Action for healthy waterways: A discussion document on national direction for our essential freshwater

Local Government New Zealand's submission to the Ministry for the Environment

31 October 2019

We are. LGNZ.

LGNZ is the national organisation of local authorities in New Zealand and all 78 councils are members. We represent the interests of councils and lead best practice in the local government sector. LGNZ provides advocacy and policy services, business support, advice and training to our members to assist them to build successful communities throughout New Zealand. Our purpose is to deliver our sector's Vision: "Local democracy powering community and national success."

This final submission was endorsed under delegated authority by Dave Cull, President, Local Government New Zealand (LGNZ) and Doug Leeder, Chair of LGNZ's Regional Sector.

This submission has been prepared by the Regional Sector Water Subgroup (RSWG)] on behalf of wider local government sector, comprising regional councils, unitary authorities and territorial authorities (the Sector)].

All those parties have been consulted and have actively contributed to the development of this submission. It represents their collective and common position on the merits and challenges of the Essential Freshwater Reform package (EFW package) as set out in the discussion document *Action for Healthy Waterways* and the accompanying draft national instruments[1].

To the extent that individual councils have made their own submissions, those submissions should be read as being in addition to the matters raised here. Individual councils' submissions inevitably address matters of particular interest and relevance to their respective regions and districts that may not be addressed in this sector-wide submission.

In preparing this submission, the Sector is very aware that it wears several 'hats' in the national freshwater conversation.

- Regional councils, unitary authorities and city and territorial authorities all have a responsibility under the Local Government Act (**LGA**) to *promote the social, economic, environmental, and cultural well-being of communities in the present and for the future*.
- Regional councils also have the regulatory function of managing water under the Resource Management Act (**RMA**) towards the specific purpose of promoting *sustainable management* and to achieve a range of environmental outcomes.
- Both the regional councils and the wider local government sector also wear the hat of a resource user in terms of their *service delivery* responsibilities for, in particular, flood management and the provision of 'three waters' services.

Where relevant this submission distinguishes between submission points made wearing these different hats. Where "regional councils" are referred to throughout this submission this also includes unitary authorities discharging their regional council functions.

[1] Draft Freshwater NES, Draft National Policy Statement for Freshwater Management and Stock Exclusion Regulations.

Foreword

Kia ora

There are very few matters of public policy where all the stakeholders aspire to the same outcome, but freshwater appears to be one of those exceptions. Everyone wants to see the quality of our lakes, rivers, wetlands and steams improve, be they central government, councils, iwi/Māori, farmers, industry, environmental groups, and rural and urban communities.

Where the views differ is in how we deliver on this outcome. Any significant policy change will, by its nature, give rise to costs and benefits, which will be hotly debated among stakeholders. This is to be expected and welcomed as part of the democratic process, one that improves policy development by inviting critical assessment and new ideas into the discussion.

That is the spirit with which LGNZ has engaged with the Essential Freshwater Package.

Regional councils have worked closely with Government and committed significant resources to help inform the thinking on freshwater policy. Using their extensive on-the-ground experience as water regulators, regional councils have also tested whether the proposed package will deliver on the intended goals, outlined the trade-offs, and looked at how the costs and benefits are likely to be distributed across the country.

The results of this work can be found in this submission. Our intent is to constructively and collaboratively help develop the new regulatory framework that delivers on the freshwater outcomes that all New Zealanders want as a key driver of their well-being.

We look forward to engaging with you as the policy development process proceeds.

Dave Cull
President
LGNZ

Doug Leeder
Chair
LGNZ Regional Sector

Key messages

In responding to the Government's substantial body of reform proposals, the wider sector is committed to work together with the Government, tangata whenua and stakeholders to deliver healthy freshwater for all our communities. The Regional Sector sees itself as a *partner* in the management of New Zealand's freshwater not as just an implementer or just another stakeholder.

The comments made in this submission are made as part of a genuine desire to deliver the fastest possible progress towards achieving sustainable and durable solutions to the issues we face.

Overall, we believe that the best way to deliver on that ambition is to build on what has already been agreed with our communities and what we know to be successful. In that regard, the Regional Sector welcomes a reform package that offers us clear direction, empowerment and the provision of tools. It does not support prescription that limits how councils can respond or which redirects our effort in ways that make us less effective as freshwater managers.

The following key messages need to be read in that context.

- In its role as both promoter of well-being and as environmental regulator, local government strongly supports the reform objectives and the desire to improve water quality and ecosystem health. In principle, we support many aspects of the package including building on the Te Mana o te Wai framework, strengthening management of freshwater ecosystem health, and national regulation to manage contaminant losses from high risk rural land use practices.
- While the support for the reform *objectives* is strong, local government is very conscious of its responsibility under both the Local Government Act and the Resource Management Act to manage land and freshwater in a way and at a rate that enables people and communities to provide for their social, economic, environmental and cultural well-being.
- Commitments to halt decline and secure improvements in water quality and ecosystem health are already reflected in the work programmes (and in many cases operative statutory plans) across regional and unitary councils. There is no shortage of commitment by all of local government to maintaining and improving water quality and the values we all share in water[2]. Despite that, we accept that there are many elements of the existing policy and legal framework that could be amended or augmented to help the Regional Sector do its job as environmental regulator more efficiently and effectively. The EFW package includes many of those changes and those proposals are commented on in this submission. Overall though, we think the reform package lacks a clear and accurate problem definition.
- One of our biggest concerns with the package is that it seems based on a premise that the issues are severe and urgent *everywhere* and, accordingly, that there is the same need for management intervention everywhere, in the same way and in the same timeframes. That is not our analysis of the challenge in front of us. Our information clearly indicates that freshwater problems remain highly variable around the country. In many respects, responses need to be far more bespoke than the EFW package suggests. Furthermore, opportunities exist for national resources to be prioritised to get the most benefit the fastest by targeting priority issues and catchments.
- We are concerned that the new and additional obligations and, in particular, the emphasis on increasing measurability, accounting and reporting of instream outcomes, will distract councils from taking the practical measures that will make a material difference for freshwater outcomes. While there is truth in the saying that 'you cannot manage what you cannot measure', in a world of limited resources there is a balance that needs to be struck. The EFW package has not got that balance right. We believe that delivering an increased emphasis on monitoring and reporting will occur at the expense of delivering practical on-the-ground programmes that we know, from decades of experience, will drive real change. The management of sediment is a

[2] See the Sector's declaration at: https://www.lgnz.co.nz/our-work/publications/local-government-leaders-water-declaration/

particular case in point. We can spend a lot of time and money trying to measure sediment in streams but no matter what we find we know the answer lies in land management programmes that deliver tangible action.

- Our scientists advise that there is not the requisite rigour behind all the proposed attributes and monitoring proposals. It appears that application of some of the proposed 23 attributes will be inappropriate in certain circumstances. The DIN/DRP attributes in particular, have been developed on a basis that means the national bottom lines will be not necessarily applicable at the regional or catchment scale. Other attributes such, and Fish-IBI, LakeSPI and ecosystem metabolism appear premature because the science is still evolving and/or their applicability and appropriateness varies according to the nature of waterbodies. Applying these attributes as proposed could lead to perverse outcomes and impose unnecessary costs.
- It is not clear to us that the EFW Package fully acknowledges the potential impact of its collective proposals and may underplay the costs of implementation. This includes:
    - The social and economic costs of the EFW package on the *well-being of communities* once implemented arising from the complex interplay of various policy regulatory and technical requirements. This concern relates both to impacts on existing water users and on our the ability to provide for the future and for the growth and development of our communities
    - The costs on the Regional Sector as regulator and challenges it will face in implementing the broad suite of proposals within the proposed timeframes. We consider that with the best will the challenge may simply be unmanageable given capacity constraints.
- Accordingly, a common thread to all our 'big picture' issues is the need to better understand social, economic and administrative costs and find ways to take them into account in both the design and implementation of the EFW package. The Sector is focused on delivering the shared freshwater objectives and the philosophy of Te Mana o te Wai while keeping the cost of doing so to a minimum and, at the same time, finding ways to continue to enable the growth and development of our communities.
- At this point we see an apparent disconnect between the Government's freshwater agenda and its other priorities, including, for example, building prosperous, connected and liveable urban areas that provide adequate housing for people and communities. While we can often do better at managing impacts than we have in that past, urban and transport development inevitably has impacts on freshwater outcomes. As a sector we would like to see greater "joined up thinking" that demonstrates alignment and integration across national priorities.
- Specific issues arise for territorial authorities as service providers. The package will require significant investment by territorial authorities and their communities to upgrade three waters infrastructure. Once again, this raises the issue of funding powers/tools and the need to look at alternatives to supplement rating revenue.
- Finally we acknowledge that the reform process is complex and has been undertaken in a relatively brief timeframe. This tends to be reflected in a proposals that remain unclear and their affect and enforceability uncertain. In many cases it is a matter of clarity of drafting. In other instances there appears to be legal uncertainty about the enforceability of certain proposals (for example, FW-FPs which may not be enforceable unless required as a condition of a resource consent, and those farming-related regulations that seem to rely on the use of Overseer outside of it recommended usage). The sector is ready and willing to assist the Government with resolving these areas of uncertainty and assisting with drafting by applying the lessons the regional councils have learned through years of implementing and enforcing regional plans.

Structure of submission

This submission has four core parts:

- **Part 1** - A discussion of the 'big picture' concerns of the Regional Sector. This section organises a number of general points around two broad themes and provides an overview of the challenges that the Regional Sector foresees in implementing the EFW package. Where relevant, it cross references to the principles we have articulated in previous feedback[3].
- **Part 2**- A description of those parts that the Regional Sector supports and would want to see retained as the proposals are finalised.

*Parts 1 and 2 have been prepared by the Regional Sector mindful of both its **promoter of well-being and environmental regulator** roles*

- **Part 3** - A detailed review of specific proposals within the EFW package (looking in turn at the Draft NPS-FM, Draft NES-FM, section 360 Stock Exclusion Regulations, and the proposals arising out of the Three Waters Reform)

*Part 3 has been prepared by the Regional Sector mindful of its **environmental regulator** role.*

- **Part 4** – a detailed review of those parts of the EFW package that impinge upon the water management infrastructure and delivery of three water services.

*Part 4 has been prepared by the Sector in its capacity as an **infrastructure and service provider**.*

Background supporting information is provided as **Appendices 1 to 7.**

The specific questions posed in the discussion document are all answered throughout this submission.

An independent national body for freshwater management

Although not part of the EFW package, we are conscious that both the FLG and KWM have suggested that it would be a good idea to have an *independent national body* to provide 'oversight' of freshwater management implementation.

LGNZ holds the view that the appropriate order of consideration is for Government to consider:

a. Freshwater management system requirements and functions (i.e. what needs to be done), and only then;
b. The institutional arrangements, including making better use of existing institutions (ie. who should do it).

With regard to b above, we note that there would appear to be a plethora of existing institutions that already have national 'oversight' roles that provide various layers of checks of balances in terms of regional councils' actions and decisions. These include:

- The Minister and Ministry for the Environment;
- The Minister and Department of Conservation;
- Office of the Auditor General;

[3] Regional Sector Commentary on Essential Freshwater Proposals He Pito Kōrero e pa ana ki Ngā Tūtohu Mō te Waimāori, Prepared by the Regional Sector Water Subgroup, September 2019

- Office of the Ombudsman;
- The Environmental Protection Agency;
- The Parliamentary Commissioner for the Environment; and
- The Environment Court (and the Court system more broadly).

In addition, regional councils are themselves electorally accountable to their communities for the performance of their organisation every three years.

It does not seem to us a wise use of resources, nor necessary, to add another entity to this list. Furthermore, we have seen no gap analysis identifying the need for such an additional agency. We are not aware there is anything that might be required that is not, or cannot, be done by these existing agencies.

Regional councils are already subject to a wide range of accountability obligations and directive interventions including:

- Official information requests (under the Local Government Official Information and Meetings Act);
- Various strategic planning, budgeting and reporting obligations (under the Local Government Act); and
- Environmental reporting obligations, enforcement action, declarations, various Ministerial directions (including directions to make or review plans) under the RMA.

We have read nothing in the FLG or the KWM reports that suggests an analysis of those existing oversight powers has been undertaken and gaps identified.

While LGNZ does not support an additional national oversight entity, this submission does support the idea that regional councils can better report collective performance.

The development of the LAWA website and associated reporting system is a critical step in that regard. Initiatives that build on (but do not replicate) that high integrity data collection and reporting system are supported.

PART 1 - General themes

The wider sector has considered the EFW package with an eye to two major considerations relating directly to our core functions.

1. First, in its role as promoter of social, economic, cultural and environmental well-being the wider sector has asked what the implications are for *community well-being* and whether those implications:
   - Have been fully identified and understood; and
   - Where they have been identified, have been fully and appropriately factored into the design of the EFW package. This includes whether the balance of the package is cognisant of the variability in the impacts likely to flow from implementation of the package.
2. Second, in its role as regulator the Regional Sector has asked whether the EFW package can and will *effectively deliver* on its objectives for improved freshwater outcomes and what effective implementation would require of regional and unitary councils (the Regional Sector) as the primary implementation agent for the package. This includes, in particular:
   - Whether the role and specific responsibilities of the Regional Sector in implementation of the package are clear; and
   - Whether the capacity exists within the wider local government sector (and the broader community) to implement the package in the timeframes envisaged.

In considering these two over-riding concerns we have applied the principles outlined in our earlier commentary[4]. These two over-riding issues are discussed in turn in this part of the submission.

A. Implications for community well-being

The implications for community well-being can be thought of in terms of:

- Impacts on existing economic activity; and
- The impacts on the future and the ability for communities to grow and adapt to new opportunities and constraints.

Impact on existing land and water use

Impact assessment to date

As the details of policy proposals began to emerge, LGNZ's Regional Sector Water Subgroup became increasingly concerned that the body of evidence being provided to support decision-making was incomplete. In particular, there appears to have been little attention paid to how the draft proposals will impact on the well-being of many communities across the country. There is certainly little evidence in the Interim Regulatory Impact Analysis of substantive research supporting the policy development.

As a result, the impacts on local communities are unlikely to be well understood by the Government. There has been little recognition that the costs to some communities are likely to be high. The lack of effort to understand their importance is a significant gap in the policy process, and in contrast to the Government's efforts to incorporate such things through its Living Standards Framework.

In a similar vein, there is a risk that a fragmented analysis of individual proposals in the package will not give an accurate picture of the implications of the package as it is imposed across the country. That is, the impact of the package as a whole may be different to the sum of the parts.

[4] Regional Sector Commentary on Essential Freshwater Proposals He Pito Kōrero e pa ana ki Ngā Tūtohu Mō te Waimāori, Prepared by the Regional Sector Water Subgroup, September 2019

The policies have been developed with little understanding of the different ways in which they will impact across different parts of the country.

A better understanding of nation-wide impacts can be gained from considering the regional viewpoints and how they fit together. The Regional Sector Water Subgroup developed a regional-scale impact assessment approach and a series of case studies from around the country in an attempt to highlight some of the gaps in the Government's analysis[5]. There are many other significant gaps that were not included as case studies, such as the impacts on local communities of the exemption for major hydro-electric schemes.

The proposed new national bottom-lines for nutrients in the NPS-FM are expected to be a big step in some areas, including those typified by soft-bottomed or spring-fed streams (because they are not currently subject to the need to manage nutrients in relation to periphyton outcomes). Case studies in the Waikato, Canterbury, Auckland and Taranaki regions consider the implications of trying to achieve these bottom-lines. A common conclusion is that meeting these will require more than the usual bag-of-mitigations, and may require extensive afforestation in some places. While, ultimately this may lead to the growth of forest-based industries, the communities living in those places would see significant impacts.

Proposed rules in the National Environmental Standard do not require a plan change process, and are intended to take effect quickly. Case studies for Southland, Bay of Plenty and the West Coast identify issues in relation to the stock exclusion and land-use intensification rules. The respective analyses for Southland and Bay of Plenty show some of the problems with a one-size-fits-all approach – in particular, how the Nitrogen-cap regulations would have very different impacts, depending on local conditions.

In seeking to address only the first two of the Government's freshwater goals (halting deterioration and beginning to improve water quality) and not the third (allocation), there is potential for unintended consequences. In effect, avoiding the allocation question risks locking in a 'grandparenting' approach and locking out new uses and activities (as discussed later in this submission). In the interim, this may result in misdirected investment and restrict the ability for owners of (in particular) undeveloped land to utilise their resources – as described in the case study for Tairāwhiti/Gisborne on whenua Māori.

Overall, there is a great deal of uncertainty in relation to many aspects of the package. The case study of Central Hawke's Bay District's municipal wastewater schemes illustrates how, in small communities already struggling to cope with the required upgrades, the potential for additional requirements may create real hardship.

These case studies are provided as Appendix 1.

To gain a fuller picture of the costs and benefits of the EFW package and the potential distributional impacts of the package across the 16 Regional Councils, LGNZ commissioned a report from independent consultancy firm, Castalia. The brief also asked Castalia to evaluate the Interim RIS.

Castalia's full report is provided as Appendix 2. Key findings from the report are provided in the Box below. They highlight deficiencies in the interim RIS and higher costs than indicated in the interim RIS as well as significant regional variation in those costs.

Castalia's Key findings

We find the Interim RIS does not meet the required criteria

Our independent evaluation of the Interim RIS is contained in Appendix A. We find that the Interim RIS does not meet the criteria for a final RIS at this point in time. The Interim RIS is deficient on the following key points:

- Inadequately defines the problem in policy terms.

[5] Regional Case Studies for Essential Freshwater: Action for Healthy Waterways, LGNZ Regional Sector Water Subgroup, October 2019

- The objectives are not defined with reference to impacted parties and the scale of improvement in freshwater needed.
- The options analysis details a good range of options with adequate information underpinning these. However, there are some technical errors and inadequate discussion of policy interdependency. The distributional impact of the proposed Package is inadequate.
- The implementation and monitoring aspects of the Interim RIS could be improved by addressing how monitoring could lead to future change to the regulatory interventions.

We find that the Freshwater Package imposes higher costs than is calculated in the Interim RIS

We were unable to replicate the size of impacts in the Interim RIS in our first principles analysis. We reviewed the specific interventions as set out in the draft National Policy Statement, National Environmental Standard and section 360 regulations. We find that some of the major cost estimates of these requirements are understated. The two largest cost impositions under our analysis were stock exclusion and the requirement for farm plans. The largest differences in costs are:

Stock exclusion

- MFE estimate: $400 million
- Castalia estimate: $775 million

Farm Plans

- MFE estimate: $138 million
- Castalia estimate: $625 million

We find that the Interim RIS should more fully address the large regional variations in impacts

Our first principles analysis also identified major differences in impacts between the regions. We would normally expect these variations to be highlighted in an Interim RIS, particularly where significant impacts on parties are likely. The regional variation is to be expected to some extent due to regional variation in geography and economic activity, however, very significant distribution of costs and benefits occurs between regions. The Interim RIS discusses benefits at a national level and acknowledges most of the costs will be localised at a catchment by catchment level. We analysed the costs on a regional basis to illustrate the variation in Figure 1.1 below:

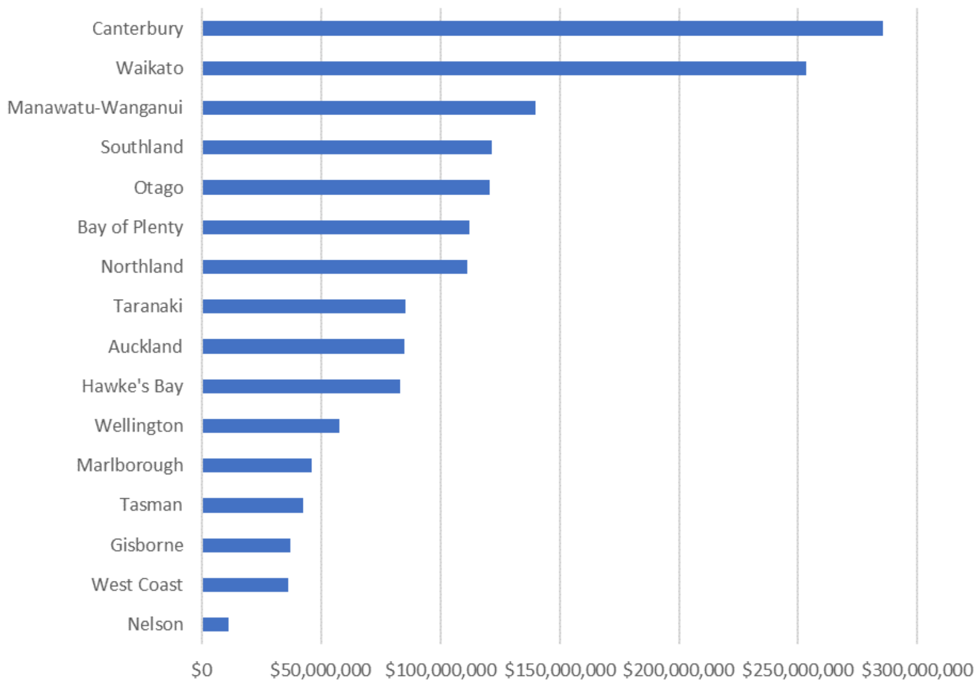

Figure 1.1: Regional distribution of total costs of quantifiable impacts

Some under-recognised issues for existing users: inability for current state to reflect 'load to come'

A specific but important issue relates to the way current state is defined. Current state is of critical importance to how the new NPS-FM will play out because it defines the minimum level at which water quality must be maintained (unless the national bottom-line is more stringent).

As we understand it, as the name would suggest, current state is to be based on monitoring data across all 23 attributes (or where that data does not exist, using best efforts). We know, however, that in many catchments there will be contaminant 'load to come'. That arises from two sources:

- Lags in the hydro-geological system such that contaminants discharged to land may take many years (even decades) to present in surface waterbodies; and
- The contaminant load relating to consented but not yet established land uses, hydro schemes, irrigation schemes and discharges.

What this means is that even to maintain waterbodies at "current state" will, in many cases, require existing land uses and discharges to significantly reduce contaminant losses.

In other words, "halting the decline" can mean far more than just limiting further land use change/ intensification or additional discharges. It can mean requiring significant and ongoing reductions in contaminant losses from existing activities.

Load to come is acknowledged in the impact analysis but that analysis nevertheless concluded that the requirement to strictly maintain water quality at current state *"does not impose real costs on individuals"*[6]. We think that too easily dismisses what could be very significant costs on existing resource users to maintain current (monitored) state.

Setting target attribute states

Section 3.9(6) of the draft NPS-FM sets out a list of matters that must be had regard to in setting the target attribute states. The notable omission from that list is the implications for people and communities (ie. social and economic matters). That is in contrast to the existing Policy CA2 f) of the existing NPS-FM which expressly requires consideration of social and economic cost.

It is important to remember that setting target attribute states is an exercise about how much (and how fast) *improvement* should be made *beyond the current state*. It is not an exercise about whether water quality should be traded away (made worse) for potential social and economic gain. The Regional Sector would agree that the latter would be entirely inappropriate. However, we find it hard to reconcile the idea that we could be involved in setting targets for improvement (beyond current state and above bottom-lines) without any regard to the cost of those targets and the impact on communities. It seems to us that that would require us to close our mind to one leg of section 5 of the Act and be an exercise quite contrary to that section of the Act.

Our solution

Amend Policy 3.9 (6) of the draft NPS-FM to include the following matters:

- <u>*The limits that would be required to achieve the target attribute states*</u>
- <u>*Any implications for resource users, people and communities arising from the target attribute state and associated limits including implications for social and economic well-being.*</u>

We propose further relevant amendments to this Clause in Part 4 of the submission.

[6] See page 224 of the Interim Regulatory Impact Analysis, Part 2

Impact on the future and communities' ability to grow and adapt

Much of the discussion on (and almost all of the impact assessment of) the EFW reform package has focused on the impact the proposals will have on *existing* land and water users. In that regard it is correct to observe that while some will face short-term adjustment costs (arising in particular from NES and s.360 regulations) most of the cost will likely be spread over a long transition – perhaps a 'generation' as the package itself suggests. That is on the basis that plans will not take effect until notification in 2023 and in terms of existing uses not until six months after the new regional plans take effect in 2025. Councils will be able to apply timeframes to the achievement of target attribute states that require progressive improvement over (potentially) decades, with 10-year interim targets. In addition, existing consented activities will be able to continue under their existing consents for the term of their consents (subject to any s128 reviews that might be undertaken).

What does not appear to have been widely discussed is the situation that applies to *any new* activity or any proposed *growth or expansion* of an existing activity. It is important to recognise that applications for new activities that affect water quality (and quantity) are received by regional councils every day[7]. That will not stop with the introduction of the new NPS-FM. These activities include new point source discharges for municipal and industrial wastewater, new rural point source discharges, land use intensification and a wide range of other activities. In addition, many small-scale activities (such as household wastewater systems) establish as permitted activities. The fate of those potential future activities[8] is far from clear under the package and no attempt appears to have been made to understand the cost associated with those activities not being able to establish or expand.

The elephant in the room is that the draft NPS-FM effectively makes the entire country 'fully allocated' in terms of the 23 attributes (including the specified contaminants). Policy 7 requires regional councils to *avoid future over-allocation*. Over-allocation occurs when one or more target attribute states is not being met and/or water has been allocated to users beyond a limit on resource use or a take limit. Target attribute states cannot be set below current state (and for *E.coli* must be set above current state). Hence, regional councils must not allow water quality to deteriorate below an attribute's current state or the national bottom-line (whichever is the more stringent). If water quality is to be strictly maintained then that is the only policy course that can be taken. Although the approach makes perfect sense in those terms, quite what that means for the future (including essential needs such as wastewater treatment and disposal from expanding/intensifying urban centres) has not been discussed nor have the potential challenges and costs been made transparent. Accordingly, there is a very high chance that the general public does not fully understand the potential consequences of what is being proposed. Because that has not be set out anywhere in the Essential Freshwater documentation, we make it explicit here.

Except insofar as we describe below, regional councils do not see any realistic pathway whereby they will be able to grant consents for any new and additional point source contaminant discharges, or allow land use change likely to result in further diffuse contaminant loss. (We accept that there may be some ability to do so in respect of activities with *de minimis* effects or which are temporary in nature). That will be true from the time the current state of the 23 attributes is determined and included in the relevant regional plan (and possibly from the date on which the new NPS-FM comes into effect). If we are wrong about that we would appreciate the Ministry for the Environment describing those circumstances and the legal pathway available.

The only way in which regional councils will be able to provide for new and additional contaminant discharges (and associated economic, social, cultural and health outcomes) will be to do one of the following:

[7] The Regional Sector received over 3100 discharge consent applications each year and at least as many land use consent applications.

[8] Including any replacement consents for existing consented activities which may be treated as a new activity given the baseline argument likely to apply.

1. First create catchment '*headroom*' by reducing existing discharges across one or more existing users or sectors. While that is possible, it will take time and careful accounting. Where there is already allocation over the national bottom-line, this will need to be eliminated before providing for any new discharges. Furthermore, in a context of people wanting water quality improvements to yield benefits for ecosystem health and recreation, making improvements only to assign those benefits as "headroom" for new users to take up is unlikely to be a feasible proposition in many instances. The gains from reduced contaminant losses and water quality will need to be shared between the environmental values, tangata whenua values and use values. Again, while that is possible, it will slow down and limit the ability for councils to create the required headroom in practice. In reality, the creation of meaningful headroom to provide for growth will likely take many years or, more likely, decades. In the meantime, councils will have to decline applications or place them in a queue pending available catchment headroom (in the same way that the Watercare municipal water take consent for further water from the fully allocated Waikato River has remained in a queue for some five years). In many instances it is quite feasible that meaningful headroom will never become available.

2. Require individual applicants for new and additional discharges to provide individual offsets for their discharges as part of consent applications (and secure those offsets through conditions of consent). This could, in theory, deliver no net increase in contaminant loads, allowing current state to be maintained and hence not infringe on the "avoid over-allocation" imperative. The Draft NPS-FM does not appear to anticipate such an approach. The concepts of 'no net loss', offsets and compensation are specifically provided for in the draft NPS-FM in respect of wetland and stream loss (where the 'effects hierarchy', including offsetting and compensation, is to apply). They are not specifically provided for across the NPS more broadly. If our interpretation of the Draft NPS is correct, then offsetting will need to form a core part of the policy solution far more broadly than the Draft NPS currently anticipates. In our opinion, the cost of this offsetting on every new discharge needs to be assessed and made transparent in the reform package and impact assessment.

   We are aware that the Government's response to the issue discussed here (and the sub optimality of the 'remedies' outlined above) may take the form of the allocation policy framework that we understand is to be the subject of public consultation in early 2020. Nevertheless, that does not, in our opinion, excuse the lack of recognition of the issue in the current package. We would also question the wisdom of erecting a policy framework that may serve to severely constrain the ability for people and communities to provide for their economic and social needs and development and risks fixing in place current land use, ahead of the availability of a mechanism to manage those risks and provide the required flexibility. We also note that there is a very high degree of uncertainty as to how and what allocation framework could practically assist with the issues identified but we await the Government's proposals in that regard before commenting further.

3. We should say for completeness that there may be an argument that the above analysis overstates the risk and potential implications for those wishing to establish a new discharge or increase an existing discharge. That argument would be based on the potential for councils to grant consents for new discharges and land use intensification on the basis that a new individual discharge need not (necessarily) result in the change in the attribute states as measured at monitoring sites (due to, for example, in river mixing and attenuation in the vadose zone and other hydrological characteristics of a particular site). If that is the assumption underpinning the proposals then we would suggest that:

   - This would appear to impose a significant burden of proof on future dischargers, large and small, to demonstrate "no effect" (which would require a very high level of understanding bio-physical and hydro-geological conditions and of very complex and often only partially understood systems and processes). That level of assessment is likely be to be well *beyond what is reasonable* to ask of all but the very best resourced applicants (a group that forms a relatively small subset of applicants).

- In the absence of very high levels of certainty about the absence of effect on attribute states, councils risk a decision-making approach that fails to address the *cumulative effect* of new and additional discharges – perpetuating problems of the past.

The Regional Sector considers that if the Government's policy approach does anticipate that the everyday consenting of new and additional discharges will proceed on the basis of each applicant having to demonstrate 'no adverse effect' on all 23 attribute states, then we would suggest that the Ministry for the Environment might like to provide analysis (including, as necessary, legal analysis) of the viability of doing that while meeting statutory responsibilities to manage cumulative effects (and under what conditions that will be possible). We further suggest that that analysis be informed by a technical assessment of the likely availability of information and the certainty around the information that is available.

For the avoidance of doubt, the Regional Sector considers that the proposed approach would place regional councils in the invidious position of either:

- Having to contemplate granting consents with a low level of confidence that there will not be a cumulative adverse effect on one or more attribute states; or
- Requiring a level of information from applicants that we know that, in the vast majority of cases, will be infeasible for applicants to provide.

Our solution

The solutions to the conundrum discussed above include:

1. Ensuring the concept of offsetting contaminant loss is more broadly applied across the NPS policy framework to provide a pathway for new and additional discharges; and/or
2. Ensuring that there are effective allocation mechanisms in place (at or before the time this NPS take full effect) that allow for the flexible use of assimilative capacity (as defined by target attribute states and associated limits on resource use); and/or
3. Providing clear direction (in both the NPS and any associated guidance) on:
    a. The approach to new and additional discharges (point source and diffuse), including those necessary to meet the essential needs of people and communities.
    b. The viability of requiring individual consent applicants to demonstrate no effect on the 23 attribute states while meeting the obligation to effectively manage cumulative effects.

Inability to respond to extant issues by making strategic choices and trade-offs

There are catchments and sub-catchments in New Zealand that, because the dominant land use is an intrinsically high discharger, have very significant water quality challenges and fail to meet national bottom-lines for one or more attributes. In some cases, the dominant land use in those catchments is both regionally and nationally important. Commercial vegetation production in the Lake Horowhenua catchment is an example. In managing that issue one option would be to encourage the relocation of commercial vegetable production into a less sensitive catchment (ie where the impacts of high contaminant loss on ecosystem health and other community values would be lower). However, the inevitable consequence of such a policy response would be that the 'receiving catchment', although less sensitive, would likely still experience some level of water quality decline. While we might well argue that *overall* the response has a better outcome for water (and has provided for the continuation of the important land use) it would, as we understand it, fall foul of the draft NPS-FM.

While we accept that the 'strategic choice' option outlined above might well have been contrary to the current NPS-FM (although our understanding of case law is that it had not been entirely foreclosed), we note that in seeking to get better outcomes for communities, councils need to have access to a full range of policy tools and options.

In short, we need the flexibility to find innovative solutions that address real world catchment-specific issues. Foreclosing the option of making strategic choices will limit the ability of councils to improve water outcomes and/or lead to significant social and economic impacts.

Our solution

Ensure regional councils retain a full range of tools to improve water quality outcomes, include provision in the NPS of a mechanism enabling councils to make strategic choices where that is the only way to improve overall water quality and maintain regional and nationally valuable activities.

Providing for development of under-developed Māori land

Many (if not most) regional councils have been under significant pressure in recent plan review/change processes to provide for the development of under-developed Māori land. This includes land held under Te Ture Whenua Act and lands returned in recent years as part of Treaty Settlements.

Regional councils find it difficult to see how they will be able to deliver on those expectations under the draft NPS-FM. Although, as noted above, we appreciate the potential to create "headroom" through plan-making processes that seek contaminant loss reductions from existing users, those existing users would need to be in the same catchment and probably sub-catchment to ensure the state of water quality is maintained (and not traded off between sub-catchments). The spatial scale at which change in water quality is assessed is important, as are the locations of monitoring sites, but in terms of the general principle of maintaining water quality everywhere, it is highly unlikely that allowing development of under-developed Māori land will be achievable.

The case study of "*Gisborne- Implications for whenua Māori – Tairāwhiti*" at Section 6 of the Case Study Report (See Appendix 1) illustrates the scale of potential impact in that region. It finds that the potential production increases from development of under-developed Māori land (in terms of both agriculture and forestry) to be significant ($98 million and $28 million in NPV terms respectively). However, it notes that various proposals would curtail that development potential and tangata whenua's development aspirations. It notes that, as kaitiaki, tangata whenua see their responsibility for land as taonga is *"to utilise and improve it for coming generations. Commercial use is simply a mechanism to achieve that cultural imperative."* The curtailment of that opportunity was found to separate the mana of hapū from the mana of the wai and that the mana of hapū was not provided for.

More broadly, we suggest that real caution is required in ensuring that current Treaty settlement arrangements are not undermined in a manner that is inconsistent with the principles of the Treaty (including the principle of 'redress') – that is particularly so where there has been significant investment from iwi/hapū, councils and communities into implementing Treaty settlements through RMA processes.

B. Will the package be effective?

Most, if not all, of the principles set out in the earlier commentary provided by the Regional Sector Water Subgroup (see Appendix 3) go to the heart of the question – will the package be effective?

In our opinion, the package presents many challenges which suggest to us that the package will not be as effective as it might be either over the short or long term. By and large, these challenges arise because the package strays from one or more of the principles previously set out.

We illustrate the point by reference to several issues.

Uncertainty

As with any area of major policy reform, the package presents many uncertainties in terms of how particular proposals will work in practice and what is expected of regional councils. These are important because uncertainty undermines effectiveness. These many uncertainties are addressed in the detailed points set out in Part 2 of this submission. We note some key areas here.

- **Existing plan compliance**. It is not clear which plans (if any) may already comply with the draft NPS-FM or which parts of existing plans may be regarded as complying.   The draft NPS-FM contains a number of new concepts including, for example, long -term visions and environmental outcomes. Whether the existing RPSs and plans might be said to already contain these 'new' provisions is unclear. We think there is a large and uncertain task in reviewing existing plans to ascertain the extent of change required to ensure compliance with the draft NPS-FM.
- **Applicability of intensification regulation**. The draft intensification regulation (NES Regulation 31) applies in FMUs where the NPS (current or proposed) has not been 'fully implemented'. Although there is an attempt to define 'fully implemented' we anticipate considerable debate and uncertainty. For example, what is meant by 'defined attributes' (does that mean defined by the relevant plan or by the draft NPS-FM)? Does a council have to have 'defined limits' that *achieve* the attributes or just any limit (broadly defined) that might contribute to, but will not deliver the attribute state? What are the 'required objectives and policies' that must be included in the plan (the 2017 NPS-FM does not specifically require the inclusion of particular objectives and policies – except for those incorporated under section 55 of the Act)?
- **Enforceability of regulations.** The enforceability of a wide range of regulations is unclear. This includes those draft NES regulations that would appear to rely on modelling of contaminant loss (eg. Overseer modelling of N loss as required by the intensification and N cap regulations). The Regional Sector's understanding has been that there are major obstacles to enforcing compliance with such limits. The enforcement uncertainty also arises in respect of FW-FPs. It is not clear whether it is a regional council's role to enforce compliance with a FW-FP but if it is, the Regional Sector is unclear whether it could do so unless the FW-FP is required as a condition of consent (ie. it is unclear if it is enforceable as a permitted activity).
- **Attributes.** Several attributes lack clarity as to providing guidance on which monitoring methodology to use and data requirements to meet for calculating numeric attribute states.

While these examples are all very specific technical matters, they are critical to whether the package will be effective in practice. Many other issues of uncertainty are identified in Part 3 of this submission. In addition, **Appendix 7** sets out some detailed comments from practitioners in relation to questions of drafting and enforceability that identify further sources of uncertainty.

In short, policy issues aside, the Regional Sector does not consider the package is "implementation ready" and would, if introduced in its current state, likely like significant difficulties and delays (and likely inconsistent implementation).

Our solution

Our solution to this problem is to take the time to work through the details of this package carefully with those who will be tasked with implementing it.   In Part 3 of this submission we identify many of the issues we see in the hope that they may be addressed through the advisory panel process. In many instances we offer some thoughts on the specific solutions. We also stand ready to assist the Ministry for the Environment, and/or the Advisory Panel, on technical and drafting matters.

DIN and DRP: National 'standards' for matters that are inherently catchment-specific

The Regional Sector has given particular consideration to the merit of national attribute states for DIN and DRP and associated national bottom-lines for those nutrients.

Based on the advice of its science advisers (see box below), the Regional Sector is of the opinion that the DIN and DRP attributes states may not be effective in improving ecosystem health in many – mostly soft-bottom and spring fed - rivers. At the same time those national bottom-lines can be expected to impose significant social and economic cost in some localities. In some instances, those costs include large-scale land use change. We note, for example, that the proposed national bottom-lines for both DIN and DRP are significantly more stringent than the limits recently included in the operative Canterbury Land and Water Regional Plan in respect of spring-fed plains and hill-fed lower streams in the Selwyn Waihora, Hinds and Waitaki sub-regions. In those, catchments nitrate-nitrogen (the major component of DIN) limits are set at levels up to 6.9 mg/L (in the case of spring-fed plains rivers) and up to 3.8mg/L (for hill-fed lower streams). These limits are obviously well above the 1mg/L national bottom-line proposed.

As per the science advice below, limiting nitrate-nitrogen in those spring-fed streams to 1mg/L will not address the macrophyte risk because macrophytes can obtain nutrient from river bed sediment not simply the water column. Other intervention measures will be needed.

While those Canterbury limits are some of the more extreme examples, other plans have set or in the process of setting DIN limits on some streams (or stream reaches) above 1mg/L. They have done so after careful consideration of risk, effectiveness and cost.

Advice of the Regional Sector's science advisers

Nutrients are undoubtedly a driver of eutrophication, which in turn is a driver of ecosystem health.

Regional Sector science practitioners question the validity of applying a correlative approach to setting attribute bands and bottom-lines at a national scale. We have yet to see the peer reviewed, published scientific papers that underpin the correlation approach to deriving those bands and bottom-lines.

Our experience from our own data sets is that there is a poor correlation between nutrient concentrations and macroinvertebrate scores which reflects the complex nature of ecosystem health with multiple drivers all working in differing ways in different locations.

In many New Zealand rivers the eutrophication outcome is periphyton growing on the hard bottomed stream bed. In this case managing dissolved nutrients is entirely appropriate in order to manage for periphyton growth.

The New Zealand Periphyton Guideline (Biggs, 2000) recognises the importance of dissolved nutrients, in addition to the frequency of flushing flows as drivers of the amount of periphyton growth.

Application of the New Zealand Periphyton Guideline across New Zealand has shown that it is a good predictor of periphyton growth in hill-fed streams but a poor predictor outside those streams.

In soft-bottomed streams and spring-fed streams (i.e. where they are groundwater fed and there is a low frequency of flushing flows) aquatic plants (macrophytes) are the dominant growth. Most macrophyte species can acquire nutrients from both the water-column and sediments (Matheson et al., 2012).

In these situations, restricting the nutrient concentrations severely may have little impact on the plant growth; so, the eutrophication requires managing in different ways (e.g. shading, reducing fine sediment input, etc.).

The difference in the eutrophication mechanism in different streams highlights the difficulty in applying a simplified national bottom-line approach to a high complex system. We suggest the following options for Rivers dissolved nutrients:

- The DIN and DRP tables are removed; OR
- Nitrogen and phosphorus are identified in the NPS as drivers of eutrophication and there is a requirement for limits to be set to manage for eutrophication (as in 2017 NPS); OR
- Where the nutrient concentrations are greater than the proposed national bottom-lines, a process is developed that regional councils must follow to ensure improvements in overall ecosystem health; OR

- Spring-fed and soft-bottomed streams/rivers are given an exception to allow setting a DIN/DRP limit greater than the national bottom-line provided there are clear plans to improve the overall ecosystem health outcomes.

We also question the validity of including the 95th percentile as an ecosystem health measure. Aside from the difficulty in being precise at calculating 95th percentiles we have not seen scientific evidence that the measurement distribution for dissolved nutrients is a driver of ecosystem health (apart from through nitrate toxicity which is covered elsewhere in the attribute tables).

Where the dissolved nutrients attributes are for toxicity (ammonia and nitrate) we believe these should remain as there is clear evidence that elevated concentrations are detrimental to ecosystem health. We note that if the DIN attribute for eutrophication remains then the nitrate toxicity attribute becomes redundant.

We believe that the nitrate toxicity national bottom-line could be raised so that 90% of species are protected (i.e. annual median of 3.5 mg/L) rather than the current 80% protection. This would be challenging to achieve in many areas with intensive agriculture but would lead to a significant environmental improvement.

The broader point that is that there are multiple stressors that influence ecosystem health (e.g. flow, temperature, sediment, nutrients, habitat) through direct and indirect pathways. Achieving improved outcomes will usually require a variety of actions appropriate to the local context. The importance of limiting nutrients will vary significantly. It is not a question of 'one size fits all'.

Accordingly, we consider that the proposal for nationally prescribed DIN and DRP limits is inconsistent with the principles of *evidence-based policy* and do not enable *tailored solutions* applicable to local solutions.

In our opinion, such limits will likely lead to an over-emphasis on driving down nutrient concentrations when ecosystem health will (in some places at least) be more directly dependent on other factors.

A more detailed review of the DIN and DRP attributes (and the concerns with the way the proposed limits been derived) is set out in **Appendix 6**.

For those reasons, the Regional Sector does not support the retention of the DIN and DRP attributes in the draft NPS-FM. Recognising the role that nutrients can play in ecosystem health (and hence the need to control nutrients in some instances) we have developed an alternative approach as set out below. In advancing this alternative proposal we emphasise the robust testing that occurs through regional plan processes.

Our solution

The recommended policy amendments below draw on and strengthen existing provisions in the current NPS-FM, also included in the draft NPS-FM 2019. They give effect in part to draft NPS-FM 2019 Objective 2.1(a), Policies 1 – 4, and clauses 3.4(1)(a) and 3.7-3.10. The amendments also remove the note currently below the Periphyton Attribute table which has very unclear status, and elevates the content and intent of that note into clear direction to councils.

The wording that follows has been discussed across the Regional Sector and has broad support. However, we accept that it could be further refined and would welcome the opportunity to work with the Government on any such refinement.

Add the following to Cl. 3.7 after sub-clause (3):

3.7 (3A) A regional council must identify appropriate nitrogen and phosphorus attributes for any FMU that:

(a) supports, or could support conspicuous periphyton; and/or

(b) has a nutrient sensitive receiving environment such as a lake or estuary; or

(c) requires an improvement in ecosystem health outcomes under section 3.7 (2) and where nutrient

management is required to achieve that outcome.

Add the following to Cl. 3.9 after sub-clause (3):

3.9 (3A) The target attribute state for an FMU for attributes identified under clause 3.7(3A) must enable the following to be met:

(a) any target attribute state for the attribute in Table 2 – Periphyton, Table 7 – Ammonia (Toxicity), and Table 8 – Nitrate (Toxicity); and

(b) any target attribute state for the attributes in Tables 13 and 14 – Macroinvertebrates, Table 15 – Fish, Tables 16 & 17 – Submerged plants, and Tables19 – Dissolved oxygen and Table 22- Ecosystem metabolism (where assessment shows nutrient levels as a controlling factor);

(c) where there is a lake receiving environment, the target attribute state for the lake attribute in Table 1 – Phytoplankton, Table 3 – Total Nitrogen, Table 4 – Total Phosphorus, and Tables 20 and 21 – Dissolved Oxygen;

(d) where the receiving environment is an estuary or harbour, any ecological health objectives for them, as set in a Regional Coastal Plan.

Could also add this default:

3.9 (3B) The target attribute states set under 3.9(4) must either be derived from FMU or regional scale monitoring, analysis and/or modelling, or otherwise Table 5 – Dissolved Inorganic Nitrogen and Table 6 – Dissolved Reactive phosphorus, must be used.

Add the following to Cl. 3.10 after sub-clause (2):

3.10 (2A) Clause 3.10(1) applies to attributes identified under clause 3.7(3A)

Remove the note which currently sits in the NPS-FM below Table 2 - Periphyton attribute table.

Amend the Ammonia (toxicity) and Nitrate (toxicity) attributes tables to increase the level of protection as indicated in Appendix 5.

Bringing about land use change

As noted earlier, some of the case study work indicates that meeting some of the national bottom-line attributes states for DIN will require land use change (at some point – accepting that the target can be set as a multi-decadal goal). The effect of meeting other attribute bottom-lines (including for DRP and sediment) could conceivably have a similar effect in some places but that has not been modelled at this point. We are also conscious that communities will not always be content with bottom-line states and will want to seek aspirational improvements well beyond bottom-line and/or will want to achieve target states in relatively short timeframes. (As we discuss elsewhere in this submission it is not clear to what extent the social and economic cost is a valid consideration when determining timeframes).

To the extent that effective implementation of the package requires land use change, the question then arises as to how that might be brought about by councils under the RMA.

There is almost no precedent of regional councils using the RMA to attempt to regulate in such a way, or to such an extent, that it knows land use change from a high returning/highly valued to lower returning/lower valued use (with consequential impacts on economic returns and capital value for individuals and communities) will be required[9]. The few recent exceptions, notably in the Lake Taupo and Lake Rotorua

[9] Noting the regional councils will general not directly regulate directly to change land use, but may regulate diffuse discharges in a way that modelling suggests cannot be complied with by current land use (and current technology).

catchments (for water quality improvements) and currently proposed for Matata (in response to natural hazard risk), have all been associated with substantial public funding support (and, in Lake Rotorua catchment case, a 15-year transition).

In the absence of public funding support (and sometimes even with that support) regional council responses to severe over-allocation to date have been based, to a large degree, on setting long-term signals and putting existing users on a gradual and long-term downward contaminant loss trajectory.

This provides transition time within which those existing users can adapt practices and (hopefully) find ways to meet increasingly stringent expectations while continuing to contribute to community social and economic well-being. This is done in the belief that over an extended period, science and technology improvements may provide opportunities for better discharge management that currently do not exist or which are not commercially viable. Time also allows economic conditions and market drivers to evolve in ways that may resolve issues in other ways. (particularly when industries may be in a 'sunset' phase).

This response is consistent with the principle of *social durability*. It is unrealistic to expect regional councils to fundamentally change that approach. If land use change is desired within shorter timeframes then we consider that the Government needs to develop some mechanism to bring that about fairly and in a way that does not undermine public confidence in, and support for, the resource management system.

Our solution

We recognise that the Government's solution to the issue identified is likely to be related to its allocation workstream (aimed at "structural change"). We understand that to be due next year. At this point we cannot be certain as to the likely nature and effectiveness of any national allocation method. Accordingly, we could ask that the Government endorse the current regional council approach of not forcing land use change through regulation unless and until an effective allocation policy is in place that deals fairly with the issues and provides for the continued well-being of communities.

One way of doing that would be to include an additional policy in the NPS-FM to the effect that councils are not expected to regulate to the extent that compliance is likely to require land use change (ie. ceasing an existing use) within (say) the next 10-15 years (as determined by credible economic modelling). We think that would give the resource user community some security and allow time for whatever allocation mechanism Government devises to be introduced and a reasonable transition period provided.

Capacity constraints

The capacity and capability requirements do not appear to have been fully scoped by government agencies. We suspect the assumptions underpinning the proposals about the ability of the Regional Sector, the Crown and other stakeholders to deliver are not based on rigorous *systems thinking* and a clear understanding of existing capacity levels. Our own research of Regional Sector capacity (which is ongoing) indicates that effective implementation of the package will require substantial additional investment.

An overview of the findings of the Regional Sector's analysis of costs and capacity constraints of the current proposal is provided as **Appendix 4.**

Regional councils have identified the following as being most costly to the sector and provided indicative costs for some aspects of the proposal. It is not a full assessment of costs to the sector.

- $23.5 million per annum in monitoring the new attributes – this figure does not include the cost to store and report data;
- Bringing forward of $45 million in spending on freshwater plans – through shifting investment earlier into years to December 2023. This represents a 50% increase in planning costs in the 2021/22 and 2022/23 years and does not include the cost of revisiting catchment limit processes that are already in train and have established limits with communities in either draft, proposed or operative regional plans;

- Funding of government-appointed planning commissioners;
- Significant increases in cost associated with meeting enhanced obligations for tangata whenua engagement, Mātauranga Māori monitoring, and the identification of tangata values and interests given the 168 unique iwi/hapū- Council relationships;
- Urgent establishment/expansion of information systems on wetlands, land use, farm practices, structures, fences etc to monitor compliance with the NES;
- While it is difficult to estimate given that some parts of the proposal are still in the options stage, the sector believes that up to 10,000 additional consent applications will need to be processed[10]. This level of additional consent applications will require further staff and staff training or temporary engagement of consultants and contractors with associated administration and compliance monitoring costs; and
- The concept of benchmarking in the intensification and N-cap proposal will come with significant cost. Benchmarking for nitrogen alone is estimated to cost $2,000 to $10,000 per farm. It will call on the same farm planning capacity needed to implement FEP across New Zealand.

Although, over the medium term, there may be some offsetting of these costs through a reduction in the budget required for plan appeals, councils will have little ability to address increased costs with increased rates until the 2021-31 Long Term Plan (LTPs) are prepared.

Regional councils are heavily investing in operational work programmes and partnerships to improve water quality. A survey in 2018 identified that regional councils contribute over $14 million per annum of goods and services supported by 125 FTE to programmes to improve water quality and freshwater biodiversity. This expenditure will double over the 2018-2028 LTP period. Across local government, there is substantial investment in infrastructure upgrades to improve water quality. For example, Auckland Council has adopted both a water quality targeted rate ($452 m) to accelerate programmes aimed at cleaning up waterways and a natural environment targeted rate ($311 m) to improve Auckland's natural environment. Other than the exemplar catchments, this aspect of improving ecosystem health is not addressed in the proposed package. Councils are concerned that expertise, funding and landowner attention will be diverted to the planning and regulatory aspects of the proposal and perversely serve to slow down improvements in freshwater health.

In brief, the Regional Sector does not consider that New Zealand has the capacity to deliver the proposal in the required timeframes. Aspects of the proposal call on the same pool of expertise particularly in freshwater science, policy/compliance, rural professionals and experts on tangata whenua values and assessment. The Regional Sector advises that to implement the package as proposed:

- It will need an additional 50 FTE per annum until 2023 – a 40% increase - to accelerate regional plans. These FTE include scientists, planners and engagement experts. This expertise is also needed to advance other aspects of the proposal. Regional council scientists would be asked to design and set up new monitoring programmes at the same time as contributing to plan development. RMA expertise will be needed to establish approaches to the proposed NES, assess consent applications. Councils are already struggling to fill current vacancies for these types of roles;
- Capacity constraints that are unlikely to be solved by access to external resources as Councils already use external scientific, planning, economics, cultural advisers, social science and legal advice, and the concurrent nature of processes, across the country , given the condensed timeframe is likely to confound availability. These same experts are also in demand by submitters (plans and consents) and consent applicants; and
- There is insufficient capacity of skilled professionals to produce the required number of FEPs within the current timeframes.

[10] For comparison, that is approximately the same number of resource consent applications the Regional Sector processes in total each year

This skill set will also be critical to the benchmarking inherent in the intensification and N-cap proposals.

The resolution of these challenges has a number of dimensions including:

1. Phasing implementation (as discussed in the *Our solution* box below); and
2. Direct and meaningful government support for implementation. The nature of that support needs to be the subject of discussion between the Regional Sector and the Government. Those discussions should focus on tangata whenua input, access to government/CRI information and expertise and, in the longer term, achieving alignment between national science funding and national policy expectations (as promoted through the EFW package) including an increased focus on applied science. Increased funding to Envirolink, LAWA and the National Environmental Monitoring Standards (NEMS) will be essential. There is an existing Environment Monitoring and Reporting group involving regional councils, MFE and Statistics NZ which could oversee the work.

Engagement with the Government should address the following matters and be set in the context of a risk/triage approach:

- How to advance the proposals on tangata whenua values, Mātauranga Māori monitoring, the resourcing of iwi/hapū and the connection to Treaty Settlements?
- How might the Regional Sector access CRI and other science expertise for assistance with monitoring protocols? What is the potential for combined data systems and linkage to reporting initiatives and the acceleration of National Environment Monitoring protocol (NEMS) and LAWA and increased funding through Envirolink?
- What is the availability and accessibility of data in central government and CRI systems to inform community discussions on aquatic life, threatened species and any other aspects relevant to additions in the proposed NPS-FM?
- What is the availability and accessibility in existing or potential central government, industry and CRI systems on farm inventories, land use and land practices?
- How to accelerate development of national tools and maps such as a wetland inventory and mapping tool, FEP templates and auditing tools?

The issue of capacity constraints arises in large part because of the draft NPS-FM's apparent focus on doing everything (i.e. all plans, all attributes and all the NES standards) at once. In our opinion, that is both unnecessary (because the risks are not the same everywhere), and counter-productive (because that can only be achieved by diluting the available capacity to the point where the quality of both the planning process (including consultation) and product are compromised.

The main reasons why risks to water quality are variable across the country are:

- Some plans already have very good level of regulatory control in place (Canterbury being a prime example, where a strong regulatory planning framework is in place – albeit it may not comply in all respects with the draft NPS-FM); and/or
- The pressure for land use change is highly variable (often linked to the existing state of development in the catchment, or resource availability - for example water for irrigation and processing); and/or
- Some catchments have a high degree of natural resilience (often related to a lack of sensitive receiving environments and short, steep rivers with high flow variability e.g. Taranaki ring plain).

It is also important to note that a number of draft, notified and operative plans and plan changes have recently been through very extensive (and expensive) community and policy development processes. Communities, tangata whenua and councils have invested heavily and in good faith to engage in the development of those documents. The processes undertaken have generally been very rigorous and the policy positions reached hard fought and invariably they represent significant strides forward. Making changes to these plans (certainly those notified and well into the process) to bring them into full compliance with the new NPS does not seem to us a priority when looking to maximise the benefit from limited national capacity.

As noted above, the amount of work associated with preparing a plan for public notification should not be under-estimated. A range of specialist skills are required including community engagement, current state analysis, catchment modelling, economic (impact) analysis and policy development and plan drafting. Those stakeholders (including resource users) with an interest in freshwater will often need a similar set of skills to be able to participate effectively in the process. Experience since the introduction of the 2011 NPS-FM suggests that, nationally, we have a capacity to produce little more than two plans per year (or 7.5 plans per three-year period). That has been the rate of progress to date based on 19 relevant plans or plan changes notified in the period 2011-2019. In our opinion that output has largely employed the available national expertise.

The draft NPS-FM would require the Regional Sector to move at a rate of 16 plans within 2.5-3 years – or more than twice as many as many as we have been producing (or potentially more if some regions continue with FMU-scale plan changes). In most cases, those new plans will be more complex and more impactful (and therefore generate more community interest) than ever before. It is difficult to see how those timeframes can be met while providing for meaningful community engagement.

Working with tangata whenua

Over recent years, regional councils have demonstrated a strong commitment to engage and work with tangata whenua. We are acutely aware of our role and responsibility in that regard. We are also aware of the challenges that presents.

While the Sector supports, in principle, the identification of tangata whenua values and interests and the inclusion of those values in regional plans, we are very aware that the task of doing that in any meaningful way is a very large one. We anticipate having to provide considerable assistance to iwi and hapū. For most regions that represents a very considerable investment.

The daft NPS requires engagement on the long-term vision (to develop a local understanding of Te Mana o te Wai), for the identification of tangata whenua values and interests, 'at every stage' of the national objectives framework process and in the development of mātauranga Maori monitoring methods.

Questions arise as to how that engagement can be efficiently and effectively undertaken (and what will constitute adequate and appropriate engagement) particularly in regions such as Bay of Plenty which has 37 different iwi, 220 hapū and over 1500 land trusts and incorporations.

While engagement on the various issues could perhaps be combined, the processes will be complex and lengthy and have to be replicated across all the various tangata whenua groupings. The task, if undertaken comprehensively, according to the spirit of engagement, will be a monumental one for some regions. In practice, engagement processes will likely need to be targeted rather than comprehensive (even if timeframes are extended).

We believe that there should be clear guidance on an acceptable level of engagement with tangata whenua in order to manage expectations and ensure the task is tractable within reasonable timeframes.

Our solution

The Regional Sector considers that a critical amendment to the EFW package will be to expressly *stage implementation* such that regions/catchments are prioritised for implementation allowing the sequencing of new and additional obligations and the efficient use of available resources. This prioritisation should apply to:

- Preparation/notification of plans
- Monitoring of attributes
- Application of the various components of the NES and regulations
- Preparation of action plans

This will involve the development of a form of *national progressive implementation programme (PIP).*

In undertaking the prioritisation for plan review the following criteria should be applied:

- The environmental risk (as assessed by water quality state and trends, land use intensification pressure). This would prioritise, for example, N-impacted catchments, and extend timeframes for planning in catchments that are already in A band and have no development pressure; and/or
- Recentness of existing plans (including community mandate associated with existing plans). Under this criterion we would suggest that any plan notified since the 2014 NPS and which includes freshwater objectives and limits in relation to all relevant compulsory values goes to the back of the queue); and/or
- Readiness of tangata whenua to participate and Treaty Settlement considerations

In terms of monitoring, we support an approach that would prioritise in the first phase:

- Monitoring all Appendix 2A attributes (and E.coli at human contact sites)
- Further testing and establishing protocols and programmes for monitoring Appendix 2B attributes.

Monitoring Appendix 2B attributes would be a second phase of implementation.

The preparation of action plans would follow the prioritisation of monitoring. That is, action plans associated with Appendix 2A attributes would be the first to be prepared (if considered necessary).

For the avoidance of doubt, we propose that the national PIP that applies the above criteria and which clearly set out the sequence of implementation (by proposal, region and, if necessary, by catchment) would be included in Part 4 of the NPS. The Regional Sector would welcome the opportunity to work with the Government to carry out the multi-criteria assessment required to develop the national PIP. We would emphasise that regional councils are best-placed to understand where the risks and vulnerabilities currently lie.

In addition, the Regional Sector continues to support the collaborative development of a national implementation plan for all parts of the proposed package that includes practical and meaningful contributions from government to resolving capacity shortfalls and in providing other forms of assistance as may be required to allow timeframes to be met. The details of that implementation plan will determine the timeframes that can be applied to the national PIP implementation.

PART 2 – Supported parts of the package

LGNZ recognises that some change is necessary to enable better management of freshwater. Although the Regional Sector has identified a number of issues and major challenges with the EFW Package there are elements and concepts within the package that are strongly supported.

The table below sets out those matters that are broadly supported. In some cases some qualifications are provided.

Proposal	Qualification/condition
RMA amendment: New Plan making process	
Plan hearings by composite national/regional/ tangata whenua Panels and appeals only where councils depart from recommendations. LGNZ supports this proposal and it is consistent with our previously expressed position. This will help the Sector to move more swiftly to address community concerns regarding water management and should result in reduced overall costs for all parties.	The obligation to use this process should not be mandatory. There are sound reasons why it may not always be efficient to use this process. In particular unitary authorities develop integrated plans with both regional and territorial rules. Trying to split these out to be addressed through separate processes would be problematic. Even regional councils with single integrated natural resource plans will encounter some difficulties in separating those provisions that implement the NPSFM and those that do not. The quality of hearings panels will be key to the success of the proposal. The limited number of qualified commissioners experienced in water management is another reason to prioritise and sequence the plan-making process. The notion that the hearings panel may make recommendations on matters that are beyond scope of the proposed freshwater planning instrument and/or submissions is alarming and contradictory to principles of natural justice. The 20 working day time frame for councils to consider whether to accept or reject the panel's recommendations is far too tight given councils' internal processes (ie. meeting schedules, agenda production, notice of meetings, etc). Furthermore, the twenty working day timeframe is unrealistic for due consideration to be given on recommendations from the Panel that are beyond the scope of submissions.

Draft NPS-FM	
Clause 1.5 - Retention of Te Mana o te Wai and a guiding principle.	Subject to issues set out in Part 3 of this submission
Expansion of the NPS to address ecosystem health. The sector agrees that the current NPSFM contains a large 'hole' in the sense that it does not address the councils' functions in respect of section 13 of the Act or the freshwater biodiversity function under section 30.	
The inclusion of an explicit focus on sediment. Sediment management is a core role of regional councils and an issue that has been given insufficient emphasis in NPS-FM implementation to date.	Subject to reservations about the sediment attributes as discussed in Part 3 of this submission. While the Regional Sector strongly believes in the importance of sediment management for water quality and ecosystem health, we consider that increased effort should be focused on increasing the depth and spread of our existing sediment management programmes (which are proven to be effective) rather than on further monitoring and reporting. Reduced sediment will result by driving better land management.
The ability to set long term timeframes for the achievement of target attribute states. The Regional Sector sees this as critical to the social durability of the NPS-FM.	
Clause 3.10 - The express provision for requiring action plans. The proposal that certain attributes be managed by taking an adaptive management approach is supported. An approach that encourages councils to monitor consider cause and effect, try different management interventions, and monitor to assess impact is sensible when dealing with highly complex biological systems. These systems do not react in predictable ways and cause and effect relationships can be multi-dimensional meaning that simple single-action responses may be ineffective.	Subject to issues set out in Part 3. In particular we suggest that an approach that strictly requires action plans on an attribute-by-attribute basis may be an inefficient approach. To maximise opportunity for efficiencies, regional councils suggest greater flexibility including the opportunity to prepare actions plans on a catchment-by-catchment rather than attribute-by-attribute basis. We also request clarification the action plans are not required by 2025 and may be prioritised over time.
Clause 3.23 - The exceptions available for setting target attribute states below the national bottom-line where current state is due to naturally occurring processes appropriate recognises circumstances outside council's and resource users control and appropriately recognises what is generally established practice.	Greater clarity is needed on what evidence will be required and how this will be received. There are potentially significant resource implications for some regions depending on what is required to demonstrate this.

Draft NES-FM	
Farm plans. In principle the Regional Sector strongly supports the notion that farms should have a farm plan that details the risks and committed responses to those risks.	Subject to issues discussed in Part 3
Livestock control regulations. In principle, the Regional Sector supports the regulation of high risk activities at the national level where those activities are likely to have a significant impact wherever they occur.	Subject to issues discussed in Part 3.
Section 360 Regulation	
National regulation for stock exclusion from water bodies is strongly supported. The Regional Sector considers that this is an appropriate expression of the leadership principle.	The 5m setback and requirements for existing fences to be moved if non-compliant is not supported for reasons discussed in Part 3.

PART 3 – Detailed submission points

Provision	Comment	Relief sought
Draft National Policy Statement for Freshwater Management		
Overview – style and architecture	The Regional Sector notes that the substantial redrafting of the NPS-FM will create a new round of uncertainty that will not assist the swift development of regional plans. That said, we acknowledge that the current NPS is unclear in many respects and its drafting is awkward in a number of places. If the NPS-FM is to be fundamentally redrafted there needs to be significant improvement in clarity and accessibility to offset the disruption that will be caused. In that regard we note that the structure, layout and drafting do not appear to conform with good practice and this will affect accessibility, usability, navigation, interpretation and implementation of the document. In some cases, drafting is not consistent with the RMA or National Planning Standards. We would request that the drafting be completed so that there is no (re)interpretation of policies required by regional plans and no (or at least very little) obvious need for any explanatory or guidance material to sit outside the NPS. The consistency/relationship between 3.15, 3.16 and 3.17 of the NPS-FM and Part 2 of the RMA needs to be improved.	Amend the document to be consistent with the RMA and National Planning Standards, and to align with good practice structure, layout and drafting principles
Clause 1.5 - Te Mana o te Wai	We support in principle the retention of Te Mana o te Wai and its further explanation including principles and hierarchy of obligations. However, as discussed below, it remains unclear how local interpretation is to be applied within this framework. The current NPS refers to the Treaty in the preamble and states that addressing	Retain Te Mana o te Wai (subject to other relevant parts of this submission, including in relation to Objective 2.1) As a minimum we suggest adding a third bullet point on page 3:

	tangata whenua values and interests across all of the well-beings is central to giving effect to the Treaty (p.4 – NPS-FM). Removing ambiguity with respect to the application of Treaty to freshwater matters would be helpful. Sub-clause 1.5(b) – the use of the term "involvement". It is not clear what the term involvement means in this context. We note it is a term linked to the International Association for Public participation (IAP2) spectrum of engagement. While council staff have an understanding of this concept, for more the term 'involvement' will mean more than being engaged in the normal everyday use of the word. Clarifying what involvement entails in the NPS would remove ambiguity and avoid on-going debate (and potential litigation).	"Te Mana o Te Wai recognises the principles of the Treaty of Waitangi in the management of freshwater resources" Clarify the intended meaning of the phrase "involvement of iwi and hapū".
Clause 2.1 - Objective	As noted above we support Te Mana of te Wai and the hierarchy in principle. Our reservations are: • That it takes a particular approach to Part 2 of the Act clearly prioritising protection of use regardless, it seems, of circumstances and implications. We accept that it is the Government's prerogative to issue national policy statements that express a policy preference for how section 5 (and Part 2 generally) of the Act should play out in respect of particular resource or particular issues. However, if the Government is to make a *"considered choice"* (as the Supreme Court referred to in *NZ King Salmon*), then we suggest it must understand the trade-off that is being made between protection, and enabling social, economic and cultural well-being. In that regard, we urge the government to undertake a thorough section 32 evaluation before confirming this objective. • We are not sure that the hierarchy provides the clarity intended. The concept of 'health and well-being' isn't a binary one such that something is either healthy or not. In a scientific sense, there is a gradation and hence choices to be made about where lines are drawn. That is the practical reality of water management. It seems feasible that health and well-being could 'prioritised' by adopting a target attribute state anywhere between pristine (A band) and national bottom-line of the NOF). The exercise of that discretion sits comfortably with the Regional	Undertake a full and comprehensive section 32 evaluation As a minimum, make the following drafting changes: The <u>primary</u> objective of this National Policy Statement is <u>to uphold Te Mana o te Wai, including ensuring that</u> ~~resources are managed in a way that prioritises~~: a) <u>as a</u> first priority, the <u>life supporting capacity of water, and</u> ~~health and well-being of waterbodies and~~ freshwater ecosystem health is safeguarded~~s~~; and b) <u>as a</u> second <u>priority</u>, the essential health needs of people <u>are provided for</u>; and c) <u>as a</u> third <u>priority</u>, ~~the ability of~~ people and communities <u>are able to</u> provide for their social, economic, and cultural well-being, now and in the future. <u>*And*</u> Do what else is required to: • confirm that providing for ecosystem health does not mean that natural/reference condition must be

	Sector. However, we expect Clause 2.1 to result in a significant debate as to its meaning and effect and whether the range of A Band to NBL is in fact available to decision-makers under this construct. • The term "essential health needs of people" will likely give rise to significant debate as to what this encompasses. We anticipate, for example, various sectors (including infrastructure providers, food producers and electricity generator will all claim (with some justification) that they are meeting the essential health needs of people. • Clause 2.1 reads as a policy rather than an objective. Drafting should align wording to be more consistent with section 5 of the RMA.	achieved, but that objectives must be set to maintain (above national bottom-lines) or improve ecosystem health in accordance with the National Objectives Framework process; • clarify what needs are considered to be "essential health needs of people.
Clause 2.2 - Policies	**Policy 1**. Clarify (and seek legal advice as necessary) about the status of the term "give effect to". Under the RMA, councils must "give effect to" higher order RMA documents and in doing so must "recognise and provide for" "have regard to" and "take into account" various matters in Part 2. This policy appears to raise the status of Te Mana o te Wai above Part 5 matters. Amend Policy 4: broaden to integrate consideration of all activities which have effects on freshwater bodies. **Policies 6, 8 and 11** Policies 6, 8 and 11 read as more like objectives than policies. **Policy 13** The purpose of this policy is unclear and raises questions about the status of economic well-being compared to social and cultural well-being, which are all 3rd in the hierarchy of obligations expressed in Objective 2.1. The wording seems to confirm that social and economic considerations are not to be enabled where than would not be consistent with Te Mana o te Wai and as required by the NOF.	Amend Policy 4 to read as follows (or using wording to similar effect): <u>Freshwater, land use, and development are managed in an integrated way, on a whole-of-catchments basis, including managing the effects on sensitive receiving environments;</u> Shift Policies 6, 8 and 11 to section 2.1. Draft policies that reflect the effects management hierarchy for rivers and wetlands Consider amendments to Policy 13 along the lines of the following: <u>Enable communities to provide for their social, economic and cultural well-being, now and in the future, subject to ensuring ecosystem health and essential health needs of people are safeguarded</u>

Clause 3.2 – Long term visions and TMOTW	3.2 (1)-(3) The mandatory inclusion of the objective is supported as is guidance on the role of Te Mana of te Wai in district and regional plans. We do note, however, that the interpretation by tangata whenua of Te Mana o Te Wai will continue to cause tension. Tangata whenua have a view that Te Mana o Te Wai is couched within "Te Ao Māori". 3.2 (4) (which refers to local interpretation of Te Mana o te Wai) should be part of the National Objectives Framework process rather than being treated as a separate process. Working through the National Objectives Framework process requires councils to identify values that are important and outcomes sought, in accordance with Objective 2.1 and the NPS-FM policies. Balancing competing interests and views will be central to a successful outcome. 3.2(5-8) Under the RMA, Regional Policy Statements include objectives, policies and methods. Accordingly, the legal status of a "long-term vision" statement is unknown. It is unclear where you would put the vision-statement in the RPS given the national planning template. We question the benefit of a region-wide vision setting process given the widely diverse communities, iwi and hapū. We expect that such a process will result in a very high-level statement that adds little benefit for NPS-FM implementation (but will add considerable cost). We also question the relationship of a region-wide vision with those set by co-governance entities in River Documents for specific catchments, and the relationship with the FMU/catchment scale framework established under the national objectives framework.	Amend (or delete) 3.2 (4) and integrate policy direction about local interpretation of Te Mana o te Wai into the National Objectives Framework.
Clause 3.3 – Tangata Whenua roles and interests	Iwi and hapū continue to express that Māori rights and interests in freshwater are a primary issue to resolve. At the heart of this are discussions about their degree of active involvement and partnership in planning and decision making for natural resource management under the RMA, such that they can exercise their genealogical responsibility to nurture freshwater and other natural resources. National direction as to how regional councils are expected to progress Treaty partnership obligations would be helpful, along with appropriate resourcing of solutions.	The government needs to provide a credible solution to this challenge. This may involve both modifying expectations of what is feasible and contributing tools and resources.

	In its absence, our concern is that council and iwi/hapū expectations often differ markedly, and lack of resolution will accordingly undermine ability to achieve Clause.3.3. Setting aside the above issue, identifying tangata whenua values and interests in a meaningful way requires an on-going process of engagement over the longer term. Whilst part of this task may be undertaken through tools such as a desktop review, the availability of such information resources varies significantly across hapū/iwi, and will in any event need to be complemented by a process of personal engagement. As noted elsewhere in this submission, the task of undertaking that extensive and on-going engagement is very large and has significant resourcing implications for both councils and tangata whenua.	
Clause 3.4 – Integrated management	We support Clause 3.4 (1), however, the term “sensitive receiving environment including the coastal environment” is not defined. We support the intent of 3.4(5) and (6) but there is a need to make it clear that district councils’ objectives, policies and methods must give effect to the RPS and should be aligned to deliver on the freshwater objectives set by regional councils in a regional plan, (ie. district plans should not set objectives (or environmental outcomes and target attribute states) relating to freshwater that depart of those required by a relevant regional plan).	Provide a definition of ‘sensitive receiving environment including the coastal environment”. Amend 3.4 to make the subservience of a territorial authority’s district plan to regional plans clear. Specifically strengthen policy directing regional policy statements, regional plans, and district plans to promote water sensitive urban design principles and practices, rather than referring to just some aspects of water sensitive urban design in an information note.
Clause 3.5 (2)	Requirement to involve communities and tangata whenua at ‘every stage of the process’ is an onerous requirement, and unreasonable in the timeframe for plan development set in clause 4.1. Involvement of iwi and hapū is addressed in 3.3.	Amend Clause 3.5(2) as follows: 2) ~~At every stage of the process,~~ R~~r~~egional councils must engage with communities to identify values, and to inform the setting of objectives, policies, limits, rules and methods. ~~and tangata whenua in order to give effect to Te Mana o te Wai, as required by clause 3.2.~~

Clause 3.7 – Environmental outcomes	Given that an environmental outcome must be set as an objective in a regional plan (clause 3.7 sub-clause 5), and given an objective is generally understood to be a statement of what is to be achieved (ie. an outcome), then separate reference to 'Environmental Outcomes' in the NPS-FM is redundant and results in unnecessary complexity.	Amend Clause 3.7 as follows: (1) Every regional council must identify the values that apply to each FMU, as follows: a) the compulsory values as set out in Appendix 1A; b) any of the other values set out in Appendix 1B that the council considers applies; c) any other value and component as the council considers, after consultation with its community and tangata whenua, applies. (2) For each FMU, or for individual waterbodies or freshwater ecosystems within an FMU, the regional council must describe as an objective in a regional plan, the environmental outcomes sought ~~that it wants to achieve~~ for the following values: a) the value Ecosystem Health, and each of its components; and b) the value Human Contact, and each of its components; and c) the value[s] [Mahinga Kai or Tangata Whenua Value and] Threatened Species; and d) any other values and components the council identifies. (3) A regional council may identify additional ~~components and~~ attributes for any of ~~the compulsory values, and components and attributes for any additional~~ values identified. Delete (4) and (5)

Clause 3.8 – current attribute state	We generally support making decisions on the current state based on the best available information at the time. However, decision makers need to be cognisant of the level of uncertainty when they set target attribute states, timeframes for achieved of target attribute states rules and other methods. Lags in the hydrological system and consented but unimplemented consents can mean that the current states does not reflect the "worst" state a water body might reach before improvements can be expected (or might mean that management interventions take longer to take show up in monitoring data that would otherwise be the case). Policy should also be included about taking into account "uncertainty" and "precautionary principles when making decisions, that is, consideration of the risks associated with assigning a current state that either over or underestimates reality.	Amend 3.8 (3) as follows: (3) If a regional council does not have ~~complete and~~ scientifically robust data on which to establish the current state of an attribute, it must use its best efforts to <u>estimate</u> ~~identify~~ a current state using the <u>data, other relevant information, and professional expert opinion, taking into account uncertainties and applying precautionary principles</u> ~~information that is available, including partial data, local knowledge, and information obtained from other sources~~.
Clause 3.9 – Target attribute state	Policy 3.9 (2) appears to require mandatory improvement of human health attributes. Where there is very good water quality for human contact (e.g. the risk of infection is less than 0.1%; the A band) it is difficult to imagine what steps could be taken improve the quality, let alone the need for it. 3.9 (5) (b): Support setting at least one interim target of 10 years or less. However, mapping out targets at 20, 30, or 40 yrs towards a long term objective is not necessarily useful. Generally, there is greater uncertainty the further we look into the future. The next targets could be set with the next plan review. As noted earlier in this submission, the Regional Sector strongly supports the ability to set timeframes for achieving target attributes states of "any length or period" as provided for in Clause 3.9 (5). However, we are concerned about the lack of criteria guiding how that discretion is to be exercised. That is particularly the case because of the absence of anything in the Objective or directive policies of the NPS that clearly supports taking social and economic considerations into account and the potential inability to 'go back to' section 5 of the Act when exercising that discretion. (At the very least we consider this	Amend Policy 3.9 (2) (a) to read "above or at the current state". Amend 3.9(5)(b) to require that at least one interim target of no more than 10 years is set. Amend 3.9 (6) to read: When setting target states, <u>interim target states and associated timeframes</u>, regional councils must: 1) Have regard to the following: i. the foreseeable impacts of climate change ii. The long-term vision set under clause 3.2 iii. The environmental outcomes set under clause 3.7(2) iv. <u>Any reduction in state the may be anticipated as a</u>

	raises issues of legal uncertainty). Target attributes set for Mahinga Kai (or tangata whenua) is a new area of work. While there has been more research on the application of mātauranga Māori and the development of indicators – setting targets in sync with other attributes based on quantified data will require the development of an acceptable approach to "measuring" qualitative data (Mātauranga Māori). Limit setting via Mātauranga Māori requires a new regime to be developed. As noted elsewhere, this will take considerable time and detailed engagement with tangata whenua. Earlier comments about the challenges that presents apply.	result of already committed further contaminant discharges and/or lags in the hydrologic system v. The limits that would be required, in accordance with Clause 3.10, to achieve the target attribute states vi. Any implications for resource users, people and communities arising from the target attribute state and associated limits including implications for social and economic well-being. Balance of clause to remain as proposed.
Clause 3.10 – Action plans	We are concerned that the NPS-FM implies a sequential approach to the setting of target attributes states followed by the setting of limits to achieve those target attribute states. In our opinion the setting of outcomes (target attribute states) and limits must be an iterative process (as the current NPS anticipates). To some extent the issue is addressed by our suggested rewording to Clause 3.9 but further clarification would be helpful. We also note that achieving target attribute states may not be entirely within the control of a regional council, especially for attributes like fish IBI We assume that the intention is that action planning, and the actions within them can be prioritised, and timeframes can be set by regional councils. It would be useful if that could be made explicit Note also that the new attribute tables in Appendix 2B are likely to result in many action plans.	Amend Subpart2 – National objectives framework to clarify that the setting of target attributes states and limits is an iterative process Amend Clause 3.10 to clarify that: Achieving some outcomes through action plans will not always be with in the complete control of the regional council That the actions and timeframes included within an action plan at set at the regional council's discretion (and cannot be constrained by provisions as may be included within a regional plan).
Clause 3.12 – Take limits	We support Clause 3.12 and would, in addition, support (through the first round of RMA amendments) a strengthening of powers to amend consent conditions during the life of a consent in order to enable phasing out over allocation (particularly where consented water takes are not being exercised).	This provision is supported.

Clause 3.13 - Monitoring	Clause 3.13(a) should specifically require monitoring of the attributes developed under clause 3.7. It is inappropriate to list "measures of the health of indigenous flora and fauna" here, as this should be addressed through the attributes identified under clause 3.7 and Appendices 2A and 2B. In principle, we support including mātauranga monitoring. However, we anticipate implementation challenges. Māori have their own mātauranga and it may not be appropriate for regional council monitoring plans to take a lead on specifying how mātauranga monitoring will occur.	Amend Clause 3.13 as follows: (1) Every regional council must establish methods for monitoring progress towards achieving target attributes states and identified <u>objectives</u> ~~environmental outcomes~~ for values and components. (2) The methods must include <u>supporting development and reporting of</u>: a) measures of the health of indigenous flora and fauna; and b) mātauranga Māori monitoring in the region
Clause 3.14 – Where deterioration detected	The term 'trend' in water management has a particular technical meaning (where a trend demonstrated through statistical analysis of long-term datasets) It is not clear what the term means in the context used in Clause 3.14(1). In particular, what length of data record must be used in analysis before a 'trend' can be said to occur. The Regional Sector sees particular challenges associated with debates about what needs to be done in accordance with this clause after 2-3 years of data. We consider that Clause 3.14 misses a step to the management approach. After detecting a trend rather than moving straight to an action plan there should be an intermediary stage of *investigating the cause* of that decline (which may, for example, be due to natural causes or to matters outside a council's ability to influence or control).	Amend Clause 3.14 (1) to more clearly define what detecting a trend indicating deterioration means (what length of data record must be used etc) Amend Clause 3.14 (2) to require regional councils to investigate the cause of deterioration, assess options, and to develop an action plan to address a decline it to the extent that this is within regional councils' control. This recognises that, in some cases a declining trend may be due to natural or climate change causes, or pressures beyond councils' control (eg fish harvest). This action planning guidance should apply to all action plans required by 3.10 or 3.14.
Clause 3.15 - Wetlands	The various wetland definitions are complex and inconsistent with the RMA and National Planning Standards. This clause needs some rework to provide a cohesive and consistent planning framework, and should be more consistent with the NESF. Sub-clause (2): The required policy is an objective. It is absolute and highly restrictive (i.e., "avoid") and yet sub-clauses (3) and (4) are not (and neither are	Amend (2) to require an objective requiring no net loss of wetlands, and that degradation of wetlands is minimised Amend (3) to require regional councils to set policies (or provide the policies in the NPS-FM) which apply the effects management hierarchy, enable wetland restoration, and reflect some of the enabling provisions in the NES (eg for education and recreation, hydro schemes, nationally

	the NES regulations). This is likely to lead to confusion and unnecessary litigation. Consider enabling provisions for strategic growth areas applying water sensitive urban design.	significant infrastructure, and public flood control and drainage). Enable regional councils to set more restrictive "avoid" policies for some wetlands, eg those with outstanding values.
Clause 3.16 - Streams	We support the effects management hierarchy for activities like reclamation, piping or diversion of a stream and wetland reclamation or drainage. Offset mitigations should be commensurate with the scale and nature of the stream/wetland values being lost. Policies should direct councils to require an evaluation to define offset actions that are commensurate with the scale and nature of the losses incurred. The definition of no net loss needs work. There is no definable "point" at which "measurable positive effects balance the negative". What is lost and what is gained will differ somewhat in nature, space and time. There will always be an element of judgement. The definition appears to relate to no net loss, not to net loss. There will be circumstances where mitigation is not appropriate due to the nature of the wetland or the nature of effects, and regional councils need to be able to specify (via policies, activity status, exercise of discretion) the circumstances where actual loss is not acceptable. Consider enabling provisions for strategic growth areas applying water sensitive urban design.	Amend definitions of net gain and net loss to clarify that no net loss means that either there is no direct and measurable loss , or that any direct and measurable loss is offset by commensurate scale and nature of gain (in the form of offset mitigation) Policies should direct regional councils to require a professional evaluation to define offset actions that are commensurate with the scale and nature of the losses incurred. (For example, if the loss is a pristine stretch of river and riparian margin, the offset actions may need to be more than if the activity impacted a stretch of already highly modified stream).
Clause 3.17 – Fish passage	Support the inclusion of this type of objective, but only to the extent that it is within regional councils' control. Clearer demarcation between the Regional Sector's role in comparison to central government agencies is needed, with need to remove duplication held by central government agencies as it relates to the outdated Freshwater Fisheries Regulations 1983, administered under the Conservation Act since 1990. Fish passage provisions should be the domain of Resource Management Act consideration, and not duplicated as a historical anomaly under the Conservation Act. The Regional Sector does not have responsibility for issues like fish harvest	Redraft Clause 3.17 (1) to make clear the any aquatic life objective is to relate to freshwater fish only to the extent that it is within a regional council's functions and responsibilities.

	under predominantly the Fisheries Act 1996, or for specific species groups under the Conservation Act; similarly fish transfers are shared responsibilities between Fisheries NZ and DOC under the Conservation Act.	
Clause 3.18 – Primary contact sites	The frequency of follow-up sampling is onerous where the cause is already known, such as after rain. We do not support transfer, or duplication, of functions for notifying the public. Notification responsibilities currently sit with district health units or district councils. That is where they should remain.	Amend Clause (3) to make sampling and reporting requirements more consistent with "*Microbial water quality guidelines for marine and freshwater recreational areas".* Amend Clause 3.18 (3) b) such that the duty to notify the public about the unsuitability of water for swimming remains with district health units or territorial authorities.
Clause 3.22 – Exceptions for large hydro schemes	Support providing regional councils with the discretion to apply exceptions but offset mitigation should be provided for nationally or regionally significant infrastructure where assessment shows that national bottom lines cannot practicably be met. In these instances, and like renewable electricity, offset mitigation may be the only practicable option.	Offset mitigation (rather than exceptions) should be provided for nationally or regionally significant infrastructure. Establish a clear process by which to add other infrastructure to Appendix 3.
Clause 3.23 – exception for naturally occurring processes	We support Clause 3.23, however, we consider there may also be a case for an exception when data or modelling indicates that under future climate change scenarios, water quality will worsen, even under natural land cover.	Consider providing for an exception for future state/decline caused by anthropogenic climate change.
Clause 24 Transitional exception	Government needs to specify the process by which waterbodies can be added to Appendix 4. Only regional councils should be able to apply and only after working through the National Objectives Framework process.	Question whether this is really necessary.
Appendix 1A	**Ecosystem Health description**: The national objectives framework enables regional councils to set objectives and target attributes states at or above current state (provided that state is above national bottom-lines). It is not appropriate to expect ecosystem health to be in a minimally disturbed state or natural state in all water bodies everywhere – some effect of human activities in a catchment is inevitable. It is not appropriate that the definition essentially states that a healthy ecosystem equates to one in a minimally disturbed	Amend the final para of Appendix 1A, section 1 as follows: In a healthy freshwater ecosystem, water quality, quantity, habitat and processes are suitable to sustain appropriate indigenous aquatic life, ~~as would be found in a minimally disturbed condition (before providing for other values)~~

	condition. It is appropriate that the A band for all attributes is set at a near natural/minimally disturbed condition. Mahinga Kai value – note this should only be compulsory where mahinga kai values have traditionally/historically existed.	
Appendices 2A and 2B		
Tables 1, 3 and 4 - Lake ecosystem health attributes (phytoplankton, TN, TP)	There are no requirements around the monitoring regime to be applied to determine attribute state, i.e. how many data points are required to calculate numeric attribute states? Are four data points (quarterly monitoring) sufficient to calculate/identify a meaningful annual median and maximum?	Clarify the monitoring requirements to determine attributes states for the attributes in Tables 1, 3 and 4.
Tables 5 and 6 - Rivers dissolved nutrients (DIN, DRP)	Nutrients are undoubtedly a driver of eutrophication, which in turn is a driver of ecosystem health. Regional council science practitioners question the validity of applying a correlative approach to setting attribute bands and bottom-lines at a national scale as discussed in Part 2 of this submission.	Make the change set out in Part 1 of this submission.
Table 10 - Suspended fine sediment (turbidity)	Turbidity is a proxy for suspended sediment; it is not a direct measurement. Although suspended sediment is the primary influence for turbidity change it is not the only one (e.g. colour of water can influence turbidity measurements). Therefore, we are wary of using turbidity as a direct measure of suspended fine sediment. We suggest that more effort is put into the development of clarity as an attribute as it is the outcome ultimately being sought. Our experience of measuring turbidity is that there is considerable variation in measurements between different instruments (Hughes et al., 2019). We suggest that more guidance is developed on measuring suspended sediment and that this could be done through MfE providing more financial support to National Environmental Monitoring Standards (NEMS). Clarification is required about why this table is now in FNU when all data used for method development is in NTU. These two measurements are not directly comparable.	Consider developing clarity as a more direct measure of the outcome sought (in preference of turbidity). Clarify the points raised in this submission in relation to turbidity.

Table 11 and 23 - Human contact – *E. coli*	The inclusion of two attribute tables for *E. coli* is confusing and makes reporting on swimmability challenging. The *E. coli* attribute table for year-round monitoring (Table 11) includes four different numeric attribute states. This was developed for the 2017 NPS-FM and attempted to blend the 2003 *Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas* with new measures based around exceedances. Now that a second attribute table has been introduced for the bathing season (Table 23) we believe Table 11 should be reworked to remove the doubling up (e.g. 95th percentile measure). We recognise that Table 23 (*E. coli* during the bathing season) directly brings the 2003 *Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas* into the NPS and we support this. We strongly support the STAG recommendation for a Quantitative Microbial Risk Assessment to be carried out in New Zealand as soon as possible. There is a disconnect between section 3.18 (primary contact sites) and Table 23. Specific requirements under section 3.18 should also be noted together with Table 23. Clarification is needed on how Table 23, the numeric attribute state (95th percentile), is to be calculated, i.e. presumably using the Hazen method, but using what dataset? Does this imply that each year, the 95th percentile is to be calculated for each site using all results obtained during the summer season?	Remove the doubling up between Table 11 and Table 23 (the 95th percentile). Clarify the other points raised in this submission in relation to E.coli.
Table 12 - Cyanobacteria in lakes and lake-fed rivers	Clarification is needed on the sampling method (some guidelines recommend composite sampling along a transect through a bloom or likely bloom area where as other protocols recommend a single depth integrated sample) and where a representative sample is taken from (deepest point or elsewhere). These types of questions could be addressed through an adequately resourced NEMs for cyanobacteria monitoring.	Insert footnote in Table 12 to clarify appropriate sampling methods.

Tables 13 and 14 - Macroinvertebrate	We note that the MCI national bottom-line (NBL) has been raised from 80 to 90 with little documentation on the reasoning for this. We have particular concerns around how the NBL can be achieved in urban catchments due to the large amount of impervious surfaces without significant removal of existing paved areas and infrastructure.	Note the concerns of the Regional Sector.
Table 15 - Fish	We fully support the inclusion of fish as an essential component of ecosystem health. We have major reservations about the robustness of the existing IBI for low diversity fish communities in New Zealand. We stress that priority effort should go into the development of more robust and meaningful fish indices. We note that a programme of fish metric development could commence immediately and use existing datasets available from some councils, e.g. Wellington, Waikato or Otago. We fully support the use of the Joy et. al. (2013) methods for wadeable streams and note that work is needed to develop methods for non-wadeable systems including lakes and estuaries. The purpose of the fish monitoring needs to be refined in terms of what we are looking to assess. Are we interested in presence/absence, diadromous fish extent, population dynamics, recruitment potential etc. The questions being asked has big implication on the required monitoring and its associated techniques.	Include the fish attribute in the NPS-FM at a later stage (once a more robust indices have been developed).
Tables 16 and 17 - Submerged plants in lakes	Vegetation cover is a critical aspect of lake ecosystem health, but the LakeSPI method is not designed to robustly assess vegetation cover. It is designed to assess vegetation composition (native versus exotic) and growing depth (an integrated picture of water clarity). It is not well suited to many of the shallow lakes that are in the worst conditions, because growing depth is irrelevant when the maximum depth is 1-3m. We think stipulating that LakeSPI is used will force monitoring funds into a method that is not fit for purpose for many of the most at-risk lakes in New Zealand.	We recommend Tables 16 and 17 are removed from Appendix 2B and submerged plant indicators are revisited when better and more universally applicable monitoring methods and indices are available.

	A review on LakeSPI is available here www.waikatoregion.govt.nz/assets/WRC/Services/publications/technical-reports/2018/TR201814.pdf Removing Tables 16 and 17 will not limit the effort being spent on lake restoration. Protecting and restoring lake ecosystems is already a high priority across New Zealand. LakeSPI is already widely used in situations where it is very helpful. But including Tables 16 and 17 in Appendix 2B may hinder, rather than help, lake monitoring and restoration efforts by forcing its use in situations where it is not helpful. We have concerns around the required management response when the submerged plants (invasive species) NBL is breached. Invasive macrophyte removal may lead to a long period of phytoplankton dominance before any natives recover (providing that the seed bank is still viable). This lag period could also create conditions that will stem any native recovery due to a reduction in water clarity. Currently we have no proven restoration techniques for macrophytes and no way of assessing what species has historically existed in non-vegetated lakes aside from seed banks that may not be viable. The requirement for invasive species monitoring to be annual (rather than every three years for native cover) seems to be based on a biosecurity risk rather than ecological health. We suggest that if SPI is included then both angles should be monitored every three years.	
Table 18 - Deposited fine sediment	We seek clarification about the proposed method for deposited fine sediment and its relevance to regions with naturally soft bottom streams. We question whether the measurement method can actually detect the small changes identified between bands, when the method has a 5% error.	Insert a footnote to Table 18 providing clarification for measuring deposited fine sediment. Confirm that the measurement method will be able to reliably measure change between bands given error margins.
Table 19 - Dissolved oxygen in rivers	We support inclusion of dissolved oxygen in rivers as an attribute but note that this will add significant costs to regional councils for monitoring. We seek clarification that the monitoring can be achieved using a flexible regime rather than continuous monitoring at one place (and therefore multiple instruments required at the same time).	Add a note to Table 19 confirming that a flexible regime is appropriate (rather that necessitating continuous monitoring at each site).

	We suggest that the NES aligns with the NEMS in terms of site placement for the appropriate monitoring of DO.	
Tables 20 and 21 - Dissolved oxygen in lakes (bottom and mid-hypolimnetic) -	We support the introduction of dissolved oxygen monitoring in lakes, but we note that many lakes will have naturally low oxygen levels. We note and support the approach outlined in the Action for Healthy Waterways discussion document allowing for an action plan approach that involves learning before taking drastic management interventions. Preventing anoxia in deep, eutrophic lakes will often require unnatural interventions such as artificial destratification. Artificial destratification may not always result in an overall improvement for holistic lake health.	
Table 22 - Ecosystem metabolism	We recognise that ecosystem metabolism is an important part of ecosystem health and agree that it should be measured. However, we question what management measures can be put in place beyond nutrient management and flow regimes (already covered elsewhere in the NPS) when the drivers are complicated and largely unknown. We question how management for this attribute can take into account naturally productive reaches? For example, do we need to get a predicted reference Ecosystem Metabolism for a site on which to base the monitored values against? Overall, we believe the science underpinning monitoring and managing for ecosystem metabolism is still in development, so we feel it is premature to include it as an NPS attribute.	We recommend Table 22 is removed from Appendix 2B.

Draft National Environmental Standards for Freshwater		
Part 2 - Wetlands, rivers, and fish passage		
Subpart 1, **Wetlands** – general	Terminology and some rules in this section are subjective. For example: whether removal of trees/other vegetation is "to maintain or restore", terms 'water take activity', 'wet pasture' and "geothermal wetland" are unclear.	Review clarity of some of the terms used and provide further clarity/precisions if practicable.
	There is the opportunity to re-write some activities as permitted activities with conditions which will minimise extra consenting burden on councils. For example, 10 (1)(a) relating to earth disturbance for education and recreation purposes could require many small-scale consents on DoC land. Rewriting as a permitted activity rule with conditions could remove this burden and achieve the same outcome.	Review regulations to make. Some low risk activities proposed to be discretionary activities permitted activities subject to appropriate conditions.
Regulation 5 - Standard wetland monitoring obligation	It is unclear whether this condition must be applied to consents verbatim or whether the intent can be conveyed using alteration (more precise/specific) wording. (This generic question arises for other provisions throughout the document that require specified conditions to be imposed). In our opinion, drafting of this condition could be improved. This will be important if the monitoring condition must be attached to a consent verbatim. The monitoring it requires is technical and specialised, yet there is no explicit requirement for a suitably qualified person to undertake it. It is inherently unclear, eg in sub-clause 1(c) how ecological decline is to be measured and what is decline to be measured relative to? The need for the urgency of the advice to the regional council specified in (2) is questioned.	Either: • Confirm that the standard wetland monitoring condition need not be included verbatim on consents: or • Redraft the condition to be more precise, effective and legally enforceable.
Regulation 6 - Standard conditions for nationally significant infrastructure	It is noted that this condition has the effect of requiring a "higher bar" than for other activities – specifically where Clause 6 applies, any consent issued where offsets are required, must achieve a "net gain". There is no apparent effects-related basis for this difference. For example, some activities related to wetlands (e.g. vegetation destruction) can still be consented (albeit as non-complying activities) when they don't relate to nationally significant infrastructure (e.g. clause 7). Clause 6 doesn't	

	apply to those non-complying activities, and therefore nationally significant infrastructure providers could be held to a higher standard for a less restrictive activity as drafted.	
Regulation 7-8	A discretionary activity consent requirement for works to maintain or restore a wetland is likely to act as a deterrent to positive action (ie. discourage beneficial wetland enhancement). Also, while it is not clear, it would appear that vegetation destruction caused by the grazing of livestock within 10m of an inland wetland would be a non-complying activity. This seems to create a conflict with the s360 stock exclusion regulation that provides allows stock exclusion to within 5 metres of a wetland.	Amend Regulation 7 to include a permitted activity rule for enhancement activities. Align the requirements for stock exclusion in relation to wetlands between the NES and the stock exclusion regulations.
Regulations 10-13 - Activity status thresholds	The thresholds between discretionary and non-complying activity status in Regulations 10 and 11 and 12 and 13 relies on a determination of the future effects of an activity on a wetland's annual median water levels, and the range of seasonal wetland water level fluctuations. We consider that this is an unworkable and inappropriate basis for determining rule activity status. In practice these matters can only be determined retrospectively. (While hydrological modelling might theoretically be possible to predict effects, it would need to be quite detailed and at a level of sophistication that would be unreasonable for a permitted activity. People should be able to determine whether they are permitted or require consent without the need to undertake detailed scientific assessment).	Redraft Regulations 10 -13 to ensure the threshold between activity status is clear and can be determined prior to work being undertaken
Regulations 12 and 13 - Earth disturbance for drainage in or within 100m of a wetland	If not for restoring a wetland, public flood control or nationally significant infrastructure, earthworks for drainage within 100m of a wetland would be a non-complying activity. This may be unduly onerous given that 100m could include land outside the wetland's catchment for particularly small wetlands. Possibly, the rule could apply to the "catchment of a wetland" where smaller than 100m. The description of earth disturbance also might preclude good practices for farm drainage. Consideration of a lower size limit for rules to apply to could also be given.	Amend Regulations 12 and 13 to refer to *"within a distance that is the lesser of:* • *100m of the wetland; or* • *The distance from the wetland to outer boundary of its catchment."*

Regulations 12(3)b and 13(b) – Earth disturbance for drainage – discretionary and non-complying activities	Rules' 12(3)b and 13(b) consenting requirement to not result in changes to annual median or natural seasonal water levels – this either places high consenting burden on landowners undertaking any earth disturbance within 100m of wetlands or on regional council to prove the condition of their wetlands in their inventory with high resolution of hydrological variability. Determining hydrological variability is challenging and would need to be undertaken on a site by site basis. In addition determining if something is 'detrimental' is subjective.	No clear relief sought, but consideration must be given to the intended outcome and ability to deliver.
Identification and mapping of wetlands	Mapping of all wetlands is a significant piece of work. Some regional councils have already gone through a process of identifying significant regional wetlands.	Regional variability for those regions who have already gone through the process of identifying significant wetlands should be provided for. A nationally consistent identification and mapping tool needs to be developed.
Sub part 2 – River bed infilling **Regulation 18** – Infilling a bed of a river	We are concerned about the lack of clarity and certainty associated with this regulation as drafted. • Whether an activity would restore or enhance natural values may, in practice, be a matter of judgement rather than a black and white criterion. Furthermore, it begs the question of what state of enhancement of restoration is required to qualify (ie. pre-infilling or the values of some pre-existing state). In our opinion this term is not clear enough to describe the activity and hence determine consent status. • The term "infilling" is not defined" It is not clear whether this is synonymous with permanent reclamation or whether in might include other, temporary activities. • It is not clear how "practical alternative" (clause (1)(d)) is to be determined. Who should determine it (applicant or council)? Given the uncertainty and discretionary judgement seemingly involved, it does not seem to us an appropriate criterion for determining activity status.	Re draft Regulation 18 to resolve the uncertainty identified.

	• It requires conditions requiring 'offsetting' so there is 'no net loss' but neither term is defined and it is not clear if this refers to spatial extent of river bed or river bed habitat *values*. • Requirement to report "declining" ecological condition to the Council (Clause (2)b)) seems to us impracticable and unenforceable (given, amongst other things natural fluctuations and variability and the difficulty of knowing at what point to report a declining trend). Ecological condition is not defined and could include be argued to included various dimensions.	
Subpart 3 - Fish passage Regulations 19 - 24	Provide for use of structure also. If fish passage is to be regulated in this way, provisions need to explicitly provide for the ongoing use of structures as well as construction so a use consent is not also required. All the permitted activity structure rules (e.g. clause 21, 22, 23 etc.) authorise the construction of structures (e.g. culvert, weir) but s13(1)(a) RMA also says "use" of a structure needs authorisation unless expressly allowed by an NES or rule.	Redraft to make it clear that the ongoing use of structures is expressly allowed also.
	Intent could be covered by guidance notes. Much of the content of this section reads more like guidance notes than enforceable rules. The whole section could be simplified and linked to fish passage guidelines which already exist. E.g. https://www.niwa.co.nz/freshwater-and-estuaries/research-projects/new-zealand-fish-passage-guidelines	Redraft to make the provisions more flexible but equally effective by simply requiring application of the NZFPG to permitted and consented activities.
Regulation 20 - Definition 'maximum allowable water velocity'	The proposed definition of 'maximum allowable water velocity' is problematic because relies on scientific knowledge that will not generally be available (ie. what water flow is required by the "weakest" species or "weakest life stage" of a species is unclear. Also, it is not clear on what basis "weakest" is defined – presumably swimming ability but this is not specified.	Redraft the definition of 'maximum allowable water velocity'.

Regulation 21 -	The conditions for a permitted activity we consider the criteria of Regulation 21 are inappropriate and unenforceable. Matters such as the bed over the full length of the culvert having to be stable for at least four fifths of the time, or the culvert having to provide for "continuity of geomorphic processes" are not clear and certain enough to be condition for permitted activities.	Redraft Regional 21 to include only clear and certain (non-discretionary and easy to ascertain) conditions.
Part 3 - Farming		
Subpart 1 – Livestock control - general	We are concerned about the ability to enforce many of the regulations relating to feedlots, sacrifice paddocks, other stockholding areas, intensive winter grazing. Examples of inherent uncertainty around the ability to enforce include: • It is not clear how the regulator will know how many days stock are in a holding area; • Whether reference to 'a day' refers to 24 hours or 12 hours (important where stock are not held over consecutive days, or for whole days at a time); • Difficulty in measuring pugging depth and area. We are also concerned that the way the regulations are currently drafted will require a significant number of consent applications on an annual basis. For example, Regulation 30 requires crop paddocks to have consents if they cannot meet any one of the conditions for a permitted activity. Crop paddocks tend to change every year. Therefore, annual consents would be required. We consider that some of the permitted activity conditions (i.e. those in 30(1)d-f.) would be more appropriately addressed through the FW-FP. Furthermore, we note that there is no lead in time for compliance with this subpart. For regions where stock holding areas are already authorised under a regional plan it would be reasonable to provide a lead in period for consenting or compliance with NES permitted activity conditions.	Review all the Livestock Control Regulations with a view to testing certainty, information availability and enforceability. Consider using the FW-FP tool to control management practices that are difficult to regulate as proposed Provide a short (say 2 years) transitional period for compliance with regulations that have capital investment implications.
Subpart 2 – Intensification –	Regulations 33, 34, 35 all rely on being able to assess the change in contaminant loss a land use change will result in. However, in practice it is very	Require a contaminant risk-based assessment rather than

decision-making criteria based on a 2017/18 contaminant loss baseline	difficult to establish reliable baseline data for N and P and there is no robust model or method to do so accurately for sediment and pathogens at the property scale. While the Overseer model theoretically allows for nutrient losses per hectare to be modelled, it relies on baseline data that may be hard to verify and numerous assumptions will need to be made. As a consequence, we fear there will be opportunities to "game" the baseline assessment. Sediment and microbial pathogens may not be able to be assessed retrospectively and/or have a very low level of confidence when used for comparative purposes. Again, this raises issues of whether any asserted difference in contaminant load (or lack of it) is actual or a simply artefact of modelling or "gaming". In our opinion, it will difficult to grant consents on the basis of this, inevitably unreliable, information. In addition, we note that a baseline derived from a single year (2017/18) will not be a reliable basis to assess actual change because the difference in contaminant loss between, for example, a dry and wet year can be significant. Hence, even if a credible 2017/18 baseline could be established there is no guarantee that that baseline is representative of the average or 'normal' level of contaminant loss from an individual property. A GMP approach (that relies on applicants demonstrating the adoption of specific practices) may be preferable but requires increased enforcement capability and does not guarantee "no change" to contaminant losses.	load-based comparative assessment. Consider using the FW-FP risk-assessment requirements to underpin that comparison, by collecting ongoing baseline information on risks of existing land use (if pastoral, arable or horticultural). Require consideration of all prior risk assessments for FW-FP in the comparative assessments (i.e., avoid selective comparisons of immediate or most dated risk assessments only)
Regulation 32 - Duration of consents	Intensification regulations are interim until the NPS-FM is fully implemented. Consent duration is therefore specified. Concern about what would happen to these consents and activities if the NPS-FW is not fully implemented in the timeframes (i.e., in light of proposals adding further resourcing pressures on regional authorities).	
Regulation 33 – requirement for FW-FP for winter grazing	Regulation 33(3)a requires a condition of consent requiring a certified farm plan. Regulation 33(4) requires that the certified farm plan to be submitted as part of the application. What is not clear is what status an application submitted without a FW-FP	Include a further regulation winter grazing where the application does not include a FW-FP a non-complying activity

	would have. That is there is no cascade to the rule structure that encourages applicants to meet the conditions of the DA rule.	
Regulation 35(2)	We consider Regulation 35(2) is unclear. We also note that it requires very detailed information on the land uses being undertaken (down to a 10ha resolution). For some mixed farm systems (notably the use of part of a dry stock farm for dairy support) that may not be realistic (for example it requires councils to be aware of which paddocks with in a drystock farm are used for grazing of young dairy stock). In practice councils will need to rely on information supplied by applicants (lease agreements etc). That may undermine the efficacy of the Regulation.	Clarify that the 10ha increase is to be measured as cumulative total. Clarify the appropriate evidential basis to make decisions about changes in land use on mixed farm systems.
Subpart 3 - FW-FP	It is not clear what the relationship is between existing FEPs and the required FW-FPs. It would appear that existing FEPs cannot be 'deemed' certified FW-FPs because they cannot have been certified by a person approved as a farm environment planner by the Minister for the Environment or Minister of Agriculture. Similarly, it is not clear that approval by a Minister retrospectively would solve this issue. There seems to us great uncertainty as to the status of existing FEPs and whether holders of such plans might not also need to have FW-FPs prepared to meet the Regulation. In other words, early adopters are not recognised/rewarded by this regulation. Rather, they appear at risk of being disadvantaged having to pay for an additional (and presumably duplicative) farm plan. We also note that the FW-FP requirement is not linked to consent status but appears to sit as an independent regulatory requirement. The ability to enforce the requirement is unknown to us and we would welcome further detailed legal advice from the Ministry for the Environment on how such technical standards work (and may be enforced) in practice. In the analysis that follows we have made our own assumption in that regard.	Amend the Regulation to make very clear that existing FEPs that meet the content requirements of the Regulation and/or which otherwise meet the requirements of the relevant regional plan or resource consent are FW-FPs for the purpose of this regulation.
Regulation 37 – Who must have an	We do not believe that the current resourcing within the primary sector and regional councils can deliver the number of required FW-FPs within proposed timeframes. The effectiveness and rate of FW-FP delivery will be contingent	Increase the FW-FP phase in timeframe. Government work with regional councils to design a

FEP	on positive engagement with landholders. At present there are few relationships owing to the lack of suitably-trained and able advisors regionally. We consider that, to avoid ineffective FW-FP delivery (in absence of landholder buy-in, adoption or input to design of action schedule), a longer and phased timeframe for delivery is required. Regional councils can assist with design of a national phased delivery approach, and have the potential to refine by region accounting for the differing needs and risks of land users on water quality. For example, smaller farms (<50ha) could have up to 10 years to comply due to numerous individuals and relatively lower contaminant loading (i.e., cover lesser net extent than fewer, commercial farms). This would help prioritise resourcing to higher impact farms and go some way to allowing resourcing capacity catch up with requirements.	manageable approach to delivery.
Regulation 38(3) – Content of FEP	Regulation 38(3) requires the FW-FP to *"identify and assess the risk of contaminant losses from the farm and with consequent impacts on freshwater ecosystem health, associated with any of the following activities"* before listing land management, land disturbance, stock management, effluent management and fertilizer management. To avoid doubt and drive greater focus of FW-FPs it would be beneficial to clarify exactly which contaminants should be risk-assessed in FW-FPs, and that clarification should include at least N, P, sediment and faecal indicator bacteria but with regional councils able to amend that focus to include other additional, regionally-important contaminants and/or contaminant management processes (e.g., stream shading, wetland denitrification).	Amend Regulation 38(3) to make clear that the contaminants to be the subject to risk assessed include, as a minimum, N, P sediment and microbial contaminants but that a regional council can require a wider range of contaminants and contaminant management processes.
Regulation 41 – FW-FP audit	The role of regional councils in respect of FW-FPs is unclear. Under Regulation 41 councils will receive information (i.e. on audit results) but are, seemingly not required to do anything with it (unless, presumably, the FW-FP is a condition of a resource consent). We note that the regulation appears to provide no obligation for farmer to comply with the FW-FP (except insofar as subparts 2 and 4 apply) Accordingly, as we understand it, unless the FW-FP is required by condition of	Clarify the role of regional councils in data storage and enforcement. At minimum the Government could usefully contribute to the design and development of national data storage systems

	a resource consent, the FW-FP/audit results are not enforceable by councils. The purpose, therefore, of councils receiving information in the form of audit results is unclear to us. Similarly, if we are not required (and indeed unable) to do anything with the information received it is not clear to us whether we need to invest in the data storage capability that would be required to be able to store, retrieve and report what could be a very large amount of information. (We understand that there could ultimately be 40-50,000 FW-FPs required nationwide). In short, the FW-FP proposal appears to us to be significantly under-developed. There is much uncertainty which makes commenting on the proposals and understanding the full implications for the Regional Sector very difficult.	
Regulation 40 - Certification	*Timeframes and prioritisation* Clarity is needed around criteria for certification of FW-FP planners and auditors. For example, as currently drafted this proposal is reliant on completion of a certification scheme, approved by Ministers (40(2)b, 41(3)b&c). It is not clear what this certification scheme will require. Further, 40(2)a and 41(3)a require three years experience in the management of pastoral, horticultural, or arable farm systems – it is unclear what this means (degree, actual on farm manager, council land management experience?). There are concerns that these will add rather than ease the alarming capability and capacity mountain already faced by regions for effective land management advisory services. Clarity is also needed about the means of (training provisions for) certifying FW-FP planners and auditors, with concerns rapid timeframes are reliant on as yet undeveloped training programmes and testing, that may or may not reflect regional priorities for FMU's and FW-FP's (i.e., offer sufficient scope to include numerous region-specific risks and management approaches). Without which, the upskilling and growth of capability will be at risk of being insufficient for effective outcomes from FW-FPs for diverse communities.	Clarify and address the concerns outlined re certification
FW-FP - Delivery	FW-FP delivery and implementation proposals are ambitious and will require highly efficient processes within regional councils and industry. Those systems	Produce, and require use of, nationally consistent, preferably

	have not been proposed. Their absence risks incompatible and meaningless information being generated by a myriad of FW-FP templates using inconsistent definitions and resolution of information. A standard template for FW-FPs is critical to both their delivery in rapid timeframes and their accounting/auditing/ reporting/ enforcement by regional councils operating with constrained resourcing. Any templates should be digital (software-based, producing geospatial datasets of farm features and action schedules) to drive the standardised reporting development and ensure meaningful reporting by regional councils and researchers can occur into the effects of action-schedules on water quality. Digital FW-FPs will also better enable automated support for and reporting by both advisors and landholders on auditable actions, reducing the likelihood of ineffective FW-FP's and the burden on regional authorities at a time when resources will be limited by the wider changes in the NPS-FM.	digital FW-FP templates
Subpart 4 - Nitrogen Cap	*Enforceability* The use of a threshold leaching value determined by the use of Overseer modelling appears contrary to current guidance on the use of Overseer in Regulation (including that issued by the PCE). Consents are required with conditions around proof of reduced nitrogen loss so in theory this needs to be enforceable. The prevailing view is that Overseer should not be used in regulation to create an 'absolute' compliance point. It can be used to assess *relative change* (i.e. change that occurs on a particular farm over a period of time) with some certainty of the extent of change (but not the absolute extent of the leaching being undertaken). While Overseer can be used to demonstrate compliance with a requirement to reduce, or not exceed an N loss, (if it is measuring change from a earlier Overseer result based on the same property and with the same base assumptions) attempting to take enforcement action on the basis of and Overseer estimate is problematic. Accordingly, we are not confident that the Nitrogen cap proposal is	

	enforceable in its current form..	
	Capacity to deliver and quality assurance Overseer budgets would be required within a short timeframe of the regulation being made operative (6 months) to enable a council to determine the "threshold value". We do not consider that this would be able to be delivered with current capacity issues. There is a significant risk of councils receiving poor quality/unreliable data. The timeframes provide no opportunity for councils to undertake (or commission) any verification/audit of those Overseer files. Without a quality assurance process we do not consider the approach would be robust	
Alternatives to the Nitrogen Cap *(as set out in the discussion document)*	*National fertiliser cap* We do not support the option of a national fertiliser cap. Such a cap must, inevitably, be a crude and inefficient means of controlling excessive nitrogen leaching. The proposal lacks detail but it would seem to ignore: • The fact that nitrogen comes into a farm system in forms other than N fertiliser (including, in particular, as brought on animal feed); • Nitrogen conversion efficiency (i.e how much nitrogen is in fact exported from a farm as product) – a critical factor if you are trying to determine environmental risk; • The variable need for nitrogen fertiliser resulting from variation soil and rainfall conditions • The variable risk of nitrogen fertiliser use (due to leaching potential associated with soil and rainfall. In addition, we would anticipate that any such national regime would be difficult to monitor and enforce in practice.	Do not adopt Option1 – national fertiliser
	Farm plan-based reductions	Engage with the Regional Sector on the detail of this proposal

	There is even less detail around how this option might work. It is difficult to know: • What (and how much) would be required in individual FW-FPs and who determines that; and • How that would be articulated in a FW-FP (ie. as a series of GMP actions; a specific Overseer-based leaching limit/reduction target; or de-intensification requirements) • Whether those FW-FPs would be associated with a resource consent (or operate independent of the consenting framework). In principle we would suggest that provided FW-FPs are enforceable, the sorts of actions and/or reduction targets required were made clear; and the farm advisory capability was in place to deliver the FW-FPs, this could be a feasible alternative to the N-Cap. However, due to the lack of critical detail (as outlined above) it is impossible to assess the practicality of enforcement by regional councils. While we do not dismiss this as an option we would need a great deal more detail before being able to comment further.	if it is to be pursued in preference to the regulatory N-Cap.
Draft Stock Exclusion Regulations		
Provision	Comment	
Use of mapping & low slope land	Mapping as a way of identifying 'low slope' land is supported and slope as a criterion has some rationality as a means of prioritising stock exclusion whilst retaining some flexibility for more targeted measures on steeper land. Mapping needs to be clear and certain to enable adoption and compliance. The proposed maps are deficient because they exclude numerous apparently non-pastoral river corridors (e.g., those with overlying canopy but subject to under-grazing and degradation of water quality; publicly owned land held under grazing license is omitted from the mapped layer). Deficiencies also arise because of the use of coarse topographic data (e.g. comparison to LiDAR	It is recommended that the mapped stock-exclusion layers are identified nationally through use of Lidar data and/or other technologies that can be more accurate. Some regional councils may be able to submit their own more accurate mapped layers to MfE for inclusion in the s360 mapping.

	suggests widespread inaccuracy).	
Setbacks - rivers	It is supported that streams smaller than 1m and drains etc. are managed through farm environment plans. Clarification is needed around the 5m average and how this is to be measured. (We note it says "across a property" but it is not clear how it applies where there are multiple streams on a property). The rationale for a 5m setback is unclear. This prevents a rational discussion of whether setback is the most efficient means of reducing contaminant loss to water and water quality outcomes. Regional and farm scale variation needs to be allowed for through FW-FPs, to ensure greater efficiency in achieving water quality outcomes. Many farms have invested heavily in riparian fencing in recent years. In the absence of clear objectives in terms of what is to be achieved from fencing, we consider it unreasonable to require those fences to be relocated simply to provide nationally consistent setbacks. In our assessment, that could be counter-productive, by degrading goodwill and engagement with landholders. To the extent that some fences may be poorly located, this should be addressed through individual engagement with farmers through the FW-FP process in light of catchment and FMU water quality objectives. There are significant issues around identifying the edge of the river in braided river systems where channels both move across a wide braided plain and where it is difficult to identify a specific 'bank'. These need to be treated/defined differently and account for the fact that set fencing may not be appropriate as it may need to move as the active bed and channel moves (e.g. Canterbury's LWRP uses the outer gravel margin rather than the river 'bank' for determining setbacks).	Provide the clarification sought. Consider having the stock exclusion regulation apply only after setbacks have been established in a FW-FP with the regulation requiring observance of those FW-FP-prescribed setbacks. If that is not legally feasible, require stock exclusion through an NPS-FM policy that requires regional rules to regulate stock exclusion with observance of FW-FP-prescribed setbacks. Ensure any national regulation does not require the repositioning of existing riparian fencing (at least until the fence is due for replacement).
Wetlands	It is unclear if there is a minimum size criterion for wetlands that the stock exclusion regulations would apply to. The draft NPS-FM requires mapping by regional councils of wetlands above 0.05ha, that are known to contain threatened species, or that are naturally less than 0.05ha. However, there is no minimum size criterion for wetlands written into the draft stock exclusion	Specify the minimum size wetland from which stock must be excluded. Provided excepts to allow for wetland grazing where such grazing is beneficial to ecological health and biodiversity

	regulations. This conflicts with that of rivers (where there is a minimum width) and creates potentially unnecessarily onerous conditions for land holders and regional authorities to manage the reporting for. Some light stock grazing is also known to be beneficial in some wetlands. Several rare, rosette native flora are readily suppressed and lost from remaining wetland refugia by stock exclusion, owing to incursions and overgrowth by exotics and other native species. Exemptions should be made by wetland type for those communities where continued grazing is preferential for biodiversity. The extent of remaining wetlands varies significantly from region to region. It is important that the proposals allow for regional variation.	objectives.
Fencing	Stock exclusion and fencing are both referred to in the regulations. It needs to be clear what is expected in terms of stock exclusion, particularly regarding the needs for permanent fencing (e.g., by waterway type, contaminant objective, natural risk or farm system). Temporary fencing of stock is an effective and highly efficient method for achieving stock-exclusion in flood-prone, mobile and/or limited stocking operations. However, it is unclear how stock exclusion will be determined and if this flexibility will be retained for decision-making by the FW-FP or an exemption process. Similarly "virtual fencing" using so called "smart collars" on animals should be provided for.	The term stock exclusion needs to be defined and provide for the use of permanent, temporary, and virtual fencing.
Application of Regulations	It is unclear whether the regulations are intended to relate only to farms over 20ha (5ha vegetable growing) as in the farming section of the draft NES-FW, or to all properties regardless of farm size. The current drafting will require the provisions against all properties (i.e. will capture a 1ha lifestyle block with 1 cow).	Confirm whether there is any size restriction on the application of the regulations. We consider the exclusion should apply regardless of property size.
Exemptions	The regulations mention but do not provide any pathways for applying for exemptions or criteria for how they will work. Equally, it is unclear whether regional planning processes are authorised to determine exemption rules for a s360 regulation. It is recommended that regional councils be the authority that can decide	Provide for exemptions to be granted by the regional council on an individual farm or wider catchment basis.

	exemptions. There needs to be provision for individual on-farm exemptions, as well as larger catchment scale exemptions if appropriate. Exemptions could be provided by a specific authorisation applied for and granted, or at the catchment scale through a regional planning process, or written into the regulations. Appropriate mechanisms would need to be clarified to provide for these pathways.	
Enforceability	The regulations do not provide any pathway for enforcing the regulations. If the regulations are not complied with there is not provision for regional councils to undertake compliance action. This needs to be addressed.	Amend the regulations to include enforcement provisions.
Cost recovery	There are no provisions for cost recovery under the s360 regulations. If councils are to monitor and enforce stock exclusion and setback provisions from waterways, they need a mechanism for cost recovery.	Provide whereby councils can recover costs associated with enforcing the stock exclusion regulations.
NES-FW	The above exemption, enforceability (of stock exclusion and setback) and cost recovery issues could be addressed by adding the stock exclusion regulations to the NES rather than as 360 regulations. This would allow for the exclusion requirements to be PA rules and individual case by case exemptions to be managed under a consenting framework. Larger (i.e catchment scale) exemptions could be PAs where identified through regional plans.	Consider whether the NES-FW is a more appropriate mechanism than s 360 regulations, to address the deficiencies identified above.

References

Biggs B. (2000) New Zealand periphyton guideline: detecting, monitoring and managing enrichment of streams. MFE publication.

Hughes, A., Davies-Colley, R. & Heubeck, S. (2019) Comparability of ISO 7027 Compliant Turbidity Sensors. NIWA, Hamilton, NZ.

Joy M., David B, and Lake M (2013) New Zealand Freshwater fish sampling protocols (part 1): wadeable rivers and streams. Massey University publication.

Matheson, F. Quinn J. & Hickey (2012) Review of the New Zealand instream plant and nutrient guidelines and development of an extended decision-making framework: Phases 1 and 2 final report. Prepared for the Ministry of Science & Innovation Envirolink Fund. NIWA Client Report No: HAM2012-081

PART 4 – Submissions made as infrastructure and service provider

Infrastructure

Central government signalled in its discussion document "Action for Healthy Waterways" a National Environment Standard for Wastewater Discharges and Overflows. The new standard would prescribe requirements for setting consent conditions on discharges from wastewater treatment plants and engineered overflow points. The requirements could include (among other things):

- "Minimum treatment standards or 'limits' for nationally-applicable wastewater quality parameters, including biochemical oxygen demand, suspended solids and bacteria"; and
- "Approaches for incorporating culturally acceptable wastewater treatment processes."

Wastewater operators would also have to comply with other requirements under the NSP-FM and be expected to be part of future nutrient allocation regimes.

Our assessment of the freshwater proposals shows they will be challenging for some in relation to infrastructure provision and particularly so where a city/district is growing or needing to grow.

Some of the proposed changes to the NPS-FM, the NES-FW and the specific proposals for a National Environmental Standard for Wastewater have real implications for the provision and maintenance of infrastructure.

We urge you to read carefully the submissions from territorial authorities, for example Tauranga City Council's, which points out many issues with the proposals and the implications as they stand. For example, the provisions for wetlands are stringent and somewhat inconsistent from a service provider perspective. The proposals do not appear to allow the use and enhancement of a wetland for stormwater management purposes, no matter how well this is done and regardless of the multiple community and environmental outcomes that can be achieved.

Wetlands

A key issue that has the potential to affect some areas is whether areas that are likely to be historically drained wetlands, but are now pasture, meet the definition of a wetland.

The RMA includes provisions that enable the review of resource consents upon a NES coming into effect. This could affect the resource consents currently held for activities, including residential development, which may be open to review in light of the provisions relating to culverts.

A consistent theme of the NES is that it provides for restoration/enhancement and activities associated with nationally significant infrastructure as discretionary activities (and are otherwise non-complying or prohibited activities). This is not very enabling. Controlled or restricted discretionary activities would help facilitate positive outcomes.

As currently written, the policies (and associated rules in the NES) relating to wetlands provide almost 'absolute' protection to wetlands. We support the need to protect wetlands, but consider this position to be unworkable in practice, particularly in terms of providing for urban growth and there is a need to provide for maintenance of existing infrastructure.

Water sensitive design

Currently, a range of water sensitive design (and similar) urban development methods are identified as an 'Information Note' to section 3.4(6) of the NPS. In order to provide an integrated approach across all of the recently proposed national directions, including the NPS for Urban Development, greater emphasis should be given on enabling and requiring more sustainable approaches to urban development.

Stream loss offsets

We consider that the provisions could be clarified and improved to better enable the offset of effects on streams.

While we agree with the emphasis of the effects management hierarchy on avoiding loss and modification, some stream loss and modification is inevitable to enable efficient growth and development. However, in our view the provisions (NPS and NES) are not clear as to how restoration, enhancement and offsetting are given effect to for a particular stream.

Vegetation destruction and earth disturbance

Amendment to the NES Standards for vegetation destruction and earth disturbance is necessary to allow modification (including enhancement) of wetlands to support urban growth. The changes required include the removal (or significant narrowing) of the prohibited activity for earth disturbance for drainage. This appears to prohibit earthworks to enhance a wetland for public drainage purposes. In our view, central government should be very cautious when utilising a prohibited activity in an NES.

Public flood control and drainage

We consider that there is a need to improve and expand the definition of 'public flood control and drainage'. This term should be expanded to include stormwater management systems and associated structures, including green infrastructure.

Water supply reservoirs

Considering the NPS-FM exception, councils question whether water supply reservoirs should be captured by the NPS-FM framework, noting that the primary policy intent of the reform package includes ensuring that New Zealanders can swim, fish, mahinga kai and enjoy freshwater resources.

The NPS-FM could recognise that water supply reservoirs are the first stage of the water treatment process, and that these assets (the artificial waterbodies behind the dam) serve as a primary water treatment process. Resource consent conditions specify the environmental flows that will be released below the dams.

Wastewater treatment plants

There are similar concerns about the application of the NPS-FM to wastewater treatment ponds. Specifically, wastewater treatment ponds can never support recreational or food-gathering.

Implications for smaller and rural councils

Some councils rely heavily on the environment to help provide safe and effective utilities for residents. In terms of wastewater, many councils provide treatment schemes with treated wastewater being discharged to land, sea or rivers, depending on the location. The nutrient caps in these proposals would (at minimum) require councils to provide additional infrastructure treatment to ensure treated water meets the reduced nutrient levels, before discharge. Reducing the nutrient levels of treated wastewater discharged to waterways will ultimately place increased cost on the council through the need for additional treatment equipment.

Given the small population size and wide geographical spread of some communities, the implementation of tertiary treatment on wastewater will impose a significant cost on our ratepayers.

Increasing the quality of treated wastewater discharged to waterways will ultimately place increased cost on ratepayers, as additional treatment equipment and infrastructure can only be funded through rates. The relatively small size of many schemes and high capital cost of wastewater equipment installation is expected to place a considerable cost burden on our ratepayers

Central Hawkes Bay (CHBDC) - case study

Affordability has been, and continues to be, a primary challenge for small councils in New Zealand. One of our regional case studies, CHBDC, looked at the implications of the proposals for the district. With around 3,000 connected users spreading the cost of operating, maintaining and in some cases significantly upgrading 6 separate wastewater networks, Council has had to plan a phased investment and look to external funding options to support the upgrades infrastructure to comply with existing requirements and meet community expectations.

The costs of the preferred treatment solutions for Waipawa, Waipukurau and Otane are estimated to be in excess of $50M spread across 15 years. With an already high wastewater targeted rate of $933 per connected user, Council has engaged economic advisers to assess the true affordability of further investment. With a rapidly growing but aging local population Council is fundamentally aware of the burden being placed on current and future generations.

In the context of the new requirements proposed by the NES for wastewater discharges and the NPS-FM, the additional regulation, policy and direction, will create challenges for public infrastructure providers in an already difficult situation for our small communities (particularly in the 3 waters arena, which is subject to additional uncertainty through a systemic review being undertaken by the Department of Internal Affairs). Nevertheless, Council considers that the work undertaken with community in the past 12 months, and the direction that Council has set for its wastewater future is setting a path for the future (albeit one fraught with challenges). Whether this path will need to change as a result of these national policy processes remains unclear

Gore District Council - Case study

The details about the specific requirements in any wastewater National Environmental Standard are unknown. However, it may be challenging for some local communities, especially those with oxidation ponds. The oxidation ponds of many small communities largely receive only domestic wastewater. A case study focused on Gore's wastewater scheme and the cost-effectiveness of eight upgrade scenarios[11] modelled to further improve performance for suspended solids, biochemical oxygen demand and bacteria (two of the eight scenarios were discharges to land, rather than water[12]). Each upgrade has strengths and weaknesses in its cost or treatment capabilities for each contaminant. The upgrades include options that are either additional or complementary to the existing system and/or replace the existing system.

The case study draws on existing research[13] from The Southland Economic Project[14] that is likely to be directly relevant to understanding the impacts of a wastewater National Environmental Standard. The research investigated the existing performance and upgrade scenarios for the wastewater schemes for eight Southland towns across the region. The upgrades looked across five contaminants: suspended solids, biochemical oxygen demand, total nitrogen, total phosphorus, and *E. coli*.

The oxidation ponds of many small communities largely receive only domestic wastewater. This case study focuses on Gore's wastewater scheme and the cost-effectiveness of eight upgrade scenarios[15] modelled to

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[11] Wastewater schemes consist of two main components: the reticulation infrastructure (i.e. pipes, pits, and pumps) and the wastewater treatment system. While a scheme's reticulation infrastructure is relevant, the research was specifically about upgrades or 'step changes' in wastewater treatment. In addition to these step changes, there are also possible actions to improve the performance of reticulation infrastructure. These actions can reduce inflows into a wastewater treatment system, increase its effectiveness, and improve the overall efficiency of a scheme.

[12] It is understood that the discharge of wastewater direct to water is abhorrent to tangata whenua and that this issue generally is not fully resolved through the treatment of wastewater before discharge.

[13] Moran, McKay, Bennett, West, and Wilson (2018) *The Southland Economic Project: Urban and Industry*. Technical Report. Publication no. 2018-17. Environment Southland.

[14] https://www.es.govt.nz/council/major-projects/Pages/Southland-Economic-Project.aspx

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further improve performance for suspended solids, biochemical oxygen demand and bacteria (two of the eight scenarios were discharges to land, rather than water[16]). Each upgrade has strengths and weaknesses in its cost or treatment capabilities for each contaminant. The upgrades include options that are either additional or complementary to the existing system and/or replace the existing system.

The case study draws on existing research[17] from The Southland Economic Project[18] that is likely to be directly relevant to understanding the impacts of a wastewater National Environmental Standard. The research was completed by Gore District Council, Southland District Council, Invercargill City Council and Environment Southland. It investigated the existing performance and upgrade scenarios for the wastewater schemes for eight Southland towns across the region. The upgrades looked across five contaminants: suspended solids, biochemical oxygen demand, total nitrogen, total phosphorus, and *E. coli*.

The key messages from our work are that for infrastructure to meet the nutrient attributes and potentially a new NES, funding for upgrades needs to be addressed. Further, other provisions, for example wetlands and fish passage, will also have cost implications for communities.

Specific submission points are made in the Table below.

effectiveness, and improve the overall efficiency of a scheme.

[16] It is understood that the discharge of wastewater direct to water is abhorrent to tangata whenua and that this issue generally is not fully resolved through the treatment of wastewater before discharge.

[17] Moran, McKay, Bennett, West, and Wilson (2018) *The Southland Economic Project: Urban and Industry*. Technical Report. Publication no. 2018-17. Environment Southland.

[18] https://www.es.govt.nz/council/major-projects/Pages/Southland-Economic-Project.aspx

Provision	Comment	Relief sought
National Policy Statement for Freshwater Management		
Part 3: subpart 3, 3.17 (2), (4)- (6) - Fish passage	Clarification is required for part 3.17.2, to identify any differentiation in the impact of fish passage barriers for native and invasive species – requiring a regional council to remove all fish barriers doesn't take account of the limited ability of councils to remove any barriers on private land and could set up perverse obligations to invest in removing barriers to the movement of exotic species that prey upon native aquatic species. Installing barriers for invasive species may be problematic as both native and invasive species could use the same waterway - how would a barrier discriminate? Could also create a potential loophole to install weir or other barriers, as well as diverts resources from doing good. The term "Structures", as used in 3.17 (4) to (6), is not defined in the NPS-FM. "Structures" could include culverts, weirs, dams, outfalls, etc. There are many structures in existence that are not owned by regional councils and trying to understand where they are or who owns them is extremely problematic. Furthermore, councils do not have the authority to compel private owners to carry out works. The remediation assessment and prioritisation are based solely on the specified ecological criteria, with no account of other factors such as cost, technical feasibility, or ability to consent the remediation option. This approach appears to ignore the effectiveness and efficiency of remediation and prioritisation processes. Funding the identification and prioritisation would be significant, as would remediation programmes. This is concerning, considering the resourcing issues raised earlier.	Consult further with regional councils on the drafting of this provision to ensure it will be practical and feasible to implement.

<table>
<tr><th colspan="3">Draft National Environmental Standard for Freshwater Management</th></tr>
<tr><td>Regulation 21:
Culverts</td><td>It is unclear if the definition of Culvert covers pump stations. Currently it appears that it does. If not, then it is very unclear what the requirements are for new structures involving flood pumps. It appears there should be policies for new flood pump builds under the definition of “public flood control or drainage” as defined in Clause 4 (definitions for sub-part 1).

For permitted activities, the conditions are onerous:

21 c) It is not clear what flow is being referred to - normal low flow or flood flow, or overall flows. They can be quite different. We suggest that it should only be for normal low flows as that is the stream flow for 90% of the time and when fish migrate.

21 d) Should be culvert span or diameter. The current wording suggests that the culvert diameter needs to be 1.3 times greater than the top width of the channel for streams less than 3m and more than 1.2 times greater than the top width of the stream +0.6m for streams greater than 3m across. This will mean a huge diameter culvert, much greater than the stream width. The top of the pipe will most likely be higher than the bank top, which is not desirable.</td><td>Consult further with regional councils on the drafting of this provision to ensure it will be practical and feasible to implement.</td></tr>
<tr><td>Regulation 22:
Weirs</td><td>These should not be permitted to the extent indicated. It is acknowledged that this section relates specifically to fish passage, however it is important that where the regional plan is more stringent for weirs, those regulations will apply.</td><td>d) at the end of i) and ii) it should state “or”</td></tr>
<tr><td>Regulation 23:
Passive flap gates</td><td>Non-complying is too onerous.</td><td>Amend so that a flapgate is a discretionary activity if it has a Fish Friendly mechanism attached to improve fish passage.

Regulation should refer to the installation of one, not the construction. The flap gate can be constructed off-site but doesn’t impact until it is installed.</td></tr>
</table>

Draft Stock Exclusion Regulations		
General **stock exclusion** requirements • Implications for scheme land • Application (stock specific and existing fences) • Exemptions and extensions • Definitions	There needs to be better clarification/definition around the term "property". Council's land is predominantly elongated riparian areas that are associated with multiple neighbouring larger farming enterprises, who licence defined areas for grazing. Because of the nature of a council's licence agreements, there may be numerous land users per council owned title (including where no legal title formally exists). There are also concerns that fencing off large setbacks between stop banks and rivers will be a significant challenge for plant pest control. Ideally setbacks should be planted and maintained however the cost for this at a 5m setback for council-managed land would be substantial. We would also need to have certainty that the addition of plants would not compromise the capacity of the area within the stop bank. Clarification of the definition of setback is also needed. To be consistent with other planning documents it should refer to a setback from the stream bank. This creates confusion for landowners. ie Setback: means the distance from the bed of a river or lake, or margin of a wetland. There is also confusion between the discussion document, Action for Healthy Waterways and farm plans. Section 8.5 of the discussion document talks about excluding stock from waterways more than 1m wide. There is also a statement about farm plans setting out how they will exclude stock from rivers and streams less than 1m wide and drains. This section is confusing as there is a distinction between rivers down to 1m wide and drains. The assumption is that drains are less than 1m wide. This is not correct as drains (artificial watercourses or drainage ditches) can be much more than 1m wide and under definitions they are not rivers or streams.	Exempt land managed by Regional Councils as part of regionally/nationally significant infrastructure – this should require a minimum setback of 2 metres but enable flexibility on setbacks where greater distances may compromise the integrity of this infrastructure (e.g. in places where stop banks are closer to rivers and stock tracking along a fence would be detrimental to the stop bank. The 5m rule should apply only to natural and modified natural rivers/systems. Artificial waterways (eg drain) should have a minimum 2 m setback. 5 m would make maintenance of drainage areas very difficult It is also recommended that exemptions are provided to Regional Councils that allow for stock exclusion while enabling the cost-effective management of this infrastructure. We suggest that the 5 m rule applies only to natural and modified natural rivers/streams.
Three Waters Management		
NES for **Wastewater**	It is difficult to comment on the proposal for minimum treatment limits in the absence of any detail about what those limits might be (and whether that will	Further work is needed to determine whether, due to the interaction of the

Discharges and Overflows	vary according to receiving environment or treatment type) For some, such limits seem likely to result in significant compliance cost. The discussion document does not reference the likely cost for communities and how that will be funded or the scale of the issue. In our assessment, the issues are large and long term. A national response in terms of assisting compliance across financially-constrained communities will be required. In other respects it is difficult to see how such a standard will benefit wastewater operators. As we understand it, the NES proposed would impose 'minimum' discharge standards and there is no guarantee that those standards will be regarded as sufficient. Regional council receiving water standards (which look set to become more stringent under the new NPS) will remain a significant limiting factor that may effectively render meaningless any national discharge limit. Similarly, it is difficult to see the costs associated with securing consents will decrease given the inevitable public interest in wastewater consenting processes. While the proposed NES might result in greater standardisation of consent conditions, there other ways that could be achieved.	RMA with an NES for Wastewater, the benefits expected will be realised. Significant analysis is required to understand the degree to which the minimum discharge standard or receiving environment standard will be the limiting factor (and hence what the benefit of minimum discharge standards is likely to be).
Stormwater and Wastewater **Risk Management Plans**	In general, the scope of proposed risk management plans is appropriate. There needs to be well defined parameters to work to (event types, ages of systems etc). There is considerable work required. Risks relating to these assets and their performance need to be considered holistically. The scope of the proposed risk management requirements for stormwater is limited to 3 aspects, but it extends beyond improvement of ecosystem health. There is insufficient information provided on the proposed content of these in the Discussion Document to make an informed response. Risk management plans should include receiving environments (whole catchment) - not just what comes out the pipe in any given place. Cumulative	Work with operators as the next phase of work is undertaken

	effects on receiving environments are important.	
Stormwater and Wastewater National Guidance	Overflows from the network are useful and solid indicators of the scale of the issue (i.e. flows through pump stations and wastewater treatment plants in excess of dry weather flow). Frequent sampling at point of discharge that gives a true representation of discharge quality provides good information. Targets need to be set for stormwater discharges from individual properties (at source) as well as for the receiving environment. Stormwater discharge quality should not be considered in isolation from the quality of stormwater inflows to the network. Monitoring costs need to be considered when setting the metrics and frequency of sampling. The scale of the issue is significant with respect to wastewater overflows. In many situations stormwater misdirected from private (commercial and residential) property is a significant contributor to overflows. There is a regulatory gap in this space that makes it difficult for network operators to enforce change: stormwater that is captured on individual sites and piped to connect to a stormwater network is not, as defined by the RMA, a 'discharge' to water or land (until it discharges to a waterbody). Therefore, regional councils cannot easily control the quality of piped stormwater from individual sites through RMA Plan rules. To improve WW network performance this regulatory gap needs to be closed (either through the Building Act or the RMA).	Work with operators as the next phase of work is undertaken

APPENDIX 1

Regional Case Studies for Essential Freshwater: Action for Healthy Waterways

Local Government New Zealand
Regional Sector Water Subgroup

Regional Case Studies for Essential Freshwater: Action for Healthy Waterways

We are. LGNZ. | Regional Sector

Cover photo: Upper Waitao catchment, Bay of Plenty

Credit: Andy Belcher

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This report was produced for LGNZ by the LGNZ Regional Sector Water Subgroup. It includes case study assessments contributed by 12 regional councils and territorial authorities. The case studies were discussed at LGNZ's Freshwater Forum in Wellington on 24 September 2019.

Within the limited time available, the regional councils and LGNZ have made all reasonable efforts to ensure the accuracy of these assessments and any other information contained within this report.

The executive summary and introduction to this report was written by Emma Moran (Senior Policy Analyst/Economist), Environment Southland and, while based on the advice and experience of a number of policy analysts and economists working for regional councils, it does not necessarily represent the views of the Regional Sector.

For clarity, this report is not intended to be a policy document.

Final

Date – 25 October 2019

Executive Summary

Successive governments, industry and our economic system in general have encouraged land development and intensification over the years. We are now faced with the legacy of those decisions, including more pressure from pollutants and a less resilient landscape. The Government's Essential Freshwater package is designed to stop further degradation of New Zealand's fresh water within the next five years and reverse past damage over the next generation. Beyond this, the Government is looking to address water allocation issues as part of its broader reforms. LGNZ's Regional Sector Water Subgroup was part of the process and views the Essential Freshwater package as both necessary and welcome.

A reset of our economic system to a more sustainable footing means considerable change for many New Zealanders. This change will create benefits and costs and, while their initial distribution may vary between people and communities, New Zealand is a small place and we can all expect to experience them in one way or another. However, leaving policy unchanged is not without its own impacts, and environmental damage and remediation is also costly. It is essential that we now fully understand how this new policy direction might play out for local communities if we are to proceed on the basis of least regrets. Unfortunately, there are many instances relevant to freshwater management where there have been unintended but entirely foreseeable consequences.

As with everything to do with water, assessing policy impacts is an extremely complex task – in many locations, the costs and benefits will be fairly moderate but there will also be cases of extremes. The purpose of this report is to bring together a series of case studies for a range of proposals from 12 councils across New Zealand. This series represents a compendium of council assessments of specific proposals in different situations. It is LGNZ's latest step in identifying some of the gaps in the Government's interim regulatory impact analysis, and suggesting an alternative 'high resolution' regional approach.

Many case studies focus on the National Environmental Standards for Freshwater where the nature of proposals means they are more 'clear cut' than those in the proposed National Policy Statement for Freshwater Management. While the focus is on specific proposals, some of the most important impacts of the Essential Freshwater Package are likely to come from what is not yet included, particularly around how water allocation will be addressed. By overlaying the proposals across an existing system of freshwater use there is a risk of locking in 'business-as-usual', which may not be the most economically efficient use of water, particularly once externalities are taken into account.

Together, the case studies in this report and in LGNZ's previous economic report on the Essential Freshwater Package[1] cover:

1. Bottom-lines for dissolved inorganic nitrogen (DIN) and, in some cases, dissolved reactive phosphorus (DRP) for Waikato, Canterbury, Taranaki, Auckland and the Bay of Plenty;
2. Stock exclusion for the West Coast , Bay of Plenty, Northland and Southland*;
3. Land use intensification in the Bay of Plenty;

[1] Moran and Keenan (2019) *Initial Economic Advisory Report on the Essential Freshwater Package*. Local Government New Zealand: Regional Sector Water Subgroup. An * indicates case studies that only appear in this earlier report.

4. Freshwater modules in farm plans for the Bay of Plenty and Southland*;
5. Whenua Māori land in Tairāwhiti/Gisborne;
6. Water quantity monitoring in the Hawke's Bay;
7. Nitrogen cap catchments in Southland and Bay of Plenty; and
8. A future national environment standard for wastewater in Southland and the Central Hawke's Bay.

Some case studies tell a similar story, such as the significant implications of the DIN and DRP bottom-lines. A case study on the Auckland region for the DIN and DRP bottom-lines showed these proposals are likely to require marked nutrient reductions in at least 800 km of streams; changes in nutrient management, particularly for DRP, which is several-times more likely to fail proposed national bottom-lines than for DIN; and major changes in rural and urban land use activities and infrastructure as most of the Waitematā watershed fails proposed national bottom-lines for either of the proposed nutrient attributes. The case study on the proposed DIN bottom-line for the Waitaki catchment in Canterbury showed the ecological benefits are expected to differ across river types: for spring-fed plains streams there may be considerable land use change and limited benefits, for hill-fed streams further reductions in DIN will deliver benefits where there are elevated nitrogen concentrations and some land use change but not at the same scale.

In the Bay of Plenty case study, the DIN and DRP proposals are unlikely to have a substantial impact in the region because many sites have elevated nutrients as a result of natural causes and so they may be exempt. In the Bay of Plenty relatively stringent nutrient limits are likely to be necessary in many catchments under the current NPS-FM because of the ecological health needs of lakes and estuaries. Waikato built on its case study in LGNZ's previous economic report and found that, as well as pastoral farming, the DIN and DRP proposals would have substantial impacts on dairy and meat manufacturing, agricultural support services and the finance sector.

For other case studies the situations are more divergent, such as the nitrogen loss cap in catchments with the highest in-stream concentrations of nitrate-nitrite (Option 1). In the case study for the Bay of Plenty, very few landowners in the upper Rangitāiki are affected, which may make the proposal difficult to implement. There are other catchments in the Bay of Plenty more heavily impacted by nitrogen, if natural nitrogen levels and receiving environments were taken into account. In contrast, a case study on the same proposal for five large catchments in Southland shows many landowners will be affected and for all farmers in these catchments to get farm plans within two years will be a challenge. The main impact will be some dairy (and possibly dairy support) farmers have shorter timeframes to reduce some of their nitrogen losses than will otherwise be the case, which may help avoid at least some damage and remediation costs. At a catchment scale, it is estimated that the nitrogen loads in the region's rivers and streams exceed the periphyton bottom-line in the current National Policy Statement for Freshwater Management (2017) by more than what is needed to achieve the nitrogen loss cap.

Where possible there are connections drawn between proposals, such as the extent to which the nitrogen cap proposal will contribute towards achieving the DIN bottom-line (Taranaki), and between the sediment bottom-line and on-farm mitigations (Northland). In the Waingongoro catchment in Taranaki the nitrogen loss cap will just be a step towards achieving the DIN bottom-line. As well, the imposition of Overseer as a regulatory tool is a cause of real concern to the regional council. In Northland, sheep and beef farms face the largest total and per hectare costs for nearly all of the sediment mitigation scenarios tested (based around stock exclusion, riparian management and farm plans).

The Bay of Plenty Regional Council assessed the estimated costs, expected benefits and timing of five proposals and found that farm plans and stock exclusion are expected to have the most significant long-term impacts across the region.

Many case studies highlighted the importance of local context or setting. An obvious example is the impact of the stock exclusion proposal on the West Coast. On the Coast most agriculture occurs on low-slope land and forms of landform modification are used (e.g. ‘humping and hollowing’) to overcome the constraints of a high rainfall environment. At present, the five metre setback in the proposal represents one percent of the West Coast’s lowland agricultural areas, but this figure will increase markedly if the proposal changes to capture ephemeral waterbodies under one metre in width. Stock exclusion, and the vegetative cover that will develop naturally over time, is likely to improve tourists’ impression of the region.

Another example is the intensification proposal in the Bay of Plenty, where one of the main trends in rural land uses is conversions from pasture and arable farming to irrigated horticulture, mainly kiwifruit and avocado. Here a lack of available tools for determining horticulture’s contaminant losses at a property scale and proposal will possibly compromise the environmental and socio-economic benefits from larger irrigated horticulture conversions in the short term. More broadly, the importance of understanding local context is evident in the relative levels of socioeconomic deprivation. A set of regional maps are included at the end of this report that underline this point.

The case study for Tairāwhiti/Gisborne found that parts of the Essential Freshwater Package will create additional hurdles to the development of whenua Māori. While well intentioned, the absolute nature of the prioritisation of water use under Te Mana o Te Wai does not capture the complexities of land utilisation, and creates impacts for whenua Māori that will be felt across the country. Māori land owners believe being kaitiaki means being good caretakers of the tāonga of the land and land’s commercial use is an essential mechanism to achieve this for coming generations.

Also included in this report is Greater Wellington’s review of a Ministry for the Environment commissioned report on the economic impacts of proposals for reducing nutrient and sediment in the Ruamāhanga Catchment (Wairarapa). This case study found that, for this catchment, the overall direction of the Government’s proposals lines up with the direction of the recommendations of the Ruamāhanga Catchment Whaitua Committee, and is unlikely to add significant costs over and above their recommendations.

The Essential Freshwater Package also signals changes to the three waters: drinking water, stormwater, and wastewater. Two case studies considered a National Environment Standard for Wastewater. A case study for the Central Hawke’s Bay District anticipated an NES for wastewater and the NPS-FM will create further challenges for public infrastructure providers in small communities. A Gore District case study indicated that a National Environmental Standard for Wastewater may mean a shift for smaller communities from oxidation ponds to mechanical plants, and issues, such as possible changes in resilience and practical constraints (e.g. lack of power).

This report shows that the interim Regulatory Impact Analysis is clearly an incomplete basis for decision-making on the effectiveness and efficiency of the Essential Freshwater Package. In the case study series, we have demonstrated some of the gaps in the evidence but there are others that are equally important, such as the impacts on local communities of the exception in relation to bottom-lines for New Zealand's six largest hydro-electricity generation schemes. We illustrated how some proposals will have significant consequences across many locations, while the implications of others will be dependent on the context and the 'sensitivity' of local communities affected. Many proposals are connected, and the cumulative impacts of the Essential Freshwater Package as a whole are yet to be explored thoroughly by anyone.

The case study series underlines how building this picture is critical to ensuring the success of freshwater reforms. In its current form, the possible impacts of parts of the Essential Freshwater Package mean that it may not align well with the purpose of the Resource Management Act and the Local Government Act, as well as that of local government itself (defined in section 10 of the LGA). More evidence is needed to determine how local government will meet its statutory responsibilities to manage fresh water in ways, or at rates that enable both current and future communities to provide for their social, economic and cultural wellbeing. This report takes a step towards understanding this issue.

Finally, this report shows how to build a fuller picture of the local and national impacts of the Essential Freshwater Package than currently exists. We propose an alternative approach through the development of a regional 'typology', which will bring impacts more into focus and allow patterns to be identified within and between regions based on their specific characteristics. Our hope is that such an approach and the case study series will help in the refinement of the proposals and their implementation, and inform the next steps of a more comprehensive national impact assessment.

Contents

1. Introduction

In early September 2019 Central Government released *Essential Freshwater: Action for Healthy Waterways* for consultation. It sets out a package of proposals (using a range of policy tools) to stop further degradation within five years and reverse past damage within a generation. Beyond this, the Government plans to address water allocation issues. The package contains an amended National Policy Statement for Freshwater Management, a new National Environment Standard for Freshwater, and regulations for both water takes and stock exclusion. It also signals upcoming proposals for drinking water, wastewater and stormwater being developed as part of the Department of Internal Affairs' 'Three Waters' Review.

The Regional Sector Water Subgroup has appreciated the opportunity to participate in the *Essential Freshwater* reform process and views the package of reforms as both necessary and welcome. In its official statement, the Regional Sector Water Subgroup stated that it strongly supports the reform objectives and the desire to improve water quality and ecosystem health.

> *The regional sector is responding to the challenge of land use intensification but accepts that responses to date have not always been effective or timely enough in the face of rapid change, complex science challenges and lengthy legal and planning processes. In many cases, it is simply too early for the results of recent regional responses to be seen in water quality outcomes or trends. It is also important to recall that successive governments (including recent governments), industry and the economic system in general, encouraged land development and intensification. Through the mid-20th century, in particular, that encouragement included subsidising large-scale land clearance and wetland drainage. We continue to live with the legacy of those changes. This legacy includes accelerated and on-going contaminant loss (particularly sediment) and less resilience in our hydrological systems generally.*
>
> ***Regional Sector Water Subgroup, September 2019***[2]

The Regional Sector Water Subgroup seeks to ensure that the likely impacts (benefits and costs) of the new proposals on communities are well understood and factored into the pace of change. It also stated that "We believe it will be important to take landowners and communities with us."

The Essential Freshwater package of reforms, along with other elements of Central Government's work programme, is likely to mean significant change for many New Zealanders. In essence, where the Government's market reforms in the 1980s saw the removal of financial subsidies from agriculture, this generation's initiatives for water are moving further towards the removal of some environmental subsidies (i.e. accounting for externalities) across most of the economy. There will be both important benefits and costs from these changes and, although their initial distribution between people and communities will be variable, New Zealand is a small place and we will all experience the outcomes.

[2] *Regional Sector Commentary on Essential Freshwater Proposals He Pito Kōrero e pa ana ki Ngā Tūtohu Mō te Wamāori.* https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/regional-sector-commentary-on-essential-freshwater-proposals.pdf

An important but challenging question that is posed with the impact assessment of any new national policy direction is how to scale up costs and benefits for different areas to the national level. However, in assessing policy implications from a single panoramic viewpoint, much of the picture can be lost. As with everything to do with water, assessing how a shift in policy may play out for communities is an extremely complex task – in many locations the impacts will be fairly moderate but there will also be cases of extremes (e.g. low and high).

A better understanding of nation-wide impacts can be gained from considering the network of 16 regional viewpoints and how they fit together - and within each region, at least some of the perspectives of 61 cities, districts and, beyond this, our local communities – including mana whenua. Exploring the breadth of New Zealand's interconnected but disparate parts helps build a national picture – rather than just relying on totals or averages.

In looking up and out to build a picture of national impacts it may be possible to develop something of a regional 'typology'. As a first step in exploring some of the gaps in the existing picture, the purpose of this report is to bring together a series of case studies on a number of specific proposals from across New Zealand. They build on the four case studies included in LGNZ's "Initial Advisory Report on the Essential Freshwater package", which was released in early September 2019.

Each case study in this report was chosen and prepared by the relevant council. The specific proposal(s) chosen were those of particular interest to a region, and so may highlight situations where there is more variability. However, this is not to say that other proposals are not also of particular interest and could also have been chosen. There are some differences in the assessment approach taken and each council is responsible for the content of its case study.

Many of the case studies have focused on the National Environmental Standards, where there is more detail and so more certainty (e.g. specific timeframes) than the National Policy Statement for Freshwater Management. While the case studies focus on specific proposals, some of the important economic impacts of the Essential Freshwater Package are likely to come from what is not yet included i.e. how water allocation issues will be addressed.

Included at the start of this report is a brief discussion on avoided costs and a regional analysis table. The table broadly characterises each region's economy and identifies the relevance of selected proposals. At the end of the report is a set of regional socioeconomic deprivation maps for five regions that illustrate how the impacts may vary spatially within and between regions.

The case study series was presented and discussed at LGNZ's Freshwater Forum. They will be used to inform LGNZ's independent review of the interim Regulatory Impact Analysis and its submission on the Essential Freshwater package.

New Zealand's regions are, in essence, collections of surface water catchments that flow from the mountains to the sea. These catchments number in the thousands and come in a seemingly endless array of shapes and sizes – they are our link to the estuaries and the coast. In developed areas, each catchment may contain one or more local communities – marae, settlements, towns or cities and their surrounding rural hinterland. These local communities are located near water because water is vital to life and central to our shared identity, as is reflected in Te Mana o te Wai.

1.1 Avoided Costs

The changes resulting from the Essential Freshwater package will mean important benefits and costs for many New Zealanders. While measuring the costs of policy is challenging, the benefits are even more so. One reason is that while the costs of change start to occur as a policy (and the actions resulting from it) are implemented, the benefits follow further down the track, and with various time lags at play, they are more distant and uncertain. Where there are markets for goods and services it is appropriate to monetise costs and benefits, but where there are no such markets then it is less appropriate.

Despite its more challenging nature, the benefits-side of the equation is no less real than the costs, and it generally falls into two parts: gains we are looking to realise, and losses that we seek to avoid. Some benefits will show up as market impacts on our economy, while others will occur as non-market impacts. The Ministry for the Environment highlighted the potential for avoided costs from the Essential Freshwater package:

> *There will be costs of action but the costs of inaction are not zero. The freshwater issues currently facing New Zealand have significant costs (e.g. the costs of on-going funding to remediate degraded waterways). In addition to improving our environment, one of the major benefits of the Essential Freshwater package is the avoidance of even greater future costs – generally environmental interventions are cheaper and more cost-effective the sooner they are implemented.*
>
> **Interim Regulatory Impact Analysis for Consultation: Essential Freshwater (page 6)**

For clarity, the 'action' and 'inaction' in this statement refers to Central Government's policy choices, and, to be more precise, it refers to 'further action' and 'no further action'.

One way of homing in on the possible avoided costs is to collect examples where the costs of environmental issues relating to water have been observed, and consider the extent to which they are relevant within a catchment or region. Such examples cover costs arising from a deteriorated environment (i.e. damage costs) and costs of fixing this environment so that the costs do not continue to occur (i.e. remediation costs). The latter are described here as remediation rather than restoration costs because once an environment has been changed then returning it to a former state can be all but impossible, particularly once ecological thresholds have been crossed. Contamination of land and water can take thousands of years to fully resolve, and the evolution of species and their habitats occurs over millions of years.

The Office of the Auditor General's report *Crown investment in freshwater clean-up* looked at four freshwater clean-up funds managed by the Ministry for the Environment to assess how effectively the funding was being used to improve freshwater quality. Collectively, the four funds are due to provide more than $190 million of investment from 2008 to 2032. These funds barely scratch the surface. To illustrate the point, Table 1.1 identifies a range of projects and programmes that Environment Southland has collected for Southland, New Zealand, and internationally – with estimates of the financial costs where they are able to be identified.

Table 1.1: Local, national and international examples of where contamination and remediation costs have occurred for human health and ecological health

Surface water	Groundwater	Lakes and estuaries

Location	Damage Costs
Southland	Living Streams Waihopai Project – Spurhead Creek water quality investigation ($ unknown)
	Remediation Costs
	Living Streams Programme: (2005-2010 $ unknown, 2010-2015 $1.6 million) ● Living Streams Waihopai Project: including staggered drain clearing ($ unknown) ● Living Streams Sandstone Project ($200,000)
	Waiau Fisheries and Wildlife Habitat Enhancement Trust ($6.7 million to date)
	Waituna Lagoon (2012-2016 $1.6 million, 2017-present $13.3 million)
New Zealand	**Damage Costs**
	Darfield contaminated drinking water (estimated $1.2 million)
	Havelock North contaminated drinking water (estimated $21 million)
	Remediation Costs
	Waikato River and Waipa River Catchment Restoration ($44 million to date)
	Taranaki Riparian Management Programme ($ unknown)
	Christchurch stream enhancement projects ($ unknown)
	Silverstream restoration projects ($ unknown)
	The Manawatu River Leaders' Accord ($54 million to date)
	Hinds/Hekeao Managed Aquifer Recharge (MAR) ($ unknown)
	Rotorua Te Arawa Lakes Programme (Funding allocated for 2008-2032 $144.2 million)
	Rotorua Te Arawa Lakes Programme – Ōkaro Catchment Lake Restoration (known funding from Regional Council $ 1.2 million, total funding unknown)
	Kaituna River Re-diversion and Maketū Estuary Enhancement Project (known costs $17.1 million, total costs unknown)
	Lake Ellesmere/Te Waihora Project ($11.6 million)
	Protecting Lake Taupo Project ($81 million)
	Kaipara Harbour Sediment Mitigation Study ($12.2 million to date)
International	**Damage Costs**
	Flint drinking water crisis – USA (US $465 million grants/allocations, total costs unknown)
	Walkerton contaminated drinking water – Canada (estimated US $64.5 million)
	Remediation Costs
	Flint drinking water crisis – USA (US $97 million for removal of lead and galvanised steel pipes, US $30-100 million for legal fees, total costs unknown)
	Ten Mile River Aquatic Habitat Restoration of Anadromous Fish Run – USA (US $8.9 million)
	Kennedy Flats Watershed Restoration Project – Canada (US $ unknown)
	Ohkay Owingeh Riparian Restoration Project – USA (US $1.8 million)

	Little Snake River Restoration on Three Forks Ranch – USA (US $5 million)
	The Skjern River Nature Project – Denmark (€35 million)
	The Emiquon Wetland Restoration Project – USA (€29 million)
	Comprehensive Everglades Restoration Plan – USA (US $10.9 billion to date)
	The Rio Grande water Fund: A Wildfire and Water Source Protection Project – USA (2014-2018 US $44.5 million)
	Tidmarsh Farms Restoration Project – USA (US $3 million)
	United States forecast treatment of nitrate contamination for community drinking water supplies – (costs per person per month range from US $30 for larger water utilities and $50 for smaller water utilities)[3]
	Restoration of leachate-impacted wetlands and associated mitigation at the University of Connecticut Landfill – USA (US $14 million)
	Project Mont-Saint-Michel – France (€200 million)
	Drakes Island Salt Marsh Restoration in the Gulf of Maine – USA (US $1 million)
	Great Lakes Restoration Initiative –USA/Canada (2010-2017 US $2.56 billion)
	Oka River Upper Estuary Restoration Project – Spain (€2.5 million)

Source: Environment Southland

The cost estimates above do not come close to capturing the full costs of these situations. In many cases the costs are likely to have been determined by the funding available rather than realistic assessments of what is needed to achieve a project or programme's objectives. Some programmes are open ended, and the financial costs shown are those to date, rather than final. Other programmes had an initial budget allocated and a set timeframe but may have continued on with more funding being received from a different source. Often individuals, community groups, organisations and landowners work voluntarily for many years before a formal project or programme, or they take over the work after it ends. Most projects involve many, many volunteer hours of work that are not accounted for, or given a monetary value. Estimates of financial costs do not usually capture this effort.

Water contamination events highlight the breadth of damage and remediation costs that can occur but these costs are often under-reported, even where comprehensive breakdowns of costs have been produced. They also do not fully capture the indirect costs as impacts flow through a community. Other less extreme situations may result in more gradual costs, such as declines in visitors to an area or in biological resources (e.g. fisheries). In most cases, this loss of revenue for a local area has not been captured in the cost estimates. In some cases the full costs may not become apparent for many years or an issue may be unresolved despite years of considerable investment. As well, an action to remedy one issue can inadvertently cause other issues.

Although challenging to measure, these avoided costs are relevant and important to consider.

[3] https://www.ewg.org/release/ewg-report-small-rural-communities-bear-costly-burden-nitrate-pollution-tap-water

1.2 Regional Analysis Table

A challenge in assessing the impacts of national policy direction is how to scale up local costs and benefits to the national level. This section presents a regional analysis table that points towards a way of developing a regional 'typology' that can be used to in this 'scaling-up' process. This regional analysis table considers two kinds of information:

1. The broad characteristics of a region's economy and
2. The relevance to a region of selected proposals within the Essential Freshwater Package.

The regional analysis table shows that regions tend to fall into types or groupings based on common characteristics. Although it tends to vary depending on the specific policy proposal in question, there are discernible patterns between regions and proposals. For example, some regions have relatively large agricultural sectors and others are strongly urban. In developing this table into a regional typology there are many other characteristics that are also relevant, such as both the proportion of Māori-owned land contained in a region and the proportion of land within a region that is Māori-owned. Another possible characteristic is a region's dependence on intensive winter grazing.

In the Regional Analysis Table below, the regions are listed from south to north. The columns for each region are shaded either blue or green – with green being used where the aspect being considered is relevant to agriculture or horticulture. Within each column three shades of blue or green are used to identify the relative importance of the topic in question (a light shade suggests a topic is less important for that region than regions which have a darker shade).

When looking across the page at the row for each region, the pattern of colours should highlight the regions where the impacts of the proposals may be similar. These patterns will help with understanding how the impacts for the regions will scale up across New Zealand (i.e. where a proposal should be given more or less weighting).

The size of a regional economy is particularly relevant to at a national scale (i.e. it is an indicator of national impacts). A sector's share of a regional economy is particularly relevant at the regional scale (i.e. it is indicator of regional impacts). Horticulture's value to an economy is usually better indicated by employment than GDP. Farm size is also a relevant consideration to the number of Farm Environment Plans as well as land area.

Region **(with the six Provincial Growth Fund Surge regions highlighted in darker shade)**	**South Island** **Southland**
A. Size of Regional Economy (GDP 2017 in millions). Highlighted if GDP >$10 billion	$5,439
B. Agriculture share of GDP and land area. Highlighted if agriculture >10% share of GDP	16.4% 1,179,116ha
C. Horticulture's share of Regional GDP. Highlighted if high GDP and/or predominantly seasonal crops	0.5% Seasonal
D. Farm Environment Plans. Highlighted if plans not already required and/or a large agricultural land area (>1 million hectares)	Required as part of permitted activity
E. Stock Exclusion Definition of lowland ≤ 5 degrees. Highlighted if region has large lowland area and pastoral	Existing stock exclusion requirements. Large lowland areas and large non-lowland areas.
F. Nitrogen Cap Catchments. Highlighted catchments are mostly pastoral but include horticulture (Option 3) Where nitrogen limits exist is noted.	N Cap catchments are Oreti River, Aparima River, Waimatuku Stream, Mataura River, Waihopai River.
G. Land use intensification	Planning restriction – 100% of the region, dairy farms, intensive winter grazing and cultivation
H. DIN and DRP relevant waterbodies (as identified by the Ministry for the Environment)	Identified as having appreciable numbers of streams that may be affected by DIN bottom-line
Major Hydro Schemes – proposed exclusion n National Policy Statament for Freshwater Management	Manapouri

South Island		
West Coast	**Canterbury**	**Otago**
$1,630	$33,843	$11,660
20.0% 187,247 ha	5.9% 2,740,336ha	5.3% 2,075,906ha
0.2% Perennial	0.6% Perennial and seasonal	1.1% Perennial
Not required	Required as part of resource consent	Not required
Stock access is managed as a permitted activity. Humping and hollowing may be a complicating factor in lowland, non-lowland is largely in conservation with some forestry.	Existing stock exclusion requirements. Large lowland areas (include arable) and large non-lowland areas.	Stock access is managed as a permitted activity. Largely non-lowland and pastoral.
No identified N Cap catchments	No identified N Cap catchments. Nitrogen limits are set over 100% of the region	No identified N Cap catchments.
No land use intensification restriction	Planning restriction – 100% of the region, >50 ha irrigation and intensive winter grazing	No land use intensification restriction
Few, if any, streams identified	Identified as having appreciable numbers of streams that may be affected by DIN bottom-line	Few, if any, streams identified
No identified hydro scheme	Waitaki	Clutha

South Island		
Marlborough	**Nelson**	**Tasman**
$2,827	$2,757	$2,125
12.6% 492,407 ha	0.3% 18,293 ha	15.2% 216,937 ha
5.1% Perennial	0.0% Not applicable	7.3% Perennial
Not required	Not required	Not required
Existing stock exclusion requirements. Some lowland, non-lowland is largely drystock.	Stock access is managed as a permitted activity. Lowland is largely urban.	Stock access is managed as a permitted activity. Some lowland, non-lowland is largely conservation and forestry.
No identified N Cap catchments	No identified N Cap catchments	N Cap catchment is Motupipi River.
Planning restriction – 100% of the region, dairy farms	No land use intensification restriction but very limited rural land.	No land use intensification restriction
Few, if any, streams identified	Few, if any, streams identified	Few, if any, streams identified
No identified hydro scheme	No identified hydro scheme	No identified hydro scheme

North Island		
Taranaki	**Manawatu-Whanganui**	**Wellington**
$8,063	$10,120	$35,442
10.6% 452,000 ha	8.7% 1,423,619ha	0.6% 455,764 ha
0.2% Seasonal	0.6% Seasonal	0.1% Perennial and seasonal
Not required	Nutrient management plan – required in Manawatu and coastal areas	Farm Environment Plans – proposal to require
Existing stock exclusion requirements. Largely lowland and dairy.	Existing stock exclusion requirements. Largely non-lowland and pastoral.	Existing stock exclusion requirements. Some lowland, non-lowland is largely conservation and drystock
N Cap catchment is Waingongoro River.	No N Cap catchments. Nitrogen limits are set over 15% of the region (Upper Manawatu, Low Rangitikei, Waikawa, Lake Horowhenua, Western lakes)	N Cap catchment is Parkvale Stream (in the Ruamahanga River Catchment). In Option 3, Mangaone and Waitohu Streams may be added as horticulture-dominated catchments.
Planning restriction – 100% of the region, dairy farms	Planning restriction – 100% of the region, 10,000 properties	No land use intensification restriction
Identified as having some streams that would be affected by DIN bottom-line and many that would be affected by DRP bottom-line	Identified as having some streams that may be affected by DIN bottom-line	Few, if any, streams identified
No identified hydro scheme	Tongariro	No identified hydro scheme

North Island		
Bay of Plenty	**Gisborne**	**Hawke's Bay**
$14,906	$1,886	$7,541
7.2% 610,282 ha	10.4% 561,326 ha	9.4% 872,612 ha
1.3% Perennial and seasonal	1.9% Perennial	3.9% Perennial and seasonal
Nutrient Management Plan – required in Rotorua Catchment	Not required	Farm Environment Management Plans – required in Tukituki
Existing stock exclusion requirements. Lowland area includes horticulture.	Existing stock exclusion requirements. Largely non-lowland in forestry and drystock.	Stock access is managed as a permitted activity. Large lowland areas (include arable), non-lowland is largely drystock.
Upper Rangitaiki River (upstream of Otangimoana River confluence). Nitrogen limits are set over <5% of the region (Lake Rotorua).	No identified N Cap catchments.	N Cap catchment is Taharua River (in the Mohaka River Catchment). Nitrogen limits are set over 15% of the region (Tukituki River).
Planning restriction –6% of the region (5 lakes, including Lake Rotorua and 85 additional farms)	Planning restriction	No land use intensification restriction
Identified as having some streams that may be affected by DIN bottom-line	Few, if any, streams identified	Few, if any, streams identified
No identified hydro scheme	No identified hydro scheme	Waikaremoana

North Island		
Northland	**Auckland**	**Waikato**
$7,011	$102,365	$22,241
9.4% 695,101 ha	0.3% 287,639 ha	8.5% 1,552,321ha
1.1% Perennial and seasonal	0.1% Perennial and seasonal	0.7% Seasonal
Farm Environment Plans required in specific catchments for sediment from highly erodible land.	Not required	Farm Environment Plans – required in Waikato-Waipa catchments
Existing stock exclusion requirements (refer to rules in section C.8.1 of proposed regional plan). Largely non-lowland and pastoral.	Existing stock exclusion requirements. Lowland area is urban, with some horticulture and pastoral.	Existing stock exclusion requirements. Large lowland areas and also large non-lowland areas.
N Cap catchment is Waipao Stream (in the Wairoa River Catchment).	No identified pastoral N Cap catchments. In Option 3 Waitangi and Whangamaire Streams may be added as horticulture-dominated catchments.	N Cap catchments are Piako River and Waihou River. Nitrogen limits are set over 45% of the region (Lake Taupō, which predates NPSFM, and Waikato / Waipa River subject to WRA Vision & Strategy).
No specific restrictions on land use intensification but water quantity limits mean that any intensification requiring more water cannot occur in fully allocated catchments	No land use intensification restriction	Planning restriction - 33% of the region (Waikato / Waipa Catchments)
Identified as having some streams that may be affected by DIN bottom-line.	Identified as having some streams that may be affected by DIN bottom-line.	Identified as having appreciable numbers of streams that may be affected by DIN bottom-line
No identified hydro scheme	No identified hydro scheme	Tongariro

2 Northland – Essential Freshwater and Sediment Mitigations for the Kaipara Harbour

2.1 Introduction

Kaipara Harbour has a surface area of 950 km^2 at high tide, making it New Zealand's largest harbour and one of the largest tidal ecosystems in the world. The catchment area spans 6,020 km^2, and falls within the bounds of Auckland Council, Northland Regional Council, and the Far North, Kaipara and Whangarei District Councils (see map in Appendix 2.1).

Most of the land in the catchment suitable for agriculture was cleared by the early 1900s. Today, there is less than 10% of the native forest cover and 5% of the terrestrial wetlands remaining. The primary land-use in the catchment is sheep and beef farming (47%), followed by dairy (23%) and plantation forestry (14%). There are 8,110 km of permanent and intermittent waterways passing through approximately 425,000 ha of pastoral land.

Because of land use change, sediment loads are estimated to be around seven times higher than before human settlement, at 700,000 tonnes per year. Accelerated infilling of the harbour with sediment is impacting the ecology and hastening the ultimate loss of the harbour.

The Kaipara Harbour Sediment Mitigation Study, jointly commissioned by Northland Regional Council and Auckland Council (with support from the Ministry for the Environment) was undertaken to assess the economic costs and environmental benefits of a range of scenarios for reducing catchment sediment losses to the Kaipara Harbour and to rivers and streams within the surrounding catchment. This paper summarises the various reports listed in the Reference section, with a focus on the findings as they relate to the *Essential Freshwater Reforms*.

2.2 Analysis

Methodology

Several modelling tools were combined in the analysis. SedNetNZ was used to estimate the various sources of sediment, i.e. land-based sources (landslide, hillslope, gully, earthflow and surficial erosion) and streambank erosion, and to calculate the total catchment sediment load (Dymond, 2016).[4] Eroded sediment is routed through the river network using a sediment budgeting method, accounting for losses in water bodies and deposition on floodplains and in the river channel.

These sediment estimates were inputted into the New Zealand Forest and Agriculture Regional Model (NZFARM) catchment economic model (Daigneault, Dymond and Basher, 2017). NZFARM was used to model a range of scenarios for reducing losses of sediment from the catchment, providing estimates

[4] SedNetNZ was also used to predict the pre-human sediment load assuming all in native forest: 120,301 tonnes per year.

of the costs associated with each scenario and predictions of the annual-average load of catchment sediment delivered to both freshwater and the harbour.

The sediment loads under each scenario were transformed into changes in three freshwater sediment attributes (suspended-sediment concentration (SSC), visual clarity, and euphotic depth)[5] at seven freshwater reporting nodes.[6] It was assumed that the SSC percentiles all change exactly proportionally to a reduction in catchment sediment load. Sediment concentration-discharge rating curves, derived for each location from monitoring data, were used to relate SSC to visual clarity and euphotic depth. For all nodes except Kaihu River at Gorge, a 50% reduction in SSC was found to increase visual clarity percentiles by approximately 70% (35% for Kaihu) and euphotic depth by approximately 35% (30%).

A Kaipara Habour sediment transportation model was developed to convert the sediment loads predicted by SedNetNZ and NZFARM into an Annual Average Sedimentation Rate (AASR) for nine depositional basin environments within the harbour (Green, Swales and Reeve, 2017).[7]

Baseline

The Baseline scenario assumes: (a) 2014 catchment landuse, (b) net farm revenue based on a five-year average of input costs and output prices over the period 2010-2014, and (c) no landowners were implementing management practices intended to reduce catchment soil erosion.[8] Because the Baseline does not account for present-day mitigation, costs and benefits (e.g. changes in net revenue and reductions in catchment sediment loads) of the various scenarios will be overstated. Present-day SSC, visual clarity, euphotic depth and AASR values were calculated as the baseline starting point for freshwater and harbour attributes. The baseline information indicates that approximately 52% of the total catchment sediment load of 691,000 tonnes per year comes from land-based sources and the remaining 48% is created by streambank erosion (Table 2.1).

The baseline information indicates that approximately 52% of the total catchment sediment load of 691,000 tonnes per year comes from land-based sources and the remaining 48% is created by streambank erosion (Table 2.1). This relatively even split suggests that management options that target only one type of erosion process or landuse may not achieve substantial changes in sediment loads.

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[5] SSC is the concentration (kg/m^3) in the water column of solid-phase material that is suspended above the bed; visual clarity is the horizontal distance (metres) that animals and humans can see in water; and euphotic depth is the depth below the water surface (metres) at which light intensity falls to 1% the intensity at the surface.
[6] The seven nodes were selected because they were the only monitoring sites in the catchment where there was sufficient water quality and quantity monitoring data to establish the present-day state and the relationships amongst the attributes.
[7] The nine basins were chosen to include a spread of locations across the harbour, those of significance to tangata whenua, and those with particularly high ecological and/or human amenity values.
[8] No mitigation was assumed in the Baseline because the present-day efforts at sediment mitigation in the catchment could not be located and precisely quantified.

Table 2.1: Key economic and sediment load variables by landuse type under the Baseline scenario

Landuse	Area (ha)	Net Revenue ($M/yr)	Land-based Erosion (t/yr)	Stream bank Erosion (t/yr)	Total Erosion (t/yr)
Dairy	140,584	$289.5	70,463	96,999	167,462
Sheep & Beef	283,999	$12.5	216,599	146,994	363,592
Deer	3,032	$3.0	769	766	1,535
Lifestyle	17,021	$1.2	4,165	7,248	11,593
Arable & Horticulture	5,488	$22.2	155	3,261	3,416
Forestry	83,596	$43.4	41,675	24,173	65,848
Native bush	53,446	$0.0	23,161	15,103	38,263
Other	14,865	$0.3	1,523	38,260	39,783
Total	**602,031**	**$546**	**358,510**	**332,982**	**691,492**

Other notable findings from the baseline scenario are:

- Total sediment loads are split between sheep and beef farms (53%), dairy (24%), plantation forestry (10%), and native bush (6%);
- Pasture, which covers approximately 74% of the catchment, contributes 79% of the present-day sediment load;
- Sheep and beef farms, while covering 47% of the catchment and generating 53% of the sediment load, only produce about 3% of the total net farm revenue across the catchment. They are typically located on steep and low productivity land; and
- 'Highly erodible land' (HEL), defined as having an average of at least one tonne of sediment per hectare per year (typically steep hill slopes), while comprising 13% (80,910 ha) of the catchment, is responsible for about 77% of the land-based erosion (see map in Appendix 2).

Net revenue is specified as earnings before interest and taxes (EBIT). Changes in net revenue, including estimates of the opportunity costs of taking land out of production, are used to show the total cost of the various scenarios as they impact on different land uses. The distribution of these costs between the public and private sector is not considered.

Scenarios

Nine sediment-mitigation scenarios and two landuse-change scenarios that were modelled (Table 2.2).

Table 2.2: Scenarios investigated

No.	Scenario name	Scenario description
0	Baseline	Current land use with no mitigation practices to match same assumptions as SedNetNZ erosion model
		Sediment-mitigation scenarios
1	Current Mitigation	Current landuse with likely proportion of mitigation practices implemented today. Assumes 80% of streams and rivers on dairy farms and 30% of streams and rivers on other pastoral land are fenced to exclude livestock (dairy cattle, dairy support cattle, beef cattle and deer) and 10% of pastoral land area with HEL has soil conservation measures.
2	Farm Management Plans on all HEL	Current landuse with farm management plans (FMP), predominately promoting soil conservation by planting poplar or willow poles, implemented on all HEL.
3	Stock Exclusion Rules	Current landuse with fencing of REC 2 or larger permanent streams for stock exclusion on all pastoral land meeting the 2017 proposed national stock exclusion regulations.
4	Stock Exclusion Rules + riparian planting	Current landuse with fencing of REC 2 or larger permanent streams for stock exclusion on all pastoral land meeting the 2017 proposed stock exclusion regulations, with 5 m stream buffer planted with vegetation.
5	Stock Exclusion + FMPs on all HEL	Combination of scenarios 2 and 3.
6	Freshwater Node 10%	Annual catchment sediment load at all seven freshwater nodes reduced by 10%.
7	Freshwater Node 30%	Annual catchment sediment load at all seven freshwater nodes reduced by 30%.
8	Marine Deposition 15%	Annual catchment sediment load in all nine harbour depositional basins reduced by 15%.
9	Marine 2mm above 'natural' AASR	AASR for catchment-based erosion is no more than 2 mm greater than AASR under "natural" land conditions (scenario 11)
		Landuse-change Scenarios
10	Full Afforestation (Pine)	All non-forest land is planted with radiata pine. Used to estimate maximum attainable mitigation while maintaining a 'productive' land use.
11	Full Afforestation (Native) & Wetlands	All non-forest land is planted with native bush and likely extent of pre-human wetlands are restored. Used to estimate 'natural' erosion loads in the catchment and thus maximum attainable mitigation.

Table 2.3 highlights the differences between the modelled scenarios and the proposed *Essential Freshwater Reforms* proposals for Farm Management Plans and Stock Exclusion. Appendix 2.3 provides details of the assumed mitigation costs and effectiveness of the various interventions.

Table 2.3: Comparison between mitigation scenarios and Essential Freshwater Reforms proposal

Issue	Modelled scenario	Essential Freshwater Reforms proposal
Farm Management Plans	Only required on farms having land defined as HEL, with costs limited to actions taken on HEL, primarily involve planting poplar or willow poles.	Require all farms to have a farm plan with a freshwater module.
Stock exclusion	Followed the 2017 proposed stock exclusion regulations, i.e. dairy cattle on milking platforms must be excluded from all permanently flowing waterways that are at least 1 metre wide at any one point, and dairy support cattle (including third-party grazing), beef cattle and farmed deer must be excluded from permanently flowing waterways on land that has a slope of between 0 and 15 degrees. While fencing was not an explicit requirement, fencing was assumed to be the on-the-ground implementation method. Adding a 5 metre wide riparian planting was an additional scenario.	Stock exclusion on "low land" land parcels where the average slope of a land parcel is less than or equal to 5 degrees (7 degrees or 10 degrees). A setback of five metres on average across the property (with a minimum width of one metre). On non-low-slope-land, stock exclusion is required where carrying capacity of the land exceeds certain thresholds.

2.3 Results

Table 2.4 summarises the total mitigation costs and change in sediment load for each of the modelled scenarios. Figure 1 shows how the total mitigation cost is spread across different landuse types. Changes in the predicted freshwater sediment attributes are shown in Appendix 2.4.

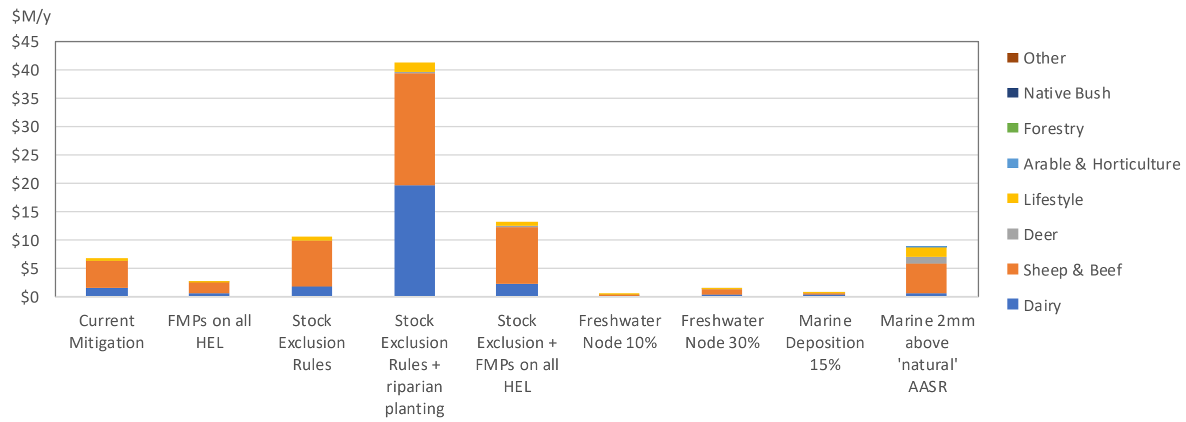


Figure 2.1: Total mitigation cost by landuse type for the nine sediment-mitigation scenarios

Table 2.4: Results in terms of mitigation cost and sediment reduction by scenario

	Mitigation cost			Sediment reduction		
Scenario	**Total (mil $/yr)**	**Average per tonne of sediment ($/t/yr)**	**As change in net Revenue ($M)**	**Land-based Erosion (t/yr)**	**Stream bank Erosion (t/yr)**	**Total Erosion (t/yr)**
Baseline	$0	$0	$372.1	358,510	332,982	691,492
1. Current Mitigation	$6.6	$81	-2.0%	-5%	-19%	-12%
2. Farm Management Plans on all HEL	$2.6	$13	-1.0%	-54%	0%	-28%
3. Stock Exclusion Rules	$10.5	$118	-3.0%	0%	-27%	-13%
4. Stock Exclusion Rules + riparian planting	$41.3	$194	-11.0%	-25%	-37%	-31%
5. Stock Exclusion + FMPs on all HEL	$13.0	$46	-3.0%	-54%	-27%	-41%
6. Freshwater Node 10%	$0.2	$5	-0.1%	-8%	-3%	-6%
7. Freshwater Node 30%	$1.2	$10	-0.3%	-24%	-9%	-17%
8. Marine Deposition 15%	$0.6	$6	-0.2%	-17%	-13%	-15%
9. Marine 2mm above 'natural' AASR	$8.7	$84	-2.3%	-11%	-5%	-8%
10. Full Afforestation (Pine)	$255.3	$543	-69%	-66%	-71%	-68%
11. Full Afforestation (Native) & Wetlands	$330.8	$546	-89%	-90%	-85%	-88%

2.4 Main findings

The findings of the study as it relates to the *Essential Freshwater Reforms* package are:

- Sheep and beef farms face the largest total and per-hectare costs for nearly all scenarios.
- The total costs of the scenarios that include fencing and farm management plans as mitigation options may be overstated by as much as $6 million per annum as some dairy and sheep and beef farmers have already fenced some of their streams (the Current scenario).
- Many of the estimates appear cheaper than one may anticipate because mitigation practices are not implemented on every parcel of land in the catchment, i.e. implemented only where landuse, slope and annual erosion rates meet specified criteria.

- Scenario 2 (farm management plans on HEL), which targets the high erosion areas, results in significant reductions in sediment loss (28%) at relatively low cost ($2.6 million per year).
- Implementing scenario 3 (stock exclusion) is estimated to cost $10.5 million per year and result in a reduction in sediment loss of 13%.
- Extending the stock exclusion rule to include 5 metre riparian buffers with riparian planting (scenario 4) would reduce total sediment load by a further 18% but at an added cost of $31 million per year.
- Combining farm management plans on HEL and stock exclusion (scenario 5) reduces total sediment load by 41% at an average cost of $46 per tonne.
- In terms of achieving improvements in freshwater sediment attributes, only the two full afforestation scenarios really stand out above the Baseline scenario.
- Scenario 5 is predicted to increase visual clarity compared to the Baseline by about 0.5 metres at four of the seven freshwater nodes and euphotic depth by about the same amount in three.

2.5 References

Daigneault, A., Dymond, J. and Basher, L. (2017). *Kaipara Harbour Sediment Mitigation Study: Catchment Economic Modelling*. Landcare Research Contract Report LC2905, Auckland, 107 pp.

Dymond, J.R. (2016). *Sediment Loads in the Kaipara Harbour Catchment and Translation to Freshwater Sediment Attributes*. Landcare Research Contract Report LC2413, Palmerston North, 31 pp.

Green, M.O. and Daigneault, A. (2018). *Kaipara Harbour Sediment Mitigation Study: Summary*. Report NRC1701–1 (minor revision), Streamlined Environmental, Hamilton, 64 pp.

Green, M.O. and Phillips, N.R. (2016). *Kaipara Harbour Sediment Mitigation Study: Project Initiation Workshop*. Report NRC1601–1, Streamlined Environmental, Hamilton, 51 pp.

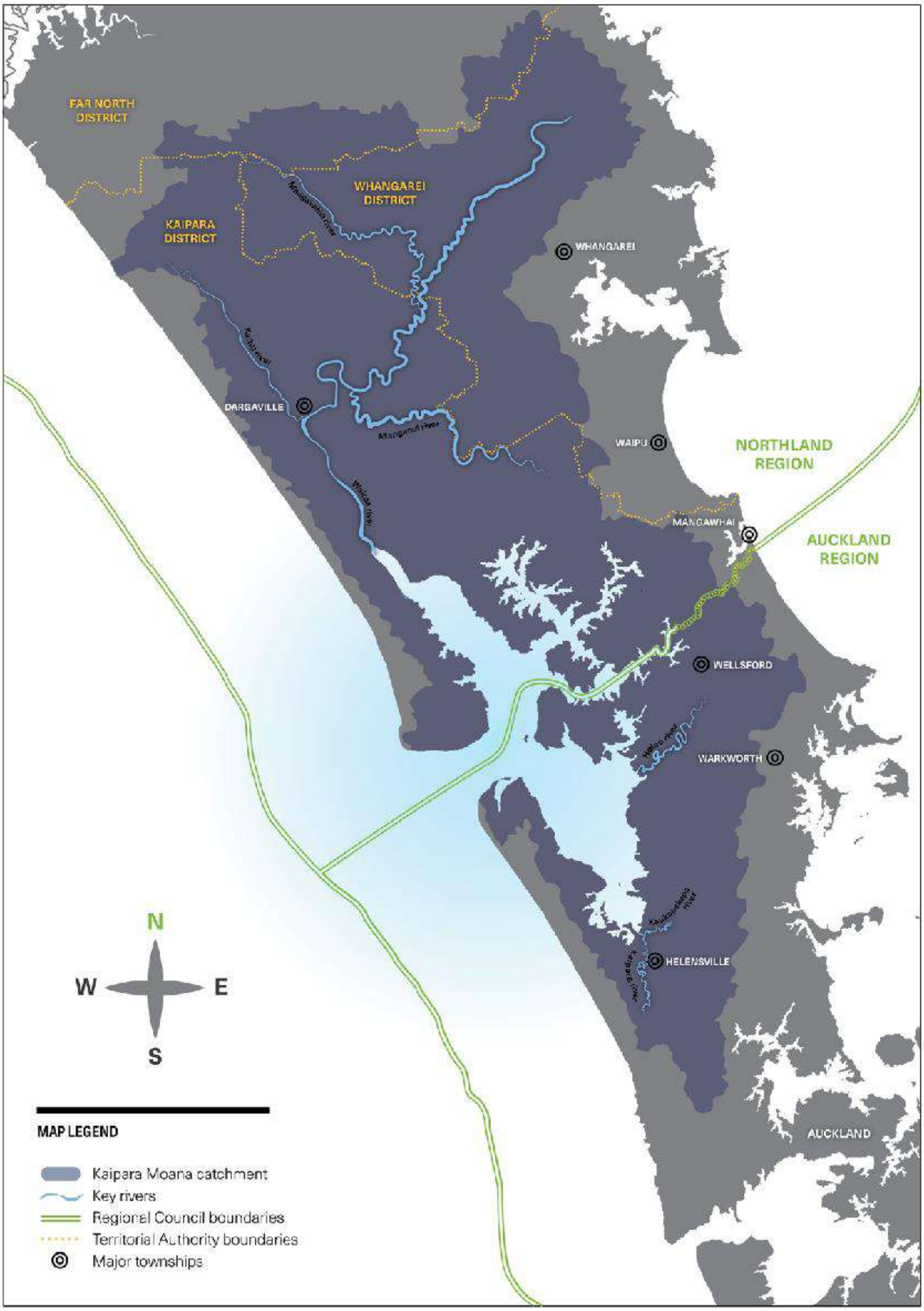
Green, M.O., Swales, A. and Reeve, G. (2017). *Kaipara Harbour Sediment Mitigation Study: Methods for Evaluating Harbour Sediment Attributes*. Report NRC1601–2, Streamlined Environmental, Hamilton, 77 pp.

Lohrer, A.M. (2017). *Kaipara Harbour Sediment Mitigation Study. Harbour Benthic Ecology Narrative*. NIWA Report 2017395HN, December 2017, NIWA Hamilton, 36 pp.

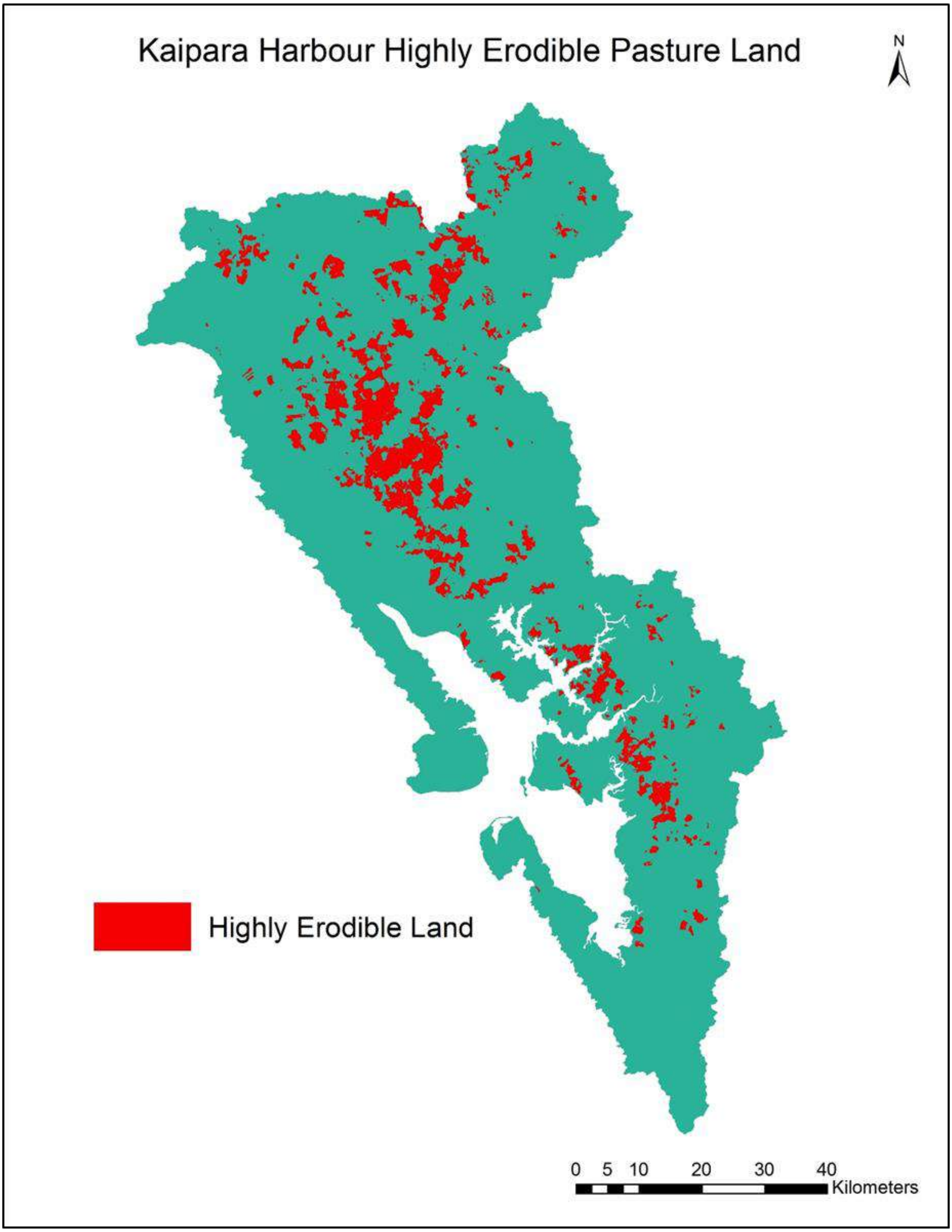
Matthaei, C. (2017). *Kaipara Harbour Sediment Mitigation Study: Narrative Assessment of Freshwater Sediment Attribute Predictions*. University of Otago, Department of Zoology, Dunedin, 31 pp.

2.6 Appendices

Appendix 2.1 Kaipara Moana catchment



Appendix 2.2 Highly erodible land



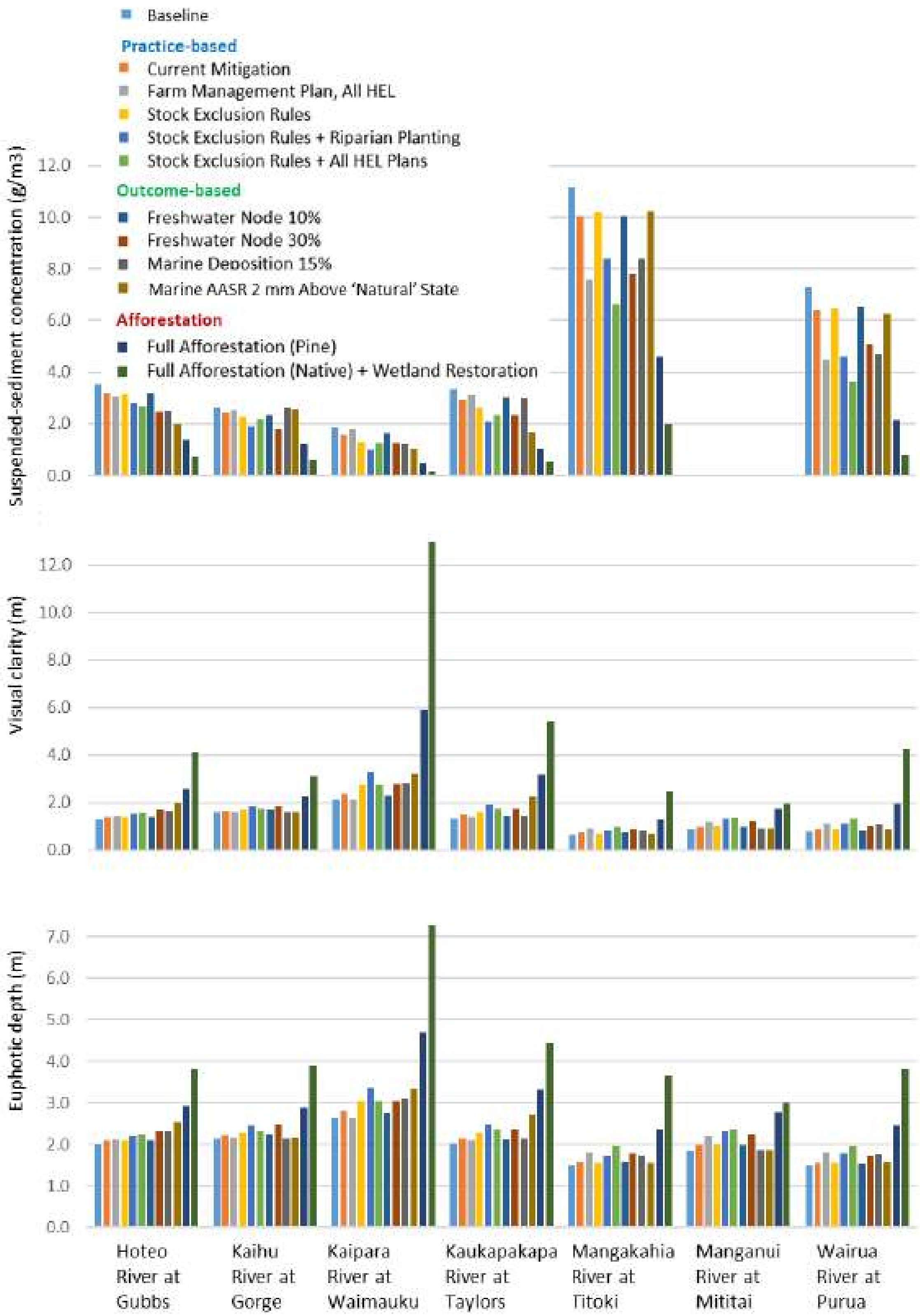
Appendix 2.3 Assumed mitigation costs and effectiveness

	Mitigation Option	Eligible Landuses	Maximum Coverage	Cost Component			Mitigation Effectiveness (% from baseline)	
				Initial capital	Maintenance	Opportunity	Land-based erosion	Bank erosion
1	Farm management plan (e.g. space-planting) for land-based erosion control	Pasture	All farms	Plan: $5000/farm up to 100 ha + $10/ha for each additional ha Implementation: $250/ha	None	None, as plan assumed to identify options where benefits offset production losses	70%	0%
2	Riparian fencing	Pasture	All REC2+ permanently flowing rivers and streams	S&B: $35/m, including materials, construction, and reticulation Dairy: $7.50/m	None	None	0%	50%
3	Constructed wetland	Pasture, arable	1 per 400 ha	$100,000/system, including planting and fencing	$300/system/yr	40% of farm income in occupied area	70%	0%
4	Farm plan + fencing	Pasture	See 1 & 2	Sum of #1 and 2	None	None	70%	50%
5	Farm plan + fencing + wetland	Pasture	See 1–3	Sum of #1, 2 and 3	Sum of #1, 2 and 3	40% of farm income in area occupied by wetland	70%	50%
6	Riparian fencing + planting	Pasture	All REC2+ permanently flowing rivers and streams	Sum of #2 and $4/m2 for planting costs	Periodic	50% of farm income in area occupied by riparian planting	50%	70%
7	Afforestation - harvest	All non-forestland	All farms	$1000/ha	None	100% of lost farm income in planted area, less new income from forestry	80%	80%
8	Afforestation - no harvest	All non-forestland	All farms	$1000/ha	None	100% of lost farm income in planted area	90%	90%

Initial capital and periodic maintenance costs are annualised over 25 years using a discount rate of 8%, which is a typical assumption for this type of analysis. Annual maintenance and opportunity costs are assumed to accrue on a yearly basis and thus are directly subtracted from the base net revenue.

Each mitigation and afforestation option has the potential to have different impacts based on farm size, location and net revenue. For example, a large sheep and beef farm next to a large stream will likely face higher absolute costs for the fencing option than for the farm management plan option because the latter consists of a large initial fixed cost ($5,000 or more) that does not vary by farm size. Conversely, a dairy farm that only needs to fence a short length of stream would likely face higher costs for constructing a wetland as this would involve taking some land out of production and thus incurring an opportunity cost.

Appendix 2.4 Freshwater attributes by reporting node



3. Auckland – Impacts of proposed nutrient guidance in urban and rural catchments

3.1 Introduction

The proposed NPSFM contains new guidance on grading nutrient availability for the Te Mana o te Wai framework, including national bottom-lines for dissolved inorganic nitrogen (DIN; median 1.0 mg/l and 95th percentile 2.05 mg/l) and dissolved reactive phosphorus (DRP; median 0.018 mg/L and 95th percentile 0.054 mg/L).

The Freshwater Management Tool (FWMT) is an advanced freshwater quality and quantity accounting framework, developed by Healthy Waters (Auckland Council) to continuously simulate flow and contaminant concentration throughout 478,000 ha of the Auckland region. The FWMT is calibrated to monitoring data, to enable objective reporting of changes in baseline water quality throughout 3,085 km of streams and rivers, under present-day and various scenarios of future climate, development and catchment management.

Process-based, continuous simulation models are efficient means of determining the impacts of proposed regulation for freshwater contaminants. Applying the proposed DIN and DRP attribute states to the Auckland region for the period 2013-2017 in the FWMT, has highlighted the potential extent, magnitude and conditions responsible for failures of the national bottom-lines in bioavailable nutrients.

3.2 Proposed nutrient attributes and the Freshwater Management Tool (FWMT)

Proposed revisions to the NPS-FM include the prioritisation of waterway health above other values of water quality. Waterway health is proposed to include new attributes for DIN and DRP concentration, required to manage rivers for ecosystem health. Both attributes are tiered into four bands, ranging A to D from lesser to increased degradation of waterway health. Freshwater management units graded D fail a national bottom-line, requiring management to at least C grade if not better, with limited exception.

In addition, the NPS-FM requires every regional council operate and maintain a freshwater quality and quantity accounting system for freshwater management units, to report on attribute states under baseline conditions. When assessing baseline or current state of attributes, regional councils must use the best information available including results from freshwater accounting systems. Using that information, limits on resource use must be identified to achieve improved targets for, or maintenance of, attribute state.

To implement the NPS-FM, Auckland Council is developing the Freshwater Management Tool (FWMT), an integrated accounting framework for contaminant processes resulting from the use and development of land on freshwater and sensitive receiving environments.

The FWMT uses open-source US-EPA modelling software (LSPC, SUSTAIN) to simulate hydrological processes (infiltration, runoff and interflow), instream flow, contaminant processes and concentrations including point (wastewater, stormwater) and non-point sources, for: nutrients (nitrogen, phosphorus), heavy metals (zinc, copper), sediment (total suspended solids) and faecal bacteria (E.coli). In so doing, the FWMT accounts for flow, instream contaminant concentration and downstream contaminant loading for the entire region (478,000 Ha), continuously (15-min timestep) and throughout 3,085 km of moderate streams and rivers (3rd order and greater). The configuration of the FWMT is diverse, with a library of 106 unique land types for which processes can be uniquely configured and 5,465 sub-catchments able to uniquely represent local climatic and land conditions with regionalised parameterisation.

3.3 Method - assessment of Baseline DIN and DRP Attribute State

For this case study, continuous time-series for nitrogen and phosphorus concentrations simulated by the FWMT have been assessed for the period 2013-2017. Simulated Total Oxidised Nitrogen (TON) and Total Ammoniacal Nitrogen (TAM) were summed to represent DIN whilst orthophosphate (PO4) represented DRP. Corresponding instream nutrient grades were conservatively assigned by the poorer scoring of 5-year median or 95th percentile statistics, at 2,761 modelled stream nodes.

All modelled stream nodes failing the national bottom-line for one or both DIN or DRP statistics were then analysed by each of ten watersheds, to estimate the area of upstream sub-catchments contributing nutrients to and potentially, requiring improved nutrient management of land use and network discharges.

All modelled stream nodes failing the national bottom-lines for DIN and DRP were also selected for corresponding median and 95th percentile statistics to be collated into watershed and regional summaries, to identify the degree of improved nutrient management required to at least attain national bottom-lines.

Three important caveats apply to case study results:

1. The FWMT is undergoing development. Whilst configured and calibrated, the FWMT has not yet undergone external peer-review. All output here should be treated as tentative and indicative only, of new DIN and DRP objective guidance for the Auckland region. All assumptions, algorithms, inputs and outputs will be externally reported and available for public scrutiny, adding to the open-source library for the modelling software. Shortly, the FWMT will be supported by a series of peer-reviewed reports documenting baseline (current state) and scenario (future state) inputs, configuration, calibration and outputs.
2. The analysis focusses explicitly on modelled stream segments, making the reporting potentially conservative as much of the stream length and upstream area that is not explicitly modelled are headwaters and small tributaries of potentially lesser or greater nutrient concentration (i.e., differing from third order or greater stream segments). Similarly, only a portion of upstream area may require management action. However, that is offset by the potential for as yet undefined nutrient objectives in Auckland,

requiring better water quality outcomes than simply attaining the national bottom-lines in DIN and DRP attributes.

3. Several sub-catchments lack an explicitly modelled stream segment within the FWMT (i.e., are too small for streams to attain 3rd order). All contaminants are accounted for throughout those and fed to coastal contaminant budgets, but the absence of direct instream simulations prevented their being graded for proposed DIN and DRP attributes. This should not be inferred as indicating instream nutrient concentrations pass the national DIN or DRP attribute bottom-lines (see Figure 5 for numerous urbanised sub-catchments simulated to "drain to sea" via <3rd order streams and unshaded).

3.4 Results

Figure 3.1 summarises the spread in modelled DIN and DRP grading for moderate streams and rivers from 2013 to 2017, regionally and by each of ten Auckland watersheds. Figure 3.2 shows the median and 95th percentile nutrient concentrations at all modelled stream segments whilst Figure 3.3 represents just those failing national bottom-lines (D-graded). Figures 3.4a and 3.4b and 3.5a and 3.5b demonstrate the extent of sub-catchments contributing to latter failing stream segments for two representative watersheds – the Waitemata (largely urban) and Kaipara (largely rural).

Watershed	Length (km) Attaining Attribute State				Percent of Modelled Stream Length Attaining DIN Attribute State
	A	B	C	D	
Hibiscus Coast	112	38	6	1	71% 24%
Islands	156	3	2	0	97%
Kaipara	758	163	92	27	73% 16% 9%
Mahurangi	48	15	4	2	69% 22% 6%
Manukau Harbour	245	65	56	162	46% 12% 11% 31%
North East	118	10	1	0	91% 8%
Tamaki	49	18	29	2	49% 19% 30%
Wairoa	313	43	5	4	86% 12%
Waitemata	76	95	51	50	28% 35% 19% 18%
West Coast	212	41	8	2	81% 15%
Regionwide	**2,087**	**492**	**255**	**251**	68% 16% 8% 8%

Watershed	Length (km) Attaining Attribute State				Percent of Modelled Stream Length Attaining DRP Attribute State
	A	B	C	D	
Hibiscus Coast	5	39	69	43	25% 44% 27%
Islands	22	106	27	6	13% 66% 17%
Kaipara	274	284	220	263	26% 27% 21% 25%
Mahurangi	6	20	27	17	9% 28% 38% 25%
Manukau Harbour	265	69	105	90	50% 13% 20% 17%
North East	33	51	40	6	26% 39% 31%
Tamaki	4	27	26	42	27% 27% 42%
Wairoa	51	118	154	42	14% 32% 42% 12%
Waitemata	11	35	88	137	13% 32% 51%
West Coast	83	80	62	37	32% 31% 24% 14%
Regionwide	**755**	**829**	**817**	**684**	24% 27% 26% 22%

Figure 3.1: Summary of regionwide and watershed FWMT-predicted grading for proposed DIN (top) and DRP attributes (bottom) across Auckland streams and rivers, for the period 2013-2017

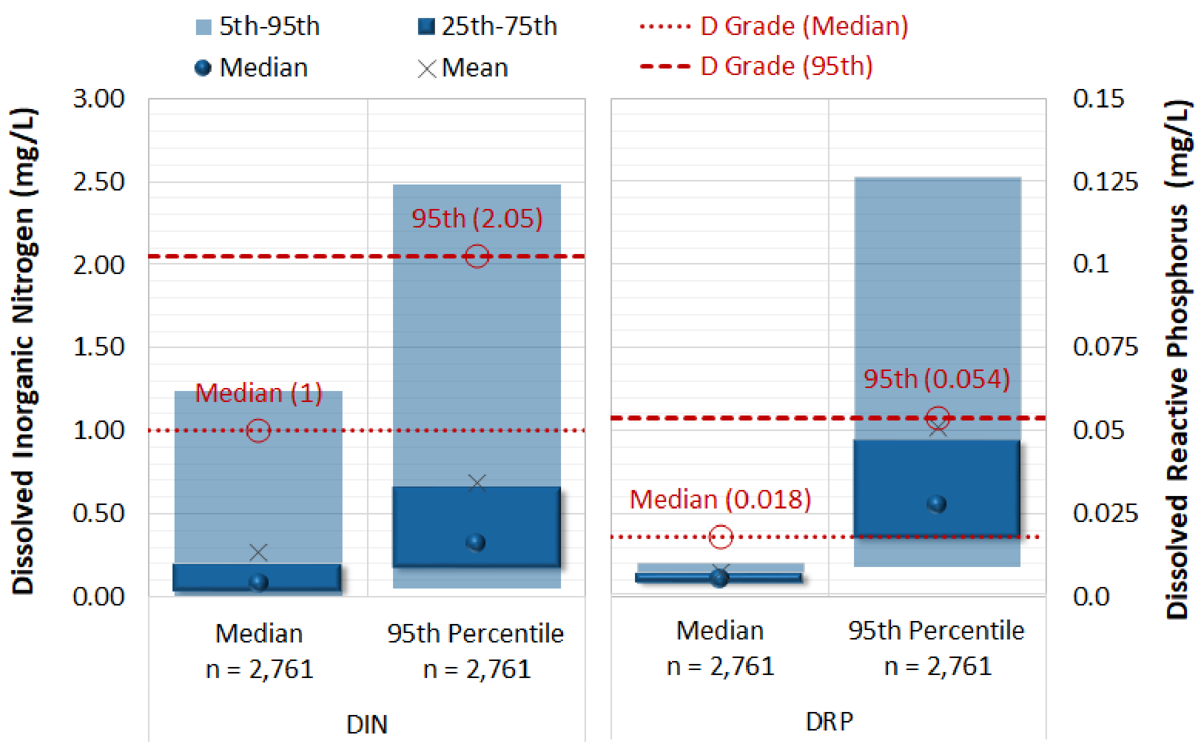


Figure 3.2: Spread in predicted median and 95th percentile concentrations of DIN and DRP for all FWMT nodes (2013-2017)

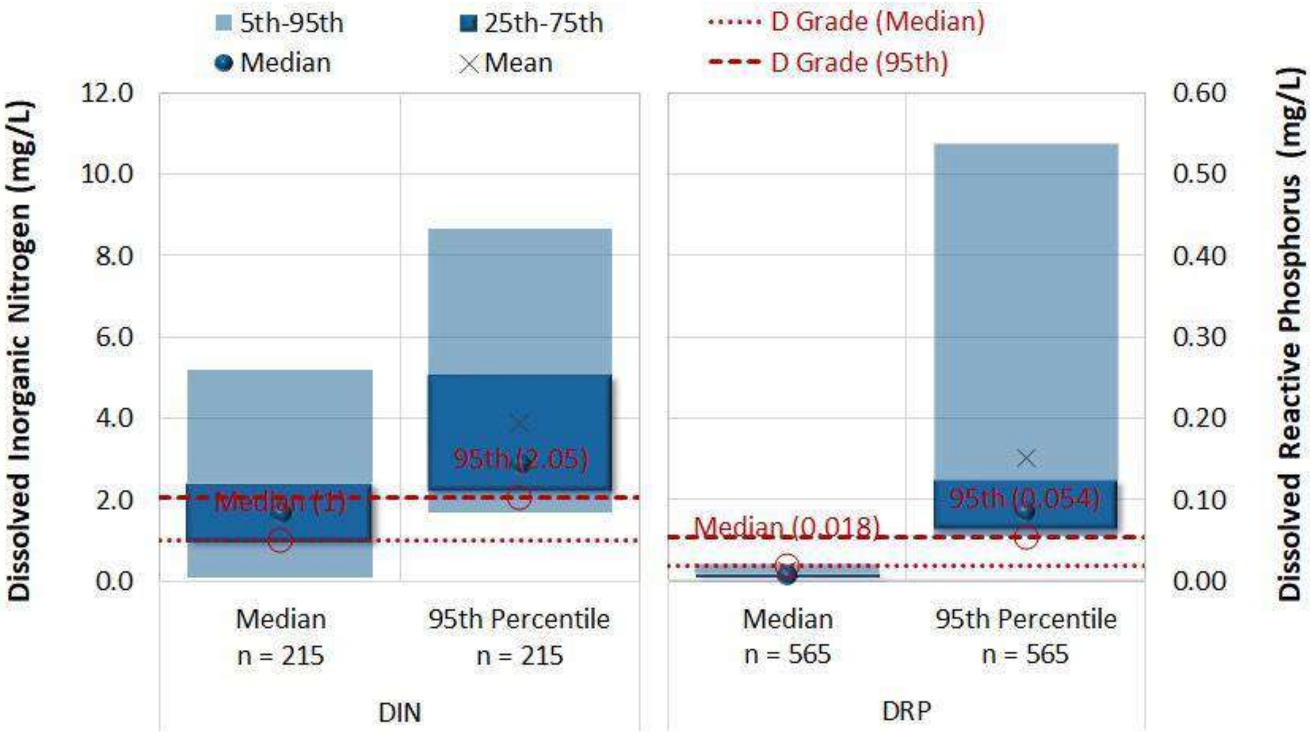


Figure 3.3: Spread in predicted median and 95th percentile concentrations of DIN and DRP for only FWMT nodes failing proposed national bottom-lines for one or both statistics (2013-2017)

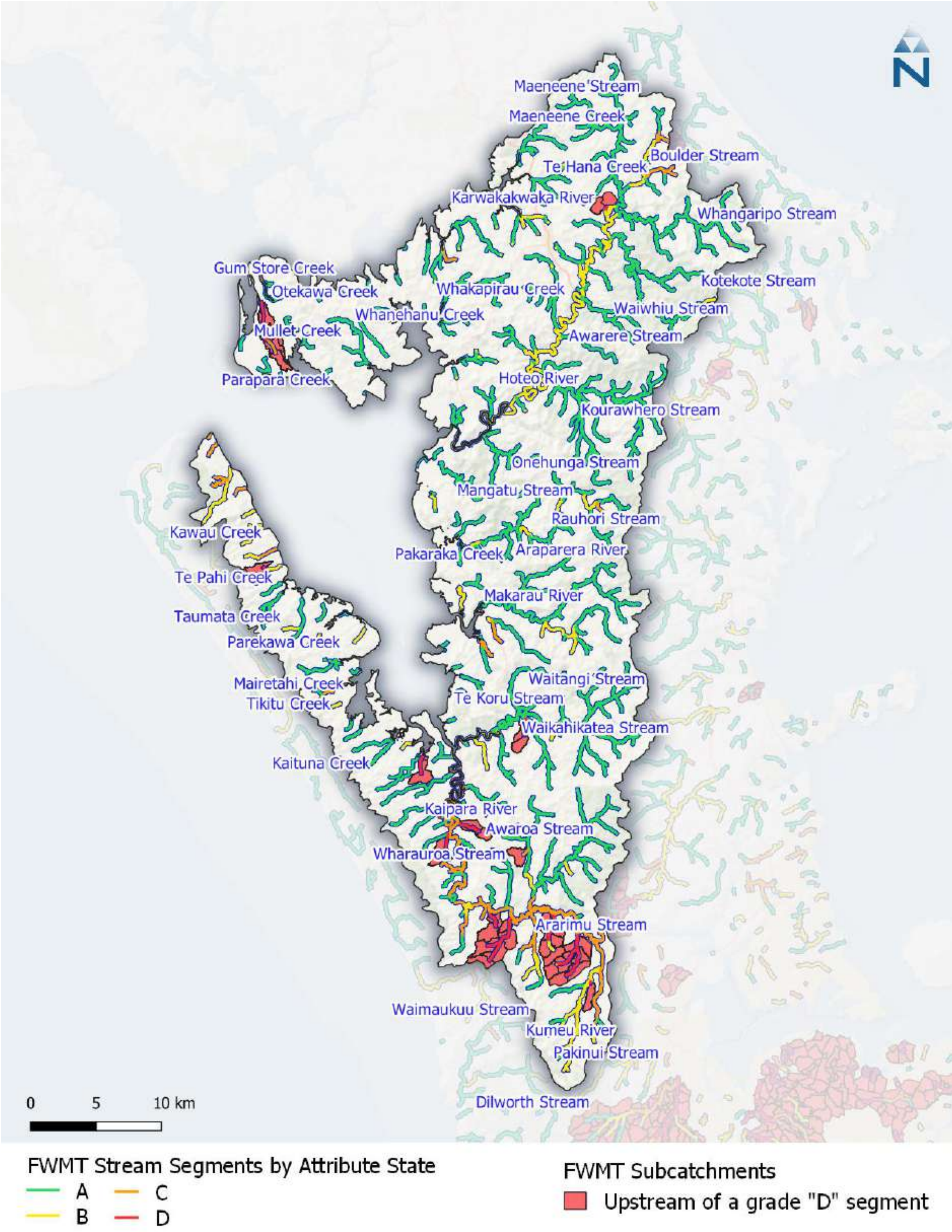


Figure 3.4a: FWMT-predicted DIN grading for stream segments and areas upstream of streams failing national bottom-lines in the Kaipara watershed

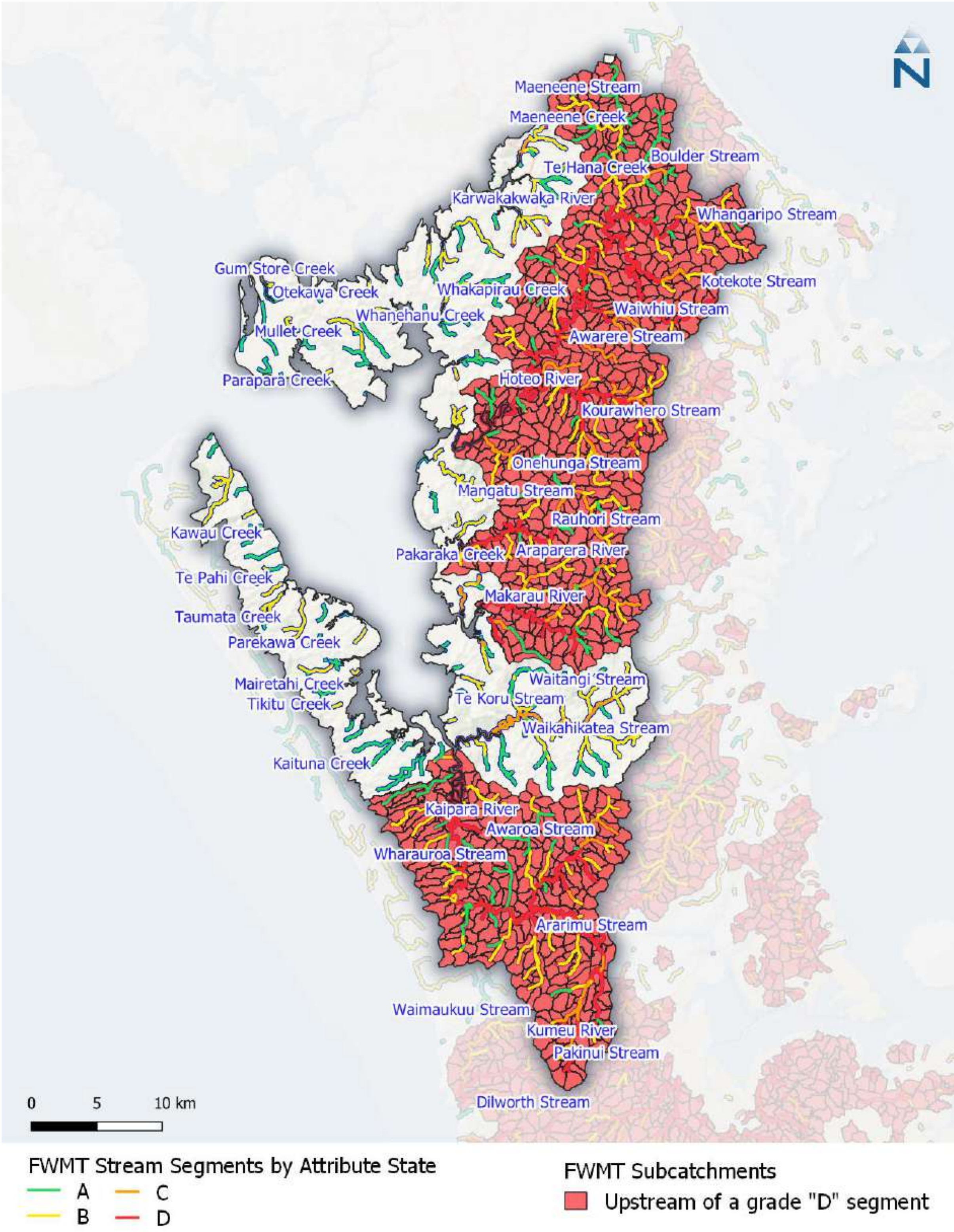


Figure 3.4b: FWMT-predicted DRP grading for stream segments and areas upstream of streams failing national bottom-lines in the Kaipara watershed

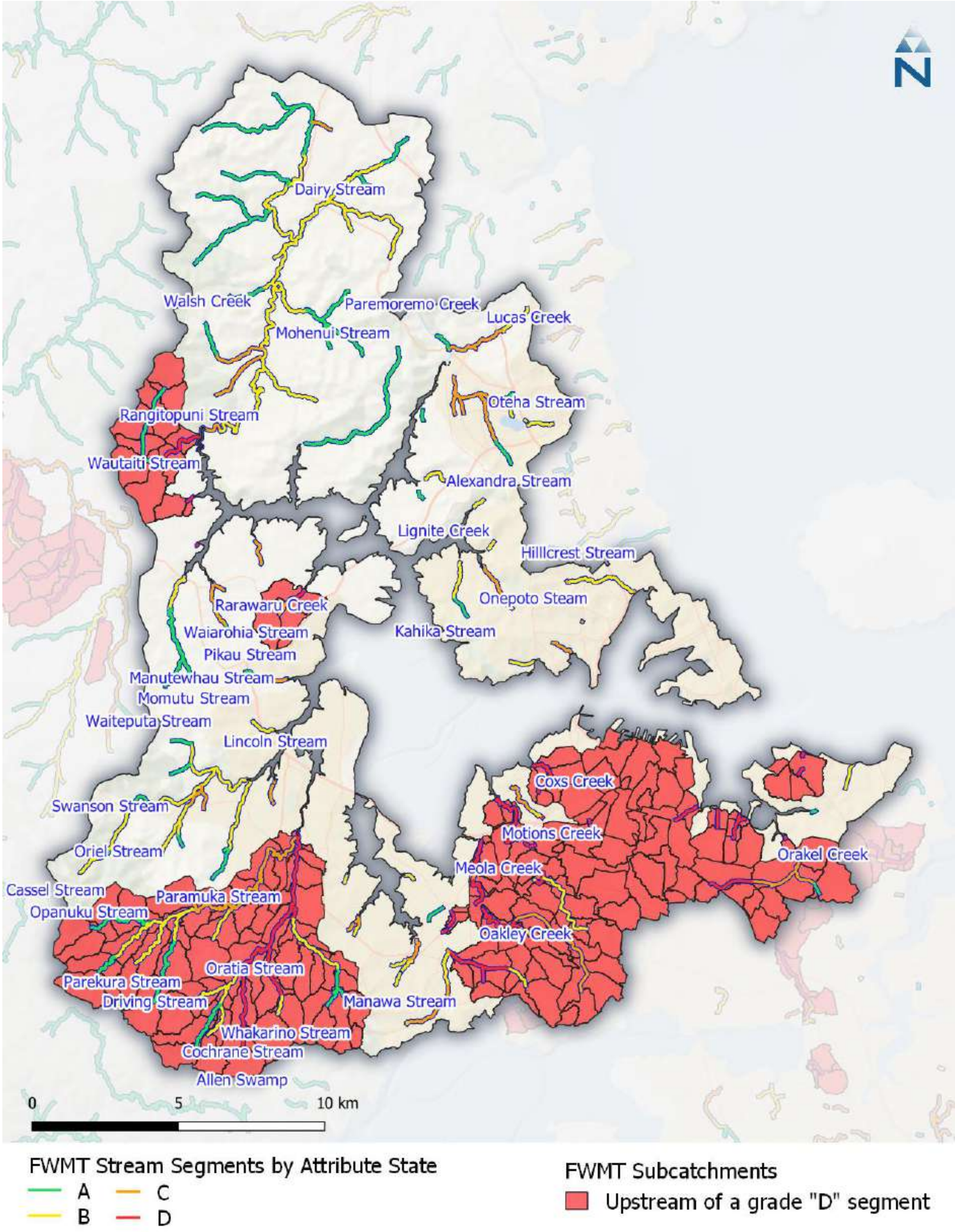


Figure 3.5a: FWMT-predicted DIN grading for stream segments and areas upstream of streams failing national bottom-lines in the Waitemata watershed

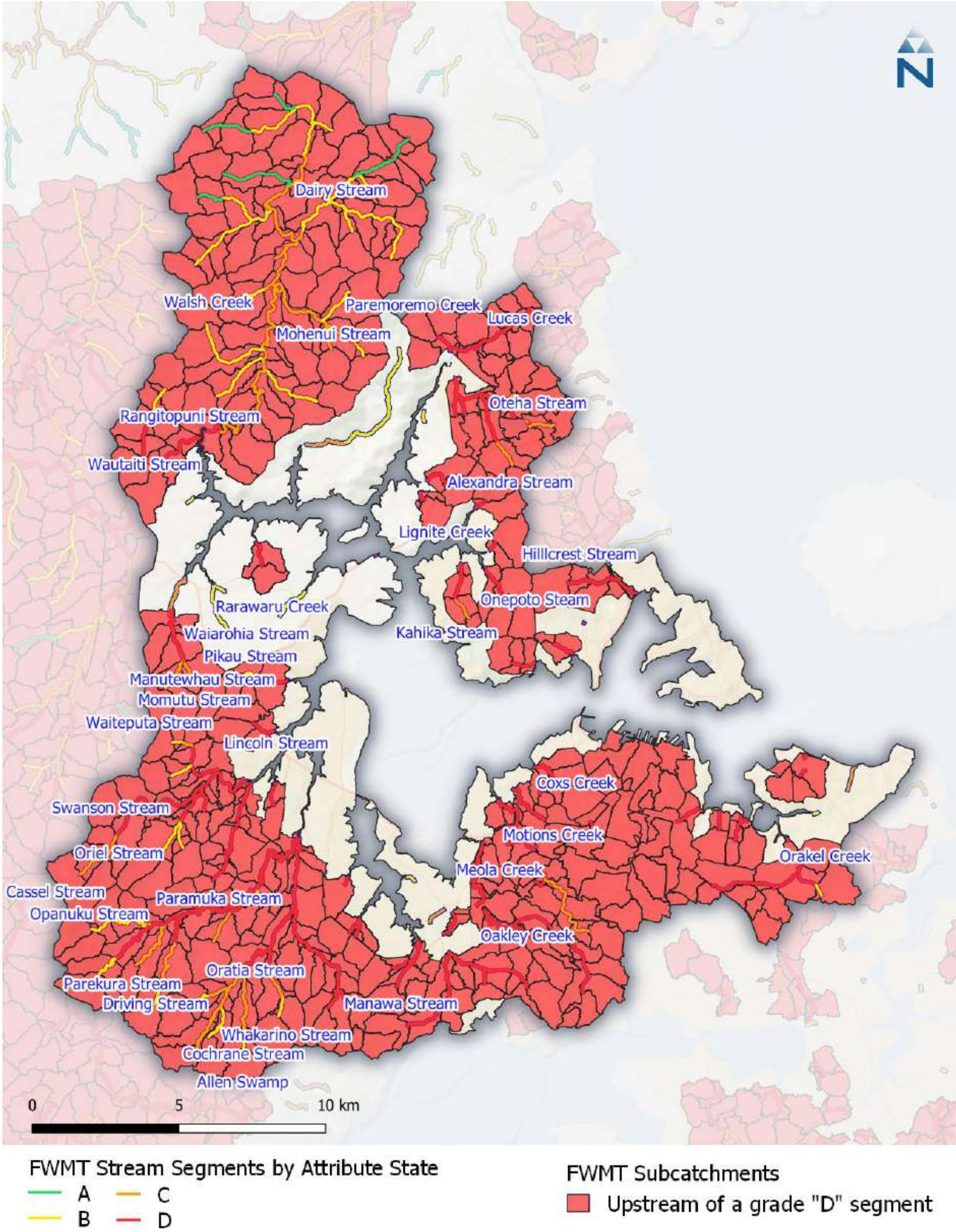


Figure 3.5b: FWMT-predicted DRP grading for stream segments and areas upstream of streams failing national bottom-lines in the Waitemata watershed

The proportion of modelled stream and river segments failing national bottom-lines are presented in Table 3.1. The proportion of major watershed area with modelled stream segments upstream of D-graded nodes is presented in Table 3.2.

Table 3.1: Proportion of FWMT nodes in modelled streams failing proposed national bottom-lines for DRP and DIN attributes (2013-2017)

Watershed	Number of Nodes in Modelled Stream Segments	Number of Nodes with Grade "D"			Percent Nodes with Grade "D"		
		DIN	DRP	Either/Or	DIN	DRP	Either/Or
Hibiscus Coast	167	1	38	38	1%	23%	23%
Islands	161	0	9	9	0%	6%	6%
Kaipara	866	25	168	192	3%	19%	22%
Mahurangi	64	1	13	13	2%	20%	20%
Manukau Harbour	448	125	76	191	28%	17%	43%
North East	133	1	6	7	1%	5%	5%
Tamaki	131	5	58	58	4%	44%	44%
Wairoa	299	4	22	26	1%	7%	9%
Waitemata	272	51	146	151	19%	54%	56%
West Coast	220	2	29	31	1%	13%	14%
Region wide	**2,761**	**215**	**565**	**716**	**8%**	**20%**	**26%**

Table 3.2. Proportion of watershed areas upstream of FWMT nodes failing proposed national bottom-lines for DRP and DIN attributes (2013-2017)

Watershed	Area Upstream of Modeled Stream Segments (ha)	Area Upstream of Nodes with Grade "D" (ha)			Percent Area Upstream of Nodes with Grade "D"		
		DIN	DRP	Either/Or	DIN	DRP	Either/Or
Hibiscus Coast	20,496	175	10,471	10,471	1%	51%	51%
Islands	24,173	0	2,974	2,974	0%	12%	12%
Kaipara	127,157	4,536	82,339	83,465	4%	65%	66%
Mahurangi	8,867	282	5,768	5,768	3%	65%	65%
Manukau Harbour	73,864	30,487	28,286	49,893	41%	38%	68%
North East	18,915	211	4,491	4,702	1%	24%	25%
Tamaki	12,899	478	6,102	6,102	4%	47%	47%
Wairoa	40,441	706	25,737	25,737	2%	64%	64%
Waitemata	34,077	12,737	31,373	31,792	37%	92%	93%
West Coast	34,149	511	10,697	11,208	1%	31%	33%
Region wide	**395,040**	**50,123**	**208,240**	**232,113**	**13%**	**53%**	**59%**

Note that only 395,040 ha drains to a simulated stream segment within the FWMT with an additional 82,960 ha of land simulated for yields but otherwise draining to coast within the model (i.e., unable to have instream concentrations determined but able to be assessed comparatively for yields and including in coastal contaminant budgets).

3.5 Findings

The FWMT is undergoing calibration and all findings produced here are tentative ahead of external peer-review. The FWMT findings are therefore indicative, but revealing that across the Auckland region:

- 68%:16%:8%:8% of modelled streams (by length) were graded A:B:C:D for DIN compared to 24%:27%:26%:22% for DRP (bold highlighting failing reaches for proposed national bottom- lines).
- 26% (800 km) of modelled stream length was graded D for either DRP and/or DIN.
- The greatest proportion of failing streams and rivers by length for DRP was in the Waitemata watershed (51%; 146 of 272 nodes spanning 137 km of stream network) and for DIN in the Manukau watershed (31%; 125 of 448 nodes spanning 162 km of stream network).
- 13% (at least* 50, 123 Ha) and 53% (at least 208,240 Ha) of sub-catchments are upstream of D-graded modelled stream and river segments for DIN and DRP, respectively.
- Manukau Harbour watershed contained the greatest area upstream of modelled failing streams and rivers for DIN (30,487 ha) and Kaipara watershed the greatest area upstream of failing rivers and streams for DRP (82,339 ha).
- Of the 8% (250 km) of modelled reaches failing DIN national bottom-lines, nearly all failed for 95th percentile whilst three quarters failed for median concentration. Half of DIN-failing reaches exceeded national bottom-lines by 1.5 to 4-fold.
- Of the 22% (680 km) of modelled reaches failing DRP national bottom-lines, all failed for 95th percentile with none failing for median concentration. Half of DRP-failing reaches exceeded national bottom-lines for 95th percentile by 1.5 to 10-fold.

*Note that the estimates are limited to sub-catchments with stream segments directly simulated by the FWMT. Approximately 83% of the Auckland region is simulated to drain to a 3rd order or greater stream with 17% configured to drain via smaller streams to the coast, whose instream dynamics have not been simulated.

The extensive areas contributing to and magnitude of failure in proposed national bottom-lines for DIN and DRP, suggests widespread and marked nutrient management actions would be required across both urban and rural areas alike for implementation of the proposed NPS-FM in the Auckland region.

By length, 8% (250 km) of streams and rivers in Auckland are likely to fail proposed national bottom-lines (graded D) for DIN and 22% (680 km) for DRP. Combined, over a quarter of modelled Auckland stream length (26%, 800 km) was graded D for DIN and/or DRP. Those failures indicate the likelihood of cumulative effects with increased concentration (in both median and 95th percentile) associated with greater stream order, highlighting that changes in nutrient management are likely required of extensive rather than localised areas.

For DRP, in 5 of the 10 major watersheds more than 25% of stream length was D-graded (mostly for 95th percentile DRP concentration). Overall, the three watersheds with greatest proportion of failing stream length were: Waitemata (51% failing DRP), Tamaki (42% failing DRP) and Manukau (31% failing DIN). For both DIN and DRP, the 95th percentile metric is more frequently D-graded, the distinction particularly stark for DRP where no modelled streams failed the median attribute band.

Along the 250 km of DIN-failing streams, 95th percentile concentrations were up to* 4 times higher than the national bottom-line (i.e., require up to 75% reduction in 95th percentile DIN concentration). By contrast, along the 680 km of DRP-failing streams, 95th percentile concentrations were up to* 10 times higher than the national bottom-line (i.e., require up to a 90% reduction in 95th percentile DRP concentration).

*Note: up to refers to the 95th percentile of relevant statistic (e.g., 95th percentile of the median or 95th percentile modelled node concentrations) – see Figure 3.

In nearly half of both DIN and DRP-failing stream nodes, the median of 95th percentile nutrient concentration was approximately 1.5 times greater than the proposed national bottom-line. Therefore, half of the 26% of failing modelled streams require a reduction of up to a third in their 95th percentile DIN and DRP concentrations, to meet proposed national guidance (at least, many streams can be expected to have to achieve better than “C” grade and greater net reduction in DIN and/or DRP concentrations).

There is marked variation across the region’s major watersheds in the spread of that necessary reduction to instream peak nutrient concentrations. The proportion of explicitly modelled stream and river nodes failing nutrient national bottom-lines varied across the ten regional watersheds, from 0% to 28% for DIN (Islands to Manukau Harbour, respectively) and 5% to 54% for DRP (North East to Waitemata).

The areas upstream of D-graded stream nodes and potentially required to undergo changes to nutrient management, varied from 1% to 41% amongst major watersheds for DIN (211-30,487 Ha) and 12% to 93% for DRP (2,974-82,339 Ha). In 5 of the 10 regional watersheds, at least half catchment areas were upstream of a failing DRP node.

The high proportion of watershed areas upstream of failing DRP stream nodes indicated that downstream or higher order rivers, are disproportionately graded D, more so than for DIN.

In Auckland therefore, the proposed DIN and DRP attributes are likely to:

- require considerable lengths of streams to undergo marked nutrient reduction (at least 800 km) through potentially extensive changes in land use and practices;
- require changes in nutrient management for both nutrient species but predominantly for DRP concentration, for which streams appear several-times more likely to fail proposed national bottom-lines than for DIN;
- require considerable change not simply to rural land use and practices, but also urban land use and infrastructure given the majority of the Waitemata watershed fails proposed national bottom-lines for either proposed nutrient attributes.

4. Waikato – Nutrient 'bottom-lines' in the Waikato and Waipā catchments

4.1 Introduction

The Waikato and Waipā river catchments cover more than 11,000 km^2, or around 45 percent of the Waikato Region. The Waikato River flows 425 km from Lake Taupo through the territorial authorities of South Waikato, Waipā, Hamilton and Waikato. The Waipā River flows from its headwaters in the Rangitoto Range in the Pureora Forest Park through the Waitomo and Otorohanga Districts for 115 km, joining the Waikato River at Ngaruawahia. The river then makes its way through lowland parts of the northern Waikato region before flowing on to the Tasman Sea at Port Waikato.

On their way to the sea, the rivers traverse a range of geological landscapes, including volcanic pumice, limestone and peat country. Land uses include diary, drystock, forestry and horticulture, as well as the urban centres of Hamilton, Cambridge, Ngaruawahia, Huntly and Otorohanga. There are around 20 large municipal or industrial wastewater treatment plants along the river.

The combined Waikato-Waipā catchment is currently the subject of Waikato Regional Plan Change 1, which, at the time of writing, has been notified and commissioners are deliberating on the submissions they have received. The objective for these catchments is set out in the *Vision and Strategy for the Waikato river*[9], which was directly inserted into the Waikato Regional Policy Statement by Treaty Settlement legislation, and which, in the case of any inconsistency between them, takes precedence over a National Policy Statement.

The Vision and Strategy aims to restore and protect the catchments so that they enable safe swimming, mahinga kai activities, and healthy ecosystems. Plan Change 1 is seen as the first step in this process, focusing on nutrients, sediment and bacterial contaminants, and aiming to get 10 percent of the way to the final 80-year objective in 10 years. Plan Change 1 defines three levels of priority for sub-catchments with actions staged accordingly. By July 2026, it is expected that Farm Environment Plans will be completed across all three priority levels, stock exclusion requirements will be in place, and those land users in the top quarter of dischargers will have reduced their estimated nitrogen leaching to the 75th percentile. The figure below shows the catchment, along with the prioritised sub-catchments.

[9] https://waikatoriver.org.nz/wp-content/uploads/2019/03/Vision-and-Strategy-Reprint-2019web.pdf

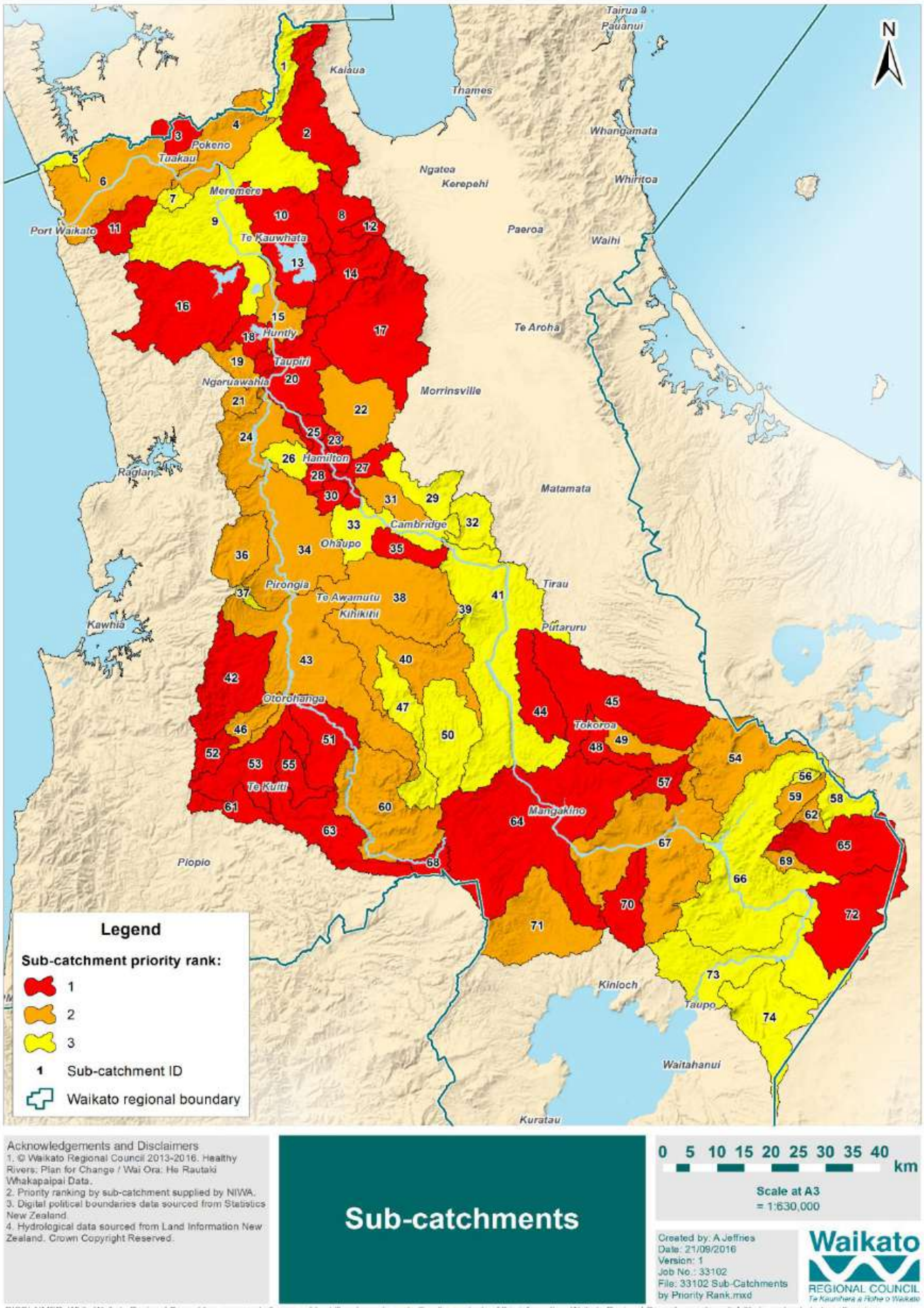


Figure 4.1: Waikato and Waipā river sub-catchments

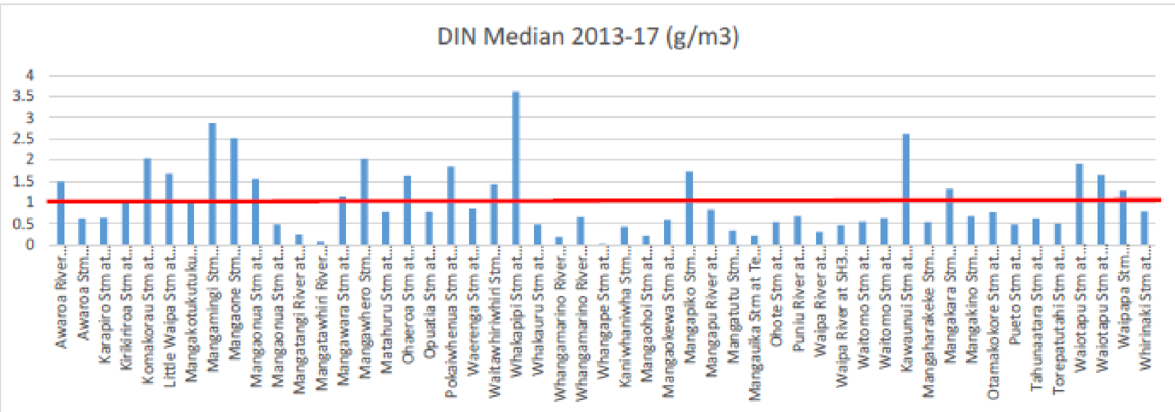
4.2 Analysis

This case study focuses on the proposed national bottom-lines for dissolved inorganic nitrogen (DIN) and dissolved reactive phosphorus (DRP) (see page 34-35 of the Draft National Policy Statement for Freshwater Management (NPS-FM)). These proposed national bottom-lines are significantly more stringent than those in the current NPS-FM. However, it is noted that, for catchments susceptible to periphyton growth, or with sensitive downstream receiving environments, nutrients would already have to be managed to levels much closer to the proposed, rather than the existing, national bottom-lines. In areas where these requirements relating to periphyton and downstream environments do *not* prevail (largely in soft-bottomed waterways) the proposed DIN and DRP bottom-lines represent a considerable increase in the efforts that will be needed to meet them. A large proportion of the Waikato region, including the Waikato-Waipā and Hauraki catchments, are characterised by such soft-bottomed streams, and can be expected to face significant additional constraints on activities involving nutrient discharges.

Waikato Regional Council maintains and extensive network of water quality monitoring sites. Data reports including five-year median values are produced annually. The most recent of these reports (Tulagi 2018) was used to describe the levels of exceedance of the proposed national bottom-lines based on five year medians (2013-2017).

Across the whole region, 27 percent of sites would breach the proposed DIN national bottom-line, and 47 percent would breach the proposed DRP national bottom-lines. Within the Waikato-Waipā catchment 39% of sites exceed the DIN bottom-line and 61% exceed the DRP bottom-line (Figure 4.2). Of the twelve sites monitored in rivers on the Hauraki plains, 42% and 75% exceed the DIN and DRP bottom-lines, respectively.

The average reduction required for those sites in breach of the DIN bottom-line in the Waikato-Waipā is 39 percent, while the average reduction required for those sites in breach of the DRP bottom-line is 53 percent. In Hauraki rivers, these reductions average a similar 36 and 57%.



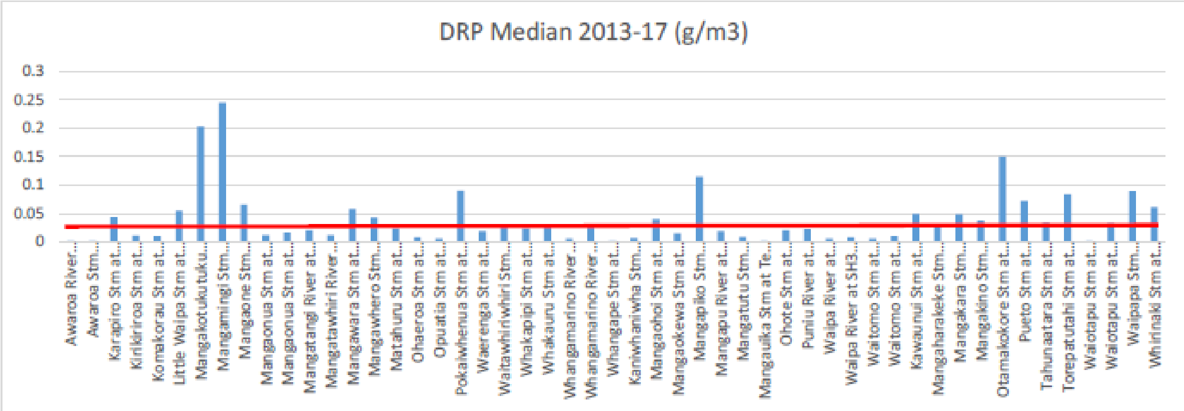


Figure 4.2: Five-year Median (2013-2017) DIN and DRP values for long-term monitoring sites within the Waikato-Waipā catchment

Note that DIN is the sum of reported site medians for Nitrate/Nitrate-N and Ammoniacal-N. Red line is proposed national bottom-line.

As an initial test of the implications of the nutrient bottom-lines in a catchment where they might be expected to have a significant effect, a land use allocation model (developed for the Waikato Regional Council's Healthy Rivers/Wai Ora project) was used[10]. The model was used to estimate the least-cost way of achieving the nutrient bottom-lines. Each sub-catchment in the Waikato-Waipā was constrained so that if current monitoring data indicated they exceeded the limits, mitigations would have to be put in place to reduce discharges; if they did not exceed the limits, they were constrained to have no degradation from current levels. There are expected to be exemptions for streams with high levels of naturally occurring nutrients levels (such as with phosphorus levels in some of the pumice country of the upper Waikato). However this was not taken into account in the modelling, which may result in some over-estimation of the costs of meeting the bottom-lines.

The modelling scenario used the same baseline as the work for Healthy Rivers/Wai Ora. That is, none of the costs of the Plan Change 1 policy package is assumed to be part of the baseline. Given that the costs of the proposed nutrient bottom-lines *per se* should only include the difference between Plan Change 1 and the new proposals, it can be argued that the estimates below overstate the costs of the new proposals. However, it is considered that the estimates here are useful for two reasons. First, Plan Change 1 costs, for the most part, have not yet been incurred by land users and hence, the costs estimated here represent the actual financial effects that can be expected to be felt. Second, it provides a hypothetical example of how these proposals might affect a catchment where the current NPS-FM has not been implemented *and* where the nutrient bottom-lines are likely to have a large impact (that is, in catchments characterised by soft-bottomed streams and without sensitive downstream receiving environments).

The results of this modelling were then used as an input to further analysis using the Waikato Regional Council's Economic Futures Model (WEFM). The WEFM is an input-output model that, amongst other things, estimates how land use change may be expected to affect the wider regional economy.

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[10] See these technical reports for background and further information about this model: Doole (2016); and Doole *et al* (2015).

4.3 Main findings

Initial model runs (with fixed land use) did not find a feasible solution. There may be various reasons for this result – one is that it is simply not possible, given the mitigations specified in the model. A subsequent run of the model, this time allowing for land use change, produced a result suggesting that achieving the nutrient bottom-lines could reduce overall land use profits by around 11 percent (or around $100 million) per year[11], and that widespread afforestation could be an important component of a cost-effective approach to meeting the nutrient constraints. These costs are not evenly distributed; some sub-catchments or farms will be more impacted than others. The model found that, for the most part, afforestation of drystock farms would be significant in a cost-effective solution (since the opportunity cost would be lower than for converting dairy land to forestry). It also suggested that a considerable amount of 'edge-of-field' mitigations (such as bunds, sediment traps, and wetlands) would be required.

Of course, the model simply shows an estimate of the lowest-cost way of satisfying the nutrient constraints. It should not be interpreted as saying that such land use change would actually happen. It is not clear how such an approach (with widespread drystock to forestry conversions) could be practically implemented, nor is it certain whether decision-makers would choose to take this path. Practicality and equity are also important policy criteria to consider – not just financial cost.

Notwithstanding that land use change may not happen in the way predicted by the model, these results were used in the WEFM to provide a hypothetical indication of what such changes might imply for the wider economy. The results of this second phase of modelling suggest that, as well as pastoral farming, there would be substantial impacts on dairy and meat manufacturing, agricultural support services and the finance sector. In total, assuming that land use change took place over the next 10 years, the model estimated that, by 2031, regional value added[12] could be around 0.9% lower than it would otherwise be.

Noting that this region-wide effect is estimated based on changes occurring across a catchment making up 45 percent of the region's total area, and that other parts of the region will also be significantly affected, the total effect on the regional economy could be expected to be higher.

If we assume that much, or all, of the afforestation takes the form of production forestry, then ultimately, once the trees are established and harvesting, processing and associated services begin, the net effect on regional value added may actually be positive. There would also be benefits from reducing net carbon emissions, and helping New Zealand achieve 2030 and 2050 emissions targets[13]. However, the local economies, communities and development patterns could be expected to look very different, with forest-based industries essentially replacing farming in some places.

[11] Note that this does *not* mean that these costs would be incurred straight away. They are an estimate of the difference between land use profitability now, and land use profitability once the limits have been achieved – which may be many years away.

[12] A similar measure to regional gross domestic product.

[13] https://www.mfe.govt.nz/climate-change/climate-change-and-government/emissions-reduction-targets/about-our-emissions

Limitations

All models are simplifications of reality, and have limitations. The land allocation model may not reflect the true variation of mitigation costs on individual farms, or the true effectiveness of those mitigations. The model is highly complex, and characterises multiple non-linear systems. This means that care is required in interpreting results, and further analysis should be done. For instance, further work is required to understand how the various systems in the model are interacting, and whether the model is finding a global optimum solution (rather than local maxima). Cost is measured in terms of the change in total profitability from land use. It does not consider farm balance sheets, and how the level and distribution of farm debt will have a bearing on responses to policy.

The WEFM assumes fixed prices, and does not allow for substitution of technologies or inputs, which can lead to economic effects being over-estimated. For example, the effects on the agricultural services and finance sectors is based on fixed relationships with other sectors. A policy change such as this could be expected to affect those relationships – for example, by increasing the demand for consultants providing services driven by the need for farm environment plans, or the finance industry may face demands to finance new mitigations.

In focusing on nutrient bottom-lines, this case study does not consider the implications of the rest of the Essential Freshwater package, nor any interactions between the various policies, including climate change policy.

4.4 Benefits

The modelling described in this case study so far is entirely focused on the costs of achieving the proposed national bottom-lines for nutrients. However, to properly understand the implications of the policies in respect of effectiveness and economic efficiency, it is important to consider the benefits against which these costs should be weighed[14]. No new work has been undertaken in respect of the benefits of achieving the proposed nutrient bottom-lines in the Waikato-Waipā catchment, but several existing studies provide useful context. Phillips (2014) undertook a study involving both revealed preference and stated preference approaches[15], as well as a joint model of both datasets.

The study estimated the marginal benefits for two hypothetical scenarios. The first scenario was based on a 30 percent reduction in median nitrogen and phosphorus across the entire catchment, and given the assumed improvement in ecosystem health, the non-market benefits ranging between \$18.9 and \$28.3 million per year[16]. Scenario 2 estimated the benefits of preventing the decline in water quality between Taupo and Karapiro as being in a range from \$32.1 to \$42 million[17]. As part of the Healthy Rivers/Wai Ora project that developed Waikato Regional Plan Change 1, the question of benefits was

[14] In this section, we discuss benefits of improving water quality, which are relevant to the criterion of economic efficiency. The effectiveness of the policies comprising the Essential Freshwater Package is not addressed.

[15] Based respectively on survey data of actual travel costs for recreational and cultural uses, and a choice modelling exercise.

[16] See Phillips (2014), p48, table 24.

[17] See Phillips (2014), p51, table 27.

addressed in through an 'integrated assessment' analysis[18]. The summary report shows a range of scenarios, from 'no further degradation' through to 'achieving water quality for swimming, taking food and healthy biodiversity', along with some 'stepping stones' in between.

A range of maatauranga maaori, social, environmental and economic indicators are considered in terms of their expected trends under different scenarios. The indicators are shown as improving or deteriorating, allowing for *short-term* trade-offs to be visualised. The figure below, for example, shows how, for a scenario in which the restoration and protection of the Waikato and Waipā rivers (in line with the Vision and Strategy) would be expected to have substantial costs in some areas (the orange dots), and substantial benefits for others (the green dots).

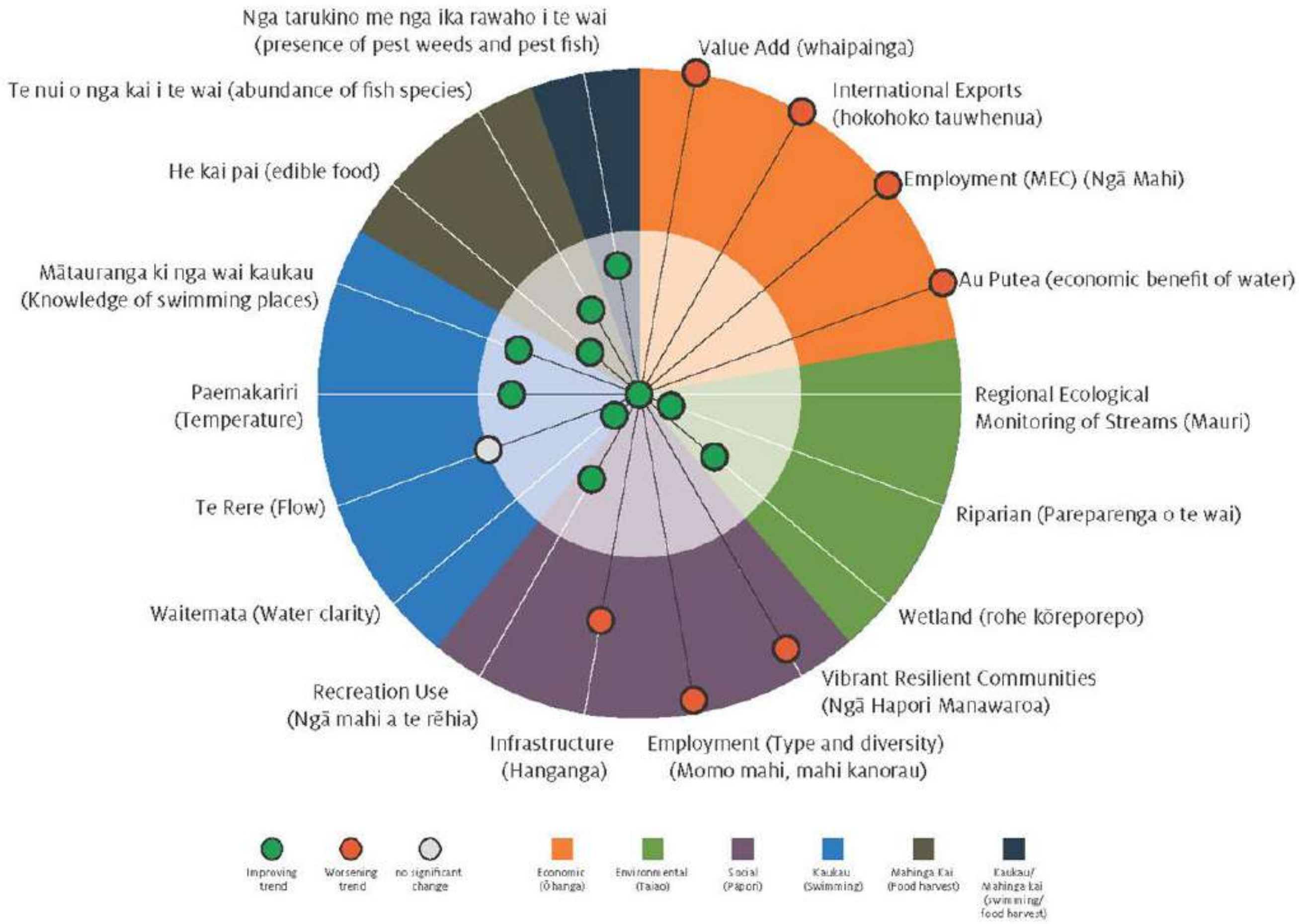

Figure 4.3: Integrated assessment for Healthy Rivers/Wai Ora Scenario: Achieving water quality for swimming, taking food and healthy biodiversity

Note the benefits described in this section were developed for different purposes, and should not be compared with estimated costs of the Essential Freshwater Package. They are included here in order to illustrate some approaches to considering the benefits alongside the estimates of costs.

[18] Summarised here: http://www.waikatoregion.govt.nz/assets/WRC/Council/Policy-and-Plans/HR/Integrated-assessment-baseline-and-scenarios.pdf. Also, see Wedderburn and Coffin (2016a) and Wedderburn and Coffin (2016b)

4.5 References

Doole, G. (2016) Model structure for the economic model utilised within the Healthy Rivers Wai Ora process. Waikato Regional Council Technical Report 2018/52. (http://www.waikatoregion.govt.nz/assets/WRC/Services/publications/technical-reports/HRWO-trs/TR201852.pdf)

Doole, G., Elliott, S., and McDonald, G. (2015) General principles underlying the development of the Healthy Rivers Wai Ora (HRWO) economic model. Waikato Regional Council Technical Report 2018/50. (http://www.waikatoregion.govt.nz/assets/WRC/Services/publications/technical-reports/HRWO-trs/TR201850.pdf)

Phillips, Y. (2014) Non-market values for fresh water in the Waikato region: a combined revealed and stated preference approach. Waikato Regional Council Technical Report 2004/17. (http://www.waikatoregion.govt.nz/services/publications/technical-reports/tr/tr201417)

Tulagi, A. (2018). Regional rivers water quality monitoring programme: Data report 2017. Waikato Regional Council Technical Report 2018/25. (http://www.waikatoregion.govt.nz/services/publications/technical-reports/2018-technical-reports/tr201825/)

Wedderburn, L., and Coffin, A. (2016a) Integrated assessment one: Assessment of scenarios from modelling round one. Waikato Regional Council Technical Report 2018/40. (http://www.waikatoregion.govt.nz/assets/WRC/Services/publications/technical-reports/HRWO-trs/TR201840.pdf)

Wedderburn, L., and Coffin, A. (2016b) Integrated assessment two: Achieving water quality for swimming, taking food and healthy biodiversity. Assessment of scenario 1 steps 10%, 25% and 50% from case 1 of modelling round two. Waikato Regional Council Technical Report 2018/41. (http://www.waikatoregion.govt.nz/assets/WRC/Services/publications/technical-reports/HRWO-trs/TR201841.pdf)

5. Bay of Plenty – Economic impact assessment of selected *Essential Freshwater* proposals

5.1 Purpose

The purpose of this case study is to provide a preliminary high level assessment of the economic impacts of five of the proposals set out in the *Essential Freshwater* package[19] (as of 5 September 2019) for the Bay of Plenty region. These five proposals potentially have the greatest impact on the Bay of Plenty region, and are sufficiently developed to enable a reasonable assessment of implications. Some general commentary about a couple of the other proposals is also provided in Appendix 5.1.

The focus of this assessment is on the costs to the agricultural sector. A separate work stream focused on implementation of the proposals is considering the costs and resourcing implications for the Bay of Plenty Regional Council (BOPRC), and therefore ratepayers, in more detail.

The aim of this assessment is to inform the Regional Sector's response to, and BOPRC's submission on, the proposals. It is expected that this assessment will also contribute to the national understanding of the proposals' impacts, and help to inform final decisions.

5.2 Scope

The proposals considered in this case study are:

National Policy Statement for Freshwater Management (NPS-FM):

A. Dissolved Inorganic Nitrogen (DIN) and Dissolved Reactive Phosphorus (DRP) attributes

National Environmental Standards for Freshwater (NES-FW):

B. Restrictions on further intensification of rural land use
C. Farm planning
D. Management of nitrogen in high nitrate-nitrogen catchments (specifically for Upper Rangitāiki)

S. 360 Regulations:

E. Stock exclusion requirements

[19] The package includes the *Action for healthy waterways* discussion document, draft National Policy Statement for Freshwater Management, proposed National Environmental Standards for Freshwater, and draft regulations under s. 360 of the Resource Management Act 1991 for stock exclusion.

5.3 Regional context

BOPRC has established nine Water Management Areas (WMAs) across the region (Figure 5.1). The current two-stage approach to implementing the NPS-FM 2014 (amended 2017) is through an initial region-wide Water Quantity Plan Change (PC9, stage one), currently in mediation prior to Environment Court hearings, followed by WMA-specific Plan Changes covering both quality and quantity (stage two). The first of these WMA-specific Plan Change processes (PC12) has been progressing since 2016, and covers the Kaituna-Pongakawa-Waitahanui and Rangitāiki WMAs. PC12 is currently in a pre-draft phase, with management options being defined. It is highly likely that the current approach will need to be reviewed in light of the proposed changes to the NPS-FM.

A process to improve water quality in the Rotorua Lakes pre-dates the NPS-FM and has resulted in a range of measures. These include rules for managing nitrogen in the Lake Rotorua catchment (PC10), restrictions on intensification in the catchments of several other lakes and an extensive non-statutory land management programme. Under the current approach, these initiatives will eventually be integrated into NPS-FM implementation in the Rotorua Lakes WMA. BOPRC has had a non-statutory land management programme for a long time, which more recently has been targeted to prioritise interventions in 11 catchments with water quality issues. This programme involves funding assistance, advice and support for landowners to improve land management practices, reduce contaminant losses and protect local waterways.

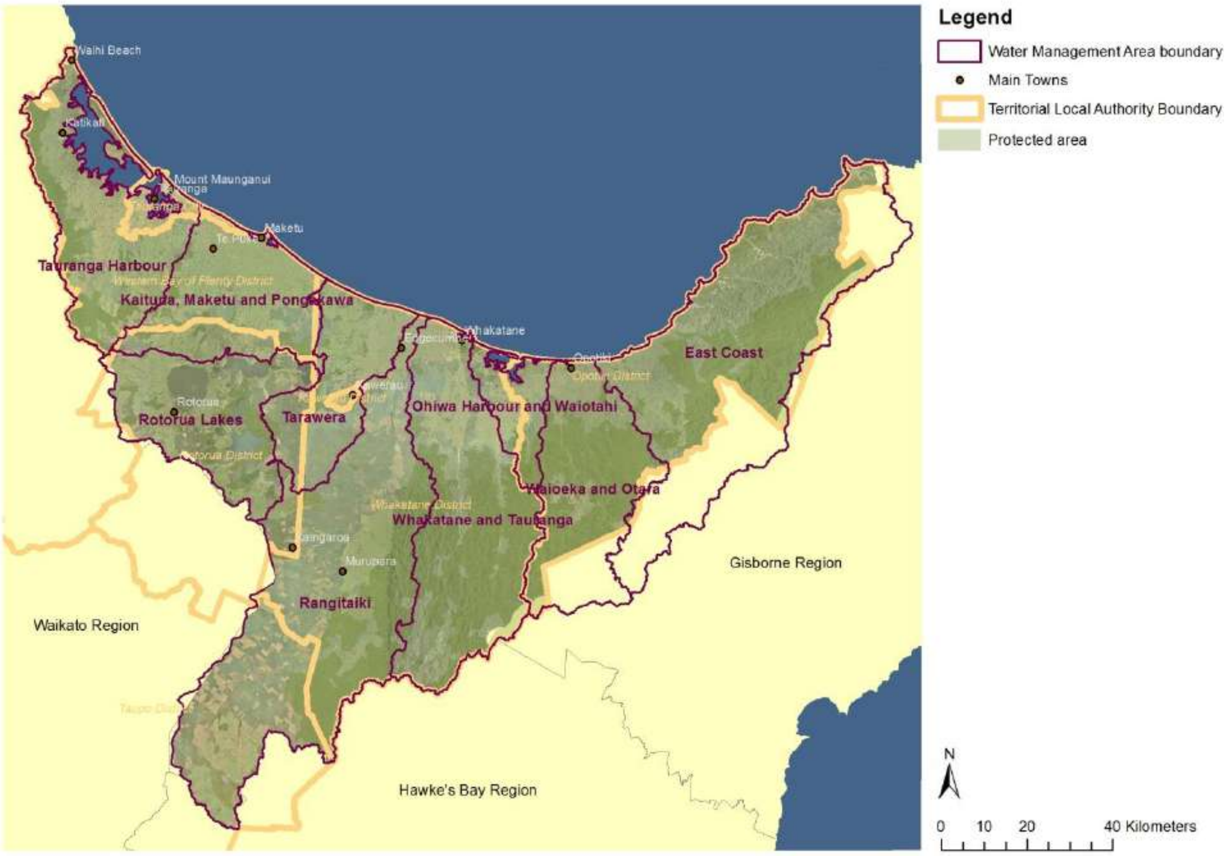

Figure 5.1 - Bay of Plenty: Water Management Areas

Water quality

Water quality in the Bay of Plenty is generally good, relative to other regions, due largely to the significant extent of native and exotic forestry, which make up 69% of the region's land area.

Carter et al. (2018) describe in detail the results of water quality assessments across the region. In summary, no river and stream monitoring sites breach the current NPS-FM or regionally-recommended (Carter, Suren, & Scholes, 2017) bottom-lines for ecosystem health attributes (nitrate and ammonia toxicity, dissolved oxygen, periphyton, benthic cyanobacteria, invertebrate communities). However, while nutrient toxicity thresholds are not breached, elevated nutrient levels around the region contribute to degradation in sensitive receiving environments.

Thirty-one out of 42 monitored freshwater swimming sites across the region (or 74%) are considered to be suitable for swimming under the current *E. coli* attribute table, while 11 sites (or 26%) are considered not suitable for swimming (Dare, 2019 in prep). This assessment would be quite different under the proposed *E. coli* attribute table for swimming sites during the bathing season in the proposed new NPS-FM; a lot more sites would fail the proposed national bottom-line (Appendix 5.1).

Lakes, as receiving environments, are sentinels of change, reflecting integrated signals of climatic and catchment processes. In the Rotorua Lakes, water quality and trends vary by attribute and site, with several lake sites failing current NPS-FM or regionally-recommended bottom-lines. Five of the twelve Rotorua Lakes do not currently meet their Trophic Level Index (TLI) targets set in the operative Regional Natural Resources Plan. TLI scores will vary from year to year reflecting natural processes (e.g. climate) and the on-going management of anthropogenic impacts.

Like lakes, harbours and estuaries in the region (e.g. Tauranga, Ōhiwa, Maketū, Waihī and Waiōtahe) are also particularly sensitive receiving environments, and in some cases are severely degraded. These receiving environments are expected to be the main drivers of land and freshwater management in their respective WMAs in the future, regardless of the proposed changes.

Land use and the agriculture sector

The Bay of Plenty region covers an area of 1.2 million hectares. Nearly half of this area is in native bush and scrub (mostly within protected areas), and nearly one-quarter is in exotic forestry (Figure 5.2). The next most common land uses are dairy, drystock and horticulture. As described in section 3.C, there is currently a strong trend of conversion from pasture and arable to horticulture (kiwifruit and avocado in particular).

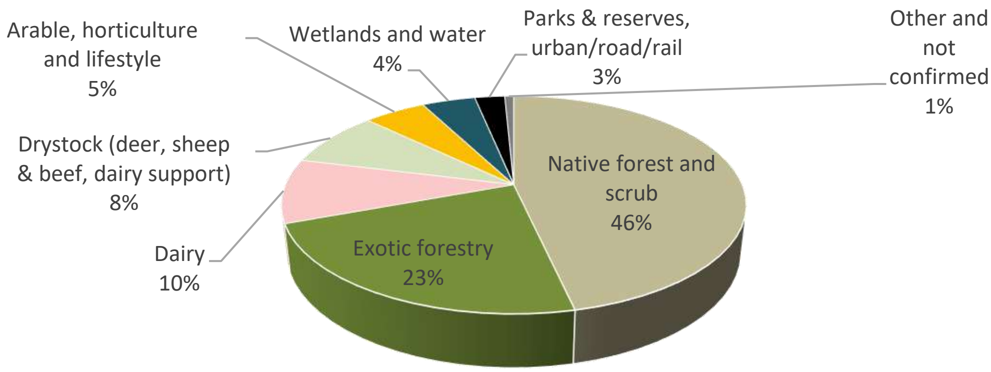

Figure 5.2 – Current land use in the Bay of Plenty

About a third of the region's land is Māori-owned[20], under a range of tenure forms. The majority of Māori-owned land is in exotic or native forest. Appendix 5.3 contains more information about Māori land in the Bay of Plenty, and the impacts of the proposals on that land.

Small farms are a feature of the Bay of Plenty; most of these are dedicated to horticulture (mainly kiwifruit and avocado). This is significant because the farming regulations of the proposed NES-FW apply only to pastoral and arable properties over 20 ha, and horticultural farms over 5 ha (clause 26). Figure 5.3 shows the number of farms by farm type and Figure 5.4 shows the number of farms by total size, as reported in the 2017 Agricultural Production Census (APC) (StatsNZ, 2018)[21].

A breakdown of the number of farms by size and farm type is only available for the Tauranga Moana, Kaituna-Pongakawa-Waitahanui, Rangitāiki and Rotorua Lakes WMAs (Figure 5.5). These four WMAs cover 80% of all Bay of Plenty farming businesses that responded to the 2017 APC, and 48% of the region's land area. Across these four WMAs, 48% of horticultural farms, 38% of pastoral farms and 69% of arable farms would be exempt from the farming proposals of the NES-FW based on total size thresholds. In terms of area across the region, an estimated 20% of land in horticulture, 10% of land in pasture and 50% of land in arable land uses would be below their respective thresholds. This would limit the impact and effectiveness of the proposed NES-FW in the Bay of Plenty.

[20] Māori-owned land is defined in this case as land included in the Māori Land Online database as at December 2015, with various corrections and amendments from other sources, including some land returned under Treaty Settlements. Māori land included here should be considered indicative only as not all Māori land in the Bay of Plenty is necessarily identified as such.

[21] The APC is sent to all GST-registered farming businesses and completion is compulsory. However, registration for GST is not compulsory for businesses with a turnover of less than $40,000 per year, but those businesses can choose to register voluntarily. There is therefore a partial and unquantifiable coverage of farming businesses below this turnover level.
For the purpose of the APC, a farm is defined as *one or more blocks of land, managed as a single operation, which is engaged in agricultural activity. This includes farming of livestock, horticulture, viticulture, nurseries, forestry, growing grain and seed crops, and land that could be used for these purposes.*
The proportion of eligible businesses that responded to the 2017 APC was 85.5 percent nationally. These businesses represented 88.3 percent of the total estimated value of agricultural operations. Values are imputed for farmers who do not return a completed questionnaire. Imputation involves replacing missing items with values based on other information available.

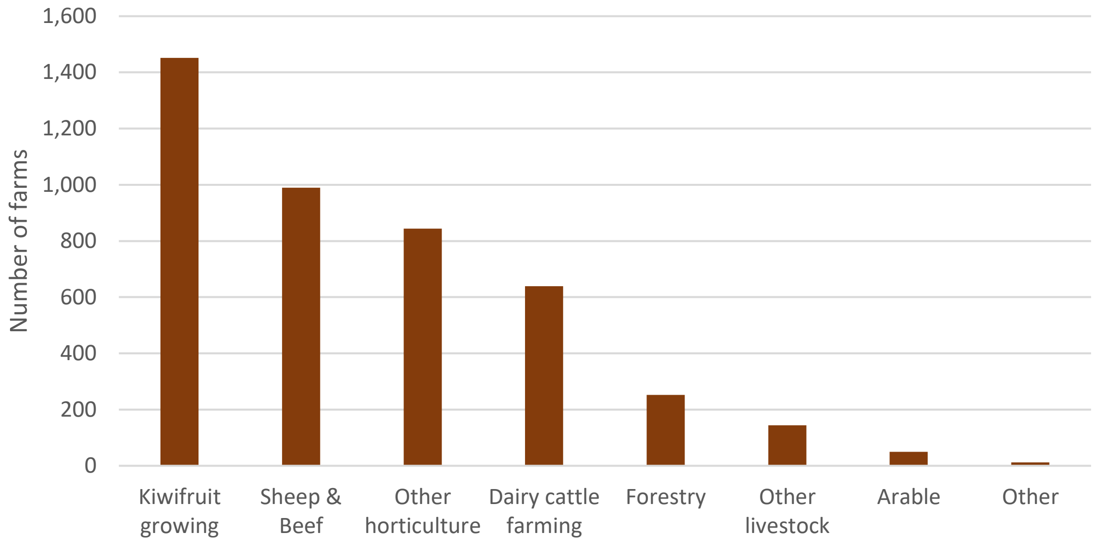

Figure 5.3 - Number of farms by farm type in the Bay of Plenty (Source: APC 2017, StatsNZ)

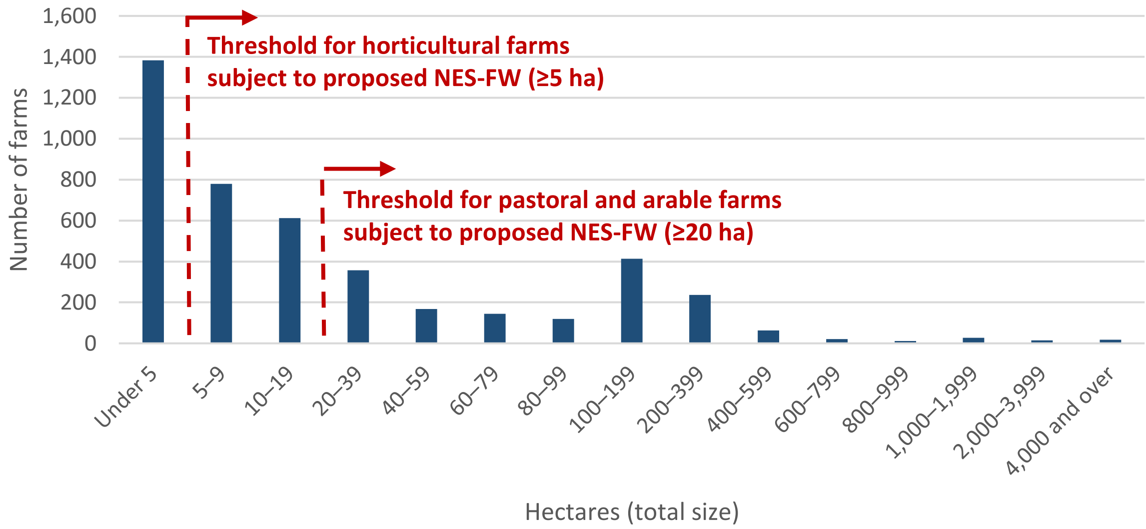

Figure 5.4 - Number of farms by farm size in the Bay of Plenty (Source: APC 2017, StatsNZ)

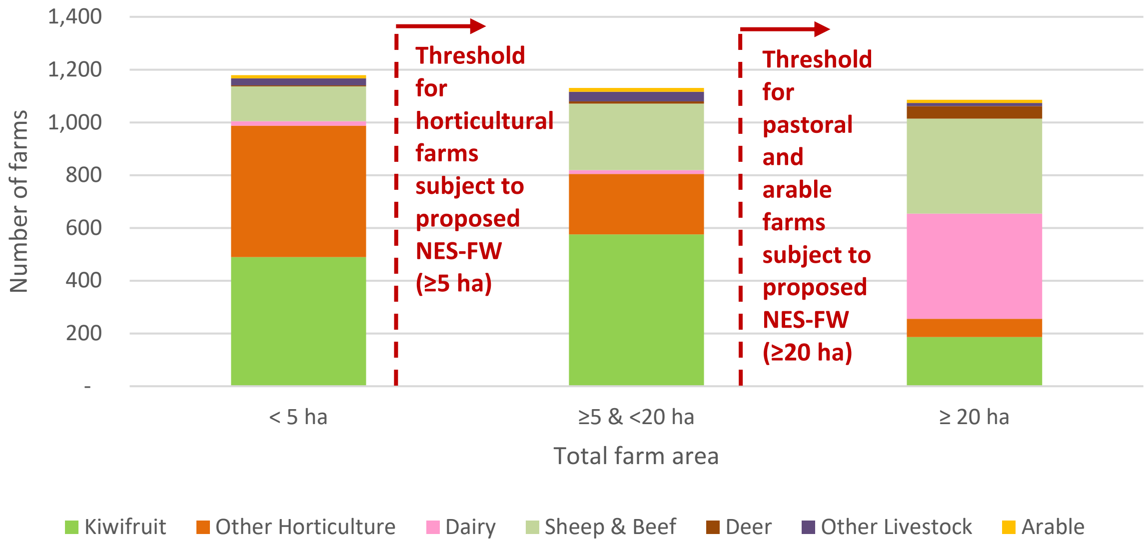

Figure 5.5 - Number of farms by farm size and farm type in the Tauranga Moana, Kaituna-Pongakawa-Waitahanui, Rangitāiki and Rotorua Lakes WMAs (Source: APC 2017, StatsNZ)

Regional economy, importance of agriculture sector and population

The regional GDP in 2017/18 was $15.8b, or $52,254 per capita, 5.6% of New Zealand's GDP (StatsNZ, 2019). The Bay of Plenty economy is fairly diverse (Figure 5.6), and between 2000 and 2017 it grew by 155%. In 2017, agriculture (including horticulture) was the third largest direct contributor to the region's GDP (7.2%), on a par with construction (7.3%) and rental/hiring/real estate (7.6%). Primary manufacturing, which includes the manufacturing of meat, dairy, fruit and cereal products, was the sixth largest contributor (6.1%).[22]

Horticulture, particularly kiwifruit, is the most valuable industry within the agriculture sector, accounting for the largest proportion of the agriculture GDP contribution described above. In 2015/16, kiwifruit accounted for about 50% of the agriculture sector's direct contribution to regional GDP (Scrimgeour, Hughes, & Kumar, 2017; StatsNZ, 2019). The agriculture sector has a significant indirect (through industries supplying agriculture) and induced (through household spending) impact on the regional economy. In the Bay of Plenty, it is estimated that horticulture has a flow-on impact on the regional economy of about half its direct contribution to regional GDP, while the pastoral and arable sectors have a flow-on impact of about a third of their direct contribution.[23]

[22] While primary manufacturing has become smaller relative to other sectors since 2000, it has actually grown between 2000 and 2017, particularly in the 2014-2017 period.
[23] Bay of Plenty input-output tables generated by Butcher Partners Ltd., based on Statistics New Zealand 2013 input-output tables.

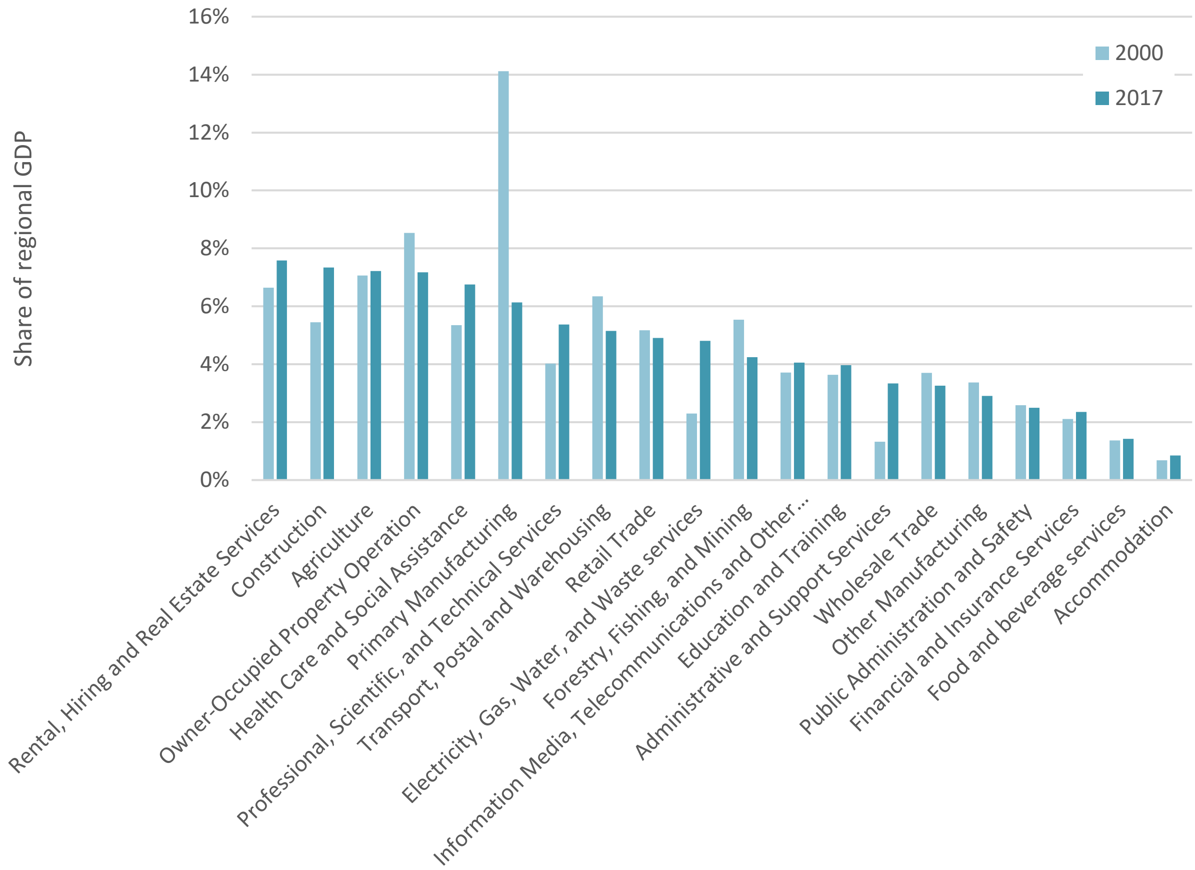

Figure 5.6 - Share of Bay of Plenty regional GDP by industry (Source: StatsNZ)

The estimated resident population of the Bay of Plenty in 2018 was 305,700, with just under half of that within Tauranga City (StatsNZ). About 26% of the Bay of Plenty population identified themselves as Māori in 2013 (Statistics New Zealand, 2015).

In 2013, the primary sector was the fifth largest employer in the region behind retail trade, health/community services, property/business services and manufacturing, employing 10% (or 11,013) of usually resident workers (Statistics New Zealand, 2015). Unemployment in the Bay of Plenty was 3.5% in the second quarter of 2019 (StatsNZ, 2019). The primary sector also has significant indirect and induced impacts on regional employment.

Levels of socio-economic deprivation are generally higher in the eastern Bay of Plenty, although these vary significantly across the region, with some areas of the western Bay of Plenty also being highly deprived. *A Regional Socioeconomic Deprivation Index Map is included for the Bay of Plenty in Section 15 at the end of this report that illustrates this point context.*

A balanced and considered approach to water quality improvements

Most people in the Bay of Plenty would probably agree with the objectives that the proposals seek to achieve, i.e., to stop degradation and improve water quality and ecosystem health. However, given the costs of these proposals and their potential socio-economic implications, it is important to consider:

- The extent of proposed water quality improvements and whether they are realistic;
- How they will be achieved (i.e., the effectiveness and efficiency of the proposals); and
- The timeframe for making the required changes.

It is anticipated that the preliminary assessment presented here will help with those considerations.

5.4 Dissolved Inorganic Nitrogen (DIN) and Dissolved Reactive Phosphorus (DRP) attributes

Proposal

The Science and Technical Advisory Group (STAG) has proposed two new attribute tables for DIN and DRP, and central government proposes to include these in the NPS-FM. The bottom-lines for these two new attribute tables are proposed to be as set out below. [24]

Attribute	Median bottom-line (mg/L)	95^{th} percentile bottom-line (mg/L)
DIN	1	2.05
DRP	0.018	0.054

As with all other attributes in the current NPS-FM, regional councils would be required to set objectives, limits and methods in regional plans (decision version by the end of 2025 (cl. 4.1)) which improve water quality where it is below these national bottom-lines, and either maintain or improve where it is above national bottom-lines (Subpart 2), unless the council can demonstrate that the water quality state not meeting national bottom-lines is due to naturally occurring processes (cl. 3.23). The timeframes to achieve these objectives are not provided in the NPS-FM; they are to be set in regional plans.

[24] In addition to this, STAG proposed removing the 'productive class' option from the current periphyton attribute table and requiring councils to use default nutrient-periphyton criteria, where no robust, locally-suitable and independently peer-reviewed criteria are available. Central government is not proposing changes to the periphyton attribute table and is proposing to provide these default criteria as guidance only. There are no 'productive class' rivers or streams in the Bay of Plenty and BOPRC is developing its own nutrient-periphyton criteria so these proposals would have had no impact in the region.

Approach

The implications of this proposal were analysed by identifying the monitoring sites that would fail the proposed new bottom-lines. From the sites identified, we excluded sites for which:

- Downstream sensitive receiving environments are assumed to be the main drivers of future nutrient reductions in the catchment, rather than the proposed new attributes (i.e. lakes, estuaries or hard-bottom streams likely to support conspicuous periphyton growth); and
- Proposed bottom-line breaches are likely due to natural conditions (e.g. geothermal activity, permeable volcanic soils, soft volcanic geology, and lack of productive land use or significant point source discharges upstream).

BOPRC has a draft catchment model for the Kaituna-Pongakawa-Waitahanui and Rangitāiki WMAs (Williamson Water & Land Advisory, 2019; Mawer, Loft, Zhao, & Williamson, 2019), summarised by Carter et al. (2019 in prep). The draft catchment model estimates loads and concentration of total nitrogen (TN)[25] and total phosphorus (TP)[26]. These results were further analysed against historical monitoring data in these WMAs to estimate likely DIN and DRP concentrations under different land use and mitigation scenarios. This was achieved by calculating the proportions of DIN:TN and DRP:TP for each monitoring site using measured data from the same data period as model estimates. DIN and DRP time series were then created by using the 5th, 50th and 95th percentile proportions for each attribute at each site, and applying those proportions to the modelled TN and TP time series. This was intended to give an indication of the likely ranges of DIN and DRP under different model scenarios.

Assessment

Link between DIN/DRP and ecological health

Ecosystems are complex; there are multiple drivers that influence ecosystem health (e.g. river flow, nutrients, habitat availability/suitability, riparian vegetation degree of sedimentation, water temperature or dissolved oxygen). A range of management activities across different drivers is likely to be required to improve overall ecological health. Nutrients present in the water explain only a small amount of total variability in Macroinvertebrate Community Index scores (an indicator of ecosystem health). Factors such as habitat, land cover, sedimentation and riparian vegetation are also important determinants of ecosystem health (Snelder, Image, & Suren, 2019).

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[25] Total nitrogen (TN) is the total amount of nitrogen present in water and available for plant growth. It includes nitrogen released from decaying plants and animals as well as dissolved inorganic nitrogen (DIN). DIN includes nitrate, ammonia, and other forms of inorganic nitrogen (Parliamentary Commissioner for the Environment, 2012).

[26] TP is a measure of all types of phosphorus present [in water]. It includes the phosphate that is stuck to soil (sediment) [or particulate] as well as DRP which is more readily available for plants. TP is an important measure because most phosphate enters our rivers attached to sediment via run-off. Over time the phosphate that is bound to the sediment dissolves, and becomes available for aquatic plant and algae growth [, as DRP]. This is particularly an issue in slow flowing rivers where the phosphorus bound to sediment can gradually dissolve, feeding aquatic weeds and algae for many years. DRP concentrations are [one of several] indication[s] of a waterbody's ability to support algae and plant growth (LAWA, 2013).

Thus, targeting a single driver of ecosystem health (such as a defined nutrient concentration) could be considered over-simplistic and may not achieve the environmental results sought. Ideally, a case-by-case assessment of the key factors behind poor ecosystem health would be required, which may not necessarily be elevated nutrient levels in every case.

Measured data

An assessment of 45 long-term monitoring sites across the region found that 23 of those sites would fail the proposed DRP bottom-line and 8 sites would fail the proposed DIN bottom-line. Twenty-five monitored sites would fail either one or both bottom-lines overall, as six sites would fail both.

BOPRC has recently become aware of a potential issue with the methodology to assess DRP concentration in the laboratory. DRP results can be inflated if samples have high levels of silica or arsenate (both of volcanic origin) which interfere with the chemical reaction between the reagent and sample. The implication is that some of the elevated DRP results may actually be partly caused by elevated silica or arsenate, so there may actually be less bottom-line exceedances than assessed here. The DRP assessment should therefore be considered indicative only and probably a worse-case scenario.

Figure 5.7 and Figure 5.8 below show the location of the 45 monitoring sites mentioned above, their assessed DRP and DIN band (with sites that fail the proposed bottom-lines highlighted in red) and land use.

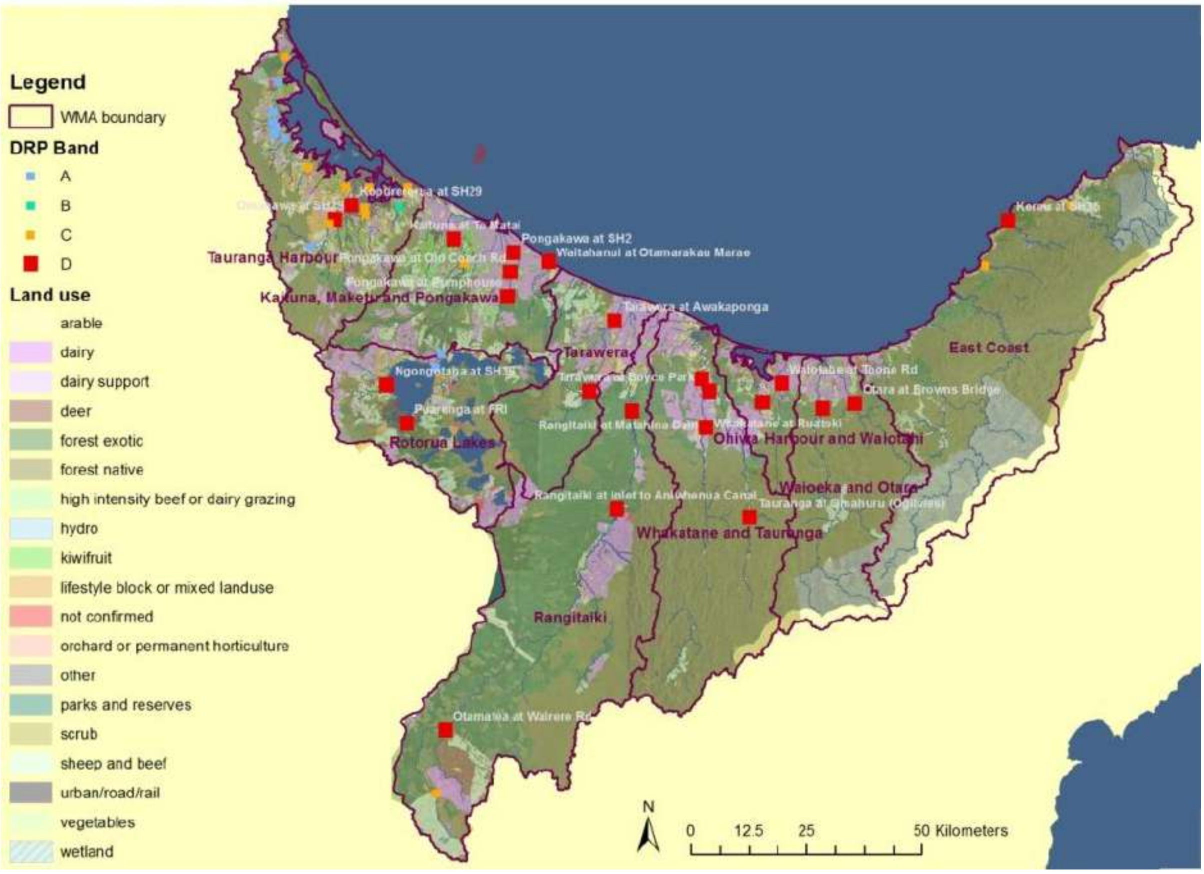

Figure 5.7 - Assessment of monitoring sites against proposed DRP attribute and land use

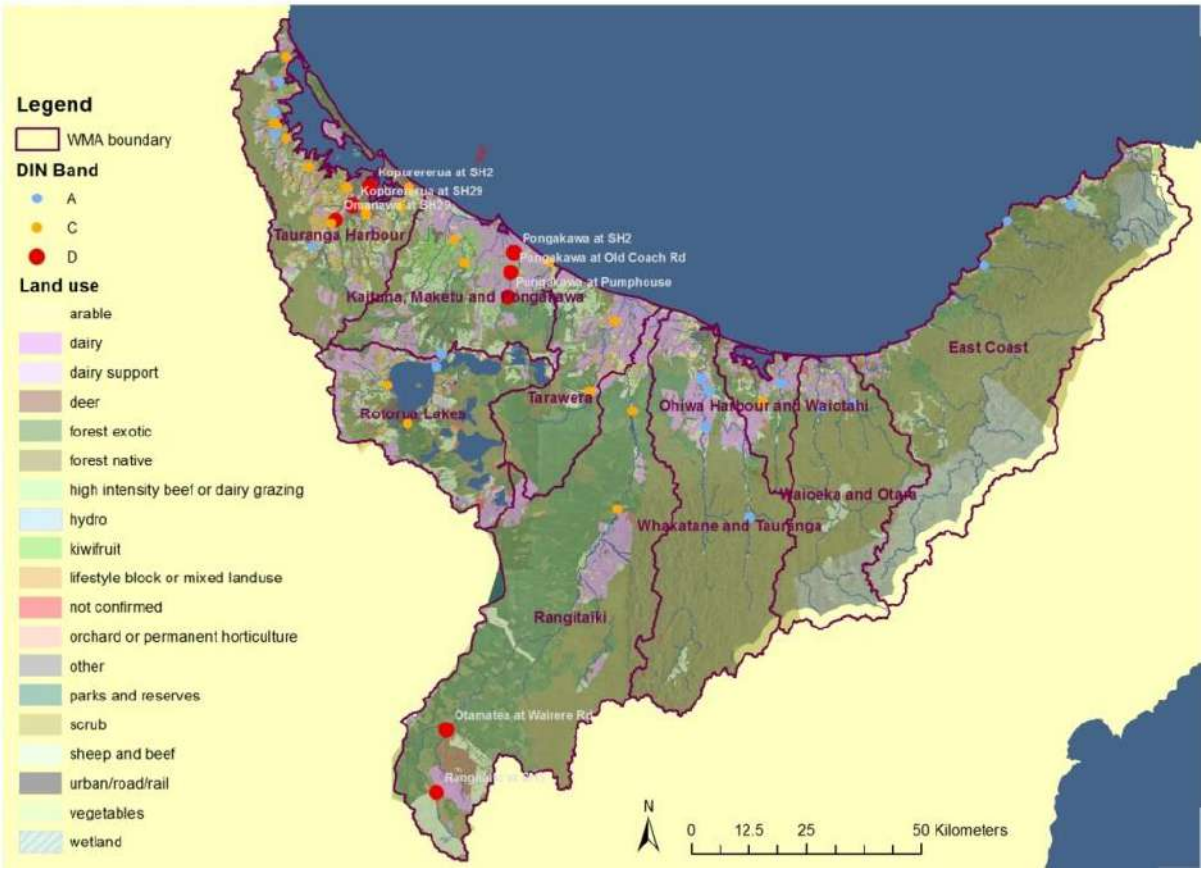

Figure 5.8 - Assessment of monitoring sites against proposed DIN attribute and land use

For the monitoring sites that fail the proposed bottom-lines, Figure 5.9 and Figure 5.10 show their assessed median and 95th percentile DRP and DIN concentrations respectively, relative to the proposed bottom-lines.

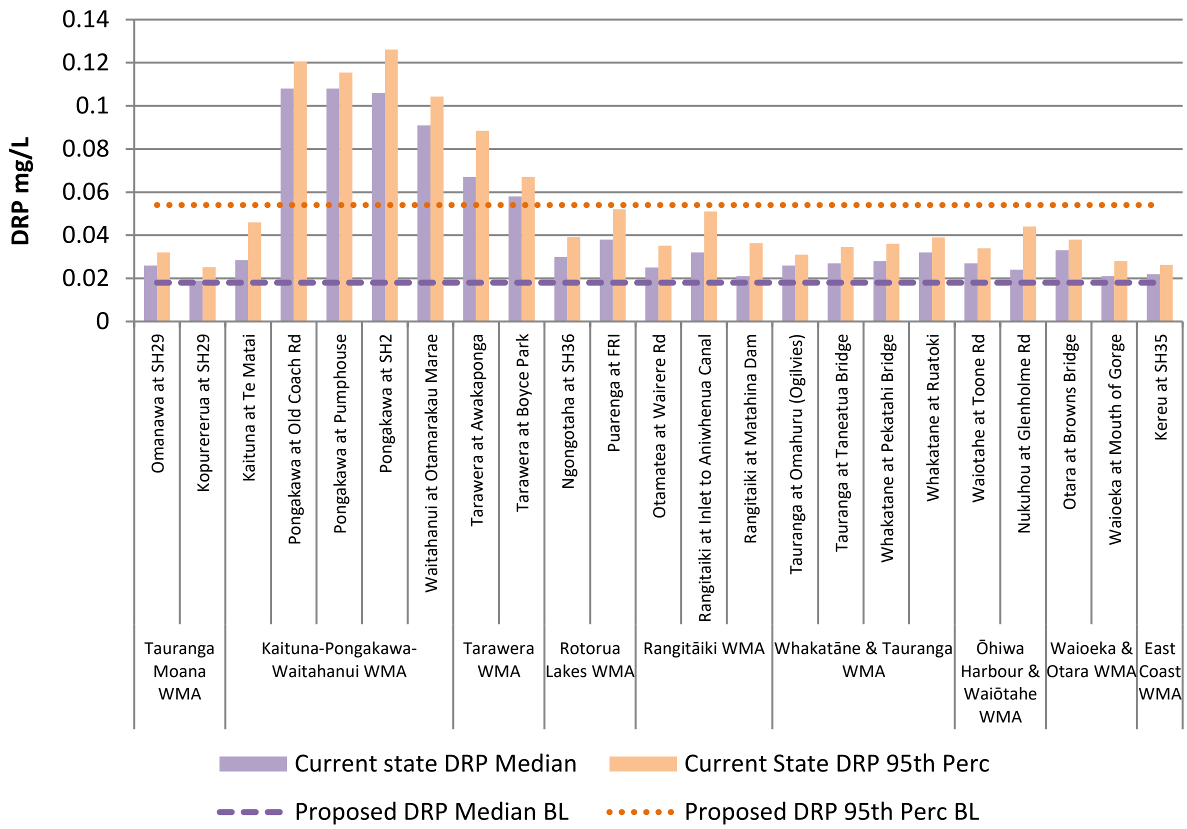

Figure 5.9 - Assessed DRP concentration for sites that fail the proposed DRP bottom-lines (BL)

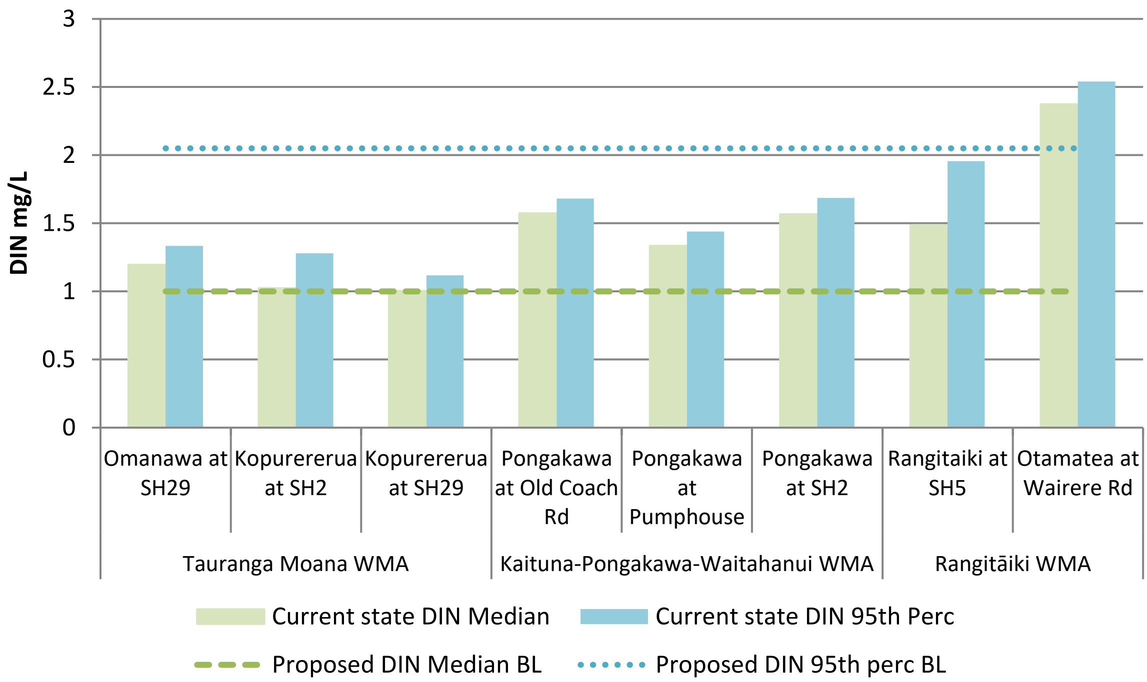

Figure 5.10 - Assessed DIN concentration for sites that fail the proposed DIN bottom-lines (BL)

Rangitāiki WMA

The draft catchment model results show that an estimated 94% and 63% of the current TN load at the Rangitāiki SH5 and Otamatea sites, respectively, is from natural processes (Carter, Tingey, & Scholes, 2019 in prep). It is tentatively estimated that even if the entire anthropogenic TN load at these sites is removed (6% and 37% respectively), the sites would be unlikely to meet the proposed DIN bottom-line[27].

In contrast, only an estimated 23% of the TP load at the Otamatea site is natural, while an estimated 64% and 67% of the TP load at Aniwhenua and Matahina respectively is natural (Carter, Tingey, & Scholes, 2019 in prep). Nonetheless, it is not possible to categorically say if these sites would meet the proposed DRP bottom-line under natural conditions; conservative estimates place these sites in either the C or D bands under natural conditions. It is also tentatively estimated that the land use and mitigation practice changes tested in the draft Rangitāiki WMA catchment model would be insufficient to meet the proposed DRP bottom-lines at the Otamatea and Aniwhenua sites. It is particularly uncertain if those changes would be sufficient to meet the proposed DRP bottom-line at the Matahina site because conservative estimates also place these sites either in the C or D bands under natural conditions.

The cost of mitigation practices for the Rangitāiki WMA evaluated in the catchment model ranged from minimal impact on baseline operating profit for dairy, to about a 10% reduction in baseline operating for drystock (Matheson, Djanibekov, Bird, & Greenhalgh, 2018). The land use change scenarios modelled included conversion to horticulture and additional pastoral land uses in the Kāingaroa Forest, upstream of the affected sites. If meeting the proposed DRP bottom-lines was possible, given the contribution of natural processes, the cost and degree of change required by landowners would be greater than the adoption of good management practice (GMP). It would likely require large-scale land use change and it is unlikely that development of the Kāingaroa Forest (Māori-owned land) would be possible. Further analysis will be required to fully understand the implications of the proposal in the Rangitāiki WMA.

Tarawera WMA

The extent to which natural processes are responsible for the failure of the Tarawera WMA sites to meet the proposed DRP bottom-line is unclear. The catchment has a large proportion of permeable soils, volcanic geology and some geothermal activity, and there are also industrial point source discharges (including of geothermal fluid) and areas of productive land use (including dairy, sheep and beef, and exotic forestry) upstream of the monitoring sites. Without a clear understanding of the exact sources of phosphorus in the absence of a catchment model, it is not possible to further assess the implications of the proposed DRP attribute.

[27] Estimated from modelled TN from natural state scenario – the likely water quality that would have occurred if the catchment was solely under native vegetation, and deriving DIN using 5th, 50th and 95th proportions of DIN:TN based on nearby measured data.

Other sites

As illustrated in Figure 5.7 and Figure 5.8, several sites fail the proposed DRP and DIN bottom-lines in the Tauranga Moana, Kaituna-Pongakawa-Waitahanui, Rotorua Lakes and Ōhiwa Harbour & Waiōtahe WMAs. All of these WMAs have downstream sensitive receiving environments, i.e. Tauranga Harbour/Waikareao Estuary, Maketū and Waihī Estuaries, Lake Rotorua, Ōhiwa Harbour and Waiōtahe Estuary. Furthermore, the sites in the Whakatāne and Waiōtahe catchment also have downstream environments that are susceptible to conspicuous periphyton growth. It is assumed that these sensitive receiving environments will be the main drivers of nutrient reductions in the future in these WMAs as the NPS-FM is implemented, and that these reductions will be more significant than those required to meet the proposed DIN and DRP bottom-lines.

The Lake Rotorua catchment has rules in place to reduce nitrogen discharges from farming activities into the lake (PC10). It is expected that actions to reduce nitrogen will also have some impact on phosphorus reduction, although this is unlikely to be sufficient on its own to achieve phosphorus objectives for the lake (Donald, Bruere, & Park, 2019). It is assumed that phosphorus limits for the lake under the NPS-FM will eventually create stronger drivers of phosphorus reduction for the river monitoring sites in the lake catchment that were assessed to fail the proposed DRP bottom-line.

Under the existing draft catchment model and subsequent analysis, it is anticipated that even if the entire anthropogenic TP load upstream of the Kaituna-Pongakawa-Waitahanui WMA monitoring sites was removed, those sites would still fail the proposed DRP bottom-lines. In other words, the DRP bottom-line failures in that WMA are due to natural processes. As summarised by Carter et al. (2019 in prep), an estimated 67% of the current TP load at both the Kaituna at Te Matai site and to Waihī estuary (downstream of the Pongakawa Stream sites) is from natural sources (as opposed to anthropogenic sources, e.g. point source discharges or productive land use). Likewise, an estimated 84% of the current TP load at the lower Waitahanui site is from natural sources.

In terms of nitrogen, the TN load to the Waihī estuary has to reduce by an estimated 66% to achieve a moderate state of ecological health (Park, 2018; Carter, Tingey, & Scholes, 2019 in prep). The changes required to achieve this reduction are also likely to result in the proposed DIN bottom-line being met at the Pongakawa Stream sites. In contrast to TP, only an estimated 17% of the TN load to Waihī estuary is from natural sources. It is tentatively estimated that a combination of land use change and improved farming practices (or mitigation) would result in the proposed DIN bottom-line being met at the Pongakawa catchment sites. However, these changes would be insufficient to achieve a moderate state of ecological health in the estuaries, meaning more stringent nutrient limits would need to be applied to meet estuarine ecological health objectives.

Several of the sites in the eastern part of the region that fail the proposed DRP bottom-line have very little productive land use upstream, are mostly downstream of native bush and have no significant upstream point source discharges (Figure 5.7). This suggests that the current state and DRP bottom-line failure is mostly due to natural processes.

DIN and DRP summary and conclusions

The proposed DIN and DRP attributes are unlikely to have a substantial impact in the Bay of Plenty due to many sites having elevated nutrients because of natural causes (Waipā and would therefore be exempt from the proposed bottom-lines), or downstream sensitive receiving environments driving more significant nutrient reductions. Furthermore, the DIN and DRP proposals may generally not be effective in achieving the ecological benefits sought because of the range of environmental drivers (i.e. water quantity, habitat, ecological processes and aquatic life) that influence ecological attributes such as macroinvertebrates and fish. This is likely to be the case in other regions too.

Although several monitored sites would fail to meet the proposed bottom-lines, relatively stringent nutrient limits are likely to be necessary in many catchments in the region, even in the absence of the DIN and DRP attributes. This is because the ecological health needs of lakes and estuaries will be key determinants of required nutrient reductions.

The proposed DRP attribute may have implications for five monitored sites across the Tarawera and Rangitāiki WMAs, out of 45 monitored sites across the whole region. However, it is possible that these sites would fail the proposed DRP bottom-lines even under natural conditions. Further assessment would be required to fully understand the implications of the proposed DRP attribute in these two WMAs.

5.5 Restrictions on land use intensification

Proposal

Until the NPS-FM has been fully implemented (by the end of 2025 as proposed), the proposal (NES-FW Part 3, Subpart 2) seeks to restrict:

- Increases in area of land in irrigated pastoral, arable or horticultural production above 10 hectares;
- Changes in land use above 10 hectares from:
  - Arable, deer, sheep or beef to dairy-support;
  - Arable, deer, dairy-support, sheep or beef to dairy; and
  - Woody vegetation or forestry to any pastoral use.
- Increases in forage cropping beyond the area in intensive winter grazing in the past five years; or if the applicant didn't previously carry out intensive winter grazing, then beyond a minimum threshold.

For any of these activities, a resource consent will only be granted if the activity does not increase nitrogen, phosphorus, sediment or microbial pathogen discharges above the enterprise or property's 2013-18 baseline (average for this period). Consents will also be subject to the applicant supplying a farm plan for the proposed activity.

Furthermore, the proposal seeks to restrict any land use change to commercial vegetable growing that would increase the applicant's net area of that activity in the freshwater management unit above their highest extent in 2013-18. The restriction would require either:

- No increase in contaminant (N, P, sediment and microbial pathogen) discharges above the enterprise's 2013-18 baseline (average for this period), to be achieved through a freshwater module in a farm plan; or
- The applicant to operate above GMP, as set out in a freshwater module in a farm plan.

As per all farming proposals in the NES-FW, the proposal would not apply to pastoral and arable farms of less than 20 hectares and to horticultural farms of less than 5 hectares. It is assumed these thresholds relate to the total area, as opposed to the effective area, of a farm. As described under regional context above, a large proportion of farming properties in the Bay of Plenty would be below these thresholds. Furthermore, it appears the proposal may (inadvertently?) not apply to properties which are currently in exotic forestry either, given the definition of "farm" in Part 3 of the proposed NES-FW. If the proposal did not apply to such properties, the requirement would effectively be a moratorium on conversions from forestry to pasture as it is highly unlikely that contaminant losses from pasture would be lower than from forestry.

Approach

In 2017, BOPRC engaged with industry groups, major landowners and community groups to identify major rural land use change patterns in the Kaituna-Pongakawa-Waitahanui and Rangitāiki WMAs (in the context of the current Plan Change for those WMAs). These trends were applied generally across the region in a case study of future water supply and demand (McIndoe & Kashima, 2018). The main rural land use change trend expected in the Bay of Plenty (excluding subdivision into lifestyle blocks and urban growth, and impacts from sea level rise) is conversion to horticulture, mainly kiwifruit and avocado, in suitable areas[28]. In the upper parts of the region's catchments, conversions to forestry are also anticipated, but these are not captured by the proposal. Furthermore, in the Rangitāiki WMA, some conversion to horticulture or grazing was expected in a relatively small part of the Kāingaroa Forest, which is currently held in trust by CNI Iwi Land Holdings. However, properties dedicated exclusively to exotic forestry may be excluded from the proposal too, as described above.

To identify the number of properties and areas likely to be captured by the proposal, we have used the same future land use scenarios described above, focusing on likely conversions to horticulture (kiwifruit or avocado) by 2025. Based on that, a broad estimation of likely implications of the proposal by WMA is presented. Costs would include administration (i.e. obtaining a resource consent, including developing a farm plan for the proposed conversion and establishing baseline losses for the property) and assessing yearly contaminant losses (e.g. through an Overseer file).

[28] Suitable areas were generally defined as not overly wet areas, LUC 1-4, less than 15 degree slope, allophanic or pumice soils only, below 250m above sea level, where current land use is anything other than lifestyle block, orchard or permanent horticulture, kiwifruit, native forest, exotic forest, water, parks and reserves, urban/road/rail, wetland and outside of DOC land, QEII covenant areas and urban growth limits. Viable conversions are assumed to be those of at least 1 hectare per property.

While there could also be some conversions to dairy, dairy support or other pastoral land uses (some have occurred in the region recently), and increases in other irrigated land uses, vegetable growing and forage cropping, these are expected to be rare over the next five years.

APC data indicates that the number of farms engaged in, and area devoted to, commercial vegetable growing in the Bay of Plenty decreased between 2007 and 2017. Likewise, the area of forage cropping harvested in the region decreased between 2012 and 2017. Therefore, no such conversions and other forms of intensification included by the proposal are assumed.

A key element of uncertainty in relation to this proposal is the baseline contaminant losses. Not all properties would have evidence of their contaminant losses over the 2013-18 period. Furthermore, while Overseer can estimate base flow losses for nitrogen and phosphorus, there are currently no equivalent tools to accurately estimate sediment and microbial pathogen discharges at a property level, or surface flow losses generally. Likewise, even if there are accurate Overseer files (for N and P) for existing pastoral land, there currently are no robust tools to predict nutrient losses from fruit crops, the main expected 'new' rural land use in the Bay of Plenty. This will present significant challenges to the effective implementation of this proposal and may prevent large conversions to irrigated horticulture.

Assessment

Across the whole region, an estimated 44,100 hectares (or about 3.7% of the region) and more than 2,000 properties would be viable for conversion, mainly from pasture, to horticulture, as described above. When the NES-FW size thresholds (i.e. >20 ha pastoral and arable properties, and >10 ha conversions) are applied, the extent of potential land use change covered by the proposal is reduced to 37,235 hectares across 765 properties. It is assumed only a quarter of that growth would occur over the next five years, or would actually be irrigated. Based on that assumption, the estimated distribution of conversions to irrigated horticulture by WMA potentially affected by the proposal is summarised in Table 5.1.

Table 5.1 - Estimate of irrigated horticulture conversions by 2025 within proposed NES-FW size thresholds by WMA (assuming 25% of convertible area within size thresholds would actually convert by 2025)

Water Management Area	Number of properties with suitable land above size threshold	Convertible area above size threshold (ha)
Tauranga Moana	26	985
Kaituna-Pongakawa-Waitahanui	46	2,142
Tarawera	10	390
Rangitāiki	46	2,907
Waioeka & Otara	8	263
Whakatāne & Tauranga	27	1,414
Ōhiwa Harbour & Waiotahe	12	549
East Coast	17	659
Total	**192**	**9,309**

Assuming an administrative cost of $7,000 per property to obtain a resource consent[29], total administrative costs of the proposal could add up to $1.3m by 2025.

If the proposal would in fact prevent those conversions from occurring due to the lack of evidence of baseline and expected future contaminant losses, there would be significant costs in terms of lost employment opportunities and economic growth for the region. As reported by Matheson et al. (2018), the estimated annual per hectare baseline operating profit for kiwifruit was assessed to be $19,500 for green and $78,400 for gold, much higher than for pastoral and arable land uses. For dairy the estimate ranged from $1,115 to $2,582, for drystock from $133 to $421 and for arable it was $2,345.[30] Most of the area expected to convert to horticulture is currently in these land uses.

In the short term, the proposal could also affect land values by making smaller properties, which would be exempt from the proposal, more attractive to potential investors, and larger properties less attractive.

It is assumed that no intensification, as defined in the proposal, would occur in the Rotorua Lakes WMA. McIndoe & Kashima (2018) describe why there is a low likelihood of intensification occurring in most of the Rotorua Lakes WMA:

> *Under (…) the [Bay of Plenty Natural Resource Plan], development in the catchments of Lakes Ōkāreka, Rotoehu, Ōkaro, Rotorua and Rotoiti is restricted to activities that do not increase the annual average export of nitrogen or phosphorus from the property compared to the property benchmark. In practice this restricts the conversion of land from forestry to pastoral farming or horticulture, from sheep and beef farming to dairying, or intensification of dairying.*
>
> *Plan Change 10 further restricts development in the Lake Rotorua groundwater catchment by requiring a reduction in the catchment load to 435 tonnes of nitrogen per annum (tN/yr) from 755 tN/yr (values based on Overseer 5.4). Generally, under the rules, existing activities will need to reduce in intensity and there is limited ability to develop underutilised land unless nitrogen discharge allocations are purchased.*
>
> *Furthermore, the water quality policies in the Regional Policy Statement (RPS) identify the above 12 lakes as catchments at risk and require the establishment of contaminant limits within those catchments. It is anticipated, at this time, that the RPS water quality policies will be included in the Rotorua Lakes WMA limit-setting process.*
>
> *Land use intensification in [this part of] the Rotorua Lakes area would be significantly restricted by all of these water quality provisions.*

[29] Including consent processing, development of farm plan and assessment of baseline and future contaminant losses.

[30] Currently, dry stock and kiwifruit profits would be higher, but the overall relativities remain unchanged (L. Matheson, pers. comm.).

While intensification and land use change could theoretically occur under existing regional rules in the catchments of other Rotorua Lakes (i.e. Rerewhakaaitu, Rotomahana, Tarawera, Rotokakahi, Tikitapu, Tarawera, Ōkataina and Rotomā), the area available for land use change in these catchments is limited. Furthermore, conversions from forestry to any pastoral land use in the Rotorua Lake catchment are not currently considered to be financially viable[31], therefore it is likely they would not be financially viable in the catchments of other Rotorua Lakes either.

Intensification summary and conclusions

There are likely to be few, if any, high risk land use change conversions in the Bay of Plenty by 2025. On the other hand, the predominant type of land use change occurring in the Bay of Plenty, and likely to be affected by the proposal by 2025, are conversions from pasture and arable to irrigated horticulture (particularly kiwifruit and avocado). The lack of available tools to determine contaminant losses for horticulture at a property scale could present significant impediments to this land use change trend. Despite the lack of these tools, it is generally expected that contaminant losses from fruit crops would be lower than from alternative land uses, if operating under GMP. Possible exceptions to this are sediment losses from contouring during the early stages of kiwifruit development, and other contaminants not included in the proposal (e.g. heavy metals, agri-chemicals). While unirrigated and smaller irrigated horticulture conversions would still be able to occur, the proposal could compromise significant environmental and socio-economic benefits associated with larger irrigated horticulture conversions in the short term, if these would be prevented. The scale of these would be much larger than any administrative costs (estimated at $1.3m by 2025) associated with the proposal.

5.6 Farm planning

Proposal

The proposal (NES-FW, Part 3, Subpart 3) would require farmers to have a farm plan with a freshwater module by 2025 (and by 2022 in the upper Rangitāiki sub-catchment or if engaged in commercial vegetable production). Importantly, the actions a farmer commits to in the farm plan are not subject to the same timelines. These can be reasonably spread over time. Timing is likely to be revisited as measurable objectives, targets and timeframes are set in regional plans.

The farm plan would identify waterbodies, critical source areas, erosion-prone areas, and other risks (e.g. irrigation, fertiliser application, effluent, winter grazing, stock holding, etc.) to waterbodies. For these areas and risks, it would set out a schedule of actions to manage risk. Plans would need to be developed by a qualified farm planner, independently audited and progress reports submitted to the regional council. It is envisaged that the requirement for farm plans would be phased in, with higher risk activities and catchments under more pressure being prioritised. It is also assumed that farm plans will at least identify and require GMP, with implementation being enforceable by the regional council.

[31] CNI Iwi Land Management Ltd, Māori Trustee, Federated Farmers of New Zealand v BOPRC [2019] NZEnv C 136, paragraphs 225 and 318(f)

Like all farming proposals under the proposed NES-FW, this proposal would only apply to pastoral and arable farms of 20 hectares or more and horticultural farms of 5 hectares or more. It is assumed these thresholds relate to the total area, as opposed to the effective area, of a farm. As described under regional context above, a large proportion of farming properties in the Bay of Plenty would be below these thresholds, and therefore exempt from this requirement.

Approach

The assessment is based on 2017 APC data (for number of farms by farm type and size) for the region (StatsNZ, 2018), and GIS datasets of land use and property boundaries. The APC also has information about the number of existing nutrient planning documents (i.e. nutrient budgets, Good Agricultural Practice, Nutrient Management Plans and other nutrient planning documents), which are assumed to partially fulfil the requirements of a farm plan under this proposal.

We have estimated the number of new farm plans required by land use. The estimated costs of developing, certifying, auditing and implementing farms plans are expressed in terms of changes to operating profit. This includes the cost of extending any existing or expected currently required farm nutrient planning documents to fulfil the requirements of the proposal.

Development/certification and auditing costs are assumed to be $3,500 (one-off) and $1,750 every year per farm plan respectively.[32] The costs are assumed to be 50% less when a farmer already has an existing nutrient management document.

It is assumed that farm plans will require “Good Management Practice”, defined as the M1 mitigation bundle in Matheson et al. (2018) and summarised in Appendix 2, except for stock exclusion and riparian buffers/setbacks as those are evaluated separately under section 3.E. Furthermore, for drystock (deer, sheep and beef, and dairy support), practices only up to M1.9 are considered given the relatively high cost of other practices within that mitigation bundle. Most mitigation practices require a more efficient use of inputs, less intensity and could generally be considered expected levels of practice.

The characterisation of mitigation costs was assessed for 13 different “average” farming and growing systems across the Kaituna-Pongakawa-Waitahanui and Rangitāiki WMAs (Matheson, Djanibekov, Bird, & Greenhalgh, 2018). In the absence of a similar characterisation for other parts of the region, this analysis was used for the rest of the region in the following assessment. The analysis should therefore be considered only indicative.

[32] A cost of between $5,000 and $7,000 is realistic to develop a farm plan from scratch (L. Matheson, pers. comm.). The lower cost of $3,500 is assumed on the basis that industry groups and/or the regional council would be expected to provide support for plan development (e.g. through a template and guidance).

Assessment

Overall, the cost of farm plans (including development, auditing and GMP implementation) is estimated to result in a 5% reduction in annual operating profit across all affected land uses in the region, from $764m to $726m (Table 5.2). The biggest impact would be on drystock farmers (18% drop in overall operating profit, ranging from 8% to 24% for different farm systems). The least impact would be on kiwifruit growers (4% overall drop, 2% for gold, 8% for green) due largely to their much larger baseline profits relative to other land uses. Dairy farming would see an overall 5% drop in operating profit, although this would range from virtually no impact for more intensive farming systems to an 18% reduction for less intensive systems. These estimates do not take into account the costs of servicing debt, which would vary for individual landowners and would exacerbate impacts.

Table 5.2 – Summary assessment of implications of developing, auditing and implementing Farms Plans in the Bay of Plenty region

Land use	Total number of farming businesses	Total area (ha)	Estimated number of farming businesses within size thresholds	Estimated total area within size thresholds (ha)	Estimated total effective area within size thresholds (ha)	Assumed number of existing nutrient management documents	Baseline EBIT/ha/year	Post-mitigation EBIT/ha	Mitigation cost/ha/year	Estimated Baseline profit/year	Farm Plan development/auditing costs per year	Estimated Farm Plan implementation costs/year	Estimated profit after mitigation/year
Kiwifruit	1,452	16,057	884	13,595	10,876	884				$ 500.1m	-$ 0.77m	-$ 19m	$ 481m
Green		*10,745*	*592*	*9,097*	*7,278*	*592*	*$19,500*	*$ 17,608*	*-$ 1,892*	*$ 167.6m*	*-$ 0.52m*	*-$ 13m*	*$ 154.2m*
Gold & other		*5,312*	*292*	*4,498*	*3,598*	*292*	*$78,400*	*$ 76,533*	*-$ 1,867*	*$ 333.2m*	*-$ 0.26m*	*-$ 6m*	*$ 326.7m*
Other horticulture	845	3,735	316	2,338	1,871	313	$19,500	$ 17,608	-$ 1,892	$ 58.2m	-$ 1.2m	-$ 5m	$ 51,7m
Sheep & beef	990	96,508	479	85,621	68,497	120	$133-$421	$109-$396	-$20 - -$25	$ 13.9m	-$ 0.7m	-$1.7m	$ 11.4m
Arable/grain growing	50	8,037	50	4,192	3,354	12	$ 2,345	$2,192	-$ 153	$ 15.1m	-$ 76,125	-$ 0.95m	$ 14m
Dairy	639	119,426	605	111,856	89,485	303	$1,115-$2,582	$955-$2,532	-$418 - $20	$ 175m	-$ 0.79m	-$ 7.83m	$ 166.4m
Deer	48	6,801	46	6,554	5,243	12	$ 229	$ 206	-$ 23	$ 1.2m	-$ 70,000	-$ 0.1m	$ 1m
Total	**4,024**	**250,565**	**2,379**	**224,157**	**179,326**	**1,632**				**$ 764.3m**	**-$ 3.6m**	**-$ 35m**	**$ 725.6m**

Impacts will vary by land use and for individual landowners, although the main cost to implement GMPs can be spread across a reasonable timeframe. The impact would potentially be significant for drystock farmers and less intensive dairy farmers.

In reality, farm plans will tailor mitigation practices to individual properties, taking into account specific property characteristics, circumstances and risks. They will encourage farmers to actively consider and manage risks, promoting voluntary behaviour change. If linked to a requirement to prepare and report an audited Overseer file (or other assessment of contaminant losses), farm plans will generate important baseline information. This information is currently either unavailable (e.g. nutrient losses from horticulture, baseline farming practices) or inaccessible (e.g. Fonterra-managed Overseer files for dairy farms). The main exception to this is properties in most of the Rotorua Lakes catchments, which are currently required to maintain accessible Overseer files. By tailoring mitigation practices, farm plans are also likely to maximise environmental benefits and minimise costs. The cost estimate presented here is therefore likely an overestimate.

Figure 5.11 illustrates the impact of the mitigation practices (listed in Appendix 5.1) on nitrogen and phosphorus base flow losses (Matheson, Djanibekov, Bird, & Greenhalgh, 2018). This scale of change in contaminant losses, plus reductions in sediment and pathogens which were not assessed, is likely to be achievable through the adoption of GMPs, through farm plans. When applied in the Kaituna-Pongakawa-Waitahanui and Rangitāiki WMA draft catchment model (Carter, Tingey, & Scholes, 2019 in prep), these mitigation practices led to reductions in contaminant loads to receiving environments, as summarised in Table 5.3, and a general improvement in water quality in relation to *E. coli* concentrations. The draft model results also showed that these reductions would be insufficient to achieve moderate states of ecological health in the Maketū and Waihī estuaries, suggesting that either more stringent mitigation and/or land use change would be required.

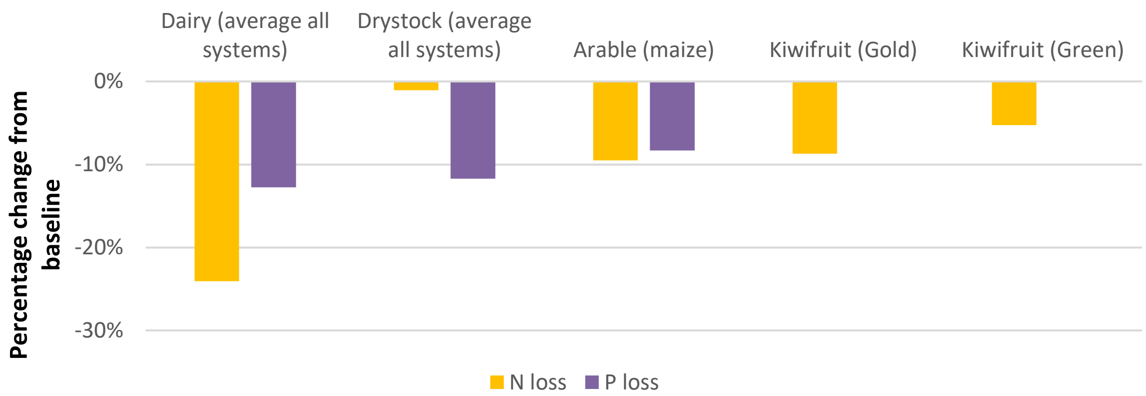

Figure 5.11 - Impact on N and P losses from mitigation practices likely to be required under farm plans
Source: Matheson et al 2018

Table 5.3 - Estimated change in contaminant load to receiving environments in the Kaituna-Pongakawa-Waitahanui and Rangitāiki WMAs draft catchment model from application of mitigation practices

	Total nitrogen	Total phosphorus	Total Suspended Solids
Maketū Estuary	-8%	-7%	-1%
Waihī Estuary	-11%	-9%	-2%
Lake Matahina	-4%	-2%	0%

Source: Carter et al, 2019 in prep

Based on BOPRC's experience with Plan Change 10 (Lake Rotorua), it is assumed that a qualified farm planner (FTE) could realistically deliver about 40 farm plans per year, if that is the only thing they did. It would therefore take about 12 qualified full-time farm planners to deliver the estimated 2,379 farm plans required across the region by 2025. This assumes that less work would be required where nutrient management documents are already in place, that all necessary information would be readily available and that farm planners will also undertake some certification and auditing roles. However, most farm planners also undertake other activities and are unlikely to be dedicated only to developing, certifying and auditing farm plans. It is also unlikely that all necessary information would be readily available.

Capacity constraints have already been identified in relation to delivering Nutrient Management Plans under Plan Change 10 for Lake Rotorua, and in relation to delivering farm plans under Waikato's Plan Change 1[33]. Therefore it is uncertain if it would be possible to deliver this number of farm plans by 2025 with currently available capacity. An increase in the availability of qualified Farm Planners, prioritisation of land uses, contaminants, or areas, and possibly an extension of the timeframe, will be required.

An increasing demand for Farm Planners around the country as a result of this proposal could lead to increased costs for landowners, if that increased demand is not matched by increased supply, particularly if timeframes are tight. Likewise, there is a risk that the quality of farms plans and audits may be compromised if Farm Planners are under pressure to complete large backlogs of farm plans and audits in a short timeframe.

Farm planning summary and conclusions

Significant benefits are expected to be achieved from farm plans including tailored mitigation practices which will result in better environmental outcomes, and in some cases also improved farm financial performance. They will also generate important baseline information in terms of contaminant losses and farming practices. The costs of developing farm plans by 2025, and auditing them once in place, are generally not major, relative to baseline operating profits of affected land uses and expected benefits (although this will vary for individuals). The main cost will be in implementing plans, which are assumed to require GMPs. However, these costs can be spread over a longer timeframe. The capacity of qualified Farm Planners to deliver farm plans by 2025 could be an issue.

[33] Statement of primary evidence of Lee Antony Matheson, on behalf of NZIPIM – Waikato Branch, to the hearing on Waikato Regional Council's proposed Plan Change 1 (Waikato and Waipa catchments – Healthy Rivers).

Despite the capacity issue, consideration should be given to extending the farm planning proposal to farms below the NES-FW size thresholds, even if it is under a longer timeframe.

5.7 Management of nitrogen in catchments with high nitrate-nitrogen levels

Proposal

Three options are proposed (NES-FW, Part 3, Subpart 4):

1. A percentile-based nitrogen cap in identified catchments, taking into account land use, soil type and climate differences;
2. A national nitrogen fertiliser cap, with more stringent provisions for identified catchments; or
3. A requirement for farmers in identified catchments to show how they will reduce nitrogen leaching and auditing their progress through farm plans.

Like all farming-related proposals in the proposed NES-FW, this proposal applies only to pastoral and arable farms of 20 hectares or more and horticultural farms of 5 hectares or more. It is assumed these thresholds relate to the total area, as opposed to the effective area, of a farm.

Option 1 would apply only to low-slope (average slope of less than 5, 7 or 10 degrees at parcel level) pastoral farms. All relevant farms would be required to submit an audited Overseer nitrogen loss figure to the regional council. The threshold will be set at the 70th, 75th or 90th percentile of nitrogen loss for each land use, taking into account soil and climatic differences.

Identified catchments are those in the highest 10% of nitrate-nitrogen concentration of monitored sites nationally and where no NPS-FM rules currently apply. The upper Rangitāiki, upstream of the confluence with the Otangimoana Stream, is the only identified catchment in the Bay of Plenty. However, based on the draft Rangitāiki WMA catchment model, 77% of the cumulative TN load of the Rangitāiki River at the confluence with the Otangimoana Stream is estimated to be due to natural causes (Carter, Tingey, & Scholes, 2019 in prep). This is likely due largely to the prevalence of pumice soils in the sub-catchment. It is unclear whether natural background nitrogen loads were considered in the selection of proposed identified catchments.[34]

Approach

The assessment focuses on Options 1 and 3. Option 2 is not specific enough to assess (e.g. what would the cap be?) and we have no baseline information on fertiliser use in the identified catchment, or means of assessing the impact of reduced fertiliser use. However, efficient fertiliser use practices are considered within the GMP mitigation measures described below.

[34] The upper Rangitāiki is also one of BOPRC's focus catchments, prioritised for land management intervention due to a trend of increasing nitrogen levels in recent years.

The identified catchment was mapped and affected properties identified. In the context of PC12, BOPRC previously commissioned Perrin Ag Consultants and Landcare Research to characterise farming systems and mitigation practices in the Rangitāiki WMA (Matheson, Djanibekov, Bird, & Greenhalgh, 2018). For sheep and beef, and deer, these characterisations were mainly based on current farming practices in the identified sub-catchment.[35]

In the absence of baseline nitrogen leaching information by property (to assess Option 1) or an indication of the extent of nutrient loss required (to assess Option 3), we describe the mitigation practices characterised by Matheson et al. (2018) and the implications these would have on nitrogen losses and sub-catchment profit. For Option 3, it is assumed that the cost of developing, auditing and implementing farm plans is already covered under the farm planning proposal discussed in section 3.C, if affected properties did not already have a farm plan. An additional cost under either option would be developing and auditing an Overseer file every year, again if affected properties were not already doing this.

Assessment

Sub-catchment and affected landowners

The identified sub-catchment (Figure 5.12) covers an area of 42,911 hectares (equivalent to about 14.5% of the Rangitāiki WMA or 3.2% of the Bay of Plenty region). As summarised in Figure 5.13, 47% of the sub-catchment is in pasture (26% sheep and beef, 11% deer, 7% dairy support and 3% dairy), with the remainder in exotic forestry (38%), native forestry (13%) and a range of other land uses (3%). The predominant soil types in the identified sub-catchment, as in the wider Rangitāiki WMA, are pumice soils.

[35] There is no available characterisation for dairy or dairy support farms for this sub-catchment. Consequently, the characterisations for a Galatea unirrigated dairy farm and a Kaituna-Pongakawa-Waitahanui WMA dairy support farm were used for this analysis. Dairy farms in this sub-catchment are quite different to those in Galatea so the analysis should be considered indicative only.

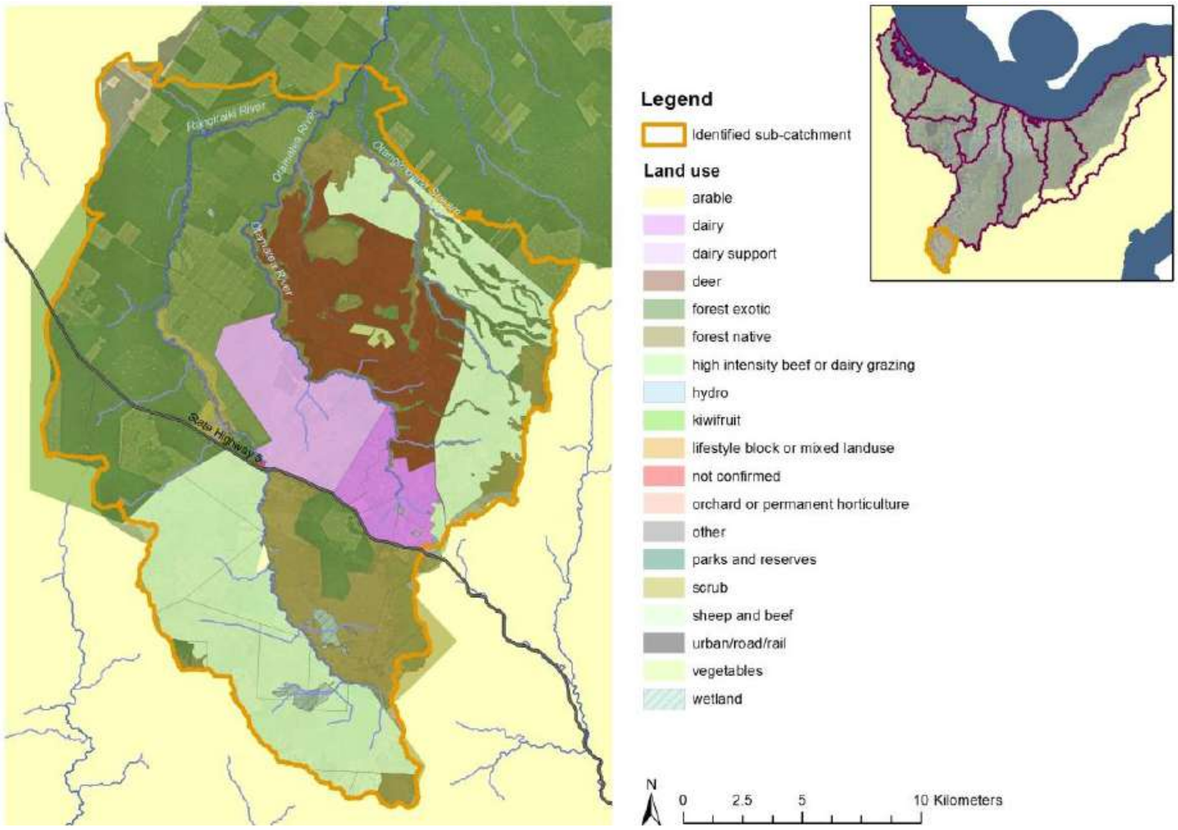

Figure 5.12 - Identified sub-catchment: Upper Rangitāiki, upstream of confluence with Otangimoana Stream

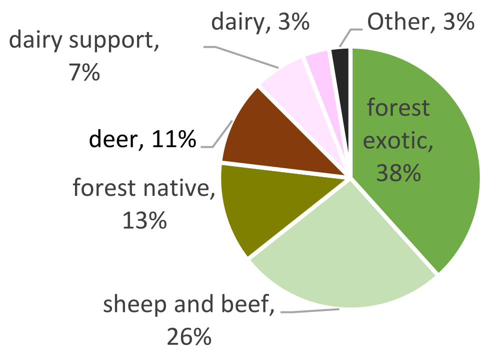

Figure 5.13 - Identified sub-catchment, land use distribution

Options 1 and 3 would affect up to five landowners. The largest of these are Landcorp Farming (Rangitāiki Station, 9,674 ha) and Lochinver Farms (Lochinver Station, 13,726 ha, of which only 10,456 ha are in the identified sub-catchment and Bay of Plenty region) (Figure 5.14). As illustrated in Figure 5.12, Rangitāiki Station has deer, sheep and high intensity beef finishing, with a small area dedicated to potatoes and some forestry (exotic and native). BOPRC understands that there has been some intensification at Rangitāiki Station in recent years. Lochinver Station runs sheep and beef south of SH5, and dairy support (including grazing for dairy heifers for export) and some exotic forestry north of SH5. BOPRC understands that planned changes to farming operations at Lochinver Station will not result in intensification (M. Kapa, pers. comm.). The ecologically significant wetland complex around Lake Pouarua is in the middle of the sheep and beef section of Lochinver Station.

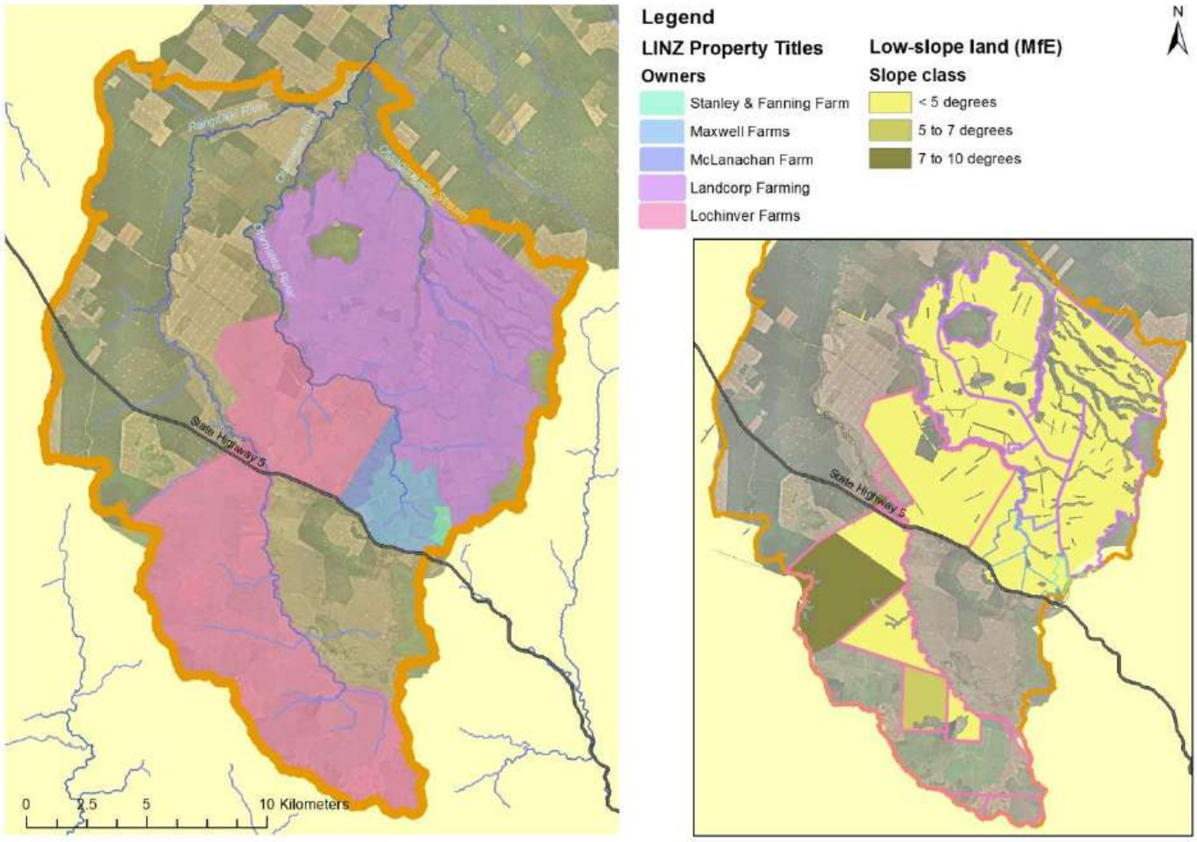

Figure 5.14 – Identified sub-catchment, land ownership and slope class

Three other much smaller farms (1,481 ha in total) north of SH5 would also be affected by Options 1 and 3; two of these are dairy farms and one is a sheep and beef farm. One of these farms (Stanley & Fanning) is only partially within the identified sub-catchment (and the Bay of Plenty region). There is also an additional smaller sheep and beef farm north of SH5 (Beijeman) but it is below the 20 ha threshold, therefore it is assumed to not be affected by the proposal.

The map on the right in Figure 5.14 shows the Ministry for the Environment's low-slope land classification for the sub-catchment. This shows that all properties north of SH5 (Rangitāiki Station, northern part of Lochinver Station and the three smaller farms) are in the <5 degrees slope class, and are therefore captured by Option 1. The southern part of Lochinver Station (south of SH5) has parcels that fall within each of the three different low-slope classes, and outside of the low-slope category. Therefore, it is unclear from the proposal whether Lochinver Station overall would be captured by Option 1, given that farms operate as entire units rather than by parcel. For the purpose of this assessment, it is assumed all five properties are captured by the proposal.

Aside from this ambiguity regarding the application of Option 1, it is worth considering some other practical challenges with implementation of Option 1 in particular. One aspect is the small number of landowners affected, and the difference between the large stations and the smaller farms.

This means that for some of the pastoral land uses (i.e. deer, dairy support, and high intensity beef) there is only one landowner for each so it would not be possible to calculate a percentile of nitrogen leaching (at least not one that would be different to their own). There are two landowners in dairy, and three in sheep and beef (assuming Lochinver station is indeed captured by Option 1). While it is theoretically possible to calculate a percentile across these, the impact of one property's leaching on the others will be significant. Although the Upper Rangitāiki is the sixth largest identified catchment (in terms of overall area), it has significantly fewer landowners than most other identified catchments and is less than a third of the size of the next largest identified catchment. Furthermore, the fact that two properties are partly outside the sub-catchment and the region may also present some implementation challenges.

Cost of reducing nitrogen losses

Figure 5.15 summarises the outputs of the characterisation of farming systems and mitigation practices relevant to this sub-catchment (Matheson, Djanibekov, Bird, & Greenhalgh, 2018). The mitigation practices modelled are listed in Appendix 6.2. As noted above, the characterisation of sheep and beef, and deer farming systems is based mainly on the operation of farming systems in this sub-catchment. The analysis assumes no baseline adoption of mitigation practices. In reality, it is likely that all landowners have already adopted at least some of the mitigation practices modelled. For example, feedback from Landcorp indicates that many of the mitigation practices modelled are already adopted within Rangitāiki Station (C. Bunny, pers. comm., 18 February 2019). The implication is that costs and nitrogen reductions are likely to be lower than shown here.

Figure 5.15 shows that the gains able to be achieved in terms of N loss reductions for drystock are marginal and come at a relatively significant cost. Although there is no available characterisation for dairy farms in this sub-catchment, they are likely to be less profitable than other dairy systems described in Matheson et al (2018) and the cost of N reductions are likely to be higher, although baseline N losses are likely to be lower. If we extrapolate these mitigation costs across the sub-catchment, the baseline sub-catchment profit for the affected land uses would decrease by 23% from $5.5m to $4.3m per year. These costs would be included within those described in section 3.C, for which the same mitigation practices are assumed.

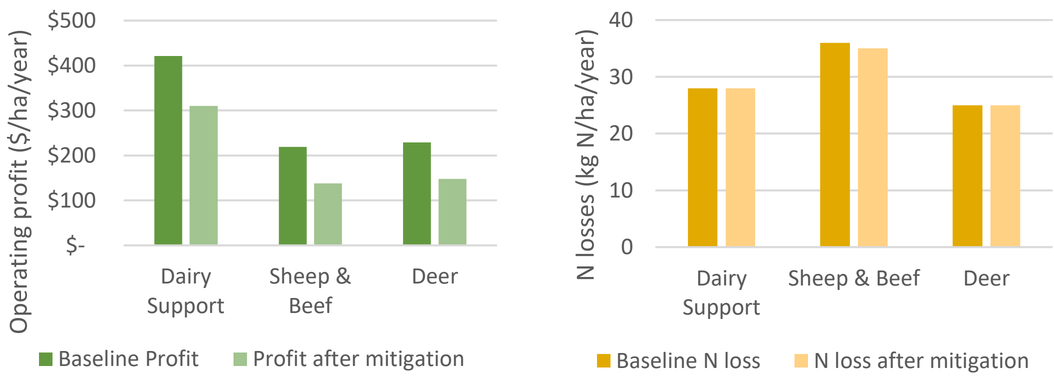

Figure 5.15 - Profit and N losses under before and after mitigation practices for drystock
Source: Matheson et al 2018

These mitigation practices were evaluated through the draft Rangitāiki WMA catchment model, taking into account assumptions about baseline mitigation uptake (Carter, Tingey, & Scholes, 2019 in prep). The preliminary results of the model indicate that the total cumulative TN load at the confluence of the Rangitāiki River and Otangimoana Stream can reduce by 4%, from 483 to 463 tonnes per year. It is important to bear in mind that, as noted above, 77% of the current TN load at that point is estimated to be natural.

There will also be some smaller administration costs for landowners (relative to mitigation costs) to get farm plans (under Option 3, but as noted above these are the same as those required under the farm planning proposal discussed in section 3.C) and audited Overseer files if they don't already have these[36]. BOPRC understands that Rangitāiki Station, Lochinver Station and at least one of the smaller dairy farms already have farm plans, although it is uncertain if these would meet the requirements of the farm planning proposal. Dairy farmers also generally have Overseer files as part of their Fonterra supply requirements. However, it is unlikely that these would fully meet the requirements of the proposal.

Nitrogen management summary and conclusions

The basis for selecting the upper Rangitāiki as a national priority catchment seems questionable. There are other catchments in the Bay of Plenty that would have been considered more heavily impacted by nitrogen, if natural nitrogen levels and receiving environments were taken into account. Because of the very few landowners affected, practical implementation of Option 1 could be challenging.

It is estimated that TN load in the sub-catchment could reduce by 4% through application of GMPs. However, this would lead to an estimated 23% reduction in sub-catchment operating profit per annum.

5.8 Stock exclusion

Proposal

The proposal (s. 360 regulations), summarised in Table 5.4 would require general exclusion from waterbodies over a metre wide on 'low-slope land' and on steeper areas with a high stocking rate carrying capacity. 'Low-slope land' has been mapped at a parcel level, where the average slope is <5°, <7° or <10°. The proposal would also require stock exclusion practices from smaller waterbodies and drains to be specified within farm plans. The proposal only applies to dairy cattle, dairy support cattle, beef cattle, pigs and deer; sheep, horses, goats and other livestock are not subject to the proposal.

[36] The discussion document assumes a cost of $3,500 per farm for developing a Farm Plan, plus $1,500 every two years for auditing. Cost of developing and auditing an Overseer file would be between $500 and $3,000 per year, depending on the quality and completeness of source information (L. Matheson, pers. comm.).

Table 5.4 - Proposed stock exclusion requirements for wetlands and large waterbodies

Stock exclusion on "Low-slope" land

Waterbody	Stock	Setback	Timeframe
Wetland	Dairy and dairy support cattle, pigs, beef cattle and deer	5 metres on average across a property (with a minimum width of 1m)	1 July 2021 for wetlands identified in regional or district plans. 1 July 2023 for all other wetlands
Wetland	Any new pastoral system for all cattle, pigs or deer establishing after gazettal	5 metres on average across a property (with a minimum width of 1m)	Immediately
Rivers (> 1 m wide), and lakes	Dairy and dairy support cattle and pigs	5 metres on average across a property (with a minimum width of 1m)	1 July 2021
Rivers (> 1 m wide), and lakes	Beef cattle and deer	5 metres on average across a property (with a minimum width of 1m)	1 July 2023
Rivers (> 1 m wide), and lakes	Any new pastoral system for all cattle, pigs or deer establishing after gazettal	5 metres on average across a property (with a minimum width of 1m)	Immediately
Rivers (> 1 m wide), and lakes	Land where any cattle or deer are feeding on fodder crops, or break feeding, or where pasture is being irrigated, or has been irrigated in the previous 12 months.	5 metres on average across a property (with a minimum width of 1m)	1 July 2021 Unless it is a new pastoral system established after gazettal, in which case, immediately

Stock exclusion from waterways on Non-low-slope land

Waterbody	Stock or land use	Setback	Timeframe
Wetland	Dairy and dairy support cattle, pigs, beef cattle and deer	5 metres on average across a property (with a minimum width of 1m)	1 July 2021 for wetlands identified in regional or district plans. 1 July 2023 for all other wetlands
Wetland	Any new pastoral system for all cattle, pigs or deer establishing after gazettal	5 metres on average across a property (with a minimum width of 1m)	Immediately
Rivers (> 1 m wide), and lakes	Dairy cattle, but not dairy support, and pigs (unless housed)	5 metres on average across a property (with a minimum width of 1m)	1 July 2021 Unless it is a new pastoral system established after gazettal, in which case, immediately
Rivers (> 1 m wide), and lakes	Beef cattle, dairy support cattle, and deer on land with a base carrying capacity • of 14SU/ha or more at the farm scale, or • 18 SU/ha or more at a paddock scale if the base carrying capacity is less than 14SU/ha at the farm scale	5 metres on average across a property (with a minimum width of 1m)	1 July 2023 Unless it is a new pastoral system established after gazettal, in which case, immediately
Rivers (> 1 m wide), and lakes	Land where any cattle or deer are feeding on fodder crops, or break feeding, or where pasture is being irrigated, or has been irrigated in the previous 12 months.	5 metres on average across a property (with a minimum width of 1m)	1 July 2021 Unless it is a new pastoral system established after gazettal, in which case, immediately

Timeframes vary by stock and waterbody type, as described in Table 5.4. Where an existing fence does not comply with setback requirements, it would be allowed to remain in place until 2025. If an existing fence has an average setback of at least 2m, and not less than 1m at any point, it could remain in place until 2035.

For waterbodies over a metre wide, the proposal requires a setback width of 5m on average across the farm, and at least 1m. Setbacks for smaller waterbodies and drains would be determined through farm plans.

Exemptions and extensions could be sought, presumably from the regional council.

Approach

The assessment focuses on rivers and streams over 1m wide, lakes and wetlands only. Wetlands and lakes are those identified in the BOPRC land use dataset, Price & Fitzgerald (2018) and a LINZ lake dataset, acknowledging this may not be a comprehensive list. For rivers and streams, wetted widths at MALF, estimated by Booker (2015), are used to identify rivers and streams over 1m wide using the River Environment Classification (REC) dataset. GIS analysis was used to estimate the length of fencing required and area of pastoral land that would need to be retired in setbacks.

For non-low-slope land, the methodology to estimate carrying capacity in relation to beef, dairy support and deer, and therefore to identify where the requirement would apply, is highly complex and BOPRC understands that necessary data for the North Island is not available. Furthermore, it is not possible to accurately identify areas where cattle or deer would regularly feed on fodder crops, that operate break-feeding, or where there is current or historical irrigation. Therefore, the analysis assumes that the requirement would apply to all of these land uses in non-low-slope land, for rivers over 1m wide, wetlands and lakes.

In addition, BOPRC's land use dataset does not distinguish between sheep and beef. These limitations may result in an over-estimation of the impact of the proposal for these land uses in these areas, although it is unclear by how much.

Another area of uncertainty is the extent of current stock exclusion and setbacks, and whether existing setbacks comply with the proposal. The vast majority of dairy farmers would have already fenced waterbodies subject to the proposal under the Sustainable Dairying Water Accord (DCANZ & DairyNZ, 2019). However, it is assumed that for most dairy farms, setbacks would not meet the setback requirements of the proposal, so fence shifting will be required. For drystock, it is assumed that the extent of current stock exclusion is much lower, and again there is uncertainty about whether setbacks, where they exist, would meet the requirements of the proposal.

Relevant costs assumed in the analysis are summarised in Table 5.5 below[37]:

Table 5.5 - Assumed stock exclusion costs

Land Use	Fencing costs ($/km)	Setback weed control ($/ha/year)	Lost profit in setbacks (S/ha/year)
Dairy	$5,000		$1,115-$2,582
Sheep & beef	$14,000	$130	$133-421
Deer	$26,000		$229

It is assumed that farm systems would remain viable under the proposed setbacks, i.e., that the same stocking rates are able to be maintained, although this would likely vary between farms. The riparian practices modelled in Matheson et al. (2018) were different than those set out in the proposal; the proposal requires more pasture to be retired into setbacks.

Assessment

Table 5.6 shows the total area of the affected land uses in the region, the area that would need to be retired from grazing into setbacks and the length of fencing required, for each one of the slope categories proposed. This ignores any existing riparian fencing or setbacks that meet the proposal's conditions so presents a worse-case scenario.

[37] From Matheson et al. 2018. Fencing costs are broadly consistent with those quoted in the *Essential Freshwater* discussion document. They do not include setback planting and maintenance costs, other than weed control, or any subsidies. As described in Matheson et al. 2018, in situations where fences need to be relocated to comply with the proposed setback requirements (i.e. assumed to be most dairy farms and some drystock farms), it is assumed some materials could be reused. However, labour costs would be greater than for new fencing. Therefore, it is assumed that relocation costs would be the same as the cost of new fencing.

Table 5.6 - Estimates of grazing area to be retired in setbacks and length of fence lines required

Land use	Area (ha)			Setbacks (ha)			Fence lines (km)		
	Low-slope land[38]	Steeper land	Total	Low-slope land	Steeper land	Total	Low-slope land	Steeper land	Total
Dairy	56,308-76,091	46,738	122,829	518-738	567	1,305	887-1,241	893	2,134
High intensity beef grazing & dairy support	3,195-5,178	6,042	11,220	32-46	94	140	50-77	154	231
Sheep and beef	12,892-21,020	79,378	100,398	222-298	772	1,070	195-307	1,299	1,606
Deer	4,438-5,242	5,076	10,318	17-21	35	56	33-42	65	107
Total	**76,834-107,531**	**137,234**	**244,765**	**788-1,103**	**1,467**	**2,571**	**1,165-1,667**	**2,411**	**4,078**

It is estimated that across the region, about 1.1% of total grazing area (or 2,571 hectares) for the affected land uses will need to be retired into setbacks. Furthermore, an estimated 4,078 kilometres of fence lines (or other exclusion method if available) would be required. The majority of this area and fence line length will be on dairy, and sheep and beef land, largely due to the greater proportion of those land uses in the region.

As noted above, although virtually all dairy farmers have already fenced waterbodies subject to the proposal, it is assumed the vast majority of them will need to shift fence lines to comply with the proposed setback requirements. It is assumed most drystock farmers would either have to provide stock exclusion for the first time, or shift existing fence lines to comply with setback requirements.

Based on the assumed costs described above and the highest estimates of setbacks and fence lines identified in Table 5.6, total costs of fencing required across the region would be up to $39.2m. As capital costs, these could be spread over several years. For example, if this cost is annualised over 25 years (the typical life of a fence) at a 6% interest rate, the cost would be $3m per year. Lost profit in setbacks is estimated to be $2.9m per year. The distribution of these costs across different land uses is detailed in Table 5.7 below. To put these costs in context, the estimated baseline profit per hectare for these land uses across the region is estimated to be about $190m per year.

[38] In the discussion document, there are three options for how to define ‘low-slope’ land, i.e. <5°, <7° and <10° on average at parcel level. In this table, when referring to low-slope land, the first number refers to the first option and the second number refers to the third option. Total values are based only on the third option.

Table 5.7 - Estimated fencing costs and lost profit from proposed stock exclusion requirements

Land use	Total fencing costs	Lost profit in setback per year (including weed control costs)
Dairy	$10.7m	$2.5m
Sheep & beef (including high intensity grazing and dairy support)	$25.7m	$0.4m
Deer	$2.8m	$20,000
Total	**$39.2m**	**$2.9m**

Increased demand for fencing contractors will potentially create new employment opportunities, although it could also increase the costs of fencing if not matched by increased supply. Likewise, increased demand for fencing materials could also increase fencing costs.

Stock exclusion summary and conclusions

Significant benefits are expected from stock exclusion including reduced contaminant losses, reduced risk from swimming and creating opportunities for habitat and aesthetic improvements through riparian planting (although riparian planting per se is not part of the proposal). Although stock exclusion and setbacks will reduce contaminant losses into waterways, there is uncertainty about the level of effectiveness of different setback widths to mitigate against different contaminants in different circumstances and locations (e.g. Valkama et al. (2018), Zhang et al. (2010)). Therefore, it is not possible to determine what would be an ‘optimal’ setback width.

The costs include fencing, whether new fences or re-locating fences that do not meet setback requirements, and lost profit from setbacks. Timeframes for the proposal vary by waterbody type and land use. As capital costs, fencings costs could also be spread over several years, which would make the cost more manageable for landowners. However, this is subject to landowners being able to access the necessary funds either from available cash flow or additional debt. Farmers that have recently completed fencing their waterways (e.g. under the Sustainable Dairying – Water Accord) would likely be highly frustrated at having to relocate their fences under the proposal. This will also divert resources from other initiatives (e.g. implementation of other GMPs through farm plans). To mitigate this impact and cost, consideration should be given to extending required timeframes to more closely align with the typical lifetime of a fence, when stock exclusion is already in place.

5.9 Case study summary, discussion and conclusions

Table 5.8 summarises the assessed impacts of all five proposals in this case study, their timeframes and the expected benefits. For farm plans and stock exclusion, which are expected to have the most significant long term impacts across the whole region, this information is also presented in comparison to baseline operating profit for the Kaituna-Pongakawa-Waitahanui and Rangitāiki WMA farm systems modelled by Matheson et al (2018) (Figure 5.16).

Table 5.8 - Summary of estimated costs, timeframes and expected benefits

Proposal	Estimated costs	Timeframe	2020-25	2025-35	2035+	Expected benefits
DIN/DRP attributes	? – Proposal is likely to not apply across all or most of the region due to naturally elevated nutrient levels and/or sensitive downstream receiving environments requiring higher levels of nutrient reduction. Tarawera and Rangitāiki WMAs could possibly be affected. If so, cost could be significant (e.g. large scale land use change required, no opportunity for intensification).	To be determined within Regional Plan				Nil – except perhaps reduced macrophytes in catchments where the proposal would actually apply (e.g. possibly Tarawera WMA?)
Restriction on land use intensification	Assumed to affect ~200 large properties across the region (~9,300ha) that would be converting to irrigated horticulture by 2025. Assumed $7,000 administration costs per property or $1.3m total. Delays in economic and environmental gains from conversions from arable and pasture to irrigated horticulture (kiwifruit and avocado). High risk land use changes are expected to be rare by 2025 but administration cost per property is assumed to be the same. Potential short term impact on land values.	2020 – 2025, regulation would cease to apply once the Regional Plan has fully implemented the proposed NPS-FM.				Potential short term increase in land values of smaller properties not subject to the proposal. Strong protection against high risk land use changes to ensure no increase in contaminant losses. Questionable benefits in relation to irrigated fruit crops.
Farm plans	Farm plan development and auditing costs assumed to be $3,500 (one-off) and $1,750 (every	Farm plan development by 2025, with high risk				Generating baseline contaminant loss and farming practice information.

Proposal	Estimated costs	Timeframe	2020-25	2025-35	2035+	Expected benefits
	year) respectively per property, adding up to $3.6m/year across the region. Farm plan implementation costs up to $35m per year across the region, but spreadable over a longer timeframe.	activities or areas prioritised. Farm planner capacity is likely to be a significant constraint to achieve the 2025 timeframe. Farm plan implementation to be determined within each plan, presumably informed by risk and regional priorities.				Potentially improved financial performance and resilience of individual farms, subject to complementary education and support services. Tailored adjustments to farming practices lead to reduction in contaminant losses (including greenhouse gases) and improved ecosystem health. Platform for other modules (e.g. greenhouse gases, biodiversity, animal welfare, etc.)
High N catchments (Upper Rangitāiki, upstream of confluence with Otangimoana Stream)	Five landowners affected. Administration costs. It is estimated the sub-catchment annual profit would fall by about 23% if all landowners applied GMPs. Potential implementation challenges.	2020 – 2025, regulation would cease to apply once the Regional Plan has fully implemented the proposed NPS-FM.				Questionable given high natural N load (significant cost in GMP uptake for 4% reduction in N load).
Stock exclusion	Fencing costs (including fence re-location where setbacks are less than requirement): $39.2m across the region, or $3m per year annualised over 25 years at a 6% interest rate. Lost profit in retired setbacks $2.9m per year across the region (including weed control but not riparian planting).	2035 at the latest. Timeframe varies by land use and waterbody type, and whether existing fences meet setback requirements.				Reduced streambank erosion and contaminant losses through filtering. Opportunity for riparian planting which in turn increases shading, improves habitat, sequesters carbon, improves aesthetic values and biodiversity. Increased amenity and recreational opportunities, lower risk of sickness from swimming. Increased employment opportunities for fencing contractors.

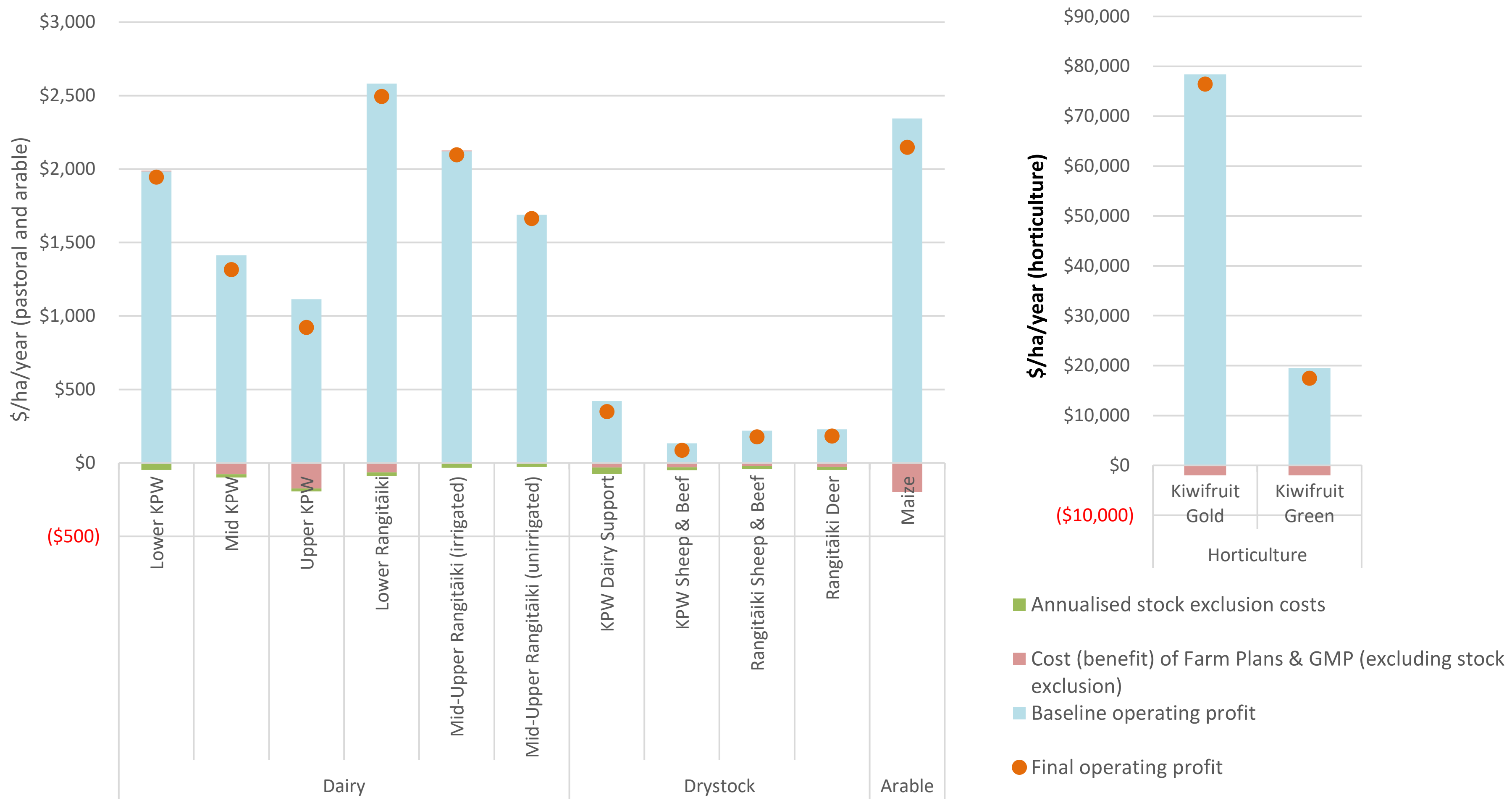

Figure 5.16- Estimated impact of farm plan and stock exclusion proposal on Kaituna-Pongakawa-Waitahanui and Rangitāiki WMA farms (based on Matheson et al. 2018)[39]

[39] Annualised stock exclusion costs assume costs are spread over 25 years at a 6% interest rate, and that exclusion from large waterbodies is required for all drystock on steeper land, regardless of base carrying capacity. This includes fencing, lost profit and weed control in setbacks but excludes riparian planting and any subsidies. This also assumes that all farm systems will remain viable with the proposed setbacks, i.e., that no reduction in stocking rates is necessary. It is assumed effective area is 90% of total area on average.

It is clear from Figure 5.16 that drystock is likely to be more heavily impacted due to their lower baseline profit. Although the impact on dairy at farm level does not appear that significant, the operating profit figures do not take into account debt servicing. Farm debt in the drystock sector is not understood to be a systemic issue as it is in dairy, but some individual drystock farmers would also have high debt levels. The Reserve Bank (2019) has identified debt in the dairy sector in particular as one of the biggest risks to financial stability. Banks are taking a more conservative stance on dairy debt, which is likely to make financing of environmental expenses, such as those required by these proposals, more challenging. This situation leaves farmers, dairy in particular, vulnerable to increased costs (such as those required by these proposals) or price drops. The average debt level for dairy farms in the Bay of Plenty in 2017-18 was $24,638 per hectare (DairyNZ, 2019), although there would be wide variation on that figure for individual farmers.

There is a risk that the proposals would lead to some landowners going out of business and defaulting on their loans, particularly when considered alongside other upcoming requirements (e.g. Zero Carbon Bill, other aspects of *Essential Freshwater* proposals not evaluated here) or external shocks (e.g. price drops). If these impacts are widespread, there could potentially be significant social and economic implications for the region (and nationally). The analysis presented here does not look at on-going viability of farming businesses, or the implications of widespread farm unviability.

Still focusing on the farm plans and stock exclusion proposals, Table 5.9 follows from Table 5.2 with the addition of annualised stock exclusion costs (subject to the same assumptions as in Figure 5.16). The overall impact of both proposals on the regional primary sector annual operating profit is estimated to be a 5.5% reduction, with drystock being more heavily impacted due to lower baseline profits and fewer farm systems 'levers' to pull. Annualised stock exclusion costs would obviously be sensitive to the period over which the costs are spread and the interest rate assumed.

Table 5.9 - Estimated region-wide impact on operating profit by industry of farm plans and stock exclusion proposals

Land use	Total number of farming businesses	Total area (ha)	Estimated number of farming businesses within size thresholds	Estimated total area within size thresholds (ha)	Estimated Baseline operating profit/year	Estimated profit after Farm Plans & mitigation/year	Estimated operating profit after FPS, mitigation and stock exclusion (annualised)	Percentage change from baseline operating profit
Kiwifruit	1,452	16,057	884	13,595	$ 500.1m	$ 481m	$ 481m	-4%
Other horticulture	845	3,735	316	2,338	$ 58.2m	$ 51,7m	$ 51.7m	-11.2%
Sheep & beef	990	96,508	479	85,621	$ 13.9m	$ 11.4m	$9.4m	-32.1%
Arable/grain growing	50	8,037	50	4,192	$ 15.1m	$ 14m	$14m	-6.8%
Dairy	639	119,426	605	111,856	$ 175m	$ 166.4m	$165.6m	-5.4%
Deer	48	6,801	46	6,554	$ 1.2m	$ 1m	$0.84m	-32.5%
Total	**4,024**	**250,565**	**2,379**	**224,157**	**$ 764.3m**	**$ 725.6m**	**$722.6m**	**-5.5%**

A more detailed assessment will be required to confidently estimate the impact of the proposals on regional GDP. The total direct contribution of agriculture to regional GDP is about 7%. It is estimated that horticulture has a flow-on impact on other industries (indirect and induced) of about half its direct contribution to regional GDP, while the pastoral and arable sectors have a flow-on impact of about a third of their direct contribution.[40] While many of the proposals will affect direct and flow-on contributions to regional GDP, there are a number of factors that will determine the extent of this.[41] The extent of impacts on farm viability (as discussed above) and landowner responses (as discussed below) are two key factors. Furthermore, some of the flow-on impacts of the agricultural sector on the regional economy are likely to increase (e.g. through additional fencing and farm planning expenses). However, the agriculture sector contribution to regional GDP is likely to continue to increase, probably by more than the estimated impact of the proposals, due to on-going conversions to horticulture, regardless of the intensification proposal.

The assessment presented here should be considered indicative and preliminary. There a number of uncertainties and assumptions, described in more detail within the assessment for each proposal, that must be noted. The analysis has relied on readily available information, able to be sourced and analysed in a limited timeframe.

Importantly, the analysis assumes no adjustment by landowners. In reality, landowners are likely to respond to any regulatory changes in a number of ways, which would reduce the overall impact of the proposals. For example, landowners may choose to change land use (e.g. from drystock to forestry, or dairy to horticulture) as a way to avoid some of the costs of the proposals (although acknowledging those choices will also carry other costs). Likewise, landowners may choose to leave the industry before these costs ‘bite’. Equally, as described above, if the proposals (along with other shocks) lead to many landowners going out of business, the implications would be greater than assessed here.

It will be important for final decisions on these proposals to focus on those which will have the greatest expected benefits (e.g. farms plans, stock exclusion, intensification restriction for high risk land use changes) while ensuring that transition times do not compromise the on-going viability of the primary sector.

[40] Bay of Plenty input-output tables generated by Geoff Butcher, based on Statistics New Zealand 2013 input-output tables.
[41] By way of comparison, the estimated economic impacts of PC10 (Lake Rotorua nitrogen management) were estimated to be 0.09% and 0.03% of the Rotorua District’s and Bay of Plenty’s GDP respectively (Market Economics, 2015).

5.10 References

Booker, D. (2015). *Hydrological indices for national environmental reporting.* Christchurch: NIWA (Report for Ministry for the Environment).

Carter, R., Suren, A., & Scholes, P. (2017). *Water quality and ecological attributes for rivers and lakes in the Bay of Plenty.* Whakatane: Bay of Plenty Regional Council (Environmental Publication 2017/06).

Carter, R., Suren, A., Dare, J., Scholes, P., & Dodd, J. (2018). *Fresh water in the Bay of Plenty: comparison against the recommended water quality guidelines.* Whakatane: Bay of Plenty Regional Council (Environmental Publication 2018/10).

Carter, R., Tingey, D., & Scholes, P. (2019 in prep). *Surface water quality modelling results for the Kaituna and Rangitaiki WMAs.* Whakatane: Bay of Plenty Regional Council (Environmental Publication).

DairyNZ. (2019). *DairyNZ Economic Survey 2017-18.* Hamilton: DairyNZ.

Dare, J. (2019 in prep). *DRAFT Recreational waters surveillance report - 2018/2019 Bathing Season.* Whakatane: BOPRC (Environmental Publication).

DCANZ & DairyNZ. (2019). *Sustainable Dairying - Water Accord: A commitment to New Zealand by the dairy sector- Five Years On, Progress Report for the 2017/18 season.* Hamilton: DCANZ & DairyNZ.

Donald, R., Bruere, A., & Park, S. (2019). *Lake Rotorua Science Review - Summary Report.* Whakatane: Bay of Plenty Regional Council (Environmental Publication 2019-02).

Fitzgerald, N., & Price, R. (2018). *Wetland extents mapping: Tauranga Moana Water Management Area.* Hamilton: Manaaki Whenua Landcare Research (Report to BOPRC).

LAWA. (2013, December 12). *Factsheet: phosphorus*. Retrieved September 5, 2019, from Land Air Water Aotearoa: https://www.lawa.org.nz/learn/factsheets/phosphorus/

Market Economics. (2015). *Economic impacts of Rotorua nitrogen reduction: district, regional and national evaluation.* Auckland: Market Economics (for BOPRC).

Matheson, L., Djanibekov, U., Bird, B., & Greenhalgh, S. (2018). *Economic and contaminant loss impacts on farm and orchard systems of mitigation bundles to address sediment and other freshwater contaminants in the Rangitaiki and Kaituna-Pongakawa-Waitahanui Water Management Areas.* Perrin Ag Consultands Ltd & Manaaki Whenua Landcare Research (Report for BOPRC).

Matthews, Y. (2018). *Kaiate Falls water quality: an assessment of public preferences for intervention options.* Hamilton: YSM Research (Report for BOPRC).

Mawer, J., Loft, J., Zhao, H., & Williamson, J. (2019). *Kaituna and Rangitaiki catchment models.* Auckland: Williamson Water and Land Advisory (Report for BOPRC).

McBride, G., & Soller, J. (2017). *Technical background for 2017 MfE 'Clean Water' Swimmability Proposals for Rivers.* Christchurch: NIWA (Report FWWQ1722).

McIndoe, I., & Kashima, A. (2018). *Freshwater constraints to economic development.* Christchurch: Aqualinc Research (Report to the Bay of Plenty Regional Council).

Milne, J., Madarasz-Smith, A., & Davie, T. (2017). *Recreational water quality monitoring and reporting in New Zealand: a position paper prepared for the New Zealand regional sector group.* Wellington: NIWA (Science and Technology Series Report No. 82).

Park, S. (2018, November 16). Setting interim guidelines for nutrient loads to Maketu and Waihi estuaries. Internal Bay of Plenty Regional Council Memorandum.

Parliamentary Commissioner for the Environment. (2012). *Water quality in New Zealand: understanding the science.* Wellington: Parliamentary Commissioner for the Environment.

Reserve Bank of New Zealand. (2019). *Financial Stability Report - May 2019.* Wellington: RBNZ.

Scrimgeour, F., Hughes, W., & Kumar, V. (2017). *The economic contribution of kiwifruit industry expansion to the Bay of Plenty, Northland and New Zealand economies (A report for Zespri International Ltd.).* Hamilton: Institute for Business Research, University of Waikato.

Snelder, T., Image, K., & Suren, A. (2019). *Analysis of habitat factors influencing invertebrate communities in streams of the Bay of Plenty Region.* Christchurch: LWP (Client Report 2018-14).

Statistics New Zealand. (2015). *Census 2013.* Retrieved February 2017, from http://www.stats.govt.nz/Census/2013-census.aspx

StatsNZ. (2018, May 8). *Agricultural production statistics: June 2017 (final)*. Retrieved August 2019, 1, from https://www.stats.govt.nz/information-releases/agricultural-production-statistics-june-2017-final

StatsNZ. (2019, August 6). *Labour market statistics: June 2019 quarter*. Retrieved August 15, 2019, from https://www.stats.govt.nz/information-releases/labour-market-statistics-june-2019-quarter

StatsNZ. (2019, March 19). *Regional goss domestic product: Year ended March 2018*. Retrieved August 1, 2019, from https://www.stats.govt.nz/information-releases/regional-gross-domestic-product-year-ended-march-2018

StatsNZ. (n.d.). *Population*. Retrieved August 2019, 1, from https://www.stats.govt.nz/topics/population

Valkama, E., Usva, K., Saarinen, M., & Uusi-Kamppa, U. (2018). A meta-analysis on nitrogen retention by buffer zones. *Journal of Environmental Quality*.

Williamson Water & Land Advisory. (2019). *Kaituna and Rangitaiki catchment models: APSIM modelling report.* Auckland: WWLA (Report for BOPRC).

Zhang, X., Liu, X., Zhang, M., Dahlgren, R., & Eitzel, M. (2010). A review of vegetated buffers and a meta-analysis of their mitigation efficiency in reducing nonpoint source pollution. *Journal of Environmental Quality*, 76-84.

5.11 Appendices

Appendix 5.1- Other proposals

This section presents a brief analysis of the implications of two other proposals not considered above.

E. coli attribute table for swimming sites during the bathing season

Under the proposed NPS-FM, a new attribute table for *E. coli* is included, applicable only to swimming sites during the bathing season (November to March), in addition to the existing *E. coli* attribute table. This attribute table is based on the 2003 Microbiological Water Quality Guidelines, which are acknowledged to be outdated and in need of review within the discussion document itself and also in Milne et al. (2017).

Under the current NPS-FM, only 11 of 42 monitored sites throughout the Bay of Plenty are considered not suitable for swimming (Dare, 2019 in prep). Under the proposed NPS-FM, 20 out of 42 monitored sites would fail the proposed E. coli bottom-line for swimming sites during the bathing season (Figure 5.17).

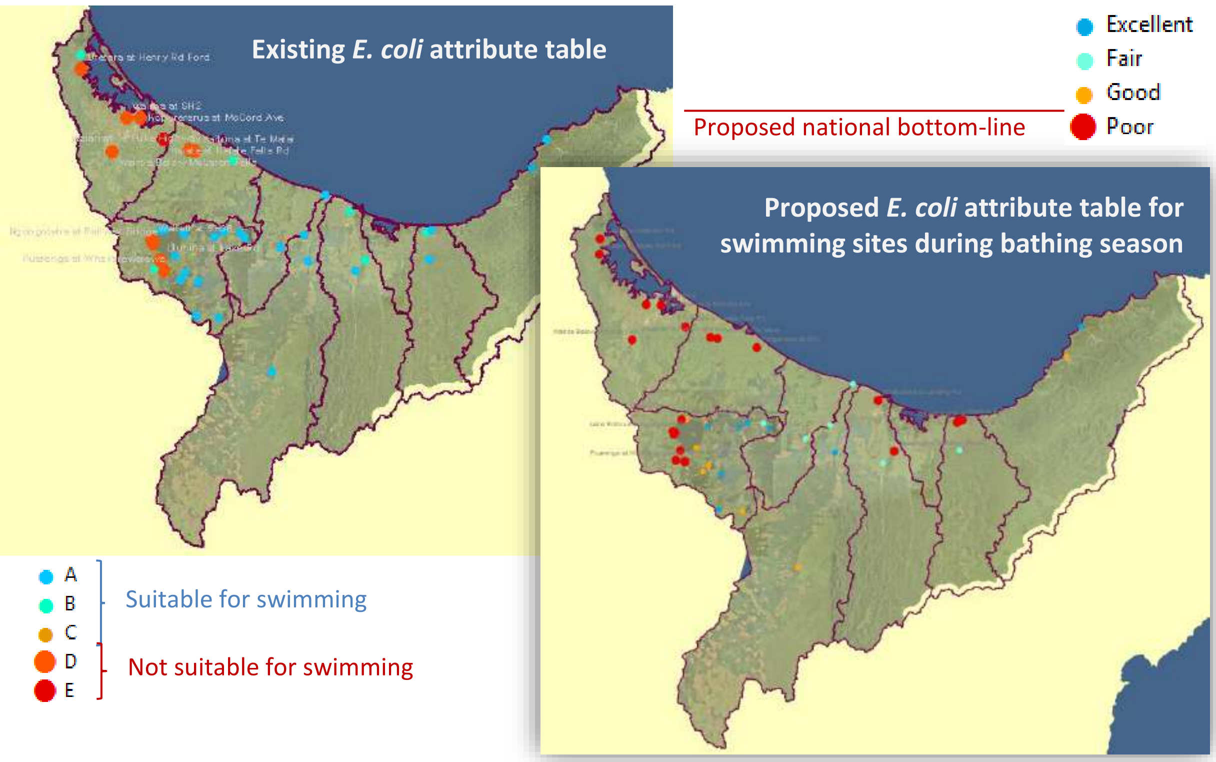

Figure 5.17 - *E. coli* attribute bands under existing and proposed *E. coli* attribute tables

Figure 5.18 shows the assessed current state (95^{th} percentile and median) relative to the proposed bottom-line (95^{th} percentile), for monitored sites that would fail the proposed bottom-line. The large differences between 95^{th} percentiles and medians suggest that the bottom-line failures are likely to be driven mainly by rainfall events, when most people are unlikely to be swimming.

Even under the current attribute table, the process to achieve a suitable for swimming state is very complex and potentially costly. For example, the annualised cost of fully fencing the catchment upstream of the Kaiate Falls (one of the swimming sites considered not suitable for swimming under the current NPS-FM) is estimated to be nearly five times the estimated annual catchment profit, and it is uncertain whether that intervention will make the site suitable for swimming (Matthews, 2018). It would generally be reasonable to expect that the proposed bottom-line could be achieved for sites where the difference between the current state and bottom-line is relatively small (e.g. through GMP, stock exclusion, land use change). However, for sites where the difference is large (e.g. Kaiate Falls), it may not be possible to meet the proposed bottom-line without more significant change and cost, if at all.

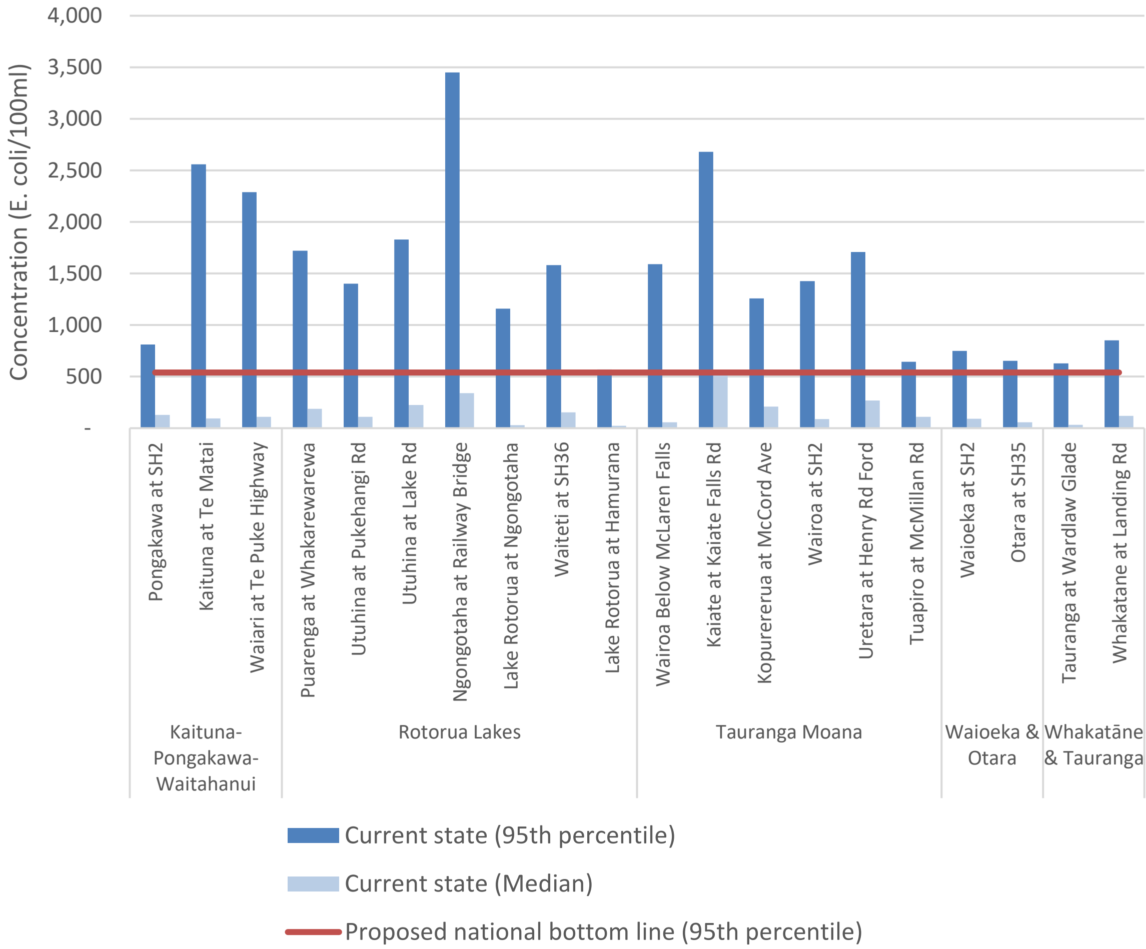

Figure 5.18 - Assessment of current state relative to proposed *E. coli* bottom-line for sites that would fail it
Source: J. Dare, pers. comm.

The 2017 NPS-FM amendments to the *E. coli* attribute table were found to be a sound approach to determine suitability for swimming (McBride & Soller, 2017). Given the likely expense and complexity that the proposed new attribute table is likely to require, for questionable benefit, the existing *E. coli* attribute table seems preferable, perhaps with the introduction of a national bottom-line which is currently lacking.

Compulsory telemetry

The discussion document also proposes to require telemetry for water users, starting with consents taking more than 20 L/s. The discussion document quotes costs of between $600 and $1,800 for a telemetry unit, and transmission costs of between $20 and $99 per month, depending on location.

There are 1,379 consumptive freshwater take consents in the Bay of Plenty. Of these, 720 (52%) are for takes ≥ 5 L/s which are subject to the Water Metering Regulations. Of these, only 205 consents (or 15% of all consents) are currently using telemetry to submit water use records, either because they are required to do so under consent conditions or the regulations (149), or because they are doing it voluntarily (56) (A. Gilchrist, pers. comm.).

Accurate water use data is essential to assess compliance with individual consent conditions and overall allocation limits of a resource; and therefore to manage the resource.

Water use data quality for consents not using telemetry is generally so poor that it renders their information of very limited use for the purposes above. Given the cost of telemetry relative to water users' profit (as described above), and the limited quality and completeness of current water use data in the Bay of Plenty, this proposal is strongly supported. Consideration should be given to extending the coverage of the requirement to all (or more) permanent consumptive takes and bringing implementation timeframes forward.

Appendix 5.2 – Mitigation practices

Source: Matheson et al., 2018

Shaded practices were not considered in the analyses.

DAIRY	1	Placement of feeding equipment
	2	Timing of effluent application in line with soil moisture levels (assumes sufficient storage)
	3	Reduced tillage practices
	4	Improved nutrient budgeting and maintenance of optimal Olsen P
	5	Laneway run-off diversion
	6	Grow maize on effluent blocks (if already growing maize)
	7	Elimination of summer cropping
	8	Reductions in seasonal stocking rate
	9	Efficient fertiliser use technology
	10	Efficient irrigation practices (soil moisture monitoring)
	11	Use of plant growth regulators [to replace N]
	12	Adoption of low N leaching forages
	13	Relocation of troughs
	14	Slow release phosphorus fertiliser RPR
	15	Reduce autumn N application – replace with appropriate low(er) N feed
	16	3m average vegetated and managed buffer around rivers, streams, lakes and wetlands subject to the Dairy Accord; 1m around drains; 5m average buffer on slopes between 8 and 16 degrees, 10m average buffer on slopes above 16 degrees.
DRYSTOCK (sheep & beef, deer, dairy support)	1	Improved nutrient budgeting and maintenance of optimal Olsen P
	2	Efficient fertiliser use technology
	3	Stock class management within landscape
	4	Adopt M1 arable cultivation practices for winter cropping
	5	Laneway run-off diversion
	6	Relocation of troughs
	7	Appropriate gate, track and race placement, design (where possible)
	8	Targeted space planting of poles
	9	Slow release phosphorus fertiliser RPR
	10	Adoption of low N leaching forages
	11	Full stock exclusion from all waterbodies greater than 1m wide at any point adjacent to farm (including drains) and wetlands. 2m average vegetated and managed buffer around rivers, streams, lakes and wetlands; 1m around drains; 3m average buffer on slopes greater than 8 degrees (or mid catchment); 5m average buffer on slopes greater than 16 degrees (or upper catchment) with associated reticulation

ARABLE	1	Grass or planted buffer strips (1m)
	2	Complete protection of existing wetlands
	3	Maintain optimal Olsen P
	4	Efficient fertiliser use and technology
	5	Cover crops between cultivation cycles
	6	Manage risk from contouring
	7	Reduced tillage practices
HORTICULTURE	1	Complete protection of existing wetlands
	2	Maintain optimal Olsen P
	3	Laneway run-off diversion
	4	Efficient fertiliser use and technology
	5	Efficient irrigation practices (soil moisture monitoring, not following fertiliser application)
	6	Grass swards under canopy, minimise bare ground and vegetated buffers around waterways.

Appendix 5.3 – Implications for Māori land

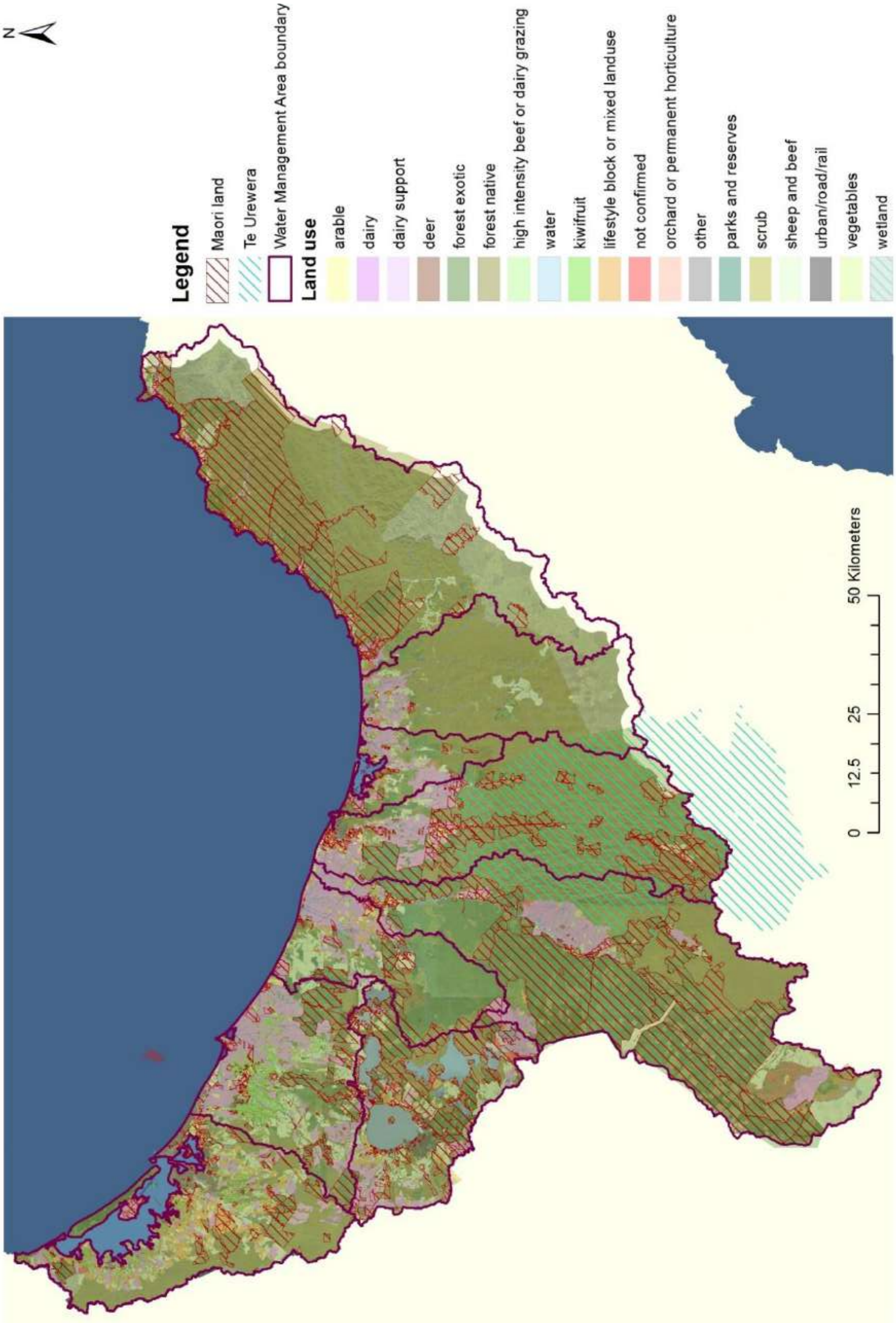

Figure 5.19 – Māori land in the Bay of Plenty region

This appendix replicates the assessment described in the body of the report, but focusing on Māori land in the Bay of Plenty (Figure 5.19). For the purpose of this assessment, Māori land is defined as land included in the Māori Land Online database[42] as at December 2015, with various additions, corrections and amendments from other sources. These include some land returned under Treaty Settlements since. Māori land included here should be considered indicative only as not all Māori land in the Bay of Plenty is necessarily identified as such. Furthermore, no distinction is made for Māori land under different forms of tenure, although this would be a key determinant of potential development opportunities.

Increasing the productivity of Māori land was a key opportunity identified in the Bay of Plenty Regional Growth Study (Schoefisch, Knuckey, Leung-Wai, Hall, Baguley, & Paling, 2015). Historically, Māori land has faced a range of barriers to development.

As described by McIndoe & Kashima (2018), Māori land in the Bay of Plenty encompasses 415,000 hectares, or about a third of the region's land area. The vast majority of this land is currently under exotic (47%) and native (39%) forestry. Of the proportion in exotic forestry, about 90,000 hectares are within high capability land[43], which could theoretically be converted into other land uses. However, due to established lease arrangements, national policy direction/legislation and challenges involved in changing land use, it is unlikely that much of this land will convert into other land uses in the short to medium term. There are only 28,000 hectares of high capability Māori land across the Bay of Plenty in other land uses, which could more realistically be further developed or converted in the short to medium term. Figure 5.20 shows the distribution of land use for Māori land in the Bay of Plenty.

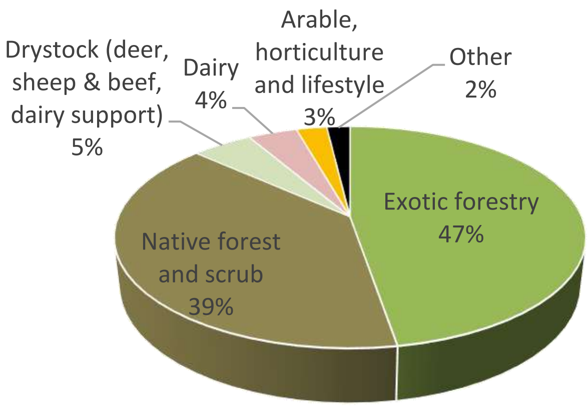

Figure 5.20 - Land use distribution, Māori land in the Bay of Plenty

[42] The database includes land that falls within the jurisdiction of the Māori Land Court under Te Ture Whenua Māori Act 1993 and other legislation – this is primarily Māori Customary and Māori Freehold Land, but also includes, General Land Owned by Māori, Crown Land Reserved for Māori and some Treaty Settlement reserves, mahingā kai and fishing rights areas.

[43] This is defined here as land classified in the Land Use Capability (LUC) categories 1 to 4, as identified in the New Zealand Land Resources Inventory database, for indicative purposes only. It is acknowledged that there can be productive land in other LUC categories.

A third of all Māori land in the Bay of Plenty is held in trust by CNI Iwi Holdings Ltd., on behalf of Central North Island iwi. Most of this land is in exotic forestry within the Rangitāiki WMA.

DIN and DRP attributes

As described in section 5.4, only five monitoring sites across the Tarawera and Rangitāiki WMAs may be affected by the proposed DRP attribute. There is Māori land upstream of these sites. In the Tarawera WMA, Māori land is currently in forestry (native and exotic), sheep and beef, and dairy, although most is of low capability so is unlikely to develop. In the Rangitāiki WMA, Māori land is mostly in exotic forestry within the Kāingaroa Forest, a large proportion of which is of high capability so it could theoretically be developed. Should the DRP attribute actually apply in these WMAs (i.e., if after more detailed assessment elevated DRP levels are determined not to be due to natural causes), it is likely that any development of Māori land would be significantly constrained and existing pastoral land uses would either need to reduce in intensity or convert to forestry.

Restrictions on land use intensification

Of the 44,100 hectares across the region that could be suitable for conversion, mainly from pasture, to horticulture, 11,000 of these are on Māori land across 1,267 properties, mostly in the Rangitāiki, Whakatāne/Tauranga and East Coast WMAs. When the proposed NES-FW size thresholds (i.e. >20 ha pastoral and arable properties, and >10 ha conversions) are applied, the extent of potential land use change on Māori land captured by the proposal is reduced to 7,542 hectares across 183 properties. Assuming, as in section 5.5, that only a quarter of this growth would realistically occur by 2025 and that it would be irrigated, Table 5.10 shows the number of properties and area of Māori land that would be affected by the proposal. There are more than 1,000 properties on Māori land that would be suitable for conversion to horticulture but that, due to their small size, would be exempt from the proposal.

Relative to all other land, Māori land is dominated by a large number of small parcels with multiple owners. A notable exception to this is the CNI Iwi Holdings land described above. Property ownership has been used to determine the area and number of properties affected. However, for Māori land in particular, this approach may underestimate the impact as several small parcels below the proposed NES-FW size thresholds owned by different parties may in fact operate as a single larger farming business, which may in fact fall within the size thresholds.

Table 5.10 - Estimate of irrigated horticulture conversions on Māori land by 2025 within proposed NES-FW size thresholds by WMA (assuming 25% of convertible area within size thresholds would actually convert by 2025)

Water Management Area	Number of properties with suitable land above size threshold	Convertible area above size threshold (ha)
Tauranga Moana	5	119
Kaituna-Pongakawa-Waitahanui	5	150
Tarawera	3	120
Rangitāiki	10	522
Waioeka & Otara	0	0
Whakatāne & Tauranga	9	386
Ōhiwa Harbour & Waiōtahe	1	55
East Coast	14	533
Total	**47**	**1,885**

As described in section 5.5, although there is a large proportion of Māori land in the Rotorua Lakes WMA, it is assumed no conversions in this area would be captured by the proposal. This is due to the WMA being generally unsuitable for irrigated horticulture, current planning restrictions and conversions from forestry to pasture currently being uneconomic.

Bearing in mind the per property administration costs described in section 5.5, the total cost of obtaining consents for conversion for the 47 properties listed above would add up to $329,000. As noted in section 5.5, the lack of an available tool to assess contaminant losses from irrigated horticulture at a property level could prevent conversions from occurring before 2025. This would have negative environmental and economic consequences, and would create another significant barrier to the development of Māori land in the short term.

As described in section 5.5, it is ambiguous if the requirement would apply to properties that are exclusively in exotic forestry. If the proposal does apply, the requirement would effectively mean a moratorium on conversions from forestry to other land uses given that forestry would generally have the lowest contaminant losses.

Farm planning

Overall, annual operating profit across all affected Māori land would drop by an estimated 3.4% from $70.3m to $67.8m, from the costs of developing, auditing and implementing farm plans. In relative terms, this is slightly less than the equivalent impact across all land in the Bay of Plenty. As with all land, drystock properties are expected to be more significantly affected due to their lower baseline profit.

Relative to all other land, and except for the CNI Iwi Holdings land, Māori land is dominated by a large number of small parcels with multiple owners. Property ownership has been used to determine the number of properties affected. However, this approach may underestimate the impact as several small parcels likely to fall below the proposed NES-FW size thresholds owned by different parties may in fact operate as a single larger farming business. Furthermore, a relatively large proportion of Māori land may be leased. In this case, the costs are likely to fall on the lessee rather than on the landowners.

It is assumed that the performance of Māori land in each land use is on average comparable to that of all other land. As described in section 5.6, it is assumed that farmers who already hold, or are required to hold, nutrient management documents (e.g. Lake Rotorua) would already face a fraction of these costs.

Table 5.11 - Summary assessment of implications of developing, auditing and implementing Farm Plans on Māori land in the Bay of Plenty region

Land use	Total area (ha)	Estimated number of farming businesses within size thresholds	Estimated total area within size thresholds (ha)	Estimated total effective area within size thresholds (ha)	Assumed number of existing nutrient management documents	Baseline EBIT/ha/year	Post-mitigation EBIT/ha	Mitigation cost/ha/year	Estimated Baseline profit/year	Farm Plan development/auditing costs per year	Estimated Farm Plan implementation costs/year	Estimated profit after mitigation/year
Kiwifruit	971	60	788	630	60				$30,7m	-$ 52,500	-$ 890,006	$29,8m
Green	*641*	*40*	*520*	*416*	*40*	*$19,500*	*$17,608*	*-$1,892*	*$10m*	*-$ 34,650*	*-$ 590,055*	*$9,4m*
Gold & other	*330*	*20*	*268*	*214*	*20*	*$78,400*	*$76,533*	*-$1,867*	*$20,7m*	*-$17,850*	*-$ 299,951*	*$20,4m*
Other horticulture	274	10	211	169	10	$19,500	$17,608	-$1,892	$4,3m	-$8,750	-$ 239,362	$4,0m
Sheep & beef	20,514	129	14,607	11,686	32	$133-$421	$109-$396	-$20 - -$25	$3,2m	-$197,531	-$ 264,327	$2,7m
Arable/grain growing	4,247	41	1,834	1,467	10	$2,345	$2,192	-$153	$8m	-$62,781	-$ 210,413	$7,7m
Dairy	16,700	133	13,663	10,930	67	$1,115-$2,582	$955-$2,532	-$418 - $20	$24,1m	-$174,563	-$ 312,285	$23,6m
Deer	127	2	127	102	1	$229	$206	-$23	$23,254	-$2,625	-$ 2,043	$ 18,586
Total	**42,835**	**375**	**31,229**	**24,983**	**180**				**$ 70,3m**	**-$498,750**	**-$ 1,9m**	**$ 67,8m**

Management of nitrogen in catchments with high nitrate-nitrogen levels: Upper Rangitāiki, upstream of confluence with Otangimoana Stream

None of the affected properties in the identified sub-catchment are Māori land. However, there are 14,350 hectares of Māori land in exotic forestry, and 880 hectares in a range of other non-pastoral land uses, within the sub-catchment. It is unlikely that this land would convert to pasture, horticulture or arable land uses by 2025 (when the proposal will no longer apply). Therefore, Māori land in the sub-catchment is unlikely to be affected by the proposal.

Stock exclusion

Table 5.12 shows the total area of the affected Māori land in the region, the area that would need to be retired from grazing into setbacks and the length of fencing required, for each one of the slope categories proposed. This ignores any existing fencing or setbacks that meet the proposal's conditions so presents a worse-case scenario.

Table 5.12 - Estimates of grazing area to be retired into setbacks and length of fence lines required, for Māori land

	Area (ha)			Setbacks (ha)			Fence lines (km)		
Land use	**Low-slope land[44]**	**Steeper land**	**Total**	**Low-slope land**	**Steeper land**	**Total**	**Low-slope land**	**Steeper land**	**Total**
Dairy	6,134-9,521	7,179	16,700	80-114	111	225	106-166	131	296
High intensity beef grazing & dairy support	1,365-1,977	2,220	4,196	15-20	33	53	20-30	49	79
Sheep and beef	1,348-2,246	14,073	16,318	37-61	171	232	35-52	267	302
Deer	7	120	127	0	1	1	0	1	1
Total	**8,853-13,750**	**23,592**	**37,342**	**131-196**	**316**	**511**	**161-248**	**449**	**696**

Under the same assumptions as described in section 5.6, Table 5.13 summarises the distribution of stock exclusion costs for Māori land by land use. Across the entire Bay of Plenty, fencing costs on Māori land are estimated to total $7.1m (or $0.5m per year if annualised over 25 years at a 6% interest rate). Lost profit from setbacks, including weed control costs, are estimated to be $0.54m per year.

[44] In the discussion document, there are three options for how to define 'low-slope' land, i.e. <5°, <7° and <10° on average at parcel level. In this table, when referring to low-slope land, the first number refers to the first option and the second number refers to the third option. Total values are based only on the third option.

Table 5.13 - Estimated fencing costs and lost profit from proposed stock exclusion requirements

Land use	Total fencing costs	Lost profit in setback per year (including weed control costs)
Dairy	$1.5m	$0.4m
Sheep & beef (including high intensity grazing and dairy support)	$5.6m	$0.1m
Deer	$31,000	$360
Total	**$7.1m**	**$0.54m**

Summary and conclusions

When considered alongside the farm planning proposal, stock exclusion would result in an estimated 5% reduction to the baseline annual operating profit of Māori land across the Bay of Plenty. Costs fall more heavily on drystock and lower intensity dairy farming. Consequently, the impact on Māori land is generally comparable to the impact on all land, acknowledging that most Māori land is in forestry, which may not be subject to these proposals and most of which is unlikely to develop, at least in the short to medium term. Nonetheless, these proposals represent additional barriers to development of Māori land, on top of other existing historical and contemporary barriers.

The proposed DRP attribute (if applicable in the Rangitāiki WMA in particular) and the land use intensification restriction would create additional barriers to the development of Māori land, which is already constrained by a range of other factors. A mitigating factor is that Māori land is characterised by many small parcels which fall outside of the proposed NES-FW size thresholds. However, it is uncertain the extent to which these currently operate as larger farming businesses, that would fall within the size thresholds.

6. Gisborne – Implications for whenua Māori – Tairāwhiti

6.1 Introduction

The overarching framework for the Essential Freshwater reform proposals is that of *Te Mana o te Wai*. This concept refers to the integrated and holistic health and wellbeing of waters as a continuum from the mountains to the sea. It is the fundamental value and concept that protects New Zealanders' special connection with freshwater, while simultaneously sustaining its ability to provide for the future wellbeing of people and our unique ecosystems. As implemented through the proposals, this would mean:

- Applying the hierarchy of obligations;
- Managing freshwater in an integrated and holistic way;
- Engaging and discussing with tangata whenua and communities, and incorporating their values into decisions relating to freshwater; and
- Recognising broader values and systems of knowledge to the management of freshwater.

While well intentioned, the proposed application of Te Mana o te Wai creates yet another hurdle for beneficiaries / owners of whenua Māori / Māori land who aspire to utilise or improve the productivity of their land. This could:

- Limit the productivity of Māori land, which already faces significant, systemic challenges, thus reducing potential future growth of regional and national GDP and the 'taniwha economy';
- Create large carbon 'sink holes' in place of thriving, sustainable ahi-kaa led enterprise in our rural and coastal hinterland;
- Continue to limit the rateability of Māori land, particularly for councils like ours with a large percentage of whenua Māori in our district (28% for Tairāwhiti); and
- Effectively estrange tangata whenua from their own awa and tāonga, by removing their ability to practice their 'divine permission' as hapū to use and access water over which they hold mana.

6.2 Context

Our region

The Tairāwhiti/Gisborne region covers an area of 8,350 square kilometres (3% of New Zealand's total land area). The region stretches from the Wharerata ranges in the south to Lottin Point in the North.

Steep to rolling hill country dominates the region's topography. The Raukumara Range forms a rugged bush-clad spine that runs the length of the region's western boundary. The highest point is Mt Hikurangi, which is the highest non-volcanic mountain in the North Island. The steep hill country grades to rolling land on hilltops, river terraces, and flats in the valleys. Valleys are generally narrow except our large rivers.

Recently formed skeletal soils cover most of the region's hill country. Pumice soils predominate in the smaller terraced areas and rolling hilly lands. They are friable, sandy or gravelly soils that drain readily and generally allow for plant growth. More alluvial soils are found along the river flats, swamps, coastal marshes and beaches.

Population

Our regional population is about 49,100 (Statistics New Zealand, 2018). Most people (37,200) live in the Gisborne urban area. Populations in the rural and coastal townships are small (generally less than 1,000 people per township).

Projections indicate that by 2048, the population will grow by over 5,100 people living in 2,565 additional households (McIlrath, Erasmus, & Fairgray, 2019). This growth is markedly lower than the projected New Zealand-wide growth of about 25%. The average household size is expected to decline from current levels of 2.76 down to 2.66 by 2048.

Age

Over the next 30 years, the proportion of youth will decline but remain above the national average. Generally, our region sees a large loss of young adults to larger cities in New Zealand seeking further education and employment opportunities.

We have the youngest population in New Zealand. One quarter of our people are aged less than 15 years compared with the national average of 20% in 2014. The 65+ age group will grow, from an estimated 14% in 2014 to 25% in 2031. Those aged 55 years and over are likely to stay in the region; this will lead to a reduction in proportion of the population that is of working age. In total, the percentage of elderly and youth will increase from 39% in 2014 to 45% in 2043.

Population and household projections suggest that our population will gradually age over time. This will change the demand for housing types, social services and community facilities. The aging population also has implications for the labour force, with more retired people relative to the number of people that can work.

Economy

Tairāwhiti's economy faces several constraints and opportunities. While labour supply is already an issue, labour constraints are expected to increase further. Making the 'best use' of available labour will be critical to capture Tairāwhiti's full potential (McIlrath, Erasmus, & Fairgray, 2019). Historically, the region's economic performance has lagged the rest of the country. From 2000 to 2017, local employment grew by 5.5% (about 1,205 jobs) compared to 28% on a national basis. In 2019, unemployment in the region stood at 4.9% (compared with 4.1% for New Zealand)

Land-based industries are critical to the Gisborne region. Fishing, forestry and mining generate the most revenue ($212 million in 2017) and agriculture is the second biggest industry (generating $187 million in 2017). This is also reflected in the labour market, where nearly a quarter (24%), or 4,470 jobs are in the primary sector (agriculture, forestry and fishing). This means that the region's economic performance is strongly linked to its natural resource base. It also points to the need to protect and enhance the district's productive capacity.

Tairāwhiti also faces challenges relating to income. The average annual household income for people in Gisborne during 2018 was $82,800, 20% less than the national average of $104,800. Moreover, a large proportion (41.90%) of our population have very low incomes, earning $20,000 or less.

Māori land

There are around 1.4 million hectares (ha) of Māori freehold land[1] in New Zealand, plus a very small area of Māori customary land[45]. Over 2 million ownership interests exist in around 26,490 Māori freehold land titles. Most Māori freehold land is concentrated in Waiariki (Bay of Plenty), Tairāwhiti (East Coast), Aotea (Manawatu/Wanganui/Taranaki) and Takitimu (Northland). There is immense potential in some of this land to be highly productive, but landowners experience significant challenges to land development.

Challenges for Whenua Māori

Development of Māori land faces additional challenges compared to land held in general title, including:

- Multiple ownership: many Māori freehold land rating units often have 100 or more owners or beneficiaries, though larger parcels of land are commonly held by incorporations;
- A lack of formal structures: approximately 50% of Māori land parcels do not have any formal structure;
- Absentee owners: a significant bulk of landowners are often listed as deceased or are uncontactable; and
- Poorer quality, isolated and inaccessible land: a disproportionate amount Māori freehold land is of poor quality, isolated, landlocked and remote, restricting its development potential.

[45] Māori customary land is land held by Māori in accordance with tikanga Māori.

A relatively large number of owners own relatively small parcels of land with 61% of Māori land titles less than 5 ha. Conversely, a relatively small number of management entities[46] control significant amounts of land – 40 large incorporations account for around one fifth of all Māori land by area, and 100 large ahu whenua[47] trusts account for about 30% of all Māori land between them.

As well, historical circumstances around Māori land ownership and development mean iwi and hapū have ended up at the 'back of the queue' for access to water. Our national and regional water management system needs to better deliver on social and cultural values of water at the same time as supporting an economy that maximises value from fresh water through wise use and investment[48].

Māori freehold land in Tairāwhiti

All of these challenges apply to most Māori freehold land across Tairāwhiti. Over 80% of Māori landowners (89,214 people) from Tairāwhiti and Opōtiki live outside of the region. This is particularly so for Ngāti Porou where 83% of their whanau live outside of their tribal region. It is also estimated that up to 30% of land interests in some blocks have not been succeeded to[49].

The Tairāwhiti region has a relatively low population and retains a degree of physical isolation from the rest of the country. There is a significant amount of Māori land in the region. Gisborne District includes approximately 228,000 thousand hectares of Māori land, equal to 28% of the District's land area.

The bulk of our Māori freehold land (around 46%) is concentrated in the northern / East Cape area of Tairāwhiti (see Figure 6.1). This also happens to be one of the largest areas of deprivation (see Figure 6.2) for our region, across two of our freshwater catchments – the Waiapu and Northern catchments, and in the case of the Waiapu, located in one our most at risk catchments due to extensive, intergenerational erosion issues.

Appendix 6.3 contains details of Gisborne District Council's role in relation to Māori land.

To give some further context, a Regional Socioeconomic Deprivation Index Map is included for The Tairāwhiti/Gisborne in Section 15 at the end of this report.

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[46] Management entities under TTWMA include: ahu whenua trusts, whenua tōpū trusts, whānau trusts, kaitiaki trusts, pūtea trusts and Māori Incorporations.

[47] Ahu Whenua trusts are designed to manage whole blocks of Māori freehold land and are often used for commercial operations.

[48] Briefing for the incoming Minister- Water Issues, 2017 https://www.beehive.govt.nz/sites/default/files/2017-12/Water.pdf

[49] When an owner dies, the Māori Land Court handles the legal process of passing on shares in Māori land from one generation to the next. The rules for who can "succeed" Māori land are set out in the Te Ture Whenua Māori Act. These rules ensure that people whose whakapapa links them with that land can succeed. Who can succeed depends on whether the person who died left a will.

6.3 Analysis

To test the economic impacts of the draft proposal, a case was developed across the Tairāwhiti region that focussed on two key aspects:

a. Implications for potential increases to regional value from utilisation of our Māori land; and

b. Implications for owner aspirations for whenua Māori.

Baseline

Under the current freshwater provisions of the Tairāwhiti Resource Management Plan, Council has a host of permitted activities and is enabling of the utilisation of whenua Māori. Appendix 6.4 lists all activities that can be undertaken without need for a resource consent.

Table 6.1: Cumulative increase in value added over study period from Māori land upgrades (in real terms, undiscounted and discounted)[50]

Sector	Evaluation period	Accumulated increase in GDP (real $m) *	Present value of increase in GDP (real $m) *
Dairy	2013-2025	$132	$71.3
Sheep and beef	2013-2025	$49	$26.2
Agriculture subtotal	*2013-2025*	*$181*	*$98*
Forestry	2013-2055	$298	$27.6
Notes: * Undiscounted sum of forecast annual increases in GDP over evaluation period. ** Discounted to present value using Treasury's discount rate of 8%.			

The economic modelling in Table 6.1 suggests that raising the productivity of whenua Māori in Gisborne would result in an accumulated total increase of approximately $181 million in value added in agriculture and $298 million in forestry in the region.

This total impact would be spread throughout the 'study period' (2013-2025 for dairy and dry stock farming, 2013-2055 for forestry). In present value terms, the value of the long-term increase in production is worth approximately $98 million in agriculture and $28 million in forestry, depending upon the speed of development. (The low present value of economic outcomes in forestry is a result of the fact that forests will not be harvested and sold for several decades).

The largest contribution to this long-term increase is expected to come from the agricultural industry. Adequately resourced and supported development of whenua Māori is likely to have a significant long-term impact on our regional gross domestic product (GDP).

This is all possible by limiting the hurdles for Māori landowners, and supporting sustainable and sensible development of Māori land. However, there are regulatory and environmental restrictions posed by the proposal on landowners aspiring to make improvements. The proposed changes pose limits to productivity of whenua Māori . This would largely affect agriculture and horticulture land uses- the most profitable and diverse options for owners of whenua Māori.

[50] Ministry for Primary Industries (2014) Growing the Productive Base of Māori Freehold Land- further evidence and analysis

Table 6.2: Summary of implications for owners seeking to increase the productivity of their whenua Māori

Implication	Detail
Limits to water allocation for irrigation and storage	While the Government is making significant investments in water storage and irrigation, the current framework deprioritises the use of water to meet future cultural wellbeing, social or economic need and demand.
Regulatory restrictions will need to increase in some areas	While figures for other industries are not included in Table 6.1, alternative utilisation for aquaculture, poultry, deer and other livestock farming, horticulture and fruit growing opportunities are also impacted, as well as employment opportunities across the region. The proposal in the Essential Freshwater Package to include new bottom-lines for nutrients (nitrogen and phosphorus) in the National Policy Statement for Freshwater Management is likely to constrain intensification of or conversion to dairying and other livestock farming.
The overall thrust of the essential freshwater package may limit the land use options available to owners of whenua Māori.	Likely to see large scale afforestation in areas of productive pastureland due to proposal. It is likely that some communities will be severely affected, while others remain resilient to land use change. Long term planning for land use and the concept of kaitiakitanga need to be considered when creating substantial changes to national direction, as proposed by the Essential Freshwater Package. While decreased abstraction for industry or commercial purposes may result in some benefits, it may also lead to perverse outcomes, such as: o enabling environmentally harmful land uses like plantation forestry in catchments with brittle landscapes and erosion issues; o limiting the ability of small holdings to have multiple streams of income from different activities on their land blocks; o limiting employment opportunities and job diversity, and may result in long waits for peaks in employment opportunities. For example, the forestry industry will raise employment by 15% to 16% during a harvest window of 2041-2055; o creating large peaks and troughs in regional GDP over decades, as it will take 25 years on average for plantations to reach maturity; o affecting our rural and urban communities looking to access local or even New Zealand produce; o decreasing the opportunity for the right land use in the right place: ▪ this is likely to affect pastoral farming and growers of annual crops the hardest – particularly leafy greens, beans, maize and corn, potato and kumara, vines such as tomato and squash, brassicas like cabbage cauliflowers and broccoli etc. ▪ it limits the likelihood of landowners wanting to swap from annual crops to new permanent crops like grapes, fruit trees, citrus or berries. While hardy when mature these need access to a reliable water supply when first planted.

Implications on owner aspirations for whenua Māori

The 2011 Te Puni Kōkiri publication ('Owners Aspirations Regarding the Utilisation of Māori Land') was used as a key reference for this case study, which assesses the implications of the proposals on aspirations for whenua Māori as expressed by its owners. Their publication included hui and interviews with owners of whenua Māori in Tairāwhiti, so our assumption is that these core aspirations apply to our region. The aspirations described are:

1. Owners want to retain the land and maintain and promote cultural connections;
2. Owners view utilisation as a cultural responsibility;
3. View utilisation as a personal Domain; and
4. Owners promote commercial utilisation[51] of whenua Māori.

Assumptions

In 2014 the Ministry for Primary Industries (MPI) published 'Growing the Productive base of Māori Freehold Land – further evidence and analysis'. It presented results from an economic model of four core industries that comprise the primary sector at a national, and most importantly, regional level. We have used this model to help us understand the potential value of our unproductive whenua Māori, and implications of the proposal on achieving this value.

Sixty eight percent of all Māori freehold land is in land classes 6 and 7, meaning that it is fairly marginal for all uses except forestry and some grazing.

Table 6.3: Māori freehold land in Gisborne by land class[52]

Tairāwhiti / Gisborne Region									
Land use class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	Share of total Māori Freehold land in region from the national total
Hectares	379	6,875	8,878	5,274	0	57,905	91,002	14,707	16%
Excludes blocks smaller than 1 ha and land classified as estuary, lake, river, or town LUCs. Source: Māori Land Court.									

Table 6.3 shows that 163,614 ha of Māori Freehold Land in Tairāwhiti is either LUC 6, 7 or 8. That equates to 88% of all Māori freehold land in the Gisborne district. For this reason, our economic model largely looks at dairy, sheep and beef and forestry.

Because of the long-term nature of forestry, the economic model for the forestry industry stretches out to 2055 so, to allow comparisons, it is important to also provide a value added table showing the discounted future value added in as a present value (i.e. in today's terms).

Unfortunately, horticulture was not modelled by the Ministry for Primary Industries at our region's level, due in part to a lack of sufficient information on regional productivity variations.

[51] Te Puni Kokiri (2011). Owners aspirations regarding the utilisation of Māori Land

52 Ministry for Primary Industries (2014) Growing the Productive Base of Māori Freehold Land- further evidence and analysis

6.4 Results

Main findings

Parts of the proposal will create additional hurdles to the development of whenua Māori

The absolute nature of the prioritisation of water use as posed under Te Mana o Te Wai does not take into account the complexities of land utilisation in the regions, and creates impacts for whenua Māori that will be felt across the country.

As outlined in our scenario, owners believe being kaitiaki means being good caretakers of the land. To owners, the commercial use of the land did not engender or require a changed mind-set as it was part of the continuum of cultural imperatives. As kaitiaki, their responsibility of receiving the tāonga of land was to utilise and improve it for coming generations. Commercial use is simply a mechanism to achieve that cultural imperative.

For smaller landblocks and whanau trusts seeking productive uses for their land that suit the complex interrelationship of whenua and wai in their catchment, the proposal effectively keeps them at the back of the queue for water use. And, despite the well-intentioned requirement to engage, it could limit authentic mana-to-mana discussion between councils and tangata whenua for the management of freshwater, due to inflexible timeframes and capacity constraints.

The proposal has the potential to create a vacuum for land utilisation that could see mass afforestation across the region, including whenua Māori. Table 6.4 sets out these implications in more detail.

Table 6.4: Implications of proposal on owner aspirations for whenua Māori

Implications on owner aspirations for whenua Māori		
Aspiration	**Detail**	**Potential implications of Essential Freshwater proposals**
Owners want to retain the land and maintain and promote cultural connections	The key view was the importance of land retention. This importance derived from the fact the land had been handed down from tipuna and as such it formed a part of a person's identity.	• Improved water quality should enhance the mauri of waterbodies, through improved health and wellbeing indicators including an increase in macroinvertebrates and less modified water. • Encouragement and support for riparian planting and protection will help to lessen risk of erosion, and provide shade over smaller waterways, decreasing the temperature and providing more dynamic littoral margin ecosystems, such as replanting grasses along the banks of known inanga spawning sites. In this instance, planting could improve the native fishery, and the connection between owner and the whenua, and their awa by enabling the practice of gathering whitebait from a traditional mahinga kai site in the future. • Emphasis on land use affecting water quality ties in with stewardship elements of kaitiakitanga, and a mountain to sea approach.

		• Some perverse outcomes from the proposal include the short timeframes for freshwater planning and engagement (2020-2025) which do not take into account the complexity or limited capacity of tangata whenua to participate. For instance:
		  ○ Iwi and hapū may not have the staff or capacity to participate in our engagement processes, or be available at the times required by our internal planning needed to balance our lack of staffing and resources with being compliant with the proposal's timeframes.
		  ○ Lack of flexibility with timeframes limits the opportunity for council staff to engage shareholders in whenua Māori. This is particularly true when looking to engage them in planning for a specific catchment during development of the proposed attribute action plans and limits. It will also be difficult to authentically engage them in the process of creating a regional vision for freshwater, and as we aim to understand what their collective view of Mana o te wai may be.
		  ○ Shareholders may be called upon by multiple councils as hapū, marae or iwi. Most have shares in many multiple land blocks, across regional/district lines- having succeeded through whakapapa connections that are not neatly confined within one region's boundary.
		  ○ Shareholders, hapū and other tangata whenua may not be based in the region. These taura here still have a valid voice and should be able to participate in the process. Council does not have the resource or capacity to facilitate this process.

1. **Owners view utilisation as a cultural responsibility**	The role of kaitiaki is not protecting the land by keeping it in the state in which it was received. Instead, aside from protection, one of the duties placed on owners is to *improve* the land in some way for the benefit of descendants. The duty to improve the land was not only to fulfil an obligation to those who had gone before, but also to those who were yet to come.	The proposal: • Ignores the mana of hapū over freshwater. • Creates additional hurdles to the development of whenua Māori that will largely impact smaller whanau trusts as opposed to the larger, more well-resourced incorporations. • Creates further tension between consenting authorities and Māori when seeking an allocation to water by deprioritising cultural wellbeing, social and economic demand for water.

<table>
<tr><td>2. View utilisation as a personal Domain</td><td>Owners want to increase or retain their individual access to their lands. This access ranges from wanting to live and/or work on the land themselves, to being able to go on to the land in relation to hunting, fishing and attending to wāhi tapu.</td><td>Few implications from the NPS for utilisation as a personal domain when separate to commercial or productive utilisation.
However, the proposed NES regulation 16(3) specifies that a qualified wetland ecologist and hydrologist must establish the natural hydrological regime of the natural wetland. The restoration of a natural wetland should also be able to be undertaken without these onerous restrictions, and often it is hapū and whanau who exercise kaitiakitanga over the land who are best place to determine these regimes.</td></tr>
<tr><td>3. Owners promote commercial utilisation[53] of whenua Māori</td><td>Owners believe being kaitiaki means being good caretakers of the land. To owners, the use of the land commercially did not engender or require a changed mind-set as it was part of the continuum of cultural imperatives.

As kaitiaki, the responsibility of receiving the tāonga of land was to utilise and improve it for coming generations. Commercial use is simply a mechanism to achieve that cultural imperative.</td><td>Under the new proposals, consent will be needed for:
New production over 10 hectares that requires irrigation – as part of this consent a certified FW-FP will be required.
Land use change to commercial vegetable production (no size limit).
As well, all commercial vegetable production will require a FW-FP. We are concerned that:
The current capacity and capability of the agriculture advisory industry may not meet the needs of Māori landowners in terms of developing and auditing FW-FP – particularly considering the sheer number of smaller land blocks.
Whanau Trusts (as opposed to larger incorporations) may struggle to access and resource:
farm scale land resource assessments;
on-farm advice, mapping and or monitoring specific to their land blocks;
expert interpretation of soil and land resource information;
land use scenario modelling; and
provision of data and information for taura here trustees (groups or whanau located outside of their traditional rohe, trustees of the land blocks).</td></tr>
</table>

[53] Te Puni Kokiri (2011). Owners aspirations regarding the utilisation of Māori Land

The proposals separate the mana of hapū from the mana of the wai.

The proposals generally address concerns around degradation of mauri but do not address issues around rights and ownership of water (i.e. recognise and provide for the relationship of tangata whenua with freshwater resources).

"Ko te awa ko au"

I am the river- the river is me.

Mana of hapū, which confers a larger capacity than kaitiakitanga, is not provided for in the proposals' direction regarding the management of water, and yet it is the basic concept of giving expression to Māori rights. Mana covers both ownership (the right to use and possess against others), and the over-riding political authority to control the use and management. In custom the hapū held mana over their territorial lands and waters.

As it is currently laid out in Part 2: 'Objectives and policies', the proposal effectively dispossesses hapū and whanau of their mana over their awa, wai Māori and other tāonga that they might need to use and access as part of maintaining and promoting their connection to their whenua as kaitiaki. In this case study, the role of kaitiaki is to improve the land in a way to benefit not only its mauri but also its future beneficiaries.

In addition, the proposed NES regulation 16(3) specifies that a qualified wetland ecologist and hydrologist must establish the natural hydrological regime of the natural wetland. The restoration of a natural wetland should also be able to be undertaken without these onerous restrictions, and often it is hapū and whanau who exercise kaitiaki over the land who are best place to determine these regimes.

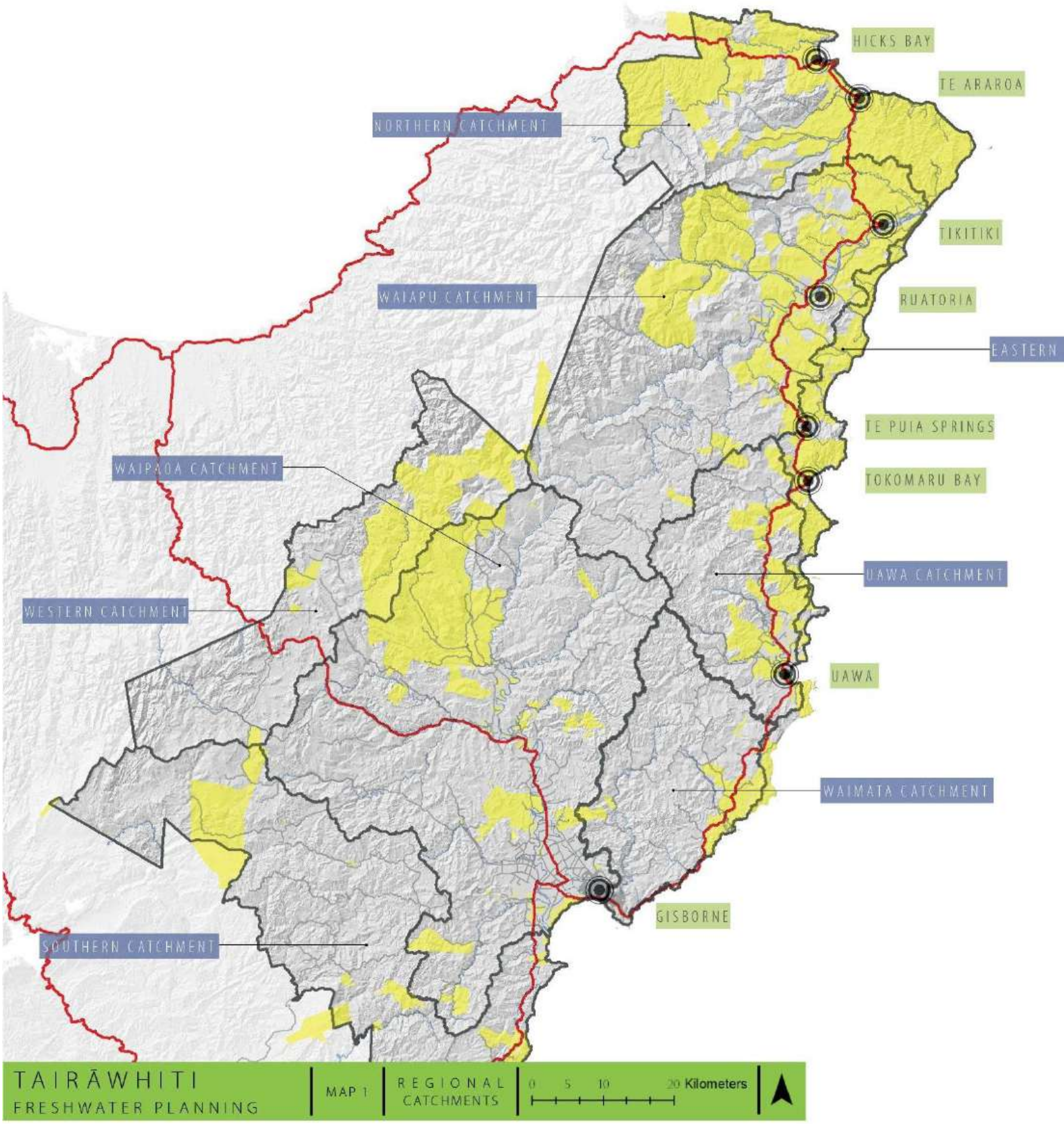
The proposal also creates further tension between consenting authorities and Māori when seeking an allocation to water by deprioritising cultural wellbeing, social and economic demand for water.

Possible relevance to other catchments or regions

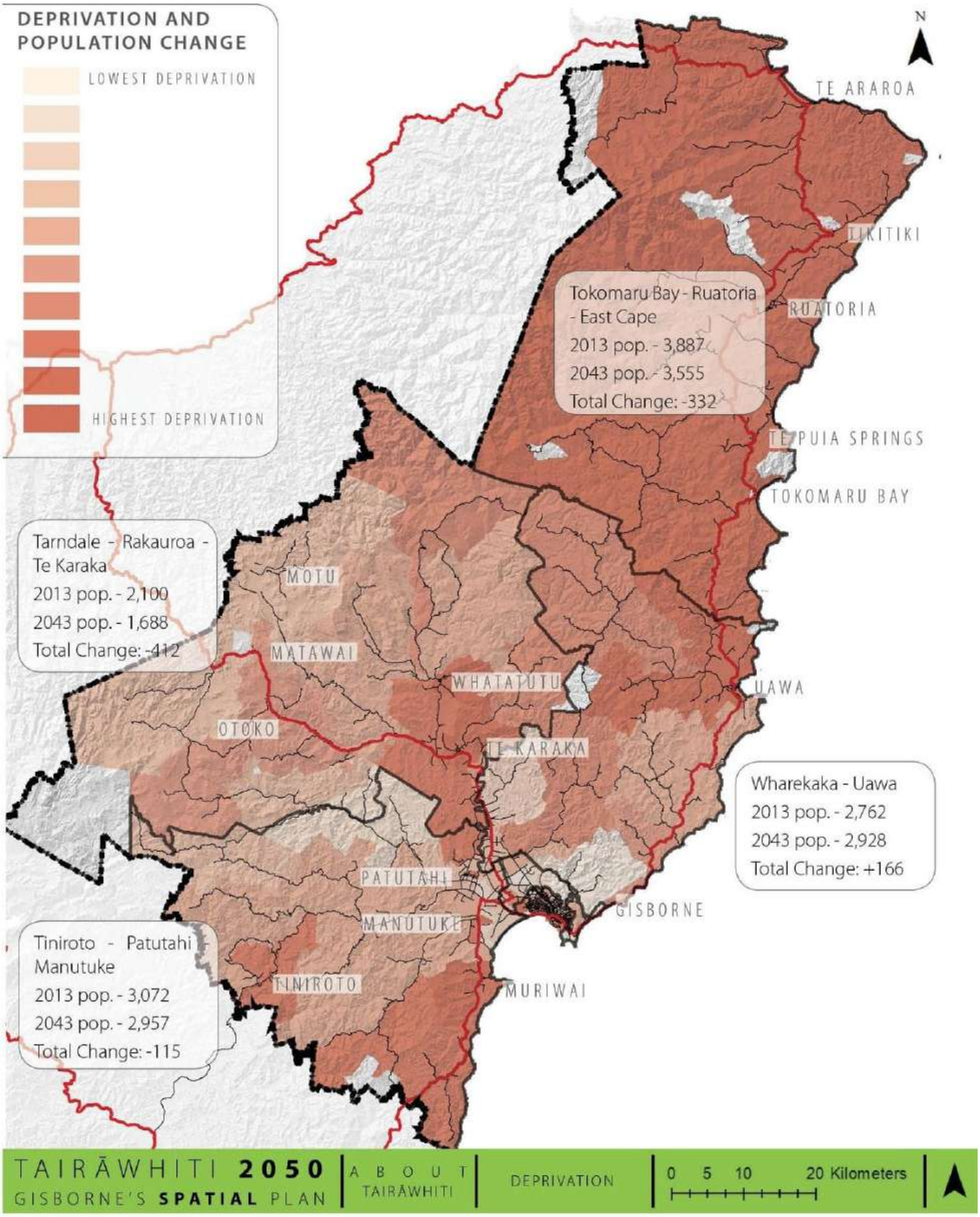
These findings will be relevant to other catchments or regions with a high proportion for Māori Land, for example Eastern Bay of Plenty and Northland.

6.5 Appendices

Appendix 6.1 Distribution of Māori land across freshwater catchments



Appendix 6.2 Deprivation and anticipated population change across the region



Appendix 6.3 Council's relationship with Māori land

Gisborne DC has a broad range of functions and duties which contribute to the sustainable management of natural and physical resources. This includes regional and district planning and sustainable land management, and effective rating policies that reflect the realities of Māori freehold land use and occupation.

The Council's role in supporting the sustainable development of Māori freehold land

An example of this is Council's Overlay Classification 3A. This land overlay acts in tandem with the government's East Coast Forestry Project to promote the best use of the worst eroding land. As well, Council has a commitment to the Waiapu Catchment Restoration Programme and the opportunity that it provides to promote better utilisation of land in the northern Tairāwhiti area.

Council officers have worked with tangata whenua and key stakeholders through a freshwater advisory group to draft our Proposed Gisborne Regional Freshwater Plan. There is a voluntary Joint Management Agreement (JMA) under s36B of the Resource management Act (RMA) 1991 in place with Te Runanganui o Ngāti Porou on behalf of nga hapū o Ngāti Porou, for the Waiapu catchment.

These collaborative freshwater management frameworks were put in place as part of our commitment to:

- Implementing representation of iwi and hapū for freshwater interests;
- Ensuring that our regional policy mechanisms reflect iwi and hapū values and interests in freshwater;
- Recognising and treating iwi as a Treaty partner with decision-making powers;
- Building the capacity of our council to provide for iwi and hapū values and interests in water allocation; and
- Building the capacity of iwi and hapū to engage on freshwater issues, including allocation.

Our rating policies for Māori freehold land

Gisborne District Council has approximately 23,300 rating units, of which 3,141 are Māori freehold land rating units. In 2012/13 the Council assessed rates of $50 million, of which $4 Million related to identified Māori freehold land. In the same period approximately $0.68 million of new rates arrears was incurred by Māori freehold land rating units (approximately 1.3% of overall rates struck or 17% of the rates levied on Māori freehold land). This affects our Council's ability to plan and provide for services and facilities. It places a greater impost on other rating units.

Our most recent 2018-2028 Long Term Plan incorporated a series of rating policies that provide incentives to use and develop Māori freehold land. While this has a positive effect for Council's income, it largely looks to improve the process of working with Council for the beneficiaries / owners of Māori freehold Land. This is achieved through:

- The provision of certainty to both Gisborne District Council and owners of Māori land in the application of rating mechanisms;
- The provision of effective and practical rating mechanisms that recognition the nature of Māori land and the isolation of parts of the Gisborne District;

- Rating policies and procedures that appropriately reflect the circumstances related to Māori land and present a realistic understanding of the annual income of owners.
- The minimisation of compliance costs to both the Gisborne District Council and owners of Māori land;
- Rating of Māori land being addressed in a fair manner in relation to comparable non-Māori land; and
- Processes and procedures relating to the rating of Māori land being clear and easy to understand.

Appendix 6.4 Activities permitted without resource consent for whenua Māori in Tairawhiti

Activities permitted without resource consent for whenua Māori in Tairawhiti	
Number	Detail of permitted activity for Māori Freehold Land
1.	The discharge of stormwater from land, roofs, paved areas and roads where contaminant reduction method have been implemented to treat the stormwater in accordance with TP10
2.	The discharge of dye tracing materials into water
3.	The discharge of water for firefighting purposes
4.	The discharge of water from rural field and tile drainage where no pumping occurs
5.	The temporary discharge of stormwater from road construction or maintenance
6.	Diffuse discharges from dairy and other intensive farming activities established before 14 October 2015, provided a Farm Environment Plan has been certified by 1 May 2021
7.	Diffuse discharges from commercial vegetable growing and cropping activities established before 14 October 2015, provided a Farm Environment Plan has been certified by 1 May 2021
8.	Diffuse discharges from new commercial vegetable growing, cropping, dairy farming and intensively farmed stock activities established after 14 October 2015, provided a farm environment plan has been certified by the consent authority
9.	Diffuse discharges from stock access or grazing when winter intensive grazing is being undertaken, provided certain setbacks are met
10.	Diffuse discharges from the discharge of greenhouse nutrient solution to land within certain nitrogen application rates
11.	Discharges from application of fertiliser
12.	The deposition of any material onto land that is solid, not a hazardous substance and biologically and chemically inert to a volume of less than $500m^3$
13.	The discharge of any contaminants into or onto land in connection with solid waste disposal at farms
14.	Discharges associated with offal pits
15.	The discharge of solid animal waste (excluding any discharge directly from an animal to land), or vegetative material, including from intensive farming, into or onto land, or into or onto land in circumstances where a contaminant may enter water.
16.	The use of land for a silage pit or the stockpiling of organic matter (including compost) and any associated discharge into or onto land where a contaminant may enter water
17.	Discharge of agrichemicals
18.	Point Source Discharges of Untreated Sewage Resulting from Overflows from wastewater reticulation and pumping stations during wet weather events until 1 July 2020
19.	The discharge of contaminants into (but not onto) land from an individual conventional on-site wastewater system (commonly known as a septic tank) if the discharge: exists prior to April 2002, or was established after and complies with all the standards
20.	Discharge of contaminants into (but not onto) land from an individual advanced on-site wastewater system if the discharge: existed prior to 17 June 2013, or was established after and complies with all the standards
21.	The discharge of greywater into land from an individual on-site greywater system if the discharge complies with all of the standards
22.	The discharge of human waste through a pit latrine into land

23.	Discharge of untreated or disinfected wastewater from portable toilets, campervan and mobile home foul water tanks
24.	The discharge of untreated or disinfected wastewater to temporary holding tanks for off-site discharge to an authorised discharge point provided that the discharge existed prior to 17 June 2013 or was established after and complies with all the standards
25.	The disposal of septage by discharge to land on the same property that the septage originates
26.	Discharge of wastewater through a deep bore or soakage pit into land from an individual on-site wastewater treatment unit is if the discharge exists prior to notification, or is established afterward and complies with all the standards
27.	The decommissioning of on-site wastewater treatment systems
28.	Introduction or planting of any plant or part of any plant (whether exotic or indigenous) in, on or under the bed and banks of a lake, river or stream where this is for the purposes of soil conservation or the avoidance or mitigation of natural hazards
29.	Stock access and associated disturbance of the bed of any lake, river or stream by livestock access resulting from a formed stock crossing provided that the stock crossing is not within an Outstanding Waterbody, or in a wetland
30.	Stock access to the bed of any lake, river or stream by livestock, excluding formed stock crossings and stock access where resource consent is required if the activity is provided for in a Farm Environment Plan
31.	Motorised vehicle entry or passage along the bed of a lake, river or stream, provided that no other practical convenient alternative access route is locally available
32.	The extraction of sand, shingle, gravel or rock in quantities less than 30 cubic metres per individual over any 12 month period from the dry bed of the river
33.	Damming and diversion of water by existing flood control structures legally established before the date of notification of this Plan
34.	The clearance and maintenance of drains
35.	The damming and diversion of water within the bed of stream, which is not permanently flowing where the volume of water impounded is less than 20 000m^3, the maximum depth of water is less than 3 metres; and the catchment area is less than 5 hectares
36.	Exotic vegetation clearance in wetland, subject to standards
37.	Harvesting or sustainable use of wetland resources
38.	The restoration of wetlands
39.	Stock access to wetlands subject to standards
40.	Vegetation clearance within the Riparian Management Area subject to standards
41.	The rules contained within the Tairāwhiti Resource Management Plan for Papakainga and Marae settlements also permit any activity excluding industrial and commercial, which comply with the General Standards. Commercial or industrial activities on Māori land are considered to be a discretionary activity in the Tairāwhiti Resource Management Plan.

7. Hawke's Bay – Water takes

7.1 Introduction

Increasing demand for water by agriculture, industry, urban users, and for recreation makes proper management and conservation of water supplies more and more important. Proper management of water use means understanding how much water is used for say, irrigation or municipal and industrial uses. Properly selected and maintained water meters can be the easiest and most accurate way to measure water flow. Measuring and reporting of water use is essential to inform decision making around regional water management. It should also be considered a tool for water users to have a better understanding of their own water use and system operation.

7.2 Findings

Between 2010-2016 consent holders were required to install water measurement devices in accordance with the Measurement and Reporting of Water Takes regulations 2010. Hawke's Bay Regional Council envisage the process to install telemetry will be similar to this process, although the detail will require consideration. The difference however is that of the 2,746 meters that have already been installed in Hawke's Bay, 48% of those are also telemetered. This means Hawke's Bay is starting from a good base by also having a good understanding of the technical detail regarding equipment, installation, servicing and data management. Table 7.1 breaks down the number consents in Hawke's Bay and the corresponding number of water meters installed. Some consents have multiple takes, each take point (meter) would require a telemetry unit. To implement the proposed regulations in the Government's recently released Essential Freshwater package, Hawke's Bay Regional Council anticipate a further 1419 telemetry units would need to be installed for current consented water takes.

Table 7.1: Water meter and telemetry installation in Hawke's Bay 2019

Rate of water take	Consents	Water meters	Water meters telemetered	Proportion of meters telemetered	Gap to fill to proposed Regulations	Estimated minimum installation costs ($)*
> 20 l/s	1,082	1,789	1066	60%	723	$725,000
> 10 l/s	581	652	191	29%	461	$460,000
> 5 l/s	208	216	45	21%	171	$170,000
< 5 l/s	328	83	22	27%	(61)	
Unknown	10	6	3	50%	(3)	
TOTALS	**2,209**	**2,746**	**1,327**	**48%**	**1355 (64)**	**$1,355,000**

**Figures are indicative only. Assumes costs are all for 'simple' installations. Additional costs not included for complex installations, annual servicing, repairs, maintenance and general running operations.*

Consented volume also needs to be a consideration. For Hawke's Bay Regional Council, if all consents 20L/second and over were telemetered and added to the existing telemetry, this would cover 89% of the consented volume. The cost benefit of getting the remaining 11% of consented volume telemetered warrants careful consideration.

Installation costs in the proposal are relatively accurate for a simple install. However not all sites are simple and would incur considerable extra cost. In the council's experience, a simple installation of one site costs $1000-$1500 to install and $20-25/month for service provider costs. There are additional costs such as a new battery every 3-5 years and maybe a refurbished unit at about $300-$500. There is also an annual council charge of $200 per consent. For more than one meter or data type, this costs a further $2200-$3000 for a base station or radio and $360-$850 per year for monitoring. A recent difficult site with no cell phone reception cost $10,000 for the installation. Service providers also charge year round regardless of the seasonal nature of the water use.

There is a perception that collecting data at 15 minute intervals will mean more accurate data. That is not necessarily the case. Telemetry just allows for more frequent, real time collection and reporting. If the data is not verified, the telemetry could be reporting incorrectly for a considerable amount of time. This could render the incoming data unusable or unreliable for informed decision-making.

It is critical that there are systems in place to compare what the water meter is reporting to that of the telemetry unit, at a suitable frequency. In Hawke's Bay Regional Council's case, to achieve this there will need to be additional staff dedicated to that role. For installation costs alone for over 1300 new telemetered sites, the cost is estimated as at least $1.35 million.

Overall there needs to be consideration of the installation, maintenance and service provider costs on the consent holder for those with low volume takes. There also needs to be consideration on the added costs on Councils for collecting and verifying the additional data.

To give some further context, a Regional Socioeconomic Deprivation Index Map is included for the Hawke's Bay in Section 15 at the end of this report.

8. Central Hawke's Bay District – Wastewater

8.1 Context

The Central Hawke's Bay District covers 333,450 hectares, and supported a population of around 14,150 in 2018. The median age, estimated at 44.5 years in 2018, is significantly older than the country as a whole (36.9 years). The median household income for Central Hawke's Bay was $76,900 in 2018 compared to $89,100 nationally. Approximately 55 percent of the working age population were employed in 2019 (compared to 67.6 percent for New Zealand). The district economy is heavily focused on agriculture (particular sheep and beef farming), with around 30 percent of district-wide GDP coming from that sector.

There are two main towns – Waipukurau and Waipawa, and a number of smaller towns, both inland and coastal. The main road and rail transport routes between Wellington and Palmerston North to the south, and Napier and Hastings to the north, pass through the district.

A National Environmental Standard for Wastewater Discharges

The Essential Freshwater Package includes proposals for a new set of standards that would prescribe requirements for setting consent conditions on discharges from wastewater treatment plants and engineered overflow points. According to the Government's Action for healthy waterways discussion document, these requirements could include:

- minimum treatment standards or 'limits' for nationally applicable wastewater quality parameters, including biochemical oxygen demand, suspended solids and bacteria;
- targets or limits on the volume and frequency of wet weather overflows;
- methods for monitoring compliance with standards or limits and reporting breaches to regional councils and the public; and
- approaches for incorporating culturally-acceptable wastewater treatment processes.

In addition, there would be a requirement to comply with any other regional council requirements under the NPS-FM (for the purposes of ensuring health and wellbeing of waterbodies and freshwater systems is maintained or improved), and to participate in whatever nutrient allocation regimes that may be established in the future.

Operators of wastewater systems will be expected to develop a risk management plan that would encompass the entire wastewater network, and that would have to consider future demand pressures on the system such as from "…climatic changes and urban growth and intensification."[54]

[54] From the *Action for healthy waterways* discussion document, p59.

8.2 Central Hawke's Bay District Wastewater

Central Hawke's Bay District Council (Council) is responsible for managing the wastewater generated by communities in the Central Hawke's Bay District and owns and operates 6 waste water treatment plants and reticulated networks. Like many other authorities and communities in New Zealand, Central Hawke's Bay has challenges in continuing to deliver wastewater services that meet the expectations of its own communities and in line with ever-changing compliance thresholds.

In 2014, Council undertook significant upgrades to its two largest treatment plants servicing the District's main urban centres of Waipawa and Waipukurau. The works involved the re-design of plants, addition of tertiary treatment processes and costs in excess of $9M. Soon after commissioning of the new plants, it became evident that the plants would not be able to produce wastewater discharges that met compliance limits. In 2017 Council was prosecuted for exceeding ammonia levels under its resource consent for the Waipawa plant.

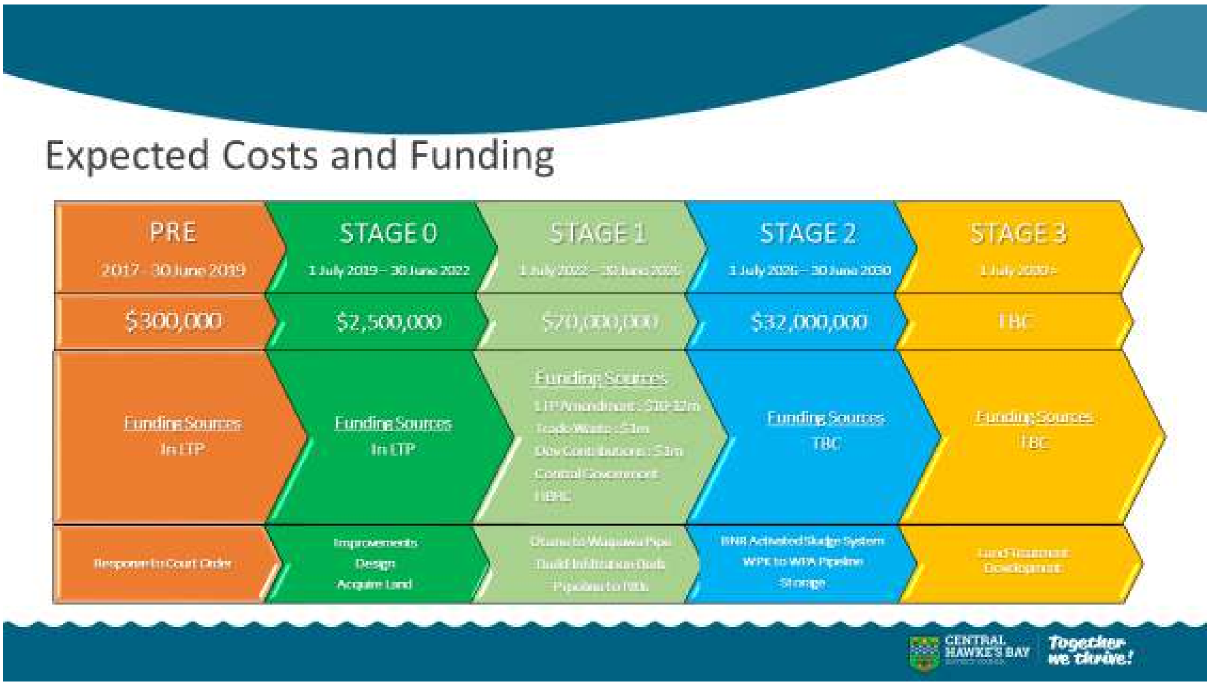
Through 2018/19, Council took stock of the challenges facing its community, the environment and the Council organisation in sustainably dealing with the district's wastewater challenges. A 'cathedral thinking' mind-set became the cornerstone of a community and technical reference group formed to guide Council's long-term solutions for wastewater. Over 12 months of intensive work with technical experts, staff, iwi and the community, and the regulator, Council have been able to determine a preferred long-term solution for the Waipawa and Waipukurau plants (as well as the nearby smaller Otane plant). These three towns comprise around half of the district's total population (30 percent in Waipukurau; 15 percent in Waipawa; and 4 percent in Otane at the time of the last available Census information).

The four well-beings were a focus through the completed work with obvious environmental improvement objectives being considered alongside social and cultural benefits and traded off against financial impacts and affordability to ratepayers.

8.3 Potential implications for Central Hawke's Bay District

Affordability has been, and continues to be, a primary challenge for small councils in New Zealand and Central Hawke's Bay is not immune. With around 3,000 connected users spreading the cost of operating, maintaining and in some cases significantly upgrading 6 separate wastewater networks, Council has had to plan a phased investment and look to external funding options to support the upgrades infrastructure to comply with existing requirements and meet community expectations.

The costs of the preferred treatment solutions for Waipawa, Waipukurau and Otane are estimated to be in excess of $50M spread across 15 years. With an already high wastewater targeted rate of $933 per connected user, Council has engaged economic advisers to assess the true affordability of further investment. With a rapidly growing but aging local population Council are fundamentally aware of the burden being placed on current and future generations.



In the context of the new requirements proposed by the NES for wastewater discharges and the NPS-FM, the additional regulation, policy and direction, will create challenges for public infrastructure providers in an already difficult situation for our small communities (particularly in the 3 waters arena, which is subject to additional uncertainty through a systemic review being undertaken by the Department of Internal Affairs). Nevertheless, Council considers that the work undertaken with community in the past 12 months, and the direction that Council has set for its wastewater future is setting a path for the future (albeit one fraught with challenges). Whether this path will need to change as a result of these national policy processes remains unclear.

9. Taranaki – Nutrient 'bottom-lines', Nitrogen Cap, and Overseer

9.1 Introduction

At present, the Nitrogen Cap (N-Cap) proposal (Option 1 within the proposed NES) applies to 13 catchments across New Zealand. This proposal is intended to contribute towards achieving the recommended in-stream nutrient bottom-lines, which target both dissolved inorganic nitrogen (DIN) and dissolved reactive phosphorus (DRP). The Waingongoro River in Taranaki is one of the designated N-cap catchments but in fact many other rivers and streams across the south Taranaki ring plain have similar DIN concentrations, and most waterways on the ringplain (both north and south) have DRP concentrations elevated well above the proposed bottom-lines (see Figure 9.1 below).

This case study assesses the implications of the proposals for nutrient bottom-lines, the Nitrogen cap and Overseer for the Southern Taranaki Ringplan and the Waingaongoro Catchment.

9.2 Context

The Waingongoro runs south from Mount Taranaki and is one of the larger rivers on the ring plain. Within the catchment, exotic grassland covers around 91% of land and indigenous forest about 7% of land. Below the National Park, land is predominantly used for intensive dairying. The Waingongoro River holds special value for Ngāruahine and Ngāti Ruanui iwi, and at the mouth of the River is Ōhawe (one of New Zealand's earliest settled places). The River is also highly valued for its aesthetic, scenic and recreational values - supporting an important trout fishery and of regional significance for contact recreation. Council monitoring shows the Waingongoro River has good to excellent stream health and positive trends using macroinvertebrate, periphyton, and chlorophyll-A measures - and little to no correlation between trends or levels of nutrients, and stream health. Nutrient concentrations in surface water are not showing significant trends, and in groundwater are reducing.

Farm-scale riparian plans (stock exclusion and streambank planting) cover almost all of the catchment and are nearing full implementation. Independent audit confirms they have improved in-stream ecological health. On completion in 2024, it is likely phosphorus loss will have reduced by 10% although nitrogen loss by less than 5% from current concentrations. Diversion of all remaining discharges of treated dairy effluent from water to land should be completed by 2025 and will reduce nitrogen loss by 10 to 15% and phosphorus loss by up to 35% - the cost to farmers is roughly $4.4 million.

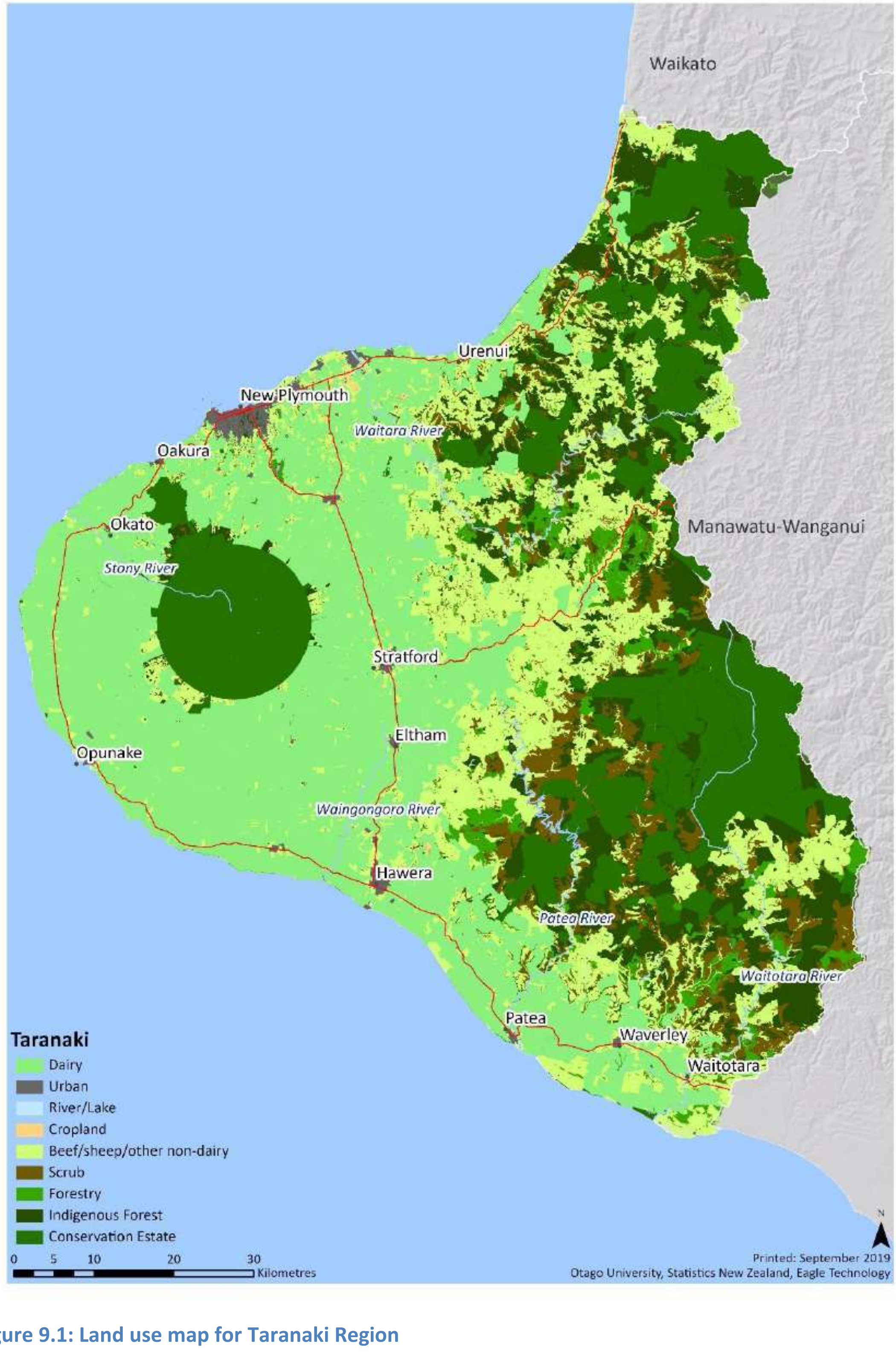


Figure 9.1: Land use map for Taranaki Region

The Waingongoro River catchment includes 585 km of river course outside the ringplain (including tributaries). With 7,500 km of rivers on the ring plain outside the National Park boundaries, the Waingongoro catchment represents 7.8% of the total stream length on the ring plain and 9.2% of the total area of the ring plain, but 9.4% of all dairy farm discharges, and 11.3% of all remaining dairy farm discharges to water. That is, the Waingongoro catchment is amongst the most intensively farmed catchments in the region, and its water quality is under the greatest pressure from rural activities (urban and industrial catchments in Taranaki have lower stream health). As already noted, however, the water quality of the Waingongoro is not significantly elevated above other waterways on the southern ring plain.

To give some further context, a Regional Socioeconomic Deprivation Index Map is included for Taranaki in Section 15 at the end of this report.

9.3 Methods and Results

The Council has commissioned Simon Harris of landwaterpeople to prepare an *Assessment of the agricultural economic impacts of DIN limit proposal in Essential Freshwater package in Taranaki*. This work is built on previous analyses conducted by Mr Harris on the Taranaki situation commissioned by the Council in the earlier development of Taranaki's freshwater plan proposals.

As detailed data was not available on the exact reductions required and the locations where it is would be required, a broad approach has been adopted. It is anticipated that the proposal will largely affect farms in the southern ring plain. Approximately 1000 farms are in the southern ring plain, and three quarters of the catchments will exceed the DIN limits. It is estimated that the reduction required will be from approximately 1.8mg/L to 1mg/L (the proposed national bottom line for DIN set out in the draft NPS-FM), representing a reduction of 44%. Three mitigation approaches were considered in the analysis to meeting the limit:

A cap on N losses where all farms above the cap must reduce their losses to the cap, and all those below cannot increase their losses.

1. A proportional reduction approach where all farms reduce by the same amount in order to achieve the required catchment reduction.
2. The land use is substituted by forestry to achieve the require reduction in N loss.

Southern Taranaki Ringplain

To achieve the N loss reductions in the southern Taranaki ringplain, manageable land uses (land use that can alter its N loss, such as farming, as opposed to land uses that cannot such as forestry and conservation forestry) must reduce N loss by 46%.

If using the N cap approach, the N cap for south Taranaki would be 27.2 kilograms of N per hectare. The costs to achieve these reductions would exceed $100,000 per annum for 33% of farms and $50,000 per annum for 70% of farms. This is likely to require large scale changes to affected catchments, and substantial disruption to the existing structure of farming and the community. Approximately 50%, dairy farms are likely to have to make major changes to the farm system, such as moving to housing of stock and the capture of all effluent. There are likely to be properties in high rainfall areas which will need to reduce losses of over 80%. This could only be achieved by conversion to forestry or retirement of the land.

The average debt to equity ratio for Taranaki farms in 2017/18 was 53%. In that year, the average farm made a loss and a return on equity of -8.4%. Approximately one quarter of farms are vulnerable to a sustained decrease in operating profit. A 46% N loss reduction could result in a 33% reduction in operating profit with land values likely to decrease by a similar amount. Such a decrease would result in a significant proportion of Taranaki farms becoming insolvent.

The overall mitigation cost of the DIN limit for south Taranaki farms is estimated to be in the order of $46-$60 million per annum.

To achieve the DIN limit, large parts of the southern Taranaki ring plain (up to 30,000 hectares or 32%of the area) will need to convert to forestry. Conversion to forestry represents the lowest N mitigation cost when returns from greenhouse gas emission absorption are included. However, it relies on a continued robust market for forest products and NZ Units, which is not guaranteed if large scale conversion to single species (radiate) forestry occurs.

The socio-economic impact to Taranaki region is expected to be substantial, particularly in the rural areas affected and for local businesses and communities that provide support services to dairy farms. Taranaki will typically expect to see falling populations in affected areas, loss of scale for services providers, and flow on impacts into the regional towns of Stratford, Hawera and New Plymouth. Household incomes of business owners and their employees will be affected, the impacts will extend into businesses that are not directly related to the agriculture sector. Conversion to forestry would result in reduced local population and associated impacts on local businesses, schools, clubs and community organisations, and a resulting reduction in health and other community services.

For specific areas and farmers, the effects of the Essential Freshwater package will be in the same order of magnitude as the last rural downturn in the 1980s – 1990s.

Waingongoro catchment (Schedule 1)

The requirement for all farmers to reduce N losses to the 75th percentile of all losses in the Waingongoro catchment will mean that all farms will have to be at or below 58 kilograms of N per hectare. Twenty-five percent of properties in the Waingongoro catchment will be affected and this would result in approximately a 10% reduction in N losses for the catchment.The Waingongoro catchment's land use is largely dairying with most of the land in higher rainfall areas (>1500mm).

The total estimated cost of meeting the interim N cap for the Waingongoro catchment is $1.2 million per annum. This is an average of $30,000 per affected property although some properties will experience costs exceeding $100,000 per annum.

There will be practical difficulties in implementing the required changes in such a short period and the reduction in profitability and associated reduction in land values would appear to have the possibility of rendering numerous farms insolvent.

Image 9.1: Mangawhero-iti Stream in the Waingongoro River Catchment

In Taranaki, the N-Cap proposal and recommended nutrient bottom-lines are quite different to the region's current policy pathway, and our analysis has found no evidence the proposed national interventions would improve ecological health as quickly, as comprehensively, or as cost-effectively as current approaches. The N-Cap proposal requires the use of Overseer to regulate a farm's performance and environmental footprint in terms of nitrogen loss, which is a major shift for farmers in the region. It is anticipated that the economic impacts of imposing nutrient bottom-lines across Mount Taranaki's southern ring plain will be considerable. This area has relatively high levels of social deprivation.

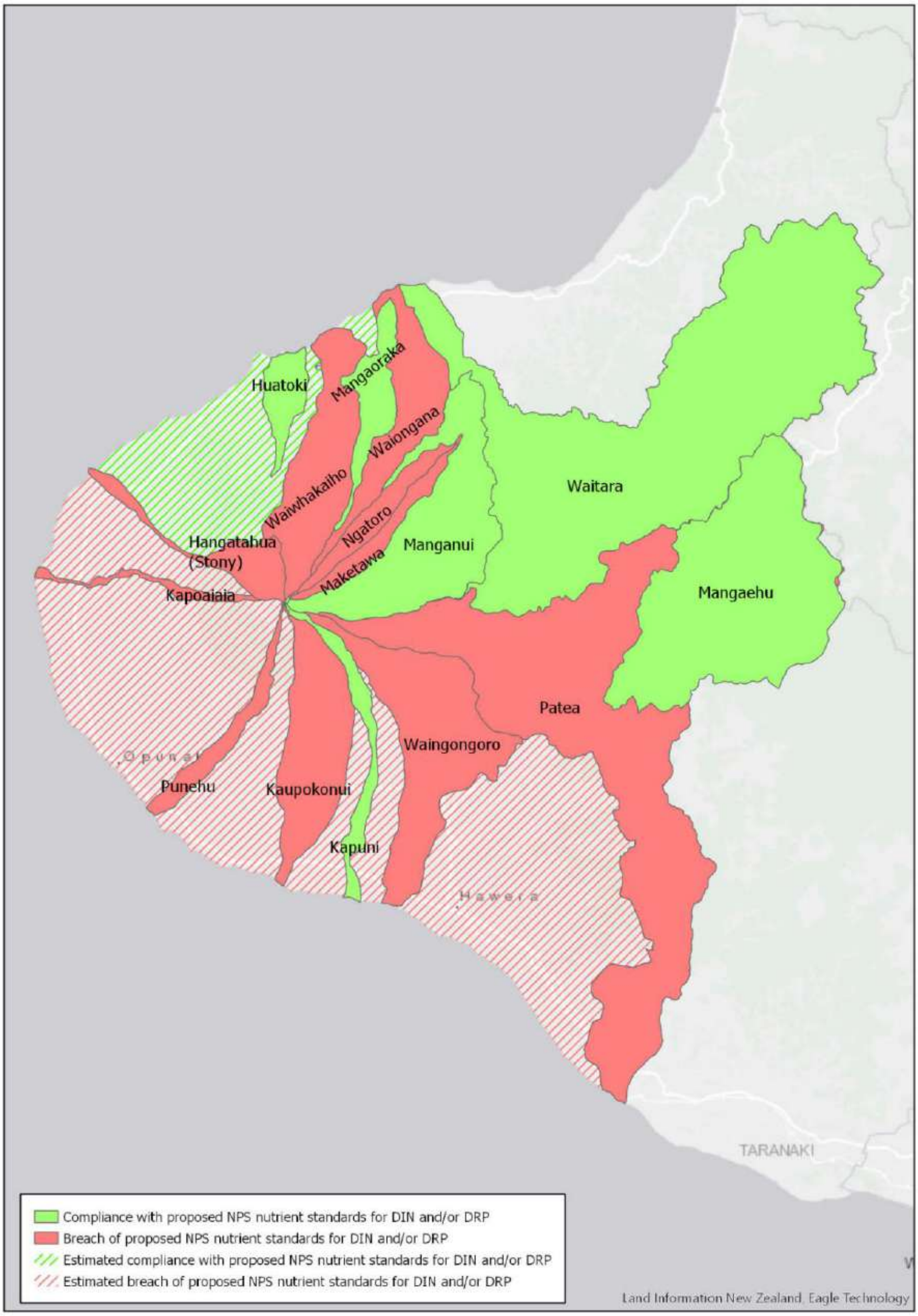


Figure 9.2: Compliance with proposed nutrient bottom-lines in catchments monitored for nutrients

10. Greater Wellington – Review of Landcare report for Ruamāhanga Catchment (Wairarapa)

10.1 Introduction

In developing the Essential Freshwater Package, the Ministry for the Environment commissioned Landcare Research to assess the economic impacts of nutrient and sediment reduction scenarios for the Ruamāhanga catchment. Landcare modelled practice-based and outcome-based scenarios across the catchment, including three nitrogen loss limits: 30kg, 50kg and 70kg N/ha/year.

10.2 Setting

The Ruamāhanga Catchment lies in the Wairarapa, to the east of the Wellington Region. It is roughly 359,000 ha in size and the main land uses are sheep and beef (46%), native bush (24%), dairy (8%), mixed cropping (5%), dairy support (3%), and forestry (3%). There are 5 rural towns and approximately 45,000 people. The Ruamahanga whaitua is a special place for the iwi in the catchment, Kahungunu and Rangitane. Wairarapa Moana (the lakes) are of particular importance.

Water quality in the Ruamāhanga Catchment ranges from very good in the Tararua headwaters to quite poor in the valley floor streams, and very poor in Lakes Wairarapa and Onoke. River, lake and wetland habitats are highly modified. The main water quality issues are *E. coli*, periphyton biomas, and phosphorous. Nitrogen is more of a localised issue and almost all farms in the catchment have nitrogen losses of less than 50kg N/ha/year. Greater Wellington Regional Council, through its whaitua committee process, is proposing to reduce the total catchment nitrogen load by 9%, phosphorous by 34% and sediment 28%. Reductions in *E. coli* are required almost everywhere.

10.3 Methods and Results

This case study reviewed the report produced by Landcare from a regional perspective. Landcare used the same catchment economic model as that relied on for the whaitua process (2017-18) to test a number of scenarios to manage nutrients and sediment. The scenarios were primarily practice-based with some outcome-based options (i.e. nitrogen loss limits). The results from the two modelling processes are comparable. Where relevant the recommendations of the whaitua committee are compared to the government's proposal.

The scenarios included a 'business as usual' (BAU), which involved the existing policy approach including new provisions in the regional plan, but not whaitua specific provisions. Practice based scenarios included sets of mitigations and land use changes. Outcome based scenarios included annual N loss rates not exceeding 30kg, 50kg, and 70kg N/ha/year. Several combination scenarios were also considered to estimate maximum mitigation potential.

Nitrogen results

The 70 and 50Kg N/ha/year N limits modelled have few N, P or sediment benefits because the area of the catchment that falls into this category is less than 1%, i.e. most farming systems already have lower N losses. A 30kg N/ha/year limit does have a modest reduction in N load (6.7%) and a corresponding decrease in farm revenue. Stock holding areas for dairy and dairy support were cost effective for mitigating N but do not reduce the total N by more than 7%.

There are several places in the catchment where the existing DIN concentrations are below the proposed DIN bottom-line of 1.0mg/l. The whaitua committee has recommended that all sub-catchments should meet this level. This would result in a reduction in N load of 9%. This decision occurred well ahead of the government's proposal. In other words the community's expectations through the whaitua process are similar to those in the Government's proposal (i.e. the proposal does not increase the expected nitrogen reductions).

Sediment and phosphorous results

Combination (practice and target) scenarios produced noticeable reductions in net farm revenue, between 7% and 46%. The benefits of multiple practices are significant with N losses reduced by 10 to 44%, while phosphorus losses and sediment losses are reduced by 5 to 64% and 3 to 48% respectively. The high end of these figures is significantly more than the load reductions recommended by the whaitua committee. The committee recommended load reductions of 34% for phosphorous and 28% for sediment.

The recommendations of the whaitua committee regarding dissolved reactive phosphorous (DRP) are all above the national bottom-line in the proposed NPS-FM.

Stock exclusion

The existing policy approach (BAU) in the catchment is more stringent than most of the stock exclusion mitigations modelled. However, stock exclusion on only wider (>1m) is estimated to gain 18% sediment loss over BAU. Stock exclusion on smaller streams may be necessary in some areas to achieve the desired sediment reductions. A 5m buffer fence around wetlands has a small impact compared to other impacts. This is mostly due to the small area of wetland in the catchment (0.5%).

10.4 Conclusion

The two higher nitrogen loss limits did not affect many farms so had few benefits for nutrients or sediment. The 30kg nitrogen loss limit had a modest reduction in nitrogen (-6.7%) and a corresponding decrease in farm revenue. Most of the farms affected are dairy or mixed arable and, while mitigation achieves most of the gains, minor land retirement is needed.

The whaitua committee process recommended a catchment reduction of 9% nitrogen (i.e. a greater reduction than modelled in the Landcare report). Their recommendation will be carried forward into the next plan change. A load reduction of 9% will achieve the dissolved inorganic nitrogen (DIN) 'bottom-line' but several sub-catchments will need to have much higher reductions: Otukura requires a 19% reduction, Parkvale 13% and Kopuaranga 12%.

The Parkvale sub-catchment is the only 'Nitrogen-cap' catchment under the government proposal in the Ruamahanga catchment. The impact on farmers from the government proposal is similar to what is being contemplated by the community at present.

The overall direction of the governments proposed policy package is in line with the direction recommended by the whaitua committee for the Ruamahanga catchment. The proposed NPS-FM is unlikely to add significant costs over and above the whaitua committee recommendations.

This case study doesn't evaluate the costs and benefits of the proposed NES (the "farm package"). The Landcare study modelled many farm practices and mitigations. These would mainly be implemented through a farm planning regime. This case study doesn't evaluate the effectiveness of the proposed farm plan system nor the costs.

10.5 Reference

Landcare Research (2019) Modelling the impact of freshwater mitigation scenarios: results for the Ruamahamga Catchment. Report prepared for the Ministry for the Environment.

11. Canterbury – Nitrogen 'bottom-line' in the Waitaki Catchment

11.1 Introduction

The Waitaki catchment is the largest in the Canterbury region. The catchment has an area of approximately 12,000 km^2, from Aoraki to the sea and approximately 350 km^2 of the catchment is within the Otago Region. The catchment is covered by three territorial authorities; Mackenzie, Waimate and Waitaki.

The hydrology of the Waitaki catchment is characterised by three large glacial–fed lakes (Tekapō/Takapō, Ōhau and Pūkaki), and a hydropower scheme linking these lakes with large canals which transport water through eight power stations. Three large artificial lakes have been formed as part of the hydropower scheme (Lakes Benmore, Aviemore and Waitaki), and there are also a number of smaller man-made and natural lakes in the catchment. The Tekapō/Takapō, Pūkaki and Ōhau Rivers have been largely de-watered due to the hydro power scheme canal diversions. The dam forming Lake Waitaki is the demarcation between the upper and lower Waitaki catchments.

The Waitaki River has always been an important waterway for Canterbury and New Zealand, and is of paramount importance to Ngāi Tahu whānui. Historically whānau and hapū lived on the shores of lakes, wetlands, streams and at river mouths. They developed use patterns in designated whānau and hapū managed rohe (territories). Modifications to the river catchment have not severed the relationship of Ngāi Tahu with the lands and waters of the Waitaki. As mana whenua, through whakapapa, Ngāi Tahu have an enduring relationship with the Waitaki that is accompanied by a responsibility to assess how changes to the use and development of freshwater resources within the Waitaki catchment impact their cultural beliefs, values, practices and most significantly their customary and Treaty rights to utilise lands and waters in the Waitaki (Tipa, Nelson and Williams, 2015).

11.2 Context

Four freshwater management units (FMUs) have been identified for the sub-region. The FMUs set for the Waitaki sub-region are illustrated in Appendix 11.1.

The Upper Waitaki FMU contains large areas of high-altitude conservation estate (40% of the total FMU). It is also regionally-distinctive in still retaining very high and extensive biodiversity values within its low-altitude basin and valley floor habitats, reflecting historically low levels of land-use intensification. As of 2015:

- In 2014 approximately 12,200 ha of land was irrigated in the upper Waitaki (1.2% of the FMU) including an estimated 3,200 ha of border dyke irrigation.
- Dairy and dairy support land uses comprised approximately 25% of the irrigated area in the upper Waitaki.
- Almost 30,000 ha (13%) of land was irrigated in the Canterbury component of the lower Waitaki catchment, 65% of which is estimated to be via spray irrigation. Conversion of properties from border dyke to spray irrigation is projected to continue at between 3% and 5% per annum.

Compared to many areas of lowland Canterbury, the Upper Waitaki FMU has limited agricultural intensification and waterways are relatively healthy. One river, the Willowburn, has been identified as particularly 'impacted' in the Upper Waitaki FMU, and in areas where intensification has occurred water quality and stream health has been impacted (Gray, 2015).

Groundwater is used as a source of drinking-water supply in most of the major population centres. Other public supplies rely on surface waters (Scott, 2015 and Scott & Etheridge, 2015). Contaminants of concern for groundwater are nitrate and faecal contamination. Shallow water supply wells are most at risk from faecal contamination, which appears to be widespread in shallow groundwater in the lower Waitaki (Shaw and Palmer, 2015).

The quality of groundwater in the Waitaki sub-region is generally better than the regional averages for Canterbury, and in the Upper Waitaki FMU in particular, concentrations of nutrients are relatively low in most of the wells sampled.

Nitrogen generally enters surface water via groundwater - aquifer properties and recharge characteristics affect the time it takes for nitrogen to travel from beneath the root zone and through the groundwater system from a source to a surface water receiving environment. Estimates of lag times indicate considerable variability may exist (Etheridge and Scott, 2015). In some locations, this means that current nitrate concentrations measured in streams may not yet reflect the full impact of current land use in the sub-region, but in others, intensification is either close to surface water measurement points, or aquifer properties are well enough understood to provide confidence in current state assessments (Shaw and Palmer, 2015.

Streams and rivers in the sub-region include alpine upland, hill-fed upper and lower, upland spring and lake-fed rivers. The surface water and groundwater are highly connected in many places throughout the Waitaki catchment - in particular in the Upper Waitaki FMU where highly permeable glacially deposited gravels result in gains and losses from many of the streams and rivers, with many 'running' dry naturally in summer months.

Water quality in rivers in the Lower Waitaki is variable, with a number of water bodies failing to meet some Canterbury Land and Water Regional Plan objectives. In the Lower Waitaki dissolved nutrients are elevated in spring fed systems compared to hill fed systems. Breaches of periphyton and invertebrate objectives in the Canterbury Land and Water Regional Plan signal that some systems are also affected by temperature, sedimentation and flows, as well as nutrient concentrations (Shaw and Palmer, 2015).

11.3 Analysis

The draft NPS for Freshwater Management has a proposed bottom-line for nitrogen in rivers at an annual median of 1.0 milligrams per litre of dissolved inorganic nitrogen (DIN). This would apply to all rivers and streams. To test the impacts of the draft proposal, a case study focusing the impacts of the proposed DIN in the Waitaki was developed. Given timing constraints, we have not been able to undertake modelling and our commentary is a 'best estimate' based on knowledge of DIN and land use around the region. This case study is informed by earlier work completed as part of Plan Change 5 to the Canterbury Land and Water Regional Plan. Plan Change 5 became operative in February 2019. We have focused only on those rivers with a current DIN concentration of >1 mg/L, have assessed current land use within these catchments, and compared this against land use in comparable catchments that do meet the DIN bottom-line. We have then drawn conclusions about the scale of land use change that may be needed to meet the DIN bottom-line, and the extent to which reductions in DIN concentrations will deliver ecological benefits in these streams.

Baseline

In February 2019 the Plan Change 5 became operative. The Plan Change addresses water quality issues both throughout the Canterbury region and also specifically within the Waitaki catchment. The Plan Change introduces new nutrient management rules and policies for farming activities in the Upper and Lower Waitaki, and sets a minimum standard that all farming activities must operate at Good Management Practice. It also introduced new rules around aquaculture and wastewater discharges and set new water quality outcomes for rivers, lakes, and groundwater within the Waitaki.

With regard to DIN concentrations in Waitaki rivers, 24 of the 27 monitored rivers have annual medians of below 1 mg/L – most have annual medians of less than 0.3 mg/L. The water quality limits set within Plan Change 5 for these rivers are for nitrate and ammonia (separately) rather than DIN. For the purpose of comparison here ammonia and nitrate have been combined to show DIN. In the Upper Waitaki the combined limits are below 1 mg/L, and consequently the proposed DIN bottom-line will not impact these catchments. These rivers include a mix of alpine upland, hill-fed upland, lake-fed, spring-fed upland and hill-fed lower streams.

Three rivers in the Waitaki have DIN concentrations above 1 mg/L – Penticotico Stream, Whitneys Creek and Waikākahi Stream. All three are spring-fed and situated in the lower Waitaki, and the water quality limits set though Plan Change 5 are also above 1 mg/L:

Table 11.1: Median DIN concentrations in three Lower Waitaki spring-fed streams

River	River type	DIN annual median (mg/L)	Plan Change 5 "DIN" limits (mg/L)
Penticotico Stream	Spring-fed plains	1.63	1.12
Whitneys Creek	Spring-fed plains	1.75	1.8
Waikākahi Stream	Spring-fed plains	3.12	2.65

The provisions of Plan Change 5 specific to the Waitaki focus on implementing Good Management Practice (GMP), which may lead to a shift from border dyke to spray irrigation. This shift is seen as necessary to reduce instream loads of Dissolved Reactive Phosphorus (DRP), sediment and *E.coli,* however it is recognised that the shift from border dyke to more efficient spray irrigation can increase DIN concentrations. The reason for this increase in DIN concentration is that while the amount of nitrogen leached below the root zone reduces due to less water being applied through irrigation, so too does the quantity of drainage water and hence stream flows. This results in less dilution of nitrogen, so nitrogen concentrations can increase. Despite this, the majority of water quality parameters and overall ecological health of these three rivers is likely to improve through action required by Plan Change 5.

Figure 11.1 illustrates the range of median DIN concentrations in different river types across Canterbury. It is largely the spring-fed rivers where we find elevated DIN concentrations above the proposed bottom -line. Alpine, upland and lake fed streams achieve the DIN bottom-line, while 66% of spring-fed rivers on the plains and 73% of spring-fed urban rivers in Christchurch do not meet the bottom-line. In some of Canterbury's hill-fed streams we also have elevated DIN concentrations, particularly in their lower reaches where there is considerable groundwater-surface water interaction. 30% of Canterbury's hill-fed lower rivers would not achieve the proposed DIN bottom-line.

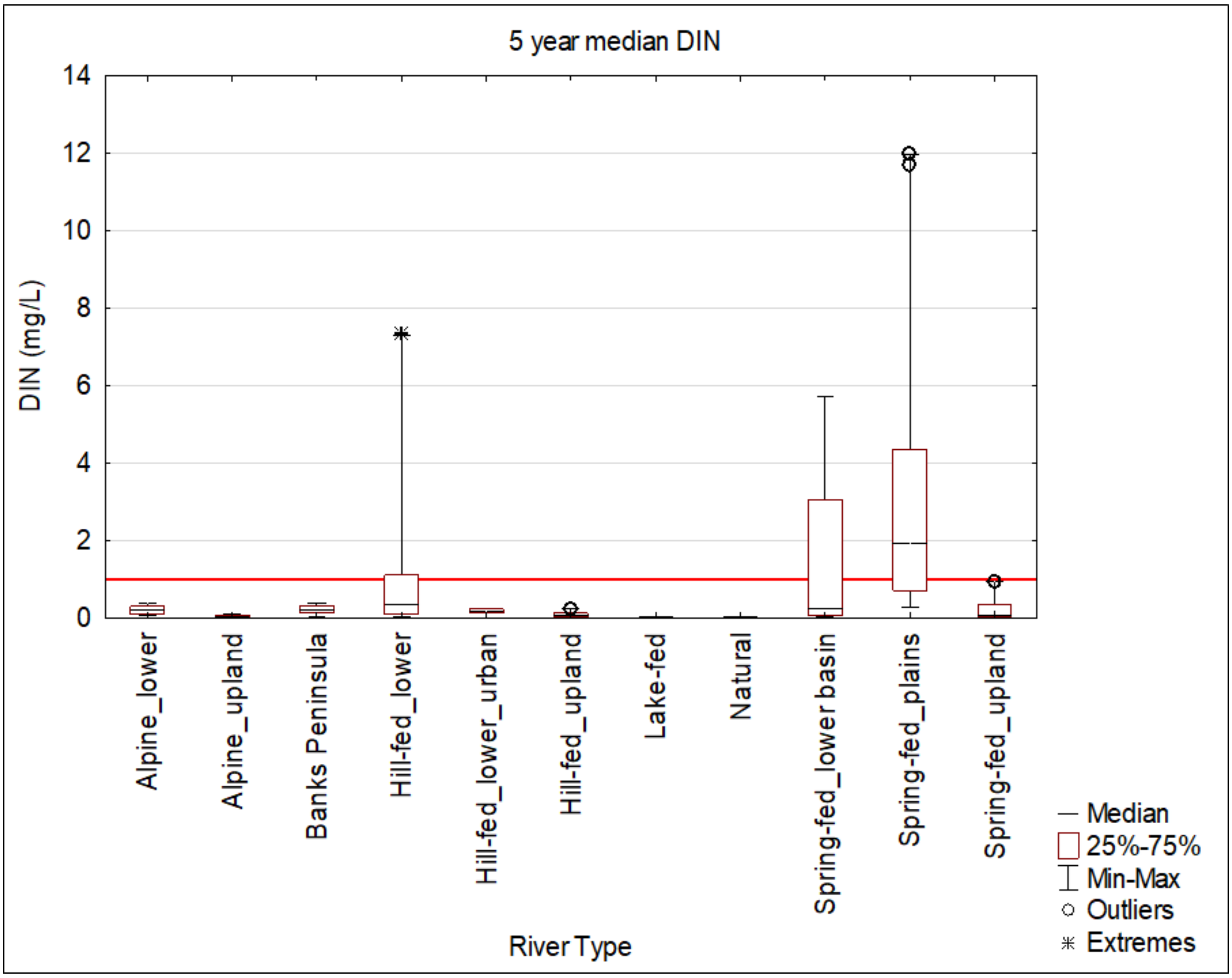


Figure 11.1: 5 year DIN concentrations (mg/L) in different river types in Canterbury

Assumptions

As noted earlier, given timing constraints our commentary is a 'best estimate' based on knowledge of DIN and land use around the region. This case study is based largely off analysis produced for Plan Change 5 in 2015 and does not attempt to accurately assess the quantitative impacts of the proposed bottom-line. Instead, it seeks to provide a sense of scale for how the proposal may impact land use and whether the proposed bottom-line will deliver on its objective. Therefore, there are many uncertainties associated with this work.

11.4 Results

We have considered two questions as part of this case study:

1. *What scale of land use change might we require in catchments with elevated DIN concentrations in order to achieve the proposed DIN bottom-line?*
2. *What ecological benefits might we expect from reducing DIN concentrations to 1 mg/L in those catchments with elevated DIN concentrations?*

What scale of land use change might we require in catchments with elevated DIN concentrations in order to achieve the proposed DIN bottom-line?

From a land use change perspective, unsurprisingly it is those catchments in the Waitaki that are predominantly intensive and irrigated-intensive agricultural land that have DIN concentrations above the proposed DIN bottom-line of 1 mg/L. Figure 11.2 shows land cover across Waitaki. It is in those catchments where the proportion of irrigated agricultural land is greater than 40% that DIN concentrations are above 1 mg/L (i.e. Whitneys Creek and Greater Waikākahi).

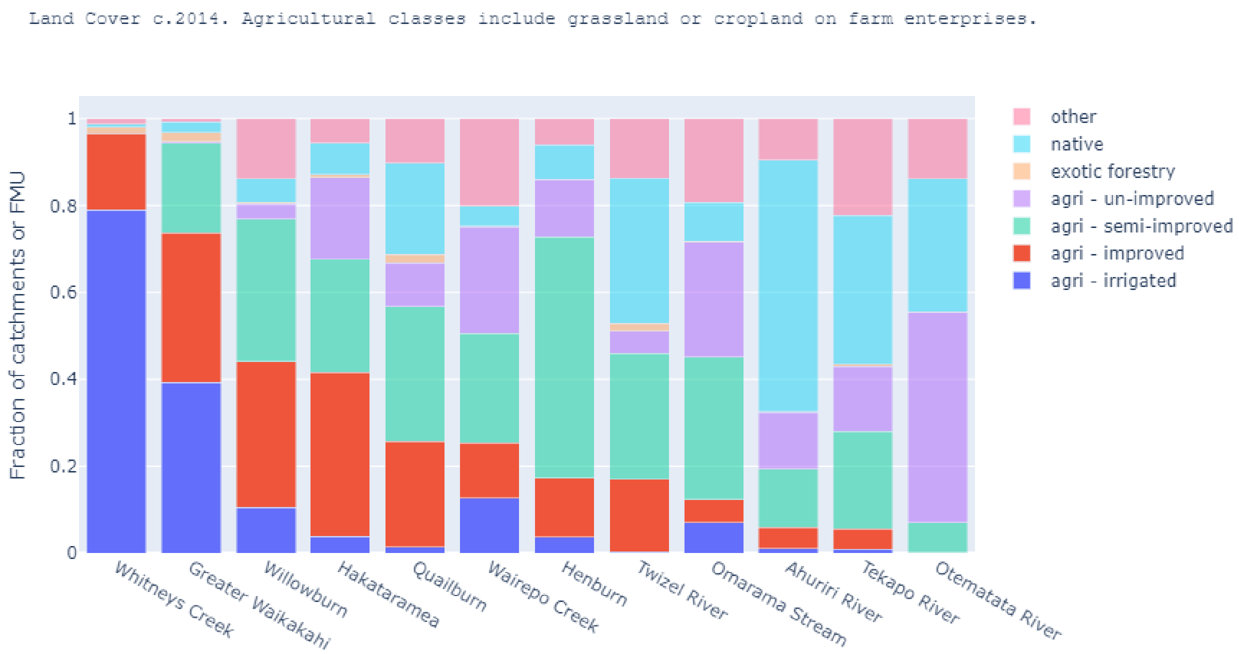


Figure 11.2: Agricultural Land use classes in the main Waitaki sub-catchments

For the purposes of this case study we've used Willowburn as a comparator. However, we do caution that this is a best estimate only and is intended to provide a general sense of scale rather than an accurate result – there will obviously be catchment specific factors that impact DIN concentrations. Willowburn is a spring-fed upland river which achieves the proposed bottom-line with an annual median DIN concentration of 0.93 mg/L (Willowburn has a Plan Change 5 nitrate limit of 0.66 mg/L so the plan is seeking improvement). Figure 11.2 (above) shows that somewhere around 10% of the Willowburn catchment is irrigated agricultural land.

Using this information as a guide, our best estimate is that large-scale land-use change would be required to achieve the proposed bottom-line in Whitneys Creek and the greater Waikākahi, and specifically a very significant reduction in irrigated land. For these catchments it may require a reduction in irrigated land of between 75-90% to achieve the proposed DIN bottom-line. This fits with other modelling in Canterbury (e.g. Selwyn-Waihora and Waimakariri) where it is only through land use of extensive sheep and beef grazing and forestry that concentrations of nitrate in spring-fed streams drop below 1 mg/L (i.e. it cannot be reached through good management practice alone).

What ecological benefits might we expect from reducing DIN concentrations to 1 mg/L in those catchments with elevated DIN concentrations?

Drivers of ecosystem health are complex. As part of the Plan Change 5 process, a range of actions were considered that would best deliver on a variety of outcomes sought by the community. Through this process it was identified that reducing nitrogen concentrations was important, but so too was the efficient use of water and fertiliser and reducing the loss of soil and the discharge of contaminants carried with soil and water into surface water. We also know that the environmental benefit of reducing DIN in spring-fed streams dominated by rooted aquatic plants (macrophytes) is likely to be limited. This is because macrophytes also obtain nutrients from the substrate of these streams; therefore, reducing the available nitrogen in the water column (DIN) does not significantly reduce the ability for plant growth and eutrophication.

Our general conclusion regarding the ecological benefits of reducing DIN concentrations is consistent with this – we expect the ecological benefits of reducing DIN to 1 in the spring-fed plains streams in the Waitaki to be limited. Other target attributes (e.g. DRP, sediment cover) and riparian shading may deliver better ecological benefits for these streams.

In those lowland hill-fed streams in Canterbury where DIN concentrations are above 1 mg/L, our initial conclusions are that greater reductions in DIN concentrations would lead to ecological benefits as it would lead to lower periphyton cover and less eutrophication. In-stream productivity in these hill-fed streams is more closely linked to water column nutrient availability compared to spring-fed streams, where a portion of the nutrients used for plant growth is taken from the sediment. While 30% of Canterbury's hill-fed lower rivers do not achieve the DIN bottom-line, none of these are found in the Waitaki.

11.5 Main findings

We expect the ecological benefits associated with the proposed DIN bottom-line to differ across river types. Through a high-level assessment of the Waitaki, we expect that for spring-fed plains streams the ecological benefits are likely to be limited, while the required land use change to achieve the DIN bottom-line will likely be considerable. Tight management of Dissolved Reactive Phosphorous (DRP) and fine sediment is likely to be more important for these streams. We consider further reductions in DIN will deliver benefits in Canterbury's hill-fed streams with elevated DIN concentrations. Similarly, we consider that achieving large DIN reductions in hill-fed streams may require some land use change, but not at the scale required in spring-fed catchments.

11.6 References

Gray, D. 2015: Upper Waitaki catchment flows, water quality and ecology: state and trend. Environment Canterbury Technical Report R15/57. Environment Canterbury.

Palmer, K. Shaw, H. 2015. Waitaki Limit Setting Process: Technical Overview. Environment Canterbury Technical Report R15/99. Environment Canterbury.

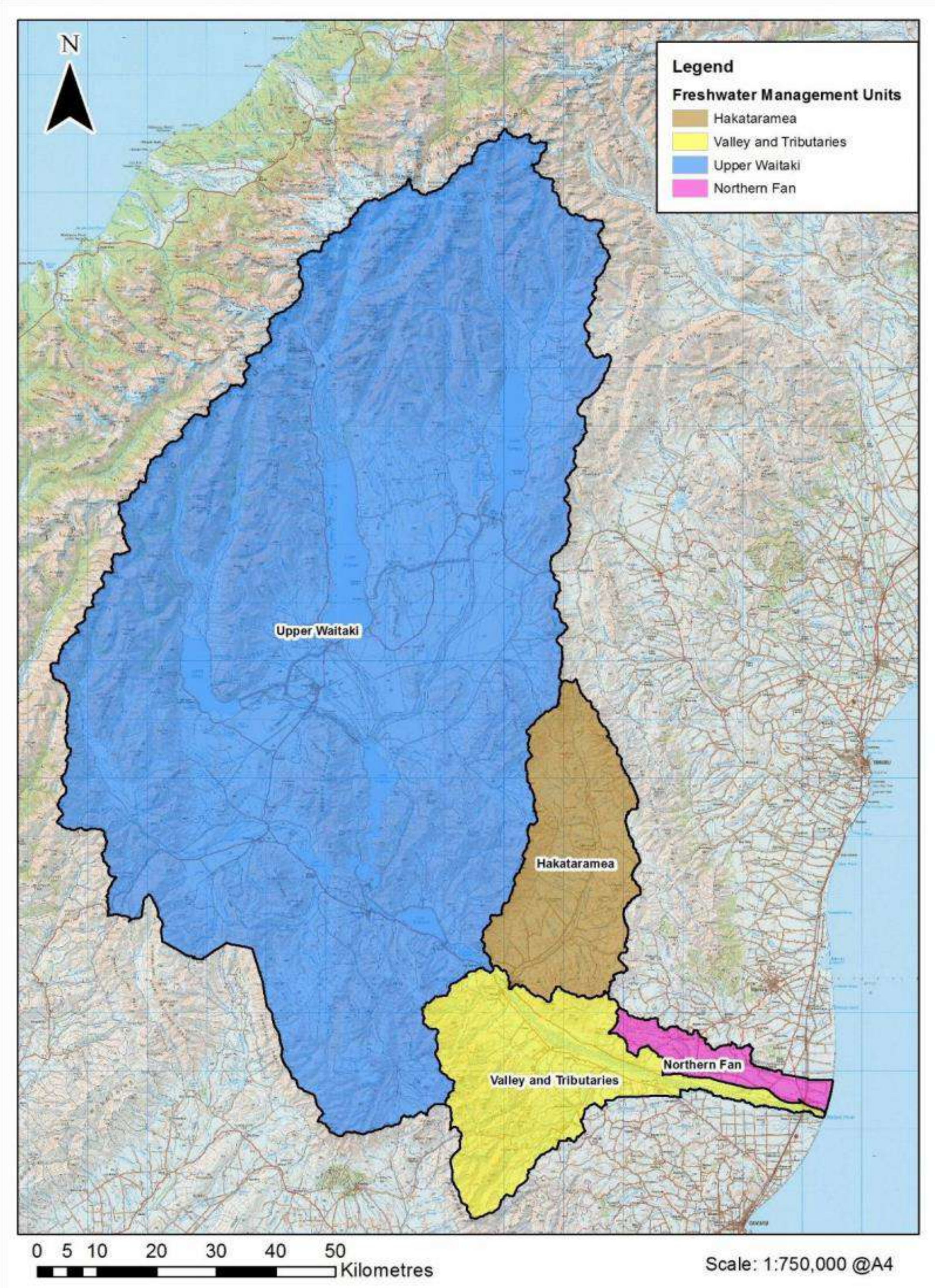
Scott, M. 2015. The current state of groundwater quality in the upper Waitaki. Environment Canterbury Technical Report R15/42. Environment Canterbury.

Scott, M., Etheridge, Z. 2015. The current state of groundwater quality in the lower Waitaki. Environment Canterbury Technical Report R15/41. Environment Canterbury.

Tipa, G. Nelson. Williams, E. 2015. The Eco-cultural Health of the Waitaki Catchment. Report prepared for Environment Canterbury by Tipa and Associates Ltd and Dr Erica Williams. July 2015.

11.7 Appendices

Appendix 1 Freshwater management units in the Waitaki



12. West Coast – Stock Exclusion Regulations

12.1 Introduction

Covering 23,000 km^2, the West Coast is a mountainous region with steep catchments that drain the western side of the Southern Alps. The vast majority of land is in the public estate with 84.2% managed by the Department of Conservation. The West Coast is the wettest region in New Zealand with annual rainfalls ranging from 2.5 - 12 metres per annum, depending on the location. Annual rainfall increases as one moves south due to the increasing orographic influence of the Southern Alps.

The West Coast has a small population of 32,000, sparsely scattered along a long narrow coastline that spans a length of over 600 km. The three main towns on the West Coast are Westport, Greymouth and Hokitika, all coastal towns situated by large rivers. Traditionally these main centres have serviced the mining and farming sectors.

Poutini Ngāi Tahu is defined as the section of Ngāi Tahu who, by whakapapa, derive their status as tangata whenua from their ancestors who held the customary title and rights to the lands of Westland (West Coast) at the time of the signing of the Treaty of Waitangi in 1840. Within the Tai Poutini (West Coast) Te Rūnanga o Ngāti Waewae and Te Rūnanga o Makaawhio are the two papatipu marae-based Rūnanga, which have manawhenua over Te Tai o Poutini from Piopiotahi (Milford Sound) in the south, to Kahurangi in the north and into the middle of the Southern Alps.

Each Rūnanga has its own area determined by natural boundaries such as mountain ranges and rivers. These takiwā are defined in the Te Rūnanga o Ngāi Tahu Act. The area that is in the exclusive takiwā of Te Rūnanga o Makaawhio extends from the south bank of the Poerua River mouth to Awarua Point. The area that is in the exclusive takiwā of Te Rūnanga O Ngāti Waewae extends from the north bank of the Hokitika River mouth to Kahurangi Point.

Poutini Ngāi Tahu holds a holistic view of the environment and believes that all things are interrelated. This includes people and their interaction with the environment. Poutini Ngāi Tahu input into resource management policy and plans is driven by this view and an all-embracing concern for the total environment.

12.2 Context

Economy

The West Coast has struggled economically with little growth observed in the last 10 years (0.1%), and this situation appears to have worsened recently (-0.3%) compared with the rest of the country (3.2%, as of 2018). Corresponding trends in regional and national employment are similar to these figures.*[1]

Both the population and economy has declined in the last 4-6 years in the northern and central parts due to significant job losses from coalmines closing, the cement works closing in Westport, and reductions in the dairy pay-out. Loss of population can severely limit the viability of a range of services and has a negative impact on the economic and social structure, and the health of small, tight-knit and often isolated communities.

Mean income and income growth lags behind the national average at $54,000 and 2.9%, compared with $60,000 and 3.7%, as of 2018. Housing affordability is three times better than the national average. Rental affordability, while a third better, is closer to the rest of New Zealand when compared with house prices.*[2]

Deprivation indices for the West Coast indicate moderate to low deprivation in areas where there is significant agricultural activity. This is particularly apparent in the Hokitika and Grey Valley areas (also Hokitika and Grey FMU's). The main urban population centres have moderate or better deprivation scores owing potentially to a conglomeration of public services, and facilities that service tourism and industry. The Franz and Fox Glacier areas are a major tourist hub, which will contribute to its higher prosperity. High deprivation is evident in areas that have lower population densities and no significant industry in the area. Many of these areas had substantial coal mining communities, which have struggled as this industry has contracted in recent times. The Buller Region (essentially the Kawatiri FMU), is such an area.

To give some further context, a Regional Socioeconomic Deprivation Index Map is included for The West Coast in Section 15 at the end of this report.

Main industry state and trends

Reliance on the region's natural resource base has been a feature of the region's population for more than 100 years. Sustainability and profitability of the natural and physical resource base is fundamental to and interconnected with the continued welfare of the region's communities.

Historically, forestry was a large source of income for the West Coast, owing primarily to the value and accessibility of native timber species. Attempts to improve the sustainability of native logging began with the 1986 West Coast Accord and ended with the Forests (West Coast Accord) Act 2000. This effectively ended the West Coasts' native logging industry, leaving exotic forestry, which accounted for 0.6% of employment in 2018.*[2]

In the earlier part of the last decade mining gold and coal was the most significant income source on the West Coast, particularly in the northern parts of the region. Global market trends and shifts in policy (e.g. safety and environmental) have substantially reduced coal mining activity and eliminated underground mining in the region. Smaller scale alluvial gold mining operations continue to be economically sustainable and provide useful income for certain communities. Overall, employment growth in the mining sector has declined substantially.

Table 12.1: Main industries on the West Coast (source: https://ecoprofile.infometrics.co.nz/)

Industry	Annual GDP 2018 (millions)	Share of GDP 2018	Proportion of population employed	Employment growth 2016-2018
Dairy and drystock farming	$205.6	Total 13.5% (Dairy 11.7%)	7.8%	-3.7
Tourism	$199.4	13.1%	21%	5.3
Mining	$106.8	7.0%	2.9%	-18.4

The region is well endowed with scenic and historic attractions and has significant land and water-based recreation assets. Tourism has more recently become increasingly important to the local economy. In 2018 tourism GDP was just below that of agriculture and employed 21% of the West Coast population. This was over twice the number of jobs provided by agriculture, with job growth increasing at 5.6% per annum from 2015-2018. Further development of private and public infrastructure is required to accommodate additional tourist numbers.

West Coast guest nights increased by 17% over the last 16 years (2003 to 2019), which while positive was approximately half of the New Zealand average increase for this period.[*1] This may not necessarily reflect less interest in the West Coast as a destination given the popularity of mobile accommodation and freedom camping. This group may account for a significant number of tourists passing through the region. From 2015 to 2017, tourist numbers and income from freedom camping in New Zealand nearly doubled.[*2]

Agriculture was the largest industry on the West Coast in 2018 in terms of GDP. At this time agriculture accounted for 14% of GDP and 8% of employment, although these figures are likely to be higher if contributions from the dairy factory are included (another 2-3%), and the work created for support industries.

Dairy farming is the main agricultural activity on the West Coast. Within the West Coast's agricultural sector, dairying accounts for 84% of the sector's GDP and 78% of its jobs. This does not include the 403 jobs provided by the dairy factory in Hokitika. Sheep and beef account for 13% GDP and 17% of jobs, with deer farming at 3% and 6% (GDP and jobs, respectively). Stock numbers have diminished for all these sectors from 2012-2017 (Table12.1).[*1]

Table 12.2: Main industries on the West Coast (source: https://www.stats.govt.nz/)

	Total sheep	Total dairy cattle	Total beef cattle	Total deer
Stock numbers 2017	40,000	156,000	27,000	28,000
Percentage change 2012-2017	-31%	-10%	-5%	-17%

The size of West Coast farms varies, as per the rest of New Zealand. Relative to the rest of the country, the West Coast has a smaller proportion of farms less than 100 ha or greater than 1000 ha. The most common farming units are between 100 ha and 600 ha (Figure 12.1).[*1]

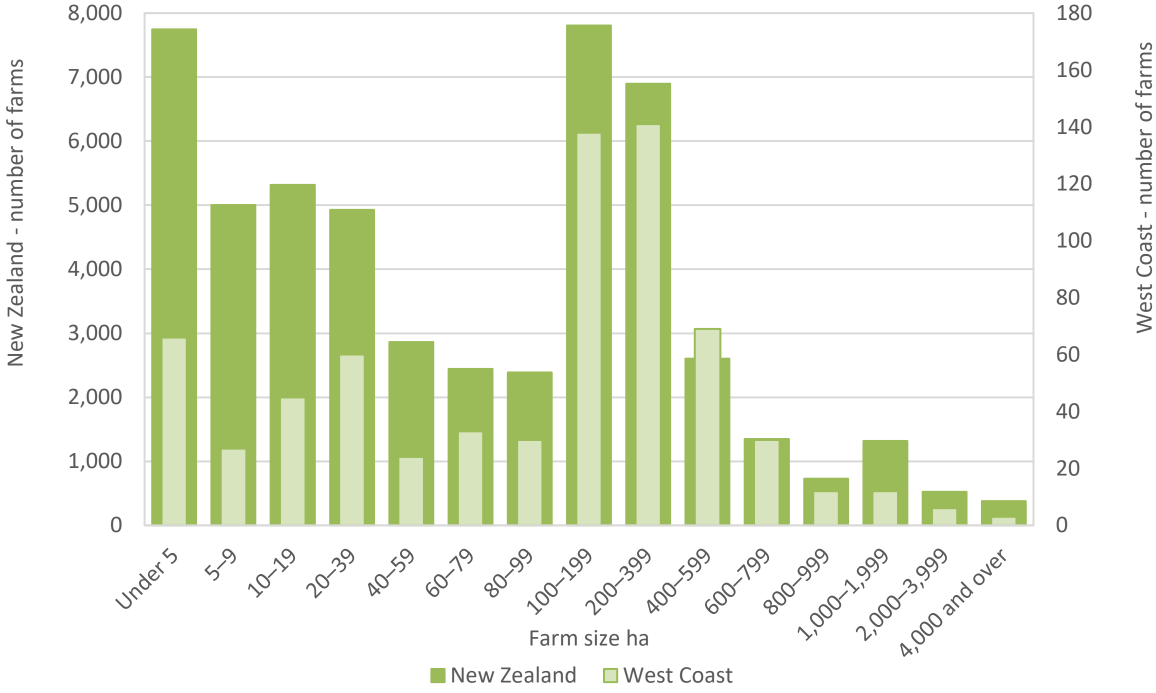


Figure 12.1: Farm size distribution on the West Coast
Source: https://www.dairynz.co.nz/publications/dairy-industry

Farming on the West Coast

High rainfall is the main climatic feature challenging agriculture on the West Coast, and the prognosis under various climate change scenarios is for more rain in the spring and winter. With increasing temperatures in the Tasman Sea more frequent intense rain events are predicted, including ex-tropical storms. 'Near future' rainfall predictions indicate up to 15% more rainfall from 2016 to 2035, particularly Hokitika south. Intensities in this area are also predicted to increase with more than a 20% increase in 99th percentile of daily rainfall by 2090.[*3] Existing and future rainfall regimes have significant on-farm ramifications for pasture and riparian management. Difficulties posed by a cool, wet climate may in part explain lower relative productivity, as demonstrated in dairy sector data. When compared to North Canterbury, the West Coast produced 327 kg of milk solids per cow, compared with 431 kg/cow. Dairy stocking rates on the West Coast are the lowest in New Zealand with milk solids per hectare half that of North Canterbury.*[4.]

Due to quantities of rainfall the soil is often very wet, which is why land drainage is a critical part of farm practice on the West Coast. Poor drainage is a major constraint on agricultural production for large areas of West Coast "pakihi" soils. These soils are acidic, infertile and often possess impermeable iron pans. To overcome waterlogging and nutrient availability constraints in a high rainfall environment, forms of landform modification are used, including hump and hollowing, and flipping.

With hump and hollowing, large machinery is used to excavate the "hollows", removing the soil and breaking through the upper iron pans, creating wide surface drains. The "humps" are built up from the excavated soil (hollows) that is deposited adjacently on the original soil surface.

This practice drastically alters the landscape with the hump-hollow sequence recurring every 45 to 50 metres across the farmland. The height difference from the bottom of the hollow to the top of the hump is about 3 metres; the actual gradient of the contours depends on the depth to the gravels and iron pan. The wide hollows and the increased relief of the humps improve the surface runoff and drainage and thereby reduce waterlogging. Both the landscape and soils are radically different from how they were before modification. Time and resources are required for organic matter and fertility to build to satisfactory levels.

Image 12.1: 'Humping and hollowing' on the West Coast

Flipping is quite different in that the infiltration and hydraulic conductivity is improved by breaking up the impeding pans in the subsoil, so the water filters down through the soil profile rather than being shed off the surface. Flipping has limited applicability on pakihi soils with inherently impeding subsoils.

The use of landform modification such as hump and hollowing on the West Coast has resulted in the growth of dairying, and agriculture in general, by allowing for greater stocking rates and by bringing into production more land that was previously unsuitable for farming. Since 1990 the West Coast dairy herd has tripled in size to about 150,000 cows, and accounted for 3.1% of New Zealand's dairy cows in 2018.*[5]

The majority of farms within the West Coast region supply to Westland Milk Products. Westland Milk Products are not direct signatories to the Sustainable Dairying Water Accord but promote similar initiatives under their Farm Excellence programme. This programme promotes fencing off of waterways – a waterway defined as, "1 m wide, 300 mm deep at some point within the property and including permanently flowing water." A minimum setback is not required, rather Westland Milk Products takes the approach of setting an appropriate setback depending on slope and risk to waterway.

Westland Milk Products currently estimate that 73% of their supplier's waterways are fenced according to their criteria. It is assumed that currently many of these riparian fences do not meet the mean width of 5 metre criteria and will require modification and relocation under the proposed exclusion rules.

It is less clear as to what proportion of current riparian fencing has a mean width greater or less than 2 metre. This will have obvious ramifications in terms of the timeframes required to meet the proposed rules.

12.3 Findings

The proposed Stock Exclusion Section 360 Regulations stipulate that land with a slope of 5 degrees or less requires fencing if it borders a river, lake or wetland. The timeframes in which this must be completed depend on the farming activity, stocking rates and species, and water body type.

Despite a significant proportion of farms having some form of riparian fencing already, it is assumed that a large number of farm streams will require new riparian fences to meet the proposed rules. The amount of time to budget and carry out the work depends on the nature of pre-existing fencing, stock species, and farm practices that are adjacent to the waterway. Based on the existing variety of fencing progress made, it is estimated that the required timeframes for fencing will be spread fairly evenly from July 2021 to 2035.

Additional labour will be needed to install many of the fences required and there will be increased sales of fencing materials. Many of the benefits from these sales will go to sources outside of the region, although there are West Coast sawmills that manufacture fence posts. New Zealand's 'clean green' image adds economic value to many industries, including the agricultural sector itself, which will be increasing its riparian fencing. A sustainable image is more important when aiming for certain market niches and premium product status - options that might be desirable for the local dairy company.

Tourism is likely to soon be the most significant local industry and will benefit from stock exclusion. Stream fencing will only improve tourists' impressions of the West Coast, but by how much is hard to determine. These riparian areas will naturally develop substantial vegetative cover in the longer term, albeit containing some undesirable species that may require control. Given the costs associated with riparian planting, and the current downturn within the agricultural sector, additional riparian planting is unlikely to be popular.

There are currently no local government subsidies for riparian fencing or planting on the West Coast. The One Billion Trees Programme has potential to assist but riparian planting does not fit easily within this framework, and to date there has been very little use of it on the West Coast according to the Ministry for Primary Industries' records.

Given that at least 84% of West Coast catchments have solely indigenous vegetation, levels of faecal contamination are low in most West Coast waterways. However, faecal contamination has been highlighted by regional monitoring and community engagement as one of the more important water quality issues. Increased exclusion of stock from waterways and wider riparian margins will reduce this contamination and improve swimmability in catchments that have a high percentage of intensive agriculture.

There are several burdens associated with implementing the fencing and exclusion required. The cost of labour and materials could be substantial on some farms, depending on quantities and types of fencing required.

Deprivation indices suggest that many areas with intensive agriculture are not overly deprived, yet a notable drop in stock numbers, jobs, and GDP across all West Coast agricultural sectors indicates that they are facing difficulties (see Regional Socioeconomic Deprivation Index Map 15.5). For example, the recent series of low milk payouts have put many dairy farmers under financial strain. Increasingly wet winter/spring conditions and more storm events threaten to increase disruptions among West Coast farms, whether this is via reduced productivity or direct removal of riparian fences via extreme flood events.

The total area of low slope (less or equal to 5 degrees), production land in the region comes to 107,074.12 ha. Within this area there are 1,203 km of waterways at least 1 metre wide. With a 5 metre buffer either side of these waterways, this represents 1% of the West Coast's lowland agricultural areas. Based on fencing needs relative to ratios of stock numbers and stock type, the fencing costs for the region are estimated to range from $16 to $33 million.

This example assumes hypothetically that all these streams require fencing or re-fencing, which may not be the case. The low cost end is based on sole use of the cheapest fencing options, with the high end utilising the costliest fencing, based on estimates from MPI[*6]. If we assume a mean cost of $24 million, spread evenly out to 2035, this represents $1.2 million per annum, excluding maintenance costs.

The above estimations exclude waterways located in the hollows of hump and hollowed land. It is common for hollows to contain water but this tends to be ephemeral and under 1 metre in width. Initiatives for tackling contaminant migration from hollows might be an option via the farm planning process. A random survey of West Coast farms indicated that the amount of land that is hump and hollowed varies widely from nothing to most of a property. While variation is significant the average amount of hump and hollowing on a farm was 21%.

As stated, few hollows have water flow that would require compulsory exclusion under the current proposed regulations. However, should fencing be considered for these areas we can examine some hypothetical scenarios. A farm with 50% hump and hollowed land would lose 5% of its grazing if a quarter of its hollows required fencing with a 5 metre setback. The average lost grazing of the farms surveyed was 3%, based on exclusion from 25% of hollows, and an average fencing cost of $55,000 to $141,000 per farm. In reality, costs will vary greatly per farm – one farm in the survey had an estimated $160,000 - $480,000 of fencing with 25% of hollows excluded.

Farms in areas that have poorly draining soils, high rainfall, and a large number of waterways could face increased economic pressure and logistic difficulties. It is likely that these difficulties are experienced by multiple farms in these areas, potentially putting financial pressure on certain communities.

12.4 Information Sources

*[1] https://www.stats.govt.nz/

*[2] https://ecoprofile.infometrics.co.nz/

*[3] https://www.niwa.co.nz/sites/niwa.co.nz/files/NZCCC%20Summary_IPCC%20AR5%20NZ%20Findings_April%202014%20WEB.pdf

*[3] https://www.mbie.govt.nz/immigration-and-tourism/tourism-research-and-data/tourism-data-releases/international-visitor-survey-ivs/international-visitor-survey-analysis-and-research/freedom-camping-by-international-visitors-in-new-zealand/

*[4] http://www.siddc.org.nz/about-siddc/south-island-dairying/

*[5] http://www.dairynz.co.nz/publications/dairy-industry

*[6] https://www.mpi.govt.nz/dmsdocument/16537-ministry-for-primary-industries-stock-exclusion-costs-report

13. Southland – Nitrogen Cap in five ‘high nitrate-nitrogen’ catchments

13.1 Introduction

The proposed Nitrogen Cap (Option 1) applies to 13 catchments around New Zealand. The Ministry for the Environment has identified these catchments as being where nitrate-nitrogen levels are in the highest 10% of monitoring sites and regional rules implementing the current National Policy Statement for Freshwater Management are not in place[55]. The Ministry’s intent is the ‘N-Cap’ proposal will target poorer environmental performance in highly nitrogen-impacted catchments, ahead of full implementation of the National Policy Statement for Freshwater Management in a region.

Under this proposal, a regional council uses information on nitrogen losses from dairy farms to set a ‘threshold’ for a catchment or sub-catchment where there are similar biophysical characteristics (e.g. poor soil drainage and high rainfall). The threshold may be set at any point from the 70th and the 90th percentile. All dairy farms with nitrogen losses above a catchment’s ‘dairy’ threshold, as well as any ‘low-slope’ pastoral farms with equivalent nitrogen losses (i.e. in the top 30% of dairy farm nitrogen losses or higher), will have to reduce to below the threshold within a certain time period.

Regional councils will have some ability to design their approach to calculating a threshold (or thresholds) within each catchment. This design will influence the distribution of farms affected within a catchment, and outcomes for local communities and the environment. All farms within the 13 catchments will be required to have a certified freshwater-module – farm plan by 2022.

Under the N-Cap proposal, five of the 13 ‘high nitrate-nitrogen’ catchments are in Southland. These catchments are: Matāura River, Waihopai River, Ōreti River, Waimatuku Stream, and the Aparima River. The five N-Cap catchments collectively cover most of the developed land in central and eastern Southland and they contain around most of Southland’s 1,000 or so dairy farms. Figure 13.1 (next page) shows the land uses within these catchments. This case study tests the economic impacts of introducing the N-Cap proposal in these five catchments for Southland and New Zealand as a whole.

This case study assesses the possible impact of the N-Cap proposal in Southland. The case study first outlines the Southland context, it then describes the analytical approach used and the results, before turning to the main findings.

A Regional Socioeconomic Deprivation Index Map is included for Southland in Section 15 at the end of this report that illustrates the various situations of the region’s local communities. In 2014, around 96,500 people lived in Southland and just over 30 percent lived in rural areas, which is high for New Zealand (where 13% of the population was rural). The high proportion of Southlanders living rurally reflects the Southland economy’s reliance on resource use. It also highlights a strong interdependence between urban and rural parts of communities across the region, with most urban centres existing to service the surrounding rural areas, and rural areas being reliant on their urban centre because of the area’s remoteness.

[55] Ministry for the Environment (2019) Essential Freshwater: Action for Healthy Waterways.

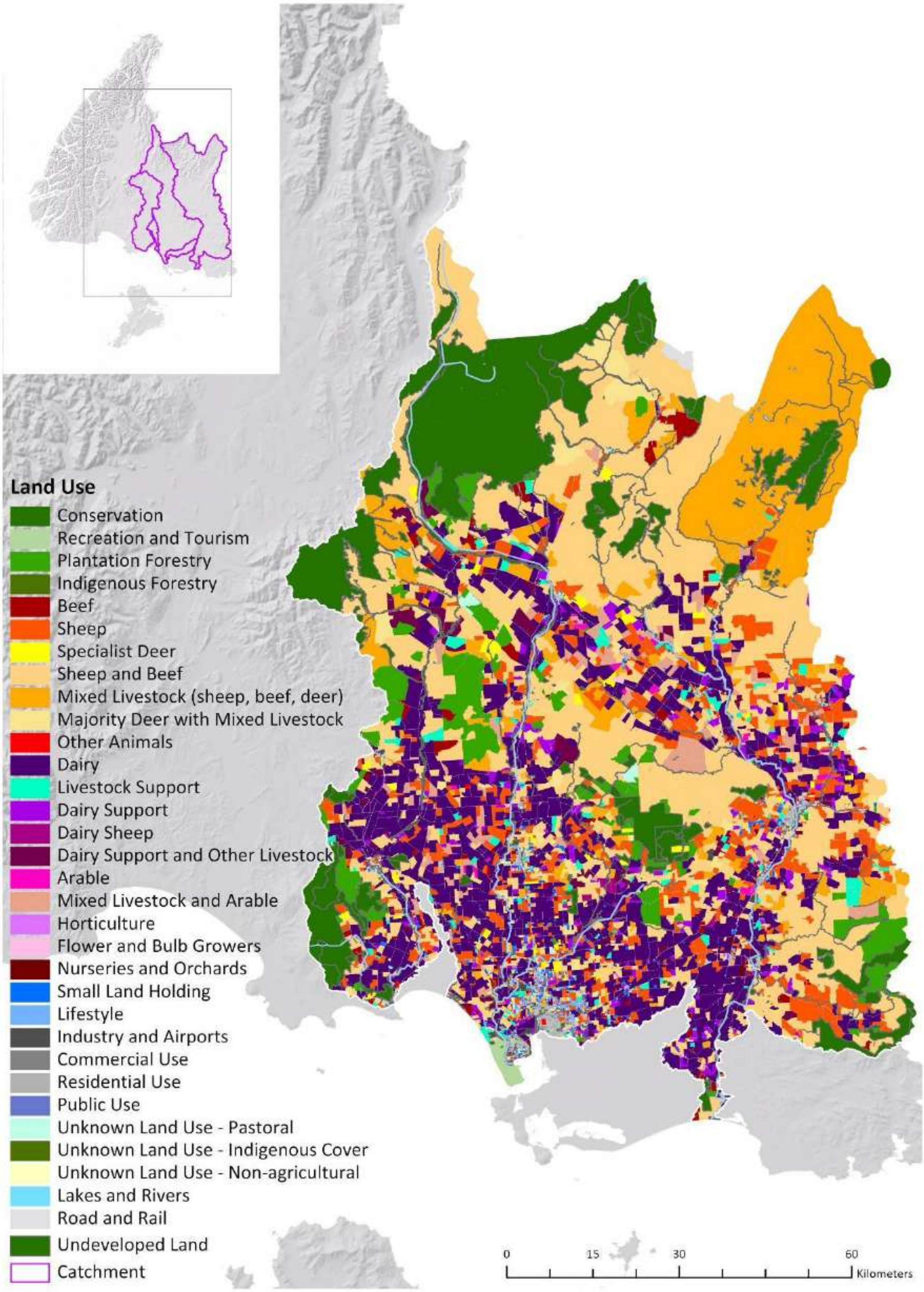


Figure 13.1: Land use map for the five Southland catchments identified in the N-Cap proposal (Option One)
Note – The spatial extent of the five N-Cap catchments is indicative only and is based on:
https://mfe.maps.arcgis.com/apps/View/index.html?appid=351afa8292624a1b990e70174d8c89bb

13.2 Context

Over time, human activities have reduced Southland's natural resilience and put it under increasing pressure.[56] Natural vegetation has been burned or cleared, land extensively drained, rivers straightened to hasten the flow of water to the coast, and land reclaimed from estuaries. Since 1840, the area of wetlands on land now in private ownership is estimated to have reduced from 220,000 ha to less than 9,000 ha by 2015 (3.2% of their original extent). These activities have changed the region's hydrology, particularly in lowland areas, and continue to occur. Nutrients, sediment and microbes (e.g. *E. coli*) now travel rapidly through the landscape, and there is far less opportunity for natural processes to attenuate them before they reach aquifers, lakes, rivers and streams, and estuaries.

Land use has changed over time but pastoral farming has always dominated agriculture in Southland. In the early days, farms were truly mixed production systems, with many farms including sheep and beef, dairy and arable enterprises. Over recent decades there has been a shift to either drystock (sheep, beef and deer)[57] or dairy. Drystock farms usually have a mix of stock types and some are quite complex, including arable cropping and dairy support. Dairy farms came and went up until the early 1990s when dairying expanded rapidly across the region. Between 1990 and 2014 drystock land declined from roughly 1.1 million ha to 795,000 ha (roughly -30%). Over the same period, dairy land increased from 16,000 ha to 255,000 ha. During this time, Southland's total stock units increased by just under 16% from roughly 9.5 million to over 11 million.

Despite this recent expansion in dairying, the debt per kilogram milksolids for Otago-Southland farms is fairly similar to a number of other regions, and close to the national average at $23 per kg of milksolids MS[58]. Average farm sizes in Otago-Southland are larger than most other regions, and so total levels of debt will be higher (e.g. $5.7 million in terms of liabilities compared to the national average of $4.1 million in 2017-18). Loan to value ratios for Otago-Southland farms is slightly higher than the national average of around 50%, reflecting lower land values than in other regions.

Southland has an abundance of rain (in the early days much of Southland was described as being "well-watered"[59]) but it does not all arrive as effective rain. With less natural water storage the landscape is more prone to water shortages. The region has a mosaic of unconfined, shallow groundwater aquifers that exchange groundwater to surface water relatively quickly[60]. Most of Southland's drinking water is sourced from the surface and groundwater in these catchments and there are often few alternate sources. Of the five N-Cap catchments, four are connected to estuaries, which are highly valued as habitats for threatened species, mahinga kai, amenity, and recreation. Some waterbodies within these catchments are degraded, particularly in lowland areas and nitrate hotspots in groundwater. In other words, water quality varies spatially within a catchment.

[56] A more complete description of the Southland context is included in Part A of Moran, Pearson, Couldrey and Eyre (2017) The Southland Economic Project: Agriculture and Forestry. Technical Report. Publication no. 2019-04. Environment Southland.
[57] Originally, drystock meant sheep and beef, but in the 1970s the term widened with the emergence of the deer industry.
[58] Matthew Newman (Senior Economist, DairyNZ), pers. comm., 5/7/2019.
[59] 1905 Cyclopedia of New Zealand (Otago and Southland Provincial Districts).
[60] Roughly 47% of all the water in Southland streams is groundwater from these aquifers (the mean base flow index for Southland is around 0.47) (Moran et al., 2017). It is highly variable across the region, with lowland streams having a much higher proportion of groundwater than alpine streams.

13.3 Analysis

This case study builds on Environment Southland's previous case study[61] on the N-Cap proposal. For each case study, Market Economics Ltd. has undertaken a round of scenario testing using the Southland Economic Model[62], which they developed for The Southland Economic Project[63]. Importantly, this model contains datasets based on the survey and modelling of 41 dairy farms and 43 drystock farms in Southland. Also, it divides New Zealand's economy into two 'regions': Southland and the Rest of New Zealand.

The first modelling round included eight scenarios. In that case study we highlighted that, while some farmers are able to achieve good environmental and financial performance, there is no clear relationship between nitrogen loss and farm profitability within a land use. A higher nitrogen loss farm may be either a high profit farm or a low profit farm. Thus, it is unlikely to make a significant difference to the economic impacts of the proposal to identify which farms will be impacted within a distribution curve for nitrogen loss – it is more a question of how many farms will be impacted.

In this, the second round of modelling, our understanding of the proposal and how to represent it has been refined, and we tested a further six scenarios. In general terms, the modelling approach used for this case study was:

1. To apply freshwater module - farm plans (referred to here simply as farm plans) to all farms in the five catchments by June 2022; and
2. To test three alternative nitrogen loss thresholds within broad slope, soil drainage and rainfall categories for a catchment.
3. To test two levels of average nitrogen loss reductions for dairy farms for the alternative nitrogen loss thresholds.

The discussion document (page 71) states the threshold "could be set at the 90th percentile, or at the 70th percentile, or a point between". Accordingly, the alternative nitrogen thresholds were tested in our modelling at 70th, 80th, and 90th percentile of dairy farms. The different combinations of the two levels of nitrogen loss reductions and three alternative thresholds resulted in six scenarios (i.e. 2 x 3 = 6).

The following three sections explain the assumptions around drystock and dairy support farms, and describe how dairy farms are included in The Southland Economic Model, and the dairy mitigation strategies used for these farms. We then shift attention to the six scenarios tested in this second round of modelling and the results.

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[61] Moran and Keenan (2019) Initial Economic Advisory Report on the Essential Freshwater Package. Local Government New Zealand.

[62] The Southland Economic Model is a dynamic computable general equilibrium model based on systems thinking.

[63] The Southland Economic Project was a joint venture between DairyNZ, Beef + Lamb New Zealand Ltd., Department of Conservation, Ministry for Primary Industries, Ministry for the Environment, Southland Chamber of Commerce, Te Ao Marama, and Environment Southland. It also closely involved Deer Industry New Zealand and New Zealand Deer Farmers Association (Southland Branch), the three territorial authorities in Southland (Invercargill City Council, Southland District Council and Gore District Council). As well, the Project has had support from Foundation for Arable Research, and Horticulture New Zealand, and forestry companies: Southwood and Rayonier. The Southland Economic Project ran for from 2014 until 2018. https://www.es.govt.nz/council/major-projects/Pages/Southland-Economic-Project.aspx

The N-Cap proposal is complex and an indicative calendar is outlined in Appendix 1 of this case study. *Further detail is available in Part C of The Southland Economic Project Agriculture and Forestry Report (2017).*

Drystock farms and dairy support farms

In developing this approach, we reviewed the 43 drystock farms included in The Southland Economic Project by their slope, soil drainage and rainfall classes and also nitrogen losses. Based on this review, it appears there will be relatively few occasions in Southland where a drystock farm's nitrogen losses will be in the same vicinity as those for the highest dairy farms with similar biophysical characteristics. We concluded that the N-Cap proposal is unlikely to directly impact the drystock industry and so the three alternative slope measurements (5°, 7°, and 10°) for 'low slope' pastoral farms were not particularly relevant. However, the extent that the drystock industry is impacted may still depend on the design of Environment Southland's approach for each catchment.

Many of the 43 drystock farms raised and/or grazed dairy cows but their nitrogen losses were generally lower than the dairy farms. There were another three drystock farms surveyed but unable to be realistically modelled in Overseer. These three farms differed in their environmental conditions, stock enterprises and yield, and crops grown but they were all relatively complex production systems. There are no specific dairy support farms in the model.

Economic Zones in The Southland Economic Model [64]

In total 41 dairy farms were surveyed and modelled for The Southland Economic Project[65] using Overseer (Version 6.2.1) and Farmax (Moran *et al*. 2017). DairyNZ's analysis of these farms indicated that there were no significant differences in dairying between the four freshwater management units (FMUs) with developed land in Southland[66]. These FMUs are still important from a policy perspective for the implementation of the NPSFM in Southland.

The analysis showed the drivers of nitrogen and phosphorus loss to water relate to soil drainage and rainfall (in that order). While other factors influence the loss of excess nutrients these were weaker correlations and/or there was a lack of information about how they were distributed across all dairy farms in Southland. Consequently, soil drainage, rainfall and FMU (because of its relevance to policy) were used to help input the 41 dairy farms into groupings for the Southland Economic Model.

Environment Southland provided DairyNZ with geographical information system (GIS) data for soil drainage, rainfall and the FMUs, along with a GIS layer of Southland's consented dairy farms. Using this information, DairyNZ created 10 economic zones (because of their spatial nature). Table 13.1 describes the economic zones and each zone's weighted average nitrogen loss.

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[64] The information in this section was written by Matthew Newman who, at the time it was written, was Senior Economist at DairyNZ.

[65] https://www.es.govt.nz/council/major-projects/Pages/Southland-Economic-Project.aspx

[66] The FMUs investigated were Waiau, Aparima, Ōreti and Matāura. Fiordland and the Islands is also an FMU but there is no dairy industry in this FMU so it was not included.

Table 13.1: Economic Zones and nitrogen loss rates in The Southland Economic Model

Economic Zone	Zone description	Nitrogen loss rate for zone (weighted average) (kg N/ha/year)
Zone 1	Te Anau;	40
Zone 2	Waiau;	44
Zone 3	Aparima and Ōreti: wet and well drained;	51
Zone 4	Aparima and Ōreti: wet and poorly drained;	33
Zone 5	Aparima and Ōreti: dry and well drained;	54
Zone 6	Aparima and Ōreti: dry and poorly drained;	30
Zone 7	Matāura: wet and well drained;	44
Zone 8	Matāura: wet and poorly drained;	25
Zone 9	Matāura: dry and well drained	47
Zone 10	Matāura: dry and poorly drained	31

In the Waiau FMU, Te Anau was separated from the lower Waiau because of its geography and it only had four dairy farms. An aggregate farm was developed using information from the four farms to protect individual confidentiality. The lower Waiau (referred to simply as 'Waiau') was kept as a single economic zone because there were not sufficient differences in rainfall within this area to justify 'wet' and 'dry' categories. The farms in both of these zones covered a range of soil types.

Similarly, the Aparima and Ōreti FMUs were considered to be not sufficiently different from each other, and the dry areas in each was largely the in the north so they were combined. The Matāura FMU was kept separate. These two areas, the Aparima and Ōreti combined, and the Matāura, were then split into zones based on rainfall and soil type. In these two areas, dairy farms with above 1,000 mm of rainfall per annum[67] were considered to be wet, and farms with rainfall below 1,000 mm of rainfall per annum were considered to be dry. Dairy farms with most of their milking platform[68] on moderately well or well drained soils[69] were considered as 'well drained', and those with most of their milking platform on very poorly drained, poorly drained, or imperfectly drained soils were considered 'poorly drained'.

Alongside these economic zones, Beef + Lamb New Zealand and Deer Industry New Zealand created large farm and small farm classifications, with small farms being further classified as either flat or mixed slope.

[67] Based on the 10-year-averages as per Overseer which uses NIWA data.
[68] Area of land used for in-milk cows.
[69] As defined by their soil characteristics in SMaps.

Large farms are defined as above 1,000 effective hectares[70] and small farms as below 1,000 effective hectares. The two approaches were fitted together within the Southland Economic Model and farms are classified using the characteristics in both.

Dairy mitigation strategies[71]

A broad mitigation process was used in the research for dairy with differences in the mitigations applied between farms reflecting their individual characteristics. The mitigation strategies were developed based on experience and farm systems knowledge within DairyNZ. Similar strategies for nitrogen mitigation[72] have been used and peer reviewed in the past.

The mitigation strategies used were the most cost-effective method of reducing nutrient loss in Overseer given the available technologies and the caveats discussed below. The strategies are not the only possible way to reduce nutrient losses but the least-cost option given the modelling constraints (e.g. the constraints of using Overseer where certain factors cannot be captured).

If a farmer had to meet a particular on-farm nutrient loss requirement then they may choose to undertake a different selection of mitigations. For example, a farmer required to reduce nitrogen losses by 10% may choose a different mitigation strategy to one required to reduce nitrogen losses by 30% (e.g. mitigations that have a large impact on farm systems and/or a large capital cost). This research aimed to meet incremental reductions in nutrient loss, not capture all conceivable mitigations. In reality, the nutrient loss requirements that a farm faces will likely influence their chosen mitigation strategy. This work sets two caveats on the mitigation strategies:

1. The farmer is operating a particular dairy system for a reason and may not want, or have the skills to, significantly change this farm system; and
2. The use of mitigations stop if the land is no longer needed in the dairy system, e.g. feed supply exceeds feed demand in perpetuity, or the land use changes from dairy.

Mitigation strategies can be broadly grouped as management changes within the current farm system, and major changes to the wider farm system. ‘Within system’ changes: a process in which reductions in farm inputs are applied sequentially to the existing farm system. ‘Between system’ changes: major changes to the farm system or significant capital investment, including (but is not limited to) barns, wetland construction, wintering practices, and effluent storage and disposal.

70A discussion on farm size is included in Drystock sections 2.2.1 and 2.3.4 of Part C of the Southland Economic Project: Agriculture and Forestry Report. Broadly, the 36 sheep and beef farms ranged from 100 hectares to well over 5,000 hectares and fell into two groups: nine larger farms (> 1,000 effective ha) and 27 smaller farms (< 1,000 effective ha). All nine large farms had a nitrogen loss rate of < 15 kg N/ha/year.

71 This section is based on a similar section in Part C of Moran et al. (2017) *The Southland Economic Project: Agriculture and Forestry*. Technical Report. Publication no. 2019-04. Environment Southland.

72 This includes mitigation modelling by DairyNZ in the Lower North Island, Waikato, Canterbury and some areas in Bay of Plenty.

The mitigation modelling focused primarily on within system changes although at higher mitigation levels (e.g. 40%) there could be major changes to a farm system through the use of fewer inputs e.g. supplementary feed[73]. The specific mitigation measures used for each farm differed. No two farms had identical strategies because of the unique nature of the farm system.

The results from these mitigation options were then analysed, particularly the impact on profit (measured by operating profit per effective milking platform hectare), production and nutrient loss. These points were then used to create mitigation curves that show the relationship between estimated nitrogen loss per total hectare and farm operating profit (EBIT) per effective hectare for a series of target points from the starting point (i.e. the base) for each farm. The methodology, key assumptions and early results were discussed with a small group of Southland farmers. Some recommendations from this group were applied to the modelling.

The nitrogen mitigation strategies are broadly illustrated in Figure 13.1 (next page). This diagram shows the overall mitigation process used when applying 'within system' mitigation strategies to each dairy farm. The process followed a standardised sequence, broadly described as: the use of any existing feed pad, stand-off pad or cow housing facility is optimised; autumn nitrogen fertiliser applications are reduced and then removed; spring nitrogen fertiliser applications are reduced and then removed; imported supplements are reduced (up to a 20% reduction from the base); and finally stocking rate is reduced (up to 20% reduction of cow numbers from the base) and the feed supply and demand balanced.

An in-depth understanding of the impacts these mitigation strategies may have on farm profitability is given in Dairy section 3.4 of The Southland Economic Project: Agriculture and Forestry Report. In general terms, there appears to be a reasonably close relationship between reductions in nitrogen loss and reductions in dairy profitability.

Dairy mitigation assumptions

For the dairy mitigation modelling, important assumptions, limitations and constraints are documented in Part C of The Southland Economic Project: Agriculture and Forestry Report (2017). Two assumptions around milk price and labour are repeated here for clarity.

A milk price of $6.50 was used to reflect longer-term average price and long term expectations. It was based on the average price received including dividend payments for owner operators for the five years prior to, and including, the season modelled (2013-14), as well as the forecast milk price for the two seasons afterwards. This assumption will significantly impact on the ability of farmers to pay for mitigation each season. The sensitivity of this assumption was explored in a sensitivity analysis, which is summarised in the report.

[73] Following the stage 1 mitigations for nitrogen and phosphorus, more targeted and specific mitigations that have a large impact on farm systems and/or a large capital cost were considered. The stage 2 mitigations were: barn construction, wetland creation, gibberellic acid applications, installation of grass filter strips and significant changes in effluent storage and disposal. These mitigations were not modelled for all farms because many are site specific.

Changes in labour requirements for a dairy farm are non-linear. Labour was treated as a fixed cost unless cow numbers dropped significantly (by more than 150 cows), which resulted in one full time equivalent (FTE) employee being removed from the farm system. This meant that if the number of cows were only reduced by a smaller amount then the number of labour units or labour costs did not change.

These steps were not applied in isolation. Each point on a mitigation curve is the result of implementing a set of mitigation options which reduce nitrogen loss while still balancing feed supply and demand.

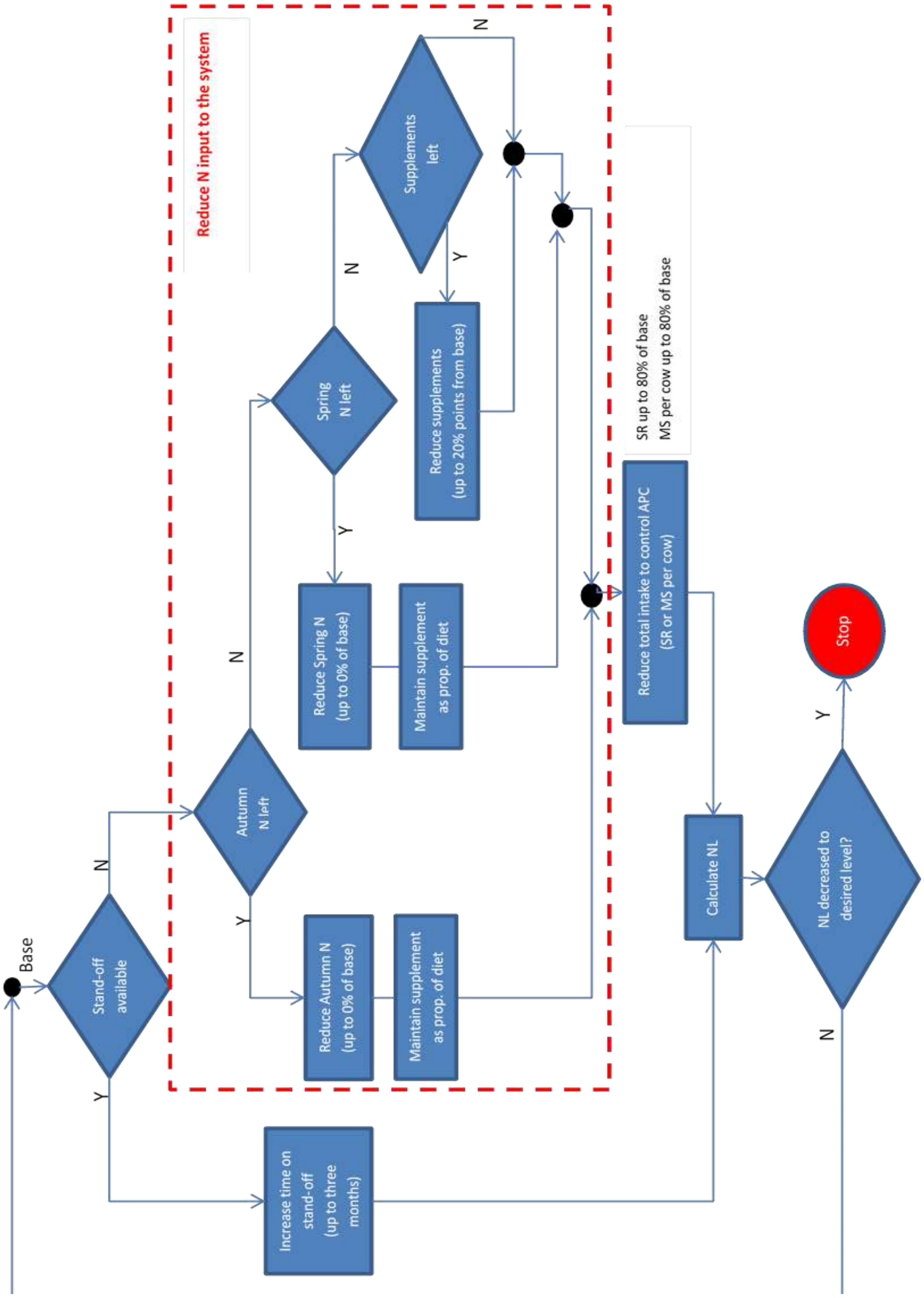

Figure 13.2: Dairy nitrogen mitigation strategies

There were also some farms that were suitable for other mitigation options including changes in cropping practices and the effluent disposal area.

If a farm had an existing off pasture structure then the first option considered was the duration of controlled grazing. The usage time of the off pasture structure was increased (if possible) to reduce the amount of time cows are grazing pasture. The extent that this mitigation could be used depended on the characteristics of the existing facilities and factors such as animal welfare. This mitigation strategy was limited by the amount of time Overseer would allow the usage of a stand-off pad to be increased. At the time of modelling a bug in Overseer meant in some cases increased use of the stand-off pad was not a valid scenario, which constrained the use of this mitigation option. This issue is likely to be addressed in subsequent versions of Overseer.

Where a farm had a high risk of nitrogen loss from effluent disposal it was resolved. The effluent area was allowed to increase by up to 10 ha (if the effluent area was a high risk area for nitrogen loss on the dairy farm) subject to the availability of suitable paddocks for effluent disposal. If a farm's effluent block had a different fertiliser programme than the non-effluent block then it was also adjusted to reflect the increased effluent area. Any predicted change in pasture production was captured and associated feed demand was adjusted if necessary. Imported feed types were analysed to see if high nitrogen content feeds could be replaced by low nitrogen content alternatives, while maintaining the amount of imported feed used as a proportion of the total dry matter intake. The alternatives used were the feed types currently used in Southland.

Baseline

In the same way as the first round of modelling, the results of the scenario modelling (described below) are compared to a baseline to measure the impacts created by the N-Cap proposal. In the baseline current land uses are modelled as staying constant into the future. While this is unlikely to be the case in reality, the proposed Southland Water and Land Plan (decisions version) constrains land use change where it involves an increase in nutrient losses. It was considered pragmatic to take this approach because the Southland Water and Land Plan is currently under appeal in the Environment Court and may change through this process. The Southland Water and Land Plan also contains some requirements around cultivation and stock exclusion that are included in this baseline.

Scenarios

The five N-Cap catchments sit within (and cover most of) the Aparima, the Ōreti, and Matāura FMUs. The catchments are adjoining, in effect forming a single block of land. In the six scenarios modelled it was assumed that the economic zones in The Southland Economic Model (described above) appropriately represent broad slope, soil drainage and rainfall categories for a catchment. Nitrogen loss reductions were tested simultaneously to dairy land in each economic zone for three alternative nitrogen loss thresholds (70th, 80th and 90th percentiles). Nitrogen loss reductions were not tested for drystock or dairy support for the reasons discussed at the start of this section.

The six scenarios used two levels of average reductions in nitrogen loss (10% and 20%) that dairy farms may face to achieve different nitrogen loss thresholds. Table 13.2 summarises these scenarios. Two levels were included because some dairy farms may be required to reduce their nitrogen losses by more than 10% and so the 20% reduction gives a broader range of potential impacts to consider.

The level of reduction for some farms may be less than 10%, but 10% is the smallest level of nitrogen reduction available in the model. If the threshold is set at the 90th percentile then the average nitrogen reduction will be less (i.e. possibly 10%) than for a 70th percentile threshold (i.e. possibly 20%). The scenarios rely on the assumption that the two levels of average reductions in nitrogen loss (10% and 20%) appropriately reflect the different thresholds of 90th, 80th and 70th percentiles.

Where the threshold is set determines the proportion of farms the proposal applies to. For example, if the threshold is at the 90th percentile then it will apply to 10% of dairy farms. In the modelling it was assumed there is some equivalence between the proportion of dairy farms and that of dairy land. For example, 10% of dairy farms will have roughly 10% of dairy land. Whether, in Southland, there is any relationship between a farm's size and its nitrogen loss is unclear. The area of dairy land in each economic zone was estimated using Environment Southland's Technical Land Use Map. In that analysis, Waituna and the Catlins were excluded from the Matāura FMU but not the smaller coastal catchments in the Aparima and the Ōreti FMUs. The additional dairy land will not create substantially different results.

Under the N-Cap all farms (dairy or otherwise) are required to have a farm plan. For each scenario it was assumed that phased adoption for farm plans will start in June 2020 and be completed in June 2022. It was also assumed that farm plans must be updated on an on-going basis. The first farm plan will cost the most ($5,200 per farm) and it must be revised every three years ($3,700 per farm). Other costs assumptions (e.g. Overseer subscription) were documented in the first N-Cap case study. For farm plans, there was no attempt to exclude the areas of the Aparima, Ōreti and Matāura FMUs outside of the N-Cap catchments. The additional farm plans will not substantially change the results.

Table 13.2: Scenarios and nitrogen reductions applied in the modelling

Scenario description	Nitrogen reductions
1. Threshold set at 90% of dairy farms – all dairy farms above this threshold reduce nitrogen loss by an average of 10%.	10% of dairy land in each economic zone reduce nitrogen loss by 10%.
2. Threshold set at 80% of dairy farms – all dairy farms above this threshold reduce nitrogen loss by an average of 10%.	20% of dairy land in each economic zone reduce nitrogen loss by 10%.
3. Threshold set at 70% of dairy farms – all dairy farms above this threshold reduce nitrogen loss by an average of 10%.	30% of dairy land in each economic zone reduce nitrogen loss by 10%.
4. Threshold set at 90% of dairy farms – all dairy farms above this threshold reduce nitrogen loss by an average of 20%.	10% of dairy land in each economic zone reduce nitrogen loss by 20%.
5. Threshold set at 80% of dairy farms – all dairy farms above this threshold reduce nitrogen loss by an average of 20%.	20% of dairy land in each economic zone reduce nitrogen loss by 20%.
6. Threshold set at 70% of dairy farms – all dairy farms above this threshold reduce nitrogen loss by an average of 20%.	30% of dairy land in each economic zone reduce nitrogen loss by 20%.

In all scenarios the N-Cap proposal was implemented on farm between June 2021 and January 2027. The impacts are only modelled out to 2027 because the N-Cap proposal is an interim measure. By 2025 regional councils are required to have a process in place to reduce contaminant losses, including nitrogen. The scenarios were carefully considered and will be useful for informing discussions.

13.4 Results

The modelling results presented here cover direct impacts to the dairy industry and indirect impacts for the regional and national economies. In Southland these impacts are likely to occur anyway (i.e. without the proposal) as Environment Southland sets freshwater objectives, limits and targets under the current National Policy Statement for Freshwater Management (2017). For instance, it is estimated that the nitrogen loads in rivers and streams at a catchment scale may exceed (go beyond) what will meet the periphyton bottom-line in the current NPS-FM by between 16.4% and 40.6%, (the range reflects different levels of risk, 20% and 10% respectively, of not achieving the periphyton bottom-line).[74]

The modelling is unable to capture the benefits that may occur as a consequence of the nitrogen reductions (e.g. reduced human health costs). Each regional council's approach will influence the resulting changes in water quality, particularly because water quality varies spatially within a catchment. Nitrogen losses at the root zone in one part of a catchment will have different outcomes than similar nitrogen losses in another part of a catchment.

It is possible that there will be impacts on dairy support, either directly through the proposal and/or indirectly via the dairy industry, but these are not captured in the modelling. Drystock farms that have connections with the dairy industry (e.g. those that raise or graze dairy cows or supply dairy farms with supplementary feed) may also be indirectly impacted. The modelling captures the connections between dairy and drystock to the extent that it was included in the farm financials. An initial review of the dairy farm financials suggests the different mitigations used for the 10% and 20% nitrogen loss reductions do not result in an obvious decrease in the grazing costs.

Value added

The value added modelling results for Scenario 1 and Scenario 6 effectively cover the range of impacts over specific industries for the six scenarios modelled for Southland. It may help to think of value added as a measure of income, as its main components are (1) industry profits and (2) wages and salaries. Tables 13.3 and 13.4 give these results for New Zealand's economy as a whole. The industries listed are those where there were noticeable changes in value added. Figure 13.2 (page after next) shows the results for all six scenarios (numbered from #1 to #6). The results are preliminary and may be refined if further work is done, particularly the analysis of land area the proposal applies to.

Regional GDP series has total agriculture in Southland as $890 million in 2017 – estimated component for dairy cattle farming is a bit over $600 million.

[74] These estimates are contained in a Ministry for the Environment science technical report: Essential Freshwater: Impact of existing periphyton and proposed dissolved inorganic nitrogen bottom-lines.

Table 13.3: Scenario 1 – Annual changes in value added from the N-Cap proposal in Southland for NZ economy ($2017 millions)

Sector and Industry	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**
Primary								
Dairy cattle farming	-5	-3	-3	-5	-6	-6	-6	-7
Drystock and other farming	-1	-1	0	-1	-1	-1	-1	-1
Other primary	0	0	1	1	1	1	1	1
Manufacturing								
Food manufacturing	0	0	0	-1	-1	-1	-1	-1
Service								
Utilities, construction, transport	0	0	0	0	0	0	0	0
Trade and hospitality	0	0	0	0	0	0	0	0
Finance, insurance, real estate, business	1	1	0	1	1	1	1	1
Other services	0	0	0	0	0	1	1	1
Total all sectors	**-5**	**-1**	**-2**	**-4**	**-6**	**-6**	**-7**	**-7**

Note – These figures are rounded to the nearest million

Table 13.4: Scenario 6 – Annual changes in value added from the N-Cap proposal in Southland for NZ economy ($2017 millions)

Sector and Industry	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**
Primary								
Dairy cattle farming	-5	-5	-14	-17	-20	-22	-23	-25
Drystock and other farming	-1	-1	0	-1	-1	-1	-1	-1
Other primary	0	0	4	5	6	7	8	9
Manufacturing								
Food manufacturing	0	1	-6	-8	-8	-9	-10	-10
Service								
Utilities, construction, transport	0	0	-1	-1	-2	-2	-4	-4
Trade and hospitality	0	0	0	0	-1	-1	-1	-1
Finance, insurance, real estate, business	1	1	0	0	0	-1	-2	-3
Other services	0	0	0	-1	-1	-1	-1	-2
Total all sectors	**-5**	**-2**	**-17**	**-23**	**-27**	**-30**	**-33**	**-37**

Note – These figures are rounded to the nearest million

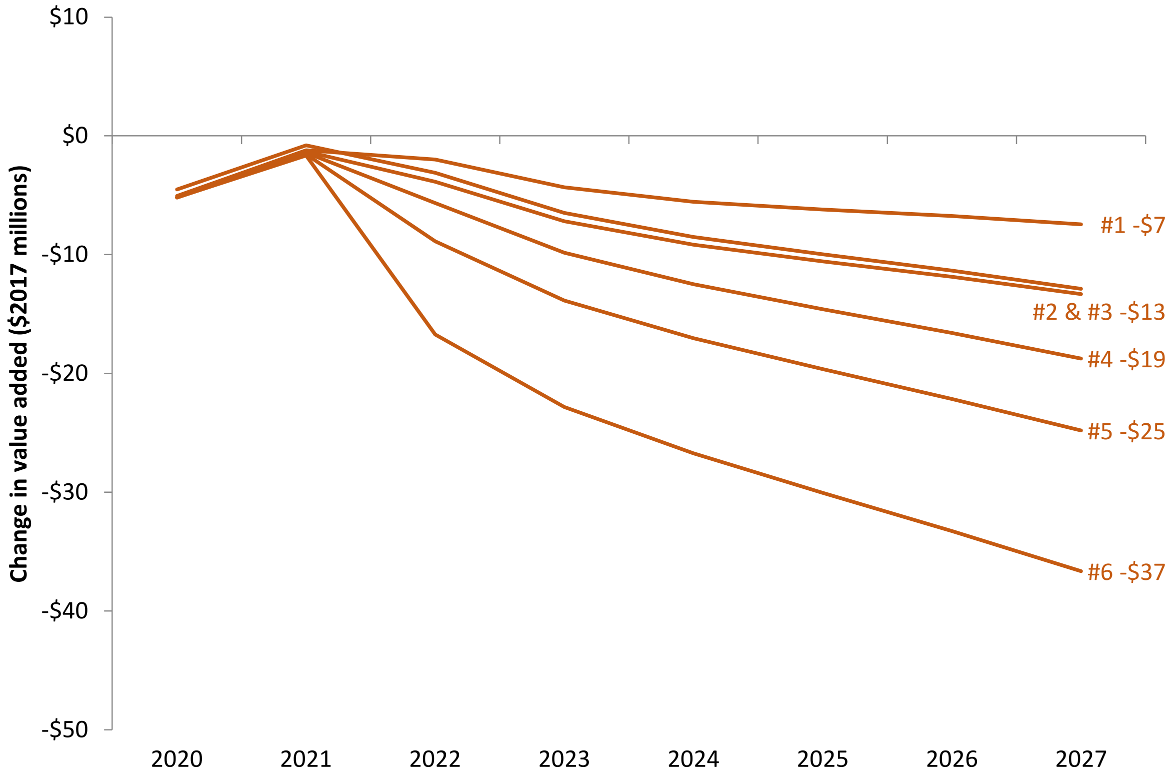

Figure 13.2: Annual changes in value added from six N-Cap scenarios in Southland for the NZ economy

Across all scenarios, the losses are slightly larger in the first year (2020) than the second year (2021) because of the immediate need for expenditure on farm plans. The losses then progressively increase from 2022 to 2027 with the increasing rates of adoption of nitrogen mitigations by dairy farms to achieve nitrogen loss thresholds. For the non-farming sectors, there are some small gains in value added initially under all scenarios for 'Finance, insurance, real estate, business services' and 'Other services'. This benefit reflects these sectors' involvement in farm plans.

The 'Food manufacturing' industries (e.g. dairy) have existing investments in factors of production. As 'Food manufacturing' experiences less supply of raw inputs locally their response is to demand more raw inputs from 'Other primary' industries around New Zealand, with small price increases to induce greater production. This behaviour helps 'Food manufacturing' reduce their losses in value added and leads to gains in value added for 'Other primary' elsewhere. However in the real world, this adaptive behaviour is unlikely to be as great as predicted by the model, especially when the Essential Freshwater package is being implemented across the whole of New Zealand. If this is the case then the losses in value added will be above those reported.

The results for 'Other primary industries' become obvious when the modelling results are shown by the two regions in the model (i.e. Southland and the Rest of New Zealand). In the short term, there are larger losses for Southland that may be slightly offset by smaller benefits for the Rest of New Zealand. Table 13.5 gives the results for Scenario 6 by Southland and the Rest of New Zealand. Figure 13.3 (next page) shows the results from all six scenarios by Southland and the Rest of New Zealand, and also the results from scenarios 1 and 6 for New Zealand as a whole from Figure 13.2 (above).

Table 13.5: Scenario 6 - Net change in value added from the N-Cap scenarios in Southland by Southland and the Rest of New Zealand ($2017 million)

Sector and Industry	2020		2021		2022		2023		2024		2025		2026		2027	
	Southland	Rest of NZ	Southland	Rest of NZ	Southland	Rest of NZ	Southland	Rest of NZ	Southland	Rest of NZ	Southland	Rest of NZ	Southland	Rest of NZ	Southland	Rest of NZ
Primary																
Southland dairy cattle farming	-5		-5		-14		-17		-20		-22		-23		-25	
Southland drystock + other	-1		-1		0		-1		-1		-1		-1		-1	
Other primary	0	0	0	0	0	4	0	5	0	6	0	7	0	8	0	9
Manufacturing																
Food manufacturing	0	0	1	0	-6	0	-7	-1	-7	-1	-8	-1	-8	-1	-9	-1
Service																
Utilities etc.*	0	0	0	0	-1	0	-1	0	-1	-1	-1	-1	-1	-1	-2	-2
Trade, hospitality	0	0	0	0	0	0	0	0	-1	0	-1	0	-1	0	-1	0
Finance etc.*	2	-1	1	0	0	0	1	-1	1	-1	0	-1	0	-2	-1	-2
Other services	0	0	0	0	0	0	0	-1	0	-1	0	-1	0	-2	0	-2
Total all sectors	**-5**	**0**	**-3**	**1**	**-20**	**3**	**-25**	**2**	**-29**	**2**	**-32**	**2**	**-35**	**1**	**-38**	**1**

**** Refer to previous table for full description of industry.***
Note - These figures are rounded to the nearest million.

In Table 13.5 'Dairy cattle farming' and 'Drystock and other farming' is only separated out from 'Other primary' industries for Southland. All primary in the Rest of New Zealand was condensed in the 'Other primary' category. In the modelling, most of the gain was additional demands for raw milk from rest of New Zealand by dairy product manufacturers (both Southland and rest of NZ manufacturers) to compensate for the fact that, while they had the investments to produce dairy products, they had a drop of supply of inputs of raw milk. It is anticipated that some of the gain to rest of New Zealand may also be for other outputs that have fallen from Southland dairy farms. Generally, there is no increase in imported feed purchases for the dairy farms under the 10%, 20% level nitrogen reductions – however there are exceptions (e.g. Economic Zone 1 – Te Anau and Economic Zone 8 Matāura wet / poorly drained).

Overall, the effect of the smaller benefits for the Rest of New Zealand is a minor softening of regional impacts at a national scale. Similarly, the impacts may be felt more acutely by some communities at a local level. For example, for Scenario 6 (70th percentile threshold and average 20% nitrogen loss reduction) the $38 million loss in value added for Southland in 2027 is made up of $25 million from 'Dairy cattle farming' and $9 million from 'Food manufacturing'. The annual loss for dairy farming is equivalent to approximately 4% of the current dairy industry in Southland.

What actually occurs between Southland and the Rest of New Zealand will depend, in part, on how the Essential Freshwater package impacts other regions. However, the variation in results highlights the importance of understanding the effects of scale and connectivity when assessing impacts.

The level of nitrogen loss reduction required of individual farms will depend on where each farm's current nitrogen loss sits in relation to the final nitrogen loss threshold (somewhere between the 70th and 90th percentile). At present, the full distribution of pastoral nitrogen losses in Southland is unknown. If a land use activity (e.g. dairy) follows a 'normal' distribution (i.e. a bell curve) then the number of farms that have to reduce by smaller percentages will possibly be lower than the number having to reduce by larger percentages. However, there is some evidence that the distribution is a more 'skewed', with more farms in the lower to mid-range of the land use activity's nitrogen losses but a long tail at the higher end. Overall, the modelling of 10% and 20% levels in nitrogen reduction appear to give a good indication of the impacts of the N-Cap proposal at catchment and regional scales.

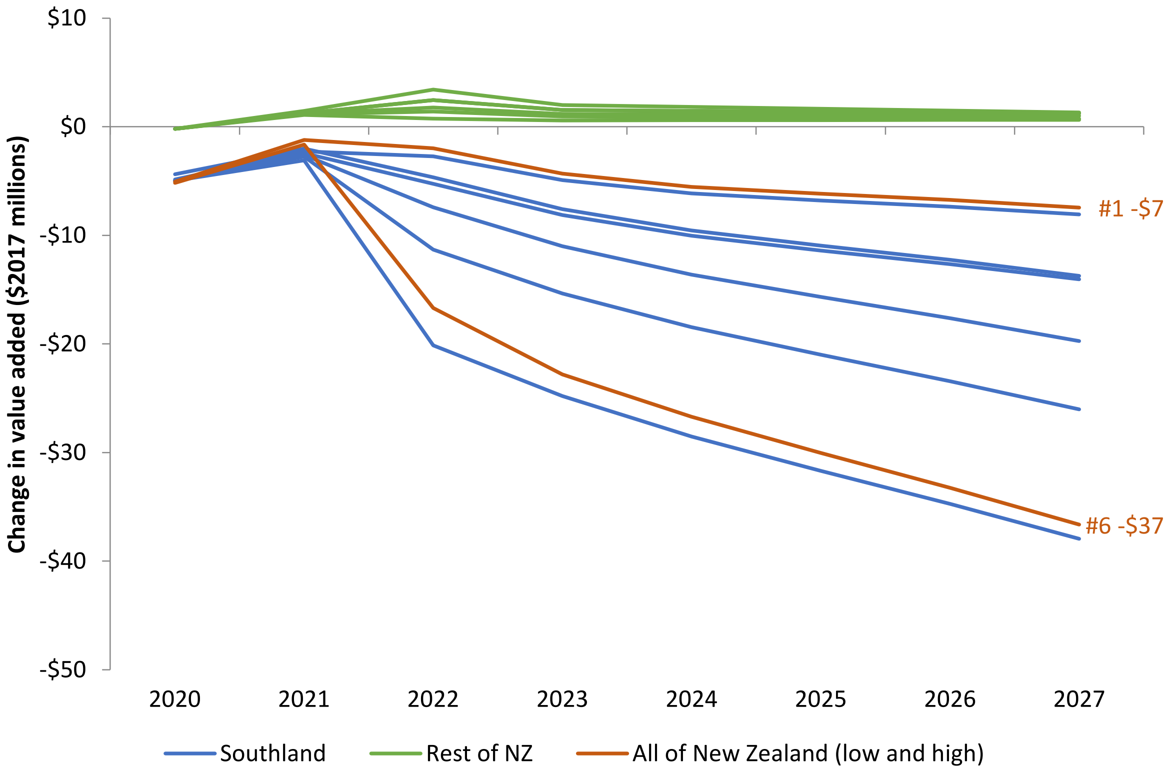

Figure 13.3: Annual changes in value added from N Cap scenarios in Southland by Southland and the Rest of New Zealand (all six scenarios), and NZ as a whole (scenarios 1 and 6)

Unsurprisingly, Scenario 6 (a nitrogen threshold set at 70% of dairy farms with an average 20% reduction in nitrogen loss) is the most extreme of the six scenarios tested. It has the highest annual loss for Southland at $38 million in 2027, which is equivalent to less than 1% of the region's gross domestic product (GDP) in 2017 ($5.4 billion). This scenario can reasonably be expected to be the most effective of the six scenarios modelled in terms of reduced nitrogen losses and will make some contribution in the future towards achieving freshwater objectives, limits and targets in Southland (once they are developed).

However, at a landscape scale, it captures a relatively small proportion of land use activities (i.e. 30% of dairy land within the five N-Cap catchments and dairy and dairy support land covers roughly 30% of the developed land in these catchments).

The results of this scenario modelling for the N-Cap proposal are influenced by the set of mitigations available in Overseer (Version 6.2.1). Mitigations requiring considerable capital investment, such as constructed wetlands and barns, were not used in the modelling because they are site-specific. Where a proposal relies on any model in regulation it has the potential to reduce its overall efficiency. In this case there is a risk that some farmers will focus more on the mitigations that are most cost-effective in Overseer rather than those that are most cost-effective on the ground. In reality, there are many worthwhile technologies, such as peak flow control structures, but their usefulness in policy can depend on how well they are represented in Overseer (if at all). Incentivising the use of a subset of the mitigations available may achieve a sub-optimal solution.

Employment

The most important employment impact from the N-Cap proposal in Southland is likely to relate to the increasing demand for farm plans. The freshwater - farm plan proposal requires all farmers in N-Cap catchments to have a farm plan within two years of the commencement date (likely to be in 2020), which in Southland means roughly 1,800 plans each year across the five N-Cap catchments[75]. This estimate may depend on whether farm plans are by property or farm business. In addition to the farm plan proposal, the N-Cap proposal requires dairy farmers and low-slope pastoral farmers in N-Cap catchments to provide their farm's baseline nitrogen loss figure in the form of Overseer output files to their regional council. However, a reasonable proportion of sheep and beef farms have low rates of nitrogen fertiliser use from one year to the next.

The requirement for farm plans and Overseer output files across much of Southland will be challenging. It is possible that some drystock farms will be unable to accurately represent their farms in Overseer[76]. The previous case study noted that experience with Plan Change 10 for the Lake Rotorua Catchment indicates seven people can complete around 300 plans per year. It is estimated that some 42 extra farm plan experts will be needed initially, then dropping to 20 or so extra employees once the first round of farm plans is completed. Any impacts from the proposal for on-farm employment were less obvious. Labour inputs tend to be 'lumpy', rather than increasing or decreasing incrementally (or smoothly). The mitigation modelling done by DairyNZ did not generally predict major changes in on-farm employment unless cow numbers dropped significantly (beyond 150 cows), which was generally not the case for reductions in nitrogen losses of 10% and 20%.

[75] Part 3 Farming of the proposed National Environmental Standards for Freshwater does not apply to pastoral and arable farms of less than 20 ha and horticultural farms of less than 5 ha (page 13). "Farm means a property, are of land, or enterprise used for pastoral farming horticultural farming, or arable farming, other than a farm engaged in intensive indoor primary production" (page 12)
[76] Of the 39 sheep and beef farms surveyed for The Southland Economic Project, an Overseer file could not be created for three farms without making significant changes to the farm operations. In addition to the 39 sheep and beef farms, seven deer farms were also surveyed. although an Overseer file was able to be created for these deer farms, the complexities of deer farm systems are necessarily not well captured. The ability to accurately represent some drystock farms in Overseer is an important consideration for its use in policy.

13.5 Main Findings

The N-Cap proposal is complex and will clearly require a significant amount of effort to implement over a relatively short period of time. As with any policy proposal, the context is important. Southland's water and land is highly connected. Over 150 years, human activities have changed the region's hydrology, particularly in lowland areas. The wetlands on land in private ownership are now 3.2% of their original extent. The exchange between groundwater and surface water happens relatively quickly and contaminants such as nitrogen now travel rapidly through the landscape. Following the removal of agricultural subsidies in the 1980s and an economic downturn in Southland, dairy farming expanded rapidly across the region. Between 1990 and 2014, total stock units in the region increased by 1.5 million (just under 16%) to over 11 million.

We tested 6 scenarios for the N-Cap proposal that focused on dairy farming and the nitrogen loss thresholds. Once the first phase of farm plans occurs between 2020 and 2022, the losses in value added for Southland's economy progressively increase from 2022 to 2027 with increasing rates of adoption of nitrogen mitigations on dairy farms. If the threshold is set at the 70th percentile then by 2027, the annual loss in value added for Southland's economy may be approximately $37 million ($2017) with a 4% loss in value added for the region's dairy industry. These financial losses are likely to occur anyway (i.e. without the proposal) as Environment Southland progressively implements the current National Policy Statement for Freshwater Management (2017).

The N-Cap proposal is likely to have positive employment benefits in relation to farm plans but any impacts for on-farm employment were less obvious. The proposal will result in annual losses in value added for dairy farmers and dairy product manufacturers. In certain cases, dairy farmers may invest in actions now to reduce their farm's nitrogen losses but are later unable to meet further requirements that are likely to come out of the regional process to fully implement the NPS-FM. In such circumstances, farmers may have chosen a different mitigation strategy. It is possible that there will be direct and indirect impacts on dairy support, but these are not captured in the modelling. Drystock farms that have connections with the dairy industry may also be indirectly impacted.

The main impact of the N-Cap proposal is to shorten the timeframes that farmers have to reduce their nitrogen losses. Shorter timeframes may have a wide range of short to medium term benefits. In Southland, improvements in water quality can show up earlier than elsewhere, which is important in a region where some waterbodies are becoming increasingly degraded and may be approaching ecological thresholds. Four of the five N-Cap catchments are connected to estuaries, which are highly valued. The proposal may help to avoid some damage and remediation costs but it will depend on where the nitrogen loss threshold is set. At a landscape scale, the scenarios apply to relatively small proportion of land use activities within the five N-Cap catchments.

This case study highlights the importance of understanding the effects of scale (local, regional and national) and connectivity between industries and communities when assessing the impacts of policy. It is probable that the design of the N-Cap approach will influence the spatial distribution of both the costs and benefits of the N-Cap proposal for local communities and the environment.

13.6 Appendices

Appendix 1 – Nitrogen Cap Calendar

Table 13.6: Indicative calendar for Nitrogen Cap (Option 1) in proposed National Environmental Standard: Freshwater

Date	Time from commencement	Action
June 2020	Estimated	Commencement date is the date on which this Standard comes into force.
December 2020	6 months	Clause 46: All dairy farms must provide the farm's nitrogen loss figure (as an Overseer output file certified as accurate by an Overseer modeller) to Council.
January 2021	7 months	Clause 47: Council must have calculated threshold values for each catchment (or sub-catchment) based on the nitrogen loss figures supplied by dairy farmers in each catchment.
June 2021	12 months	Clause 46: Other low-slope pastoral farms must provide the farm's nitrogen loss figure (as an Overseer output file certified as accurate by an Overseer modeller) to Council.
December 2022	18 months	Clause 48: Every farmer with a low-slope pastoral farm that is within the threshold value must provide annual Overseer output file (certified by an Overseer modeller) of their farming activities for the past year.
January 2022	19 months	Clauses 44 and 45: The permitted activity status changes for low-slope pastoral farms and all dairy farms that exceed the threshold value for the catchment (or sub-catchment). Their activity status becomes either controlled or discretionary. All non-permitted farms must reduce to threshold within 5 years of gaining consent.
December 2025	6.5 years	Within 3 years of granting consents, farms must provide evidence to Council to show that nitrogen loss has been reduced by at least 50% of the difference (as %) between the farm's baseline nitrogen loss figure and the threshold value for the catchment (or sub-catchment).

14. Southland – Wastewater National Environmental Standard for Gore District

14.1 Introduction

Central government signalled in its discussion document "Action for Healthy Waterways" a National Environment Standard for Wastewater Discharges and Overflows. The new standard would prescribe requirements for setting consent conditions on discharges from wastewater treatment plants and engineered overflow points. The requirements could include (among other things):

- "minimum treatment standards or 'limits' for nationally-applicable wastewater quality parameters, including biochemical oxygen demand, suspended solids and bacteria"; and
- "approaches for incorporating culturally acceptable wastewater treatment processes."

Wastewater operators would also have to comply with other requirements under the National Policy Statement for Freshwater Management and be expected to be part of future nutrient allocation regimes.

The details about the specific requirements in any wastewater National Environmental Standard are unknown. However, it may be challenging for some local communities, especially those with oxidation ponds. The oxidation ponds of many small communities largely receive only domestic wastewater. This case study focuses on Gore's wastewater scheme and the cost-effectiveness of eight upgrade scenarios[77] modelled to further improve performance for suspended solids, biochemical oxygen demand and bacteria (two of the eight scenarios were discharges to land, rather than water[78]). Each upgrade has strengths and weaknesses in its cost or treatment capabilities for each contaminant. The upgrades include options that are either additional or complementary to the existing system and/or replace the existing system.

The case study draws on existing research[79] from The Southland Economic Project[80] that is likely to be directly relevant to understanding the impacts of a wastewater National Environmental Standard. The research was completed by Gore District Council, Southland District Council, Invercargill City Council and Environment Southland. It investigated the existing performance and upgrade scenarios for the wastewater schemes for eight Southland towns across the region. The upgrades looked across five contaminants: suspended solids, biochemical oxygen demand, total nitrogen, total phosphorus, and *E. coli*.

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[77] Wastewater schemes consist of two main components: the reticulation infrastructure (i.e. pipes, pits, and pumps) and the wastewater treatment system. While a scheme's reticulation infrastructure is relevant, the research was specifically about upgrades or 'step changes' in wastewater treatment. In addition to these step changes, there are also possible actions to improve the performance of reticulation infrastructure. These actions can reduce inflows into a wastewater treatment system, increase its effectiveness, and improve the overall efficiency of a scheme.

[78] It is understood that the discharge of wastewater direct to water is abhorrent to tangata whenua and that this issue generally is not fully resolved through the treatment of wastewater before discharge.

[79] Moran, McKay, Bennett, West, and Wilson (2018) *The Southland Economic Project: Urban and Industry*. Technical Report. Publication no. 2018-17. Environment Southland.

[80] https://www.es.govt.nz/council/major-projects/Pages/Southland-Economic-Project.aspx

There are a range of towns in Southland and each territorial authority (Gore District Council, Invercargill City Council, and Southland District Council) is faced with a different set of circumstances in terms of its infrastructure.

The supply of essential services, such as wastewater reticulation and treatment, is a sizeable investment for local communities that make it possible for people to live and work together. These services form part of a local community's natural and built assets or 'wealth' and, where they are delivered sustainably (in all of its components); they contribute to a community's wellbeing.

14.2 Context

Overall, there are 1.2 million hectares (ha) of developed land in Southland. Around 3.3% of this land area is used for urban activities, such as residential and commercial areas, transport networks, and industry. These activities create stormwater and treated wastewater that is discharged either directly or indirectly to fresh or coastal water[81]. In Southland, a relatively large proportion of people live rurally (twice the national average) and towns are service centres for their local area.

Most towns and settlements lie on valley floors near rivers and streams (and in some cases, also lakes). Many are part of a series or chain within a catchment – lying either upstream or downstream from one another – connecting (through surface water and groundwater) the headwaters of a river, or one of its tributaries, with an estuary. These town chains largely follow the road network but, in some cases, they diverge. Towns tend to sit across these river catchments, at the centre of a wider area of influence, and their effects flow downstream. For example, the Ōreti River connects Mossburn at one end with New River Estuary at the other. There are some small coastal towns and settlements, such as Drummond, Waikawa, Orepuki, and Colac Bay (between Orepuki and Riverton/Aparima), that are not part of a town river chain.

Figure 14.1 shows many of the chains of towns and settlements connected by rivers and streams in Southland.

Southland's towns are located near water – because water is vital to life. However, many towns have an uneasy relationship with it, in terms of both water quantity and quality. Water is managed in towns through the use of extensive stormwater drainage networks, flood protection schemes, and water supply schemes. Also critical are the region's transport networks' many bridges and culverts. Despite the abundance of rain in many parts of the region, it does not all arrive as effective rain and water is also managed through water shortage measures. The landscape today is more prone to water shortages because of its reduced water storage capacity (e.g. removal of tussock grasslands), extensive drainage and river straightening. Flood events and drought are likely to become more of an issue as the effects of climate change intensify.

[81] Discharges are either via the end of a pipe (point source) or diffuse through or across land (non-point source).

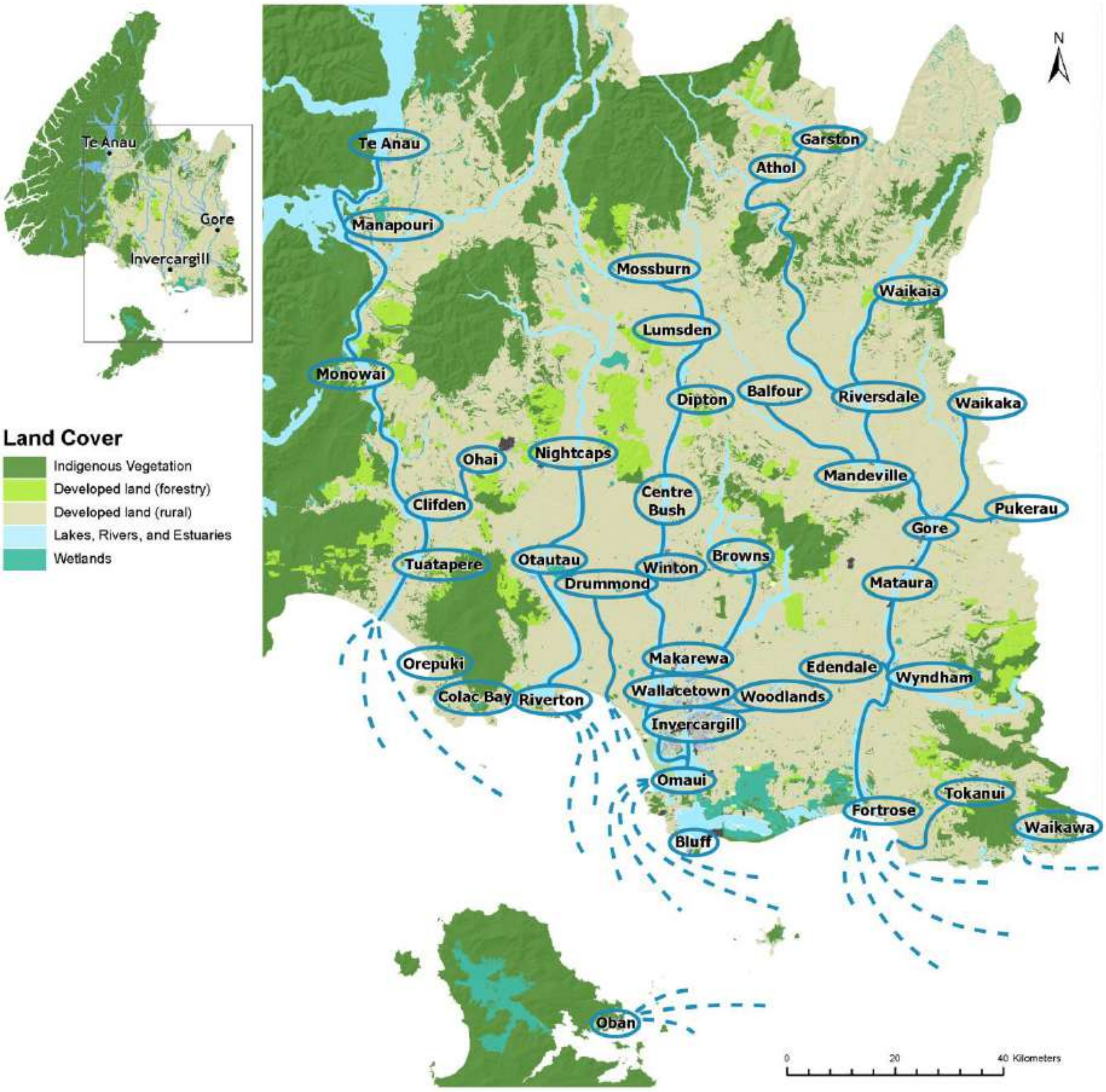


Figure 14.1: Southland towns and settlements connected by rivers and streams
Source Environment Southland

Invercargill and 38 Southland towns and settlements[82] are connected to one or more municipal water related schemes: wastewater, stormwater, and a potable water supply. Invercargill and 24 towns in the region are served by municipal wastewater schemes. In general, a town or settlement gained one or more of these 'three waters' schemes to improve public health[83].

[82] This total includes Southland District Council's wastewater scheme for the reserve at Curio Bay and stormwater schemes at Colac Bay and Thornbury.

[83] Local Government New Zealand (LGNZ) has a Three Waters project (prepared by Castalia Strategic Advisors) that aims to improve potable water, wastewater, and stormwater in New Zealand. An issues paper prepared as part of this project in 2014, *Exploring the issues facing New Zealand's water, wastewater, and stormwater sector*, gives a national overview of the state and performance of local potable, wastewater and stormwater assets and services.

In some cases, the reason for a scheme is now historic, dating back to a time when the town had a larger population or a particular economic activity occurring in the area. A number of schemes were set up to supply services to more than one town.

In Southland, the reticulated collection of wastewater began in some towns in the early 20th century but others still had nightcarts up until the 1970s. Except for Invercargill, which had an early septic tank, wastewater treatment systems were not introduced in the region until the 1960s and 1970s. The wastewater schemes that were developed at this time were usually funded through loans and also subsidies under the Public Health Act 1956 (e.g. Otatara). These subsidies where phased out by 1989 and at the time it was described as "the end of an era" for wastewater development in rural communities because the likelihood of communities being able to afford a new scheme was remote (Boyle, 2000, p.120). The Ministry of Health reintroduced subsidies in 2003 (the Sanitary Works Subsidy Scheme) for small, semi-rural communities but they ended again in 2009[84].

Town wastewater treatment has usually been designed to reduce suspended solids and biochemical oxygen demand. While some schemes have land-based discharges, many towns discharge treated wastewater into the region's rivers and streams. There is a wide range of technologies used but, on a per household basis, the schemes were relatively consistent in their performance for suspended solids and biochemical oxygen demand. The performance for *E. coli* was variable across the towns, and even more so for nutrients, which are a more recent focus for wastewater treatment. The water quality standards for stock drinking, contact recreation, shellfish gathering and drinking water require lower concentrations than those generally achieved by the treatment systems.

More information is available on which Southland towns and settlements are connected to a municipal water related scheme, and their experiences in the development of wastewater schemes in The Southland Economic Project: Urban and Industry Report (2019). The report also includes a discussion on patterns of settlement, including the relationship with water, and community assets.

14.3 Gore District

Gore District covers around 125,400 ha of land and water in north-east Southland, and includes the towns of Matāura, Gore, and Waikaka (as well as their surrounding rural areas). These communities are distributed across just over 120,000 ha of developed land (ES Land Use Map, Pearson & Couldrey, 2015). The District also contains slightly less than 3,900 ha of land in indigenous vegetation that includes Croydon Bush and Dolamore Park Scenic Reserves (ES Land Use Map, Pearson & Couldrey, 2015). In 2013, the District's total population was around 12,000 (or just under 13% of people living in Southland) – roughly 10 people for each square kilometre of developed land. There were almost 5,000 dwellings (just over 90% occupied) in the District, and median personal income was $28,800. Within the Gore District there are 3816 rating units in Gore, 800 rating units in Matāura and 1348 rural rating units (GDC Website).

[84] The Hon. Tony Ryall (Minister of Health) stated in Parliament in 2010 that the Sanitary Works Subsidy Scheme was closed to new applications in June 2009 as the available funding was fully committed (https://www.parliament.nz/mi/pb/order-paper-questions/written-questions/document/QWA_21997_2010/21997-2010-hon-damien-oconnor-to-the-minister-of-health/).

Gore District Council manages physical assets and services that support its local communities. These assets and services include around 900 kilometres of roads[85], 2 urban water supplies, 1 rural water supply, three wastewater schemes, as well as complex stormwater schemes, libraries, cemeteries, community halls, reserves and parks, and other activities. The District's rural and urban ratepayers contribute to the cost of these assets and services through general, targeted and uniform annual general rates (based on the capital value of their property). A large proportion of revenue from rates is spent on essential infrastructure. In 2015/16 the proportion of rates revenue was around 37%, with $2.38 million of rates funding spent on roading and transport (with total funding, including National Land Transport Fund assistance, around $3.49 million), and $2.92 million of rates spent on the three waters assets (water, wastewater, and stormwater) (GDC 2015/16 Annual Report).

In comparison to Southland District, Gore District Council manages a handful of wastewater schemes. These schemes are located at Gore, Matāura and Waikaka and the treatment systems centre on oxidation ponds, although Gore has also invested in an Actiflo plant for phosphorus removal. In addition to the treatment systems, the schemes have a combined total of 103 kilometres of pipes and 13 pump stations. These schemes all remove and treat wastewater from residential properties, businesses and community facilities. Gore has a medium-size scheme and receives considerable volumes of trade waste from local seasonal industry, which requires a high level of treatment. Gore District has a trade waste bylaw for limiting volumes and strength of waste and hazardous substances. Parts of Gore's wastewater scheme are connected to its stormwater scheme – which adds more complexity. The three schemes discharge either directly into the Matāura River, or a tributary of the Waikaka Stream, which eventually flows into the Matāura River.

The three wastewater schemes are an important investment for local communities – in 2016 the District's wastewater assets had a total replacement value of around $41 million. The Matāura treatment system was built in 1962 (upgraded in 2008), the Gore treatment system in 1973 (upgraded in 2009), and the Waikaka treatment system in 1986 (upgraded in 2007). Funding for these schemes was originally provided through a mix of central government subsidies and local government loans. To manage the costs for the District's ratepayers, the Council plans upgrades of its wastewater schemes around the duration of discharge consents. The suitability of current wastewater treatment facilities (centred on oxidation ponds) and long term operational viability of these schemes will be key decisions for the Council over the next 10 years. Gore District's Operations and Maintenance Budget for wastewater activity for 2017/18 is just under $1.7 million (GDC Annual Plan 2017/18).

For further context, Gore's location and role, present situation, settlement and development, and future outlook are described in Part B of The Southland Economic Project: Urban and Industry Report (2018). Also included in Part B of that report is a description of Maruawai ('valley of water') and an overview of environmental issues related to water quality for Gore District.

Gore has a combined stormwater/wastewater scheme in approximately 40% of the network in the urban area. A large amount of stormwater also gravitates through the combined network and is treated via the wastewater ponds before discharge. In 2016 the Gore network had 3,793 connections and roughly 10% of these connections are commercial or trade properties. The combined wastewater and stormwater network adds complexity to monitoring and treatment.

[85] Of this total length of roads in Gore District, 60% (540 km) is sealed and 40% (360 km) is unsealed.

Some wastewater pump stations may use the stormwater network to discharge overflow when the pump station becomes overwhelmed during rainfall events.

The main contributors of trade waste are meat and milk processing plants[86]. Trade waste users hold their own consents with the Council to discharge to the network and are closely monitored. Gore's economic development strategy is likely to increase the flow of trade waste over time.

Gore's wastewater treatment system is located south of the town. The incoming wastewater is initially screened to remove solids then treated into a ten hectare primary oxidation pond that is mechanically aerated. The wastewater then passes into a secondary oxidation pond of the same size for polishing. Depending on river flow conditions, the wastewater may then pass through a mechanical treatment Actiflo Plant to further remove phosphorus before discharge. The site has 2 discharge points to the Matāura River, and either discharge point can be in operation depending on river conditions.

Image 14.1: Gore's Actiflo plant (a chemical treatment process to reduce phosphorous and suspended solids)

The current resource consent for the wastewater discharge was granted in August 2006 and will expire in December 2023. The resource consent consists of a stepped quality expectation that follows average seasonal Matāura River flow conditions. As the river flow reduces beyond certain set points, the wastewater discharge quality must improve dramatically. The Actiflo plant is required to operate when the River is below 60 cumecs to ensure that discharge quality expectations are achieved.

[86] Following the completion of this research, the trade waste flows received by Gore increased with the commissioning of the Matāura Valley Milk processing plant at McNab in 2018.

Part C of The Southland Economic Project: Urban and Industry Report (2018) includes a more complete description of the Gore Wastewater Scheme.

14.4 Analysis

A more complete account of the methodology used in this research is available at the start of Part C of The Southland Economic Project: Urban and Industry Report. It describes the town selection process, contaminants, treatment methods, scenario development, economic modelling, and assumptions.

To develop information for municipal wastewater in Southland, the region's four councils scoped and commissioned research on the wastewater treatment for eight towns across the region: Te Anau, Ohai, Nightcaps, Winton, Gore, Matāura, Bluff and Invercargill. The research created a set of case studies that investigated:

1. The current performance of municipal wastewater treatment systems in terms of the waste in their discharges; and
2. The effectiveness of modelled scenarios to further improve their discharges and the financial costs of these scenarios.

The towns were selected to cover as wide a range of different situations as possible. Municipal wastewater schemes are largely driven by public health issues, and so population (present and historic) is a determining factor. At a regional scale, Southland's population is relatively stable (deaths and outward migration being balanced by births and inward migration) but there is strong variability between local communities – with growth in some towns and declines in other towns, reflecting changes in the economy. In total, the eight towns represent over 70% of the people living in the region.

The case studies were created using a four stage process. In the first stage, Stantec (formerly MWH) used the National Policy Statement for Freshwater Management 2014 as a guide for developing modelling scenarios for upgrading a town's existing wastewater treatment system. In developing these scenarios, Stantec estimated how the upgrades could improve the quality of treated wastewater discharge and their financial costs. Most of the modelled scenarios were 'bolt-ons' or additions to the existing treatment system. Only one of the scenarios (a membrane bioreactor) involved abandoning the existing treatment system and replacing it with an entirely new system. All of the case studies currently discharge to water and the scenarios modelled included upgrades that were land-based discharges. This information, including the specific caveats and limitations for each scenario, is included in the appendices of this report.

The scenarios developed for this research are largely theoretical and not all of the scenarios were modelled for all case studies. The number of scenarios modelled was largely based on each town's existing circumstances. For example, the existence of a new Te Anau wastewater consent for a discharge to land guided the 2 scenarios modelled. The scenarios modelled are not necessarily viable options or are being considered by any particular council. They would need to be subjected to due diligence, detailed feasibility assessments, consent processes and council consultation processes.

In the second stage, Market Economics used Stantec's scenarios to build an understanding of the relationship between the estimated effectiveness (improvements in the quality of treated wastewater) and costs.

The results are a 30 year forecast reported on an annual 'per household' basis to account for the different sizes of the towns – this measure should <u>not</u> be interpreted as a cost to ratepayers. The number of households was calculated using Statistic New Zealand five yearly projections. The results for the scenarios were then compared to the costs and effectiveness of the existing (or base) wastewater treatment system.

In the third stage, Environment Southland translated Market Economics' analysis into a series of easily accessible graphs that are presented in this report. During this stage, new inflow concentration data and valuation became available for the existing treatment system and the data used was updated[87].

The information from the town case studies is a key input into The Southland Economic Model for Fresh Water, which is a regional model of Southland's economy developed within The Southland Economic Project.

Baseline

This section describes the baseline results for Gore (i.e. what is actually occurring). The total annual inflow of wastewater into the Gore treatment system is estimated at around 2,198,600 m^3, with the daily flow ranging between 5,800 m^3 and 6,200 m^3. Table 14.1 identifies the quantity of contaminants removed annually from the raw wastewater by the existing treatment process: total suspended solids, biochemical oxygen demand, total nitrogen, total phosphorus, and *E. coli*. Table 14.2 gives information on the average quality of the treated wastewater discharged to the Matāura River.

Table 14.1: Annual contaminant loads and concentration (*E. coli*) removed from wastewater

Contaminant 2013 to 2016	Total SS (tonnes)	BOD (tonnes)	Total N (tonnes)	Total P (tonnes)	*E. coli* (cfu/100 ml)
Average (4 years)	472.8	521.6	84.0	12.8	~9,995,000

Table 14.2: Annual contaminant concentrations and loads in wastewater discharge

Contaminant	Total SS	BOD	Total N	Total P	*E. coli*
Concentrations	**(g/m^3)**	**(g/m^3)**	**(g/m^3)**	**(g/m^3)**	**(cfu/100 ml)**
Average (5 years)	35.1	12.9	11.8*	1.2	4,580
Loads	**(tonnes)**	**(tonnes)**	**(tonnes)**	**(tonnes)**	
Range (4 years)	40.7 to 92.0	14.4 to 38.4	25.9**	1.2 to 4.0	N.A.
Estimated loads	77.2	28.4	25.9**	2.6	N.A.

Source: Environment Southland consent monitoring data
* Based on 2 data points only
** Estimated

[87] The Stantec and Market Economics work is covered by separate disclaimers.

Gore's existing wastewater characteristics are particularly complex because of trade waste and stormwater. A relatively high volume of trade waste is accepted into the wastewater system from meat processing factories, and other industrial and commercial properties. Major trade waste customers are seasonal, which causes wastewater composition to vary greatly throughout the year. As well as high volumes of trade waste, around 40% of the reticulated wastewater network is combined with stormwater. In these parts of the town, wastewater and stormwater use the same pipes, and a large volume of stormwater is received at the wastewater treatment system.

The total replacement value of all the assets in the wastewater scheme is $33.1 million (2016 GDC Asset Valuation) (around $8,000 per household). The largest contributor is the gravity mains in the pipe network, which accounts for roughly 68% of the replacement value. The treatment system (including the Actiflo plant) is valued at $5.7 million. The rest of the scheme's value is made up of assets such as manholes and pump stations.

The annual depreciated value of the wastewater scheme is $504,000 and the annual operating cost is $1,230,000. These 2016 figures were used to determine the total 30 year cost of the existing system in Table 14.3 (below) using the methodology described in Part C of the Urban and Industry Report.

Figure 14.2 shows the relative performances of the existing system (with and without Actiflo) for each of the five contaminants considered (red and purple) compared to the assumed concentrations of the inflow of wastewater to the treatment system (black). Except for phosphorus, the concentrations of the contaminants were transformed[88] before being plotted to make it possible to include all five different contaminants on the same graph.

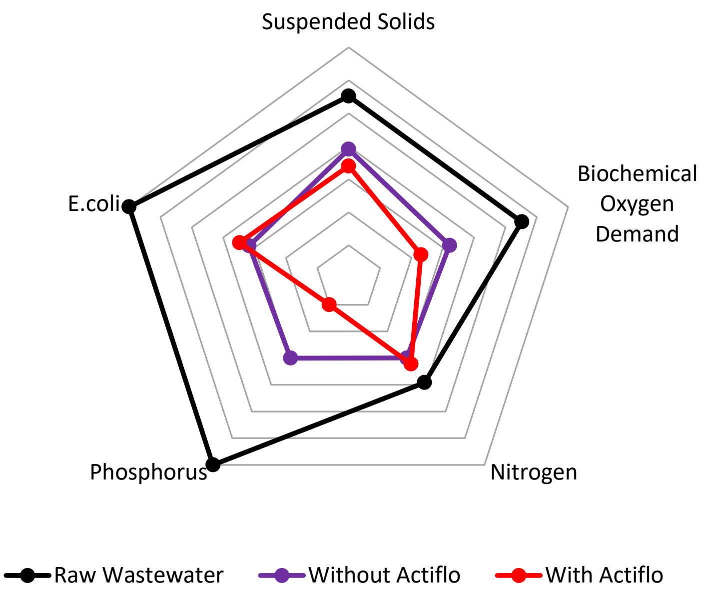


Figure 14.2: Gore baseline scenarios (existing system)

[88] The *E. coli* concentration was log transformed and those for BOD, SS and TN were ln transformed.

Scenarios and Results

Eight scenarios were developed for the Gore wastewater system (the scenarios and treatment processes as listed below with more details are in Appendix 2 of the Urban and Industry Report). The scenarios are ordered by their total cost (lowest to highest). Further work is needed to determine whether any scenario is technically feasible.

Scenario	Treatment Process (new units in bold)
Existing System	Liquid: 3 mm screen, primary pond, secondary pond, Actiflo (operational during low river flows) Solid: storage in pond
1. Pathogen reduction	Liquid: 3 mm screen, Primary Pond, Secondary Pond, Actiflo (operational during low river flows), **UV Disinfection** Solid: storage in pond
2. Phosphorus reduction	Liquid: 3 mm screen, primary pond, secondary pond, Actiflo **(operating 365 days/year)** Solid: storage in pond
3. Rapid infiltration	Existing process **+ high rate infiltration (rapid infiltration basins etc.)**
4. Nutrient reduction	Liquid: 3 mm screen, primary pond, secondary pond, **trickling filter, moving bed biofilm reactor, Actiflo (operating 365 days/year)** Solid: as existing
5. Nutrient and solids reduction	Liquid: 3 mm screen, primary pond, secondary pond, **trickling filter, moving bed biofilm reactor, Actiflo (operating 365 days/year), cloth/disc filter** Solid: as existing
6. Slow infiltration	Existing process **+ slow rate infiltration (spray irrigation etc.)**
7. Enhanced treatment	Liquid: 3 mm screen, **fine screen, membrane bioreactor (MBR)** Solid: as existing
8. Tertiary treatment	Liquid: 3 mm screen, primary pond, secondary pond, **trickling filter, ultrafiltration (UF), reverse osmosis (RO)** Solid: as existing **RO Reject Stream Treatment: moving bed biofilm reactor, wetland, UV**

Table 14.3 gives the scheme's total cost for the capital investment and annual operating costs over 30 years. The additional annual cost per household is based on 4,035 households and the same 30 year time period (the annual average number of households forecast between 2016 and 2046).

Table 14.3: Gore Wastewater Scenarios

Scenario	Total 30 year cost	Additional annual cost per household
Existing scheme	$72,483,000	$599
1. Pathogen reduction	$76,252,000	+$31
2. Phosphorus reduction	$76,649,000	+$34
3. Rapid infiltration (includes partial cost of land purchase)	$90,883,000	+$152
4. Nutrient reduction	$99,551,000	+$224
5. Nutrient and solids reduction	$105,740,000	+$275
6. Slow infiltration (includes partial cost of land purchase)	$118,617,000	+$381
7. Enhanced treatment	$137,848,000	+$540
8. Tertiary treatment	$228,309,000	+$1,287

Figures 14.3, 14.4 and 14.5 show the target treated wastewater concentrations which were used to design the upgrade scenarios. The same axes have been used as in Figure 14.2 (above) so the performance of the upgrade scenarios can be compared to that achieved by the existing treatment system. The concentrations used for the discharge to land scenarios are at the point of discharge to groundwater, and are based on the stated assumptions for soil type and depth to groundwater. Except for phosphorus, the concentrations of the contaminants were transformed[89] before being plotted to make it possible to include all five different contaminants on the same graph.

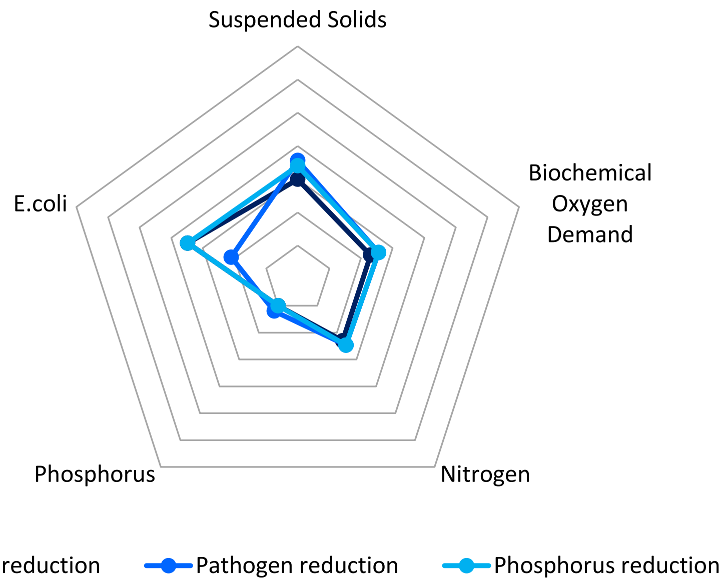


Figure 14.3: Gore 'discharge to water' scenarios

[89] The *E. coli* concentration was log transformed and those for BOD, SS and TN were ln transformed.

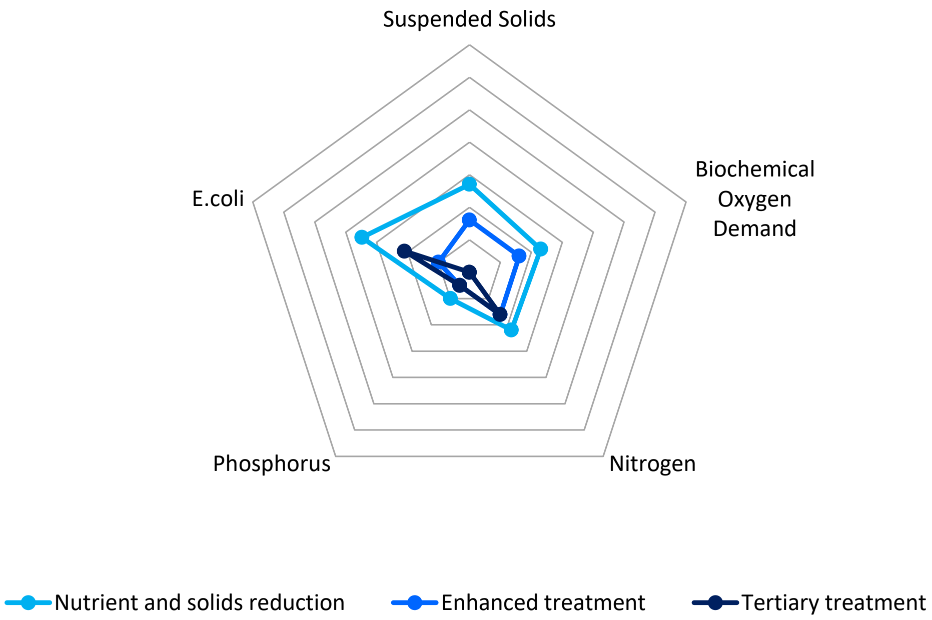


Figure 14.4: Gore 'discharge to water' scenarios (continued)

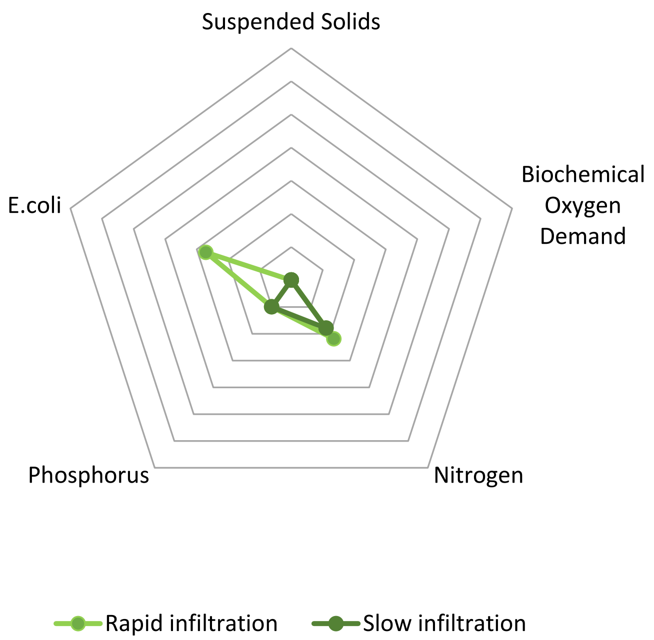


Figure 14.5: Gore 'discharge to land' scenarios

The results below for total suspended solids, biochemical oxygen demand and E. coli (and other results for total nitrogen and total phosphorus) are illustrated in a series of simple graphs in the Southland Economic Project: Urban and Industry Report.

Total Suspended Solids

The existing system (the base) removes a substantial proportion of total suspended solids from the inflow of raw wastewater through its different treatment processes. The screen removes large solids, the ponds add some removal via bacteria and settlement, and the Actiflo plant adds further removal through clarification. Overall, the existing treatment system removes just over 91% of the total suspended solids in the wastewater inflow. The Gore system receives a base inflow load of 550.00 tonnes of solids annually, of which 472.78 tonnes are removed through treatment, and 77.22 tonnes are discharged to surface water.

Of the eight scenarios modelled for Gore, Scenario 3: *Rapid infiltration*, Scenario 6: *Slow infiltration* and Scenario 8: *Tertiary treatments* are likely to be the most effective at removing total suspended solids. These three scenarios use additional filtration (mechanical filtration for Scenario 8 and filtration through the underlying soil for the land discharge scenarios 3 and 6) to remove suspended solids over and above the existing system. Scenario 7: *Enhanced treatment* is also relatively effective for this contaminant. The least effective scenario appears to be Scenario 1: *Ultraviolet disinfection,* which is technology designed for treating *E. coli* (pathogens). Table 14.4 summarises the scenario treatment capabilities for total suspended solids (kilograms per household per year – kg/hh/year) in comparison to the wastewater inflow and the base removal (existing system). Table 14.4 also gives the resulting discharge for the base and all scenarios.

Table 14.4: Annual Loads – Suspended Solids (treatment removal and discharge)

Scenario	Load removed (kg/hh/year)	Treatment removal as % of inflow	Improvement as % of base removal	Discharge load (kg/hh/year)	Discharge as % of inflow
Existing System	117	86.0%	N.A.	19	14.0%
1. Pathogens	117	86.0%	0.0%	19	14.0%
2. Phosphorus	120	88.0%	2.4%	16	12.0%
3. Rapid infiltration	136	99.6%	15.9%	1	0.4%
4. Nutrients	125	92.0%	7.0%	11	8.0%
5. Nutrients & solids	128	94.0%	9.4%	8	6.0%
6. Slow infiltration	136	99.6%	15.9%	1	0.4%
7. Enhanced	134	98.0%	14.0%	3	2.0%
8. Tertiary treatment	136	99.6%	15.9%	1	0.4%

The four most effective scenarios (Scenarios 3, 6, 7 and 8) have an additional annual cost for wastewater treatment of between $152 and $1,287 per household. Of these scenarios, Scenario 3: *Rapid infiltration* is likely to deliver improvements at the lowest additional cost. Scenario 1: *Ultraviolet Disinfection* will not improve removal of total suspended solids yet its capital cost will increase costs to the households.

Scenarios 3 and 6 (the 2 land-based technologies) are likely to deliver similar improvements for total suspended solids to Scenarios 7 and 8, but have a marked difference in cost and may not be feasible for some of the time around Gore. It is unknown how these costs will change once the full cost of land is included, as land purchases vary considerably.

Improvement in a wastewater treatment system's performance reduces the concentration of contaminants in its discharge. The results suggest that achieving similar volumes of total suspended solids discharged can have a wide range in costs per household. The better performing scenarios potentially reduce the level of total suspended solids in the wastewater discharge to almost zero, but at a wide range in annual costs per household.

Biochemical Oxygen Demand

Biochemical oxygen demand is treated within the existing treatment system via the primary and secondary ponds. The existing treatment system reduces just over 96% of biochemical oxygen demand, which as with the total suspended solids, is a considerable proportion of the raw wastewater inflow. For biochemical oxygen demand, the Gore system receives a base inflow load of 550.00 tonnes annually, of which 521.62 tonnes are reduced through treatment, and 28.38 tonnes are discharged to surface water.

Of the eight scenarios modelled, Scenario 3: *Rapid infiltration*, Scenario 6: *Slow infiltration* and Scenario 8: Tertiary treatment are likely to be the most effective for further reducing biochemical oxygen demand. They were also the better performing scenarios for suspended solids. Two scenarios, Scenario 1: *Ultraviolet disinfection* and Scenario 2: *Phosphorus reduction*, are less effective for this contaminant because their treatment capabilities are not designed to reduce biochemical oxygen demand. Table 14.5 summarises the scenario treatment capabilities for biochemical oxygen demand in comparison to both the wastewater inflow and the base reduction (existing system). It also gives the resulting discharge for the base and all scenarios.

Overall, the different scenarios are likely to make relatively small improvements because the existing treatment system performs particularly well for this contaminant.

Table 14.5: Annual Loads - BOD (treatment reduction and discharge)

Scenario	Load reduction (kg/hh/year)	Treatment reduction as % of inflow	Improvement as % of base reduction	Discharge load (kg/hh/year)	Discharge as % of inflow
Existing System	129	94.8%	N.A.	7	5.2%
1. Pathogens	129	94.8%	0.0%	7	5.2%
2. Phosphorus	129	94.8%	0.0%	7	5.2%
3. Rapid infiltration	136	99.6%	5.0%	1	0.4%
4. Nutrients	131	96.0%	1.2%	5	4.0%
5. Nutrients & solids	131	96.0%	1.2%	5	4.0%
6. Slow infiltration	136	99.6%	5.0%	1	0.4%
7. Enhanced	134	98.0%	3.3%	3	2.0%
8. Tertiary treatment	136	99.6%	5.0%	1	0.4%

The four most effective scenarios (Scenarios 3, 6, 7 and 8) have an additional annual cost for wastewater treatment of between $152 and $1,287 per household. Of these 4, the 2 land scenarios (Scenario 3 and 6) are the lowest additional cost but it is not known how these costs will change once the full cost of land is included, as land purchases vary considerably. The relatively small improvements that can be made in treatment and discharge for this contaminant are likely to increase the annual cost per household.

E. coli

The existing treatment plant has substantial capability to remove *E. coli* from the raw wastewater inflow through its oxidation ponds and Actiflo plant. On the whole, the existing system removes 99.54% of *E. coli*, which is a greater proportion than for any of the other four contaminants. Yet even very small residual amounts of *E. coli* can still pose a risk to human health. For *E. coli*, the Gore system receives base inflow concentrations of 10 million cfu/100 mL, which is reduced by 9,995,400 cfu/100 mL through treatment, so that a concentration of 4,600 cfu/100 mL is discharged to surface water.

Of the scenarios modelled, Scenario 1: *Ultraviolet disinfection*, Scenario 3: *Rapid infiltration*, Scenario 6: *Slow infiltration*, Scenario 7: *Enhanced treatment* and Scenario 8: *Tertiary treatment*, are relatively effective for further removal of *E. coli*. These scenarios deliver more than tenfold additional reduction and include the 2 land-based technologies. Scenario 2: *Phosphorus reduction*, Scenario 4: *Nutrient reduction* and Scenario 5: *Nutrients & solids* are less effective for this contaminant, relative to the other scenarios, as they are not specifically designed to include pathogen reduction. Table 14.6 summarises the scenario treatment capabilities for *E. coli* compared to the wastewater inflow and base removal (existing system). It also gives the resulting discharge for the base and all scenarios.

Table 14.6: Annual Concentrations – *E. coli* (treatment removal and discharge)

Scenario	Conc removed (cfu/100 mL)	Treatment removal as % of inflow	Improvement as % of base removal	Discharge conc (cfu/100 mL)	Discharge as % of inflow
Existing System	9,995,419	99.95%	0.000%	4,581	0.046%
1. Pathogens	9,999,874	99.999%	0.045%	126	0.0013%
2. Phosphorus	9,997,000	99.97%	0.016%	3,000	0.030%
3. Rapid infiltration	9,999,491	99.994%	0.041%	509	0.0051%
4. Nutrients	9,997,000	99.97%	0.016%	3,000	0.030%
5. Nutrients & solids	9,997,000	99.97%	0.016%	3,000	0.030%
6. Slow infiltration	9,999,999	99.99999%	0.046%	1	0.00001%
7. Enhanced	9,999,990	99.9999%	0.046%	10	0.0001%
8. Tertiary treatment	9,999,874	99.999%	0.045%	126	0.0013%

The five scenarios that deliver additional capability for *E. coli* (Scenarios 1, 3, 6, 7 and 8) have a wide range of additional annual costs for wastewater treatment. Scenario 1: *Ultraviolet disinfection* is likely to deliver improvements at the lowest additional cost but was less effective for other contaminants, given it specifically targets pathogen reduction.

14.5 Main Findings

All eight Southland towns included in the research currently discharge treated wastewater directly to a surface water body – a stream, river, or estuary. There are examples of schemes with discharges to land in Southland (e.g. Otautau) but they were not selected for the research because they were considered likely to be less of a priority in the setting of limits for water quality in Southland.

To date, wastewater treatment systems have usually been designed to reduce suspended solids and biochemical oxygen demand. There is a wide range in the type of technology used across the towns, with more complex treatment systems generally being used where there are larger urban areas. Despite the range of technologies used, the towns were relatively consistent in their performance for suspended solids and biochemical oxygen demand. Considerable reductions are also achieved for E. coli but for this contaminant even a very small amount remaining still indicates a potential risk to human health from the discharge. The level of E. coli reduction that the existing treatment systems achieve varies across the towns. Nutrients are a more recent focus and their reduction was even more variable across the towns.

Based on the scenarios modelled for all eight town case studies, the key findings of the research were:

1. There were marked differences between the towns, particularly between the smaller and larger municipal wastewater schemes. These differences are driven by variability in the relative contributions of domestic, commercial and industrial waste streams, and the types of existing technologies being used to treat these waste streams within each scheme. On a per household basis, the quality of treated wastewater discharged was roughly similar in most cases.
2. Location is important for many reasons. A town's context or position within the landscape influenced settlement and development, essential infrastructure, and the downstream receiving environment. Many towns in Southland are part of a chain along a river catchment. For some of the scenarios to be viable, there needs to be suitable land available and, in parts of Southland, environmental conditions are likely to be limiting factors.
3. The capacity to further remove contaminants depends on the contaminant in question and the design of the existing wastewater treatment system. Where a large proportion of a contaminant (e.g. suspended solids and biochemical oxygen demand) is already removed there is less capacity for further removal. Conversely, where a small proportion of a contaminant is currently removed (e.g. total nitrogen and total phosphorus) there is more capacity for further removal. Further removal is also influenced by the nature of the wastewater streams and the characteristics of the site.
4. In general, the scenarios that were designed for further treatment of a specific contaminant were lower cost, and the scenarios that were designed for further treatment of several contaminants were higher cost. The higher cost scenarios usually involved sophisticated technology (mechanical and biological plants) that can bring with it increased risks of failure.
5. The 'discharge to land' scenarios assumed land treatment rather than just land disposal, and their performance was relatively effective for most contaminants. Key site conditions needed for treatment are sufficient depth to groundwater and suitable soil types. A preliminary review of the land within 4 kilometres of the towns indicated that these

conditions are unlikely to exist for most towns. In some cases, Southland's soil and climatic conditions are likely to mean that a discharge to water will need to be retained.

6. The treatment processes for reduction of phosphorus and *E. coli* on their own are relatively simple and were the lower cost scenarios modelled. Reduction of nitrogen is more difficult and the relevant scenarios cost considerably more. The treatment process to reduce nitrogen also reduces phosphorus, although not as effectively as the process that is specific to phosphorus reduction. The more advanced treatment processes modelled for Gore, Winton and Invercargill resulted in a higher degree of reduction of a number of contaminants but were at a much higher cost.

The variations in costs between similar scenarios for different towns were driven by the size and nature of the existing wastewater scheme. The context, particularly the environmental conditions (climate, soils and groundwater), was relevant to the performance of discharge to water and discharge to land scenarios. For discharges to water, water flows (volume) in the receiving environment are also relevant because they influence the effects of a discharge on the water body. The performance of some scenarios may vary at different times of the year (e.g. biological nutrient reduction and slow rate infiltration). Understand the water quality issues of the receiving water body for each scheme are important because different scenarios are relevant for different contaminants.

Many schemes in Southland are based around oxidation ponds and largely receive domestic and commercial wastestreams (the notable exceptions are Gore and Invercargill). If a wastewater National Environmental Standard means a shift to mechanical plants then more work is needed to understand issues like changes in carbon from increasing treatment, change in resilience to disturbances (e.g. earthquakes, drought, floods, sea and groundwater level rise), the impact of increasing sludge quantities on landfills, and the installation and use of power, especially for sites currently unpowered.

There are important limitations to the research that are documented in the Executive Summary of The Southland Economic Project: Urban and Industry Report (2018).

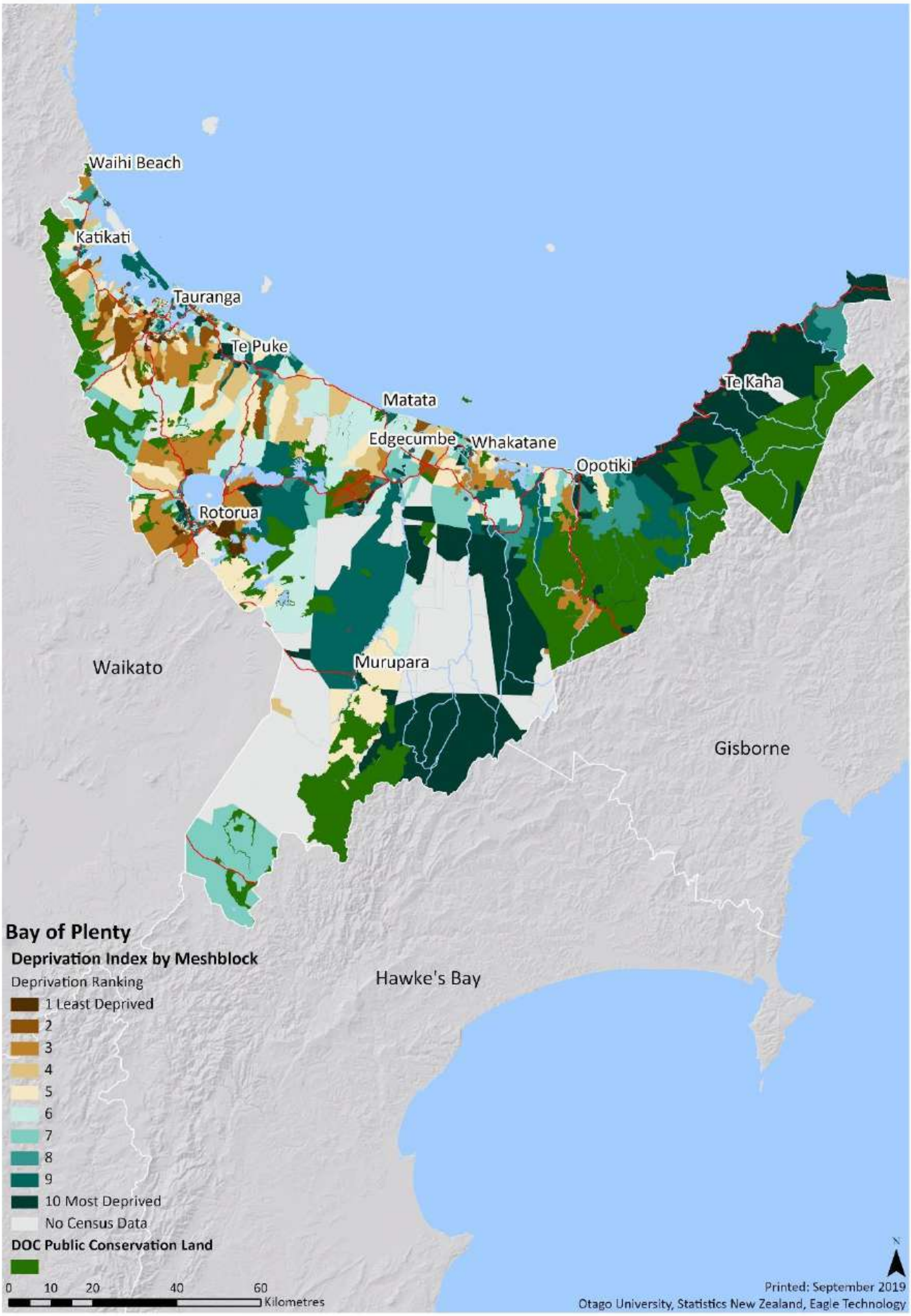
15. Regional Socioeconomic Deprivation Index Maps

It is clear that there are many factors at play when considering the impacts of policy, and the outcomes for communities will be highly variable. Change that is manageable for one community may be more challenging for another. A useful indication of the local 'receiving environment' is the Ministry of Health's Index of Deprivation, which estimates the relative socioeconomic deprivation of an area. This Index combines census data relating to income, home ownership, employment, qualifications, family structure, housing, access to transport and communications. Using this index it is possible to easily identify socioeconomic differences within and between regions.

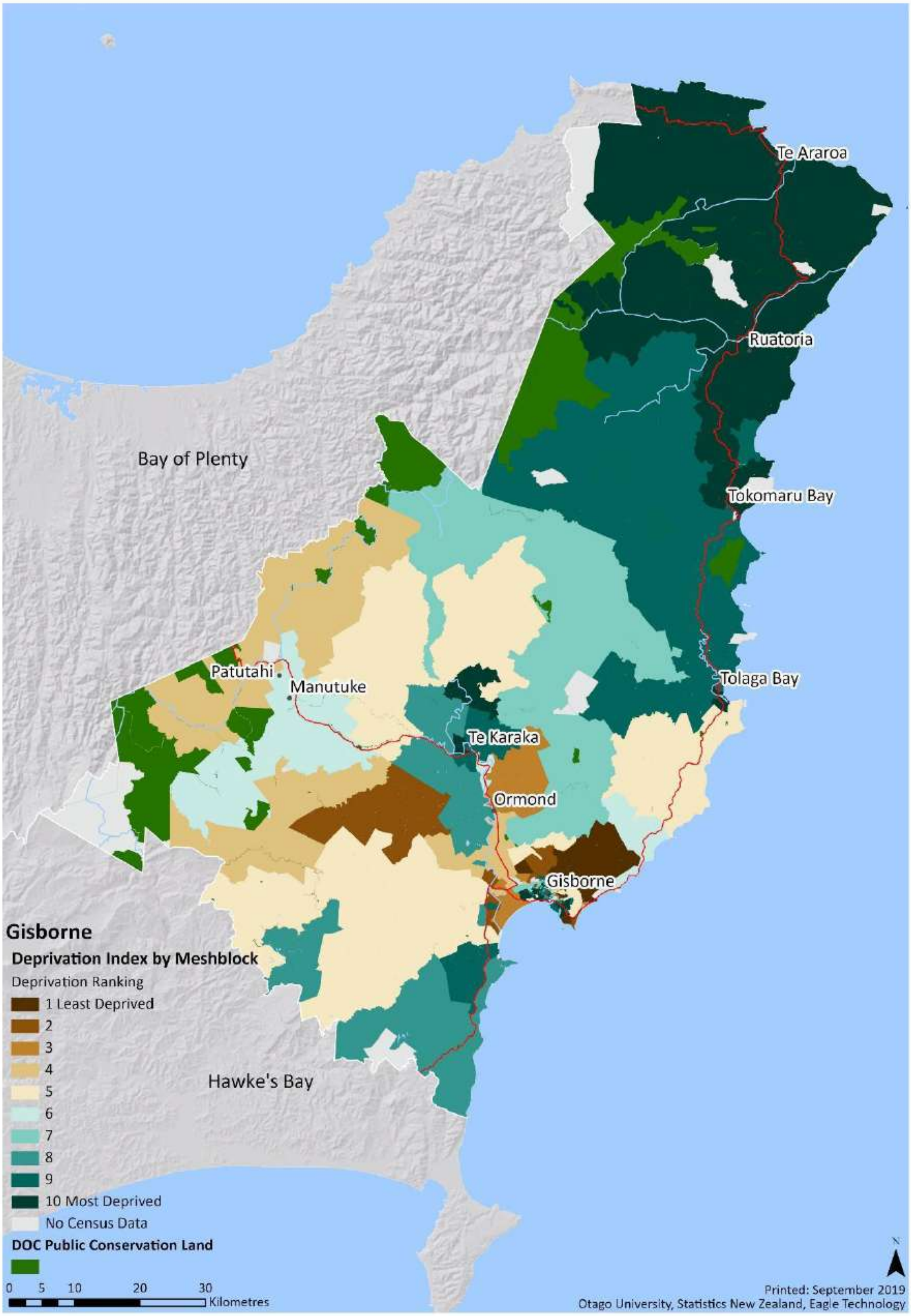
The six maps included here show the relative deprivation in 2013 by census mesh block (meshblocks are the smallest geographical area defined by Statistics New Zealand and have a population of around 60-110 people). The maps only shows census mesh blocks for developed land – with undeveloped land (e.g. conservation areas) shaded green. The exception is the West Coast, where 2 maps are included to illustrate with and without conservation land showing.

A further step in building a picture of national impacts may be to consider the relationship between a local community's relative social deprivation and its land use activities in the surrounding areas.

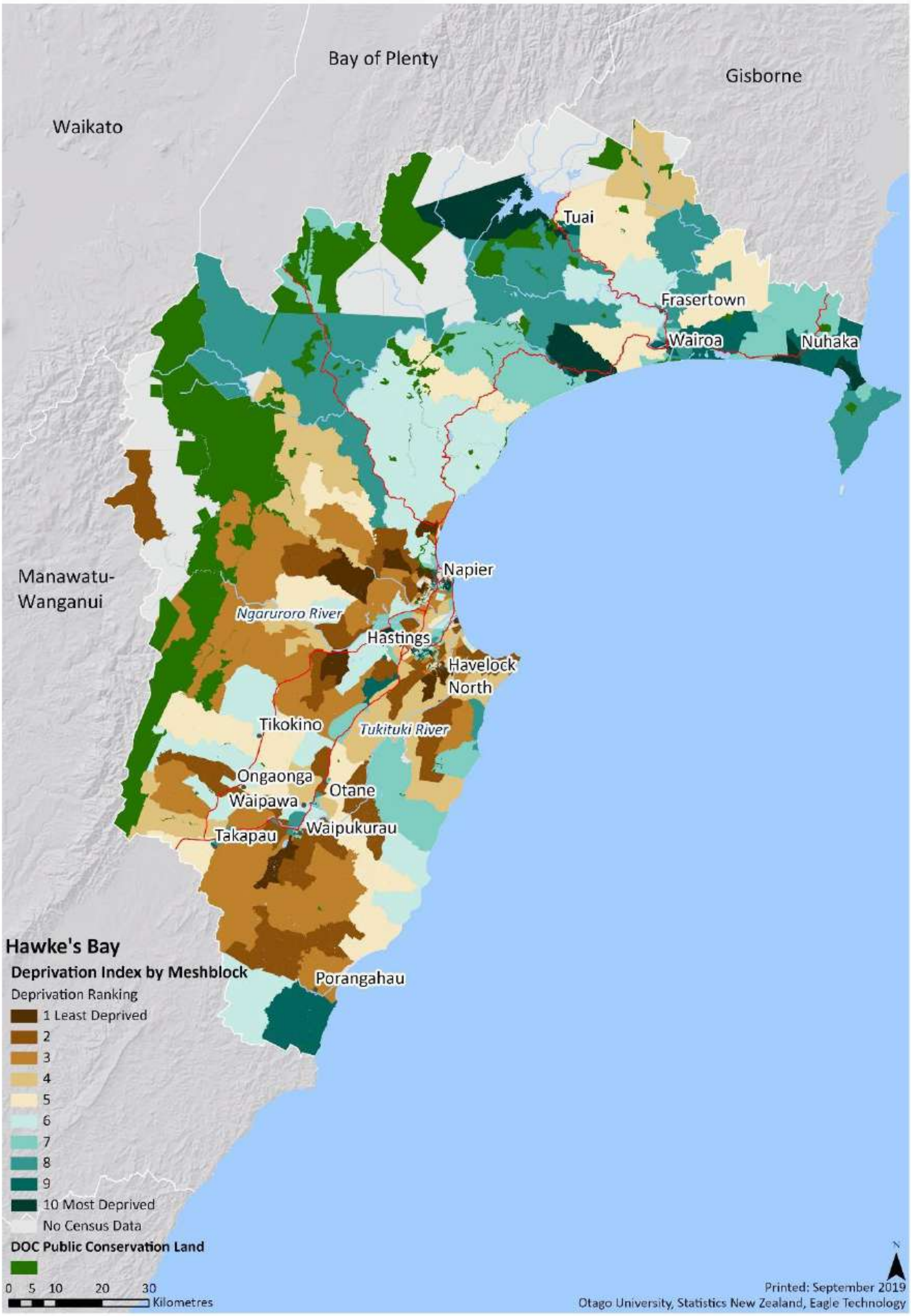
15.1 Bay of Plenty



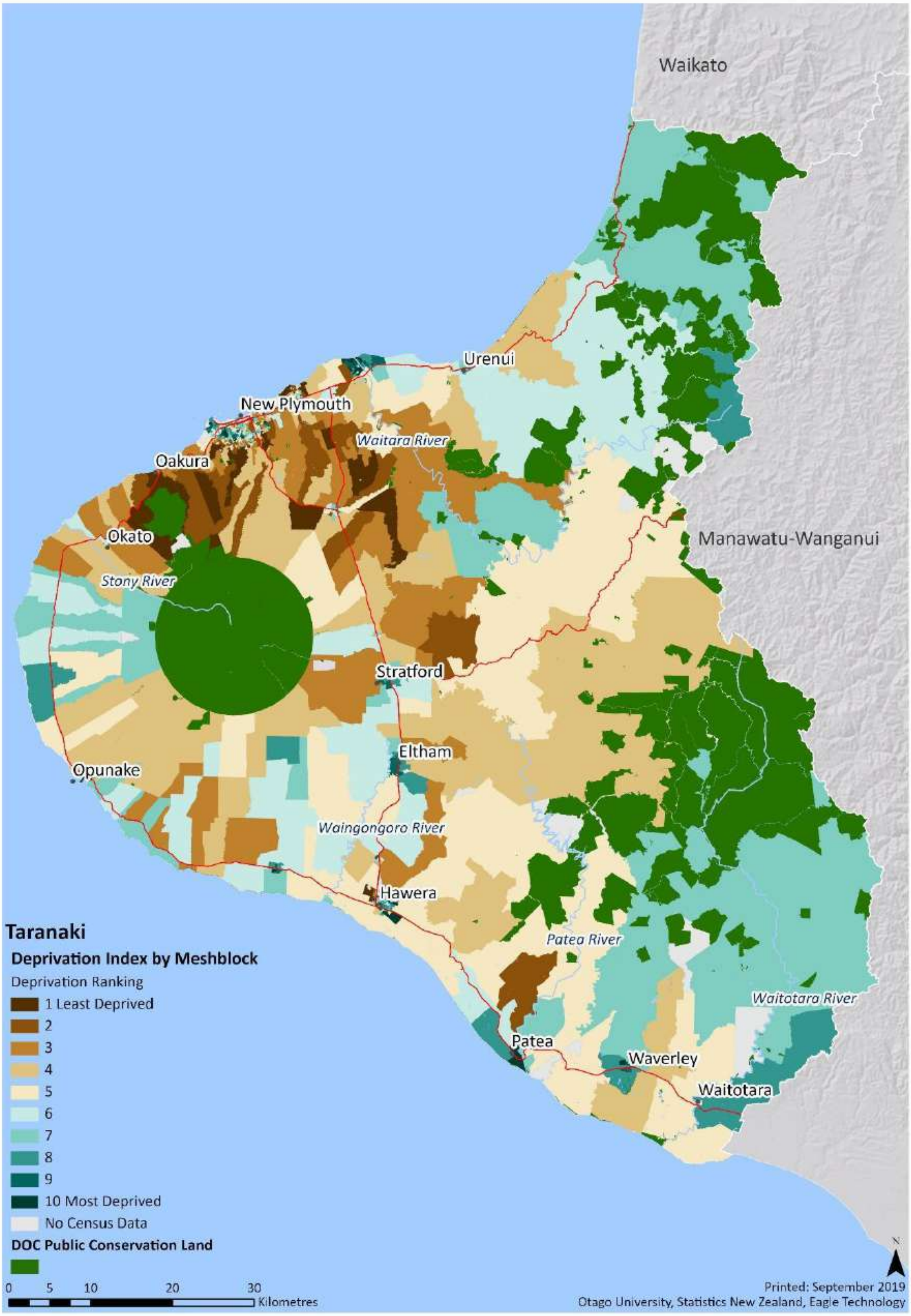
15.2 Gisborne



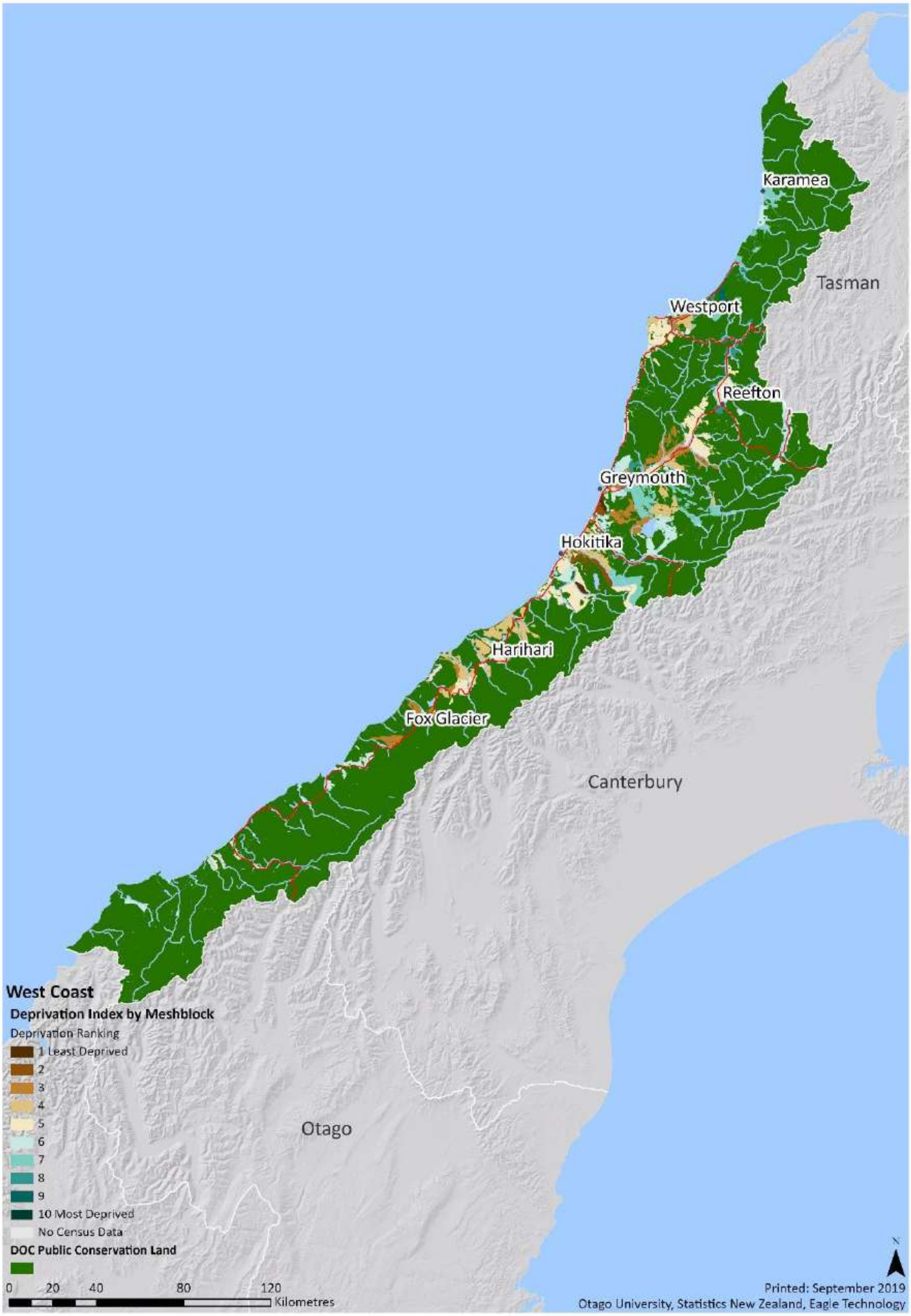
15.3 Hawke's Bay

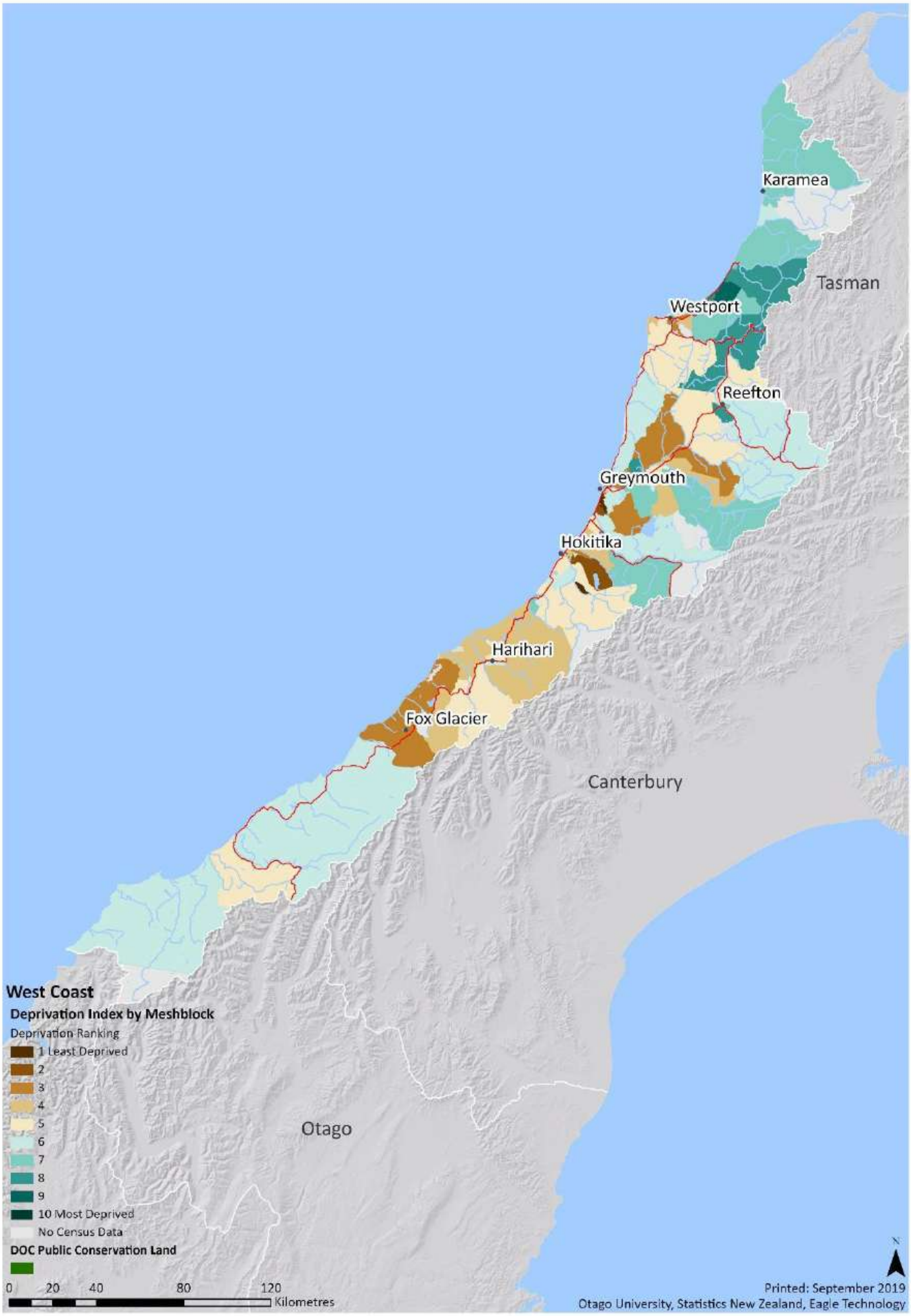


15.4 Taranaki

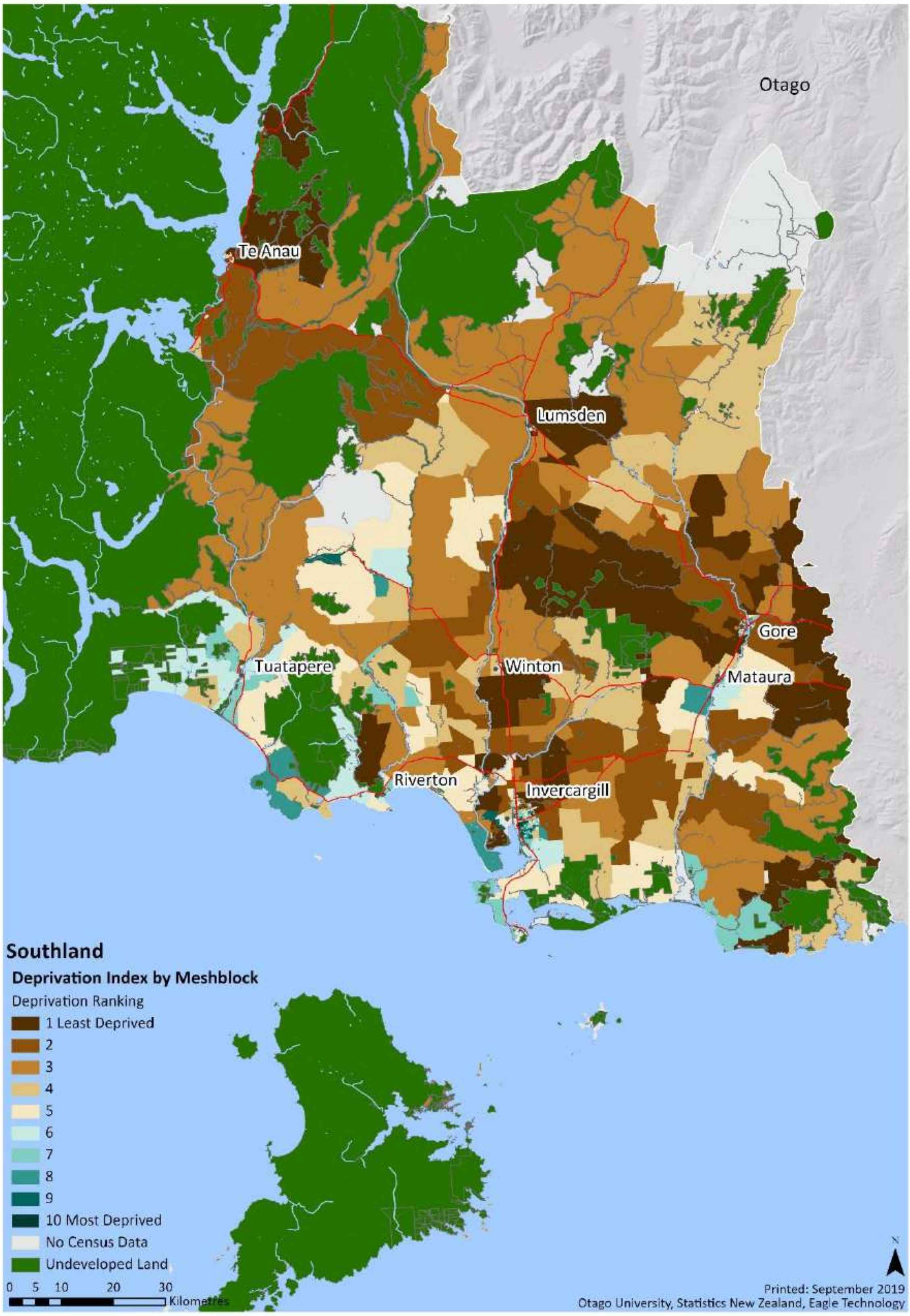


15.5 West Coast (with and without public conservation land showing)




Karamea
Tasman
Westport
Reefton
Greymouth
Hokitika
Harihari
Fox Glacier
Canterbury
Otago
West Coast
Deprivation Index by Meshblock
Deprivation Ranking
1 Least Deprived
2
3
4
5
6
7
8
9
10 Most Deprived
No Census Data
DOC Public Conservation Land
0 20 40 80 120
Kilometres
N
Printed: September 2019
Otago University, Statistics New Zealand, Eagle Technology

15.6 Southland



APPENDIX 2

Evaluation of the Essential Freshwater Package

Evaluation of the Essential Freshwater Package

Report to Local Government New Zealand

October 2019

Acronyms and Abbreviations

DIN	Dissolved Inorganic Nitrogen
DRP	Dissolved Reactive Phosphorus
Freshwater	Freshwater Package
Freshwater Package	Essential Freshwater Package
FW	Freshwater Package
FW-FP	Freshwater Farm Plan
ha	Hectares
Interim RIS	Interim Regulatory Impact Statement
LGNZ	Local Government New Zealand
MFE	Ministry for the Environment
MPI	Ministry for Primary Industries
NES	National Environmental Standards
NPS	National Policy Statement
NPS-FW	National Policy Statement for Freshwater
Package	Essential Freshwater Package
RMA	Resource Management Act 1991
RPS	Regional Policy Statement
Section 360	Resource Management Act, section 360
TAs	Territorial Authorities

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Executive Summary

The Government is proposing amendments to a range of legislative and regulatory instruments that regulate the use, taking, and activities that impact upon freshwater (Freshwater Package). There are 20 options discussed by MFE that form the Package in the *Action for Healthy Waterways* discussion document and Interim Regulatory Impact Statement (Interim RIS). These options describe the smaller set of specific, actionable interventions contained in a new National Policy Statement for Freshwater (NPS), a new National Environmental Standard (NES) and regulations under section 360 of the Resource Management Act (RMA).

The proposed Freshwater Package has a range of costs that impact upon land owners, other users, local communities, and those tasked with administering the Freshwater Package. There are also associated benefits to local communities, direct extractive and recreational users of freshwater, and also non-users. The impacts of the Freshwater Package will vary by region. Some regions have a higher number of waterways and large agricultural production sector (by GDP and number of farms). Other regions have a greater urban population and fewer farms and impacted waterways.

Local Government New Zealand (LGNZ) has engaged Castalia to evaluate the Interim RIS and conduct an economic evaluation of the costs and benefits of the Freshwater Package. LGNZ has also asked Castalia to assess the distribution of the impacts across the 16 Regional Councils[1]

We find the Interim RIS does not meet the required criteria

Our independent evaluation of the Interim RIS is contained in Appendix A. We find that the Interim RIS does not meet the criteria for a final RIS at this point in time. The Interim RIS is deficient on the following key points:

- Inadequately defines the problem in policy terms.
- The objectives are not defined with reference to impacted parties and the scale of improvement in freshwater needed.
- The options analysis details a good range of options with adequate information underpinning these. However, there are some technical errors and inadequate discussion of policy interdependency. The distributional impact of the proposed Package is inadequate.
- The implementation and monitoring aspects of the Interim RIS could be improved by addressing how monitoring could lead to future change to the regulatory interventions.

We find that the Freshwater Package imposes higher costs than is calculated in the Interim RIS

We were unable to replicate the size of impacts in the Interim RIS in our first principles analysis. We reviewed the specific interventions as set out in the draft National Policy Statement, National Environmental Standard and section 360 regulations. We find

[1] In this report the term "Regional Council" encompasses all 11 Regional Councils and also five Unitary Authorities. We exclude Chatham Islands.

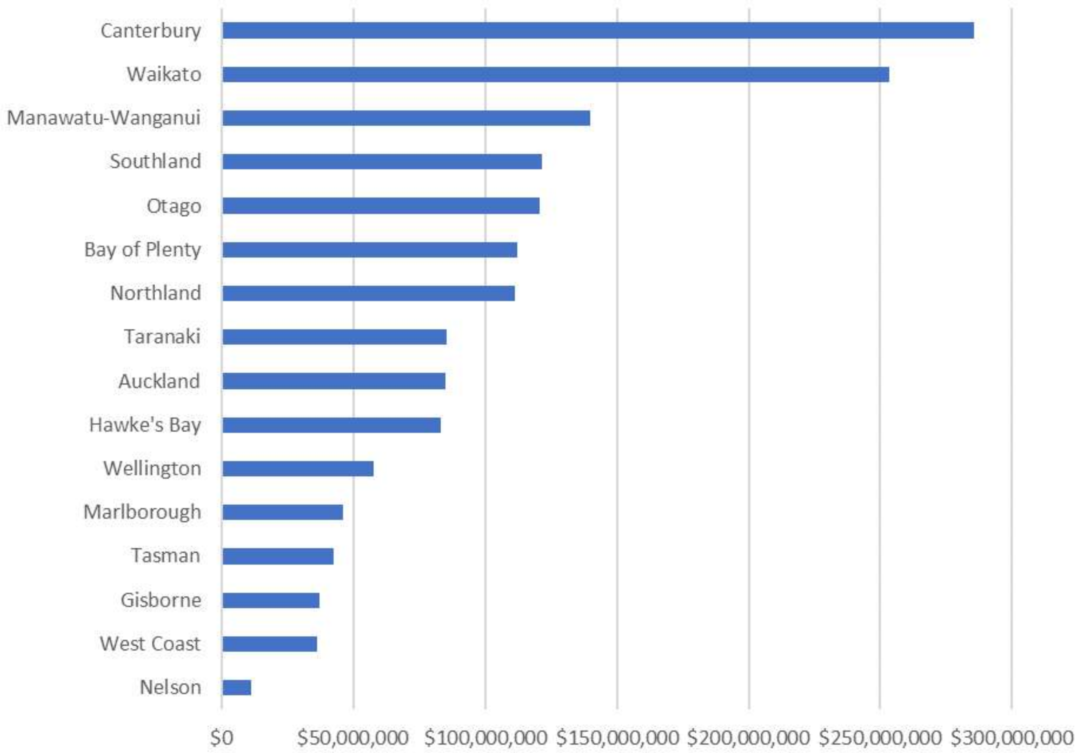
that some of the major cost estimates of these requirements are understated. The two largest cost impositions under our analysis were stock exclusion and the requirement for farm plans. The largest differences in costs are:

- Stock exclusion:
  - MFE estimate: $400 million
  - Castalia estimate: $775 million
- Farm plans:
  - MFE estimate: $138 million
  - Castalia estimate: $625 million

We find that the Interim RIS should more fully address the large regional variations in impacts

Our first principles analysis also identified major differences in impacts between the regions. We would normally expect these variations to be highlighted in an Interim RIS, particularly where significant impacts on parties are likely. The regional variation is to be expected to some extent due to regional variation in geography and economic activity, however, very significant distribution of costs and benefits occurs between regions. The Interim RIS discusses benefits at a national level and acknowledges most of the costs will be localised at a catchment by catchment level. We analysed the costs on a regional basis to illustrate the variation in Figure 1.1 below:

Figure 1.1: Regional distribution of total costs of quantifiable impacts



1 Introduction

This paper underpins the Castalia evaluation of the Interim RIS for the Freshwater Package. The evaluation is contained in Appendix A. In order to reach the conclusion in the evaluation, we analyse the impacts of the proposed regulatory changes in terms of the parties impacted, the nature of the impacts and the size of those impacts.

This paper is set out as follows:

- We define exactly what regulatory changes are proposed in the Essential Freshwater Package (Section 2).
- We identify which parties stand to be impacted by proposed regulatory changes and describe qualitatively the potential impacts both positive and negative (Section 3).
- Material costs and benefits are quantified using an appropriate range of techniques. The methodology and the sources are set out in Appendix D.
- We analyse how the quantified impacts will be distributed regionally where possible (Section 4).
- Finally, we provide sensitivity analysis of the two largest cost impacts, highlighting where key assumptions and variables can change the quantum (Section 5).

Our full analysis of the specific regulatory requirements imposed by the Package is set out in the Appendices in terms of our independent assessment of the Interim Regulatory Impact Statement from MFE (Appendix A), affected landowners (Appendix B) and Regional Councils (Appendix C).

2 Regulatory Changes in the Essential Freshwater Package

In this section we identify exactly what regulatory changes the Government is proposing compared to existing regulations for freshwater.

2.1 Existing Freshwater Regulatory Regime

The New Zealand regulatory regime for freshwater is contained in a range of statutory standards, and regulatory mechanisms devolved to Regional Councils for standard-setting, regulation, oversight and enforcement.

The Resource Management Act 1991 (RMA) defines the principle of sustainable management, and the relative priority of legislative and regulatory instruments. Under section 360 RMA, the Government can make regulations, including for:

- Freshwater discharge
- Requirements for water permit holders
- Coastal permits
- Measures relating to livestock exclusion.

The Government has regulated various freshwater matters under section 360 already including water take measurement and reporting requirements. There is an existing Freshwater National Policy Statement (NPS) which is an instrument under the RMA that provides national-level direction on how local authorities should carry out their responsibilities under the RMA for managing fresh water.

National environmental standards (NES) are regulations made under section 43 RMA. All current national environmental standards apply nationally, however, these can also apply to any specified part of the country. There are no current NES for freshwater.

Regional Councils define the resource management issues, and policies and methods to manage natural and physical resources including freshwater. Regional Councils pass Regional Policy Statements (RPSs) that local authorities must give effect to in regional and district plans.

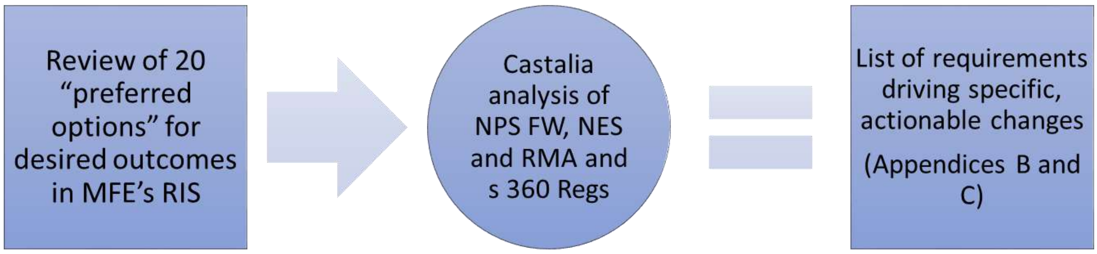
Regional Councils can also pass Regional Plans (optional, with the exception of coastal plans) that give effect to NPSs, national planning standards and Regional Policy Statements (RPSs). They must also not be inconsistent with water conservation orders. Regional plans can cover soil conservation, land uses that affect water quality and quantity, aquatic ecosystems, biodiversity, discharge of contaminants, taking, damming and diverting water, and allocation of natural resources.

Territorial authorities (city or district councils) must prepare a district plan for its district to achieve sustainable management. It must give effect to national policy statements and regional policy statements and must not be inconsistent with regional plans and any applicable water conservation orders. District plans cover issues related to the functions of territorial authorities, including the effects of land use and the control of impacts from activities on biodiversity, rivers, and lakes.

2.2 Proposed Regulatory Changes in the Essential Freshwater Package

The MFE Discussion Document and Interim RIS for the Package proposes a range of regulatory changes and describes these under 20 different headings. There are three regulatory instruments that will deliver the impacts: a NPS for Freshwater, a new NES, and a new section 360 RMA regulation. This section sets out the full list of proposals in MFE's Interim RIS for the Package, and then classifies these where specific requirements are imposed on parties (which generate impacts). Our process is explained in Figure 2.1:

Figure 2.1: Castalia's process to define proposed regulatory changes



Freshwater Package in Interim RIS contains a longlist of 20 different changes focussed on outcomes

The Package as described in the Interim RIS is organised under 20 headings reflecting desired outcomes. Under each heading, it discusses the requirements from regulation and other factors that will lead to the outcome. In Table 2.1Table 2.2 we describe the proposed regulatory changes.

Table 2.1: Proposed Regulatory Changes in Essential Freshwater Package

Change	Description and regulatory instrument
Recognising all components of ecosystem health	Suite of complementary options aimed at managing biophysical freshwater ecosystems holistically. Ensuring fish passage is provided for as a specific actionable requirement on Regional Councils. Regional councils must provide for fish passage in line with the NZ Fish Passage Advisory Group's guidelines. Structures constructed after the NES must provide for fish passage. Includes a range of regulations for culverts, weirs, passive flap gates, dams, fords, and non-passive flap gates. **NPS-FW and NES**
Preventing further loss of streams	Stream and river bed infill becomes a prohibited activity unless certain criteria are met relating to public use, restoration or infrastructure development. Any consent must include mitigation and reporting requirements. **NPS-FW**
Directing clearer ecological outcomes for river flows and water levels	The new NPS proposes mandating telemetry (direct electronic transmission) for all consumptive consented water take over 5 litres per second (these water takes already have to measure their water use but haven't had to report it automatically yet). **NPS-FW**

Nutrient attributes for managing ecosystem health	MFE wish to consult on new attribute tables for dissolved inorganic nitrogen (DIN) and dissolved reactive phosphorus (DRP). A bottom line is being considered, but has not been decided on. Farms in certain catchments (13 in total) must comply with additional nitrogen management requirement. **NPS-FW**
Reporting on the five components of ecosystem health	Regional councils are required to report against the five compulsory values (water quality, water quantity, habitat, aquatic life and ecological processes) annually. **NPS-FW**
Sediment	Proposed attribute mapping for suspended sediment (as measured by turbidity) that includes bottom lines and bands setting out a range of 'attribute states', with a system for classifying rivers, reflecting that the natural levels of sediment in rivers varies widely across New Zealand. However, no specific requirements on affected parties yet identified. **NPS-FW**
E. coli for Swimming	The new NPS requires councils to make waterways safe for swimming rather than just wading during the 'swimming season' (1 November to 31 March). This would impose a limit of 540 *E. Coli* per 100ml, similar to the A band in the current NPS. **NPS-FW**
Providing for Māori values and attributes of freshwater health	Stronger requirements on regional councils to incorporate Māori values and attributes into regional freshwater planning. These options are: ▪ Creating a 'mahinga kai' compulsory value for the National Objectives Framework, equivalent to ecosystem health and human health for recreation, ▪ Creating a new value category for 'tangata whenua' values in the National Objectives Framework. **NPS-FW**
Te Mana o te Wai in the Freshwater NPS	Reframing Te Mana o te Wai in the current Freshwater NPS by clarifying current provisions, further embedding the concept, and requiring an approach that prioritises the essential value, health, and wellbeing of freshwater bodies. **NPS-FW**
Providing for Hydro-electricity Generation Infrastructure	Regional Council may exempt renewable hydro schemes from the Package of freshwater regulation. Does not result in any specific impact relative to the status quo. **NPS-FW**
Maintaining or improving water quality	Requiring Regional Councils to include specific, measurable and time-bound freshwater objectives; clearer definition of freshwater quality; additional reporting requirements which Regional Councils must define. **NPS-FW**
Direction to Territorial Authorities (TAs) to Support Integrated Management	TAs must manage the effects of land use for urban development on fresh water in their district plans. This change makes it more likely that TAs will ensure freshwater objectives are met in urban areas. **NPS-FW**
Wetlands	Greater obligations for wetland monitoring including physical characteristics and regular and incidental reporting to Regional Councils

	Vegetation destruction on or near wetlands will generally become a non-complying activity (prohibited) and a discretionary activity requiring consent where certain criteria are met relating to public use, restoration or infrastructure development. Earth disturbance of wetlands becomes a discretionary activity when within 10m of a wetland subject to a range of conditions, similar to those for vegetation destruction. Controls on water takes from wetlands are increased. **NPS-FW and NES**
Freshwater modules in farm plans	Certain farms will be required to have a certified freshwater farm plan. These include commercial vegetable production farms and farms in specified catchments. The farm plans involve geographical mapping and reporting, certification and audit. **NES**
Reducing excessively high nitrogen leaching (nitrogen cap)	Farms in catchments where nitrate-nitrogen levels are in the highest 10 per cent of monitoring sites and regional rules implementing the NPS-FM are not in place (13 catchments in total) must comply with additional nitrogen management requirements. Under this proposal, every flat or gently rolling (low-slope) pastoral farm in the identified catchments would be required to provide an audited Overseer nitrogen loss figure to their regional council. Based on the results of the Overseer profiles, the regional council will require the most polluting farms to develop and implement a plan to reduce nitrogen losses. There is no certainty about where the threshold for highest polluting farms would be set, though a range between the 70th and 90th percentile is discussed. **NES** (Part 3, Subpart 4). MfE's *Action for Healthy Waterways* discussion document contains two additional options proposed to this "Option 1" contained in the draft NES: ▪ <u>Option 2:</u> This proposal envisages caps or thresholds for total nitrogen applied in fertiliser per hectare per year, based on research findings and good management practice. The caps would be applied nationally, with a higher threshold set for higher nitrogen-demanding crops and land uses. There are, however, no proposed caps at present. ▪ <u>Option 3</u>: This option proposes requiring farmers in catchments with high nitrate-nitrogen levels to complete Farm Plans with a freshwater module. Farmers would then be required to show, in the freshwater module in their farm plan, how they will rapidly reduce nutrient leaching. Independent auditors would monitor their progress against the plan and the regional council could take enforcement action if required. Under option three, four additional catchments would be added to the 13 catchments envisaged Option 1.
Stock Holding Areas and Feed Lots	Feedlots, holding stock in stockholding areas, sacrifice paddocks, intensive winter grazing, all have stricter requirements on their

	use. This section applies only to farms > 20 ha and horticultural farms > 5 ha. **NES**
Intensive Winter Grazing on Forage Crops	In freshwater management units where the current NPS has not yet been fully implemented, restrictions will be imposed upon intensive winter grazing and irrigated production. **NES**
Agricultural intensification	In freshwater management units where the current NPS has not yet been fully implemented, restrictions will be imposed upon high-risk land use changes (dairy farm conversions or forestry to pastoral farming) and commercial vegetable production. **NES**
Updating RMA (Measurement and Reporting of Water Takes) Regs	Mandatory daily electronic transmission of data for all water take consents captured by the current Regulations (ie, consented water takes over 5 litres per second). **Update to the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010**
Stock exclusion	The Government also proposes regulations to exclude stock from waterways more than one metre wide (except on steep land with low stocking rates). A 5-metre setback will be required and implementation timeframes depend on the type of stock. **New Section 360 regulation**

Our analysis of the regulatory instruments focusses on specific requirements for affected parties and Regional Councils

Impact evaluation requires analysis of actual specific, actionable requirements contained in the regulatory instruments themselves. The Freshwater Package, as described in the Interim RIS, is organised by subject area and desired outcome. However, not all of these changes drive actual impacts that can be determined at this point.

The specific, actionable requirements for change arising from the Package are contained in three regulatory instruments (NPS FW, NES or section 360 regulations). We have analysed these instruments in terms of the actions required by affected parties. Our full analysis is contained in Appendix B for impacts on affected parties and in Appendix C for impacts specifically on Regional Councils.

Some of the regulatory proposals in the RIS do not (yet) have specific, actionable requirements. There are three reasons why we have focussed on a sub-set of the 20 topics listed in the Interim RIS:

- The changes require standards for outcomes to be included in the overarching regulatory framework which guide other specific changes, and may lead to later regulatory change. For example, the RMA amendment to “recognise all components of ecosystem health” will not immediately create impacts other than specifically listed changes to fish passage. The changes themselves will only impose some very minor administrative impacts
- The changes do not yet include specific, actionable, requirements on affected parties. For example, the sediment changes have not yet landed on a specific, actionable rule change

- The regulatory change does not result in any impacts to parties, and appears to preserve the status quo. For example, the exemption for hydro schemes does not result in any specific impact relative to the status quo.

In Table 2.2 we list the requirements. This sub-set of specific, actionable requirements is what we analyse for impacts in the remainder of this report.

Table 2.2: Specific, actionable requirements from the Package

NPS FW	NES	Section 360/RMA reg
Requirements on affected parties and Regional Councils		
New standards for E Coli	Wetland monitoring obligations	Water quantity requirements
Allowing for fish passage	Clauses for nationally significant infrastructure	Stock exclusion regulations (fencing)
	Wetland restrictions: ▪ Vegetation destruction ▪ Wetland earth disturbance ▪ Wetland water takes	
	Stream and river bed infilling	
	Fish passage	
	Farming practices restrictions: ▪ Livestock control (feedlots, holding stock, sacrifice paddocks, intensive winter grazing) ▪ Intensification (winter grazing, irrigated production, high-risk land use changes)	
	Farm plans preparation, certification, audit: ▪ Within two years to specified farms ▪ By 2025 to all farms	
	Additional Nitrogen management in Schedule 1 catchments	
Additional requirements on Regional Councils only (not already mentioned above)		
New overarching framework clarifying how Te Mana o te Wai affects management plans		

Integrated management requirement		
Additional compulsory attributes for measurement by RCs		

3 Impacts of the Regulatory Changes

This Section identifies the complete set of impacted parties, and qualitatively describes the expected impacts, both positive and negative.

3.1 Parties impacted by costs and benefits of regulatory changes

The parties impacted by the costs and benefits of the regulatory changes have been partially identified in the Interim RIS. However, our detailed analysis of the specific, actionable requirements in the regulatory instruments themselves has brought out a refined set of impacted parties.

Impacts are categorised in terms of direct impact on users or non-users (who derive non-use costs or benefits) and the administrative impact.

Table 3.1: Impacted Parties and Classification of Impacts

Impacted parties	Classification
	Costs
Extractive users of freshwater (mainly agricultural farmers)	▪ Extractive use both as a source of irrigation water, stock drinking water. ▪ Extractive use as a sink for waste, run-off or discharge ▪ Additional costs of compliance with the requirement ▪ Lost/foregone income from reduced extractive use ▪ Lost/foregone income from reduced production on land taken out of production (for example, riparian strips) ▪ Direct costs of compliance (cost of water meters, new fencing, preparing farm plans and so on)
Industrial users	▪ Foregone income from extractive use ▪ Direct costs of compliance (cost of water meters and so on)
Regional Councils	▪ Administrative costs of implementation, monitoring and enforcement ▪ Costs of ongoing policy management
Central Government	▪ Administrative costs of implementation ▪ Costs of ongoing policy management
Territorial Authorities	▪ Administrative costs of implementation, and ongoing policy management
	Benefits
Extractive users of freshwater (mainly agricultural farmers)	▪ Improved water quality for: – Local drinking water supply – Farmers' own use on-farm – Reduced risk of illness from poor quality water
Industrial users	▪ Improved water quality for industrial use (for example, bottling for drinking water) ▪ Protection of hydropower generation capacity ▪ Protection of commercial freshwater species

Recreational users	▪ Non-extractive use and some minor extractive use for recreation, such as: – Fishing – Swimming – Boating
Iwi and Māori	▪ Value in the Mauri of the waterway, reflected in principles such as Te Mana o te Wai. ▪ Mahinga kai
Local communities	▪ Regulating ecosystem services benefits include the moderation of river and streamflow (both reduction in peak flows and increases in low flows), the filtration of runoff, and the sequestration of carbon ▪ Cultural ecosystem services benefits for local communities such as waterways that are safe for swimming, recreational benefits for freshwater anglers and benefits from traditional practices of mahinga kai ▪ Supporting ecosystem services benefits include the provision of suitable habitat for indigenous and valued exotic flora and fauna ▪ Conservation of soil productivity ▪ Protection of potentially valuable biological resources ▪ Health benefits from reduced pathogens and incidence of disease
Non-users	▪ Existence value of cultural ecosystem services benefits ▪ Option value from environmental quality improvements ▪ Bequest value of environmental quality improvements ▪ National benefits arising from maintenance of the identity and brand value based on high-quality natural environments

3.2 Categories of Impacts of Regulatory Change

In this section we describe each type of cost and benefit that will result from regulatory change. Some of the regulatory changes can be grouped together in terms of the impact (cost or benefit) that results.

We then describe, qualitatively, the potential scale of each impact (Negligible, low, moderate, high). Figure 3.1 describes the materiality assessment framework.

Figure 3.1: Materiality assessment guide

Assessment	Description
Negligible	The proposed change would require very little change to land activity, or administration by those implementing the change or affected by it, or would affect only a small number of people/organisations with limited flow-on effects
Low	The proposed change would impose a small impact or compliance burden on those implementing the change or affected by it, or only affect a small number of people/organisations
Moderate	The proposed change would impose a moderate impact on those implementing the change or affected by it, or affect a moderate number of people/organisations
High	The proposed change would have a significant impact on those implementing the change or affected by it, or the change would affect many people/organisations

The following table contains our assessment of the specific requirements from the Package that drive impacts (costs and benefits). We describe the costs and benefits and then assign a materiality score to the impact.

Table 3.2: Overview Table of Costs and Benefits

Regulatory Change	Who is impacted	Materiality
Package in its entirety	Category benefits apply to the extent the individual requirements improve the water quality, and rate of flow (**category benefits**): ▪ Benefits to extractive users of improved water quality and flow ▪ Benefits to recreational users of water from improved quality and absence of pathogens ▪ Benefits to local catchment community of ecosystem services provided by waterway ▪ Benefits to non-users in local catchment community, and elsewhere in New Zealand in the existence of improved freshwater	High
Administrative implementation of Te Mana o Te Wai	▪ Costs to Iwi and Regional Councils in terms of increased consultation time and resources ▪ Benefits to Iwi and wider public from improved user/beneficiary engagement in water quality	Moderate
Stock exclusion	▪ Costs for land owners of installing and maintaining fencing and culverts/bridges ▪ Costs of lost productivity from fenced land	High
Water quantity requirement	▪ Costs for land owners of installing meters and ongoing operation and maintenance ▪ Benefits to extractive and recreational users of water from improved flows	High

Wetland monitoring	▪ Cost for land owners to monitor and report ▪ Costs for Regional Councils to administer the monitoring regime	Moderate
Wetlands restrictions	▪ Cost for land owners in foregone production on current wetland area	Moderate
Fish passage	▪ Cost to Regional Councils for preparing strategies and plans and capital cost of fish passage bridges. Cost of periodic revision to those strategies/plans ▪ Benefits to non-users (existence of indigenous fish species; option value)	Low
Nationally significant infrastructure in wetlands	▪ Project specific costs on project beneficiaries (public, regional funders) due to increased costs from wetland remediation and mitigation ▪ Project specific benefits to non-users (existence of improved wetland)	Low
River bed infilling	▪ Costs of foregone production from inability to fill rivers, or higher cost of river crossing construction and maintenance	Low
Farming practice: Land use restrictions	▪ Cost to land owners from foregone production from using feedlots, holding stock, sacrifice paddocks and winter grazing	Moderate
Farming practice: Intensification restrictions	▪ Cost to land owners from foregone production from converting sheep and beef or forestry land to dairy farming, more intensive irrigation, converting to vegetable production	Moderate
Freshwater farm plans	▪ Cost to initially prepare, update, monitor and audit individual farm freshwater plans	High
Additional Nitrogen management	▪ Costs for land owners in specific Schedule 1 catchments	Moderate (High on a regional basis)
Category: Regional Council implementation	▪ Regional Councils will have administrative costs to implement the Package which cannot be linked directly to a specific regulatory requirement. These will be a one-off fixed cost to acquire capability, then recurring	Moderate
Category: Central Government implementation	▪ Central Government (MFE) will have one-off administrative costs to implement the Package and ongoing policy oversight administrative costs	Low

4 The Size of Impacts of Regulatory Change

This section quantifies the material impacts of the regulatory interventions from the Package. We first assess the national impacts of the regulatory changes in section 4.1. Then we analyse the regional distribution of the impacts from the regulatory changes in section 4.2. We use a range of analytical techniques appropriate for each cost and benefit, as the nature of impacts is diverse.

Our methodology is necessarily indicative, as an in-depth study of each impact would be required to provide definitive quantitative analysis. We will seek to identify the driver for each impact, for example, the length of unfenced waterways in a region requiring remediation measures. This provides the basis for our sensitivity analysis in section 5.

4.1 National impacts of regulatory changes

We assess the size of those impacts classified as “high” and “moderate” with estimates. Some impacts are more difficult to quantify due to localised conditions or highly variable circumstances. We are able to quantify an estimate of some the impacts of the regulatory changes with more precision. Some costs and benefits are more readily measurable than others.

Some category impacts (mostly benefits) cannot be attributed to specific requirements

Some impacts from changes to farming practice cannot be attributed to a specific intervention. Some benefits in particular are difficult to estimate with confidence. Benefits from improved environmental outcomes are particularly difficult to quantify for a number of reasons.

There are a range of benefits that will accrue to a range of parties (users, non-users) and local communities which cannot be attributed to specific requirements. In this case, the reasons are mainly:

- MFE has not attempted to quantify the benefits of improved freshwater quality from the perspective of users, non-users or Māori (this is necessarily not possible under the Te Mana o te Wai framework)
- Ecosystem services derived from improvements to freshwater quality, water flows and wetland health are generally not traded goods so complex methods are needed to estimate benefits
- Recreational use values are hard to estimate, and require sophisticated methods such as travel cost method. There is only limited such survey information available in New Zealand. Some LGNZ case studies highlight recreational use benefits from improved freshwater outcomes
- Non-use values are also not traded. These are hard to value. Non-use values include existence value (the value to an urban-dweller of clean rivers in a region of New Zealand they may never visit) and option value (the value of the future option of using freshwater).

Some impacts cannot be quantified with accuracy

The costs of some restrictions on certain farming practices are difficult to estimate due to regional variability. The distribution of costs of restrictions on farming practices such as using feedlots, holding stock, sacrifice paddocks and winter grazing depend on the intensity of dairy and cattle farming.

Costs are generally more easily measurable for natural resource impacts. More accurate cost estimates are possible where cost impositions relate to traded goods (for example, length of fencing required or time spent monitoring) or where studies have quantified non-traded goods (for example, ecosystem services from wetlands).

Benefits are often non-traded and widely dispersed among the community as wellbeing improvements (rather than on specific individuals). We refer to the LGNZ case studies for specific benefits where these are relevant. We note one severe limitation on assessing the size of benefits of the Package: The Interim RIS appears to deliberately avoid measuring specific benefits of the changes.

Table 4.1 sets out the high-level impacts. The full explanation of the methodology and sources for data and information are contained in Appendix D. We then highlight the which regulatory requirements drive the most cost for the Package.

Table 4.1: Overview Table of Quantitative Analysis of Regulatory Change Impacts

Intervention	Party impacted and category	National NPV cost	National NPV benefit
Package in its entirety	These category benefits apply to the extent the individual requirements improve the water quality, and rate of flow (**category benefits**): ▪ Benefits to extractive users of improved water quality and flow ▪ Benefits to recreational users of water from improved quality and absence of pathogens ▪ Benefits to local catchment community of ecosystem services provided by waterway ▪ Benefits to non-users in local catchment community, and elsewhere in New Zealand in the existence of improved freshwater		Significant but unknown
Administrative implementation of Te Mana o te Wai	Regional Councils: ▪ Administrative cost of consultation during each planning cycle and adjust the costs depending on population of Māori and number of Iwi in a region Iwi: ▪ Compliance: Time cost of consulting with Regional Councils	$5 million	Unknown

Stock exclusion	Land owners: ▪ Costs for land owners of installing and maintaining fencing and culverts/bridges ▪ Costs of lost productivity from fenced land	>$775 million[2]	Mahinga Kai (Gisborne)—Riparian planting will improve the native fishery, and the connection between owner and the whenua, and their awa by enabling the practice of gathering whitebait from a traditional mahinga kai site in the future. Mahinga Kai also qualifies as a non-traded direct-use benefit.
Freshwater farm plans	Land owners (users): ▪ Compliance cost of preparing farm plan (where one does not already exist) ▪ Compliance cost of ongoing updating and audit	$625 million	Unknown
Water quantity requirement	Land owners (users): ▪ Sum of capital costs of telemeters plus opex for data transmission Regional Councils: ▪ Ongoing administrative costs of data collection	$159 million	Unknown

[2] These figures are only for low-slope land as there was no reliable data for length of streams and rivers that would require fencing on higher slope land that requires fencind due to intensity of farming.

Wetlands restrictions	Land owners (users): ▪ Opportunity cost from agricultural production based on halting current rate of wetland loss (cumulative disbenefit for 30 years)	$54 million	Unknown
Land use conversions/ intensification	Land owners (users): ▪ Opportunity cost of reduced agricultural production based on historical rate of intensification projected out for period (30 years) and the net difference in EBIT per ha of sheep and beef and dairy	$29 million	Unknown
Wetland monitoring	Regional Councils: ▪ Administrative costs: Mapping costs once per 10 years, annual mapping costs, annual council monitoring costs	$17 million	Unknown
Fish passage	Regional Councils: ▪ Administrative cost of Regional Council plans and strategies incurred each planning cycle	$6 million	Unknown
Nationally significant infrastructure in wetlands	Infrastructure owners/developers ▪ Compliance cost of amending designs, increased construction costs. Very difficult to quantify given the uncertainty of nationally significant infrastructure projects, the location, and the impact on wetlands	Unknown	Unknown, likely to be counted as category benefits

Stream/river bed infilling	Land owners: ▪ Opportunity cost of production on in-filled streams and rivers. Very difficult to quantify given unknown number of rivers that could be infilled, location, topography and so on	Unknown	Unknown, likely to be counted as category benefits
Farming practice: Intensification restrictions	Land owners: ▪ Opportunity cost of lost production from restriction on changing land use to higher earning farm policy	Unknown-relative ranking of impact on regions available	In regions with high proportion of agricultural land and higher intensity (stock unit per ha) in beef cattle production and dairy production the impacts will be greater. These regions are Bay of Plenty, Taranaki, Waikato, Hawke's Bay and Northland. In regions with a lower intensity of beef cattle and dairy production, the impacts will be relatively less.

Additional Nitrogen management	Land owners in specific Schedule 1 catchments identified. ▪ There are five in Southland; two in Waikato; and one each in Hawke's Bay, Bay of Plenty, Northland, Taranaki, Tasman and Wellington. Difficult to estimate costs on those individual catchments due to variability.	MfE's Interim RIS suggests that the cost of additional nitrogen management in these catchments is likely to be low because the policy focusses on encouraging best practice nitrogen management rather than land use change. Improvements in nitrogen management generally have minimal impacts on farm profitability, and in some cases even improve profitability[3]. However, case studies provided by LGNZ, suggest that there may be significant costs for farmers.[4]	Waikato: ▪ DIN and DRP reduction lead to non-market benefits of $18.9-$28.3 ▪ Water quality between Taupo and Karapiro is estimated to generate benefits of $32.1 to $42 million. Taranaki: ▪ Waingongoro River is thought to improve leading to unquantified recreational use benefits West Coast: ▪ Unquantified benefits from improved swimmability in catchments that have a high percentage of intensive agriculture.

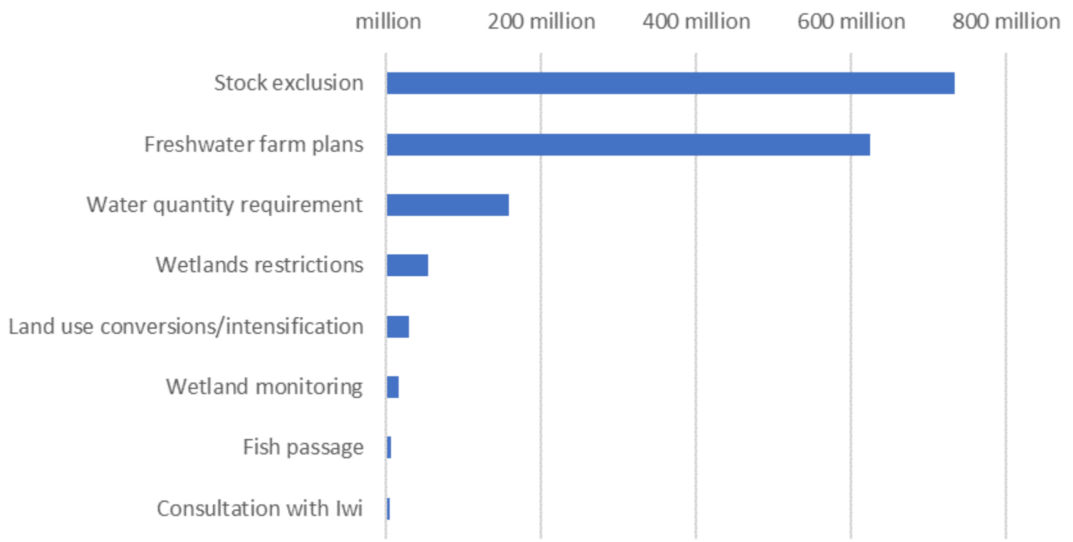
[3] See, for example, Beukes,P.C., Edwards, P. and Coltman, T. (2017). Modelling options to increase milk production while reducing N leaching for an irrigated dairy farm in Canterbury. Journal of New Zealand Grasslands. (79) 139-146.

[4] For example, the Taranaki regional council reports that "The calculated cost of [meeting N-Cap restrictions in the high N catchment of Waingongoro River] is $55,000 per year per farm (worst 10%), or $53,000 per year per farm (worst 30%). These figures have been previously provided to the Council when reviewing options for interventions towards developing the next generation Land and Freshwater Plan. On a catchment scale, these costs represent respectively about $825,000 and $2.4 million annually. Over the 10 year life of a Plan, these costs are $8.2 million and $24 million, respectively. Southland tested six scenarios for N-Cap restrictions (with thresholds of 70, 80, and 90 percent and adoption rates of 10 and 20 percent) and reports that by 2027, in the most extreme scenario (70% threshold with a 20% adaptation pace), the annual loss in value added for Southland's economy may be approximately $37 million ($2017) with a 4% loss in value added for the region's dairy industry.

The major quantifiable cost drivers of the Freshwater Package are the farm plans and stock exclusion requirements

The requirement to implement freshwater farm plans, the stock exclusion requirements and water quantity measurement requirements are the major cost drivers of the Package. Figure 4.1 illustrates the magnitude of national quantifiable costs.

Figure 4.1: Scale of specific costs for Freshwater Package



4.2 Regional distribution of the impacts of regulatory change

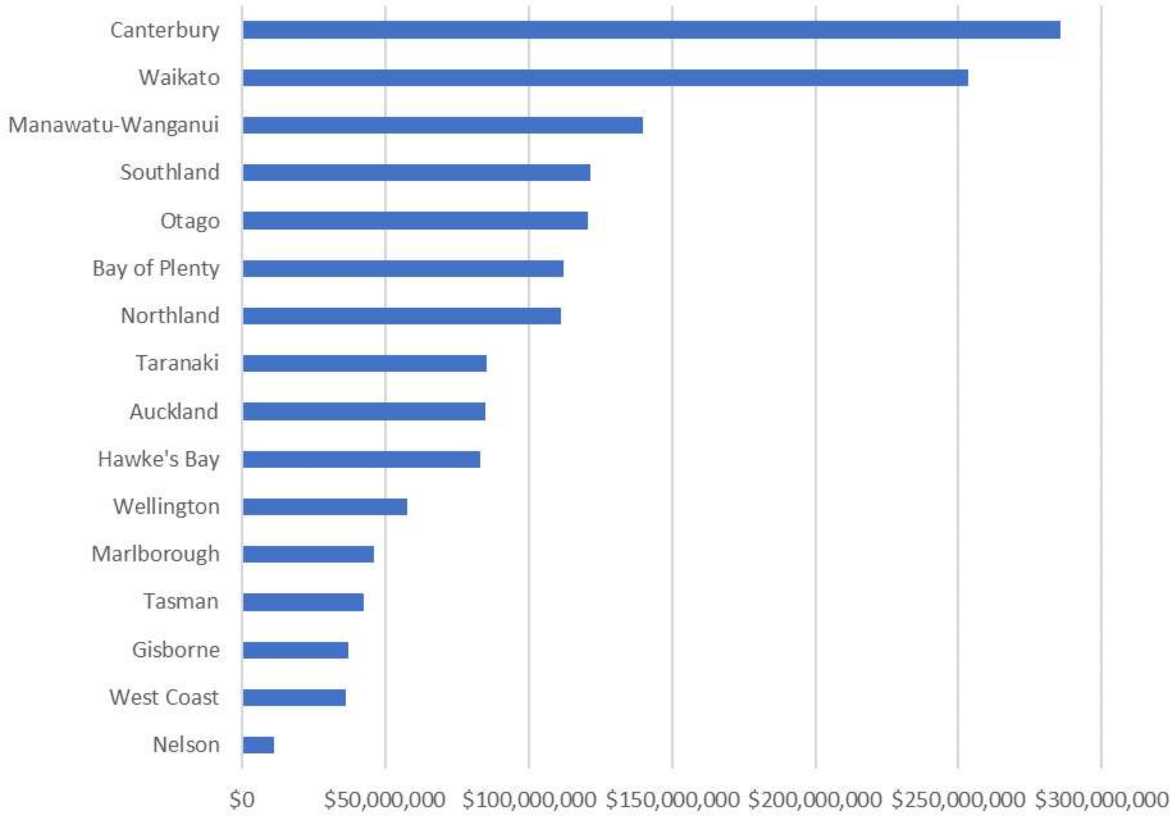
This section assesses the distribution of impacts across the regions. We use regional scalars to identify where these cost drivers are low, medium or high by cost, benefit and region, where possible. The distributional analysis uses regional scalars to assess the impact of the Package by region.

Highest total cost of quantifiable interventions are incurred in Canterbury and Waikato

Some of the cost impositions of the Package can be more accurately estimated. Our analysis of these costs is based on a bottom-up, per-region assessment. For each cost estimate, we use regionally-specific data. This allows us to assess the magnitude of costs by region.

The highest quantifiable costs are incurred in the large agricultural regions of Canterbury and Waikato. Higher costs are also incurred in Manawatu-Wanganui, Otago, Bay of Plenty, Northland and Southland.

Figure 4.2: Regional distribution of total costs of quantifiable impacts

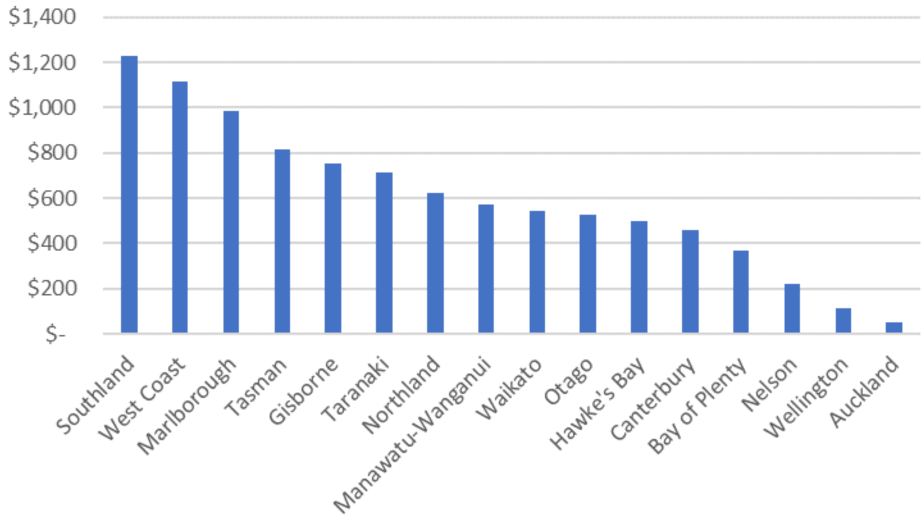


Costs of quantifiable interventions are highest on a per-resident basis in Southland, Marlborough, West Coast, Tasman and Gisborne

The distribution of costs of the Package is higher on a per resident in some regions. This does not mean that residents actually bear higher costs, rather, it indicates the impact that the Package has on the regional economy. The imposition of costs on a regional resident basis is informative when considering offsetting benefits and where these are enjoyed.

Southland, Marlborough, West Coast, Tasman and Gisborne incur the highest costs on a per regional resident basis for those costs which can be quantified. Auckland, Wellington, Nelson, Bay of Plenty and Canterbury incur the lowest per regional resident costs. The average quantifiable cost per New Zealand resident is $445 or 0.73 percent of GDP.

Figure 4.3: Per resident costs of quantifiable interventions



Māori land will be disproportionately impacted by restrictions on intensification

The regional distribution analysis does not address the impact of the two new restrictions on intensification on Māori land. Māori land is widely regarded as under-developed and less-intensively used as other land. This is due to historical reasons, cultural reasons and diverse ownership and title complexities that change some of the incentives of ownership. The LGNZ case study from Tairāwhiti is discussed in the next Box.

Box 4.1: Tairāwhiti case study—Gisborne region and Māori land

Tairāwhiti is an interesting case study to consider the impact of restrictions on both farming practices and land-use intensification. The Freshwater Package could risk imposing disproportionately higher costs on Māori landowners (and Māori in the local economy). This is because of the high proportion of Māori customary land and Māori freehold land. The restrictions on land use and intensification could disproportionately impact Māori given the historical differences in land use intensity compared to other non-Māori farm land in New Zealand.

Māori land issues

There are around 1.4 million hectares (ha) of Māori freehold land[1] in New Zealand, plus a very small area of Māori customary land[1]. Over 2 million ownership interests exist in around 26,490 Māori freehold land titles. Most Māori freehold land is concentrated in Waiariki (Bay of Plenty), Tairāwhiti (East Coast), Aotea (Manawatu/Wanganui/Taranaki) and Takitimu (Northland). There is immense potential in some of this land to be highly productive, but landowners experience significant challenges to land development.

Historical circumstances around Māori land ownership and development mean iwi and hapū have not had priority access to fresh water resources.

Challenges for Whenua Māori

Development of Māori land faces additional challenges compared to land held in general title, including:

- multiple ownership: many Māori freehold land rating units often have 100 or more owners or beneficiaries, though larger parcels of land are commonly held by incorporations;
- a lack of formal structures: approximately 50% of Māori land parcels do not have any formal structure;
- absentee owners: a significant bulk of landowners are often listed as deceased or are uncontactable; and
- poorer quality, isolated and inaccessible land: a disproportionate amount Māori freehold land is of poor quality, isolated, landlocked and remote, restricting its development potential.

Māori customary land is held in diverse ownership structures and in multiple small parcels. However, a relatively small number of management entities control significant amounts of land—40 large incorporations account for around one fifth of all Māori land by area, and 100 large ahu whenua[3] trusts account for about 30% of all Māori land between them.

The bulk of Tairāwhiti Māori freehold land (around 46%) is concentrated in the northern / East Cape area. This also happens to be one of the largest areas of social deprivation and crosses two freshwater catchments – the Waiapu and Northern catchments. The Waiapu is one of the most at-risk catchments due to extensive, intergenerational erosion issues.

Regional benefits include ecosystem services from avoided wetland loss—impacting Canterbury, Southland and Waikato

There is some evidence of the likely benefits from reduced wetland loss. This is measured in terms of the value of ecosystem services provided. Inland wetlands are estimated to provide ecosystem services valued at $48,640 per ha per year for inland wetlands and $368,220 per ha per year for coastal wetlands.

We estimate that these benefits will be disproportionately enjoyed in Canterbury, Southland and Waikato.

Table 4.2: Estimated benefits from prevention of loss of wetlands by region

Region	Estimated benefits
Auckland	$374,008
Bay of Plenty	$346,396
Canterbury	$9,989,151
Gisborne	$356,077
Hawke's Bay	$169,277
Manawatu-Wanganui	$418,591
Marlborough	$806,229
Nelson	$-
Northland	$648,154
Otago	$1,999,761
Southland	$8,484,354
Taranaki	$183,621
Tasman	$905,591
Waikato	$8,360,132
Wellington	$292,050
West Coast	$5,596,683

Source: MfE Interim RIS

Recreational benefits in LGNZ Case Studies (Non-Traded Direct Use Benefits)

The LGNZ case studies identify a range of benefits from the regulatory change to recreational users of freshwater. The benefits are generally difficult to quantify, but relative orders of magnitude are apparent.

The table below shows several examples of recreational benefits from improved freshwater quality identified by Regional Councils in their case studies:

Table 4.3: Benefits from regulatory change to recreational users

Region	Qualitative assessment of recreational use benefits
Waikato	Nitrogen and phosphorus reductions have been associated with recreational use benefits in Waikato. A 30 percent reduction in median nitrogen and phosphorus across the entire catchment, and given the assumed improvement in ecosystem health, is assumed to generate non-market benefits from $18.9 to $28.3 million per year. Benefits of preventing the decline in water quality between Taupo and Karapiro is estimated to generate benefits of $32.1 to $42 million.

Taranaki	The Waingongoro River is said to be highly valued for its aesthetic, scenic and recreational values—supporting an important trout fishery and of regional significance for contact recreation.
West Coast	Increased exclusion of stock from waterways and wider riparian margins will reduce this contamination and improve swimmability in catchments that have a high percentage of intensive agriculture.

Source: LGNZ

Commercial benefits identified in the LGNZ case studies (traded non-use benefits)

- **Tourism Benefits (West Coast)—**The West Coast Region is well endowed with scenic and historic attractions and has significant land and water-based recreation assets. Tourism has more recently become increasingly important to the local economy. In 2018 tourism GDP was just below that of agriculture and employed 21% of the West Coast population. This was over twice the number of jobs provided by agriculture, with job growth increasing at 5.6% per annum from 2015-2018. Tourism is likely to soon be the most significant local industry and will benefit from stock exclusion. Stream fencing will only improve tourist's impressions of the West Coast, but by how much is hard to determine.
- **Maintaining A Premium Brand for New Zealand Produce (West Coast)—** Higher water quality standards will help New Zealand maintain its sustainable image. A sustainable image is more important when aiming for certain market niches and premium product status - options that might be desirable for the local dairy company.

Cultural Benefits Identified in the LGNZ Case Studies (Non-Traded-Non Use Benefits)

- **Mahinga Kai (Gisborne)—**Riparian planting will improve the native fishery, and the connection between owner and the whenua, and their awa by enabling the practice of gathering whitebait from a traditional mahinga kai site in the future. Mahinga Kai also qualifies and a non-traded direct-use benefit.
- **Cultural Benefits (Taranaki)**—The Waingongoro River holds special value for Ngāruahine and Ngāti Ruanui iwi, and at the mouth of the River is Ōhawe (one of New Zealand's earliest settled places). Therefore, improving the quality of the water to protect its Mauri of this sacred water body.

Health Benefits Identified in the LGNZ Case Studies

- **Human Health Benefits (Gore, Southland)**—Southland notes that it is important to consider the benefits that may occur as a consequence of the nitrogen reductions (e.g. reduced human health costs).

5 Sensitivity Analysis

We conducted a sensitivity analysis for the two highest-cost components of the proposed Essential Freshwater package:

- **Stock Exclusion**—our sensitivity analysis found costs ranging between NZ$775 million and NZ$1.5 billion depending on assumptions on the cost and length of fencing and the amount of grazing land forfeited
- **Farm Plans**—our sensitivity analysis found fixed costs ranging between NZ$92-184 million depending on the assumptions on the number of farms requiring farm plans and assumptions on the cost of conducting farm plans and annual auditing and compliance costs ranging between NZ$43-55 million.

Our sensitivity analysis shows that the considerable policy uncertainty around key proposals of the Essential Freshwater package can dramatically alter the costs of implementing it. Therefore, cost estimates included in the Interim RIS should be viewed with scepticism.

5.1 Stock Exclusion Sensitivity Analysis

The Interim RIS estimates a total cost of NZ$600 million for its proposed stock exclusion regulation for the cost of stock exclusion on both low-slope land and on high-intensity high slope land. However, we could not replicate these findings and instead found **a range of costs between NZ$775 million and NZ$1.5 billion** for the cost of stock exclusion on low slope land alone. Our range depends on the impact of three key variables. We considered the impact of:

- **Cost of Fencing—**we consider a range of region-specific fencing costs for cattle exclusion only or cattle and sheep exclusion
- **Length of Fencing—**we considered whether only currently unfenced areas would need to be fenced or if existing fences would need to be replaced to meet the 5m setback requirement
- **Land Lost due to setback**—we consider a scenario where the 5m setback applies only to newly fenced streams and rivers and a scenario where the 5m setback applies to all rivers and streams greater than 1m wide.

We chose to test these variables because we believe that they are the most uncertain and likely to have the largest impact on the cost of stock exclusion. Our sensitivity analysis addresses this uncertainty, by considering the different possible scenarios implied by what has been written about stock exclusion. Table 5.1 describes the key variables tested.

Table 5.1: Key Variables Tested in The Sensitivity Analysis

Model Variable	Reason
Cost of Fencing	The Interim RIS assumes NZ$5 per meter for fencing. However, this cost of fencing is only appropriate for excluding cattle. Meanwhile the *Action for Healthy Waterways* discussion document speaks only of stock exclusion and does not clarify whether the proposed regulation would

	aim to exclude only cattle or all stock. Therefore, we consider one scenario where cost of fencing per meter is equivalent to the cost of fencing appropriate to exclude cattle and another scenario where we consider the cost of fencing appropriate to exclude cattle and sheep. Under the second scenario, we based the proportion of fencing for each type of livestock on the proportion of livestock that each type of stock represents in a given region. We did not consider the cost of deer fencing as deer form a small percentage of total livestock in New Zealand; however, it is worth noting that deer fencing is considerably more expensive than sheep fencing and would increase overall costs.
Length of Fencing	The Interim RIS assumes that farmers will only have to fence currently unfenced sections of rivers and streams wider than 1m on low slope land. However, the Interim RIS also notes that the "the majority of existing fencing may, however, need to be relocated over time to provide the required five metre setback." This would incur considerable additional costs. Therefore, we consider a scenario wherein only unfenced sections of rivers and streams wider than 1m are fenced and a second scenario that requires fencing or refencing the entire length of rivers and streams wider than 1m.
Land Lost due to Setback	The Interim RIS assumes a quantity of lost grazing land resulting from the 5m setback requirement equivalent to a 5m setback for new fencing along currently unfenced rivers and streams. However, as previously mentioned, the stock exclusion regulation may require moving existing fences back to meet the 5m setback requirement for all fencing. This would dramatically increase the quantity of grazing land lost. As a result, we consider a scenario that accounts for grazing land that would be lost along currently fenced rivers and streams.

The results of the sensitivity analysis are shown in Table 5.2. For each variable, we present a range of impacts, because the variables are interrelated. For example, if you assume higher cost sheep fencing *and* a longer amount of fencing as you refence existing fences to meet the 5m setback requirement, then the cost will be higher than only assuming a higher cost of fencing for currently unfenced rivers and streams.

Table 5.2: Sensitivity Analysis Across Key Variables

	Sensitivity Range	Impact on Overall Cost
Cost of Fencing	NZD4.15-14.75 per meter[5]	Between NZ$ 155-422 million
Length of Fencing	16,884km-49,016km[6]	Between NZ$315-583 million

[5] "Ministry for Primary Industries Stock Exclusion Costs Report." MPIE, 2017 Accessed at: https://www.mpi.govt.nz/dmsdocument/16537/direct

[6] Length of Rivers and Streams provided by MfE (assumes both sides need to be fenced) and percentages of rivers and streams already fenced sourced from: Neverman, A. et al (2019). Impact testing of a proposed sediment attribute: identifying erosion and sediment control mitigations to meet proposed sediment attribute bottom lines and the costs and benefits of those mitigations

Land Lost due to Setback	13,507ha-39,202[7]	Between NZ$37 and 137 million

The largest cost variation is seen by comparing the cost of fencing presently unfenced areas of rivers and streams and the cost of fencing presently unfenced areas of rivers and streams and refencing existing fenced areas to meet the 5m setback requirement. The impact on overall cost is between NZ$315-583 million. These figures represent the additional cost attributable directly to increasing fence length.

Similarly, a large cost variation, between NZ$155-422 is seen with cost of fencing, but this is to be expected considering that the average cost of fencing for cattle is around NZ$5.40 and the average cost of fencing to exclude sheep is NZ$12.4. As a result, when we considered a scenario where that included a proportion of higher cost sheep fencing equivalent to the percentage of sheep in a given region, costs were markedly increased.

Finally, the cost of forgone grazing land due to the 5m setback requirement ranges from NZ$37-NZ$million depending on if you require the setback only for newly fenced areas or along all rivers and streams.

Table 5.3: Matrix of Total Costs for Different Sensitivity Scenarios

	Cattle Fencing Only NZD (Millions)	**Cattle and Sheep Fencing NZD (Millions)**
Unfenced Streams and Rivers Only; 5m Setback only applies to new fencing	$775 million	$930 million
Fencing unfenced areas and refencing existing fenced areas; 5m setback applies to all fenced areas	$1,161 million	$1,584 million

The table above shows the interplay between our variables in four different scenarios. In the table above land forgone due to setback and the length of fencing are considered together because it would not be possible to create the 5m setback along already fenced areas without moving existing fencing and refencing the stretches of river and stream that are currently fenced. Similarly, and refencing would be setback to 5m as required under the stock exclusion policy.

5.2 Farm Plan Sensitivity Anlaysis

The Interim RIS estimates a fixed cost of NZ$100 million for its proposed FW-FP regulation. The Interim RIS also estimates annual costs of NZ$38 million based on an estimated cost of NZ$1,500 per audit on a biannual basis. Further, the Interim RIS does not attempt to quantify audit costs for farmers or compliance costs for local governments.

[7] Calculated based on the length of river to be fenced or refenced multiplied by 4 (the first meter of the setback is assumed to have no value.

We found **a range of fixed costs between NZ$92 million and NZ$184 million and annual compliance costs between NZ$43 and NZ$55 million**. Our range depends on the impact of two key variables. We considered the impact of:

- **Percentage of farmers requiring a FW-FP—**we consider a range of assumptions from 50 percent (the Interim RIS estimate) to 100 percent
- **Cost of Council Compliance—**we assume the compliance cost for local government as a percentage of the cost of an audit.

We chose to test these variables because we believe that they are the most uncertain and likely to have the largest impact on the cost of the costs of implement the FW-FP regulation. Table 5.1 describes the key variables tested.

Table 5.4: Key Variables Tested in The Sensitivity Analysis

Model Variable	Reason
Percentage of farmers requiring a FW-FP	The Interim RIS assumes that only 28,000 farms—approximately 50 per cent of New Zealand's 52,785 farms—would require a farm plan; we do not find any justification for this assumption. The Interim RIS mentions that some individual farms, regional councils, and agricultural associations are implementing farm planning; however, it is not clear what percentage of farms that would represent. Furthermore, it is not clear if these existing farm plans would comply with the requirements for FW-FP laid out in the proposed NPS. Therefore, we consider a range of percentages of farms required to create a FW-FP between 50% and 100% (assuming that existing farm plans are not compliant).
Cost of Council Compliance	The Interim RIS does not attempt to quantify the cost of compliance for councils. However, as the Interim RIS notes "Costs to regional councils to administer the FW-FP regime will be significant." For our analysis we considered that compliance costs would form a percentage of the cost of a farm plan audit (assumed to be NZ$1500 per audit.)

The results of the sensitivity analysis are shown in Table 5.2. For both variables, we present a range of impacts. For the cost of council compliance, the cost of audits is fixed at NZ$39.5 million. This is based on the assumption that 100 percent of farms will have farm plans that must be audited, regardless of whether the farm plans were put into effect as a result of this regulation or were previously implemented as a result of individual farmer initiative, agricultural accord, or regional council requirement.

Table 5.5: Sensitivity Analysis Across Key Variables

	Sensitivity Range	Impact on Overall Cost
Percentage of farmers requiring a FW-FP	50%-100%	Between NZ$92-184 million
Cost of Council Compliance	5-20% of audit	Between NZ$4-15.8 million

The largest cost variation results from considering the percentage of farmers that will be required to implement an FW-FP, that would not have otherwise implemented a plan. This has the potential to increase the fixed costs of farm plans by NZ$92 million.

Considering the Cost of Council Compliance can add between NZ$4-NZ$15.8 million to the annual costs of the FW-FP requirement (in addition to the NZ$39.5 million paid annually by farmers for audits). This brings the total annual cost of the FW-FP to between NZ$43 and NZ$55 million. Over time, this recurring cost adds significantly to the cost of implementing the FW-FP regulation.

Appendix A: Evaluation of the Regulatory Impact Statement

Castalia RIS Evaluation Matrix				
QA Criteria	**Status Quo & Problem**	**Objectives**	**Options Analysis**	**Implementation & Monitoring**
Overall	**What is our overall assessment?** **Does not meet criteria (interim assessment)** This is only an interim RIS, which will be used for the limited purposes of informing decision on policies to consult on, and to support consultation. Therefore, our assessment might change when the final RIS is prepared. Our overall assessment is based on the following conclusions: Problem definition: This interim RIS inadequately defines the problem in policy terms (focussing on symptoms). Objectives: The objectives are not defined with reference to impacted parties or the scale of improvement desired with reference to impacted parties. Options analysis: A good range of options with apparently good level of information underpinning these. The interim RIS generally uses appropriate analytical approaches to choose options, depending on the complexity and level of existing knowledge about a particular issue. There are some errors and isolated failures to correctly calculate impacts (some figures could not be replicated with reasonable assumptions). The discussion of policy interdependency is inadequate. The options analysis inadequately deals with regional distribution of costs and benefits. A more in-depth analysis of the available options, with clearer definition of objectives would enable more informed decision-making. Implementation and monitoring: The interim RIS does a good job of detailed description of implementation issues and ongoing monitoring. The final RIS will need to improve on explaining how monitoring could change the Package in future and identifying the risks of inadequate implementation by Regional Councils. The interim RIS does not identify beneficiaries among the various communities of interest, nor does it quantify the benefits with reference to those communities. This makes trade-offs between options difficult for decision-makers. This includes an understanding of variable regional impacts that needs more development for the future RIS.			
Complete	**The standard** **The problem is identified and explained** Key features of the current situation are described (including any existing legislation, regulations, and relevant features of the market).	**The standard** **The objectives describe the desired outcome** Relevant policy objectives are identified in addition to the purpose of the RIS. Any constraints are stated, such as time or budget.	**The standard** **All possible options identified and described** The full range of practical options (regulatory and non-regulatory) that may wholly or partly achieve the objectives are identified. Within any regulatory options, the full (viable) range of regulatory	**The standard** **An implementation path is identified and explained?** How the preferred option(s) will be given effect is described, including timing, communication, transitional arrangements, and any enforcement strategies.

	Relevant decisions that have already been made are explained. The problem is identified, and the costs and benefits under the status quo are described (i.e. the outcomes expected without intervention).		responses are identified, including the range of settings that could be adopted	Plans for monitoring and evaluating the preferred option are outlined, including performance indicators and how the necessary data will be collected.
	Our assessment: **Does not meet criteria** *Problem definition lacking* The problem has not been adequately identified. The problem is described as "existing freshwater management framework is not achieving the sustainable management of freshwater resources". This is only a partial description of the policy problem. It is a description of the symptoms. The problem is not defined from the perspective of any affected parties (or society as a whole). The current freshwater outcomes are described as simply "degraded". The RIS gets close to defining the problem as inefficient regulatory enforcement, when it describes problems with interpretation and implementation of the existing regulations, and that the current standards are not set to provide for a (not described) level of ecosystem health.	**Our assessment:** **Partially meets criteria** *Objectives identified* The objectives repeat clearly the Government's objectives statement. At a high level these are: Stopping further degradation and loss, Reversing past damage. Some of the objectives describe the desired outcome in terms of: Access to safe drinking water Improving habitat of freshwater fish Safe swimming environment and safe for fishing and food gathering Restore Mauri The objectives statements do not identify why the objectives are important in terms of benefits to parties or communities of interest. The importance of the objectives is treated as self-evident.	**Our assessment:** **Meets criteria** There are regulatory proposals listed under 20 headings. Each heading discusses multiple options including regulatory and non-regulatory options considered. In general, the RIS does a good job of identifying the full range of practical options within the current regulatory architecture and available scientific research.	**Our assessment:** **Meets criteria** The RIS identifies the specific legislative and regulatory instruments, and the timing, needed to implement the Package. Monitoring is already provided for in the existing Environmental Reporting Act 2015. A regulatory evaluation is already planned for the already in-force Freshwater NPS. The timeframe for that evaluation will be moved in order to review the effectiveness of the Package.

	The costs and benefits of the status quo are not described in terms of the impacts on parties without the intervention. Rather, the status quo is described as just leading to continued poor freshwater health without reference to impacted parties. *Key features of the current situation* The RIS does a fair job of describing the current situation, including existing legislation, regulations and relevant features of the freshwater system (but not the market for freshwater use and non-use) *Relevant decisions that have already been made* A comprehensive history of freshwater regulation is provided in section 2.2, and an exempted option (RMA reform) listed.	*Constraints* The RIS acknowledges that freshwater allocation (quality and quantity) is not considered. Nitrogen discharge will be considered separately. Taxes on inputs are also out of scope.		
Convincing	**The standard** **The problem needs to be addressed** The scope of the problem and its impacts is described. The root cause of the problem (not just the symptoms) is identified. The scale of the problem is demonstrated using empirical or anecdotal evidence.	**The standard** **The objectives will identify the best option** Any potential trade-offs between the objectives is identified. The Government's desired outcomes are explained in the context of the problem, while ensuring specificity does not unduly limit the range of options.	**The standard** **The best option has been selected** The options are evaluated against the objectives, ensuring the analysis is commensurate with the size and complexity of the problem, the magnitude of the impacts, and risks. Costs and benefits are identified under preferred option(s) for stakeholders. Options are compared against consistent criteria.	**The standard** **The implementation path is realistic** Any implementation risks are identified, and how these risks will be mitigated is described. How the proposal would interact with, or impact on, existing regulation is described—including scope to reduce or remove any existing regulations.

				How the monitoring and evaluation process will identify if any additional changes are needed is explained.
	Partially meets criteria *Scope of problem and its real-world impacts are well described in terms of symptoms* The RIS does a good job of describing the symptoms of the regulatory inefficiency in management of freshwater resources. It cites and provide key evidence and extracts from the *Environment Aotearoa 2019* report from MFE which describes the state and health of freshwater resources, and the contributing factors. It accurately describes the interrelating legislative and regulatory frameworks, and rule-setting and enforcement system. However, the RIS does not identify the root cause of the problem. Where it gets close to describing the costs of the status quo (not acting), it only briefly mentions higher costs of remediation. The RIS repeats that poor environmental outcomes will continue under the status quo without relating this back to affected parties. For example, a potential problem is that freshwaterways have significant pubic good elements. The externalities associated with	**Partially meets criteria** *Trade-offs between objectives not identified* There are twenty individual regulatory proposals, each with up to seven options considered. There is a general issue across all regulatory proposals and options to inadequately discuss the trade-offs between objectives. The objectives are all directed at improving water quality/health, and are not conceived from the perspective of affected communities of interest. We would expect to see trade-offs described in terms of: Agricultural revenue and trade balance Social welfare in the agricultural sector (increased financial burdens contributing to foreclosures, increasing the need for social support, and potentially contributing to mental health issues in the agricultural sector). Undercutting national and local regional growth strategies.	**Partially meets criteria** *Evaluation is incomplete due to gaps in objective setting* This is an interim RIS. The recommended options are selected based on acknowledged partial analysis. However, the RIS cannot be convincing in terms of option selection if it does not specify the beneficiary communities of interest/parties and the amount of benefits that would result. The complex options analysis could have done more to identify the clear interdependencies between policies. *Regional distribution is a key issue that is inadequately dealt with* There will be large regional variations in impacts from the options on the costs side, and benefits may not always offset in the regions bearing costs. The Interim RIS does not adequately discuss how costs and benefits are distributed. *Some issues in the technical analysis identified*	**Partially meets criteria** *Implementation risks* Much of the Package will be implemented under existing regional council planning mechanisms. Other aspects will require significant regional council investment and staffing. These issues are not adequately discussed in terms of risks. *Impact on existing regulation* The impact on existing regulation and mechanisms is clearly explained. The Package fits within the current processes and timeframes. *Additional changes resulting from monitoring and evaluation* There is inadequate discussion of how the monitoring and evaluation could result in any change to the Package.

	private use have not been fully dealt with from a regulatory (or other) standpoint to ensure that resources are used optimally. This problem could have many symptoms including decline in water system health, crowding out of other valuable uses, including option values, etc.	Undermining major source of funding for local government in agricultural regions.	There are isolated issues of inaccuracy or incomplete analysis. For example, the RIS claims a total cost of NZ$600 million for it's preferred option to implement the stock exclusion rule. However, we were unable to replicate this analysis and instead found a range of costs for the stock exclusion rule between NZ$775million and NZ$1.5 billion. The range of costs results from policy uncertainty about length of fencing, cost of fencing, and the amount of grazing land forgone to meet the 5m setback requirement. We also identified conceptual errors that indicate a need to define a more coherent overarching analytical framework. For example, analysis of the costs of requiring farmers to include a freshwater module to their farm plans included costs of 'implementing actions' in the farm plan, however we note that the costs of implementing changes to comply with regulations should already be captured under the regulations themselves, so estimating them again under the farm planning requirement would be double counting.	
Clear and Concise	**The standard** **The problem is clearly described?**	**The standard** **It is clear how the objectives will be applied**	**The standard** **The analysis of options is presented consistently**	**The standard** **The implications are clear for affected parties**

	The problem in the context of the status quo is explained. Tables and subheadings are used where appropriate.	Hierarchy and any relationships between the objectives are clearly identified.	The outcome of the options analysis summarised and presented in a consistent format.	The information is presented in a clear way for affected parties to understand any resulting implications.
	Does not meet criteria The problem itself and its root causes are not adequately described. Symptoms are comprehensively discussed.	**Does not meet criteria** The hierarchy and relationships between the objectives are not identified.	**Meets criteria** The analysis of options is presented consistently.	**Partially meets criteria** The information is not presented in a clear way. However, this is a complex Package of regulatory interventions. The implications for regulated parties (mainly farmers) and those tasked with implementation and enforcement (Regional Councils) is necessarily buried in the recommended options themselves (of which there are 20).
Consulted	**The standard** The parties consulted and the form of consultation is explained. Key feedback is summarised, with emphasis on any significant concerns raised about the preferred option, and how the proposal has been altered to address these concerns If limited or no consultation undertaken, the reasons why are stated.			
	The interim RIS has been produced for the purposes of consultation. It is clear that wide-ranging consultation with stakeholders has been undertaken so far and more is planned. A range of specific groups and bodies have been set up specifically for the purpose of consulting on the regulatory proposal (listed in section 2.6).			
Assessment KEY:	Does not meet criteria	Partially meets criteria	Meets criteria	

Appendix B: Additional Requirements of the Regulations for Affected Parties (Landowners)

1 New Requirements under the Proposed NPS

Change	Actions Required of Affected Parties	Resource Requirements	Cost type, Nature
Water Quantity Requirements	The new NPS proposes mandating telemetry (direct electronic transmission) for all consumptive consented water take over 5 litres per second (these water takes already have to measure their water use but haven't had to report it automatically yet).	According to the EFW discussion document: "Up to 11,000 water permits will be affected, though many larger permit holders have telemetry installed, so will already comply. A telemetry unit costs between \$600 and \$1800 to install. Data transmission may cost up to \$20–\$30 a month in areas of good cellular coverage, and up to \$99 per month without coverage"	Cost type: Compliance, water users Variability: Variable depending on the number of water takes each user has Driver Options: Number of water permits per water user.
New Standards for *E. Coli*	The new NPS requires councils to make waterways safe for swimming rather than just wading during the 'swimming season' (1 November to 31 March). This would impose a limit of 540 *E. Coli* per 100ml, similar to the A band in the current NPS.	Additional stock exclusion costs where waterways currently fail the standard (I'm not sure how many waterways this includes).	Cost type: Compliance, livestock farmers Variability: Variable depending on the length of waterways that are not fenced and the number of crossings without

			adequate bridges or culverts Driver Options: length of waterways that are not fenced and the number of crossings without adequate bridges or culverts
Allowing for Fish Passage	Regional councils must provide for fish passage in line with the NZ Fish Passage Advisory Group's guidelines "both in plan-making and consenting, and in imposing design requirements on some types of new in stream structures less than four meters high, including: Ensuring that new structures such as weirs, culverts and tide flap gates be required to meet minimum design standards to enable fish passage Identifying existing structures and prioritising changes to enable fish passage"	Additional construction costs for new in-stream structures. Fish ladders are likely to be necessary in places where important native species need passage.	Cost type: Compliance, developers responsible for in-stream structures Variability: Variable depending on the number of in-stream structures. Driver Options: Number of in-stream structures.

2 New Requirements under the Proposed NES

Change	Actions Required of Affected Parties	Resource Requirements	Cost type, Nature
Wetland Monitoring Obligations	"If the standard wetland monitoring obligation is a condition of any consent granted for the purpose of this Standard, the holder of the consent must-	Large additional monitoring and reporting	Cost type: Compliance, Landowners with

	a) monitor the condition of the wetland (in terms of, at least, extent, vegetation, hydrology, and nutrients); and b) provide the results of monitoring to the consent authority at least annually, or in accordance with any monitoring plan; and c) advise the regional council if the monitoring indicates a decline in the ecological condition of the wetland. The advice required by subclause (1)(c) must be given by phone immediately (or as soon as practicable), and be confirmed in writing within 20 working days after the phone advice. (3) The written confirmation must include a description of the scale of the decline and any known, actual, or likely reasons for it."	responsibilities for landowners with consented wetlands.	wetlands on their properties Variability: Variable depending on the number of wetlands. Driver Options: Number wetlands each property has to monitor.
Clauses for Nationally Significant Infrastructure (wetlands)	"Any consent granted for activities referred to in this subpart that relate to new or existing nationally significant infrastructure must include at least the following conditions: a) to the extent that adverse effects on a wetland cannot be avoided, remedied, or mitigated, any residual adverse effects on the wetlands must be offset to achieve a net gain: b) the person undertaking the activity is subject to the standard wetland monitoring condition for the duration of the consent: c) the person undertaking the activity must implement best practice erosion and sediment control measures for the duration of land disturbance, and these must be installed before the start of the land disturbance and be maintained until the site is stabilised against erosion."	These requirements will add to the costs of nationally significant infrastructure projects.	Cost type: Compliance, Developers of nationally significant infrastructure Variability: Variable depending on the number of wetlands threatened by each infrastructure project. Driver Options: Number of wetlands threatened by infrastructure projects.
Vegetation Destruction (wetlands)	"Vegetation destruction carried out in, or within 10 m of, any part of a natural wetland is a discretionary activity if it is carried out- a) for the purpose of restoring or maintaining the wetland; or	Opportunity cost of maintaining vegetation close to wetlands. This may be particularly	Cost type: Compliance, landowners, developers

	b) for education or recreation purposes (including the construction and maintenance of structures such as boardwalks and signage that are constructed for educational or recreational purposes); or c) for the purpose of maintaining or meeting the operational needs of an existing hydro scheme; or d) for public flood control or drainage; or e) for the purpose of building, maintaining, or operating any new or existing nationally significant infrastructure. Vegetation destruction in, or within 10 m of, any part of a natural wetland is a non-complying activity if it is carried out for any purpose other than a purpose identified in [this section]"	significant on undeveloped land. Where vegetation is cleared, there would be substantial additional compliance costs in securing consent.	Variability: Variable depending on the number of wetlands and the value of land protected. Driver Options: area and cost of land protected from development.
Earth Disturbance (wetlands)	Is a discretionary activity when within 10m of a wetland subject to a range of conditions, similar to those for vegetation destruction. When earth disturbance is for the purposes of drainage, the buffer zone in which is a discretionary activity extends to 100m. Earth disturbance within these buffer zones that does not fall under one of the conditional exclusions is a prohibited activity.	Costs of being generally unable to disturb land near a wetland. Where land is disturbed there would be additional compliance costs in securing consent.	Cost type: Compliance, landowners, developers Variability: Variable depending on the number of wetlands and the need to disturb riparian land. Driver Options: Area of land protected from development, and the need to disturb riparian land.
Water Take Activities (wetlands)	"A water take activity is a non-complying activity if- a) it is not a discretionary activity; and b) the work will-	This will be associated with the opportunity costs of avoiding the hydrological changes described. This will be	Cost type: Compliance, water users Variability: Variable depending on the

	i) result in a greater than 0.1 m change beyond the wetland's annual median water level; and ii) cause changes in the wetland's seasonal (summer to winter) water level fluctuations (minimum or maximum water levels) that have a detrimental effect on the extent, ecological quality (type and diversity of aquatic plant and animal communities) or functioning of the wetland."	on a case-by-case basis, and may be impossible to estimate.	demand for water abstraction Driver Options: unfulfilled demand for water abstraction
River Bed Infilling	Is a prohibited activity unless it is part of an activity: "designed to restore or enhance the natural values of the stream or of any adjacent or associated ecosystem; or b) done for the purpose of building, maintaining, or operating new or existing nationally significant infrastructure; or c) required for the purposes of flood prevention or erosion control; or d) for which there are no practical alternative methods of enabling the activity to take place. (2) Any resource consent granted for the discretionary activity must include at least the following conditions: a) to the extent that the adverse effects cannot be avoided, remedied, mitigated, any residual adverse effects on the river must be offset to achieve a no net loss; and b) the person undertaking the activity must- i) monitor the condition of the river for the duration of the consent; and ii) inform the consent authority if the monitoring demonstrates that the ecological condition of the river is declining."	Again, there is an opportunity cost to avoiding infilling, but again this may be incalculable. There are likely to be substantial compliance costs if infilling is has a case to be granted as a discretionary activity.	Cost type: Compliance, landowners, developers Variability: Variable depending on the need to infill river beds Driver Options: Length of waterways in the catchment and historical incidence of infilling.
Fish Passage	Requirements for fish passage only apply to structures constructed after the commencement date of the NES (existing structures are not included). Includes a range of regulations for culverts, weirs, passive flap gates, dams, fords, and non-passive flap gates.	In each case there are well-established methods for allowing fish passage. There	Cost type: Compliance, developers of in-stream structures

	Many standard culverts are permitted activities, however developers must: " provide the following to the relevant regional council within 20 working days of construction being completed: i. the standard fish passage structure information: ii. information on at least the type or shape of culvert (e.g. pipe, box, arch), material, height, width, length, drop height, slope, culvert substrate, and alignment." Discretionary culverts must "not [be] contrary to the regional council's objectives for aquatic life (as required by the NPS)." The conditions for weirs are similar in terms of stringency. The construction of passive flap gates is generally a non-complying activity. Where resource consent is granted for passive flap gates, the person constructing the structure must: "provide the following to the relevant regional council, within 20 working days of construction being completed: i) the standard fish passage structure information: ii) at least, the number of flap gates, dimensions, material, and whether any culverts present."	would be compliance costs associated with meeting the NES, but in most cases it seems unlikely to prohibit construction in waterways.	Variability: Variable depending on the number of in-stream structures and the existence of native and invasive fish species. Driver Options: Number of in-stream structures and the existence of native and invasive fish species.
Farming	This section applies only to farms > 20 ha and horticultural farms > 5 ha.		
Livestock Control	Use of land for feedlots is a discretionary activity and must meet the following conditions: "a) the base of the feedlot must be sealed to a minimum permeability standard of 10-9 metres per second: b) the area must be sited at least 50 m away from waterbodies, water abstraction bores, drainage ditches and coastal marine areas:	These restrictions on livestock control seem targeted at poor practices. In most cases, they seem unlikely to impose substantial additional costs on farmers.	Cost type: Compliance, farmers Variability: Variable depending on the number of feedlots and stockholding areas and the incidence of sacrifice paddocks and

c) all animal effluent, or water or bedding material containing effluent, must be collected, stored, and disposed of in accordance with regional council regulations or a current discharge permit: d) if the consent is granted before the date that is 2 years after the commencement date, the applicant must, by that date, have a certified FW-FP for the farm to which the consent applies." The requirements for 'holding stock in a stockholding area' for more than 30 days in a 12-month period or more than 10 consecutive days are very similar to the conditions for the discretionary use of feedlots. The use of land for sacrifice paddocks is a permitted activity if the paddock is more than 50m from a waterway. If not, this use is discretionary, and farmers must supply a fresh water module farm plan with their application for resource consent. Intensive winter grazing is a permitted activity if it complies with the following conditions: " a) the grazing does not take place on land with a slope equal to or greater than 10 [15] degrees: b) the grazing does not take place over more than 30 ha [50 ha]or 5% [10%] (whichever is greater) cumulatively or in one contiguous area of the farm: c) any grazing on sloping land takes place progressively downhill from the top of the slope to the bottom of the slope: d) stock is not grazed in any critical source area: e) a vegetated strip of at least 5 m [20 m] that does not include any annual forage crop species is maintained between the grazed area and any water body or drainage ditch, and all stock are excluded from this strip during the grazing:	However, where intended activities require resource consents, costs to farmers may be high. The legislation may also require upgrades to feedlots and stockholding areas (if current facilities do not meet the standards).	intensive winter grazing. Driver Options: Number of feedlots and stockholding areas and the incidence of sacrifice paddocks and intensive winter grazing.

	f) the grazed paddock is re-sown within 1 month, or as soon as practicable, after the end of the grazing: g) pugging to a depth of more than an average of 20 cm [10 cm] does not occur over more than 50% of the paddock." Intensive winter grazing is a restricted discretionary activity if: "b) in a freshwater management unit to which clause 31 applies, the total area in annual forage crop does not exceed the highest total area in annual forage crop in any farm year between 2013/14 and 2018/19." Applications for resource consent made before two years after the commencement date must commit to providing a certified FW-FP by by that date. Any Application after two years after the commencement date must include a FW-FP.		
Intensification	The restrictions on intensification apply only in freshwater management units where national policy statements for freshwater management have not been fully implemented. Full implementation means that a regional council has: "i. defined limits and action plans for the defined attributes and included them in the regional plan; and ii. included any required objectives and policies in the regional policy statement or plan; and iii. published all required action plans." Any resource consent granted for intensive winter grazing as a discretionary activity in areas where the total area in forage crop exceeds the highest total area in forage crop in any farm year between 2013/14 and 2018/19 must include at least the following conditions: "a) the applicant has a certified FW-FP; and	The impacts on farmers will depend on whether their local council has fully implemented the NPS FM. In places where this has occurred, there should be no additional costs to farmers. Where this has not occurred, farmers have restricted opportunities to intensify land use, which may (or may not) affect the value of their businesses.	Cost type: Compliance, farmers and landowners Variability: Variable depending on the unfulfilled demand for intensification. Driver Options: Area of land with unfulfilled intensification potential, and potential value of this intensification.

b) the FW-FP includes actions to avoid, remedy, or mitigate the adverse effects of the activity's contaminant discharges into freshwater, or into land in circumstances that may result in the contamination entering water; and c) the nitrogen, phosphorus, sediment, or microbial pathogen discharges of the farm that will result from the increased land used will not exceed the average discharges of those contaminants from the farm during the farm year 2017/2018." Increases of more than 10 ha in the area of land that is irrigated production after the commencement date is a discretionary activity. Resource consents granted for this activity must include: "a) the applicant has a certified FW-FP; and b) the FW-FP includes actions to avoid, remedy, or mitigate the adverse effects of the activity's contaminant discharges into freshwater, or into land in circumstances that may result in the contamination entering water; and c) the nitrogen, phosphorus, sediment, or microbial pathogen discharges of the farm that will result from the increased land used will not exceed the average discharges of those contaminants from the farm during the farm year 2017/2018." Restrictions on high-risk land use changes after the commencement date apply to: "a) land that was used for arable, sheep, deer, or beef farming (old use) is changed to being used for dairy support (new use): b) land that was used for arable, sheep, deer, beef, or dairy support farming (old use) is changed to being used for dairy farming (new use): c) land that was used for wood vegetation or forestry (old use) changes to any form of pastoral farming (new use)."	Most of these regulations are 'discretionary' rather than restrictive. They are not hard limits on intensification. However, intensification activities must demonstrate the avoidance of adverse impacts on freshwater, which may not be feasible in some instances.

	These changes are permitted activities if: "A change from an old use to a new use is a permitted activity if, since the commencement date, the total additional amount of land used on the farm over the farm year for a new use is less than 10 hectares." Changes of more than 10 ha are discretionary and must include the following the same conditions stipulated for irrigated production, above. Changes in land use to commercial vegetable production are permitted activities if: "following the change, the total area of land in a freshwater management unit that is used by the farm for that purpose does not exceed the greatest total amount used for vegetable growing in that freshwater management unit by the farm in any one farm year between the 2013/14 and 2018/19 farm years." Otherwise, it is a discretionary activity. Any resource consent granted for this discretionary activity is subject to the same conditions as stipulated for irrigated production, above.		
Freshwater Module of Farm Plans	"(1) Within 2 years after the commencement date, the following farms that do not already have a certified FW-FP must have a certified FW-FP: a) farms used for commercial vegetable production: b) farms in the catchments and subcatchments identified in Schedule 1: c) farms in the Kaipara catchment that are on highly erodible land: d) farms in the following 2 exemplar catchments: i)) Pelorus: ii) Manuherekia. (2) By 31 December 2025, every other farm to which this Standard applies must have a certified FW-FP."	There are likely to be substantial costs associated with the addition of FW-FMs to farm planning. We will have to form some assumptions about the time each would take and the relevant opportunity cost of that time.	Cost type: Compliance, farmers Variability: Fixed per farmer Driver Options: Complexity of land holding and number of freshwater features.

In short, FW-FPs include requirements for geographical reporting, mapping of waterbodies and other farm characteristics, identification of possible risks to freshwater quantity and quality, and actions to mitigate these risks. The specific requirements are described in full below. Certification: FW-FPs must be certified by an environmental planner "approved by the Minister for the Environment and the Minister for Agriculture." Environmental planners may not be approved unless they have the following quals: "a) 3 years' experience in the management of pastoral, horticultural, or arable farm systems: b) Successful completion of relevant training or qualification, and approved completion of requirements of the certification scheme approved by the Minister for the Environment and the Minister of Agriculture." Audit: All people responsible for an FW-FP must arrange to have their compliance with this plan audited by someone other than the certifying planner. Again, the auditor must be suitably qualified and approved, with similar requirements to the certifying planner. In addition, auditors must be a member of an international standards organisation accredited audit programme. Audits must occur within 24 months of the first certification of an FW-FP, and occur every two years from then on. Specifically, each FW-FP must include: "a) the physical address of the farm: b) the legal description of the land: c) the farm identifier (if any): d) the name, address, and contact details of the land owner:	The NES FM does not specify whether farmers or councils should bear the costs of certifying and auditing farm plans. Given the qualifications each requires, and the competition for talent identified by LGNZ, this is likely to be a large cost. Again, we will have to make some assumptions about the number of FTEs this will require.

e) the contact details of the person responsible for overseeing the implementation of the FW-FP: f) reference to every relevant resource consent, along with the date it was granted and the date (if any) on which it expires: g) mapping requirements that meet the requirements of subclause (2): h) a risk assessment that meets the requirements of subclause (3): i) action points that address the risks identified under subclause (3) and meet the requirements of subclause (4): j) for farms in the catchments and subcatchments identified in Schedule 1, action points to reduce nitrogen discharges in accordance with subclause (5).” Subclause 2: “The mapping required in an FW-FP must, whether using maps, aerial photography, or both, clearly show the following: a) the boundaries of the property: b) the boundaries of the main land management units within the property: c) location of soil types: d) location of permanent or intermittent rivers, streams, lakes, drainage ditches, ponds, overland flow paths, and wetlands: e) the location of source protection zones for human drinking water: f) the location of riparian vegetation and fences (including virtual fences) adjacent to waterbodies: g) the location on all water bodies where stock access or crossing occurs: h) the location of any critical source areas for nutrient loss, soil loss, or both.” Subclause 3: “The risk assessment part of the FW-FP must identify and assess the risk of contaminant losses from the farm, with consequent impacts on		

freshwater ecosystem health, associated with any of the following activities carried out on the farm: a) land management activities occurring on or near the locations referred to in subclause (2)(d) – (h): b) previous or existing land uses that may be hazardous, such as- i. offal pits and farm dumps: ii. land on which an activity or industry described in the Hazardous Activities and Industries List is being, or has been, undertaken: c) management of erosion-prone land: d) management of soil loss resulting from land disturbance: e) irrigation: f) stock management, especially near waterbodies, drainage ditches, and riparian margins: g) fertiliser and effluent management: h) management of contaminant loss as a result of land disturbance: i) management of activities required by this Standard to have a FW-FP." Subclause 4: "The action points in an FW-FP must identify the actions that the person implementing the FW-FP is undertaking, or will undertake, to avoid, remedy, or mitigate the loss of contaminants, along with timeframes for those actions." Subclause 5: For farms identified in Schedule 1: "The action points in an FW-FP must identify the actions (with timeframes where relevant) that the person implementing the FW-FP is undertaking, or will undertake, to avoid, remedy, or mitigate the loss of nitrogen in accordance with: a) any relevant plan rule; or		

	b) where there are no relevant plan rules, best practice options appropriate for the farm type, size and operation."		
Additional proposal for the management of Nitrogen in Schedule 1 Catchments	These additional requirements, if adopted, would replace some of the reporting and action planning activities identified under the section on FW-FPs, above. This proposal applies only before the NPS FM is implemented and only to farms in the following catchments: Taharua River Hawke's Bay Waipao Stream Northland Mataura River Southland Oreti River Southland Waimatuku Stream Southland Aparima River Southland Waihopai River Southland Waingongoro River Taranaki Motupipi River Tasman Region Piako River Waikato Region Waihou River Waikato Region Parkvale Stream Wellington Upper Rangitaiki and Otangimoana Rivers Bay of Plenty	These requirements appear to be considerably more onerous than the standard requirements (Both in terms of the monitoring/modelling required and the possible restrictions on pastoral farming).	Cost type: Compliance, farmers Variability: Variable depending on whether the waterways breach standards. Driver Options: Likelihood of waterway nutrient levels breaching standards in each catchment.

In these areas, "*Every farmer of a dairy farm or a low-slope pastoral farm (that is not a dairy farm) must provide the nitrogen loss figure for the farm to the relevant regional council-* *a) in the form of an electronic Overseer output file certified as accurate by an Overseer modeller; and* *i) for dairy farms, 6 months after the commencement date; and* *ii) for low-slope pastoral farms (other than dairy farms), 12 months after the commencement date."* Two years after the commencement date in these catchments "*Low-slope pastoral farming and all dairy farming is a controlled activity if, at any time, the nitrogen loss figure for the farm exceeds the threshold value for the catchment or subcatchment in which the farm is located."* *"A resource consent granted for the controlled activity must include at least the following conditions:* *a) the farm must have a certified FW-FP that includes actions that will, within 5 years, reduce the farm's nitrogen loss by the difference (expressed as a percentage) between-* *i) the farm's baseline nitrogen loss figure; and* *ii) the threshold value for the catchment in which the farm is located:* *b) by 30 September in each year the farmer must provide the relevant local authority with-* *i) an Overseer output file for the previous farm year, certified by an Overseer modeller; and*		

	ii) documentation certified by an approved auditor that shows whether the farmer is complying with the FW-FP as it relates to reducing nitrogen loss: *c) within 3 years after the granting of the consent, the farmer must provide evidence to the relevant regional council to show that nitrogen loss from the farm has been reduced by at least 50% of the figure referred to in (a) above:* *d) the consent expires on a specified date not later than 5 years after the date it is granted."* Dairying and pastoral farming in these catchments are discretionary activities when nitrate loss exceed threshold figures and the farm does not have a certified FW-FP, or the FW-FP does not identify actions that will reduce nitrogen loss in line with the threshold value. The requirements for a resource consent are similar to those described for controlled activities above.		
Section 360 Regulations (on Stock Exclusion)	Regulations on stock exclusion apply only to rivers more than one metre wide. These regulations do not apply to steep land with low stocking rates. Under these regulations: "a) Dairy and beef cattle, and pigs, are not permitted to cross water bodies except by a dedicated culverted or bridged cross point (unless that crossing is no more than twice per month). b) Where an existing fence does not comply with setback requirements, it shall be allowed to remain in its current positions until 2025, unless the existing setback has a minimum 2 metre average width and is not less than 1 m setback, in which case the setback requirements do not apply until 2035.	Farmers will incur additional fencing costs in proportion with the length of waterbody that does not currently comply. Some farmers will also need to construct culverts or bridges to avoid stock entering waterways on regular crossings.	Cost type: Compliance, farmers Variability: Fixed based on the length of waterways that are unfenced. Driver Options: Length of waterways that are unfenced.

c) Landowners may seek an exemption from stock exclusion requirements, or an extension of the phase-in timeframes."

Stock exclusion on "Low-slope" land

Waterbody	Stock	Setback	Timeframe
Wetland	Dairy and dairy support cattle, pigs, beef cattle and deer	5 metres on average across a property (with a minimum width of 1m)	1 July 2021 for wetla identified in regional district plans. 1 July for all other wetland
Wetland	Any new pastoral system for all cattle, pigs or deer establishing after gazettal	5 metres on average across a property (with a minimum width of 1m)	Immediately
Rivers (> 1 m wide), and lakes	Dairy and dairy support cattle and pigs	5 metres on average across a property (with a minimum width of 1m)	1 July 2021
Rivers (> 1 m wide), and lakes	Beef cattle and deer	5 metres on average across a property (with a minimum width of 1m)	1 July 2023
Rivers (> 1 m wide), and lakes	Any new pastoral system for all cattle, pigs or deer establishing after gazettal	5 metres on average across a property (with a minimum width of 1m)	Immediately

Appendix C: Additional Requirements of the Regulations for Regional Councils

1 New Requirements under the Proposed NPS

Change	Actions Required of Affected Parties	Resource Requirements	Cost type, Nature
New Overarching Framework	Councils must clarify how the overarching principles of Te Mana o te Wai affect their management plans and decision making. According to the EFW discussion document: “every regional council must develop, and articulate in its regional policy statement, a long-term vision that gives effect to Te Mana o te Wai. The long-term vision must: Be developed through discussion with tangata whenua and communities about their long-term wishes for waterbodies in the region Be informed by an understanding of the history of, and current pressures on, waterbodies in the region. Express what tangata whenua and communities want their waterbodies to be like in the future.”	1 FTE iwi liaison position for developing each regional policy statement. Targeted additional training on the overarching framework for council management.	Cost type: Admin, RC Variability: Fixed per council Driver Options: cyclical on plan reissue
Integrated Management Requirement	The draft NPS FM has several new directives under Section 3.4, however the only specific requirement is that: “Every regional council must insert the following method (or words to the same effect) into its regional policy statement: “District plans must include objectives, policies, and methods to avoid, remedy, or mitigate the cumulative adverse effects of land use on freshwater bodies, freshwater ecosystems, and sensitive receiving environments resulting from urban development.”” These methods may include, for example:	It will be straightforward for regional councils to include this wording in region plans. It will be substantially more difficult for territorial authorities to include these objectives in district plans.	Cost type: Admin, RC Variability: Fixed per council Driver Options: cyclical on plan reissue

	"Regulating impervious surface cover and/or requiring on-site infiltration; Requiring treatment of contaminants at source; Using zoning/designations to avoid all, or certain types of development in areas where the effects on freshwater could not be adequately managed; Provision of green infrastructure (especially for stormwater management); Use of best practice Water Sensitive Urban Design or Low Impact Design techniques."		
Additional Compulsory Attributes	Additions have been made to the attributes that comprise the compulsory values. As far as I can tell from cross-checking the draft NPS FM with the NPS FM 2017, the following 11 categories have been added: Suspended fine sediments (rivers) Macroinvertebrates (MCI*,QCMI) Macroinvertebrates (ASPM) Fish (IBI (rivers) Lake submerged plants (native) Lake submerged plants (invasive) Deposited Sediments (rivers) Dissolved oxygen Dissolved oxygen (lakes) Dissolved oxygen (lakes – seasonally stratifying) Ecosystem metabolism (rivers)	This represents a doubling of the number of attributes that need to be measured. It is difficult to estimate the effort required to do this. It may be less than double the current effort (they will already be visiting/sampling). But it could also be more than double (some new fields may be resource-intensive)	Cost type: Admin, RC Variability: Varies by number and frequency of tests Driver Options: Number of testing stations, points, or length of rivers and estimated testing number and frequency
Water Quantity Requirements	Objectives for minimum flow (required in the 2017 NPS) will be required to state the desired ecosystem health outcome. Minimum flows and allocation must clearly relate to achieving these objectives. Councils will also be required to consider groundwater where it is connected to surface water.	Where councils' objectives are already science-based, this will not require extra resources. Where councils have simply guessed, they	Cost type: Admin, RC Variability: Fixed per study, number of studies estimated Driver Options: cyclical on plan reissue

		will need to undertake or commission new scientific assessments.	
Reporting of Compulsory Values	Regional councils are required to report against the five compulsory values (water quality, water quantity, habitat, aquatic life and ecological processes) annually. They will also be required to compile a 'synthesis report card' every five years.	Extra scientific and research staff.	Cost type: Admin, RC Variability: Fixed per council, every five years Driver Options: every five years
New Standards for *E. Coli*	The new NPS requires councils to make waterways safe for swimming rather than just wading during the 'swimming season' (1 November to 31 March). This would impose a limit of 540 *E. Coli* per 100ml, similar to the A band in the current NPS.	Additional monitoring and enforcement costs in proportion with the number of waterbodies failing to meet the standard.	Cost type: Admin, RC Variability: Fixed per waterway Driver Options: length or number of waterways & estimate of fails
Allowing for Fish Passage	Regional councils must provide for fish passage in line with the NZ Fish Passage Advisory Group's guidelines "both in plan-making and consenting, and in imposing design requirements on some types of new in stream structures less than four meters high, including: Ensuring that new structures such as weirs, culverts and tide flap gates be required to meet minimum design standards to enable fish passage Identifying existing structures and prioritising changes to enable fish passage"	Additional monitoring and enforcement costs in proportion with the number in stream structures and obstacles.	Cost type: Admin, RC Variability: Fixed per waterway Driver Options: length or number of waterways & estimate of fails
Exclusion of Hydro Generation	The exemption of 6 hydro-generation schemes is a new addition. Under these exclusions, Regional councils may "have regard to the importance of not adversely impacting the generation capacity and responsiveness of a scheme" and can "set target attribute states that are below national bottom lines". However, regional councils must still	While this allows councils more flexibility, it may also expose them to legal disputes over whether their targets and	Cost type: Admin, RC Variability: Fixed depending on the number

	"set target attribute states that, to the extent possible, improve any water body or freshwater ecosystem affected by any scheme."	oversight improves water quality "to the extent possible"	of exempt hydro schemes in each region Driver Options: Number of exempt hydro schemes in each region.

2 New Requirements under the Proposed NES

Change	Actions Required of Regional Councils	Resource Requirements	
Wetland Monitoring Obligations	"If the standard wetland monitoring obligation is a condition of any consent granted for the purpose of this Standard, the holder of the consent must- a) monitor the condition of the wetland (in terms of, at least, extent, vegetation, hydrology, and nutrients); and b) provide the results of monitoring to the consent authority at least annually, or in accordance with any monitoring plan; and c) advise the regional council if the monitoring indicates a decline in the ecological condition of the wetland. The advice required by subclause (1)(c) must be given by phone immediately (or as soon as practicable), and be confirmed in writing within 20 working days after the phone advice. (3) The written confirmation must include a description of the scale of the decline and any known, actual, or likely reasons for it."	Additional monitoring and review responsibilities.	Cost type: Admin, RC Variability: variable depending on the number of wetlands per region Driver Options: Number of wetlands per region
Vegetation Destruction (wetlands)	"Vegetation destruction carried out in, or within 10 m of, any part of a natural wetland is a discretionary activity if it is carried out- a) for the purpose of restoring or maintaining the wetland; or	Additional monitoring and review responsibilities.	Cost type: Admin, RC Variability: Variable depending on the pressures on riparian

	b) for education or recreation purposes (including the construction and maintenance of structures such as boardwalks and signage that are constructed for educational or recreational purposes); or c) for the purpose of maintaining or meeting the operational needs of an existing hydro scheme; or d) for public flood control or drainage; or e) for the purpose of building, maintaining, or operating any new or existing nationally significant infrastructure. Vegetation destruction in, or within 10 m of, any part of a natural wetland is a non-complying activity if it is carried out for any purpose other than a purpose identified in [this section]"		areas in each waterway Driver Options: Length of waterways in each region, value of land in each region
Water Take activities (wetlands)	"Any resource consent granted for a water take activity for the purpose of restoring a wetland to its natural hydrological state must include the following conditions a) a qualified wetland ecologist and hydrologist must establish the natural hydrological regime of the wetland: b) the person undertaking the activity is subject to the standard wetland monitoring obligation for the duration of the consent."	The costs of having qualified wetland ecologists and hydrologists available to assess resource consent applications.	Cost type: Admin, RC Variability: Variable depending on the demand for water abstraction Driver Options: Demand for water abstraction
Fish Passage	Requirements for fish passage only apply to structures constructed after the commencement date of the NES (existing structures are not included). The regional council must determine whether the passage of fish is desirable (as is generally the case for native and sports fish species) or undesirable (as in the case of some introduced fish species).	Additional planning and scientific burden.	Cost type: Admin, RC Variability: Variable depending on the number of ins-stream structures and the existence of native and invasive fish species.

			Driver Options: number of ins-stream structures and the existence of native and invasive fish species.
Farming			
Livestock Control	There are a series of regulations on feedlots, sacrifice paddocks, and other stock holding decisions that are likely to require councils to increase monitoring and enforcement activities, and review larger numbers of resource consent applications. Intensive winter grazing is a restricted discretionary activity if: "b) in a freshwater management unit to which clause 31 applies, the total area in annual forage crop does not exceed the highest total area in annual forage crop in any farm year between 2013/14 and 2018/19."	Increased monitoring, enforcement, and resource consenting costs.	Cost type: Admin, RC Variability: Variable depending on the number of feedlots, stock holing areas and the prevalence of intensive winter grazing and sacrifice paddocks. Driver Options: Number of feedlots, stock holing areas and the prevalence of intensive winter grazing and sacrifice paddocks.
Intensification	The restrictions on intensification apply only in freshwater management units where national policy statements for freshwater management have not been fully implemented. Full implementation means that a regional council has:	This is likely to make the full implementation of the NPS more urgent,	Cost type: Admin, RC Variability: Variable depending on the

"i. defined limits and action plans for the defined attributes and included them in the regional plan; and ii. included any required objectives and policies in the regional policy statement or plan; and iii. published all required action plans." Any resource consent granted for intensive winter grazing as a discretionary activity in areas where the total area in forage crop exceeds the highest total area in forage crop in any farm year between 2013/14 and 2018/19 must include at least the following conditions: "a) the applicant has a certified FW-FP; and b) the FW-FP includes actions to avoid, remedy, or mitigate the adverse effects of the activity's contaminant discharges into freshwater, or into land in circumstances that may result in the contamination entering water; and c) the nitrogen, phosphorus, sediment, or microbial pathogen discharges of the farm that will result from the increased land used will not exceed the average discharges of those contaminants from the farm during the farm year 2017/2018." Increases of more than 10 ha in the area of land that is irrigated production after the commencement date is a discretionary activity. Resource consents granted for this activity must include: "a) the applicant has a certified FW-FP; and b) the FW-FP includes actions to avoid, remedy, or mitigate the adverse effects of the activity's contaminant discharges into freshwater, or into land in circumstances that may result in the contamination entering water; and c) the nitrogen, phosphorus, sediment, or microbial pathogen discharges of the farm that will result from the increased land used will not exceed the average discharges of those contaminants from the farm during the farm year	which may drive-up costs for councils. Many of the regulations may also require greater monitoring and enforcement effort, and more resource consenting work.	demand for intensification. Driver Options: Area of underdeveloped land, economic potential for intensification.

	2017/2018." Restrictions on high-risk land use changes after the commencement date apply to: "a) land that was used for arable, sheep, deer, or beef farming (old use) is changed to being used for dairy support (new use): b) land that was used for arable, sheep, deer, beef, or dairy support farming (old use) is changed to being used for dairy farming (new use): c) land that was used for wood vegetation or forestry (old use) changes to any form of pastoral farming (new use)." These changes are permitted activities if: "A change from an old use to a new use is a permitted activity if, since the commencement date, the total additional amount of land used on the farm over the farm year for a new use is less than 10 hectares." Changes of more than 10 ha are discretionary and must include the following the same conditions stipulated for irrigated production, above. Changes in land use to commercial vegetable production are permitted activities if: "following the change, the total area of land in a freshwater management unit that is used by the farm for that purpose does not exceed the greatest total amount used for vegetable growing in that freshwater management unit by the farm in any one farm year between the 2013/14 and 2018/19 farm years." Otherwise, it is a discretionary activity. Any resource consent granted for this discretionary activity is subject to the same conditions as stipulated for irrigated production, above.		
Freshwater Module of Farm Plans	"(1) Within 2 years after the commencement date, the following farms that do not already have a certified FW-FP must have a certified FW-FP: a) farms used for commercial vegetable production:	The NES FM does not specify whether farmers or councils	Cost type: Admin, RC Variability: Variable depending on the

b) farms in the catchments and subcatchments identified in Schedule 1: c) farms in the Kaipara catchment that are on highly erodible land: d) farms in the following 2 exemplar catchments: i)) Pelorus: ii) Manuherekia. (2) By 31 December 2025, every other farm to which this Standard applies must have a certified FW-FP." In short, FW-FPs include requirements for geographical reporting, mapping of waterbodies and other farm characteristics, identification of possible risks to freshwater quantity and quality, and actions to mitigate these risks. The specific requirements are described in the 'affected parties' dusument. Certification: FW-FPs must be certified by an environmental planner "approved by the Minister for the Environment and the Minister for Agriculture." Environmental planners may not be approved unless they have the following quals: "a) 3 years' experience in the management of pastoral, horticultural, or arable farm systems: b) Successful completion of relevant training or qualification, and approved completion of requirements of the certification scheme approved by the Minister for the Environment and the Minister of Agriculture." Audit: All people responsible for an FW-FP must arrange to have their compliance with this plan audited by someone other than the certifying planner. Again, the auditor must be suitably qualified and approved, with similar requirements to the certifying planner. In addition, auditors must be a member of an international standards organisation accredited audit	should bear the costs of certifying and auditing farm plans. Given the qualifications each task requires and the competition for talent identified by LGNZ, this is likely to be a large cost. We will have to make some assumptions about the number of FTEs this will require.	number of farm titles in the region Driver Options: Number of farm titles in the region.

	programme. Audits must occur within 24 months of the first certification of an FW-FP, and occur every two years from then on.		
Additional proposal for the management of Nitrogen in Schedule 1 Catchments	These additional requirements, if adopted, would replace some of the reporting and action planning activities identified under the section on FW-FPs, above. This proposal applies only before the NPS FM is implemented and only to farms in the following catchments: Taharua River Hawke's Bay Waipao Stream Northland Mataura River Southland Oreti River Southland Waimatuku Stream Southland Aparima River Southland Waihopai River Southland Waingongoro River Taranaki Motupipi River Tasman Region Piako River Waikato Region Waihou River Waikato Region Parkvale Stream Wellington Upper Rangitaiki and Otangimoana Rivers Bay of Plenty In these areas, "*(1) Every regional council with farms to which this subpart applies must calculate a threshold value for each catchment or subcatchment to which this subpart applies, as at 7 months after the commencement date, based on the nitrogen loss figures supplied under clause 46(1)(b)(i) by dairy farmers in each catchment.*"	The requirement for councils to set threshold values will require additional scientific and policy effort. Councils will also be burdened with greater monitoring and enforcement costs, and greater resource consenting costs.	

Two years after the commencement date in these catchments "*Low-slope pastoral farming and all dairy farming is a controlled activity if, at any time, the nitrogen loss figure for the farm exceeds the threshold value for the catchment or subcatchment in which the farm is located."*

"A resource consent granted for the controlled activity must include at least the following conditions:

a) the farm must have a certified FW-FP that includes actions that will, within 5 years, reduce the farm's nitrogen loss by the difference (expressed as a percentage) between-

i) the farm's baseline nitrogen loss figure; and

ii) the threshold value for the catchment in which the farm is located:

b) by 30 September in each year the farmer must provide the relevant local authority with-

i) an Overseer output file for the previous farm year, certified by an Overseer modeller; and

ii) documentation certified by an approved auditor that shows whether the farmer is complying with the FW-FP as it relates to reducing nitrogen loss:

c) within 3 years after the granting of the consent, the farmer must provide evidence to the relevant regional council to show that nitrogen loss from the farm has been reduced by at least 50% of the figure referred to in (a) above:

d) the consent expires on a specified date not later than 5 years after the date it is granted."

Dairying and pastoral farming in these catchments are discretionary activities when nitrate loss exceed threshold figures and the farm does not have a

	certified FW-FP, or the FW-FP does not identify actions that will reduce nitrogen loss in line with the threshold value. The requirements for a resource consent are similar to those described for controlled activities above.		
Section 360 Regulations (on Stock Exclusion)	Regulations on stock exclusion apply only to rivers more than one metre wide. These regulations do not apply to steep land with low stocking rates. Under these regulations: "a) Dairy and beef cattle, and pigs, are not permitted to cross water bodies except by a dedicated culverted or bridged cross point (unless that crossing is no more than twice per month). b) Where an existing fence does not comply with setback requirements, it shall be allowed to remain in its current positions until 2025, unless the existing setback has a minimum 2 metre average width and is not less than 1 m setback, in which case the setback requirements do not apply until 2035. c) Landowners may seek an exemption from stock exclusion requirements, or an extension of the phase-in timeframes."	Councils will incur additional monitoring and compliance costs and may have to consider exemptions and extensions on an *ad hoc* bass.	

Stock exclusion on "Low-slope" land

Waterbody	Stock	Setback	Timeframe
Wetland	Dairy and dairy support cattle, pigs, beef cattle and deer	5 metres on average across a property (with a minimum width of 1m)	1 July 2021 for wetlands identified in regional or district plans. 1 July 202 for all other wetlands
Wetland	Any new pastoral system for all cattle, pigs or deer establishing after gazettal	5 metres on average across a property (with a minimum width of 1m)	Immediately
Rivers (> 1 m wide), and lakes	Dairy and dairy support cattle and pigs	5 metres on average across a property (with a minimum width of 1m)	1 July 2021
Rivers (> 1 m wide), and lakes	Beef cattle and deer	5 metres on average across a property (with a minimum width of 1m)	1 July 2023
Rivers (> 1 m wide), and lakes	Any new pastoral system for all cattle, pigs or deer establishing after gazettal	5 metres on average across a property (with a minimum width of 1m)	Immediately

Appendix D: Methodology and Sources for Size of Impacts

Intervention	Methodology to Determine Impact	Scalars	Data and Research Sources
Stock exclusion	Sum of: ▪ Capital and maintenance costs of new fencing along rivers and streams wider than 1m on low-slope land ▪ Capital costs of culverts and bridges (assumed to be $5,000 per structure) ▪ Opportunity cost of production on set-back land (assumed to be $2,747 per ha EBITD) Sensitivities: ▪ Fencing length: Fencing remaining unfenced rivers and streams or refence entire river and stream length (due to 5m set back requirement ▪ Fencing type: fencing appropriate for cattle only or proportional amount of fencing appropriate for sheep and cattle ▪ Land Lost due to Setback: assume that 5m setback applies only to new fencing or to all fencing	▪ Length of waterways on low-slope land requiring fencing ▪ Proportion of livestock in region that are cattle. ▪ Number of farms per region	▪ Fencing costs from MPI ▪ Culvert and bridge costs from MFE ▪ Opportunity cost of set-back from MFE
Freshwater farm plans	Sum of: ▪ One-off initial implementation cost ($3,500) ▪ Ongoing monitoring and audit cost of farm plan (plus estimated cost per farm for Council Monitoring as a percentage of the cost of auditing Farm Plans). Sensitivities: ▪ Percentage of Farms that require a farm plan: assume that all farms will require a new compliant farm plan,	▪ Number of farms per region	▪ Implementation, monitoring, and auditing costs from MFE

	50 percent of farms, 75 percent of farms, 95 percent of farms and 100 percent of farms. ▪ Cost of Council Compliance Monitoring (% of audit cost): 5%, 10%, 15%, or 20%)		
Water quantity requirement	Sum of: ▪ Capital costs of telemeters ($1200) ▪ Cost of data transmission (OPEX) ($714)	Number of water abstraction consents (which was based on reported totals for Bay of Plenty, Canterbury, Southland, and Wellington, and taken to be an average per council of the residual number to make 20,000 water abstractions across the country as a whole)	Number of water abstraction consents data from: ▪ Bay of Plenty Regional Council ▪ Canterburymaps.co.nz ▪ Southland Water Plan ▪ Wellington Regional Council
Wetlands restrictions	Opportunity cost from agricultural production based on halting current rate of wetland loss (cumulative disbenefit for 30 years)	▪ Current rate of wetland loss by region ▪ Profitability of different land uses by region ▪ Proportion of land under each land use by region	▪ Rate of wetland loss from Belliss et al. (2017) ▪ Profitability of sheep and beef by region from Beef + Lamb NZ ▪ Profitability of dairy by region from DairyNZ
Land use conversions/intensification	Opportunity cost from intensification based on the difference in profitability between sheep and beef and dairy farming assuming all intensification is halted (cumulative disbenefit over 30 years).	▪ Current rate of intensification by region ▪ Profitability of different land uses by region	▪ Intensification rates by region from MFE ▪ Profitability of sheep and beef by region from Beef + Lamb NZ

Wetland monitoring	Sum of: ▪ Mapping costs per region scaled by area with a maximum cost of $2.5 million for the largest region ▪ Annual council monitoring costs (assumed to vary in proportion to the number of wetlands per region and to have a mean value of $100,000).	▪ Land area by region ▪ Number of wetlands by region	▪ Land area by region from MFE Wetland number estimated from wetland area estimates from MFE
Fish passage	Capital cost of retrofitting fish passage measures (assumed to be $1,000 per structure given that "the vast majority of structures will be culverts, and require only minor rehabilitation with spat ropes, baffles, or fish ramps"), multiplied by an estimate of the number of fish passage structures required (assumed to be 7,500, or between a quarter and a half of the national total of 20,000).	▪ Length of waterways with slope of less than 10 degrees per region	▪ Length of low-slope waterways by region, MFE Pers comm. Deborah Burgess.
Administrative implementation of Te Mana o te Wai: Consultation with Iwi	Estimate of the additional human resources required for meaningful consultation with iwi (assumed to be 1 FTE per 25,000 Māori residents).	Number of Māori residents per region.	Number of Māori residents per region taken from StatsNZ
Nationally significant infrastructure in wetlands	Very difficult to quantify given the uncertainty of nationally significant infrastructure projects, the location, and the impact on wetlands	Would scale by: ▪ Number of future projects that disrupt wetlands ▪ Cost of applying for consents ▪ Cost of remediation or ecological offsetting required under the new regulations.	

River bed infilling	Very difficult to quantify given unknown number of rivers that could be infilled, location, topography and so on	Would scale by: ▪ Future rate of land capture through river bed infilling under business as usual ▪ Potential profitability of land that cannot be captured due to restrictions on river bed infilling	
Restrictions on intensive farming practice such as winter grazing and sacrifice paddocks	Rankings of regions by: ▪ Stocking intensity of dairy cows by region ▪ Stocking intensity of beef cattle by region Combination of these two rankings to produce a meta-ranking of cow stocking intensity (assumed to be proportionate to demand for intensive stock management practices)	Stocking intensities by region	Stock numbers by region from StatsNZ Land use areas by region from MFE
Additional Nitrogen management	Specific Schedule 1 catchments identified. There are five in Southland two in each of Bay of Plenty and Waikato and one each in Hawke's Bay, Northland, Taranaki, Tasman and Wellington. Difficult to estimate costs on those individual catchments due to variability. The MfE's Interim RIS suggests that the cost of additional nitrogen management in these catchments is likely to be low because the policy focusses on encouraging best practice nitrogen management rather than land use change. Improvements in nitrogen management generally have	Would scale in proportion with: ▪ Number of farmers required to change practices. ▪ Costs of these changes in practice net the beneftis.	

minimal impacts on farm profitability, and in some cases even improve profitability[8].		

[8] See, for example, Beukes,P.C., Edwards, P. and Coltman, T. (2017). Modelling options to increase milk production while reducing N leaching for an irrigated dairy farm in Canterbury. Journal of New Zealand Grasslands. (79) 139-146.

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APPENDIX 3

Guiding principles to apply to the reform Ngā mātāpono mō te whakahoutanga

We consider that ten inter-related and interdependent principles apply when assessing the design of any resource (including water) management system.

- **a. Subsidiarity**. The principle that decisions are best made closest to community of interest remains critical to effective and responsive resource management.
- **b. Values-based decision-making**. Difficult values-based choices in policy design and implementation are best made within a democratic governance structure where decision-makers are accountable to the electorate.
- **c. Evidence-based policy**. The design of policy and regulatory interventions must be evidence-based (accepting there will always be some uncertainty). The problems to be addressed and the effectiveness of solutions proposed must be understood and assessed with reference to reliable and robust data.
- **d. Tailored solutions**. 'One size fits all' policy solutions will often not be appropriate as what may be applicable in one catchment will not necessarily be effective or necessary in another. Catchments differ from each other in many ways - in soils, climate, hydrology and land use, meaning the risks faced and appropriate responses will be highly variable. Policy responses accordingly need to be flexible and able to be tailored to local circumstances.
- **e. Leadership**. Although a 'one size fits all' will often not be appropriate for reasons explained in this report, there are issues where a single decisive national intervention is required to avoid the 'reinventing of wheels' and to reduce exposing communities to costs associated with region by region litigation.
- **f. Social durability**. Policy solutions to wicked or complex problems must be socially durable - meaning they must be capable of community support over a sustained period. The burdens imposed must be fair and proportionate and the pace of change demanded must reflect the scale of the task and the (at times) intergenerational origins of the problems to be addressed.
- **g. Effective intervention options**. Both regulatory and non-regulatory options to address issues should be seen to be objectively considered. Choice of intervention must be based on an assessment of what will most effectively achieve sustainable practice change (along with questions of public and private affordability). We should learn from international experience where that helps to identify effective and ineffective policy direction. Management tools need to be proven fit for purpose. Science should underpin decision-making wherever possible.
- **h. Adaptive management**. There will always be an element of uncertainty, in our understanding of the problem(s), the effectiveness of policy interventions and in the future pressures on resources that may arise. Adaptive management and the ability of management agencies to respond rapidly to new evidence and in the face of unanticipated events is critical (although it must be balanced against the need to provide a reasonable level of certainty for resource users).
- **i. Outcomes focus**. Because there is great complexity and variability in water quality, and because there is often uncertainty about cause and effect relationships, management responses need to keep a focus on outcomes and trends. Key questions will be "are we seeing what we want in our water bodies? Are we heading in the right direction?"
- **j. A systems approach**. Because of the wicked or complex nature of the problem we need to take a systems approach. That means that, when we think about the policy interventions, we need to also think about the changes needed to support the intervention and make it work in practice. This includes education and training and skills, IT and information management systems, science and technology, institutional structures and capacity. A systems approach necessitates a whole of government approach to policy implementation.

The RSWS regards these ten principles as some of the key considerations for *effective and efficient* solutions under the RMA. The above principles are relevant to determining whether the proposals are likely to be the least costly way to meet objectives and whether policy proposals will do what they are designed to do, not just in theory, but in practice.

APPENDIX 4

Implementation of Essential Freshwater: Implications for costs and capacity in the Regional Sector

Summary

The Regional Sector supports the Government's intent to accelerate improvement in water quality but has consistently raised the need to bring communities along, and to factor capacity and capability constraints into the rate of change. The Regional Sector does not consider that New Zealand has the capacity to deliver the proposal in the required timeframes. However, with prioritisation, redesign and a staged approach to implementation the package will deliver the intent. As proposed the package will require a scale of capacity that is simply not available in New Zealand in the short to medium term; it is critical that the existing capacity and capability is focussed on those aspects of the package, and in those places, where the most effort is required to meet the policy intent of halting and reversing the decline in water quality.

Councils have identified the following as most costly to the sector and provided indicative costs for some aspects. It is not a full assessment of costs to the sector.

- $23.5 million per annum in monitoring the new attributes – this figure does not include the cost to store and report data.
- Bringing forward of $45 million in spending on freshwater plans – through shifting investment earlier into years to December 2023. This represents a 50% increase in planning costs in the 2021/22 and 2022/23 years and does not include the cost of revisiting catchment limit processes that are already in train and have established limits with communities in either draft, proposed or operative regional plans.
- Funding of government-appointed planning commissioners.
- Significant increases in cost associated with meeting enhanced obligations for tangata whenua engagement, Mātauranga Māori monitoring, and the identification of tangata values and interests given the 168 unique iwi/hapū- Council relationships.
- Urgent establishment/expansion of information systems on wetlands, land use, farm practices, structures, fences etc to monitor compliance with NES.
- While it is difficult to estimate given that some parts of the proposal are still in option stage, the sector believes up to 10,000 additional consent applications will need to be processed[19]. This level of additional consent applications will require further staff and staff training or temporary engagement of consultants and contractors with associated administration and compliance monitoring costs.
- The concept of benchmarking in the intensification and N-cap proposal will come with significant cost. Benchmarking for nitrogen alone is estimated to cost $2,000 to $10,000 per farm. It will call on the same farm planning capacity needed to implement FEP across New Zealand.

Councils are heavily investing in operational work programmes and partnerships to improve water quality. A survey in 2018 identified that Councils contribute over $14 million per annum of good and services supported by 125 FTE to programmes to improve water quality and freshwater biodiversity; this expenditure will double over the 2018-2028 LTP period. Across local government, there is substantial investment in infrastructure upgrades to improve water quality. For example, Auckland Council has adopted both a water quality targeted rate ($452 m) to accelerate programmes aimed at cleaning up waterways and a natural environment targeted rate ($311 m) to improve Auckland's natural environment. Other than the exemplar catchments, this aspect

[19] For comparison, that is approximately the same number of resource consent applications the Regional Sector processes in total each year

of improving ecosystem health is not addressed in the proposed package. Councils are concerned that expertise, funding and landowner attention will be diverted to the planning and regulatory aspects of the proposal and perversely serve to slow down improvements in freshwater health.

Aspects of the proposal call on the same pool of expertise particularly in freshwater science, policy/compliance, rural professionals and experts on tangata whenua values and assessment. The Regional Sector advises that to implement the package as proposed:

- It will need an additional 50 FTE per annum until 2023 – a 40% increase - to accelerate regional plans. These FTE include scientists, planners and engagement experts. This expertise is also needed to advance other aspects of the proposal. Regional council scientists would be asked to design and set up new monitoring programmes at the same time as contributing to plan development. RMA expertise will be needed to establish approaches to the proposed NES, assess consent applications. Councils are already struggling to fill current vacancies for these types of roles.
- Capacity constraints that are unlikely to be solved by access to external resources as Councils already use external scientific, planning, economics, cultural advisers, social science and legal advice, and the concurrent nature of processes, across the country , given the condensed timeframe is likely to confound availability. These same experts are also in demand by submitters (plans and consents) and consent applicants.
- There is insufficient capacity of skilled professionals to produce the required number of FEPs within the current timeframes. This skill set will also be critical to the benchmarking inherent in the intensification and N-cap proposals.

Although, over the medium term, there may be some offsetting of these costs through a reduction in the budget required for plan appeals, councils will have little ability to address increased costs with increased rates until the 2021-31 Long Term Plan (LTPs) are prepared.

Direct and meaningful Government support for implementation will be essential, even if the package is redesigned. The nature of that support needs to be the subject of discussion between the Regional Sector and Government. Those discussions should focus on tangata whenua input, access to Government/CRI information and expertise and ,in the longer term, achieving alignment between national science funding and national policy expectations (as promoted through the EFW package) including an increased focus on applied science. Increased funding to Envirolink, LAWA and the National Environmental Monitoring Standards (NEMS) will be essential. There is an existing Environment Monitoring and Reporting group involving Councils, MFE and Statistics NZ which could oversee the work.

Engagement with Government should address the following questions:

- How to advance the proposals on tangata whenua values, Mātauranga Māori monitoring, the resourcing of iwi/hapū and the connection to Treaty Settlements?
- How might the Regional Sector access CRI and other science expertise for assistance with monitoring protocols? What is the potential for combined data systems and linkage to reporting initiatives and the acceleration of National Environment Monitoring protocol (NEMS) and LAWA and increased funding through Envirolink?
- What is the availability and accessibility of data in central government and CRI systems to inform community discussions on aquatic life, threatened species and any other aspects relevant to additions in the proposed NPS-FM?
- What is the availability and accessibility in existing or potential central government, industry and CRI systems on farm inventories, land use and land practices?
- How to accelerate development of national tools and maps such as a wetland inventory and mapping tool, FEP templates and auditing tools?

Background

The Regional Sector supports the Government's intent to accelerate improvement in water quality but has consistently raised the need to bring communities along, and to factor capacity and capability constraints into the rate of change. Since the 2011 NPS-FM, Councils have increased expenditure on freshwater science and planning, all acting towards improving the health of freshwater systems. Cost and capacity constraints will hinder the ability to further accelerate programmes.

All 16 Councils were surveyed to assess their current investment in freshwater planning, the information and monitoring they already have in place, and their approach to implanting the NPS-FM 2017. Six Councils were interviewed in depth on how they would adjust their approach given the proposed changes.

The costings and implementation issues are based on the proposal contained in the Action for Healthy Waterways, September 2019.

Overview of Council's existing approaches to implementing 2017 NPS-FM

All Councils have an operative water plan (or a plan under appeal) that addresses freshwater and some aspects of intensification and ecosystem issues that are the focus of the proposed changes.

Councils have structured their implementation of the NPS-FM into "planning areas" variously referred to with terms such as water management areas, zones, whaitua. Across New Zealand there are 70 of these planning areas. Councils have or intend to consult/engage with tangata whenua and communities in these areas to develop locally specific limits. In some regions these planning areas are same as the Freshwater Management Units (FMUs) but in others the planning area may contain multiple FMUs – not all FMU have been determined. Across NZ there is an estimated 200 FMUs.

Councils intend to fully meet the 2017 NPS-FM in two ways: half the Council intend to notify a single plan change incorporating all catchment limits and other regional provisions; the other half intend to progressively notify location-specific plans (or progressive plan changes to a region-wide plan.

Many regional plans already address broader aspects of ecosystem health alongside water quality and are already aligned with the proposed changes to the NPS-FM that clarify aquatic life and broader aspects of ecosystem health should be addressed alongside water quality. All Councils have region-wide plan provision that are in addition to catchment-specific limits. These region-wide provisions typically address issues such as fish passage, clearance of riverbeds and wetland protection.

All Councils report that it takes two years to gather an adequate information base for planning. That base involves additional monitoring (in addition to State of Environment monitoring), identification of tangata whenua values, discussions with communities on values, economic and social assessment, catchment modelling and development of management options. This work is complete in 40% of planning areas and underway in a further 30%.

Only 3 Councils have formally extended their timeline beyond 2025. All others had intended to notify plans compliant with NPS-FM by 2025; 6 Councils intend to notify plans prior to 2025 with all others notifying in 2025[20].

Councils are heavily investing in operational work programmes and partnerships to improve water quality. A survey in 2018 identified that Councils contribute over $14 million per annum of good and services supported by 125 FTE to programmes to improve water quality and freshwater biodiversity; this expenditure will double over the 2018-2028 LTP period. Across local government, there is substantial investment in infrastructure upgrades to improve water quality. For example, Auckland Council has adopted both a water quality targeted rate ($452 m) to accelerate programmes aimed at cleaning up waterways and a natural environment targeted rate ($311 m) to improve Auckland's natural environment. Other than the exemplar catchments, the

[20] https://www.mfe.govt.nz/fresh-water/national-policy-statement/regional-councils-implementation-programmes

operational partnership (catchment programmes) aspect of improving ecosystem health is not addressed in the proposed package. Councils are concerned that expertise, funding and landowner attention will be diverted to the planning and regulatory aspects of the proposal and perversely serve to slow down improvements in freshwater health.

Timelines for implementation under proposed changes

The proposed changes remove the ability to extend planning timelines out to 2030 but also clarify that compliance with the NPS-FM is based on the notification of decisions - not notification of a proposed plan - a clarification that effectively removes 2 years from Councils' timelines. Given the need to revisit the evidence-base, add new compulsory values and new attributes, all Councils will now be on a very similar timeline.

The evidence bases for existing plans and plans in process will all need reviewing and potentially revisiting in light of the proposed NPS, particularly the reframing of Te Mana o Te Wai, the new compulsory values and the new attributes.

The revised NPS-FM also requires new monitoring protocols, monitoring programmes and increased capacity to monitor the new attributes. Development of these will occur in parallel with planning processes. Scientists from the regional sector consider it is premature to add some of the new variables to the NPS-FM, and they are wary of using others in their current form. Several attributes lack clarify on which methodology to use and data requirements for calculating numerical attribute states. National Environment Monitoring Standards (NEMS) are need for collecting, analysis and reporting data.

In parallel, Councils would be setting up to implement the proposed NES requirements both in preparation of data/information systems, consent systems, compliance monitoring, permitted activity monitoring and enforcement procedures. Some of the proposed NES require considerable work including identifying wetlands, farm practices and benchmarking farms.

To complete the proposed package there will be many demands on Councils time and resources. These are set out in the table below. Communities, industries and iwi will need to adjust their capacity and funding if they want to effectively contribute to these processes.

Indicative timeline for Councils to implement proposed changes	
July 2020 to June 2021	• Monitoring design and protocols for new monitoring • Prepare evidence base for new compulsory values – aquatic threatened species, and tangata whenua/mahinga kai values • Engage tangata whenua and communities in vision and outcomes • Establish approach and systems for consenting, compliance monitoring and enforcement of NES and s.360 • For high Nitrogen catchments, baselines collected and threshold set
July 2021- June 2022	• Engage tangata whenua and communities in target states and limits • First year of monitoring new attributes • First tranche of FEP due and Tranche 1 stock exclusion
July 2022 – June 2023	• Drafting and testing of RSP and plan changes, technical reports and s.32 • Refinement of options with tangata whenua and communities • Prepare action plans for Appendix 2B attributes
July 2023 – Dec 2023	• Schedule 1 consultation • Notification of proposed RPS and regional plan(s) changes

The timeline is extremely challenging, particularly given that all Councils would be on a similar timeframe calling on the same external resources and stakeholders. Of particular note and discussed in more detail below are:

- The need to set the vision and outcomes before new monitoring begins.
- The need to have tangata whenua/mahinga kai values identified by June 2020 with attributes for the new tangata whenua compulsory values set by 2021.
- The need to set limits in the same year of monitoring the new attributes.
- The need to quickly establish the information base for implementing the NES and s.360 stock exclusion regulations.

The above timeline assumes that Councils are able to resource the additional work. Councils funding is set through the Long Term Planning process under the Local Government Act. Funding for 2020-21 year is already set as year 3 in the 2018-28 LTP. It can be changed through a special consultative procedure on 2020-21 Annual Plans although that would need to be initiated in early 2020. Changes to the 2020-21 Annual Plan would require information on changes to the NPS and NES to be confirmed very early in 2020 and are further complicated by new Councils still being in the establishment phase. Additional rating to support the accelerated programme is therefore unlikely to be available until July 2021 when the new 2021-2031 LTP comes through. Councils may be able to accelerate the vision work by adjusting existing planning work programmes but new monitoring requirements and the requirement to assemble information on new compulsory values are problematic given their urgency and costs.

Vision statement in the RPS

The regional sector questions the usefulness of this exercise. RMA plans operate at a detail level of attributes and there is very little scope for other than current state or improve. There are existing strategies in place which have already established visions– Environment Southland has *People, Water and Land – Te Mana o te Tangata, te Wai, te Whenua* developed in partnership with Ngāi Tahu ki Murihiku, Auckland Council is currently developing a strategy Our Water Future and has just finished consultation including that on a proposed vision - . '*te Mauri o te Wai o Tāmaki Makaurau – the life supporting capacity of Auckland's waters – is protected and enhanced'*.

These are expensive exercise and will deflect public attention and resources of tangata whenua and councils away from developing plan provisions. The proposal is particularly problematic if it has to be completed prior to developing objectives and limits and setting attributes as it will further crunch timelines.

Given the high demands on the package on Councils and all participants in freshwater management, the sector questions the priority and usefulness of this part of the package.

Preparing the evidence base for plans - Tangata whenua values

Most Councils have in place a partnership arrangement with local iwi, often established as part of Treaty legislation. Some post-settlement governance entities are still forming, and in the process of establishing arrangements with Councils. There is strong interaction between these partnership arrangements and the advancement of changes to regional policy statements and regional plans.

The form of the new compulsory values is not known; NPS provisions for either a tangata whenua or mahinga kai compulsory value have not been drafted. The Action for Healthy Waterways discussion document is clear that the identification of values, attributes etc. is a role for tangata whenua and the role of Councils is to enable and support tangata whenua locally. Councils have been working with tangata whenua to identify values including mahinga kai and include these in planning frameworks. These typically cost between $20,000 to $50,000 per planning area where there is a single iwi or an established grouping. It is uncertain whether these will need to be revisited.

There are 168 unique iwi-Council relationships[21], each of which will need to play a role in determining the new compulsory value. The current NPS-FM also refers to involvement of hapū reflecting a strong requirement for very local involvement of tangata whenua at catchment and potentially sub-catchment scale. To meet the 2023 timeframe, the majority of community discussion and the setting of limits should occur in the 2021-22 year, there is then time pressure to have information on tangata whenua values by June 2021.

Councils are concerned that the tight timeframes will prevent a genuine understanding and community discussion of tangata whenua values and the hinder the development of plan provisions that meet tangata whenua expectations.

Councils would welcome a discussion with Government on how to advance the proposals on tangata whenua values, the resourcing of iwi/hapū and the connection to Treaty Settlements.

Preparing the evidence base for plans – Aquatic life/threatened species

The addition of a new compulsory value on aquatic life/threatened species links closely with the addition of new attributes in Appendix 2B. Some Councils are confident that their existing plan provision adequately address threatened species, fish passage and other aspects of aquatic life/ecosystem health as proposed in the revised NPS. Others consider they would need to introduce more information into existing or proposed community consultation processes. The main implementation concerns are the logistics/scheduling and capacity constraints arising from having to discuss limits and/or actions plans at the same time as establishing monitoring of the new attributes.

Councils are considering a collective gap analysis across existing plan provisions to assess whether existing plan provisions meet the new requirements of the proposed NPS and identifying provisions that could be used in other regions. The work will include collective advice on aspects that are uncertain such as how to set load limits for suspended sediment (given the revised definition of a limit) and developing pragmatic plan provision for FMUs that are in the A-band and have very few risks in the catchment.

The discussion document at section 4.5 refers to a process where the Ministry for the Environment (MfE) will work with Councils to identify where plans need updating to include new requirement from the proposed changes. The Draft Regulatory Impact Statement at Section 6.1 states that "overall the new changes will not substantial alter existing freshwater planning processes". This statement and proposed approach by MfE align well with the Councils' proposal for a gap analysis.

The Department of Conservation and Fish and Game Councils also have responsibility for aquatic life and threatened species. In addition, the CRIs hold databases including the National Freshwater Fish Databases held by NIWA.

Councils would welcome a discussion with central government to assess the availability and accessibility of data in central government and CRI systems that could help inform community discussions on aquatic life, threatened species and any other aspects relevant to additions in the proposed NPS-FM. In the longer term, discussion should also focus on improving alignment between national science funding and national policy expectations.

Monitoring the revised Attribute set

As stated above, scientists from the regional sector consider it is premature to add some of the new variables to the NPS-FM, and they are wary of using others in their current form. Some still need testing, or refinement as to what is being assessed (is it fish extent, population or recruitment?) and some are not applicable in the most at-risk systems – for example, submerged plant are not suitable for shallow lakes. There is more clarity needed around methods usually achieved through developing National Environment Monitoring Standards (NEMS) for collecting, analysis and reporting data. This development of these protocols is not a minor task but there is

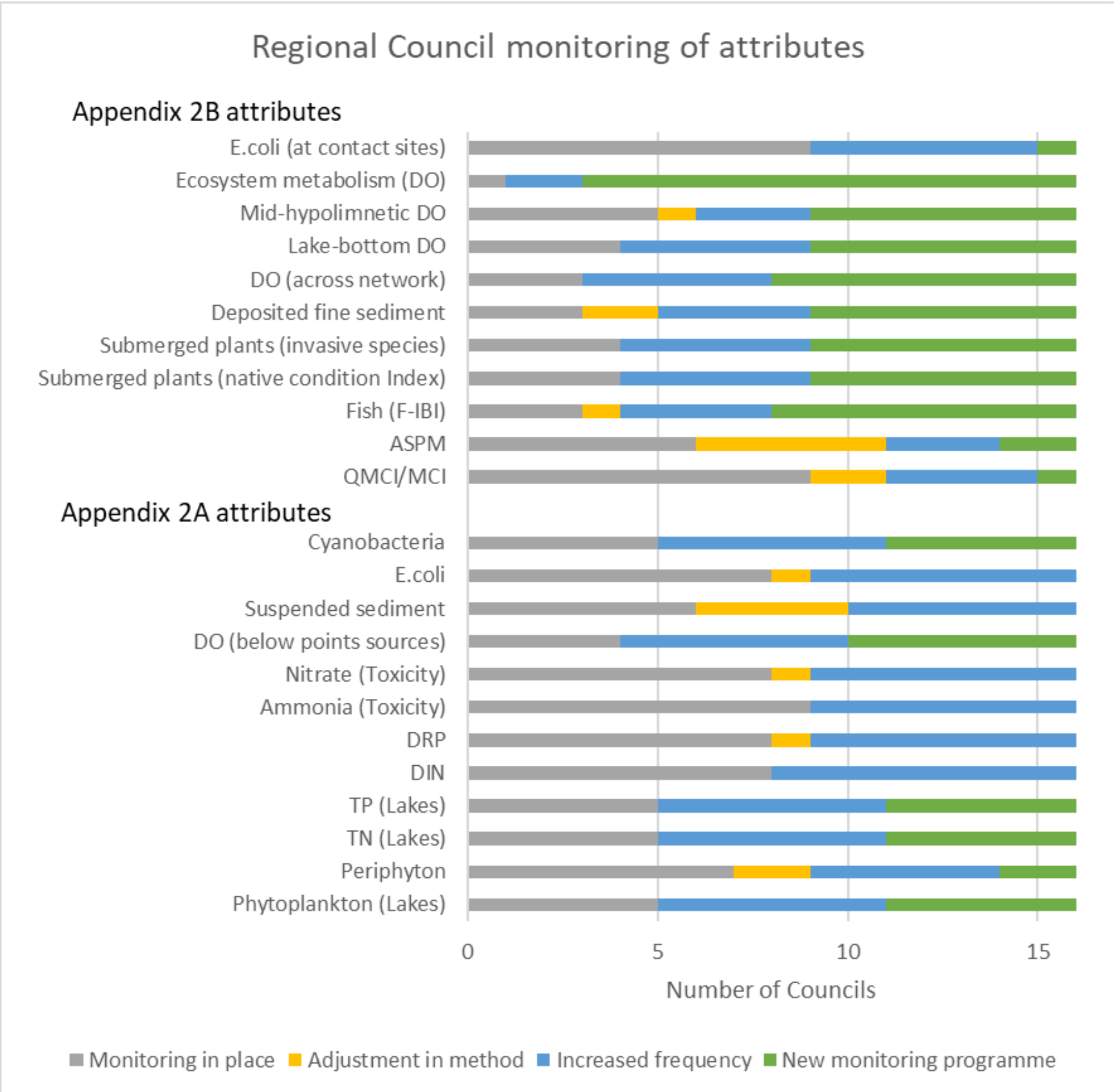
[21] http://www.tkm.govt.nz/

experience within the regional sector of monitoring all proposed variables. However, Councils will require access to CRI and other external scientists to develop protocols.

The NPS-FM as proposed puts a considerable new monitoring burden on Regional Councils. Some of the new attributes are already monitored by some of the councils but it does vary considerably. The burden is financial but also in a capacity sense. Regional Council scientists are being asked to design and set up new monitoring programmes at the same time as being asked to contribute scientific information for plans required by 2023. The accounting assessing and reporting requirements also represent a significant increase. In the same way as for monitoring this will require extra resourcing while scientists are also required for planning processes.

The more direct inclusion of Mātauranga Māori monitoring methods has significant resource implications for some regions, this includes Councils as well as tangata whenua.

The graph below shows the extent of adjustments Council will need to make to monitor the full suite of attributes set out the draft NPS-FM. Each council has assessed, for each attribute, whether it has existing monitoring in place, will need to adjust methods, will need to increase frequency either in time or space or has no existing monitoring and will therefore need a new monitoring programme.



Other than DIN, DRP and suspended sediment, the Appendix 2A Attributes are already in the NPS-FM 2017 and the need for new programmes and or increased frequency reflects those Councils still to fully implement monitoring under the current NPS-FM.

Of particular note in the Appendix 2B attributes is that at least half the councils need to implement new programmes for Fish-IBI, the lake-related DO measures and ecosystem metabolism.

There is not enough clarity in monitoring requirements to accurately cost the proposals. Two Councils have provided estimates on the additional monitoring requirements, assuming certain methods, frequency and analysis. The new programmes work out at $130,000 to $150,000 per FMU, of which about $45,000 is for lake monitoring. Given there is an estimated 200 FMU, and assuming that half of these have lakes in then, then estimated cost is $23.5 million per annum, and excludes the cost to store and report data.

Councils are considering a collective approach to the development of monitoring protocols and systems for recording data particularly for the new attributes.

Councils would welcome a discussion with Government to assess the availability and accessibility of data in CRI systems, access to staff from CRIs and other research agencies for assistance with monitoring protocols, the potential for combined data systems and the link to reporting initiatives.

Increased funding to Envirolink, LAWA and the National Environmental Monitoring Standards (NEMS) will be essential. In the longer term, discussion should also focus on achieving alignment between national science funding and national policy expectations, including an increased focus on applied science. There is an existing Environment Monitoring and Reporting group involving Councils, MFE and Statistics NZ which could oversee the work.

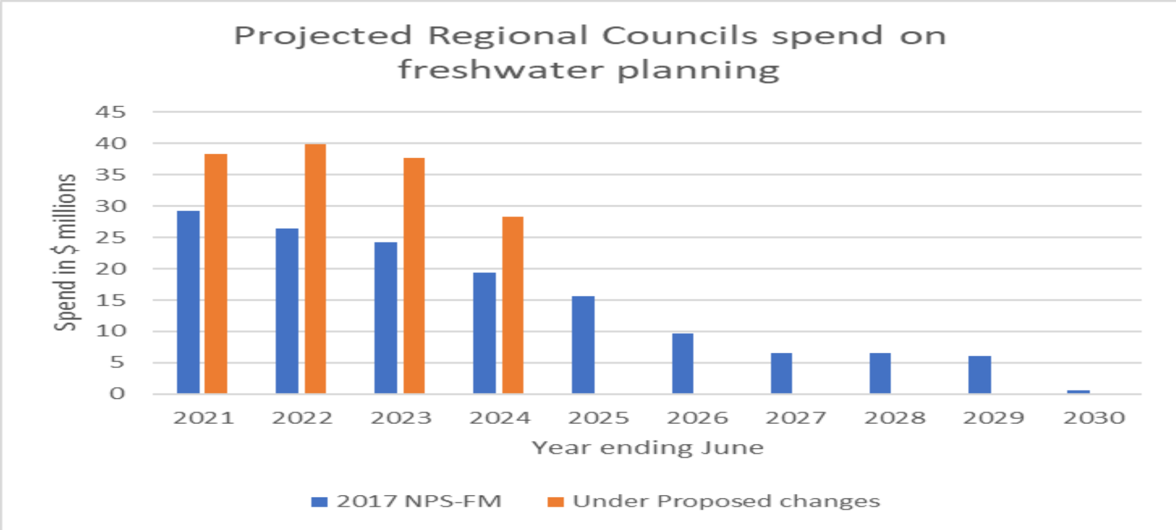
Condensed planning timelines – cost implications

The condensed planning timelines will require Councils to redistribute planning costs into earlier years.

The graph below compares, for the combined regional sector, the cost trajectory for getting all plans notified under the existing NPS-FM with that required to notify all plans by December 2023. Overall, $45 million of expenditure would need to shift into years up to December 2023 – a 50% increase in planning costs in the 2021/22 to 2022/23 years. The reallocation requires an assumption that some of the expenditure can be brought forward into the 2020/21 year even though funding through the next LTP cycle does not start until July 2021. Councils recognise that this is a redistribution of costs, and that in later years it will be offset by the removal of appeals to the Environment Court on other than points of law.

A similar assessment of FTE requirements estimates an additional 60 FTE required in years 2021/22 and 2022/23 - a 40% increase over existing FTE. Of the additional FTE 25 are scientists, 25 are planners/RMA specialists and the remainder are community and iwi/hapū engagement specialists. The science and RMA skills sets are also critical to establishing the new monitoring programmes and implementing the proposed NES. The proposal has multiple demands for these skills sets and councils are already struggling to fill current vacancies for these types of capacity. Capacity constraints that are unlikely to be solved by access to external resources. Councils already use external scientific, planning, economics, social science and legal advice, and the concurrent nature of processes across the country is likely to confound availability. Industries, consent holders, communities, iwi and many others will also have demand for these people.

The analysis of costs and FTE does not include revisiting catchment limit setting processes that are already in train and have established limits with communities in either draft, proposed or operative regional plans.



National Environmental Standards – Information needs

The draft National Environmental Standards and Stock Exclusion Regulations require an information base and mapping of wetlands, land use, farm practices, structures, fences etc. All Councils have mapped significant wetlands, but the proposal requires mapping down to 500 m^2. There are emerging remote sensing techniques – these are being trialled and the ability to map to a very small scale is unknown, and the analysis/data is expensive. Ground truthing may still be required particularly for compliance/enforcement procedures. Councils are pleased to see that Government has attempted to map low slope land for the purposes of stock exclusion regs and would like this approach extended to other parts of the proposal.

A major uncertainty for councils is the proposal around Farm Environment Plans – the detail is not finalised and neither the role of councils nor the connection to compliance/enforcement and existing FEP are clear. Councils endorse a system of farmer/grower-owned plans with an emphasis on achieving good management practice. However, Farm Environment Plans provide important data to Councils to track progress against RMA plan objectives, to conduct catchment accounting, provide information to assess compliance and prioritise compliance monitoring. The FEP system must have an assurance system that has the confidence of Councils and their communities and tangata whenua.

The proposal needs further refinement including the role of Council in gathering and acting on information. Systems will be needed for gathering, storing and reporting data and progress. There is a strong rationale for these systems being nationally-driven, given that FEP are used by government, industry and market quality assurance systems as well as Councils. Development of parallel systems is not efficient and places even greater demands on farmers/growers.

Councils would welcome discussion with government on the development of national tools such as a wetland inventory and mapping tool, FEP templates and auditing tools, and an inventory of farms that allows tracking of progress with FEP and audit. Given the speed with which Councils will have to set up systems for compliance , an initial focus on existing national databases with information on land use, land practices etc. is warranted.

National Environmental Standards – Consent requirements and compliance monitoring

The time between the finalisation of the regulations and the time to implement is very tight. Increased consenting requirements will increase the demand for RMA consultants in the preparation of applications and consultancy support to Councils. Implementing the regulations will call on similar resources as those needed to accelerate planning, evidence gathering and monitoring. It is difficult to estimate the number of additional consents likely to be required but it is significant (potentially tens of thousands across the country). As an example, in the Waikato, the proposed N-Cap provision will generate the requirement for around 400 consents in a single catchment (not region wide). This equates to approximately 2 FTE's over a year to process consents for just one rule in the proposal across one council.

Both the intensification and the N-cap proposal require benchmarking existing discharges. The benchmarking is estimated to cost $2,000 per farm, but the system-wide components of such a benchmarking process are complex. Benchmarking for Nitrogen in the Taupo catchment was approximately $1,350,000, of which $593,000 was internal labour costs and $759,000 external expenditure to AgResearch. This equated to an average of approximately $11,700 per farm. Again, this benchmarking will call on the same expertise that is also needed to inform planning, and to develop FEP across New Zealand.

Some of the cost of implementing the regulations will fall to consent applicants, additional costs on those who are being asked to adjust practice to improve water quality. The amount covered by Council will be a political decision and is more than likely to further increase Council costs. The Stock Exclusion regulations have no provisions for cost recovery for monitoring and enforcing s.360 regulations.

Capacity constraints

The regional sector does not consider that New Zealand has the capacity to deliver the proposal in the required timeframes. Aspects of the proposal call on the same base pool of expertise particularly in freshwater science, policy/compliance, rural professionals and experts on tangata whenua values and assessment. The science and planning requirement simply to support the shorter planning timeframes is estimated to require an additional 25 planners and 25 scientists. These estimates exclude the FTE needed to establish new monitoring programmes and recording systems. Tasman District Council have estimated additional staff requirements for the whole package as at least 6-8 additional FTEs to meet the 2023 deadline to develop and process the necessary plan changes, new monitoring programmes, and implementation plans, and at least 8-12 additional staff across policy, environmental information, consents and compliance departments, to meet the ongoing requirements. Tasman District Council represents 5% of the FMU and 13% of the planning areas across New Zealand – meaning their additional capacity could be factored by 8 to 20 times to give New Zealand's requirement. This scale of capacity is simply not available in New Zealand in the short to medium term; it will be critical that the existing capacity and capability is focussed on those aspects of the package and in those places where the most effort is required to meet the policy intent of accelerating work to halt and reverse the decline in water quality.

The table below sets out the critical capacities required to support each aspect of the proposal. Although the package has only a small component of operational work programmes in the exemplar catchments, Councils have extensive programmes and partnerships for catchment restoration. These too call on the same resources and are included in the table below.

Type of expertise	Specifics	Component of the package				
		Shorter planning timeframes	Increased monitoring	NES databases	NES compliance and enforcement	Catchment programmes
Scientists	Freshwater ecologists, catchment modellers, and expertise in actions	↑	↑	↑		↑
Freshwater planners	Planning/policy/consent staff	↑			↑	

Farm advisory	Farm planners and farm systems expertise	↑		↑	↑	↑
Tangata whenua values	Eliciting, recording and assessing attributes for tangata whenua values, Mātauranga Māori monitoring	↑	↑			↑

There is insufficient capacity of skilled professionals to produce the required number of FEPs within the current timeframes. It will take time to grow this capacity (university, experience, certification). In Canterbury, it has taken approximately 5-years to deliver c. 2,500 farm environment plans under its current planning framework with support from industry and irrigation schemes.

Councils would welcome a discussion with Government on a strategy to increase capacity in critical skills, noting that a significant increase in New Zealand's capacity cannot be achieved in time to assist with meeting the 2023 deadline. Therefore, Councils would also welcome a discussion of how existing resources within government and CRIs/science agencies could assist in the interim, and in the long term how science funding can be more closely aligned to government policy priorities.

As stated above Councils would welcome a discussion with Government on how to advance the proposals on tangata whenua values, the resourcing of iwi/hapū and the connection to Treaty Settlements.

Table 7 – Ammonia (Toxicity)

Value (and component)	Ecosystem Health (Water Quality)	
Freshwater Body Type	Rivers	
Attribute Unit	mg NH4-N/L (milligrams ammoniacal-nitrogen per litre)	
Attribute band and description	**Numeric Attribute State**	
	Annual Median	Annual Maximum
A 99% species protection level: No observed effect on any species tested	≤0.03	≤0.05
B 95% species protection level: Starts impacting occasionally on the 5% most sensitive species	>0.03 and ≤0.24	>0.05 and ≤0.40
C 90~~80~~% species protection level: Starts impacting regularly on the 10~~20~~% most sensitive species (reduced survival of most sensitive species)	>0.24 and ≤0.54~~1.30~~	>0.40 and ≤0.92
National Bottom-line	**0.54~~1.30~~**	**0.92**
D Less than 90% species protection level: Starts impacting regularly on the 10% most sensitive species (reduced survival of most sensitive species). Starts approaching acute impact level (ie risk of death) for sensitive species	>0.54~~1.30~~	>0.92
Numeric attribute state is based on pH 8 and temperature of 20°C. Compliance with the numeric attribute states should be undertaken after pH adjustment.		

Source: Hickey, C. W. (2014). Derivation of indicative ammoniacal nitrogen guidelines for the National Objectives Framework. NIWA Memo to MfE (MFE13504; 7 March 2014). https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/derivation-of-indicative-ammoniacal.pdf

Table 1: Freshwater ammoniacal-N toxicity guidelines:

Guideline Type [a]	Grading Ammoniacal-N concentration (mg NH_4-N /L)	Surveillance Ammoniacal-N concentration (mg NH_4-N /L)	Description of Management Class
NOF attribute state A	<0.03	<0.05	Pristine environment with high biodiversity and conservation values. Based on statistical 99% species protection level.
NOF attribute state B	0.03-0.24	0.05-0.40	Environments which are subject to a range of disturbances from human activities, but with minor effects. Based on statistical 95% species protection level.
NOF attribute state C [b]	0.24-0.54	0.40-0.92	Environments which are measurably degraded and which have elevated concentrations from point source discharges or diffuse organic inputs. Potential for marked diurnal temperature and pH variability associated with excessive macrophyte, river periphyton and lake phytoplankton growths. Based on statistical 80% species protection level.
Acute	3.9	7.8	Environments which are significantly degraded. Probable chronic effects on multiple species.
Method of comparison [c]	Annual median	Annual 95th percentile	

Note: Based on pH 8.0 and 20°C. Compliance with the numeric attribute states would be after pH adjustment.
[a] MfE proposed NOF band classification [1]. Technical basis provided in Description of Management Class. "Acute" values are from U.S. EPA (2013) [3].
[b] Note this bottom line threshold differs from that proposed in MfE (2013). Values are based on the 90th percentile threshold (Appendix 2).
[c] Significant daily or seasonal variation in physico-chemical conditions (primarily pH) may require incorporation of short-term monitoring data into the NOF guideline assessment for chronic exposures.

Table 8 – Nitrate (Toxicity)

Value (and component)	Ecosystem Health (water quality)	
Freshwater Body Type	Rivers	
Attribute Unit	mg NO_3 - N/L (milligrams nitrate-nitrogen per litre)	
Attribute band and description	**Numeric Attribute State**	
	Annual Median	Annual 95th Percentile
A High conservation value system. Unlikely to be effects even on sensitive species.	≤1.0	≤1.5
B Some growth effect on up to 5% of species.	>1.0 and ≤2.4	>1.5 and ≤3.5
C Growth effects on up to 10~~20~~% of species (mainly sensitive species such as fish). No acute effects.	>2.4 and ≤3.8~~6.9~~	>3.5 and ≤5.6
National Bottom-line	**6.9 ~~3.8~~**	**9.8 5.6**
D Growth effects on more than 10% of species (mainly sensitive species such as fish). Impacts on growth of multiple species, and starts approaching acute impact level (ie risk of death) for sensitive species at higher concentrations (>20 mg/L).	~~>6.93.8~~	>5.6

Note: This attribute measures the toxic effects of nitrate, not the trophic state. Where other attributes measure trophic state, for example periphyton, freshwater objectives, limits and/or methods for those attributes will be more stringent.

Source: Hickey, C. W. (2013). Updating nitrate toxicity effects on freshwater species. Prepared for MBIE. Funded by Envirolink. NIWA Client Report HAM2013-009. 39 pages. http://envirolink.govt.nz/assets/Envirolink/1207-ESRC255-Updating-nitrate-toxcity-effects-on-freshwater-aquatic-species-.pdf

The recommended freshwater nitrate toxicity guidelines are:

Guideline Type	Grading Nitrate concentration (mg NO_3-N /L)	Surveillance Nitrate concentration (mg NO_3-N /L)	Description of Management Class
Chronic – high conservation value systems (99% protection)	1.0	1.5	Pristine environment with high biodiversity and conservation values.
Chronic – slightly to moderately disturbed systems (95% protection)	2.4	3.5	Environments which are subject to a range of disturbances from human activities, but with minor effects.
Chronic – highly disturbed systems (90% protection)	3.8	5.6	Environments which have naturally seasonally elevated concentrations for significant periods of the year (1-3 months).
Chronic – highly disturbed systems (80% protection)	6.9	9.8	Environment which are measurably degraded and which have seasonally elevated concentrations for significant periods of the year (1-3 months).
Acute	20	30	Environments which are significantly degraded. Probable chronic effects on multiple species.
Method of comparison	Annual median	Annual 95th percentile	

APPENDIX 6

RSWS Technical Critique of STAG DIN/DRP Attribute

28 August 2019

General support for proposals to "raise the bar on ecosystem health":

1. We support the drive to improve Ecosystem Health throughout New Zealand waterways and recognise this will be achieved through improvements at catchment (e.g. nutrient and sediment generation) and reach scale (e.g. local habitat quality, riparian condition).
2. There are multiple stressors that influence Ecosystem Health (e.g. flow, temperature, sediment, nutrients, habitat) through direct and indirect pathways (e.g. Figure 1), so achieving improved outcomes will usually require a variety of actions appropriate to the local context (see pg. 43 of Action for healthy waterways discussion document)
3. Direct toxic effects of nitrate and ammoniacal nitrogen on stream fauna are already addressed through existing NPS-FM attributes
4. Nutrients also affect Ecosystem Health through eutrophication (i.e. nutrient enrichment leading to excessive algae/periphyton) and associated stressors (e.g. degraded habitat, food web changes and dissolved oxygen variability)
5. Eutrophication in rivers is addressed through the Periphyton attribute in the current NPS-FM. Guidance for this attribute also requires consideration of downstream waterbodies.
6. Periphyton biomass is an important component of Ecosystem Health and influences multiple values including recreation, mahinga kai and sports fisheries. Nutrient management will often (but not always) be required to achieve desired periphyton outcomes – stream shade can also be effective at controlling periphyton biomass in small streams, although potential consequences for downstream waterbodies will need to be considered
7. We recognise there is a gap in national direction for nutrient management of primary production in those waterways that do not have conspicuous periphyton growth (e.g. soft-bottomed waterways that may be dominated by macrophytes – roughly 25% of NZ waterways)
8. Existing and proposed NPS-FM monitoring requirements (e.g. fish, macroinvertebrates and ecosystem metabolism) are likely to largely address the gap for waterways without conspicuous periphyton, and complement the existing Ecosystem Health attributes by requiring actions to address 'Poor' states of Ecosystem Health indicators
9. We support further development of attributes, relevant to the Ecosystem Health value, that recognise natural variability and local context, so that responses can be appropriately and effectively targeted

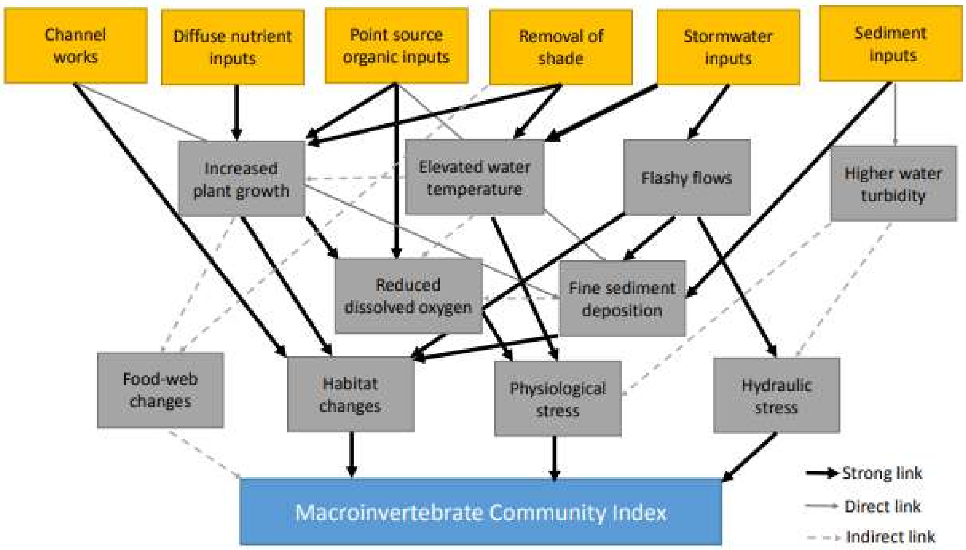


Figure 1 *Pathways by which various pressures (orange boxes) influence the MCI.*

Source: Collier et al. (2014).

STAG proposal for a national DIN/DRP attribute

10. STAG have recommended a compulsory DIN/DRP attribute[22] that sets out a single set of numbers that would apply to all rivers throughout New Zealand. In practice, limit-setting in many rivers may result in more stringent nutrient levels than those proposed by STAG due to requirements for managing periphyton biomass and sensitive downstream environments (see pages 47-49 of discussion document).
11. The nutrient attributes are based on analysis of the relationships between DIN & DRP and a suite of indicators of Ecosystem Health (MCI, QMCI, ASPM, Fish IBI, Chla and three functional indicators) using a range of datasets from streams throughout New Zealand.
12. Implicit in the STAG approach is an assumption of a causative relationship between increasing or decreasing nutrient levels and changes in Ecosystem Health. That is, reductions in DIN and DRP below the proposed national bottom-line will result in improvements in Ecosystem Health. However, the technique they are using identifies correlations rather than causation and there is a very real risk that observed correlations between DIN/DRP and Ecosystem Health measures are spurious (i.e. observed relationships are driven by other, hidden, causative factors). This creates a very significant risk that actions taken to reduce nutrient levels within a specific catchment or FMU, will fail to address the underlying causes of degraded Ecosystem Health.
13. The risk of identifying spurious correlations can be mitigated by undertaking a multi-factor analysis and identifying the relative effects of inter-correlated, or confounding variables. STAG have not taken confounding factors into account in their analysis.
14. Catchment vegetation cover and land use are often identified as the ultimate drivers of stream ecosystems and more proximate drivers (e.g. nutrients, sediment, temperature and habitat) often respond to changing land use. Therefore, without accounting for multiple, inter-correlated variables, nutrients may be assumed to drive Ecosystem Health, when other variables (e.g. sediment, temperature) may be the underlying cause, or interact with nutrients in complex ways

[22] Freshwater Science and Technical Advisory Group. Report to the Minister for the Environment. June 2019.

15. Figure 2 shows results of recent analysis carried out for MfE by Dr Ton Snelder. The plots below show the response of MCI to a range of predictors when all other variables in the model are held at their mean value (i.e. assessing the relative importance of each predictor). The predictor panels are arranged top left to bottom right in order of importance. In this analysis, NO3N (usually the largest contributor to DIN) is ranked 11th in terms of predictor importance for MCI (DRP was not an important predictor in the model). The top-ranked predictors were related to land cover (proportion of upstream catchment in indigenous forest), elevation, rainfall and substrate. There is usually a very strong relationship between nitrate levels and catchment land use, so correlations between nitrate and measures of Ecosystem Health may relate more strongly to catchment land use (and the myriad changes cascading from land use change) rather than direct or indirect effects of nutrients themselves.

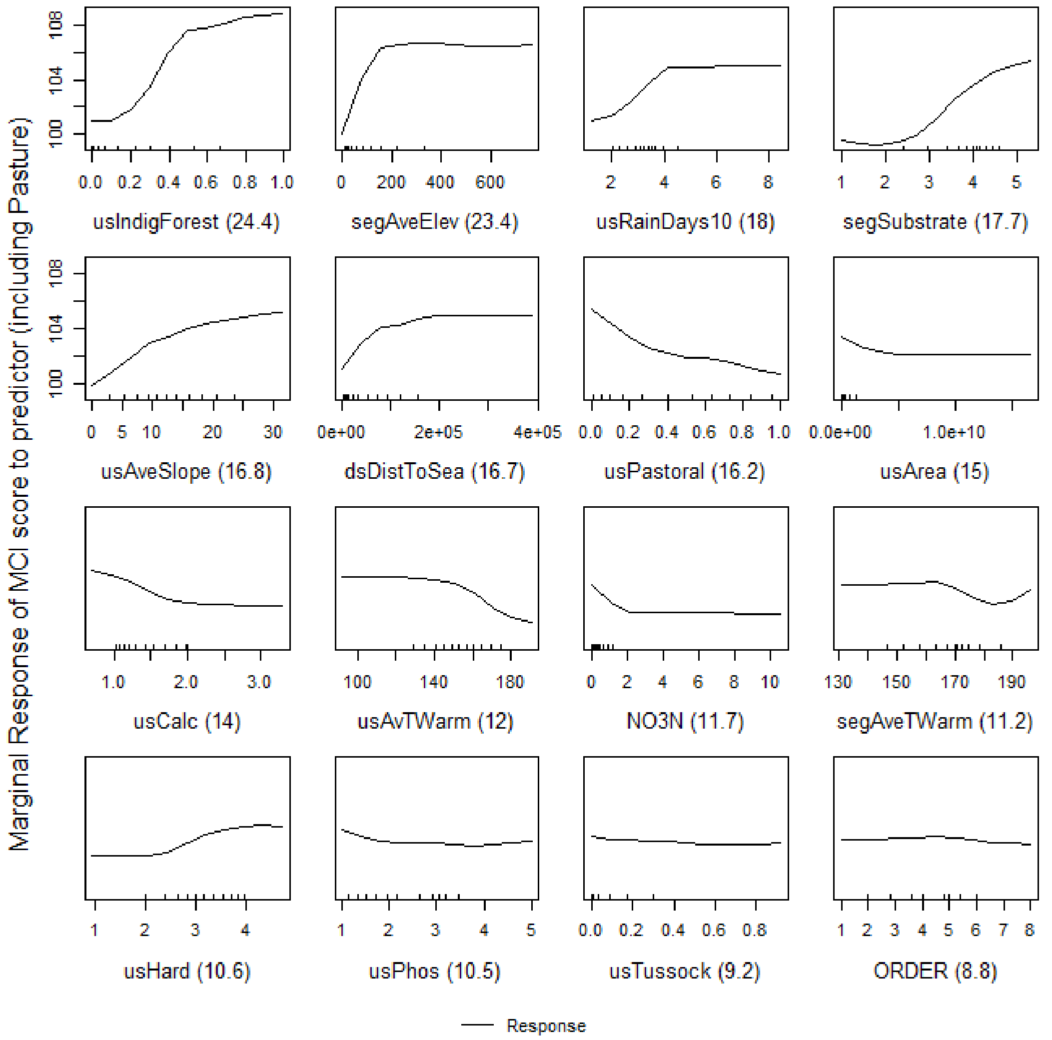


Figure 2. Source: Snelder_PredictMCIUsingRF. Analysis for MfE.

16. In a comprehensive national study aimed at identifying biological indicators of relevance to freshwater policy, Clapcott et al (2017) concluded "*the MCI is responsive to multiple stressors, but not all stressors, and as such provides a good indicator of the overall condition of the macroinvertebrate component of stream ecosystem health. However, the MCI is not diagnostic and cannot inform specific management decisions on resource use*". In their analysis, chlorophyll a, sediment, slope and flow were identified as the most important drivers at reach scales, whereas vegetation cover, flow and slope were most important at catchment scales.

17. STAG have assumed that correlations between dissolved nutrients and measures of Ecosystem Health are "diagnostic" – using this to determine nutrient attribute thresholds. This is inappropriate. The "multiple lines of evidence" approach is actually a series of potentially spurious correlations, where other inter-correlated drivers of ecosystem health are ignored.
18. If the DIN/DRP attribute could overcome the significant risk of spurious correlations (e.g. through accounting for inter-correlations), we have several other concerns relating to the variability inherent in the collected datasets and the resulting predictive power of a national set of numbers.
19. The DIN/DRP approach proposed by STAG is based on a premise that there is a single set of DIN/DRP concentrations that can reliably predict Ecosystem Health outcomes at the national scale.
20. As one would expect, there is considerable variation (scatter) in the national datasets used by STAG to assess relationships between DIN/DRP and measures of Ecosystem Health. Some of this variability is explained by the observed relationships, but a large proportion of the variation is unexplained. This affects the predictive power of observed relationships. For example, there is considerable scatter in the MCI dataset used by STAG (see Figure 3 below from draft version of STAG report), to the extent where the full range of MCI values occur at DIN and DRP values exceeding the proposed national bottom-lines. That is, MCI values can be 'Excellent' at nutrient concentrations above the proposed bottom-line (i.e. 'False positives'). There are also 'False negatives' – sites where nutrient concentrations are below the proposed bottom-line, yet MCI values are 'Poor'. The extent of false site classifications has not been assessed (to our knowledge), but would be a valuable test of the predictive power of the DIN/DRP relationships.

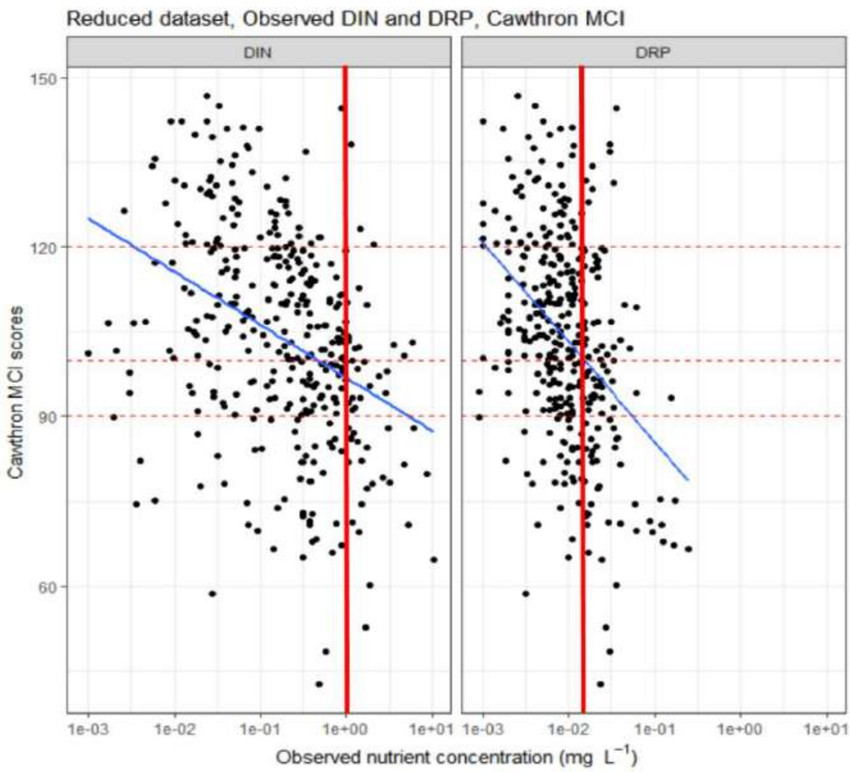


Figure 3: Relationships between the MCI scores for Regional Council monitoring sites and the observed site median DIN and DRP for 375 sites distributed throughout New Zealand. The blue lines are linear regressions. Source: "25.06.2019 – STAG report addendum – Nutrient metrics for circulation to working groups" [Red lines have been added to show proposed national bottom-lines]

~~21. With information currently available from STAG, it is not possible to assess the degree of variability in the datasets used by STAG, or the strength of statistical relationships~~

22. One approach to improving predictive power would be to develop regional, rather than national models using a suite of relevant driver variables. Regional models tend to perform better than national models by taking local context into account. Recent research in Waikato and Horizons regions have been useful in identifying important drivers of Ecosystem Health.
23. In Waikato Region, Pingram et al. (2019) found that *"improving sediment, riparian and instream habitat management groups … could reduce the extent of Poor QMCI scores by around a third each, each equivalent to c.2600-2800km of the stream network (<1000km for nutrient management; Table 2)."*
24. In a survey-based study of Otago streams, Wagenhoff et al (2011) found that *"Fine sediment seemed the more pervasive stressor, apparently counteracting and overwhelming any initial subsidy effect of increased nutrients, and accounting for more of the variance in biological response variables.*"
25. In the Manawatu region, Graham et al (2019) identified that "*the best-fitting model for each macroinvertebrate metric consisted of a combination of physicochemical, hydrological, and periphyton drivers, highlighting that macroinvertebrate relationships with environmental drivers are complex*". They identified that "*Periphyton yield (max or mean Chl a) and flow (median flow) were selected in all four best-performing multiple linear models for MCI*". (See Figure 4.4.10 below)

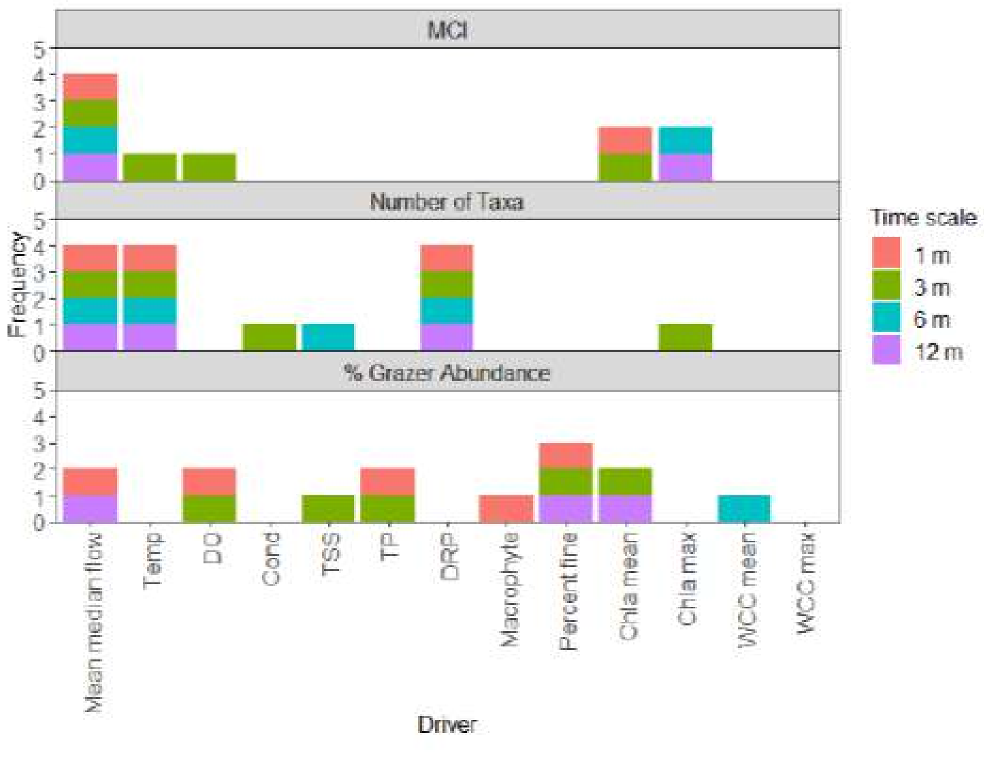


Figure 4.4.10: Frequency of drivers in best-fitting models for each invertebrate metric at the four timescales.
This is for the dataset of all sites with effective flows.

26. There is uncertainty about how Ecosystem Health measurements, associated with existing and/or proposed monitoring requirements, might influence requirements to achieve the DIN/DRP criteria. For example, where Ecosystem Health is measured as 'Fair' to 'Excellent' based on MCI or Fish IBI, but nutrient levels exceed bottom-lines, would nutrient reductions still be required? If

robust, regional research identified specific drivers for ecosystem health (e.g. Pingram et al 2019), would the national DIN/DRP attribute 'trump' this research and require reductions in nutrient levels, despite other factors being demonstrated as the most effective way to achieve desired ecosystem health outcomes?

27. The conference presentation by Death et al (2018) is identified by STAG as the foundation for the DIN/DRP approach. In that analysis there were 16 different lines of evidence, with ten of those relating to invertebrate metrics. Across those 16 measures the range in DIN bottom-lines (C/D threshold) was 0.2 to 9.1 mg/L, and the range for DRP was 0.012 to 0.275 mg/L. Following weighting of individual measures and removal of measures showing non-significant relationships, Death et al. (2018) proposed 'average' bottom-lines of 1.66 and 0.054 mg/L for DIN and DRP, respectively.
28. Ecosystem Health is described by multiple components (pg. 42 of discussion document). It seems unreasonable that a single set of numbers for DIN and DRP can be meaningful across all measures of Ecosystem Health at a national scale. The approach taken appears to be a gross simplification of very significant complexity in both the measures of Ecosystem Health and the multiple and varying drivers of those measures.
29. The proposed STAG bottom-lines are 1.0 and 0.018 mg/L for DIN and DRP, respectively. It is not clear how and why STAG have altered the datasets used by Death et al (2018).
30. In the independent peer-review carried out by eminent lake scientist Prof. David Hamilton, the most substantive criticisms of the approach adopted by STAG related to the issue of correlation vs causation, decisions made regarding the suite of indicators (i.e. the make-up of the multiple lines of evidence) and the choice to use p-value rather than R^2 to determine whether individual measures should be included or not. It is not clear how Prof. Hamilton's concerns have been addressed during STAG's final development of the DIN and DRP attributes for New Zealand rivers.

Recommendations

- We recommend the proposed DIN/DRP attributes should not be included in the NPS-FM
- We recommend strengthening existing attributes and guidance in the NPS-FM so there are four controls for nutrient impacts on ecosystem health based on the mechanisms that nutrients impact on ecosystem health
- Three types of control are in the NPS-FM now i.e. the ammonia toxicity table, the periphyton attribute (and associated notes) and the nitrate toxicity attribute.
- It is recommended that each of these be amended from their current form in the NPS-FM. Each of these has clear, peer reviewed science to inform policy and an established mechanism/rationale by which setting limits in policy provide protection for ecosystem health.
- These controls should be able to be applied in an effects-based manner, customisable to specific regions, FMUs or catchments. This is the approach that regional councils are currently taking with regard to nutrient management.
- The level of toxicity allowed for as the national bottom-line is a policy decision. The science is clear about what percentages of species protection is provided for at differing concentrations. Lowering the concentration that is the national bottom-line for toxicity is a potential way to strengthen protection for ecosystem health with a clear set of evidence to back up the setting of the thresholds.
- The fourth control is consideration of downstream nutrient sensitive environments. The ammonia attribute and nitrate toxicity attribute should be amended to provide a similar note or policy around accounting for sensitive downstream environments as is provided in the current Periphyton attribute. Further, the periphyton attribute should keep this consideration of downstream environments with its requirements to set both DIN and DRP exceedance for periphyton growth.

- Overall, providing further clarity in the NPS-FM around setting nutrient limits for ecosystem health is recommended. For example, further guidance would be valuable on the ammonia toxicity, nitrate toxicity and periphyton requirements as well as those of downstream environments in a catchment or freshwater management unit. Elevating the guidance on setting nutrient exceedance criteria from the footnotes of an attribute table to another part of the policy framework is potentially a start for this.
- It is also recommended that consideration be given to ensuring the information required (monitoring and science) for setting the nutrient criteria for periphyton is being undertaken and resourced both nationally and regionally.

References

Clapcott J, Wagenhoff A, Neale M, Storey R, Smith B, Death R, Harding J, Matthaei C, Quinn J, Collier K, Atalah J, Goodwin E, Rabel H, Mackman J, Young R (2017). Macroinvertebrate metrics for the National Policy Statement for Freshwater Management. Prepared for the Ministry for the Environment. Cawthron Report No. 3073. 139 p. plus appendices.

Collier KJ, Clapcott J, Neale M (2014). A macroinvertebrate attribute to assess ecosystem health for New Zealand waterways for the national objectives framework – Issues and options. Environmental Research Institute report 36, University of Waikato, Hamilton.

Death, R. G., Canning, A., Magierowski, R. and Tonkin, J., 2018. Why aren't we managing water quality to protect ecological health?. In: Farm environmental planning – Science, policy and practice. (Eds L. D. Currie and C. L. Christensen). http://flrc.massey.ac.nz/publications.html. Occasional Report No. 31. Fertilizer and Lime Research Centre, Massey University, Palmerston North, New Zealand. 13 pages.

Graham, E. Stephens, T., Wright-Stow, A., Matthews, A., Brown, L., Patterson, M. and Patterson, M. (2019). Drivers of macroinvertebrates in the Horizons region. NIWA Client Report No: 2019136HN. Prepared for Horizons Regional Council and DairyNZ. 103 p.

Pingram, M.A., Collier, K.J., Hamer, M.P., David, B.O., Catlin, A.K. and Smith, J.P., (2019). Improving region-wide ecological condition of wadeable streams: Risk analyses highlight key stressors for policy and management. Environmental science & policy, 92, pp.170-181.

Wagenhoff, A., Townsend, C.R., Phillips, N. and Matthaei, C.D., (2011). Subsidy-stress and multiple-stressor effects along gradients of deposited fine sediment and dissolved nutrients in a regional set of streams and rivers. Freshwater Biology, 56(9), pp.1916-1936.

Appendix 7

Notes on Implementation/Drafting/Enforceability

There are significant issues with the way both the NES and s360 regulations are currently drafted, that impact on the ability for them to be understood, implemented and enforced. In this section some examples are shown, but these are by no means all the issues in the documents. It is suggested that the regional sector formally offers assistance at the redrafting stage to help check things from an implementation and enforceability perspective. Members of CMG and CESIG have particular skills in this area.

A three lens approach is suggested for rewriting:

1) Write in a way that is enforceable under the RMA. E.g. there is a workable rules hierarchy and if standards/regulations are not met there is an offence against the RMA.

2) Ensure there is consistence of responsibility. I.e. is the regional council or the FEP auditor responsible for ensuring farming related standards are met.

3) Ensure consistency of definitions and rules. There is room for some provisions to become guidance rather than regulation (e.g. fish passage).

Some examples of unworkable rules are:

1) Any rule that is 'time' linked.

   E.g. 21(f) – the bed of the substrate is stable for at least four fifths of the time, 29(1) – holding stock for more than 30 days in a 12 month period or for more than 10 consecutive days.

It is impossible for the regulator to prove the required standard if needing to enforce.

2) Any rule that is slope/angle linked

   E.g. 30(1)(a) activity does not take place on a slope greater than 10 degrees.

Slope is not uniform (varies throughout a paddock) and it is difficult to measure.

3) Any rule linked to data required prior to an activity commencing to later prove non-compliance.

   E.g. 10(2)(a) activity that results in greater than 0.1m change beyond the wetland's annual median water level

Difficult for regulator to know if this change has occurred and therefore enforce.

4) Generally impracticable rules

   E.g. 30(1)(g) pugging to an average depth of 20cm across not more than 50% of the paddock.

Difficult to measure and therefore enforce.

Identification and inclusion of some of these issues in the FEP rather than as regulation may help address these things.

Definitions

Definitions are scattered throughout the documents and are often unclear. Definitions need to be clear, consistent and in one place at the beginning of the document. Some examples of unclear definitions:

- For all subpart clauses with multiple conditions, be explicit by using "and" or "or" to demonstrate which of the two applies to the particular clause (e.g., Subpart 1, Clause 6 has numerous conditions but unclear if that is an "and" or "or" requirement);
- Stock exclusion not defined – pros for not doing so include flexibility in regional plan rules (to ensure exemptions can be made) whereas cons are inability to latter drive permanent fencing (to ensure outcomes for bank erosion and runoff attenuation);

- Natural wetland – define wet pasture more clearly. Also internally inconsistent between S360 and NES;
- Constructed wetlands – exclude constructed wetlands – what if they are contiguous with natural wetlands, are they considered natural or constructed?;
- Geothermal wetland – as above, is it influenced/fed by geothermal water and/or in a broader area of geothermal activity;
- Vegetation destruction – "destroying" and "significant" are ambiguous terms (e.g., significantly destroying significant indigenous vegetation). Also, how to accommodate changes in vegetation composition over seasons and years being natural process but otherwise leading to non-compliance if the reporting doesn't account for that natural variation;
- Margin of wetland – how to define the extent from which monitoring is obliged for change in extent, including the need to account for seasonal variation in hydrology and vegetation cover (e.g., extent might be determined remotely by satellite imagery, for summer period, with change in extent accounting for +/-XXX m2 uncertainty in that image-estimated extent). Secondary issue regarding stock being excluded to 5m from wetland but no vegetation destruction within 10m of margin;
- Bankfull discharge and bankfull width – the definitions applied do not suit braided rivers with mobile bank channels and/or gently sloping banks. Equally how to accommodate incising channels with outward migration (erosion) where the setback should migrate as the channel migrates (averaging may cover);
- Setback distance – should explicitly distinguish between braided (mobile) channels and non-braided (stable) channels. Braided channels should be defined from active bed (gravel substrate – consistent with ECan definition) and non-braided channels are harder to define regionally with potential to focus on 2-yr AEP flow but that regional variation exists in channel form and migration (incision and lateral movement). If an average and 1m-minimum criterion for stock exclusion is retained, then bankfull width offers greater certainty for implementation (amidst some flexibility of how it is then applied through that average requirement). West Coast streams might need to be treated separately as per braided rivers due to their uniquely extreme seasonal variation in rainfall and hydrology;
- Maximum allowable water velocity – the weakest species or lifestage is problematic to define without clear guidance on what "weakest" means and is not information that Regional Council's will necessarily hold;
- Critical source area – requires a degree of shared understanding as to what constitutes a CSA. Definition is so broad that it potentially classes all shallow depressions as CSAs. Generally it is supported that CSA's are managed through FEP to determine risks and appropriate actions. However current drafting requires multiple consenting requirements triggered by presence of CSA (ie. In relation to crops) which could be better managed through the FEP process;
- Dairy cattle and dairy support – definitions internally inconsistent between S360 and NES leading to uncertainty;
- Milking platform – relied upon to define "dairy support" and exclusion of parts of the property affected by dairy support provisions, but otherwise not defined. Risk that could lead to changes in behaviour only on parts of farm instead of wider farm. Potential to rely on ECan definition of milking platform;
- Horticultural farming – overlaps with "commercial vegetable production" which could be avoided by explicitly excluded one from other;
- Sacrifice paddock – absent from definition. Also reliant on other terms undefined – for instance on "severely damaged" and "pasture renovation";

- Low-slope land – internally inconsistent between S360 and NES (e.g., reliance on "land" and "titles" between both for same term);
- Non-low-slope land – not defined, should be any land not classed as "low-slope land";

General comments:

- There are difficulties in assessing stringency of rules (NES vs regional plan). For example, if an activity is a PA in both the NES and a regional plan, but with different PA conditions, which rule prevails? If a Plan rule is stricter but takes effect later than the NES, does the NES apply in the interim period?
- Messaging throughout documents is confusing and inconsistent.
- It is unclear how non-complying activities are assessed in relation to policy. What if there is not relevant policy yet in the regional plan. Is the NPS FM deferred to?
- There needs to be provision for regional differences. It is unclear whether the whole NES is intended as an interim until regional processes are complete, or just those parts specified.