actions that are needed most urgently for improvement.

6. *Should the rates of change be the same or different across the four main contaminants (nitrogen, phosphorus, sediment, and E. coli), noting that contaminant losses vary across activities?*

Few of the recommendations in this report are targeted to just one contaminant. Instead, the holistic hauora-focussed approach means that all impacts of activities on water will be considered in the context of the FMU, catchment, and landscape. The timing of actions will be guided by the state of hauora in the catchment, and the urgency to implement mitigations dependent on the landscape.

Protecting other values for fresh water (e.g. access)

7. *What types of methods would you like to see used to protect the other values for freshwater (i.e. those other than ecosystem health, human health and mahinga kai)?*

The draft freshwater objectives collectively support hauora, which in turn supports many of the other values. The recommendations of this report also take a holistic hauora-focussed approach, which means that actions designed to support hauora will be appropriate even where they have not been directly specified in this report. In some instances, there will be tension between values, but these can be resolved through Te Mana o te Wai providing guidance.

Types of limits

8. *What resources should be the focus of limits to achieve environmental outcomes?*

Recommendations on limits are embedded in the package of advice, and tie in to the hauora planning framework through a combination of rules and the Environmental Management Plans. The limits subsection of the Regulatory Expectations section sets out the Regional Forum's recommendations specific to limits. While the recommendations show the types of limits that would be set, the exact requirements of the limits would be specific to each FMU to respond to the scale of change required. Overall, the key focus of limits is managing high-risk activities, tied to landscape susceptibility risks.

Regulatory mechanisms

9. *In terms of regulation, what is your general preference in terms of certainty versus flexibility in managing economic activities?*

The intent is to offer certainty where possible, while preserving as much flexibility as possible – overall, there needs to be a balance between the two. Some aspects of our recommendations require certainty, particularly where the recommendation has a big impact. Where the impact is smaller or there is more room for innovation, then more flexibility is able to be provided for. The recommendations are built on a catchment-centred approach that allows individual flexibility dependent on collaborative effort. This means that the recommendations provide for flexibility, but the regulatory backstop is also needed to provide certainty that change will occur.

The recommendations in this report are generally input-based, which are easier to manage and provide more certainty than an output-based approach. While philosophically an output-based approach would be preferred, it is recognised that the limitations of an output-based approach would be too problematic to base the package of recommendations on. Some input-based controls can reliably predict output, which is what the recommendations have primarily focussed on.

Non-point sources / land use

10. *What types of methods would you prefer to see to encourage less land to be used (e.g., land retirement, use of wetlands) and land to be used less (e.g., de-intensification) in the future?*

While some recommendations are targeted towards forms of de-intensification, a key focus is transitioning of land use in ways which are appropriate for the landscape. This includes, but is not limited to, wetland restoration or creation, and the re-purposing of land. The balance of these methods will be determined on an FMU basis, based on the state of hauora in the FMU.

The use of the term ‘re-purposing’ has been a deliberate choice throughout the report, rather than ‘retiring’, as it better conveys that land still has value and use even if not in food and fibre production. Re-purposing also does not necessarily mean taking land out of food production, but may result in a change of the type of food being produced. Overall, the package of recommendations in this report will result in increased ecological services, while protecting food production systems.

11. *What types of methods would you like to see used that will encourage activities to better fit their location?*

The hauora planning framework ensures that activities and actions are better suited to their location at all scales (property, catchment, and FMU). Recommendations that will assist with this include landscape susceptibility risk assessments, to be responded to by Environmental Management Plans and to inform the policy framework. These recommendations are set out in the Regulatory Expectations section.

Point sources

12. *What types of methods would you like to see used to further manage municipal and industrial wastewater and stormwater discharges?*

Recommendations specific to urban and industrial wastewater and stormwater are addressed in specific sections of the report. Overall, key recommendations are to grant not further consents for direct discharges of stormwater to water by 2035 and to end discharges of wastewater to water by 2045. In relation to stormwater, key focusses are treatment and slowing down the movement of water across the landscape.

Hydro-electric generation schemes

13. *If Council was to set target attribute states below national bottom lines for the Manapōuri Scheme, then what are important factors to consider when developing methods for the Waiau FMU?*

The Regional Forum's thoughts and recommendations specific to the Waiau FMU are explained in a dedicated section of this report. Given the hauora-focussed approach of these recommendations, the Regional Forum's opinion is that the target attribute states should not be set below national bottom lines.

Appendix C: Summary of Recommendations

1. Integrated Catchment Management, Monitoring, Modelling, and Learning Recommendations

1.1 Environment Southland and Te Ao Mārama Inc implement Integrated Catchment Management by applying an FMU Hauora Planning framework at Freshwater Management Unit (FMU), catchment, and sub-catchment scale, and resource it for success. It is expected the first version of FMU Hauora Plans will be designed and published by December 2023.

1.2 Environment Southland introduce Freshwater Management Unit (FMU) hauora rules to guide regional planning and management of freshwater resources.

1.3 Freshwater Management Unit (FMU), catchment, and sub-catchment Hauora Plans be structured with a 20-year time horizon. These cascading and nested sets of plans should be reviewed, and if need be, revised on a five yearly basis, informed by FMU monitoring, updates in scientific knowledge pertaining to catchment dynamics, and evaluation of regional impacts of climate change.

1.4 Environment Southland and Te Ao Mārama Inc continue to use the Southland Economic Project to anticipate risks, identify opportunities, and manage impacts, by FMU, as Hauora planning evolves.

1.5 FMU integrated catchment management is supported by integrated catchment monitoring which includes hauora monitoring programmes designed and resourced to incorporate Ngāi Tahu indicators of health and cultural monitoring.

2. Co-Governance of FMU Hauora Planning and Management Recommendations

2.1 Environment Southland and Te Ao Mārama Inc co-design Freshwater Management Unit (FMU), co-governance arrangements that support implementation and management of FMU Hauora Planning (hauora-led Integrated Catchment Management). It is expected that co-governance arrangements provide for genuine community representation and diversity, are appropriately resourced to function effectively, and are fully supported with all necessary information relevant to the concerns of hauora planning and management.

2.2 Environment Southland and Te Ao Mārama Inc collaborate to support and deliver a programme of co-governance talent development in order to secure future regional capability for co-governance of FMU Hauora Planning and Management.

2.3 Environment Southland and Te Ao Mārama Inc implement FMU Hauora co-monitoring across all regional FMU, incorporating Ngāi Tahu indicators of health to complement existing monitoring programmes.

3. Climate Change Recommendations

3.1 Within the FMU Hauora Planning framework, anticipated regional climate change effects, risks, and opportunities are accounted for in planning and implementing freshwater management initiatives and projects, in order to balance hauora outcomes against climate-change resilience outcomes, including protection of food production systems.

3.2 Within the FMU Hauora Planning framework, prioritise initiatives and projects that are complementary to both hauora outcomes and climate-change resilience outcomes, including water security and biodiversity.

3.3 Within the FMU Hauora Planning framework, identify risks to hauora from legacy sites (for example, known retired dumps and/or contaminated sites), and undertake a thorough investigation and co-analysis of management and mitigation options for implementation. It is expected that risk assessment factoring in climate change effects will inform prioritisation of interventions to manage such legacy sites within each FMU.

4. Regulatory Expectations Recommendations

Landscape Susceptibility Risks

4.1 For each FMU, develop a landscape susceptibility risk matrix to define key landscape risks to freshwater. Landscape susceptibility risk matrices are to be informed by the best available technology (for example, physiographics, radiometrics, and/or lidar). An illustrative prototype of a landscape susceptibility risk matrix is included in Appendix E: Illustrative Prototype of a Landscape Susceptibility Risk Matrix.

4.2 For each FMU, landscape susceptibility risks to freshwater are to be defined and published as FMU Landscape Susceptibility Schedules, and specified risks are to be responded to within Environmental Management Plans within each FMU.

Environmental Management Plans and Resource Consents

4.3 Environment Southland requires Environmental Management Plans for all land and water uses likely to influence FMU hauora outcomes. Environmental Management Plans will be expected to explicitly reference relevant Landscape Susceptibility Schedules and demonstrate alignment to relevant regional FMU Hauora Plans.

4.4 Environment Southland develop a specific "mini" Environmental Management Plan template for land uses which do not exceed the threshold to be categorized as commercial farming or business operations. For example, lifestyle blocks, and landholding less than 20 hectares in rural zones. It is anticipated that a checklist approach will be most useful in triggering landowner actions that contribute to improved freshwater management.

4.5 Environment Southland develop checklists (or decision-trees), by FMU, that define land-use and water-use activities that require:

a. resource consent,
b. an environmental management plan, or
c. a mini environmental management plan.

4.6 Environmental Management Plans are informed, guided, and constrained by FMU Landscape Susceptibility Schedules, developed from FMU Landscape Susceptibility Risk Matrices.

Livestock Intensity

4.7 As part of managing key landscape susceptibility risks to freshwater by FMU, Environment Southland define farm stock-carrying capacity thresholds that require either resource consent or a specific response within a farm environmental management plan.

4.8 As part of managing key landscape susceptibility risks to freshwater by FMU, Environment Southland define intensive winter grazing thresholds that require either resource consent or a specific response within a farm environmental management plan.

Nutrient Management

4.9 As part of managing key landscape susceptibility risks to freshwater, Environment Southland defines a cap on the annual application of nitrogen (synthetic and organic), that to exceed requires either resource consent or a specific response within a farm environmental management plan.

4.10 As part of managing key landscape susceptibility risks to freshwater by FMU, Environment Southland define available phosphorous (Olsen P soil test) thresholds that require either resource consent or a specific response within a farm environmental management plan.

4.11 Environment Southland restricts the application of soluble phosphate and nitrogen when local soil temperatures and soil moisture conditions are not appropriate. It is expected that the Environment Southland soil monitoring network, or some other suitable regional monitoring network, or installed meters, or hand-held meters will be used to determine when soil conditions are appropriate. Environmental Management Plans may be used to provide flexibility and environmental protection in cases where application may be justified outside of usual parameters.

4.12 Environment Southland require that Environmental Management Plans must include an annual nutrient budget (planned application), and require that proof of nitrogen and phosphorous application (actual application) is recorded annually with inclusion of application trace maps.

4.13. Environment Southland implement a farm soil testing protocol which defines frequency and intensity of soil testing required of land-users, when this is required as a resource consent condition. It is expected this soil testing protocol is guided both by FMU landscape susceptibility risk matrices, and by the key indicators of soil health. (This protocol might be promoted amongst the wider community as representative of sound "hauora management practice", influencing soil management practices where resource consent is not required).

Early Adoption, and Mitigation Reporting

4.14 Environment Southland includes provision within Environmental Management Plans for land users to record early-adoption investment, initiatives, and projects undertaken from 2010 (the year the regional plan first became operative) onwards in order to better understand and recognise the scale of existing early-adoption investment.

4.15 Environment Southland and Te Ao Mārama Inc collaborate to map and stocktake known examples of "early adoption" of land-use change and major mitigation investments since 2010 in order to recognise and acknowledge the positive contribution to freshwater outcomes. Examples could include transition to less intensive farming systems, development of major wetlands, re-forestation efforts, and conservation initiatives.

4.16 Environment Southland and Te Ao Mārama Inc collaborate to maintain a register of land-use change and major mitigation investments from when the Southland Water and Plan change becomes operative in order to track, record, report and recognise gains to freshwater outcomes.

Benchmarking

4.17 Environment Southland embed a "risk and mitigation scorecard" within environmental management plans to:

a. to enable benchmarking, at a regional and FMU level, by land users; and
b. to enable targeted extension, and monitoring of businesses considered to represent a high risk to freshwater hauora outcomes.

Compliance and Enforcement

4.18 Environment Southland maintains sufficient effective compliance and enforcement capabilities, sustaining investment in key compliance capability areas.

4.19 Environment Southland demonstrates a consistent willingness to act in firm and predictable ways in response to infringements and serious breaches of regulations.

4.20 Environment Southland gives an immediate priority focus for compliance and enforcement efforts to protecting existing wetlands from drainage and degradation within current regulations.

5. Repurposing Land Recommendations

5.1 Environment Southland repurpose, where appropriate, its own public land for increased ecosystem services that align with FMU Hauora objectives.

5.2 Environment Southland role-models land repurposing for increased ecosystem services, sharing information, knowledge, and insights from land repurposing projects to inspire and inform other regional landowners and managers to initiate land re-purposing initiatives.

5.3 Environment Southland and Te Ao Mārama Inc actively engage with other regional managers of public land (Territorial Authorities, DOC, LINZ) to promote, explore, and support opportunities for land re-purposing that supports improved ecological outcomes that align with FMU Hauora objectives.

5.4 Environment Southland undertake or sponsor a thorough geospatial and physiographic analysis, by FMU, to identify locations and areas most suited to repurposing for increased environmental services aligned with FMU Hauora Objectives (for example, steep farmland in FMU headwater areas), ensuring the resulting analysis is available to all regional landowners and users.

5.5 Environment Southland and Te Ao Mārama Inc collaboratively promote and support indigenous forest planting and indigenous re-forestation projects, including wetland and tussock land projects.

6. Wetland Protection, Restoration, and Development Recommendations

6.1 By 2025 Environment Southland is to undertake an analysis and stocktake by FMU, including use of physiographics and radiometrics, to identify:

a. The specific loss of wetlands, by FMU, since 1995, in order to support and quantify the Ngāi Tahu Ki Murihiku aspiration for wetland land cover extent lost since 1995 to be restored to the same extent by 2035.
b. Wetlands needed to address water quality issues.
c. Locations and areas most suited to wetland restoration or development, ensuring the resulting analysis informs hauora plans and is available to landowners and users. Consideration of urban and industrial wetland priorities should be included.

6.2 Environment Southland lead the formation of a regional wetlands task force, encouraging a multi-agency approach, to plan and manage a regional programme of wetland development. The wetlands task force purpose is to leverage collaborative energy, innovation, and co-investment in enabling capabilities, and operations at scale to accelerate wetland re-establishment across all FMUs, in support of FMU Hauora Objectives. In particular the wetland task force will:

a. Involve territorial authorities, Ngāi Tahu, experts in wetland implementation and land management, and a range of partners.
b. Explore and implement a variety of funding models, mechanisms, and sources, incorporating the core principle of fairness and recognising the value of wetlands (e.g., as assets, as essential infrastructure, through rates or tax incentives).
c. Co-ordinate efforts to deliver on priorities and targets established through hauora plans and enable strategic wetland placement to ensure the 'right wetland in the right place'.
d. Build capacity for delivery and knowledge of wetland development and maintenance methods across the region.
e. Support landowners and communities seeking to establish and maintain wetlands, whether small scale or large scale.
f. Support implementation of the suite of Regional Forum recommendations.

6.3 Ensure that when developing wetlands for water treatment and water quality purposes:

a. Pollutants are treated at source or as close as possible to source.
b. Intensive land uses develop highly constructed wetlands equivalent to 5% of area of the intensive land use, either on the property or in the best location off property using supporting mechanisms, for addressing nitrogen.
c. Extensive land uses develop simpler wetlands and sediment traps designed for addressing sediment and nutrients.
d. Associated flow regimes in permanently flowing waterbodies assist treatment with sufficient flow.

6.4 Environment Southland and Te Ao Mārama Inc collaboratively establish targets, by FMU, for the amount and quality of wetland restoration or development expected at five-year increments as part of hauora planning.

6.5 Environment Southland develop permitted activities and streamlined consenting processes for wetland restoration and development, including "farm-gate approvals" for small-scale wetland projects, as a high priority initiative.

6.6 In concert with the wetlands task force, Environment Southland provide targeted facilitation support to large-scale wetland restoration and development projects.

6.7 Ensure tougher enforcement for non-compliance with current regulations that prevent wetland drainage.

6.8 Recognising the sensitivity and significance of Organic (peat soils), utilise the recommended risk matrix approach to determine appropriate land use on Organic (peat) soils, and support landowners to protect and restore them as wetlands where it is feasible to do so, especially where significant catchment hauora gains are probable.

6.9 Incentivise early action, recognising there is no time to waste and ramping up effort through the wetlands task force will take time.

6.10 Provide credit and recognition for early adopters and those who have retained existing wetlands, whilst increasing pressure on land users delaying action or with higher impact activities.

6.11 Prioritise wetland restoration and development in FMUs with greatest degree of economic buffering and consider targeted support for local communities that have disproportionate economic impacts.

7. Waiau FMU Recommendations

Waiau River Classification

7.1 For the purpose of hauora-led integrated catchment management of the Waiau FMU, the Waiau river should be classified as lake-fed, in accordance with its original state. Such a classification will allow for management of freshwater objectives against reference state conditions, and importantly, culturally, represents recognition of the whakapapa (lineage) of the Waiau river.

Establishing Hauora-Led Flow Regimes

7.2 Mandatory flushing flows must be instituted as soon as possible and remain in place while more comprehensive changes to the lower Waiau flow regime are developed, and are to:

a. be a minimum of five flushing flows annually,
b. be undertaken at times and intervals most conducive to the ecological health of the lower Waiau, and
c. incorporate gradual increase and decrease of flow rates for the benefit of river health (for example, giving consideration to riverbank erosion effects).

7.3 The flow regime for the lower Waiau must be revisited by the time of the next plan change and an approach developed that will guide the reconsenting of the Manapōuri scheme upon expiry of existing consents, based on:

a. improving the life supporting capacity of the river,
b. a synthesis of available science,
c. the potential for staged implementation,
d. understanding the impact on national electricity supply and options for security of supply,
e. exploration of management options including storage or 'banking' of flows, variable flows, and increased minimum flows, and
f. consideration of lake levels and water temperature.

Science Programme

7.4 In order to support establishment, and review, of a new flow regime and other actions that help restore te mana o te Waiau, undertake a programme of additional science that is:

a. funded by ES, with support from Meridian,
b. established in partnership with Ngāi Tahu and community stakeholders,
c. informed by a gap analysis of existing science,
d. on-going,
e. able to support intergenerational understanding of the river, and
f. addresses predicted climate change effects.

Waiau Catchment Hauora Planning

7.5 Support an integrated ki uta ki tai approach in the Waiau catchment by relying on a hauora plan for the catchment in its entirety, and by:

a. Managing contaminant load reductions in the tributaries of the Waiau guided by periphyton objectives.
b. Reviewing and undertaking further modelling and analysis of FMU contaminant load reduction targets needed to meet freshwater objectives once the revised flow regime for the lower Waiau is confirmed.

8. Urban and Industrial Wastewater Recommendations

Investigation of Alternate Treatment and Disposal Options

8.1 Environment Southland and Te Ao Mārama Inc co-invest with the region's three Territorial Authorities in a study of established and emerging alternate treatment and disposal options in order to inform and catalyse detailed investigation of future wastewater management options for Southland. Study results are expected to encompass urban and industrial contexts, and it is expected that study results will be shared with regional commercial entities with a stake in wastewater management.

8.2 For every existing consented wastewater discharge a thorough, extensive, and detailed investigation is undertaken to identify the range of potential and possible options that will provide for wastewater treatment and disposal without direct discharge to water.

8.3 The terms of reference for each discharge-specific investigation are to be developed in conjunction with Environment Southland and Te Ao Mārama Inc to ensure the integrity and transparency of each investigation for all key stakeholders.

8.4 Investigations are to be commissioned and complete within three years of notification of the plan change (thus, anticipated to be complete no later than December 2026).

Co-Analysis of the Investigation Implications

8.5 Consideration and analysis of the findings from each site-specific investigation is to be undertaken in conjunction with Environment Southland and Te Ao Mārama Inc, applying a "co-analysis" process which further ensures the integrity and transparency in respect of the resulting investment decisions that follow.

8.6 Environment Southland and Te Ao Mārama Inc are to develop the supporting "co-analysis" concept in detail, and communicate this concept to affected stakeholders (regional Territorial Authorities and commercial entities) no later than 30 March 2024, in order to manage expectations of the co-analysis process. It is expected that an outline of the co-analysis approach to be adopted will be appended to the Terms of Reference for each site-specific investigation.

Implementation Planning

8.7 Following the co-analysis of each site-specific investigation findings, an investment and implementation plan is to be developed by Territorial Authorities (for urban wastewater) and by commercial entities (for industrial wastewater), outlining the planned treatment and disposal system upgrades necessary.

8.8 Territorial Authorities will make investment provision for the resulting wastewater system upgrades within their 2027 - 2037 Long Term Plan, indicating when specific wastewater system infrastructure will be upgraded.

8.9 Where it is determined that specific wastewater infrastructure will not be upgraded within the 10-year period to 2037, Territorial Authorities will outline their strategic intent for remaining specific system upgrade investments in the period to 2045.

8.10 Commercial entities will be expected to register their strategic intent and investment provisions for planned wastewater system upgrades with Environment Southland no later than December 2027, in order to provide transparency for the purpose of co-governance decision making.

8.11 Respective FMU and Catchment Hauora Plans are to be updated to reflect the resulting planned wastewater system upgrades.

8.12 Over the period 2024 to 2028, FMU and Catchment Hauora Monitoring Plans will establish hauora baselines for each catchment where consented discharge of wastewater to waterbodies currently occurs in order to subsequently quantify and articulate hauora changes resulting from wastewater infrastructure upgrades.

Implementation Management

8.13 Territorial Authorities and commercial entities are to work closely with Environment Southland and Te Ao Mārama Inc to ensure implementation of specific wastewater system upgrades occur within scheduled timeframes.

8.14 Industrial dischargers must provide and apply an environmental management plan aligning to relevant FMU Hauora Plans to renew consents.

8.15 At Environment Southland's discretion, existing discharge consents may be reviewed both to reflect the stated wastewater system upgrade investment intent, and to incentivise investment in system upgrade implementation.

8.16 Respective FMU and Catchment Hauora Plans are to be updated to reflect the resulting implemented wastewater system upgrades.

8.17 FMU and Catchment Hauora Monitoring Plans will report annually on changes to waterbody hauora seeking to establish direct or indirect relationships between wastewater infrastructure upgrades and waterbody hauora outcomes.

Evaluation and Learning

8.18 It is recommended that a programme of evaluation be designed to determine the efficacy of the process, and progressively capture insights that will:

a. Facilitate learning amongst key stakeholders to support process improvement within each phase.
b. Be of potential interest to other communities, nationally and internationally, which may be considering best-practice options as they manage their own waste-water treatment and disposal challenges.

8.19 This programme of evaluation might be considered as a form of longitudinal research. Consideration should be given to engaging an external research partner from the outset to support the design and implementation of the programme of evaluation.

9. Localised Wastewater Systems Recommendations

9.1 Implement a programme to register and certify septic tank and other alternative non-networked toilet systems, to inform FMU hauora planning and monitoring. Registration should include information such as geolocation, age/installation date, capacity, outlet description, and ownership. Registration might be efficiently managed within the Environmental Management Plan for many Southland properties.

9.2 Implement a certification programme for septic tanks and alternative toilet systems, that as a minimum considers:

a. system maintenance,
b. bypass pipes or overland flow paths to surface water,
c. the operation and performance of the disposal field (if applicable), and
d. the suitability/environmental risk of the system, considering the environmental setting it is installed in.

9.3 Where existing septic tank or alternative toilet systems do not meet certification requirements, they must be repaired, retired, upgraded, or replaced with a system that complies with current building/environmental regulations.

9.4 The time frame for undertaking repairs, upgrades, replacements, or retirements will be determined by Environment Southland, taking into account the risks posed to water quality and the extent and cost of work required.

9.5 In order to facilitate and incentivise innovation in managing localised wastewater systems, consent new technology trials with enabling provisions in the plan and consenting framework.

9.6 Permit the use of alternate technologies for localised wastewater systems in appropriate settings (for example, composting toilets).

10. Stormwater Management Recommendations

Investigation of Alternate Treatment and Disposal Options

10.1 Environment Southland co-invest with the region's three Territorial Authorities in a study of established and emerging alternate treatment and disposal options in order to inform and catalyse detailed investigation of future stormwater management options for Southland. Study results are expected to encompass urban and industrial contexts, and it is expected that study results will be shared with regional commercial entities with a stake in stormwater management.

10.2 For every existing consented stormwater discharge a thorough, extensive, and detailed investigation is undertaken to identify the range of potential and possible options to filter high risk stormwater from roading, industrial sites, and other sources prior to it entering a stormwater network and to identify the range of potential and possible options for filtering urban stormwater prior to its discharge into a waterbody.

10.3 The terms of reference for each discharge-specific investigation are to be developed in conjunction with Environment Southland and Te Ao Mārama Inc to ensure the integrity and transparency of each investigation for all key stakeholders.

10.4 Investigations are to be commissioned and complete within three years of notification of the plan change (thus, anticipated to be complete no later than December 2026).

Co-Analysis of the Investigation Implications

10.5. Consideration and analysis of the findings from each discharge-specific investigation is to be undertaken in conjunction with Environment Southland and Te Ao Mārama Inc, applying a "co-analysis" process which further ensures the integrity and transparency in respect of the resulting investment decisions that follow.

10.6 Environment Southland and Te Ao Mārama Inc are to develop the supporting "co-analysis" concept in detail and communicate this concept to affected stakeholders (regional Territorial Authorities and commercial entities) no later than 30 March 2024, in order to manage expectations of the co-analysis process. It is expected that an outline of the co-analysis approach to be adopted will be appended to the Terms of Reference for each discharge-specific investigation.

Implementation Planning

10.7 Following the co-analysis of each discharge-specific investigation findings, an investment and implementation plan is to be developed by Territorial Authorities (for urban stormwater) and by commercial entities (where any existing consented industrial stormwater discharge exists), outlining the planned treatment and disposal system upgrades necessary.

10.8 Territorial Authorities will make investment provision for the resulting stormwater system upgrades within their 2027 - 2037 Long Term Plan, indicating when specific stormwater system infrastructure will be upgraded.

10.9 Where it is determined that specific stormwater infrastructure will not be upgraded within the 10-year period to 2037, Territorial Authorities will outline their strategic intent for remaining specific system upgrade investments in the period to 2045.

10.11 Commercial entities (where any existing consented industrial stormwater discharge exists) will be expected to register their strategic intent and investment provisions for planned stormwater system upgrades with Environment Southland no later than December 2027, in order to provide transparency for the purpose of co-governance decision making.

10.12 Respective FMU and Catchment Hauora Plans are to be updated to reflect the resulting planned stormwater system upgrades.

10.13 Over the period 2024 to 2028, FMU and Catchment Hauora Monitoring Plans will establish hauora baselines for each catchment where consented discharge of stormwater to waterbodies currently occurs in order to subsequently quantify and articulate hauora changes resulting from stormwater infrastructure upgrades.

Implementation Management

10.14 Territorial Authorities and commercial entities are to work closely with Environment Southland and Te Ao Mārama Inc to ensure implementation of specific stormwater system upgrades occur within scheduled timeframes.

10.15 Industrial dischargers must provide and apply an environmental management plan aligning to relevant FMU Hauora Plans to renew consents.

10.16 At Environment Southland's discretion, existing discharge consents may be reviewed both to reflect the stated stormwater system upgrade investment intent, and to incentivise investment in system upgrade implementation.

10.17 Respective FMU and Catchment Hauora Plans are to be updated to reflect the resulting implemented stormwater system upgrades.

10.18 FMU and Catchment Hauora Monitoring Plans will report annually on changes to waterbody hauora seeking to establish direct or indirect relationships between stormwater infrastructure upgrades and waterbody hauora outcomes.

10.19 From the earliest opportunity, work with Territorial Authorities to run a fixed-term amnesty programme incentivising people to declare illegal stormwater discharges and cross-connections, and to support them in getting them appropriately resolved (making it as easy as possible to do the right thing).

10.20 In conjunction with Territorial Authorities, continue to monitor, explore, and address the source of wastewater and stormwater cross-contamination.

10.21 integrate dedicated stormwater filtration into new developments and retrofit stormwater filtration into existing high-risk infrastructure such as urban roading and industrial areas, prior to stormwater from these areas entering a stormwater network.

10.22 Environment Southland develops a standard defining minimum treatment requirements for stormwater that will apply from 2035.

10.23 Environment Southland does not grant any new resource consents for unfiltered storm-water discharges to water, and from 2035 any unfiltered stormwater discharges that don't meet the standards developed in response to recommendation 10.22.

10.24 Consider the following initiatives in respect of future stormwater planning and management measures.

a. For future developments:
    i. Limit the amount of stormwater increases from new connections.
    ii. Regulate for minimum percentage of area as treatment for stormwater, or provision of permeability, to slow water across landscapes.
    iii. Mandate minimum requirements for on-site stormwater storage and/or primary treatment (by swales, etc). It is expected this measure would support dual outcomes of treating stormwater and slowing water across landscapes during intense rainfall events.
b. For existing sites and households mandate minimum requirements for on-site stormwater storage.

Evaluation and Learning

10.25 In conjunction with evaluation of wastewater planning and management efforts (recommended above), it is recommended that a programme of evaluation be designed to determine the efficacy of the process, and progressively capture insights that will:

a. Facilitate learning amongst key stakeholders to support process improvement within each phase.
b. Be of potential interest to other communities, nationally and internationally, which may be considering best-practice options as they manage their own stormwater treatment and disposal challenges.

10.26 In conjunction with evaluation of wastewater planning and management efforts (recommended above), this programme of evaluation might be considered as a form of longitudinal research. Consideration should be given to engaging an external research partner from the outset to support the design and implementation of the programme of evaluation.

11. Water Quantity Recommendations

11.1 Environment Southland review existing water quantity limits every ten years, considering the need to implement revisions due to climate change effects and to continue to meet the needs of Te Mana o te Wai.

11.2 Environment Southland supports and encourages innovations and local projects with potential to improve water quantity resilience and water security, in both rural and urban settings.

12. Outreach and Education Recommendations

12.1 Environment Southland undertakes a region wide outreach programme to introduce mandatory Environmental Management Plans, with an emphasis on rural users, small business operators, and rural support professionals.

12.2 Environment Southland and Te Ao Mārama Inc co-invest in a programme of education in cultural monitoring in order to secure sufficient talent and capacity for cultural monitoring of waterbodies within hauora-led integrated catchment monitoring.

12.3 Environment Southland work with Lincoln University to explore the potential for regional application of a multi-criteria decision-making (MCDM) framework for supporting decision-making about land-use change (developed through the Our Land and Water National Science Challenge).

12.4 Environment Southland collaborate with Territorial Authorities to ensure infrastructure managers and contractors are aware of, and account for, roadside run-off considerations when maintaining infrastructure such as unsealed roads and associated drainage structures. For example, grader operators might be targeted given their influence in maintaining and modifying rural roading networks. Develop best practice guidelines and checklists for use by contractors in the field (including forestry).

12.5 Develop and publish freshwater "hauora management practice" checklists for urban households and industrial sites, emphasizing both positive ecological outcomes and water security. Note that many Australian cities have extensive existing information resources pertaining to water conservation which may serve as a useful starting point.

12.6 Environment Southland promote information resources available to support farmers to recycle and utilise nutrients more effectively within farming operations.

13. Technology Recommendations

13.1 Environment Southland invests in a technology monitoring programme to:

a. More effectively understand the potential advantages, costs, and challenges of leveraging emerging technology to promote improved freshwater outcomes.
b. Increase the organisation's capacity to effectively integrate emerging technology when appropriate.
c. Provide guidance to other Southland organisations and entities in respect of potential technology investments relating to water quality monitoring and management.

13.2 In implementing a technology monitoring programme, Environment Southland explores the potential for partnerships with other like-minded organisations to leverage technical knowledge and expertise. Potential technology monitoring partners might include:

a. Other regional councils – Otago Regional Council.
b. Regional training institutes – Southern Institute of Technology.
c. Universities – Otago, Lincoln, or Massey.
d. CRIs - Landcare Research or AgResearch.
e. National Science Challenges – Our Land and Water or NZ Biological Heritage.

13.3 Environment Southland secures access to appropriately qualified, responsive soil science advice to support effective physiographic informed risk analysis and decision-making.

13.4 In order to promote sustainable, resilient, regional farming systems, Environment Southland promote the development and integration of technology to harness the energy potential of farm effluent and other by-products (for example, on-farm bioenergy plants).

13.5 Environment Southland continues to support the application of promising technology in support of regional predator control and eradication programmes.

Appendix D: Murihiku Southland Integrated Catchment Management – Implementation Matrix

		2021 – 2025	2026 – 2030	2031 – 2035	2036 – 2040	2041 – 2045
1	**Co-Governance**	2021 LTP update. 2024 LTP update. Plan Change Two: • notified no later than Dec 2023. • becomes operative from Dec 2025. Regional and FMU Co-governance: • co-design of co-governance arrangements are complete no later than Dec 2024. • co-governance established by Dec 2025.	2027 LTP update. 2030 LTP update. Co-governance capability development phase 1 investment from Jan 2026. Review of regional and FMU co-governance arrangements complete no later than Dec 2030.	2033 LTP update. Co-governance capability development phase 2 investment from Jan 2031.	2036 LTP update. 2039 LTP update. Co-governance capability development phase 3 investment from Jan 2036. Review of regional and FMU co-governance arrangements complete no later than Dec 2040.	2042 LTP update. 2045 LTP update. Co-governance capability development phase 4 investment from Jan 2041.
2	**FMU Hauora Planning, Management, and Monitoring**	FMU Hauora Plans finalised by Dec 2023. Nga Tahu indicators of health and cultural co-monitoring programme designed in conjunction with FMU Hauora Plans by Dec 2023. Environmental Management Plans (EMP) mandatory from 2025. 2024 to 2028 – monitoring to establish hauora baselines for each catchment.	Nga Tahu indicators of health and cultural co-monitoring programme established. 2024 to 2028 – monitoring to establish hauora baselines for each catchment (continued). Reporting against hauora baselines possible from 2029 onwards.	Specific FMU limits adjusted in response to baseline monitoring and updated risk analysis. Meridian's current resource consent expires Nov 2031.	Specific FMU limits adjusted in response to baseline monitoring and updated risk analysis.	Specific FMU limits adjusted in response to baseline monitoring and updated risk analysis
3	**Ecosystem Preservation and Restoration**	Wetlands task force established no later than Jan 2024. Regional wetlands stocktake complete by Dec 2024. Regional wetland planning and targets defined by Dec 2025. Regional estuary recovery planning and targets established by December 2025.	Regional wetland target #1 achieved by 2030. Estuary recovery target #1 achieved by 2030.	Regional wetland target #2 achieved by 2035 (including wetland loss since 1995 being restored to the same extent). Estuary recovery target #2 achieved by 2035.	Regional wetland target #3 achieved by 2040. Estuary recovery target #3 achieved by 2040.	Regional wetland target #4 achieved by 2045. Estuary recovery target #4 achieved by 2035.
4	**Wastewater and Stormwater Infrastructure**	Three Waters - new publicly owned water service entities established by July 2024. 2024 to 2026: Investigation and co-analysis of alternate wastewater and stormwater treatment and disposal options. Concept for "co-analysis" finalised and communicated to affected stakeholders no later than 30 March 2024.	2026 to 2027 - wastewater and stormwater treatment and disposal implementation planning. 2027 to 2032 - wastewater and stormwater treatment and disposal stage 1 implementation. Commercial entities to register strategic intent and investment provisions for planned wastewater and stormwater system upgrades no later than Dec 2027.	2027 to 2032 - wastewater and stormwater treatment and disposal stage 1 implementation (continued). 2033 to 2037 - wastewater and stormwater treatment and disposal stage 2 implementation.	2033 to 2037 - wastewater and stormwater treatment and disposal stage 2 implementation (continued). 2038 to 2045 - wastewater and stormwater treatment and disposal stage 3 implementation.	2038 to 2045 - wastewater and stormwater treatment and disposal stage 3 implementation (continued).
6	**Outreach and Education**	Region wide outreach programme to introduce mandatory Environmental Management Plans (EMP). Investment in cultural monitoring capacity, and community understanding. Develop and publish freshwater "hauora management practice" guides and checklists for urban households and industrial sites.	Work with Lincoln University to explore the potential for regional application of a multi-criteria decision-making (MCDM) framework to guide agri-business land-use choices			
7	**Key Climate Change Considerations**	In respect of rainfall, the positive phase of the Interdecadal Pacific Oscillation (IPO) may depress the impacts of anthropogenic climate change	In respect of rainfall, the positive phase of the Interdecadal Pacific Oscillation (IPO) may depress the impacts of anthropogenic climate change. Other climate change effects expected to intensify, including sea-level rise, reduced snowfall, and intensity of weather events.	Potential for early change to negative phase of the Interdecadal Pacific Oscillation (IPO) which may enhance anthropogenic climate change impacts in respect of rainfall (wetter summers, with more intense rain events). Other climate change effects expected to intensify, including sea-level rise, reduced snowfall, and intensity of weather events.	Potential for change to negative phase of the Interdecadal Pacific Oscillation (IPO) which may enhance anthropogenic climate change impacts in respect of rainfall (wetter summers, with more intense rain events). Other climate change effects expected to intensify, including sea-level rise, reduced snowfall, and intensity of weather events.	Interdecadal Pacific Oscillation (IPO) predicted to be in a negative phase, and to enhance anthropogenic climate change impacts in respect of rainfall (wetter summers, with more intense rain events). Other climate change effects expected to intensify, including sea-level rise, reduced snowfall, and intensity of weather events.

Appendix E: Illustrative Prototype of a Landscape Susceptibility Risk Matrix

Using the concepts of source (or supply) and transport limitation, the pattern(s) of contaminant generation can be predicted by the Physiographic Environment Classification[21]. For example, a wider range of contaminants are likely to be generated from imperfectly to poorly drained agricultural soils during periods peak drainage. This reflects both adequate supply (e.g., land disturbance and contaminant source) and sufficient transport capacity (e.g., artificial drainage/overland flow). Conversely, contaminant generation from well-drained soils with high infiltration rates and equivalent land use pressure are likely to be lower under an equivalent land use pressure and precipitation intensity. In this case, the supply remains the same, but the transport capacity is reduced due to higher soil infiltration rates. In the first setting, the installation of artificial drainage is often used to mitigate the drainage limitation, effectively resulting in a similar outcome to the well-drained soil environment. However, mole-pipe drainage does not facilitate the same level of interaction between water and the soil matrix and as a result contaminants are often elevated in drainage discharges.

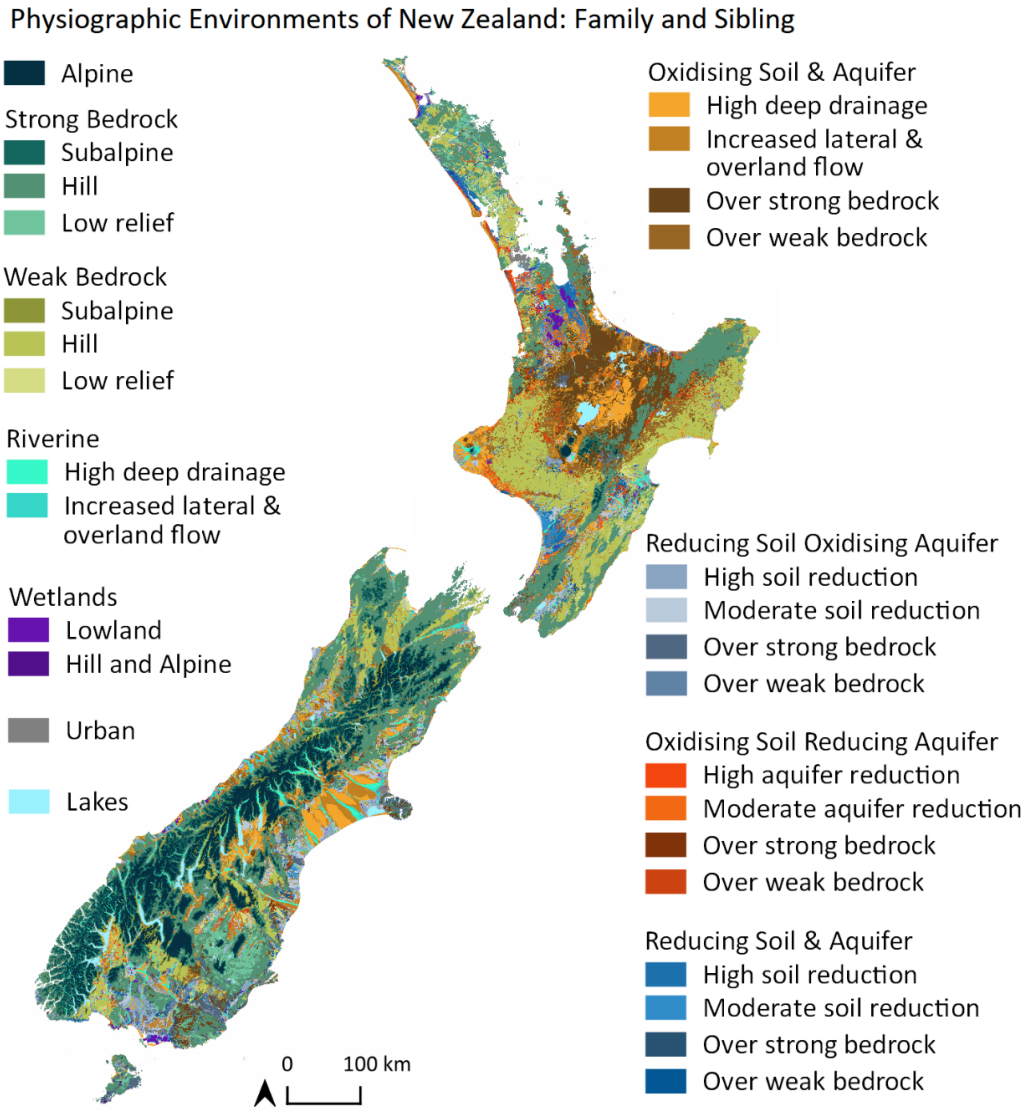
Collectively, these landscape factors interact to determine the differential sensitivity and magnitude of discharge of one or more contaminants to water. Therefore, water quality at a catchment-scale represents the outcome of multiple, spatially variable processes which influence the generation, transport, and transformation of contaminants across the contributing catchment.

Inherent landscape susceptibility for contaminant generation considers both the hydrological pathway contaminants take and how the landscape regulates water quality contaminants through dilution, resistance to erosion, filtration and adsorption, and attenuation of both N and P species. Each environment has distinct properties that can be used to predict the susceptibility of a contaminant for loss. Table 1 summarises for each Physiographic Family and Sibling class the hydrological pathway, the role of landscape in regulating contaminants, and the risk to the receiving environment defined as concentration and/or load to surface water, groundwater, or both. Where the landscape has a high regulating capacity it is good at reducing the risk to the receiving environment provided the specified hydrological pathway is active. When there is variation to the predicted hydrological response, variants apply. The ability of the landscape to regulate contaminants when a hydrological variant is active is summarised in Table 2. The variants may apply at different times of the year and modify the ability of the landscape to regulate contaminants. When active, the variant supersedes the predicted response for an environment.

The risk to water quality from agriculture, horticulture, forestry, and urban land uses (here after 'land use') for each Physiographic Environment is provided through a matrix by contaminant and species in Table 3 and for the variants in Table 4. The risk matrix assumes a uniform source (land use pressure) in each environment for assigning risk, while the actual contribution from an area maybe significantly different depending on the actual land use type and intensity (i.e., native forest or high producing exotic grassland). This means for a high risk of loss to be realised, a contaminant source is required. This also applies to the variants where risk to water quality for all contaminants is significantly increased when bypass of the soil zone occurs by either overland flow, artificial drainage, or cracking soils. However, this risk is only realised if there is a contaminant source. For example, overland flow occurring in Alpine or natural state environments may be a relatively large volume of water, but the contaminant source load is low, and the nutrient status of the sediment has not been enriched. These contributions to a receiving environment are generally considered background load.

Importantly, the risk assessment presented here is preliminary and subject to refinement through an Our Land and Water, Sources to Sink project which aims to refine and improve the quantification of risk. This refinement will provide additional documentation and validation to support the landscape classification. In addition to this, an assessment of attenuation and uncertainty at various spatial scales will also be undertaken. Interactive maps of the risk matrix are available at www.landscapedna.org/maps.

[21] Pearson, L. and Rissmann, C. (2021). ***Physiographic environments of New Zealand: Inherent susceptibility of the landscape for contaminant loss***. Land and Water Science Report 2021/25.


Physiographic Environments of New Zealand: Family and Sibling
Alpine
Strong Bedrock
Subalpine
Hill
Low relief
Weak Bedrock
Subalpine
Hill
Low relief
Riverine
High deep drainage
Increased lateral & overland flow
Wetlands
Lowland
Hill and Alpine
Urban
Lakes
Oxidising Soil & Aquifer
High deep drainage
Increased lateral & overland flow
Over strong bedrock
Over weak bedrock
Reducing Soil Oxidising Aquifer
High soil reduction
Moderate soil reduction
Over strong bedrock
Over weak bedrock
Oxidising Soil Reducing Aquifer
High aquifer reduction
Moderate aquifer reduction
Over strong bedrock
Over weak bedrock
Reducing Soil & Aquifer
High soil reduction
Moderate soil reduction
Over strong bedrock
Over weak bedrock
0
100 km

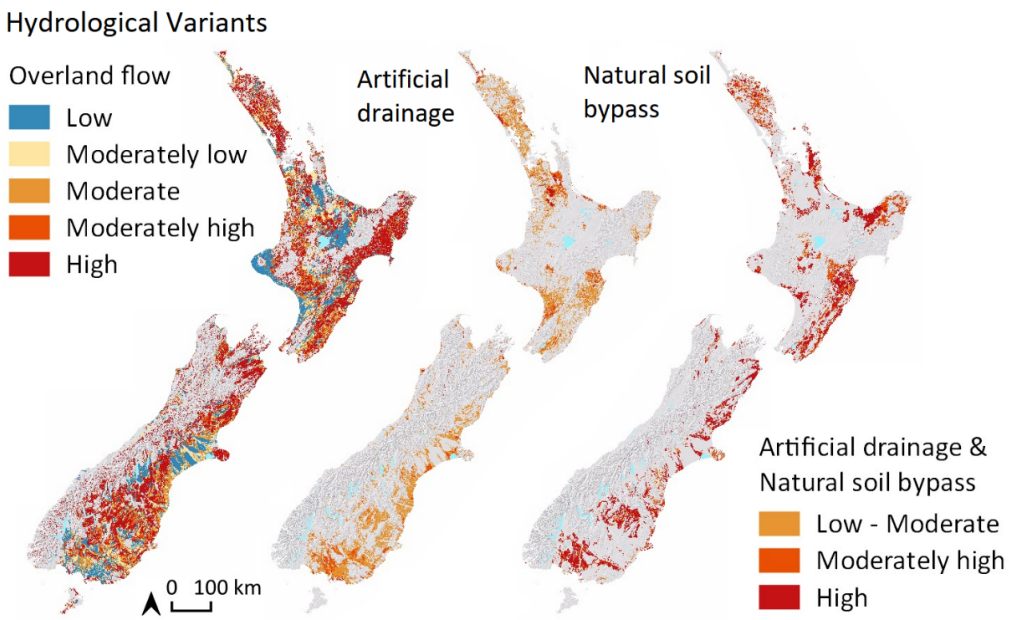

Hydrological Variants
Overland flow
Low
Moderately low
Moderate
Moderately high
High
Artificial drainage
Natural soil bypass
Artificial drainage & Natural soil bypass
Low - Moderate
Moderately high
High
0
100 km

Table 1. The role of landscape in regulating contaminants by Physiographic Environment. If the landscape function is high it is good at reducing the risk to the receiving environment. The risk to the receiving environment is defined as concentration and/or load to surface water, groundwater, or both. For the landscape to perform its regulatory function, the predicted hydrological pathway must be active. See hydrological variants when alternative pathways are active.

Family	Sibling	Contaminant pathway (dominant hydrological pathway)	How the landscape regulates water quality contaminants					Risk to receiving environment
			Dilution	Resistance to erosion	Filtration and adsorption	Attenuation: N-Reduction	Attenuation: P-Reduction	
Alpine	**Alpine**	Precipitation falls mainly as snow over the winter months and accumulates until spring. Melt water runs over the land surface and converges to form streams. Overland flow is the dominant pathway water takes to leave the land.	High	Low	Low	Low	Low	Load to surface water
Strong Bedrock	**Subalpine**	Lateral drainage through the soil zone either to stream or a neighbouring lowland environment. Recharge to the underlying aquifer is limited by the permeability of the bedrock. Overland flow is common due to seasonal wetness (see Overland Flow variant when pathway is active).	Moderately high	Low - Moderately low	Moderately low	Moderate	Moderate- low	Load to surface water
	Hill	Lateral drainage along contact with bedrock discharging to stream or neighbouring environment. Slope and depth to bedrock controls overland flow risk where the steeper the slope or shallower the bedrock the more likely it is to occur (see Overland Flow variant when pathway is active). Limited aquifer potential unless bedrock is fractured.	Moderate	Moderately low - Moderate	Moderately low - Moderate	Moderately high	Moderately low	Concentration & load to surface water, minor groundwater contribution
	Low relief	Lateral drainage along contact with bedrock discharging to stream or neighbouring environment. Depth to bedrock controls overland flow risk where the shallower the bedrock the more likely it is to occur (see Overland Flow variant when pathway is active). Limited aquifer potential unless bedrock is fractured.	Moderate - Low	Moderately low - Moderate	Moderately low - Moderate	Moderately high	Moderately low	Concentration & load to surface water, minor groundwater contribution
Weak Bedrock	**Subalpine**	Lateral drainage through the soil zone either to stream or a neighbouring lowland environment. Recharge to the underlying aquifer is limited by the permeability of the bedrock. Overland flow is common due to seasonal wetness (see Overland Flow variant when pathway is active).	Moderately high	Low	Moderately low	Moderate	Moderate - low	Load to surface water
	Hill	Lateral drainage along contact with bedrock discharging to stream or neighbouring environment. Slope and depth to bedrock controls overland flow risk where the steeper the slope or shallower the bedrock the more likely it is to occur (see Overland Flow variant when pathway is active). Minimal aquifer potential.	Moderate	Low	Moderately low - Moderate	Moderately high	Moderately low	Concentration & load to surface water, minor groundwater contribution
	Low relief	Lateral drainage along contact with bedrock discharging to stream or neighbouring environment. Depth to bedrock controls overland flow risk where the shallower the bedrock the more likely it is to occur (see Overland Flow variant when pathway is active). Minimal aquifer potential.	Moderate - Low	Low - Moderately low	Moderately low - Moderate	Moderately high	Moderately low	Concentration & load to surface water, minor groundwater contribution
Oxidising Soil and Aquifer	**High deep drainage**	Deep drainage through the soil zone to an underlying water table aquifer. Water table depth is an important control over attenuation capacity associated with filtration and retention of contaminants, and the occurrence of overland flow (see Overland Flow variant when pathway is active).	Low	High[1]	High[1]	Low	High	Concentration & load to groundwater
	Increased lateral and overland flow	Deep drainage through the soil zone to an underlying water table aquifer with increased lateral and overland flow due to seasonal wetness (see Overland Flow variant when pathway is active). Water table depth is an important control over attenuation capacity associated with filtration and retention of contaminants, and the occurrence of overland flow.	Low	Moderately high – High[1]	Moderately high – High[1]	Low - Moderately low	Moderately high - High	Concentration & load to groundwater, minor surface water contribution
	Over strong bedrock	Deep drainage until contact with bedrock which transitions to lateral flow. Slope and depth to bedrock controls overland flow risk where the steeper the slope or shallower the bedrock the more likely it is to occur (see Overland Flow variant when pathway is active).	Low	Moderately high – High	Moderate - High	Low - Moderately high[2]	Moderate[2] - High	Concentration & load to surface water, minor groundwater contribution
	Over weak bedrock	Deep drainage until contact with bedrock which transitions to lateral flow. Slope and soil depth controls overland flow risk where the steeper the slope or shallower the soil the more likely runoff is to occur (see Overland Flow variant when pathway is active).	Low	Moderate - High	Moderate - High	Low - Moderately high[2]	Moderate[2] - High	Concentration & load to surface water, minor groundwater contribution

Family	Sibling	Contaminant pathway (dominant hydrological pathway)	How the landscape regulates water quality contaminants					Risk to receiving environment
			Dilution	Resistance to erosion	Filtration and adsorption	Attenuation: N-Reduction	Attenuation: P-Reduction	
Oxidising Soil Reducing Aquifer	**High aquifer reduction**	Deep drainage through the soil zone to an underlying water table aquifer. Water table depth is an important control over attenuation capacity associated with filtration and retention of contaminants.	Low	Moderately high – High	Moderately high - High	High[3]	High[3] (soil zone retention)	Minimal if water drains to groundwater
	Moderate aquifer reduction	Deep drainage through the soil zone to an underlying water table aquifer with increased lateral and overland flow due to seasonal wetness (see Overland Flow variant when pathway is active). Water table depth is an important control over attenuation capacity associated with filtration and retention of contaminants.	Low	Moderately high - High	Moderately high - High	Moderately high - High	Moderately high - High	Minimal if water drains to groundwater
	Over strong bedrock	Deep drainage until contact with bedrock which transitions to lateral flow. Slope and depth to bedrock controls overland flow risk where the steeper the slope or shallower the bedrock the more likely it is to occur (see Overland Flow variant when pathway is active).	Low	Moderately high – High	Moderately high - High	Moderate - High	Moderate - High	Minimal if water drains through soil to surface water
	Over weak bedrock	Deep drainage until contact with bedrock which transitions to lateral flow. Slope and soil depth controls overland flow risk where the steeper the slope or shallower the soil the more likely runoff is to occur (see Overland Flow variant when pathway is active).	Low	Moderate - High	Moderate - High	Moderate - High	Moderate - High	Minimal if water drains through soil to surface water
Reducing Soil Oxidising Aquifer	**High soil reduction**	Lateral drainage through the soil zone either to stream or a neighbouring environment. Recharge to the underlying water table aquifer is limited by soil permeability. Overland flow is common due to seasonal wetness (see Overland Flow variant when pathway is active). Artificial drainage is common under agricultural land uses (see Artificial Drainage variant details if present).	Low	Moderate – Moderately low	Low	High	Low	Concentration & load to surface water, minor groundwater contribution
	Moderate soil reduction	Lateral drainage through the soil zone either to stream or a neighbouring environment. Lateral drainage is likely to become more vertical (deep) during the drier months. Recharge to the underlying aquifer is limited by the soil permeability (likely higher than high soil reduction sibling as soils are imperfectly drained). Overland flow occurs due to seasonal wetness (see Overland Flow variant when pathway is active). Artificial drainage is likely under agricultural land uses (see Artificial Drainage variant details if present).	Low	Moderate	Moderate	Moderately low – Moderately high[4]	Moderately low – Moderately high[4]	Concentration & load to groundwater and surface water
	Over strong bedrock	Lateral drainage along contact with bedrock. Slope and depth to bedrock controls overland flow risk where the steeper the slope or shallower the bedrock the more likely it is to occur (see Overland Flow variant when pathway is active). Limited aquifer potential. Artificial drainage may be present under agricultural land uses (see Artificial Drainage variant details if present).	Low	Moderate – Low	Low - Moderate	Moderate - High	Low - Moderate	Concentration & load to surface water, minor groundwater contribution
	Over weak bedrock	Lateral drainage along contact with bedrock. Slope and depth to bedrock controls overland flow risk where the steeper the slope or shallower the bedrock the more likely it is to occur (see Overland Flow variant when pathway is active). Limited aquifer potential. Artificial drainage may be present under agricultural land uses (see Artificial Drainage variant details if present).	Low	Moderate – Low	Low - Moderate	Moderate - High	Low - Moderate	Concentration & load to surface water, minor groundwater contribution
Reducing Soil and Aquifer	**High soil reduction**	Lateral drainage through the soil zone either to stream or a neighbouring environment. Recharge to the underlying aquifer is limited by the soil permeability. Overland flow is common due to seasonal wetness (see Overland Flow variant when pathway is active). Artificial drainage is common under agricultural land uses (see Artificial Drainage variant details if present).	Low	Moderately low - Low	Low	High	Low	Concentration & load to surface water, minor groundwater contribution

Family	Sibling	Contaminant pathway (dominant hydrological pathway)	How the landscape regulates water quality contaminants					Risk to receiving environment
			Dilution	Resistance to erosion	Filtration and adsorption	Attenuation: N-Reduction	Attenuation: P-Reduction	
	Moderate soil reduction	Lateral drainage through the soil zone either to stream or a neighbouring environment. Lateral drainage is likely to become more vertical (deep) during the drier months. Recharge to the underlying aquifer is limited by the soil permeability (likely higher than high soil reduction sibling as soils are imperfectly drained). Overland flow occurs due to seasonal wetness (see Overland Flow variant when pathway is active). Artificial drainage is likely under agricultural land uses (see Artificial Drainage variant details if present).	Low	Moderate	Low - Moderate	Moderately high - High	Low – Moderately low	Concentration & load to groundwater and surface water
	Over strong bedrock	Lateral drainage along contact with bedrock. Slope and depth to bedrock controls overland flow risk where the steeper the slope or shallower the bedrock the more likely it is to occur (see Overland Flow variant when pathway is active). Limited aquifer potential. Artificial drainage may be present under agricultural land uses (see Artificial Drainage variant details if present).	Low	Low - Moderate	Low - Moderate	Moderate - High	Low - Moderate	Concentration & load to surface water, minor groundwater contribution
	Over weak bedrock	Lateral drainage along contact with bedrock. Slope and depth to bedrock controls overland flow risk where the steeper the slope or shallower the bedrock the more likely it is to occur (see Overland Flow variant when pathway is active). Limited aquifer potential. Artificial drainage may be present under agricultural land uses (see Artificial Drainage variant details if present).	Low	Low - Moderate	Low - Moderate	Moderate - High	Low - Moderate	Concentration & load to surface water, minor groundwater contribution
Riverine	**High deep drainage**	Deep drainage through the soil zone to an underlying water table aquifer. Water table depth is an important control over attenuation capacity associated with filtration and retention of contaminants. Water table depth may also govern susceptibility to overland flow.	High	Moderate - High[4]	Moderate - High[4]	Low	Moderate - High[4]	Load to groundwater
	Increased lateral and overland flow	Deep drainage through the soil zone to an underlying aquifer with increased lateral and overland flow due to slowly permeable soils, seasonal wetness, and sloping land (see Overland Flow variant when pathway is active).	High	Moderately high - High	Moderately high - High	Low - Moderately low	Moderately high - High	Load to groundwater, minor surface water
Wetlands	**Lowland**	Lateral drainage through the soil zone either to stream or a neighbouring environment. Overland flow occurs more often than other lowland environments due to the shallow water table (see Overland Flow variant when pathway is active). Artificial drainage is common under agricultural land uses (see Artificial Drainage variant details if present).	Low	Low - Moderate	Moderately high – High Filtration (anion exchange Low)	High	Low	Concentration & load to surface water, minor groundwater contribution
	Upland	Lateral drainage through the soil zone either to stream or a neighbouring environment. Overland flow occurs due to the limited storage capacity in the soil zone in upland environments and seasonal wetness (see Overland Flow variant when pathway is active). Artificial drainage is likely under agricultural land uses (see Artificial Drainage variant details if present).	Low - High	Low – Moderately low	Moderate – High Filtration (anion exchange Low)	High	Low	Concentration & load to surface water, minor groundwater contribution
Urban	**Urban**	Overland flow to the stormwater drain. Artificial drainage through the storm water network with discharge typically direct to surface water.	Recharge domain dependent	High	Low	Low	Low	Concentration & load to surface water, minor groundwater contribution where land is pervious.

[1] Depth to water table is an important factor. Shallow water table depths are highly connected to the aquifer and contaminants can enter an aquifer relatively quickly. Deep unsaturated zones may take years to reach groundwater.

[2] Dependent on depth to bedrock and redox state at contact with bedrock.

[3] The stronger the reducing conditions the more likely nitrogen reduction via denitrification will occur, however phosphorus becomes more mobile (reduction is low). In oxidising conditions, phosphorus reduction is high and nitrogen reduction is low.

[4] Dependent on how active the flood plain is, how well sorted the soil and unsaturated zone materials, and the depth to water table. Where the water table is shallow there is a high connectivity for N loss and risk of overland flow is elevated. P loss can be elevated where soils are dominated by large cobbles with little matrix and the water table is shallow.

Table 2. How the ability of the landscape to regulate contaminants is altered hydrological variant pathways are active. Variants apply only when the hydrological pathway is active and supersedes the predicted response for an environment (from Table 4). If the landscape function is high it is good at reducing the risk to the receiving environment. The risk to the receiving environment is defined as concentration and/or load to surface water, groundwater, or both.

Hydrological Variants	**Contaminant pathway (when active only)**	**How the landscape regulates water quality contaminants**					**Risk to receiving environment**
		Dilution	**Resistance to erosion**	**Filtration and adsorption**	**Attenuation: N-Reduction**	**Attenuation: P-Reduction**	
Overland flow	Occurs when soils are saturated and/or infiltration is limited. Pathway is active after prolonged or intense rainfall.	N/A[1]	Low	Low	Low	Low	Concentration & load to surface water
Artificial drainage	Likely where agricultural soils have impeded drainage or a shallow water table. Pathway is most active during the wetter months.	N/A[1]	Moderate – Moderately high	Moderate – Moderately high	Low - Moderate	Moderate – Moderately high	Concentration & load to surface water
Natural soil zone bypass	Occurs when soils are cracked (under soil moisture deficit) or jointed. Pathway is active following extended periods of soil moisture deficit.	N/A[1]	Moderate	Low	Low	Low	Concentration & load to groundwater

[1] Dilution potential is assessed by the Physiographic Environment recharge domain which is indicative of water source and relative volume. This does not change with the hydrological variant.

Table 3. Inherent susceptibility of the landscape for contaminant loss by Physiographic Environment. Nitrogen, phosphorus, and microbes require a source or input for losses to occur. Sediment risk is elevated if nutrient status is also elevated. Where a high susceptibility equals a high risk of loss from agricultural, horticultural, forestry and urban land uses. The contaminants have been colour-coded red, orange, and yellow for high, moderately high, and moderate risk respectively. Where the risk is provided as a range, the highest risk is used for the colour. See hydrological variants for contaminant loss when alternative pathways are active.

Family	Sibling	Nitrogen			Phosphorus		Sediment	Microbes
		Nitrate & Nitrite	Ammoniacal	Organic (Dissolved & Particulate)	Particulate	Dissolved Reactive	Particulate	Particulate
Alpine	Alpine	High	High	High	High	High	High	High
Strong Bedrock	Subalpine	Moderately high	Moderately high	Moderately high	Moderately high	Moderately high	Moderately high	Moderately high
	Hill	Low – Moderate	Moderate – Moderately high	Moderate – Moderately high	Moderate – Moderately high	Moderate – Moderately high	Moderate – Moderately high	Moderate – Moderately high
	Low relief	Low – Moderate	Moderate – Moderately high	Moderate – Moderately high	Moderate – Moderately high	Moderate – Moderately high	Moderate – Moderately high	Moderate – Moderately high
Weak Bedrock	Subalpine	Moderately high	Moderately high	Moderately high	Moderately high	Moderately high	High	Moderately high
	Hill	Low – Moderately low	Moderate – High	Moderate – High	Moderately high – High	Moderate – Moderately high	Moderately high – High	Moderately high – High
	Low relief	Low – Moderately low	Moderate – High	Moderate – High	Moderately high – High	Moderate – Moderately high	Moderate - High	Moderately high - High
Oxidising Soil and Aquifer	High deep drainage	High	Low	Low	Low	Low	Low	Low
	Increased lateral and overland flow	Moderately high - High	Low – Moderately low	Low – Moderately low	Low – Moderately low	Low – Moderately low	Low – Moderately low	Low – Moderately low
	Over strong bedrock	Moderately low[1] – Moderate	Low – Moderately high[1]	Low – Moderately high[1]	Low – Moderately low	Low – Moderately high[1]	Low – Moderately low	Low – Moderately low
	Over weak bedrock	Moderately low – Moderate[1]	Low – Moderately high[1]	Low – Moderately high[1]	Low - Moderate	Low – Moderately high[1]	Low - Moderate	Low - Moderate
Oxidising Soil Reducing Aquifer	High aquifer reduction	Low – Moderately low	Low – Moderately low	Low – Moderately low	Low	Low	Low – Moderately low	Low
	Moderate aquifer reduction	Low – Moderately low	Low – Moderately low	Low - Moderately low	Low – Moderately low	Low – Moderately low	Low – Moderately low	Low – Moderately low
	Over strong bedrock	Low – Moderately low	Low – Moderate	Low – Moderate	Low – Moderately low	Low – Moderately Low	Low - Moderate	Low - Moderate
	Over weak bedrock	Low – Moderately low	Low – Moderate	Low – Moderate	Low - Moderate	Low – Moderately Low	Low - Moderate	Low - Moderate
Reducing Soil Oxidising Aquifer	High soil reduction	Low	High	High	High	Moderately high	High	High
	Moderate soil reduction	Low – Moderately low	Moderate – Moderately high	Moderate – Moderately high	Moderate – Moderately high	Moderately low - Moderate	Moderate – Moderately high	Moderate – Moderately high
	Over strong bedrock	Low – Moderately low	Moderate – High	Moderate – High	Moderate – High	Moderate – Moderately high	Moderate – High	Moderate – High

Family	Sibling	Nitrogen			Phosphorus		Sediment	Microbes
		Nitrate & Nitrite	Ammoniacal	Organic (Dissolved & Particulate)	Particulate	Dissolved Reactive	Particulate	Particulate
	Over weak bedrock	Low – Moderately low	Moderate – High	Moderate – High	Moderate – High	Moderate – Moderately high	Moderate – High	Moderate – High
Reducing Soil and Aquifer	High soil reduction	Low	High	High	High	Moderately high	High	High
	Moderate soil reduction	Low – Moderately low	Moderate – Moderately high	Moderate – Moderately high	Moderate – Moderately high	Moderate	Moderate – Moderately high	Moderate – Moderately high
	Over strong bedrock	Low – Moderately low	Moderate – High	Moderate – High	Moderate – High	Moderate – Moderately high	Moderate – High	Moderate – High
	Over weak bedrock	Low – Moderately low	Moderate – High	Moderate – High	Moderate – High	Moderate – Moderately high	Moderate – High	Moderate – High
Riverine	High deep drainage	High – N load Low – N conc.[2]	Low	Low	Low	Low	Low	Low
	Increased lateral and overland flow	High – N load Low – N conc.[2]	Low - Moderately low	Low - Moderately low	Low - Moderately low	Low - Moderately low	Low - Moderately low	Low - Moderately low
Wetlands	Lowland	Low	High	High	High	Moderately high	Moderate[3] – Moderately high	High
	Upland	Low	High	High	Moderately high - High	Moderate - Moderately high	Moderate[3] – Moderately high	High
Urban	Urban	Variable - High[4]	Variable - High[4]	Variable - High[4]	Variable - High[4]	Variable - High[4]	Variable - High[4]	Variable - High[4]

[1] Dependent on depth to bedrock and if denitrification occurs at contact with bedrock.

[2] Concentration in groundwater does not increase due to high dilution potential.

[3] Sediment is largely organic material.

[4] Urban municipal wastewater has been treated through the wastewater treatment plant however the degree of treatment is variable. The overall risk varies according to the waste composition, degree of treatment and wastewater treatment plant effectiveness including disposal method. Discharges to land have a lower risk as there is potential for further land-based treatment relative to discharges directly to water. Stormwater varies according to source area and degree of treatment. Other contaminants also are present, including but not limited to heavy metals, hydrocarbons (petrol), oils and grease, pesticides, plastics, and microplastics, etc. Risk of loss is considered high as there is no removal of contaminants once they are transported.

Table 4. Inherent susceptibility of the landscape for contaminant loss by seasonal or episodic variants. The risk when these pathways are active supersedes the risk for the environment. Nitrogen, phosphorus, and microbes require a source or input for losses to occur. Sediment risk is elevated if nutrient status is also elevated. Where a high susceptibility equals a high risk of loss from intensive land uses.

Hydrological Variant	Nitrogen			Phosphorus		Sediment	Microbes
	Nitrate & Nitrite	Ammoniacal	Organic (Dissolved & Particulate)	Particulate	Dissolved Reactive	Particulate	Particulate
Overland flow	Low	High	High	High	Low	High	High
Artificial drainage	Moderately low - Moderately high	Moderately low - Moderate	Moderately low - Moderate	Moderate	Moderately low	Moderate	Moderate
Natural soil zone bypass	High	High	Moderate	Low	Moderate	Low	High

Appendix F: Hauora Principles

The Hauora principles listed below are derived from the 2020 report 'Draft Murihiku Southland freshwater objectives: Providing for hauora, the health and well-being of waterbodies in Murihiku Southland'. A more thorough explanation of each principle is provided within that report.

The following principles are all considered equally applicable and are presented here in no particular order. The 'A' to 'F' labels are provided for ease of identification and consistency when the hauora principles are discussed in various contexts

Principle A. A state of hauora will be the result of the interaction of a combination of attributes, including Ngāi Tahu Indicators of Health.

Principle B. The nature and behaviour of particular waterbodies is important to understand when considering attributes.

Principle C. Nationally directed attributes alone cannot describe a state of hauora for waterbodies, so additional measures are needed, including assessing against Ngāi Tahu Indicators of Health.

Principle D. Where a water quality attribute is associated with risk of people getting sick, this risk will be reduced to the lowest possible level.

Principle E. Where a water quality attribute is assessing levels of toxicity or aspects of harm to aquatic species, in order to avoid harm to these species this risk will be reduced to the lowest possible level.

Principle F. Hauora is most likely to be provided for when waterbodies are closest to their natural condition, so an understanding of natural state or reference state is needed to help decision-makers.

Appendix G: Climate Change Effects in Southland

New Zealand's first national climate change risk assessment report of 202022 emphasized that New Zealand's climate is already changing:

> "Over the past century, temperatures have increased, glaciers have melted, and sea levels have risen. Such changes will continue and their impacts increase. This will have far-reaching consequences for people, the natural and built environment, the economy and governance."

In 2018, NIWA delivered a report, Southland Climate Change Impact Assessment[23], for Environment Southland, Invercargill City Council, Gore District Council and Southland District Council. The report considered potential impacts of climate change on a range of components of climate, hydrology and coastal processes across Southland using climate modelling under four different global warming scenarios (differentiated by differing projected levels of greenhouse gas emissions). In addition to identifying projected climate change impacts for the Southland region at mid-century and end of century, the report provided some discussion of the potential implications of the projected climate change impacts for Southland's council infrastructure, agriculture, forestry, fishing and aquaculture, and tourism.

Some of the report's key climate projections for the period to 2040 are summarised below.

By 2040 climate change effects in the Southland regional will include:

1. Increases in annual mean and minimum temperatures, with the greatest warming increases experienced during the Autumn season.
2. Decreased annual frost days.
3. Increased annual hot days (where the temperature is 25 °C or above) and increases in high temperature extremes.
4. Increased heatwave days each year, more so in the northern parts of the Ōreti and Matāura catchments.
5. Increased rainfall, with the greatest increase occurring during the winter season.
6. Decreased number of annual wet days in Fiordland, Waiau, and the southern extents of the Ōreti and Matāura catchments.
7. Increased number of annual wet days in central parts of the region.
8. Increased annual number of heavy rain days – heavy rainfall events are expected to occur three to four times as often, relative to the current climate.
9. Increased river flow rates with seasonal differences as follows:
    a. Spring: some increase, especially in the Ōreti and Matāura catchments.
    b. Summer: stable or decreasing, with some increases in the Ōreti and Matāura catchments.
    c. Autumn: stable or increasing.
    d. Winter: stable or increasing, with increases in the Waiau, and northern parts of the Ōreti and Matāura catchments.
10. River Mean Annual Flood (MAF) levels are expected to increase.
11. Water supply reliability will be more variable with some parts of Southland experiencing increased reliability, and others decreased reliability.
12. Central and northern Southland are projected to experience the largest increase in drought conditions - a 20% to 30% increase.
13. The risk of wildfire is expected to increase, and fire seasons are expected to increase in duration.

[22] Ministry for the Environment (2020). *National Climate Change Risk Assessment for Aotearoa New Zealand: Main report – Arotakenga Tūraru mō te Huringa Āhuarangi o Āotearoa: Pūrongo whakatōpū.* Wellington, NZ, Ministry for the Environment.

[23] Zammit, C., et al. (2018). *Southland Climate Change Impact Assessment*. Wellington, NZ, National Institute of Water & Atmospheric Research Ltd.

14. Sea level rise (SLR) within the region is expected to continue, possibly at accelerating rates, accentuating the effects of storm tides and flood events, exacerbating existing coastal erosion, and raising groundwater levels in coastal and estuarine fringes.

In essence the general regional trend is to a more dynamic, less benign regional climate, punctuated by more frequent extreme weather events – a regional climate that is warmer and wetter, yet with increased hot days, heatwaves, droughts, and wildfires, as well as more intense rainfalls and flood events. The increasing intensity and extremes can be expected to place additional stress and pressure on both natural and production ecosystems.

The 2018 NIWA report also emphasized the continuing influence and additional "climate noise" of natural variations in climate patterns, including the following three large-scale oscillations that influence climate in New Zealand:

1. the El Niño-Southern Oscillation (ENSO), which occurs every 2 to 7 years, with impacts lasting around a year;
2. the Interdecadal Pacific Oscillation (IPO), which can last from 20 to 30 years; and
3. the Southern Annular Mode (SAM), which can last for several weeks, but changes phases quickly and unpredictably.

The report noted that, "Those involved in (or planning for) climate-sensitive activities in the Southland region will need to cope with the sum of both anthropogenic change and natural variability."

Of interest the report notes that, "For rainfall, the fact that we may have recently moved into a positive phase of the Interdecadal Pacific Oscillation may depress the impacts of anthropogenic climate change over the next decade or so." If this were the case, the next decade may be considered to represent a window of opportunity to invest in gains in water quality, ahead of a more challenging period when the next negative phase of the IPO amplifies the effects of climate change induced rainfall patterns.

Regardless, it is expected that over time, as climate change effects increase, the magnitude of the challenge of improving regional freshwater resources will increase. A 'mitigation dollar' invested today is expected to return significantly greater benefits than the same inflation-adjusted investment in 10 or indeed 20 years' time. This 'escalating challenge' effect also supports the concept of acting earlier rather than later, adding to the sense of urgency but also creating a sense of current opportunity in respect of more effectively managing regional freshwater resources.

The report also offered some insightful discussion of these climate change impacts by industry sector, including:

1. council infrastructure
2. agriculture
3. forestry
4. fishing and aquaculture
5. tourism

The need for monitoring, adaptation and learning in response to climate change effects seemed common to all these sectors.

The full report can be accessed via the following Environment Southland webpage (https://www.es.govt.nz/about-us/news?item=id:26gju0toa1cxbymvk9a7).

Appendix H: Key Elements of Best Practice ICM24

Institutional Engagement

Communication and co-ordination between agencies and their joint and several points of engagement with iwi and communities is important because catchment-related initiatives are more effective when:

1. They have the support of the key relevant agencies.
2. The messages and information coming from their different perspectives are aligned.
3. ICM decision-making occurs within an overarching resource management framework with defined objectives and investment strategies: this enables decision-making that is consensual and coordinated across the public and private interests in the catchment. Such a framework, provided by government, supports catchment managers and communities in making difficult decisions.

Stakeholder and Community Engagement

Stakeholder and community engagement is the community dimension of institutional engagement in ICM. Trust will arise out and good communication and shared understandings of different needs and points of view. This is important because catchment-related initiatives at all scales (macro, meso, and micro) are more effective when:

1. Local stakeholders are involved in on-the-ground projects.
2. Groups are supported by good facilitation, which is key to developing dialogue and relationships and working through the conflict and roadblocks that emerge when different stakeholders come together.
3. Good communication is enabled amongst people and groups.
4. Social gatherings allow everyone to have fun and celebrate success.

Good Leadership

Good leadership, including of collaborative or partnership processes is important because catchment-related initiatives are more effective when:

1. Clear goals and roles are set at the start of the process.
2. Different groups have effective representatives.
3. Group leaders build and maintain groups so they can stay motivated to achieve their objectives.

Capacity Building

Capacity building is vital because much of the challenge of implementing integrated management lies in promoting change in the behaviour of the different parts of the respective agencies, different user groups and even wider communities. Factors that enhance community engagement in group activities and building group capacity and partnerships with local government and industry are closely linked. Catchment-related initiatives often have to last a long time, so this is important because they are more effective when:

1. Adequate provision (amount and duration) of resources is made for the development of people and organisations.
2. Iwi and communities are supported in their capacity to take part in ICM processes.
3. Succession planning is considered for ICM community representatives and agency staff, who can easily "burn out", as well as for public and private sector technical experts who may move on as a result of organisational change.
4. Capacity building is recognised as a two-way process, whereby technical or policy experts pass knowledge to political leaders, industry, NGO participants, individuals, and the broader community but that knowledge is also transferred from these “non-technical” participants back to the technical

[24] Clare Feeney, W. A., Annette Lees, Maree Drury. (2010). ***Integrated Catchment Management: A review of literature and practice*.** Retrieved from https://environment.govt.nz/publications/integrated-catchment-management-a-review-of-literature-and-practice/)

experts. This also encourages transdisciplinary research, where knowledge is created, discussed, and understood from various world-views – t promoting the harmony and longevity of ICM initiatives.

Judicious Regulation

Judicious regulation is regarded by most of the interviewees and international literature as an essential component of ICM. This is important because catchment-related initiatives are more effective when regulation:

1. Is introduced as part of a community consultation process aimed at allowing communities to reach shared understandings of the issues and management options.
2. Provides a framework within which a range of voluntary or supporting methods are provided to help achieve measurable ecological objectives.

Long Term Funding

Long term funding promotes more effective catchment-related initiatives because:

1. The macro and meso scale ICM requires sustained financial investment in financial and human resources over the planning, implementation, and review phases, yet funding is often provided over a five-to-seven-year timeframe, when perceptible changes to resource condition often occur on much longer timeframes (for example 20-50 years or more).
2. At the micro scale, experience suggests it takes up to three years to establish a functioning group and a further three years to achieve tangible environmental outputs, while environmental outcomes become apparent over the next 20-30 years, so funding is needed over this latter period to monitor the changes and feed this information back into the process.
3. Seed or set-up funding can help get things started, but few people in rural or urban communities can remain solely responsible for long-lived programmes without the long-term support of their catchment managers – the regional councils.
4. Explicit long-term funding of monitoring and review will support regional councils' capacity to monitor the interventions and outcomes of other agencies engaged in initiatives that contribute to beneficial outcomes in catchments.

The Four Well-beings

The four well-beings – social, economic, cultural, and environmental – are becoming more important. Catchment-related initiatives are more effective when:

1. Socio-economic issues have been identified during the planning process and acknowledged and accepted by the community.
2. Community and internal/external stakeholder engagement helps catchment managers to identify, prioritise and monitor catchment issues, management options and community outcomes across all four well-beings.
3. Catchment management goals tie together economic and environmental sustainability objectives.
4. Land-users can see a clear benefit (short, medium, or long-term) to the economic sustainability of their operation and objectives and activities make a clear link between environmental and economic benefits.

Collaborative Monitoring

Collaborative monitoring promotes adaptive management. This promotes more effective catchment initiatives because:

1. It encourages learning and adaptation amongst project participants and communication with other catchment projects
2. It leads to an empowered group of stakeholders keen to find out more to continue an adaptive management process
3. Monitoring is key to adaptive management and adaptive management is key to effective ICM.

“Top Down” Together With “Bottom Up”

“Top down” together with “bottom up” approaches promote more effective catchment-related initiatives because:

1. The strength of the on-site approach is in the implementation of on-site works that lead to improvement in urban and/or rural environmental condition.
2. The strength of the ICM approach is in relation to social outcomes, where the community-based approach has proved successful in creating awareness and creating a good deal of acceptance of the “care” ethic.
3. The most comprehensive outcome gains can be made through a combination approach involving individual landowner action set within a strategic ICM framework.

Appendix I: Science Scenario Modelling in Support of the Regional Forum

In early 2021, scenarios were identified with the Regional Forum which were subsequently tested in the economic and science models to assist the Regional Forum in exploring thoughts on methods and timeframes. Eleven specific science scenarios and seven combined science scenarios were modelled across the whole study area – meaning the Southland region excluding the Fiordland and Islands Freshwater Management Unit (FMU). The table below, summarises the eleven specific science scenarios modelled.

Scenario		Brief Description
1	**Existing Rules and Regulations (ER&R) Scenario.** Fully implement existing rules and regulations.	Load reductions achievable when modelled against the requirements of both the Proposed Southland Water and Land Plan, and central government's Essential Freshwater Package regulations.
2	**Restoration of Indigenous Vegetation Scenario.** Restore indigenous vegetation lost since 1996.	Restoration of indigenous vegetation to where it has been lost since 1996 (based on land-use maps).
3	**Our Land and Water 2015 Mitigation Set Scenario.** Full implementation of established on-farm good management practices (GMP) as of 2015.	Total nitrogen (TN) and total phosphorus (TP) contaminant load reductions modelled based on full implementation of "established" farm mitigation options as of 2015 (reported in research sponsored by Our Land and Water National Science Challenge).
4	**Our Land and Water 2035 Mitigation Set Scenario.** Full implementation of established and developing on-farm good management practices (GMP) as of 2035.	Total nitrogen (TN) and total phosphorus (TP) contaminant load reductions modelled based on full implementation of both established and "developing" farm mitigation options, anticipated for 2035.
5	**Wetlands #1 Scenario.** Wetlands returned to 1996 extent.	Wetlands reinstated to where they were lost from since 1996, based on land-use maps. The wetlands treat their catchment nutrient load according to typical treatment performance from science literature. Total wetland re-establishment area of **2,230 ha.**
6	**Wetlands #2 Scenario.** Wetlands optimised to 5% of catchment.	Wetlands assumed to be restored or placed such that wetlands occupy 5% of the pastoral land within a contributing catchment. The wetlands treat the nutrient load from that pastoral land according to typical treatment performance from science literature. Total wetland re-establishment area of **34,400 ha.**
7	**Wetlands #3 Scenario.** Large "community scale" wetlands.	Wetland assumed to be restored or placed in low lying areas that were wetland areas – based on the Peat Wetland physiographic unit. The wetlands treat their catchment nutrient load according to typical treatment performance from science literature. Total wetland re-establishment area of **21,780 ha**
8	**Wastewater discharge to land Scenario.** Direct-to-water discharges shifted to land treatment method.	Known point source wastewater discharges currently discharging to rivers treated and put to land instead. 24 direct-to-water discharges (16 municipal and 8 industrial discharges) shifted to land treatment method.
9	**Retirement #1 Scenario.** Retirement from production of flood-prone land	The retirement from production of land classified as a floodway (land within existing stop banks or flood channels).
10	**Retirement #2 Scenario.** Retirement from production of publicly owned land.	The retirement from production of publicly owned land. Land owned by all local and national government entities were included within this scenario (SRC, SDC, ICC, GDC, DOC, LINZ).
11	**Stocking Rate Reductions Scenario.** Reduced regional stocking rates of 10% for dry stock farms, and 20% for dairy farms.	Reduced regional agriculture stocking rates (destocking) of 10% for dry stock farms, and 20% for dairy farms. Based on separate farm modelling conducted for the Southland Economics Project.

The table below, summarises the eight combined science scenarios modelled.

Scenario		Scenarios Included in Combination
1	**Combined Scenario 1**	• Wetlands #1 Scenario • Wastewater Discharge to Land Scenario.
2	**Combined Scenario 2**	• Restoration of Indigenous Vegetation Scenario • Wetlands #1 Scenario • Wastewater Discharge to Land Scenario.
3	**Combined Scenario 3**	• Our Land and Water 2035 Mitigation Set Scenario. • Wetlands #1 Scenario • Wastewater Discharge to Land Scenario.
4	**Combined Scenario 4**	• Restoration of Indigenous Vegetation Scenario • Wetlands #2 Scenario. • Wastewater Discharge to Land Scenario.
5	**Combined Scenario 5**	• Our Land and Water 2035 Mitigation Set Scenario. • Wetlands #2 Scenario. • Wastewater Discharge to Land Scenario.
6	**Combined Scenario 6**	• Restoration of Indigenous Vegetation Scenario • Wetlands #3 Scenario. • Wastewater Discharge to Land Scenario.
7	**Combined Scenario 7**	• Our Land and Water 2035 Mitigation Set Scenario. • Wetlands #3 Scenario. • Wastewater Discharge to Land Scenario.
8	**Combined Scenario 8**	• Our Land and Water 2035 Mitigation Set Scenario. • Wetlands #1 Scenario • Wastewater Discharge to Land Scenario. • Retirement #1 Scenario. • Retirement #2 Scenario.

Appendix J: Economic Scenario Modelling in Support of the Regional Forum

In early 2021, scenarios were identified with the Regional Forum which were subsequently tested in the economic and science models to assist the Regional Forum in exploring thoughts on methods and timeframes. Nine specific economic scenarios and five combined economic scenarios were modelled. The table below, summarises the nine specific economic scenarios modelled.

Scenario		Brief Description
1	Sediment Control Scenario A	Stock exclusion with planted riparian buffers of 5 metres on all non-ephemeral waterbodies equal to or greater than 1m wide, along with retirement of steep erosion prone land in the headwaters based on Land Use Capability (LUC) classes 8 and 7e, implemented over a 10- year period
2	Sediment Control Scenario B	Stock exclusion with planted riparian buffers of 10 metres on all non-ephemeral waterbodies equal to or greater than 1m wide, along with retirement of steep erosion prone land in the headwaters based on Land Use Capability (LUC) classes 8, 7e, and 17% of 6e, implemented over a 5-year period
3	Wetlands Scenario 1	Over 15 years, return 2,230 hectares of land to wetlands (reflecting the approximate amount of wetlands lost since 1996)
4	Wetlands Scenario 2	Over 15 years, as a freshwater management tool, implement large-scale wetlands in locations that provide the likely best outcomes in terms of improving and maintaining water quality. 34,400 hectares of land in total repurposed as wetlands
5	Wetlands Scenario 3	Over 15 years, as a freshwater management tool, establish large community-based wetlands. 21,780 hectares of land in total repurposed as wetlands
6	Indigenous Vegetation Scenario	Over 15 years, return 7,490 ha to indigenous vegetation
7	Retirement of Flood-Prone Land Scenario	Over 15 years, retire 8,790 ha of flood prone land (repurpose for ecosystem services)
8	Retirement of Public Land Scenario	Over 15 years, retire 86,000 ha of public land (repurpose for ecosystem services)
9	Municipal Wastewater Discharge to Land Scenario	Shifting wastewater treatment to land-based discharges when current consents expire, assuming Territorial Authority funding of required upgrades

The table below, summarises the five combined economic scenarios modelled.

Scenario		Scenarios Included in Combination
1	Combined Scenario 1	• Wetlands Scenario 1 • Indigenous Vegetation Scenario • Municipal Wastewater Discharge to Land Scenario
2	Combined Scenario 2	• Retirement of Flood-Prone Land Scenario • Retirement of Public Land Scenario • Sediment Control Scenario A
3	Combined Scenario 3	• Retirement of Flood-Prone Land Scenario • Retirement of Public Land Scenario • Sediment Control Scenario B
4	Combined Scenario 4	• Wetlands Scenario 1 • Indigenous Vegetation Scenario • Retirement of Flood-Prone Land Scenario • Retirement of Public Land Scenario • Municipal Wastewater Discharge to Land Scenario

5	Combined Scenario 5	• Wetlands Scenario 1 • Wetlands Scenario 1 • Indigenous Vegetation Scenario • Retirement of Flood-Prone Land Scenario • Retirement of Public Land Scenario • Sediment Control Scenario B • Municipal Wastewater Discharge to Land Scenario

Appendix K: Established (2015) and Developing (2035) Pastoral Farm Mitigations

In 2021, New Zealand researchers conducted a high-level desktop analysis of farm typologies to establish the theoretical levels of gains that might be made in respect of losses to water of nitrogen (N) and phosphorus (P) based on full implementation of sets of established and developing pastoral farm mitigation options across dairy and sheep/beef farms[25]. This national level analysis considered what gains might have been theoretically achievable based on established mitigation options, as at 2015, and what gains might be theoretically achievable based on both established and developing mitigation options anticipated by 2035. The table below summarises the mitigation actions considered.

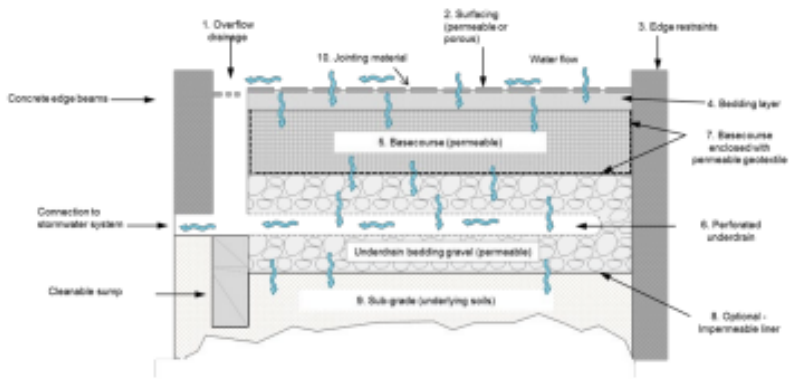
2015 Established Mitigation Actions (Dairy)	**2015 Established Mitigation Actions (Sheep/Beef)**
1. Fencing out stock access to all rivers 4th order or above. 2. Improved management of fertiliser to avoid over-applying nutrients. 3. improved irrigation water practices such as improved scheduling and variable rate irrigation (VRI). 4. Scheduling applications of farm dairy effluent (FDE) for periods when soil is sufficiently dry to retain the applied liquid, or via low rate or VRI systems for irrigated typologies. 5. Off-paddock grazing management which includes off-paddock wintering of dairy cattle via the use of barns and standoff pads.	1. Fencing out stock access to all rivers 4th order or above, but with an allowance to periodically graze margins to keep weeds under control. 2. Improved management of fertiliser to avoid over-applying nutrients. **3.** Land retirement from grazing as supported by several national programmes.
2035 Developing Mitigation Actions (Dairy)	**2035 Developing Mitigation Actions (Sheep/Beef)**
1. Retention dams, bunds, or sediment traps. 2. Strategic grazing of pasture within critical source areas (CSAs). 3. Strategic grazing of crops within CSAs. 4. Tile drain amendments. 5. In-stream sorbents. 6. Alum applied to pasture or crops in CSAs. 7. Controlled release fertiliser. 8. Variable rate fertiliser. 9. Variable rate irrigation and fertigation. 10. On-off grazing in autumn/winter. 11. Edge of field attenuation. 12. Controlled drainage. 13. Constructed wetlands. 14. Decreasing N inputs (fertiliser and supplements) by half. 15. Catch crop. 16. Nitrification inhibitors. 17. Fencing out stock access to 100% of permanent streams.	1. Controlled release fertiliser. 2. Variable rate fertiliser. 3. Edge of field attenuation. 4. Controlled drainage. 5. Constructed wetlands. 6. Increasing the area in plantation forestry from 12.5% to 25% of the property. 7. Fencing out stock access to 100% of permanent streams, but with an allowance to periodically graze margins to keep weeds under control.

[25] Richard W. McDowell, R. M. M., Chris Smith, Andrew Manderson, Les Basher, David F. Burger, Seth Laurenson, Peter Pletnyakov, Raphael Spiekermann & Craig Depree (2021). ***"Quantifying contaminant losses to water from pastoral land uses in New Zealand III. What could be achieved by 2035?"*** New Zealand Journal of Agricultural Research 64(3): 390-410.

Appendix L: Stormwater Management Devices in the Auckland Region

Source: Cunningham, A., Colibaba, A, Hellberg B., Roberts G.S., Symcock R., Vigar N., Woortman W., (2017). ***Stormwater management devices in the Auckland region GD01***, Auckland Council: https://knowledgeauckland.org.nz/publications/stormwater-management-devices-in-the-auckland-region-gd01/

Pervious pavement

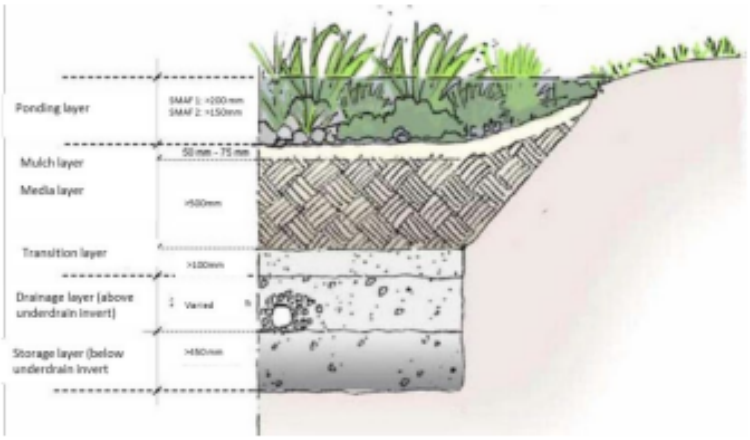


1% AEP detention	✘
50% & 10% AEP detention	✘
Detention for stream protection	✓
Retention (unlined)	✓
Water quality*	✘

* Not considered to be treatment device if designed as active system. Passive systems do not trigger stormwater management provisions.

Description	Any system providing hard or trafficable areas which also provides for downward percolation of stormwater runoff. This includes no-fines concrete or porous asphalt, permeable pavers (water percolates through gaps between pavers), porous pavers (water percolates through the paver) and stabilised loose material (e.g. pebble or shell held in reinforced units or bound by resin). The flow of stormwater from the surface to the collection system is slowed through infiltration and is temporarily stored and slowly released by the basecourse, resulting in detention of the flow peaks. Passive paving systems receive water only from the paved surface. Active paving systems receive additional runoff from external surfaces (such as adjacent roads). Only active systems trigger stormwater management provisions; for this reason, pervious paving is considered as providing retention (if soils are permeable and a permeable liner is used) and detention, but not treatment.
Mana whenua alignment	Pervious paving can recharge groundwater but must be used in conjunction with water quality treatment to align with kaitiakitanga, Taiao and Mauri Tu. Also hand weeding and hand maintenance would align with the principles of Taiao. Iwi management plans are a vital resource and should be referred to early in design.
Treatment synergies	Particularly effective if combined with: • Upstream: Pre-treatment (to remove sediments) • Downstream: Retention (bioretention or swale) and detention (wetlands and ponds).
Advantages	• Improved hydrological response of stormwater peak flow by holding and releasing in a controlled manner • Providing amenity/landscape feature • Passive systems do not trigger stormwater management provisions and therefore do not require any additional land areas outside the paving area to treat the stormwater runoff.
Disadvantages	• Prone to clogging, especially if located lower than adjacent landscaping • If pervious paving fails, the surface will be considered out of compliance • Generally not suitable for volume control or extreme storm event management • Not suitable for traffic areas of high acceleration, deceleration or turning.
Design considerations	See design chapter including: • Slopes <5% (3°) for active designs, <12% (7°) for passive designs. >15 m from slopes of >15% • Infiltration rates through or around the paver of 120 mm/hour over life of device (therefore 1200 mm/hour at construction). Must be designed and installed according to the manufacturer's specification including joining sand and loading. Pre-treatment must be provided to remove sediments. Aggregate must be free of fines, not crush under loading and have a known void space • Requires notice on land title to inform owner that maintenance is required.
Innovation opportunities	• Colour, paving stone shape, interlocking shape, modularisation, including plants.

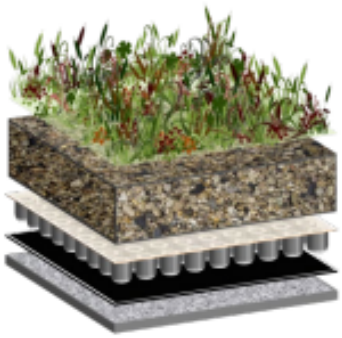
Bioretention devices



1% AEP detention	✘
50% & 10% AEP detention	✘
Detention for stream protection	✓
Retention	✓
Water quality	✓

Description	A bioretention device (rain gardens, planter boxes, bioretention swales etc.) is a sunken garden with an engineered soil media and an underdrain. These devices pass stormwater through both soil and plants which absorb and filter contaminants before stormwater flows through the underdrain to the surrounding ground or the conveyance system. Bioretention devices help remove pollutants and slow down stormwater flows, recharge freshwater bodies and can have a high aesthetic and amenity value. Two designs are provided for: bioretention devices which provide retention, detention and water quality treatment; and bioretention devices which provide water quality treatment only.
Mana whenua alignment	Bioretention devices can be planted with native species and act as ecological corridors for birds, invertebrates and reptiles. Planting with harvestable plants can be considered as well as educational signage, with cultural context and history and can include Māori names. Hand weeding of these devices would align with the principles of Taiao and kaitiakitanga. Iwi management plans are a vital resource and should be referred to early in design.
Treatment synergies	Particularly effective if combined with: • Upstream: Pre-treatment to remove gross solids and coarse sediments • Downstream: Additional retention (swales) or detention (wetlands).
Advantages	• Provides a full suite of stormwater management with detention, retention and water quality treatment • Bioretention devices provide enhanced amenity, safety and aesthetic value through planting and educational opportunities.
Disadvantages	• Require very specific construction methods and very specific operation and maintenance • Plant growth and die-off management is needed during establishment phase • Generally not suitable for volume control or managing extreme storm events.
Design considerations	See design chapter including: • The device is sized such that it can pass the water quality flow through the device within 72 hours • Specified infiltration and ponding footprints based on mitigation requirements. Specific media with specified infiltration rates. Specified media depths • Bioretention media, transition layer and underdrain aggregate all meet standard specifications.
Innovation opportunities	• Planting layout and species. Shape, size and depth can be adjusted (based on detention and retention volume requirements), modularisation.

Living roof

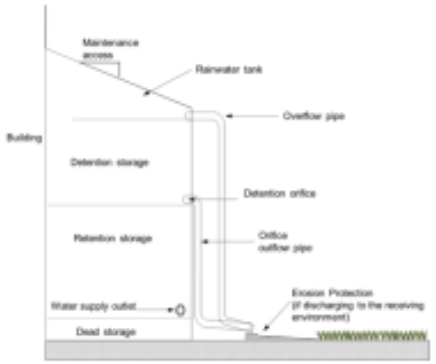


1% AEP detention	✘
50% & 10% AEP detention	✘
Detention for stream protection	✘
Retention	✓
Water quality	*

* Only treats water from rainfall and roof materials.

Description	A green roof is a roof largely covered by vegetation, growing in a substrate on top of waterproof and root-resistant layers. It is designed and constructed to manage stormwater runoff and is made of a waterproof membrane, root barrier, insulation layer, drainage layer, filter fabric, growing medium and plants. Intensive living roofs have a deep soil media and support a wide range of plants and structures (including accessible spaces, gardens or parks). Extensive living roofs have lightweight layers of free-draining media to support drought-resistant vegetation.
Mana whenua alignment	Living roofs align with Taiao through the protection of the natural environment. They may showcase certain native species and act as an urban sanctuary for certain reptile and insect species. Engaging early with mana whenua can help create a design which reflects mana whenua values and kaitiakitanga. Iwi management plans are a vital resource and should be referred to early in design.
Treatment synergies	Particularly effective if combined with: • Downstream and on-site: rainwater tank (detention and retention) • Other linkages to green urban space.
Advantages	• Perceived open space and enhanced building design, or visually mitigating less desirable building aspects • Reduced energy costs through insulation of a building and localised cooling around air conditioner intakes • Decreases urban temperatures. Noise insulation and enhanced air quality and dust interception. Increased service life for underlying roof materials • Is regarded as pervious surface therefore, if used as passive device, does not trigger stormwater management provisions.
Disadvantages	• Higher construction and maintenance costs with certain designs • Intensive monitoring period required to ensure that plant stress and die-off is managed • Generally not suitable for volume control or extreme event management.
Design considerations	See design chapter including: • Building code compliance, particularly regarding structural support and safety • Minimum substrate depth of 50 - 100 mm (depending on design and plants), with substrate permeability of 1500 mm/hr (+ drainage layer) or 3600 mm/hr (no drainage layer) • Maximum roof slope of ≤15° (27%) • Safe design to ensure public and maintenance access is compliant. Access for maintenance requires full Health and Safety compliance (e.g. fall barriers)
Innovation opportunities	• Planting layout and species, shape, plant texture and function, amenity aspects, learning opportunities, urban food source, modularisation, retrofitting.

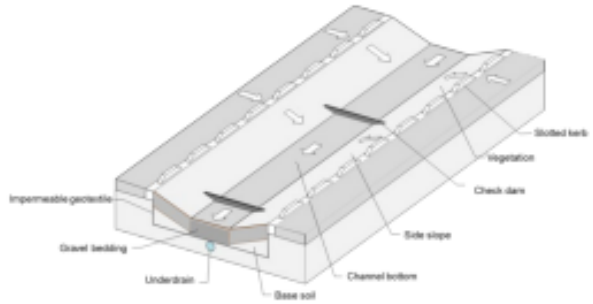
Rainwater tank (non-potable)



1% AEP detention	✓
50% & 10% AEP detention	✓
Detention for stream protection	✓
Retention (with reuse)	✓
Water quality	✘

Description	Rainwater tanks are used to collect water from the roof and detain it prior to release. Water can also be retained for use on site as supplemental water. The water from these tanks can be for household use (flushing the toilet and laundry supply) or outside purposes (such as garden watering and washing cars).
Mana whenua alignment	Rainwater tanks that include reuse and/or recharge (in permeable soils) align with kaitiakitanga, Mauri Tu and Taiao and the protection of environmental health. Iwi management plans are a vital resource and should be referred to early in design.
Treatment synergies	Particularly effective if combined with: • Multiple households detaining roof runoff volumes to similar tank systems • Upstream: Pre-treatment (such as gutter filters) to remove gross solids • Downstream: Additional retention (such as bioretention) and detention (wetlands etc.).
Advantages	• They reduce the use of potable water from the public water supply system for non-potable uses (such as garden irrigation) • They reduce the annual volume of water which runs off from a site and capture the first flush of roof runoff which may contain pollutants from the roof (metals, organic litter etc.).
Disadvantages	• Where used for retention, the asset owner must commit to using retained water • Where potable supply is required from the rainwater tank, extensive treatment processes may be required (NB: potable use is not covered in this guideline document) • Size of the tanks can be large and can be perceived as having poor aesthetics • Generally not suitable for volume control or extreme storm event management • Require regular inspection and maintenance by the homeowner.
Design considerations	See design chapter including: • Building Code requirements for plumbing (including backflow prevention), Health Act requirements (for potable water use), detention volumes for impervious surfaces. Requires notice on land title to inform owner that maintenance is required • Conveyance (such as guttering) designed to accommodate the size of the storm the tank is designed for.
Innovation opportunities	• Shape (multiple options available to accommodate design needs), size (assuming minimum detention volumes are met), location, retrofitting, pump systems, automation. Linking overflows to other devices.

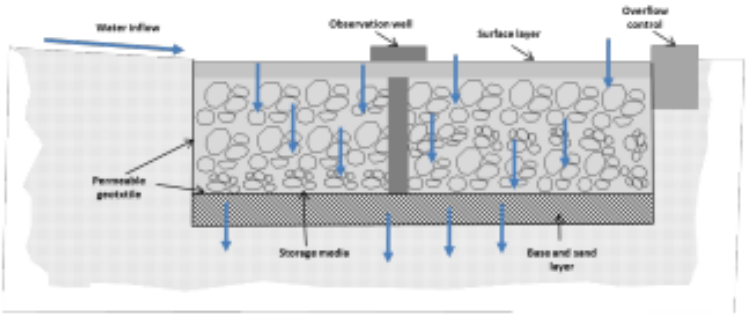
Swale



1% AEP detention	✘
50% & 10% AEP detention	✘
Detention for stream protection	✘
Retention	✘
Water quality	✓

Description	Swales are broad, planted channels used to treat stormwater runoff. They direct and slow stormwater across vegetation, grass or similar ground cover and through the soil. Swales help filter sediments, nutrients and contaminants from incoming stormwater before discharging to downstream stormwater system or waterways. Some swales have liners to direct filtered runoff, or rocky linings to slow fast flows. If vegetated, swales are simple to maintain and can fit well in urban design.
Mana whenua alignment	Mana whenua preference is for vegetated swales with minimum maintenance (little or no mowing). Swales may be planted with native grasses and other vegetation and can be designed to act as ecological corridors. Filtering sediments aligns with the principles of Taiao and kaitiakitanga. Iwi management plans are a vital resource and should be referred to early in design.
Treatment synergies	Particularly effective if combined with: • Upstream: Pre-treatment to remove sediments • Downstream: Additional detention (wetlands) and/or any retention devices (bioretention).
Advantages	• Can provide separation of vehicle and foot traffic, amenity and safety • Simple to construct with well-understood operation and maintenance • Potential to include infiltration through the base in suitable subsoil conditions. Potential to include some detention through use of check dams. Can reduce piped reticulation.
Disadvantages	• Easily damaged (e.g. compression of soil from vehicles) and requires signage • Maintenance access can be difficult, particularly if the device or the adjacent roads are narrow • Land take can be large, particularly where storage/volume control is needed • Not suitable where slope is greater than 8%. Not suitable on geotechnically unstable ground • Generally not suitable for volume control or extreme event management.
Design considerations	See design chapter including: • Average hydraulic residence time of 9 minutes, with minimum 30 m length • Velocity: less than 0.8 m/s for water quality and less than 1.5 m/s for 10% AEP • Used on slopes of less than 8% only. Check dams needed for slopes greater than 5% • Check dams needed for slopes of greater than 5%. Underdrains needed for slopes of less than 2%. Side slopes: minimum slope 3H:1V for vegetated swales. Minimum slope of 5H:1V for mown grasses • Media composition (including compost percentage, void space), loading specification • Must be protected from compaction (e.g. vehicles).
Innovation opportunities	• Including diverse native planting, layout and species, shape, media composition.

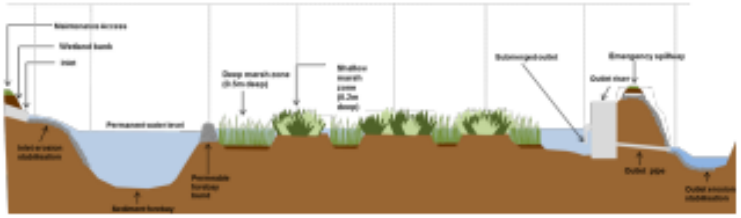
Infiltration devices



1% AEP detention	✘
50% & 10% AEP detention	✘
Detention for stream protection	✘
Retention	✓
Water quality	✘

Description	Infiltration devices (trenches and pits) collect and hold (retain) water below ground for disposal to the groundwater table. Some sediment can be removed by filtering in the stone reservoir or by *in situ* soils adjacent to the excavation where the stormwater is stored but treatment is limited. Soils must be permeable enough to disperse stormwater in a reasonable time and ensure the device is ready to receive further inflow. Only clean water should be discharged to infiltration devices. All other water should be pre-treated to protect aquifers and prolong operational life. They do not function in impermeable soils such as clay.
Mana whenua alignment	Infiltration devices may be designed and constructed to align with mana whenua values if they can include such aspects as: pre-treatment to ensure the mixing of waters does not lead to contamination; cultural monitoring during excavation. Retained water must be clean water only (e.g. road water only once it has passed through water quality treatment devices). These align with the principles of Taiao. Iwi management plans are a vital resource and should be referred to early in design.
Treatment synergies	Particularly effective if combined with: • Upstream: pre-treatment to remove gross solids, any planted retention device • Downstream: additional retention (swales, bioretention) or detention (ponds or wetlands).
Advantages	• Provide 100% reduction in load to the surface receiving waters, thereby meeting the pre-development hydrology conditions for retention • Can be used to recharge groundwater and can be used for retention of up to 50% AEP design storms, if sized correctly. Are underground and therefore generally unobtrusive.
Disadvantages	• High failure rate if no pre-treatment is provided or if surrounding soil conditions are not suitable or if sited on steep slopes. Not suitable on geotechnically unstable ground. If clogged, the device is difficult to refurbish • Can impact groundwater if located close to high contaminant loads, or where industrial spills might occur • Upstream drainage must be completely stabilized • Generally not suitable for volume control (detention) or managing flows from large storms • Difficult to monitor effectiveness.
Design considerations	See design chapter including: • Slopes of 6° (10.5%) or less only and located 3 m or more from buildings, slopes or trafficked areas • Soakage and soil testing required. Use in permeable soils (>10 mm/hr), but not so coarse as to allow soakage • Device invert should be at least 2 m from the seasonal groundwater level • Pre-treatment needed to reduce sediment loads and prolong device life.
Innovation opportunities	• Location, as part of a suite of devices, shape, depth, groundwater table exploration and recharge.

Wetlands



1% AEP detention	✓
50% & 10% AEP detention	✓
Detention for stream protection	✓
Retention	✘
Water quality	✓

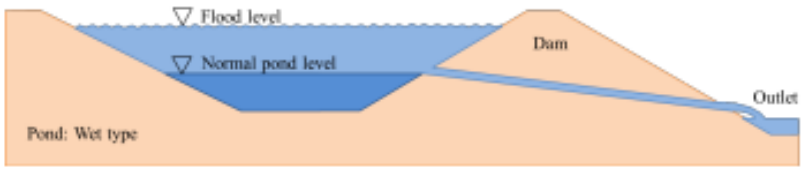
Description	Constructed stormwater wetlands are ponded areas, densely vegetated with water-loving plants that mimic the treatment processes of natural wetlands with detention, fine filtration and biological adsorption, to remove contaminants from stormwater runoff.
Mana whenua alignment	Wetlands provide excellent opportunities for alignment with mana whenua values including: opportunities for early design collaboration, species selection (including species for harvest, such as flax), naming, signage, cultural monitoring, sourcing plants, maintenance contracts. Wetlands can align with the principles of kaitiakitanga, Mana, Taiao, Mauri Tu, Ahi kā , Mahi Toi and Tohu. Iwi management plans should be referred to early in design.
Treatment synergies	Particularly effective if combined with: • At source: rainwater tanks, living roofs and pervious paving • Mid-catchment: pre-treatment to remove gross solids, any quality treatment (swales, bioretention, proprietary devices) any retention (bioretention, pervious pavement etc.).
Advantages	• Reducing downstream flood potential and providing water quality treatment (removing a broad range of pollutants) • Minimising downstream channel erosion. Extreme event flow and volume management • Aesthetics through planting and added amenity value for local communities with educational opportunities • Providing a naturalised haven for aquatic and bird species and enhancing green corridors for existing riparian environments, with improved biodiversity and habitat.
Disadvantages	• Does not provide significant retention function • Plant selection can be limited for areas of significant/frequent inundation. Maintenance of vegetation can be difficult, can also promote pests and weeds if poorly maintained • Safety, e.g. potential drowning and vector source • Water temperatures can increase if there is insufficient shade from vegetation.
Design considerations	See design chapter including: • Structural design according to relevant dam specifications and guidelines (e.g. NZSOLD 2015 and TP109). At least 80% of wetland area vegetated. Detention volumes (including those for stream protection and flood mitigation). Forebay size (minimum 15% WQV). Emergency spillway • Flow velocities of <0.1 m/s for <50% AEP, <0.5 m/s for up to 1% AEP • Slopes: internal below PWL: <1V:4H, internal above PWL: <1V:3H, mowing: <1V:5H, and safety benches <1V:8H. • Maintenance access: >3.5 m width and 1V:8H slope.
Innovation opportunities	• Planting layout and species, shape, bathymetry. Multiple social, cultural and environmental benefits.

Dry ponds (detention basins)

1% AEP detention	✓
50% & 10% AEP detention	✓
Detention for stream protection	✓
Retention	✘
Water quality	✘

Description	Dry ponds have a temporary pool formed (with a planted base) by capturing and releasing stormwater at a slow rate which drains down to the base of the pond between storm events. They provide protection of downstream channels from frequent smaller storms. Dry ponds can service multiple purposes during antecedent periods (such as providing open fields and green space).
Mana whenua alignment	Dry ponds can provide alignment with mana whenua values including: • Native species selection (including those for harvesting) • Educational signage • Cultural monitoring • On-going maintenance contracts. Iwi management plans are a vital resource and should be referred to early in design.
Treatment synergies	Particularly effective if combined with: • At source: rainwater tanks, living roofs and pervious paving • Mid-catchment: pre-treatment to remove gross solids, any quality treatment (swales, bioretention, proprietary devices) any retention (bioretention, pervious pavement etc.).
Advantages	• Reducing downstream flood potential. Minimising downstream channel erosion. Extreme event flow and volume management • Aesthetics and amenity with benefits from accessible open green space between storm events • Provide and enhance green corridors for existing riparian environments, with improved biodiversity and habitat • Distinct advantages over wet ponds (including easier maintenance).
Disadvantages	• Does not provide retention or water quality benefits • Temporary standing water can be a potential safety issue • Introduces a dammed water hazard.
Design considerations	See design chapter including: • Structural design as required in relevant dam specifications and guidelines (e.g. NZSOLD 2015 and TP109) • Detention volumes (with up to the 1% AEP design event) • Planted in any wetted channel. No trees or shrubs planted on the embankment • Maintenance access to underdrain.
Innovation opportunities	• Potential amenity value from open space, planting layout and species, shape.

Ponds (wet)



1% AEP detention	✓
50% & 10% AEP detention	✓
Detention for stream protection	✓
Retention	✘
Water quality	(✓)*

* limited

Description	Wet ponds detain stormwater inflows within a permanent ponded area. A forebay captures the first flush and provides coarse sediment and gross pollutant reduction, while the body of the pond can promote sedimentation (if slow flows allow for longer detention times and minimised turbulence). Limited water quality treatment occurs in ponds. When constructed in conjunction with extended detention, they provide protection of downstream channels from frequent smaller storms. Early consultation with Auckland Council is essential to validate pond design, maintenance requirements and intended stormwater management outcomes.
Mana whenua alignment	Wet ponds are **not** supported by mana whenua as a stormwater management device.
Treatment synergies	Can be effective if combined with: • At source: rainwater tanks, living roofs and pervious paving • Mid-catchment: pre-treatment to remove gross solids, any quality treatment (swales, bioretention, proprietary devices) any retention (bioretention, pervious pavement etc.).
Advantages	• Reducing downstream flood potential. Extreme event flow and volume management. Reducing downstream channel erosion. • Aesthetics through planting and added amenity value for local communities with educational opportunities • Providing a naturalised haven for aquatic and avian species • Providing and enhancing green corridors for existing riparian environments, with improved biodiversity and habitat.
Disadvantages	• Does not provide retention or sufficient water quality treatment. Can cause a significant increase in water temperatures, habitat for pests and weeds • Requires resource consent when discharging into streams • Standing water can be a potential drowning hazard and vector source (mosquitos and vermin).
Design considerations	See design chapter including: • Structural design according to relevant dam specifications and guidelines (e.g. NZSOLD 2015 and TP109). Detention volumes (including PWV and up to the 1% AEP design event), forebay size (minimum 15% PWV). Maximum depth of 2 m • Should be off-line to waterways with planting for safety and shading • Requires maintenance access with >3.5 m width and 1V:8H slope. High grade and durable structure for outlet and erosion control on outlet with sediment drying area • Safety considerations including emergency spillway, safety bench, signage • Slopes: internal below PWL: <1V:4H, internal above PWL: <1V:3H, mowing: <1V:5H, and safety benches <1V:8H.
Innovation opportunities	• Planting layout and species, shape, bathymetry. Can provide multiple social, cultural and environmental benefits.