Interim Regulatory Impact Analysis for Consultation: *Essential Freshwater*

Part II: Detailed Analysis

08 August 2019

Table of Contents

Quality Assurance Statement

The Ministry for the Environment's Regulatory Impact Analysis Panel has reviewed the Regulatory Impact Analysis (RIA) developed by the Ministry for the Environment, and produced for the *Essential Freshwater* work programme (dated 8 August 2019).

Due to the size and complexity of the RIA, which contained 20 sections with separate analyses outlined in Appendices, the Panel has provided an assessment for each of the separate RIA. The Panel considers that all of the RIA meet the quality assessment criteria, except - Appendix 17: *Intensive winter grazing on forage crops*. This particular appendix partially meets the assessment criteria. How the issue can be a problem locally is described well. However, the RIA requires further analysis on the extent of the current situation nationally. We expect the consultation process will help to gather information to address the following issues:

- further detail of how the preferred option will work in practice; and
- whether the preferred option is the best solution to address the problem.

Overall the RIA are written clearly and concisely, and make the case for the recommended change, with the key elements of the proposal being clear and the most important impacts having been identified. The Panel considers that the RIA provides sufficiently robust analysis and information to support the proposed public consultation on the *Essential Freshwater* work programme.

Some of the individual RIA require further assessment of the impacts and costs on users and Local Government. However, we understand that this analysis is set to be undertaken during (but also informed by) planned public consultation. A final RIA will be developed following public consultation and when final policy decisions are being sought.

Though there is no overarching statement of the overall impacts of the package, we recommend that this be developed through and after consultation and included in the final RIA.

Statement on Detailed Analysis

This document should be read in conjunction with *Interim Regulatory Impact Analysis for Consultation: Essential Freshwater Part I: Summary and Overview*. It provides detailed analysis of each of the policy areas. Part I contains more high-level information on each of the policy areas and a summary of the impacts of the package as a whole.

All of the limitations and constraints on the analysis outlined in section 1 of Part I also apply to this analysis.

Unless otherwise stated, all options analyses use the following criteria:

> ***Effectiveness:*** *The option provides a solution to the problem. The problem has been completely addressed.*
>
> ***Timeliness:*** *The option prevents further degradation of fresh water in New Zealand in a timely fashion.*
>
> ***Fairness:*** *The option treats all stakeholders (rural, urban, future and current generations) equitably. The costs fall on those that contribute to the problem and not other parties (ie, on central or local Government).*
>
> ***Efficiency:*** *The option is cost-effective. The option achieves maximum benefits with minimum wasted effort or expense. This criterion should consider impacts, either negative or positive, on the wellbeing of people (individuals and communities).*
>
> ***Principles of the Treaty of Waitangi:*** *The option appropriately provides for the principles of the Treaty of Waitangi. The option promotes partnership and protects Māori rights/interests and relationships with their taonga.*[1]
>
> ***Te Mana o Te Wai:*** *The option puts the well-being of the water first, and promotes values-based (based on the needs of the community), holistic management to sustain the wellbeing of the people. The option acknowledges mātauranga Māori.*

The options comparison tables found in the appendices use the following key:

++	much better than doing nothing/the status quo
+	better than doing nothing/the status quo
0	about the same as doing nothing/the status quo
-	worse than doing nothing/the status quo
- -	much worse than doing nothing/the status quo

[1] *You can read about the principles of the Treaty here: https://www.waitangitribunal.govt.nz/treaty-of-waitangi/principles-of-the-treaty/*

Appendix 1: Recognising all components of ecosystem health

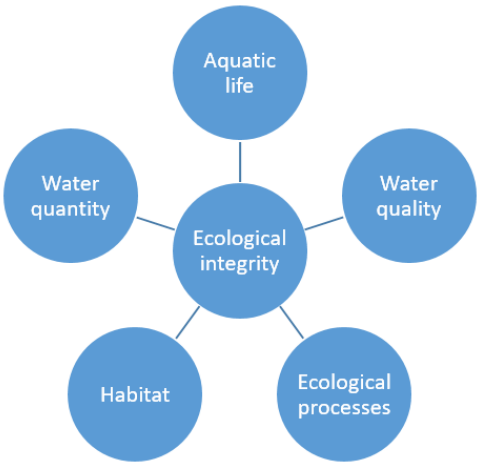
This regulatory impact analysis assesses a range of options aimed at managing ecosystem health holistically. Some more detailed options to address some particular aspects of ecosystem health (flows and levels, preventing stream loss, preventing loss of wetlands, managing nutrients, sediment, dissolved oxygen, and reporting on ecosystem health) are analysed separately.

Context

The National Policy Statement for Freshwater Management (NPS-FM) directs councils to provide for ecosystem health in all freshwater management units, and to improve the integrated management of fresh water, including by recognising the interactions between environments connected to water, and managing cumulative effects. Despite this, freshwater management approaches for ecosystem health can be fragmented and narrow, and fail to promote restoration or manage risks to indigenous and threatened species.

To date, central national direction and local authority management effort has tended to focus on water quantity and quality (and in the case of the latter, narrowed further towards the small set of water quality attributes in Appendix 2). But the presence (or absence) of aquatic life, physical habitat, and the interaction between all these components is also necessary for a healthy functioning ecosystem and the benefits we derive from it (Figure 1).

Figure 1: Components of freshwater ecosystem health



The narrow focus on quality and quantity is evident in the current NPS-FM. There is relatively little (if any) direction to manage habitat or aquatic life. This focus is under-valuing other components, and does not promote taking a holistic approach in regional planning to safeguard ecosystem health now and in the future.

New Zealand's freshwater ecosystems provide habitats for approximately 39 native freshwater fish species and 10 sports fish species (Goodman et al. 2014). Many native species are of significant biodiversity value both nationally and internationally. Freshwater fish are highly valued as taonga and mahinga kai, and for supporting cultural, recreational and commercial fisheries.

Despite their importance, three-quarters of New Zealand's native freshwater fish species are threatened or declining. The widespread migratory species, such as koaro and inanga, appear to be declining in both abundance and distribution. Their habitat, including where populations are surviving in farm drains and urban streams, is not always identified and managed. While freshwater

objectives set for freshwater management units may achieve improvements for some aspects of water quality, and minimum flows and allocation limits may protect some aspects of the available habitat, they do not necessarily provide for the particular needs of fish populations that may be threatened in that unit.

A significant issue is lost habitat connectivity caused by artificial barriers, which will be contributing to a reduction in the abundance and distribution of freshwater fish within catchments. This is because around one third of New Zealand's native freshwater fish species need access to the sea, and all fish, including trout and salmon, require access to, from and within freshwater habitats to complete their life cycle. The impact that a structure can have on the in-stream environment is dependent on the structure type, its size and location in the river network. Tide gates around river mouths can present the first (and fatal) barrier to whitebait and juvenile eels. Perched culverts under roads and railways can restrict movement throughout catchments, while dams can obstruct access to high quality upstream parts of a catchment.

We only have partial information on the number and location of barriers, which makes management difficult. Many barriers are the legacy of a time when less weight was placed on the implications for fish passage, or often structures become a barrier over time because of poor design or maintenance against erosion. Rough estimates from DOC and NIWA suggest there are at least 20,000 in-stream structures in our waterways, and that upon assessment possibly between a quarter to a half will be found to present a possible or likely barrier to fish passage. Currently the decision to survey and record fish barriers is at the discretion of councils, and effort has been patchy, but recent work on a database and software application to store standardised information may help address this.

The problem

Freshwater ecosystems, and all their components, are not being adequately recognised and safeguarded.

Options

Maintain Status Quo

Council management effort would continue to focus on water quality (particularly where attributes have been defined in Appendix 2) and quantity, sometimes overlooking other factors that should be provided for.

Providing for fish passage would likely be informed by the NZ Fish Passage Guidelines, but their use may not be universal around the country. Specific habitat needs of threatened species may be provided for in some areas, but without consistent monitoring around the country the locations of populations may not be identified or managed sufficiently. The cumulative effect of fish population fragmentation and loss of suitable habitat will contribute to the decline of freshwater fish and other freshwater species.

Option 1: Amend the description of the ecosystem health value

Amend the existing description of ecosystem health in the NPS-FM, to clarify that:

a) There are five specific components to ecosystem health that must all be managed: aquatic life, water quality, water quantity, habitat, and ecological processes.
b) The ecosystem needs to be managed in a way that is appropriate for the ecosystem type.
c) A healthy ecosystem is one that is appropriate to that type of freshwater body, when it is in a minimally disturbed condition. This avoids the possible interpretation that degraded or altered water bodies have ecosystems that are 'appropriate' to that state of degradation.

d) Councils need to account for a wide range of stressors and pressures that affect ecosystem health. If a wide range of examples is not provided, there is concern that the focus may be inappropriately narrow.

This option does not change the intended meaning of the existing description, but does aim to make that intention clearer. The effect will be to make it clearer to Councils and their communities what they are required to manage, which should contribute to improved decision making and accountability. The fact that the intended meaning does not change will minimise the risk of councils incurring costs to redo plans based on a different value description.

The description would make it clear that to define the top of the A band, councils and government will need to estimate what a fully intact ecosystem in a minimally disturbed state would be. This would provide a consistent benchmark from which to compare changes across ecosystem health metrics, and is common in many overseas jurisdictions. There are various approaches to estimate these conditions, and estimates are already available in many instances. Some guidance is also available. Setting the top of the A band based on reference conditions does not imply that this should be the target state that communities should aim for; there are other values that people will want the freshwater management unit to provide for so as to provide for their economic wellbeing. But setting the various water states as deviations from a common benchmark of a minimally disturbed state will allow more explicit recognition of the trade-offs communities are making in the decisions.

This option also includes amending references to safeguard "life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems of freshwater" in Objectives A1 and B1 to recognise "freshwater ecosystem health, its constituent components, and indigenous species". The current wording largely re-states the purpose of the RMA and does not materially add to national direction on freshwater management. At the same time, the existing wording refers to some (but not all) aspects of ecosystem health because it predates the introduction of the national objectives framework and the ecosystem health value description.

Benefits that will accrue to the community include an improved understanding of what must be managed, and consequently improved decision making, and making it easier for communities to hold councils to account.

Criterion	Option 1 Amend the description of the ecosystem health value
Effectiveness	**++** Clarification that councils must manage habitat, aquatic life and ecosystem processes as key components of freshwater ecosystems. No change to intention of existing description.
Timeliness	**+** Builds on and encourages emerging trends in freshwater management towards holistic management. Relies on councils amending their regional plans, which will happen over the next ten years
Fairness	**0** All stakeholders treated equitably.
Efficiency	**++** Improving understanding of what must be managed is an efficient method of improving decision making, and makes it easier for communities to hold councils to account.
Principles of the Treaty of Waitangi	**0**
Te Mana o te Wai	**+** Reference to a minimally disturbed state complements Te Mana o te Wai, where the first obligation is to the needs of the water body.
Overall Assessment	**++** Helps avoid incorrectly narrow interpretations of ecosystem health management.

Option 2: Direct regional councils to set objectives for fish, informing consenting decisions and mitigation of structures. Specify minimum design standards

This option could be implemented through an amendment to the NPS-FM and a national environmental standard (NES). Regional plans would be required to provide for the diversity and abundance of fish within an area, and include policies to control the design and operation of structures in order that their biological performance achieves the objectives.

The plan provisions would be required to 'take into account' any Freshwater Fisheries Management Plans and Sports Fish and Game Management Plans approved by the Minister of Conservation pursuant to the Conservation Act 1987 (s.17J – N). When preparing regional plans, s.66 of the RMA already requires councils to have regard to management plans prepared under other Acts. The proposal provides greater clarity by specifically identifying Fisheries Management Plans. The Parliamentary Commissioner for the Environment has previously recommended that Freshwater Fisheries Management Plans be pursued in order to achieve greater protection of eel habitat and improve consistency across regions.[2]

While Fish and Game NZ has produced such plans, to date the Department of Conservation has not. One reason for this inaction is the current weak link between these plans to interventions outside of the Conservation estate, where the vast majority of impacts occur. This option addresses this, clarifying the role of the plans prepared by Department of Conservation and Fish & Game NZ as

[2] *Update Report: On a pathway to extinction? An investigation into the status and management of the longfin eel*, Parliamentary Commissioner for the Environment, December 2014. https://www.pce.parliament.nz/media/pdfs/Longfin-eels-Update-Report-web.pdf

Fisheries Managers, and the role Regional Councils have in resource management. Having a stronger vehicle for these plans should encourage DOC to prepare them.

Rather than directing councils to account for these management plans, the NPS-FM could direct councils to 'give effect' to them. This is a stronger direction and reduces the scope for councils and their communities to describe an objective that expresses their specific values, as opposed to those of the Department of Conservation and Fish and Game NZ. Some stakeholders are likely to consider this preferable. However, without DOC having prepared any fisheries management plans it is not possible to evaluate what "giving effect" to them would do. In addition, given that the only management plans that do exist are for sports fish, such strong direction might result in insufficient focus on indigenous species given their habitats is a matter of national importance in Part 2 of the RMA.

The proposed option includes requiring Councils to amend their plans so that they have regard to principles of good design for fish passage when considering consents. When considering applications for structures in stream beds, consenting authorities would have regard to:

a) The extent it achieves no greater natural impediment to fish movements than in immediately adjoining stream reaches.
b) The extent that it provides efficient and safe passage of all organisms and life stages with minimal delay, except where there are specific requirements to limit the movement of undesirable species in order to meet objectives.
c) The extent it provides a diversity of physical and hydraulic conditions leading to a high diversity of passage opportunities for aquatic organisms.
d) Continuity of geomorphic processes such as the movement of sediment and debris.
e) Biological performance necessary to achieve objectives for the foreseeable life of the structure (maximise durability and minimise maintenance requirements), and any proposed monitoring and maintenance plan to the extent necessary to achieve this.

The matters described above are principles of good fish passage design, and councils would need to explicitly consider these when deciding to grant or renew a consent application. They seek to maintain connectivity that would have been there in the absence of the structure. While they generally discourage new barriers, they do not seek to prevent barriers where they serve to protect non-migratory species from invasive species. They also avoid placing unnecessary restrictions on structures in reaches where connectivity is not required.

For an objective to work, item (e) must influence the design and operation of structures so that they perform in such a way that the objectives are delivered.

These principles do not prevent authorities from granting an application that does not meet these principles if it would be consistent with the sustainability purpose of the RMA. The principles would suggest a likelihood of more significant environmental effects that must be considered against any other benefits derived from the barrier, thereby encouraging mitigation of these effects.

The risk of specifying principles is that they don't drive sufficient change because they are ambiguous and specific requirements aren't clear.

Minimum fish passage design standards

This option also includes directing councils to change their regional plans, so that:

a) New culverts, weirs and fords less than four metres high must meet minimum design standards (specific parts of Appendix G of the Guidelines), or otherwise demonstrate that their effects would be no more than minor through the consenting regime.
b) New passive tide and flood gates are strongly discouraged, in favour of structures that provide fish passage. This could be by defining passive gates as non-complying, or prohibited activities through the NESFM.

The effect would be that, rather than just requiring consenting authorities to have regard to principles of good fish passage design in making decisions, a stronger approach would specify minimum standards.

This Option would capture the majority of structures and form a regulatory backstop making it clear what minimum expectations are. There is a risk that they become default, rather than minimum standards.

There is also a risk that large dams (>4m high) are seen to be uncontrolled. However smaller-scale obstructions, such as weirs and culverts, are the most problematic artificial barriers because there are many of them. It is also unlikely that the absence of minimum standards on these will encourage larger dams to be built over smaller ones due to the proportionally high expense involved in construction and building consents.

Criterion	Option 2 Direct objectives and considerations for consenting structures
Effectiveness	++ Habitat connectivity for fish will be better safeguarded, and the specific requirement to account for Fisheries Management Plans has potential to improve consistency across regions
Timeliness	+ Relies on councils amending their regional plans, which will happen over the next ten years
Fairness	**0** All stakeholders treated equitably
Efficiency	+ Provides clarity, and supported by detailed guidance
Principles of the Treaty of Waitangi	**0**
Te Mana o te Wai	+ Connections from the mountains to the sea is fundamental to Te Mana o te Wai
Overall Assessment	++ Performance of in-stream structures deliver fish objectives

Option 3: Direct Councils to assess existing structures, maintain records, and develop rehabilitation strategies

Require regional councils to collect and maintain records of fish passage performance for new and (known) existing structures. To help compile records, this option proposes setting conditions for permitted and consented activities that will require infrastructure owners to provide information directly to regional councils upon completion of construction. This could be facilitated by the inclusion of structures in the national database.

Councils would then be required to develop a rehabilitation strategy to achieve mitigation of existing structures. The strategy must seek to establish methods for assessing biological performance, explain how effort will be prioritised, and seek to prioritise and achieve mitigation of existing structures. This

strategy must give effect to any ecological objectives relating to fish population health (diversity and abundance) (see Option 2).

Additional ecosystem health monitoring is considered in Option 8, and the separate RIS for Ecosystem Health Reporting (refer to Appendix 5).

There is a recently developed tool that is fit for purpose for Councils to use for collecting and maintaining records to satisfy this policy. This is as a result of a $166,750 investment from MBIE (through an Envirolink Grant).[3] The cost is associated with the time to do the assessment. Depending on access at the structure, and the structure type, it takes 4-10 minutes at a site on average. For most common structures (culverts, fords, weirs) the tool processes the information collected and assigns a risk category to the structure indicating potential for it being a barrier (ie performance). This automation reduces time and training costs for the person in the field to make this assessment themselves. The councils can use this information to inform how they decide to prioritise their mitigation efforts in order to achieve their objectives.

The tool was published in January 2019. Uptake to date has been limited to a few regional councils. One key reason is that fish passage barriers have received low priority for monitoring effort to date, as is the case with many ecosystem health measures other than water quality. This policy option aims to address this problem. Anecdotally, another possible reason includes wariness of a tool that makes the collected data publicly available, as this highlights the scale of the legacy created from the accumulation of in-stream structures over decades.

Costs are likely to be largest in attempting to rehabilitate existing structures. Rough estimates from DOC suggest there are at least 20,000 in-stream structures in our waterways, and that upon assessment possibly between a quarter and a half will be found to present a possible or likely barrier to fish passage. The vast majority of these will likely be culverts, and found to require minor rehabilitation with spat ropes, baffles or fish ramps. The approximate cost of remediation at a small (less than 4 metre high structure) is as follows:

Rehabilitation (small structures)	**Approximate cost**[4]
Spat rope or baffles in a small culvert	$200 to $300
Fish ramp on a vertical barrier	$1000 to $3000
Fish friendly tide or flood gate	$1500 to $4000
Removal of a weir	$40,000 to $50,000
Replacement of a ford or culvert with a bridge	$80,000
Dam removal (simple)	Under $100,000

Criterion	**Option 3 Assess existing structures, maintain records, and prioritise mitigation**
Effectiveness	++ Allows councils, their communities and government to set limits, prioritise remediation and other policy

[3] https://www.niwa.co.nz/freshwater/management-tools/fish-passage-assessment-tool

[4] Estimates provided by Auckland Council. Will be greater for remote or difficult to access locations.

Timeliness	+ Record collection for new structures will be required upon Gazettal of the NES, the timing of the rehabilitation strategy depends on implementation requirements for councils to implement the NPS
Fairness	**0** All stakeholders treated equitably
Efficiency	+ Tools are available to collect and maintain records
Principles of the Treaty of Waitangi	**0**
Te Mana o te Wai	+Connections from the mountains to the sea is fundamental to Te Mana o te Wai
Overall Assessment	+ Location and size of problems known, remediation prioritised

Option 4: Add a new compulsory value for threatened species

A new compulsory value could be added to Appendix 1 as follows:

- Threatened species – specified areas in the freshwater management unit support a population of indigenous freshwater species that are threatened or in decline nationally. The aquatic habitat, water quality, and flows or water levels in the freshwater management unit support the presence and survival of the identified species, and may include specialised habitat or conditions needed for only part of their life-cycle.
- Threatened species are taxa that meet the criteria specified by Townsend et al. (2008) for the categories Nationally Critical, Nationally Endangered and Nationally Vulnerable.
- Including a compulsory value for threatened species in the NPS-FM means that regional councils will be required to apply the value to all freshwater management units in their region, and consider objectives and attributes accordingly. Areas where threatened species are identified as a value may overlap with areas identified for other values, including "fishing", where the freshwater management supports fisheries of species such as trout and salmon. In that case, councils will need to resolve the management needs of all species.
- The value description needs sufficient detail for councils and communities to decide whether or not it applies, and guide what sort of objectives and methods they want to set to provide for the value.
- A new value for threatened species would support direction recommended for the National Policy Statement for Indigenous Biodiversity. The recommended approach in that national policy statement is for councils to identify significant natural areas in the terrestrial domain according to standardised significance criteria. The four criteria are representativeness, diversity and pattern, rarity and distinctiveness, and ecological context.
- Adding a value for threatened species is consistent with the 'rarity' criteria, which was described by the Biodiversity Collaborative Group in their report to Ministers in 2018 as including 'threatened' and 'at risk' (including 'naturally uncommon') species using publications (for plants, mammals, birds, and reptiles) prepared and regularly updated by the Department of Conservation.

Criterion	Option 4 National value for threatened species
Effectiveness	+ Aquatic life, especially native species that are declining or under threat, will be better safeguarded

Timeliness	**0** Relies on councils amending their regional plans (objectives already apply to most FMUs; this direction can only apply to new plan changes)
Fairness	**0** All stakeholders treated equitably
Efficiency	**+** Targets actions at places where threatened species live
Principles of the Treaty of Waitangi	**+** Threatened species are a taonga, unique to Aotearoa
Te Mana o te Wai	**+ +** Increases the recognition that the first obligation is to the water by requiring consideration of what the water body would naturally provide for
Overall Assessment	**+** Improves the management of habitat according to the vulnerability of the species

Option 5: Add direction for spatial catchment planning

Addressing cumulative effects of activities through limit setting is not fully addressing the incremental losses of freshwater ecosystem health within catchments, or historic losses that have already occurred. The Government is undertaking a spatial planning programme through the Urban Growth Agenda, and spatial planning is within scope of the proposed comprehensive review of the resource management system. However, for councils implementing the NPS-FM now, there needs to be better emphasis on longer term spatial planning at a catchment scale to sustain the potential of freshwater resources to meet the reasonably foreseeable needs of future generations.

A new policy in the NPS-FM could direct councils to identify and manage or restore:

a) Areas where ecosystem health is degraded or at significant risk from cumulative effects, including areas where water quality is below a national bottom line, areas where water quantity is over-allocated, high-risk erosion prone areas, high-risk sediment generating areas, and receiving environments that are sensitive to sediment or nutrients.
b) Areas where restoration of water bodies or changes in land use are desirable, including removing barriers to fish passage.

Effective, proactive and integrated catchment planning can resolve trade-offs and consider incremental/cumulative effects of activities on ecosystem health. The holistic and integrated management of freshwater will help support Te Mana o te Wai in policy development and freshwater management practice, encourage restoration where it is needed, and provide direction to the development of freshwater modules in farm plans and wastewater management plans.

Carrying out spatial catchment planning will have resource implications for councils and will place extra pressure on those with processes already in place to implement the NPS-FM. Other potential costs from spatial catchment planning include unknown constraints on resource use as a result of actions communities choose to take, for example identifying areas for restoration or as inappropriate for development. Benefits include the costs avoided by taking a proactive approach to safeguarding natural capital and ecosystem health because prevention of degradation is more cost effective than restoration.

Criterion	**Option 5 Spatial catchment planning**
Effectiveness	**+** Would allow for proactive planning, and so would help solve the problem by addressing aquatic ecosystem health as part of the wider environment, not as separate components within separate water bodies

Timeliness	- May slow down amendments to regional plans that are needed to give effect to the NPS-FM
Fairness	**0** All stakeholders treated equitably
Efficiency	**0** To a large extent councils are doing this already when they establish the status quo for a catchment
Principles of the Treaty of Waitangi	**0**
Te Mana o te Wai	+ Recognising the natural interactions across all water bodies, and connections from the mountains to the sea, is fundamental to Te Mana o te Wai
Overall Assessment	**0** While there are aspects of this option that would bring about an improvement in freshwater management, there is not enough extra benefit to justify the risk of delaying implementation of the NPS while councils get to grips with the requirements

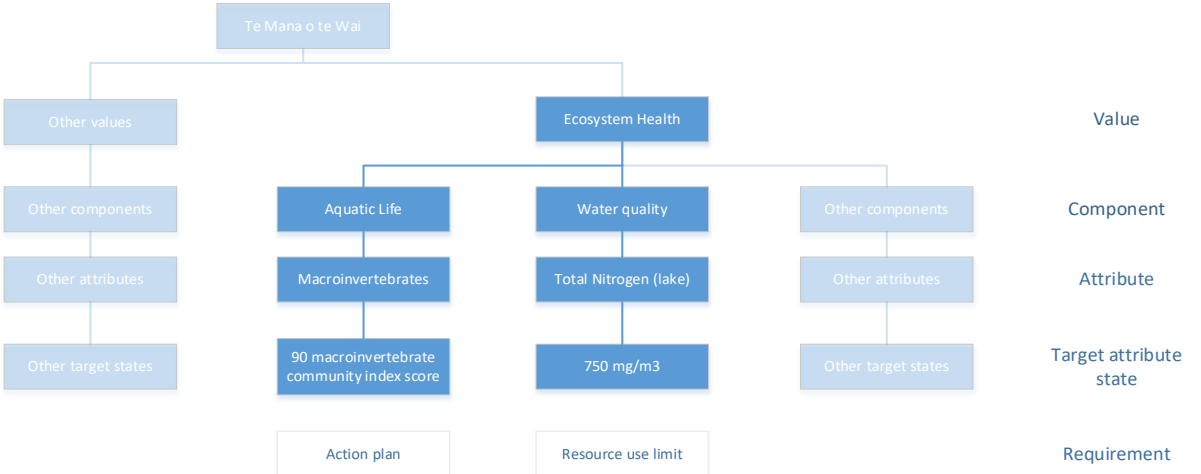
Option 6: Make a distinction between objectives set for attributes and objectives set for values

Making a distinction between an environmental outcome sought generally for a value (eg for ecosystem health), and the environmental outcome sought for specific attribute state will help direct a holistic approach to freshwater management. The outcome sought for the attribute, which could be called a "target attribute state" is then more clearly associated with limit setting. The NPS-FM will be amended to require councils to also set an environmental outcome for the Ecosystem Health value as a whole, and/or each of the five components in the value description. These are to be expressed as objectives in regional plans, and described on report cards (proposed in the Environmental Reporting RIS described in Appendix 5).

The objective hierarchy is illustrated in Figure 1, showing the relationship between environmental outcomes, attributes and targets. Also illustrated is where trigger levels and action plans would relate (explained in the following Option 8).

This approach will also address the problem identified for flows and levels, where councils do not set objectives for flows, but do set limits in the form of allocation limits and minimum flows.

Figure 1: Relationship between values, components, attributes, targets, action plans and resource use limits. Does not include all ecosystem health components or attributes. Triggers, targets, and report grades are fictional.



Criterion	Option 6 Distinguish between objectives set for attributes and objectives set for values
Effectiveness	+ Improved objectives will focus community effort on what is needed for the ecosystem, as well as what is needed to achieve particular attribute states
Timeliness	**0** Relies on councils amending their regional plans, which will happen over the next ten years (objectives already apply to most FMUs; this direction can only apply to new plan changes)
Fairness	**0** All stakeholders treated equitably
Efficiency	+ Focuses attention on the importance of setting an environmental outcome for the value, while also using the attributes to set intended states that can then be clearly associated with quantifiable limits
Principles of the Treaty of Waitangi	**0**
Te Mana o te Wai	+ + Allowing recognition of the value as a whole before deciding on the intended state for the component parts, is more holistic and so more in line with Te Mana o te Wai
Overall Assessment	+ This option improves the objective setting framework by stepping the councils and communities through a staged process to manage ecosystem health (and other values) as a whole before considering the component parts, which on their own are not sufficient to safeguard ecosystem health

Option 7: Monitoring and responding

The current National Objectives Framework requires councils to identify appropriate attributes of ecosystem health, and then set freshwater objectives to be achieved through setting resource use limits. This limit setting approach works well conceptually with water takes and discharges of contaminants, where there is sufficient certainty between an individual's resource use and a sustainable quantum that can be allocated amongst users in the management unit in order to achieve the freshwater objective. [5]

However, there are other attributes that are very important parts of ecosystem health, but which do not lend themselves easily to management through a limit setting approach, at least not at the national scale. To ensure these attributes are being managed, this option proposes requiring councils to undertake monitoring to detect possible issues, and develop an action plan to investigate and respond to evidence that suggests there is a problem, the current state is acceptable, or deterioration is occurring. This encourages an approach that allows for decision making in the face of uncertainty, and is appropriate when there are a wide range of reasons for a deterioration, a variety of actions that might be taken, or the specific actions depend on the catchment and situation. It is

[5] For further explanation see 'A draft guide to limits under the National Policy Statement for Freshwater Management 2014 (as amended in 2017)': https://www.mfe.govt.nz/publications/fresh-water/draft-guide-limits-under-national-policy-statement-freshwater-management

suited to cases where the drivers or necessary actions may not be very clear or consistent at the national level, and need to be determined and addressed at a smaller spatial scale.[6]

The current NPS-FM requires monitoring of macroinvertebrate communities, the health of indigenous flora and fauna, and any objectives councils have set for attributes through the National Objectives Framework (at a minimum). Ministry officials, STAG, and other advisory groups do not consider this to be sufficient.

In order to maintain or improve waterbodies and freshwater ecosystems, the proposed approach is that in addition to requiring every regional council to identify the range attributes appropriate to manage ecosystem health as per the existing National Objectives Framework, to also require them to identify attributes appropriate to manage by monitoring and evaluation. We propose requiring a compulsory set of appropriate attributes and actions, and councils are to choose their own in addition. For all these compulsory attributes, other than ecosystem metabolism, there is a bottom line which must trigger an investigation and response to improve the state. This is set at the boundary of the C and D management bands of the attribute tables recommended by the STAG.[7] Councils will also be required to respond to deteriorating trends, in order to at least maintain current state and halt declines.

[6] Reynolds J, Knutson M, Newman K, Silverman E, Thompson W, 2016, A road map for designing and implementing a biological monitoring program. *Environmental Monitoring and Assessment*. 188. 10.1007/s10661-016-5397-x.

[7] Freshwater Science and Technical Advisory Group: Report to the Minister for the Environment, June 2019.

Indicator and water body	Attribute and monitoring instruction	Take action when monitoring indicates health is declining, or current state is below the following bottom lines:
Fish (Rivers - wadeable)	Fish health, using measures of diversity and relative abundance (Fish IBI is an available method)	Fish IBI score of 18 or lower[8]
Macroinvertebrates (Rivers - wadeable)	The following, using at least 200-fixed count subsampling:	one or more of the following applies:
	Macroinvertebrate Community Index (MCI)	<90
	Quantitative Macroinvertebrate Community Index (QMCI)	<4.5
	Average Score per Metric (ASPM)	<0.3
Dissolved oxygen (Lakes, DO)	DO, in all lakes	Bottom DO concentrations below 0.5 mg/L
	DO, in seasonally stratifying lakes:	Mid-hypolimnetic DO concentration below 4 mg/l
	DO, in rivers	7-day mean minimum of less than 5.0 mg/L or 1-day minimum of less than 4.0 mg/L
Ecosystem metabolism (rivers)	Ecosystem respiration (ER) and gross primary productivity (GPP). Calculated using continuous DO measurements.	No national bottom line will be specified
Macrophytes (Lakes)	Lake Submerged PIant Indicators (LakeSPI)	If either or both apply: - Native Condition Index <20%, - Invasive Impact Index >90%

The attributes in the previous table are addressed in the following subsections.

Fish

Freshwater fish are the highest-valued group of aquatic biota. They are valued as part of healthy ecosystems, their contribution to biodiversity and for their cultural value – particularly as mahinga kai. They are also a useful time and spatial integrating indicator of downstream and upstream health.

[8] The F-IBI as defined by Joy, M. K., & Death, R. G. (2004). Application of the Index of Biotic Integrity Methodology to New Zealand Freshwater Fish Communities. *Environmental Management, 34(3)*, 415-428. The calculation has been changed to exclude salmonids to ensure they have no positive or negative weighting on the IBI score.

Of the 39 species of native fish nationally, 28 are threatened or at risk of extinction according to the Department of Conservation's Threat Classification System.

Despite their importance and threat status, fish are not systematically monitored in some regions of New Zealand. The following eight regional councils regularly monitor native fish: Waikato, Wellington, Gisborne, Tasman, Southland, Auckland, Otago and Nelson.

The Fish Index of Biotic Integrity (Fish IBI) is a multi-metric index designed to reflect the overall quality of the fish community. The method to calculate the IBI is that developed by Joy and Death (2004). The maximum Fish IBI score possible is 60, and the minimum is 0.

The proposed trigger for action is either a declining trend, or a score of 18 which reflects a severe loss of fish community integrity. A conservative worst case estimate is that approximately 20 percent of rivers by length nationally have scores at or below this level for reasons other than natural causes, and that this policy would affect[9]. This proportion is expected to be higher in regions where land and water use has resulted in a substantial loss of species richness, such as Waikato, Manawatu and Canterbury. This is where the greatest action is expected to be required.

Because of the effect of other proposed direction (such as improved management of wetlands, sediment, habitat, nutrients and fish passage), the proportion of rivers requiring substantial additional actions from this policy option will be much lower than 20 percent nationally. The benefit of this policy will be to ensure that councils are addressing problems in a strategic and planned way using all the methods they have at their disposal.

Monitoring fish communities is relatively expensive for councils, compared to water quality sampling, because it involves specialised skills (eg, electric fishing and identification in the field), and is more complex and time-consuming. Cost estimates (including personal travel and time) are approximately $1500 to $2500 per reach, per visit. One off capital expenditure is also required for vehicles, nets (around $4000 per set) and electrofishing machines (around $20,000 each). Annual sampling is considered adequate, which will lower the cost. To further address cost, a cheaper and faster molecular tool for detecting fish species in freshwater is being developed, funded by a $299,000 MBIE Envirolink Tools Grant.

Macroinvertebrates

Macroinvertebrate monitoring is currently undertaken by all councils. The current NPS-FM requires the monitoring of the Macroinvertebrate Community Index (MCI), a measure originally developed to indicate organic and nutrient pollution and based on presence and absence data. The STAG considers this insufficient for managing broader ecosystem health. Their recommended additional measures are the Quantitative MCI (QMCI) which accounts for the relative abundance of species, and the Average Score Per Metric (ASPM) which is a multi-metric index that better reflects community health, developed by Collier (2008).

These three measures are not mutually exclusive and complement one another. All three can be calculated with the same data, however there will be some additional laboratory processing costs for any councils that currently do not pay for abundance counts. Requiring a minimum of 200-fixed count sub sampling (as opposed to full counts) will help minimise additional cost, while still providing informative data.

[9] It is estimated approximately 36 percent of rivers by length have a Fish IBI score below 18. Of these it is possible that 16 percent could have a low score naturally, and would require no action upon investigation.

The STAG also recommends raising the MCI action trigger level from 80 to 90. A score of 80 signifies "severely polluted" at which point remediation will be costly, and below this level there is little ability to identify changes in the health of rivers. Raising the score to 90 signifies greater expectation to prevent degradation, and is expected to have little impact on the number of rivers requiring action, with less than 1 percent of rivers likely to fall within this range.

Dissolved oxygen (rivers)

Dissolved oxygen (DO) is an important aspect of ecosystem health and needs to be managed throughout catchments. Currently the DO attribute in the NPS-FM applies only below point sources in rivers, which provides no direction for the management of DO as affected by other pressures in the catchment. Wider monitoring of DO is important to inform future management and restoration actions to help prevent further decline of ecosystem health.

Areas that are most at risk of low DO concentrations are warm, un-shaded, slow-flowing lowland rivers, where aquatic plants or periphyton are abundant. DO is less likely to be a problem in faster flowing, cooler streams and rivers.

We have limited information on the current state of DO in rivers, but, based on collated data from 12 regional councils, NIWA and Cawthron in 2015, it is estimated that 15 percent of streams and rivers may be below the national bottom line (which currently applies only to areas down stream of point source discharges). [10]

We propose to amend the NPS-FM so that the existing DO attribute table applies in all river reaches, and is not limited to "below point sources" of pollution. This would require councils to monitor DO and act upon it if concentrations are below the bottom line, or there is a declining trend.

To assist with these changes we propose to provide guidance on the monitoring and management of DO. This will increase the likelihood that management actions will be cost effective and achieve the intended outcomes. A National Environmental Monitoring Standard (NEMS) has been prepared with Ministry funding, and is available to support councils.

This option would acknowledge the status of DO as a key determinant of ecosystem health in fresh water, that is influenced by both point source and non-point source discharges.

An action plan requirement is proposed because it is not possible to specify specific interventions to raise low DO levels in New Zealand rivers and streams generally at the national scale.

Concentrations of DO vary widely in rivers on a 24-hour cycle, and is therefore best characterised by continuous measurements, using loggers that are deployed in the waterbody of interest for a period of several days or weeks. Councils tend to measure DO continuously at a limited number of "problem" sites at present.

There will be implementation costs for councils to increase monitoring of DO, prepare management plans and carry out management actions. The amount of loggers needed would depend on the region and the distribution of stream and river types needed for adequate representation. Dissolved oxygen loggers cost between $5000 and $13,000 each depending on the model, and have a working life of about five years. The capital cost for establishing a new DO monitoring site varies between less than $5000 and upwards of $80,000 depending on whether construction and consenting for a

[10] Depree, C., Unwin, M., Young, R. (2016) Dissolved Oxygen data collation and preliminary analysis. NIWA Client Report HAM2016-008. https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/dissolved-oxygen-data-collation.pdf

dedicated mounting structure are needed. In small streams, dedicated structures are usually not required.

Deployed loggers need to be serviced by trained technicians at least monthly to check calibration and fouling. Many monitoring locations will require a boat to access, which will increase the cost of capital expenditure and labour. The ease of site access and potential to combine visits with existing monitoring will be important factors influencing costs. Technician time is also required to download and audit data. Cost estimates for staff time range from 40 to 85 hours per site per year.

To improve DO concentrations, targeted interventions will be required. Some methods for addressing DO involve resource use limitation (such as flow and nutrient management), while others require specific restoration actions (such as increasing riparian shading, aeration, or removal of macrophytes). There will be financial costs associated with these actions that will fall to different parties and vary in magnitude depending on the management response.

Restoration and management actions that will improve DO will also have other benefits for other ecosystem health components (eg, increasing shading through riparian planting would reduce growth of nuisance aquatic plants, improve DO, reduce temperatures and provide greater habitat diversity).

Dissolved oxygen (lakes)

Dissolved oxygen (DO) is required to maintain biogeochemical processes at the bottom of lakes in order to safeguard the capacity of phosphorus to bind to sediments, and minimise nutrient (phosphate and ammonium) release from lake sediments. Low DO at the bottom can release large quantities of previously bound nutrients, leading to excessive nuisance plant growth and eutrophication.

Oxygen is also required to support habitat for aquatic fauna such as fish life. In seasonally stratified lakes a bottom layer of cold water is formed (known as the hypolimnion) that is isolated from the warmer well-mixed surface. Without adequate management, this layer can become anoxic (without oxygen) as the summer progresses and its supply of oxygen is consumed by bacteria and other bottom-dwelling organisms. If this occurs, the lake will not be able to support fish that require colder deeper water in summer.

Given these biogeochemical and habitat aspects, the STAG recommends they be monitored and managed separately. The levels proposed to trigger action are at points of degradation. For bottom DO this is a level below which it is expected that biogeochemical conditions would likely result in nutrient release from sediments. For the mid-hypolimnetic DO there would be significant reduction in habitat for aquatic life, stress on a range of fish species, a likelihood of local extinctions if no other refuge is available, and loss of ecological integrity.

There are at least 90 lakes where councils measure DO already (out of 3820 lakes larger than one hectare). Based on the lakes that have been monitored, half are poorer than the proposed bottom line levels and thus would require action. Without diminishing the urgency of this issue, this statistic is likely to be an over-estimate of the proportion of degraded lakes nationally. This is because monitoring is biased towards those lakes under most pressure and therefore likely to require management.

The condition of lakes is the result of nutrient loads from the catchment, and the legacy of historic nutrient inputs over decades which have been stored internally in lake sediments, as well as local factors such as lake morphology (shape, area, depth). Management is therefore complex, and recovery can take a long time. A monitoring and action plan is therefore required to tailor a

response. Sometimes, depletion of DO in bottom waters of lakes can occur under natural conditions. This is more likely in deep lakes that are likely to remain stratified for longer under calm conditions (ie, the bottom waters and surface layers do not mix). As with the other metrics, councils would be required to demonstrate that such conditions were the result of natural processes.

DO in lakes is measured by many councils already. It needs to be measured at least monthly at different points in the water column using a submersible logger deployed from a permanent lake monitoring buoy, or by field staff from a boat. To save time and money, some councils currently monitor lakes by way of surface water sampling via helicopter. This approach is not possible for lake DO monitoring. Including a lake DO monitoring requirement will therefore increase the time needed and costs for lake monitoring for some councils.

Ecosystem metabolism

Ecosystem metabolism relates to the Ecosystem Processes component of the Ecosystem Health Framework, and of the five components, this is the most data-poor component. The proposal is to require councils to calculate Gross Primary Productivity (GPP) and Ecosystem Respiration (ER) based on 7 consecutive days of continuous DO and temperature monitoring of rivers, and using the approach of Young et al (2008).[11]

This is not currently a regular feature of council state of environment monitoring programmes. To date the Cawthron Institute has gathered data collected from 156 sites between 1993 and 2009 for a DOC project to quantify the relationships between human pressure and ecological integrity. In 2018, Hawke's Bay Regional Council collected data as part of an ongoing pilot ecosystem health assessment. The Waikato Regional Council has also collected data for 28 large non-wadeable rivers.[12]

Internationally, the development of functional indicators of ecological processes has trailed behind the development of indicators that describe structural ecosystem health components. However, recent research has provided management guidelines for ecosystem metabolism (Young et al. 2016).[13] Furthermore, most of the data required to calculate ecosystem metabolism can be collected when assessing DO.

In addition to filling a data gap to better represent ecosystem health, ecosystem metabolism would also help better represent conditions in large non-wadeable rivers that are not possible to monitor using macroinvertebrate measures.

There is still some uncertainty over the exact management band boundaries spanning the range of good ecosystem health to poor, and it is expected that a range of management interventions would be required based on the circumstances of the catchment. The STAG recommends that given the importance of ecosystem metabolism to managing ecosystem health, and acknowledging the current state of knowledge, it would be appropriate to require monitoring but not specify a bottom line for action. Such a policy would assist management now, but also allow accurate management bands to be developed to better manage it in the future.

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[11] Young, R. G., Matthaei, C. D., & Townsend, C. R. (2008). Organic matter breakdown and ecosystem metabolism: functional indicators for assessing river ecosystem health. *Journal of the North American Benthological Society*, 27(3), 605-625. doi:10.1899/07-121.1

[12] https://www.cawthron.org.nz/media_new/publications/pdf/2015_12/CR2770_Development_of_mgmt_bands_for_ecosystem_metabolism_for_non-wadeable_rivers.pdf

[13] Young RG, Clapcott JE, Simon K (2016). Ecosystem functions and stream health. *Advances in New Zealand Freshwater Science*. NZ Freshwater Sciences Society, NZ Hydrological Society.

Assuming DO monitoring is being undertaken, then any additional costs will be minor. This is because ecosystem metabolism is calculated using continuous DO, temperature and river depth. It is common for dissolved oxygen loggers to measure temperature concurrently (as it is required for calculating oxygen saturation).

Macrophytes (lakes)

New Zealand's native aquatic plants help maintain lake ecosystem processes and provide food and habitat for other aquatic organisms. Invasive aquatic plants can negatively impact on native species and lake ecosystem processes. Lakes with high ecological condition have a high number and diversity of native aquatic plants, and an absence or a low number and diversity of invasive aquatic plants.

Lake Submerged Plant Indicators (LakeSPI) is a method of characterising the ecological health of lakes based on the amount of native and invasive plants growing in them. LakeSPI is a function of an accumulation of a number of stressors (similar to macroinvertebrates and fish), and reflects general health.

The STAG recommends that trigger levels for action be associated with the two component sub-indices of LakeSPI: the invasive impact index, and native condition index. At the levels proposed, the STAG estimates that 38 percent of lakes would trigger investigation. Management response to increase native plant condition usually involves reducing nutrient and organic matter input and/or increasing water clarity. Targeted interventions are required to remove invasive plants, such as mechanical removal or spraying.

Most regional councils and the Department of Conservation have undertaken LakeSPI assessments and, to date, LakeSPI assessments have been carried out on more than 300 New Zealand lakes. LakeSPI data are collated and reported on the LAWA website as a key indicator of lake health.

LakeSPI is described as a cost-effective tool, however with the exception of very shallow lakes the method requires scuba-diving skills and qualifications, a certified boat operator and a minimum of three people. There are constraints on the availability of trained personnel to undertake the surveys[14]. To reduce costs, it is likely that the method could be adapted to use remote-controlled underwater cameras for example.

The more significant cost implication will be that councils will have a greater requirement to improve the state of submerged plants in lakes. In some lakes that is likely to involve ongoing surveillance and management of invasive species.

Lakes can lose their submerged plant populations under relatively short timeframes; this can be associated with severe storms that stir up sediment or nuisance algal blooms that block the light available for underwater plant growth. Devegetated lakes are more likely to support nuisance algal blooms because their bottom sediments are not protected by plants, so that sediment and nutrients are easily mixed into the water. This situation can create a stable state where establishing submerged plants can be difficult.

In some situations it may be preferable for councils to leave populations of invasive macrophytes in place, if they are providing a useful ecosystem function and the lake no longer supports native macrophytes. The community may prefer invasive macrophytes over nuisance algal blooms. The consequences of macrophyte removal or management will need to be considered by councils when creating their management plans.

[14] https://www.doc.govt.nz/globalassets/documents/science-and-technical/inventory-monitoring/im-toolbox-freshwater-ecology/im-toolbox-freshwater-ecology-lakespi.pdf

Criterion	Option 7 Monitoring and responding to specific ecosystem health metrics
Effectiveness	+ Councils monitor a wider range of ecosystem health metrics, and develop actions to respond
Timeliness	+ Relies on councils amending their regional plans, which will happen over the next ten years
Fairness	**0** All stakeholders treated equitably
Efficiency	++ Targets actions that are appropriate to the issue and catchment. Stronger evidence base supports decision making
Principles of the Treaty of Waitangi	**0**
Te Mana o te Wai	+ Broader way of monitoring ecosystem than water quality alone
Overall Assessment	+ More complete evidence base, and clearer pathway for it to inform action

Options ruled out of scope, or not considered

Remove the permitted activity status of existing in-stream structures

Many councils permit existing structures that may have been authorised at the time of construction, but which do not provide for fish passage. This option would involve removing the permitted activity status for these legacy barriers, thereby bringing their management into the consenting regime. The effect would trigger the owner to apply for a resource consent and have the council consider the effects. If the consent was declined, the owner would need to apply for another consent to remove the structure, or attempt to mitigate the effects if possible, and apply again.

This has been ruled out because there are thousands of structures and councils lack the capacity to undertake such an assessment. This is unlikely to be an efficient way of encouraging prioritisation of remediation effort.

Additional compulsory attributes with resource use limits

Rather than managing the proposed compulsory monitoring attributes with Action Plans, another option could be to require limits to be set on resource use, as is the case for the existing attributes in the current National Objectives Framework (NOF). We have proposed using action plans for the following reasons:

- the extent that proactive objectives could be set for some of the metrics is unclear, and if there would be appropriate resource use levers at the national scale
- freshwater indicators of habitat or aquatic life have complex relationships with multiple stressors, which makes them difficult to manage by setting specific limits on resource use
- for some of the attributes, while there is confidence in the bottom line, there is some uncertainty in the location of bands.

Inclusion of all the metrics as monitoring requirements allows measures of ecosystem health to be considered holistically, to give a greater understanding of the state of catchment ecosystems as a whole, and provides for action plans to address issues.

There is also a much wider range of measurable ecosystem health components that could be considered for national direction. For example, Fish and Game New Zealand's proposed redrafted

NPS-FM included compulsory attributes for riparian cover and pH. The STAG considered and prioritised the full range of possible attributes in terms of their contribution to ecosystem health and the urgency of a requirement for national direction to councils. Based on this, the sufficiency of the underlying science, the time required for policy analysis, and capacity of local government, some potential attributes have not been progressed to a sufficient point to be considered for these proposed reforms at this time.

Recommendation

To date, central national direction and local authority freshwater management effort has tended to be focussed on aspects of water quality and quantity. But ecosystem health has three other components – physical habitat, the presence (or absence) of aquatic life, and the interaction between all these components. All five components are necessary for healthy functioning ecosystems and the benefits people derive from them. Councils must manage all components. Specific requirements in regards to managing fish, habitat and a wider range of compulsory metrics are needed to support this.

A comprehensive combination of the options is recommended to support and encourage councils to manage the broader components of ecosystem health, and ensure they are being adequately safeguarded.

The complementary options we propose progressing are:

- Option 1 Amend the description of the ecosystem health value.
- Option 2 Direct objectives and considerations for consenting structures.
- Option 3 Assess existing structures, maintain records, and prioritise mitigation.
- Option 4 National value for threatened species.
- Option 6 Distinguish between objectives set for attributes and objectives set for values.
- Option 7 Monitoring and responding to specific ecosystem health metrics.

We do not recommend progressing with Option 5 (spatial catchment planning) at this time. While there are aspects of this option that would bring about an improvement in freshwater management, there is not enough extra benefit to justify the risk of delaying implementation of the NPS while councils get to grips with the requirements.

The advantages of these options over the status quo is that:

- it is clear to councils, and the community, that there are five specific components of ecosystem health that must all be managed. This avoids a focus on water quality and quantity only
- it is clear that councils need to account for a wide range of stressors and pressures that affect ecosystem health, such as accounting for fish barriers
- benefits accrue to the community: improved understanding of what must be managed (improved decision making), and easier to hold councils to account
- improved decision making and transparency.

These amendments would support other direction in the Essential Freshwater package to:

- recognise Te Mana o Te Wai
- direct transparent reporting so that councils, communities and government can make informed decisions, and understand where the information gaps are
- better manage nutrients
- prevent further losses of stream and wetlands.

Progressing these recommendations means that regional councils will need to review and amend their regional plans to give effect to the direction on how they manage ecosystem health. They may need to fill technical gaps in their competency or management programmes, and undertake additional monitoring. Investment has been made in some tools to assist.

It is more cost effective to provide for fish passage in the design and construction of new structures, than to remediate existing ones. Nevertheless a small increase in consenting or design costs is expected. Councils are free to decide how they prioritise remediation of existing fish barriers, and to whom the cost falls. Costs associated with the other options will be around any additional monitoring or required actions. To some extent the policies are aimed at making good management practices clearer, rather than imposing additional and new obligations.

Our wellbeing is underpinned by healthy freshwater ecosystems. Examples of cultural, social and economic benefits include supporting mahinga kai, recreation, social licence for resource users, and protecting or enhancing our brand for exporters.

What do stakeholders think?

Stakeholders are generally in favour of the recommended options. There is strong support for recognising all five aspects of ecosystem health. Regional Councils are concerned about additional monitoring costs. The Ministry will continue to work with councils to help them implement these policies, and support guidance and monitoring tool development.

Essential freshwater advisory groups

Some members of the Kahui Wai Māori were concerned that the ecosystem health value was exclusive to the biophysical aspects of freshwater, because they see people as being inseparable from ecosystems. A biophysical freshwater focus is, however, relevant in terms of providing specific national direction about managing the ecosystems for values that benefit people. A more holistic approach that incorporates the water body, the ecosystem, and the people connected to it is part of Te Mana o te Wai. National direction on Te Mana o te Wai may more fittingly take that more holistic approach.

The Science and Technical Advisory Group provided extensive feedback on drafting a new description for ecosystem health in a way that encompasses all five biophysical components of ecosystem health. This feedback has been incorporated. They support taking a biophysical approach to ecosystem health and the minimally disturbed reference. They also advocate for requiring councils to manage a wider range of specific attributes, which was echoed by the other advisory groups

The advisory groups supported adding a new compulsory value for threatened species, and proposals to improve management of fish passage. The groups thought targeted guidance for farmers was needed on how they can provide for stock crossings in a way that does not impact on fish passage (eg, correct installation of culverts). Existing guidance is available from individual councils, and DairyNZ, however this could benefit from a review and update to ensure consistency with the proposed policy requirements, and to reflect latest recommended practice described in the recently published New Zealand Fish Passage Guidelines.[15]

[15] Waterway technical notes: practical approaches to waterway management, DairyNZ Ltd, (2016). Available at https://www.dairynz.co.nz/media/4329877/waterway-technical-notes.pdf (accessed 25 June 2016)

Regional Councils

The Regional Sector Water subgroup was consulted on early recommendations for Essential Freshwater. Key points in their feedback in April and May 2019 are that:

- they support recognising all five aspects of ecosystem health
- any changes to the description of ecosystem health should be better aligned with the purpose of the RMA and matters of national importance. They don't necessarily support a value description that implies objectives should be set against minimally disturbed conditions everywhere
- there are significant costs to monitoring fish health. They do not consider the FishIBI suitable for use as an attribute
- action plans to address fish would likely be far broader than just tools and methods available in the RMA, and they are concerned it over-reaches what a NPS can legitimately demand
- they supported direction to provide for threatened freshwater species but would caution against wording that might require this value to be protected (or avoid any adverse effect)
- proposals for fish passage need to be well integrated with proposals for retaining habitat in flow setting, monitoring fish abundance, and providing for threatened species
- any benefits of spatial planning need to be assessed against the realities of delivering on this within NPS implementation timeframes
- support in principle use of the dissolved oxygen attribute wider than just downstream of points source discharges, but consider it costly and unnecessary in all water bodies or FMUs. There is concern that attribute bands may be set too protectively.

New Zealand Fish Passage Advisory Group

The New Zealand Fish Passage Advisory Group comprises 15 member organisations from iwi, industry, consultancy and government. It was formed in 2014 to promote, enhance and advocate for improved fish passage and connectivity of our waterways. The group prepared the New Zealand Fish Passage Guidelines for structures up to four metres high, which can provide a useful basis for national direction, along with the new Fish Passage Assessment Tool. The group has not been directly consulted as a whole.

Fish and Game New Zealand

Fish and Game has a function under the Conservation Act to advocate for the management of sports fish and their habitat both generally and in any statutory planning process. In May 2018, they provided the Minister for the Environment with a redrafted NPS-FM. Relevant proposals included the following:

- **Amendments to the definition of Ecosystem health** to clarify that healthy ecosystems are resilient to stress from human induced pressures and climate change.
- **Specific objectives and policies relating to habitat quality** to ensure the maintenance or improvement of physical habitat (which includes the bed and the riparian margin)
- **A policy that fish passage should be managed** in accordance with the NZ Fish Passage Guidelines and monitoring requirements related to fish passage
- **New attribute tables with bands and national bottom lines** that require attribute states to be set for measures covering the full range of ecosystem health components, including physical habitat, aquatic life and ecosystem processes. Amendments are also proposed to existing attribute tables.
- **New monitoring requirements** relating to habitat, aquatic life and ecological processes eg, of fish communities, fish passage, measures of the health and habitat of indigenous flora and

fauna and valued introduced species, and assessing and reporting the length of natural streams and rivers lost to piping or artificial straightening.

Operators of hydro-electric power generation schemes

Hydro-electric dams are major barriers to migration in some river networks, and operators say there is pressure on them to address fish passage, particularly from iwi. However, they describe facing substantial challenges to modify large structures, which were designed at a time when less weight was given to the consequences of impeded fish passage. They consider that often their options are limited by the (effectively) irreversible decisions that have already been made when deciding to build the infrastructure in the way that it was. Sometimes offsetting (ie, restoring another site) can be used as mitigation, often addressed through consenting processes for such infrastructure.

The recommended options do not prevent consenting authorities from granting an application, but aim to improve decision making and evidence, and as a result it will be likely that significant environmental effects require better mitigation. Large dam operators are already subject to scrutiny due to the obvious nature of the adverse effects associated with them.

Summary table of costs and benefits of the preferred approach

Additional costs of proposed approach, compared to taking no action			
Affected parties	**Comment**	**Impact**	**Evidence certainty**
Regulated parties	Consent holders may need to undertake mitigation of existing structures, depending on council priorities. Unknown cost from possible constraints on resource use that may occur as a result of council and community actions.	Approximately $20 million over time, and depending on council and community decision making	Low
Regulators	One-off capital costs for councils for monitoring equipment, and ongoing monitoring costs which they may recoup via consents from resource users.	Approximately $2 million	Low
Wider government	No impact	-	High
Other parties	-	-	
Total Monetised Cost		Approximately $22 million	Low
Non-monetised costs	*Medium*		

Expected benefits of proposed approach, compared to taking no action			
Affected parties	**Comment**	**Benefit**	**Evidence certainty**
Regulated parties	Resource users maintain their social licence to operate. Brand protected or enhanced for exporters and tourism.	Medium	Medium
Regulators	Demonstrate and achieve purpose and their functions under the RMA	Medium	Medium
Wider government	Healthy ecosystems support wellbeing (see 'other parties' below). Contribute to MfE target that no threatened freshwater fish increase in threat status. Support DOCs stretch goals and outcomes. Contribute to implementing Convention on Biological Diversity.	Medium	Medium
Other parties	Healthy freshwater ecosystems underpin a range of ecosystem services that our society and economy benefit from, such as: Cultural services: intrinsic values provide satisfaction and underpin wellbeing. Benefits accrue to cultural heritage, sense of identity, mahinga kai, recreation (eg fishing, kayaking, tramping), and tourism. Regulatory services: Maintenance of water quality (filtering, attenuation), and attenuation of flood flows Provisioning Services: Drinking water, agriculture, industry, hydro-generation, and food.	High	Medium
Total Monetised Benefit		NA	NA
Non-monetised benefits		Medium	Medium

Appendix 2: Preventing further loss of streams

Context

Causes of stream loss

Urban centres in New Zealand have less than 10 percent indigenous vegetation cover remaining.[16] In these modified environments, rivers and streams often represent one of the last refuges for biodiversity. However, urban streams have been piped, straightened and channelised to a large extent. This is continuing, and greenfield development in particular (ie, in areas with no existing infrastructure) can result in stream loss through piping and infilling to increase the amount of useable land, and it can increase impervious surfaces like roads and roofs, which changes stream flow patterns.

Water bodies that drain urban land exhibit a range of consistently observed symptoms of degraded ecosystem heath. In streams these symptoms have been termed "the urban stream syndrome", and include: elevated concentrations of pollutants; flashy flows (extreme high flows during rain, with periods of very low flow in-between); modified or channelized streambed shape and composition; barriers to fish passage; and low biodiversity dominated by weeds, pests and species that are more tolerant of poor water and habitat quality.

Rural streams and rivers are also at risk of modification through diversion and piping[17]. This is continuing, resulting in continuing habitat loss for aquatic animals and plants.

Streams that have been piped or filled in show some of the most pronounced adverse effects of stream modification, and are characterised by a reduced range of species, lower food availability (macroinvertebrates and leaf litter), reduced fish passage up or downstream, and altered flow patterns and sediment transport. Permanently diverting or relocating streams and rivers is less damaging than piping but can result in a net loss of habitat.[18]

Extent of stream loss

Urban streams have been piped to a large extent: Auckland's headwater streams are largely piped, and in Wellington, the Kumutoto, Pipitea, Tiakiwai, Tutaenui, Waipira, and Waitangi streams have all been piped to allow for urban development, resulting in the loss of at least 5 km of stream habitat.[19] In the catchments of Porirua at Porirua East and Takapuwahia/Elsdon, Wellington, approximately 9.6 and 3.9 km of stream have historically been piped.[20]

The loss of stream habitat continues, though we do not have exact figures nation-wide. From 2003-2008, 15 km of stream loss was consented in the Greater Wellington region.[4] Stream loss is not

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[16] Clarkson BD, Kirby CL, Wallace KJ. 2018. Restoration targets for biodiversity depleted environments in New Zealand. Prepared for the Biodiversity Collaborative Group by The Environmental Research Institute, University of Waikato

[17] Taranaki Regional Council. 2010. Small Stream Modification in Taranaki. Taranaki Regional Council, Stratford.

[18] Streams and rivers may be diverted temporarily during construction projects to allow works to be carried out in dry stream or river beds. Temporary diversions are considered separately to permanent diversions because they are a means of avoiding adverse effects.

[19] Greer MJC, Grimmond D and Fairbrother P. 2017. The environmental and economic costs and benefits of the pNRP stream piping provisions. Greater Wellington Regional Council, Publication No. GW/ESCI-T-18/6, Wellington.

[20] Greater Wellington Regional Council, unpublished data

confined to heavily urbanised centres. In Southland, there was 4.9 km of stream habitat modification (piping and infilling) consented over the last ten years (including river bank reclamation of about 3,000 m^2 on the left bank of the Whitestone River), and an additional 1.1 km has been applied for.[21]

Taranaki Regional Council reported a sharp increase in stream piping and diversion for the purposes of increasing the available land area for farming, coinciding with the increasing intensification of dairying in 2006-2008.[22] Between 1995 and 2009, Taranaki Regional Council issued 267 consents involving modification of 43.6 km of stream, and an analysis of aerial photography showed that a substantial amount of additional modification was carried out under permitted activity rules or without resource consent.

Current regulations

Under the current regulatory regime set by regional councils, gradual loss of stream and river habitat will continue. Existing regional plan provisions vary in both complexity and the level of protection afforded to streams and rivers. For example, the Auckland Unitary Plan identifies areas where significant adverse effects on streams, lakes, wetlands and other ecological areas must be avoided, and specifies stricter activity statuses for more damaging activities such as new infilling or drainage (see example in Impacts section).

A more permissive example is the Proposed Southland Water and Land Plan, which provides little policy direction to encourage the preservation of existing stream and river habitat. For example, culverts are a permitted activity with no restrictions relating to the loss of habitat or length of culvert.

Many plans allow for the installation of culverts below a length threshold (often 20 m) as a permitted activity providing conditions are met (eg, installing the culvert deeply enough to allow for movement of stream bed materials, providing for sufficient flow capacity, allowing passage of fish, preventing adverse impacts to erosion and sedimentation, and protection of property downstream). Such rules are necessary to allow for some culverting to avoid the adverse effects of stock and vehicle crossings.

River crossings are a regulated activity under Regulation 5(1)(d) of the National Environmental Standard for Plantation Forestry (NESPF). The NESPF notes that river crossings can have adverse effects on sedimentation, fish passage, erosion, and the accumulation of debris. The NESPF sets detailed requirements to manage these effects, but does not provide direction on how to address stream habitat loss caused by culvert installation.

Even in regions that have planning provisions seeking to avoid or minimise the loss of aquatic habitat, it is common practise to compensate for removal of stream habitat through piping or infilling by planting of riparian margins in a different location. Riparian planting is not an adequate way to remedy all aspects of stream degradation. In addition, there is a risk that mitigation actions will not be as successful as intended, and can take a long time to establish an environment in the state intended (eg riparian planting takes time to grow).[23] This results in continuing cumulative loss of stream habitat.

[21] Environment Southland, unpublished data.

[22] Taranaki Regional Council. 2010. Small Stream Modification in Taranaki. Taranaki Regional Council, Publication No. 537059, Stratford

[23] Brown MA. 2014. Towards Robust Exchanges: Evaluating Ecological Compensation in New Zealand (Thesis, Doctor of Philosophy (PhD)). University of Waikato, Hamilton, New Zealand

The problem: Cumulative loss of habitat, particularly in small streams, is adversely affecting freshwater ecosystems

Habitat loss in streams and rivers happens because the:

a) cumulative effect on aquatic ecosystems of multiple instances of piping or infilling stream or river beds is not adequately recognised
b) ecology of rivers and streams (particularly small contributing waters) is under-valued when compared to the economic value of maximising profits from developments and transporting rainfall runoff as quickly as possible
c) effects of piping or infilling a stream in one location are often not adequately offset or compensated for by common approaches, such as riparian planting, in another location.

One of the reasons why habitat loss in streams and rivers is a problem is because many of New Zealand's native species are threatened with or at risk of extinction.[24] Many native ecosystems and habitats have been cleared or altered, and this is continuing.

Urban areas expanded in area by 10 percent between 1996 and 2012. Population growth is expected to continue; projections estimate New Zealand's population may reach 5 million in the next five years.[25] This will result in ongoing pressure on native habitats and biodiversity.

Linkages

Proposed National Policy Statement for Indigenous Biodiversity

These proposals are consistent with recommendations made by the Biodiversity Collaborative Group to the Minister for the Environment to maintain certain ecological attributes, for example, species occupancy across their natural range.[26] The proposals are also consistent with the Biodiversity Collaborative Group's recommendations relating to compensation and offsetting.

The reporting requirement would complement the accounting requirements for water quality and water quantity already required by the NPS-FM.

Proposed National Policy Statement for Urban Development

The proposed National Policy Statement for Urban Development (NPSUD) focuses on providing direction to local authorities to ensure their RMA plans enable and support beneficial growth and development. The NPSUD contains proposals intended to provide for the efficient use of land and infrastructure, which could help to incentivise green infrastructure.[27]

The NPSUD proposal requires local authorities in the major urban centres (Auckland, Hamilton, Tauranga, Wellington, Christchurch and Queenstown) to work with infrastructure providers (including Three Waters providers) and others to create a Future Development Strategy (FDS) to identify how and where development capacity can be provided and where it should be avoided.

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[24] Ministry for the Environment & Stats NZ. 2019. New Zealand's Environmental Reporting Series: Environment Aotearoa 2019.

[25] Stats NZ. (2016). National Population Projections: 2016 (base) – 2068 Key facts. Retrieved from https://www.stats.govt.nz/informationreleases/national-population-projections-2016base2068

[26] Biodiversity Collaborative Group. 2018. Report of the Biodiversity Collaborative Group. Biodiversity (Land and Freshwater) Stakeholder Trust. Wellington.

[27] Any system that uses a combination of natural and built environments to retain or restore natural ecosystem processes and reduce the environmental impact of the built environment, eg, stormwater systems allowing for soakage and storing of water in a way that mimicks natural systems.

This could have positive outcomes for urban water bodies if restrictions are placed on areas where Te Mana o te Wai would be adversely affected by urban development, for example by preventing the loss of waterbodies. The FDS will also require RMA plans to give effect to it, which could help regional and territorial authorities integrate their freshwater management and land use functions.

The NPSUD contains proposals that are intended to enable intensive urban development in areas where it is most appropriate. Intensive development is broadly considered to have better overall outcomes for urban water provided that good practices are implemented at the same time. Higher urban density will provide efficiencies in the provision, operation and maintenance of three waters infrastructure and services. It may also reduce the amount of contaminants in urban water runoff per capita compared to less intensive development, thereby placing less pressure on urban water bodies.

National Direction on Rural Land-use

As part of Essential Freshwater, there is a proposal that regulations are introduced to exclude stock from waterways. It is also proposed that all stock crossings where animals cross more than twice per month will need to be bridged or culverted.

Without strong direction to discourage activities that damage streams, the policy measures above may have the unintended consequence of increasing the incentive to pipe or divert waterways to reduce or avoid the need for fencing. This is more of a risk in regions with more permissive consenting requirements for stream piping and modification.

Options assessment

This proposal's objective is to help stop further degradation and loss by directing regional councils to discourage stream loss where it can practicably avoided, remedied or mitigated, and where this is not possible to require offsetting and compensation for residual adverse effects.

Summary assessment

Criterion	Option 2: Objective and policy in NPS-FM	Option 3: Regulation of damaging activities	Option 4: Offsetting and compensation	Option 5: Review the SEV technique	Option 6: Monitoring and reporting
Effectiveness	++	+	+	++	+
Timeliness	+	++	+	+	+
Fairness	++	++	+	+	+
Efficiency	+	++	+	+	+
Principles of the Treaty of Waitangi	+	+	0	0	0
Te Mana o te Wai	++	++	0	0	+
Overall Assessment	++	++	+	+	+

Option 1: Maintain status quo

The status quo would be expected to result in further loss of stream habitat, particularly in regions with more permissive planning frameworks. Effects of stream habitat loss are likely to continue to be

mitigated inadequately, leading to a cumulative decline in habitat and contributing to decline of aquatic species.

This option does not place the wellbeing of the water first as it places greater value on allowing for development. Because it is more cost effective to preserve ecosystems rather than restore or recreate them, this option imposes substantial costs for rehabilitation and restoration on future generations. Maintaining the status quo is likely to lead to the continuing loss of natural habitats in urban areas, reducing the ability of urban communities to connect with natural freshwater ecosystems.

Option 2: Policy specifying no net loss of habitat or ecosystem function

This option would introduce an objective in the NPS-FM to halt the loss of river[28] habitat and ecosystem function, with an accompanying policy directing councils to make or change regional plans to:

(1) maintain river extent and ecosystem health; and
(2) establish monitoring methods to evaluate the effectiveness of the plans in achieving this objective.

The intent is for this option to apply to resource consenting decisions.

Definitions

Several details relating to definitions would need to be resolved to aid implementation of the policy. One option considered was to restrict this policy to urban areas. Restricting the policy to urban areas would be difficult to define and could lead to perverse outcomes by encouraging loss of stream habitat that was outside the definition of the policy. Much of stream and river loss occurs in urbanising catchments during development of greenfield areas, in many cases through private plan changes in areas that are not previously defined as urban. There is evidence that stream and river habitat loss is also occurring in rural areas. Urban streams and rivers are at greater risk of modification, but urban areas cover approximately 0.8 percent of our land[29], and there are many more rural streams overall. This suggests that it would be appropriate to apply the policy to all land use types.

The intent is for this option (and for Option 3) to apply to permanent and intermittent streams and rivers everywhere. National and international research shows that intermittent streams are valuable ecologically but are particularly at risk from hydrological alteration, piping and infilling, suggesting that they should be managed in the same way as permanent streams and rivers.

River habitat is not just the area where water flows; riparian margins are important for providing for habitat quality and ecosystem function. Riparian vegetation provides shading which helps regulate stream temperature, it filters and slows down runoff, and it provides inputs of organic matter such as sticks and leaves, which in turn provide habitat and food for aquatic animals.

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[28] We propose to use the RMA definition of a river in this policy; the RMA does not specifically define a stream although it is captured by the definition of a river. A 'river' is defined in the RMA as "a continually or intermittently flowing body of freshwater; and includes a stream and modified watercourse; but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation or farm drainage canal)". Streams are included in this definition and therefore rivers and streams are both referred to. See Additional Information 1 for definitions.

[29] Ministry for the Environment & Stats NZ. 2019. New Zealand's Environmental Reporting Series: Environment Aotearoa 2019.

Neither the NPS-FM nor the RMA define stream or river habitat, or provide guidance on how to define the edge of the water body. However, many councils have existing methods for defining the spatial extent of different water bodies. A policy requiring councils to maintain river extent and ecosystem health would be well supported by a consistent and robust definition of where river habitat ends, with guidance on how to measure this.

Though not defined in legislation, stream ecological function can be quantified using the Stream Ecological Valuation technique, which was developed in Auckland and requires further development to apply at a national level (see Option 5).

The RMA definition of "river" excludes artificial waterways such as farm drainage canals. Determining whether a stream is natural or artificial is not always straightforward and there is a lack of consistent guidance on defining artificial waterways. In any case, many artificially constructed waterways are the last vestiges of aquatic habitat where there was previously a stream or wetland. They can provide habitat for threatened species such as longfin eel and black mudfish. It is recommended that policy direction takes into account, and provides for the protection of, the ecological values of such habitats.

Existing permitted activities

To maintain the extent and ecosystem health of rivers overall, it would be necessary to quantify and address the effects of many activities that currently have a permitted activity status in regional plans, providing certain conditions are met. Examples include the clearance of riparian vegetation, extraction of material from rivers, minor river bank protection works, erosion control structures, construction and maintenance of some structures, demolition and removal of existing structures, and planting of plants. Imposing a more restrictive activity status of such activities would be a significant change that would add to the administrative burden for councils. More work would be required to determine the benefits and impacts of such a proposal and we recommend this as an area for future work.

Monitoring

Option 2 would require councils to establish monitoring methods to evaluate the effectiveness of the plans in achieving no net loss of river habitat and ecosystem function.

In addition to the broad direction above, we recommend requiring councils to collect and report information from new resource consents on gains and losses in river habitat, and the causes of the gains and losses (eg, as part of existing accounting requirements).

Methods for quantifying stream modification, eg by remote sensing, are being developed currently, and as these techniques become more widespread, it will become easier for councils to quantify current and historical modification of waterways.

Criterion	Option 2: Policy specifying no net loss of habitat or ecosystem function
Effectiveness	++ Provides high level direction but councils may interpret this differently leading to inconsistent outcomes.
Timeliness	+ Would take time for Councils to incorporate into plans, if not accompanied by rules in National Environmental Standard.
Fairness	++ This would apply to all councils, and allow councils to develop rules that align with local circumstances.
Efficiency	+ Would be a flexible approach to rule setting (councils would be able to develop rules that suit local circumstances).

Principles of the Treaty of Waitangi	+ Depends on how councils chose to implement the objectives and policies. However, would likely prevent further habitat loss which would help protect waterways for cultural use (eg, mahinga kai).
Te Mana o te Wai	++ Would likely prevent further loss of waterways which would help protect them for cultural use (eg, mahinga kai).
Overall Assessment	++ Likely to be better than status quo.

Option 3: Targeted regulation of damaging activities

This option would restrict the most destructive activities through regulations in a National Environmental Standard (NES) and National Policy Statement that would direct councils what course of action to take when issuing resource consents. It would set activity statuses in regional plans for the most destructive activities to rivers as non-complying in the first instance and then provide exceptions where more lenient activity statuses might be appropriate.[30] This would set a higher bar for applicants to demonstrate that the effects of their activities were being adequately addressed. The targeted activities might include:

- piping or infilling the bed of a lake, or any river, where the piping or infilling is greater than 20m in length
- permanently diverting a river that results in a net loss of habitat or ecosystem function.

An example of where a more lenient activity status might be appropriate is the installation of culverts to provide for stock crossings. One approach would be to specify a permitted activity status for such culverts provided that conditions are met relating to installation, design specifications and biological performance (eg, fish passage).

If a non-complying activity status is introduced in the NES, it would also be necessary to amend the NPS-FM to introduce policy direction on the circumstances in which councils may approve a resource consent application to pipe or infill a river bed, or permanently divert a river.

In several existing plans, councils specify areas of high preservation value where activities are restricted more than in the generally applicable plan provisions. There is a risk that setting a minimum standard in an NES or similar regulation would provide a justification for councils to relax their standards in the next iteration of their plans. This risk can be mitigated by ensuring there is higher level policy preventing the net loss of streams as described in Option 2, and by including a clause stating that councils may impose more stringent regulations.

The intent of this approach is to:

a. strongly discourage the loss in extent and degradation of condition of permanent and intermittent streams and rivers, and where loss cannot be avoided, ensure that offsetting or compensation approaches adequately make up for the loss (see Option 4).
b. discourage activities that have been identified as the most destructive to rivers. This could be achieved with rules in the NES and policies in the NPS that are intended to be minimum standards, and council rules or consents can be more stringent. Targeted activities include:
    i. piping

[30] This is a similar approach to the NES on Air Quality and is similar to the proposed approach for wetlands.

ii. earthworks/ infilling or disturbance of the bed
iii. permanent diversion or relocation that results in a net loss of habitat

c. not duplicate or undermine existing planning frameworks that manage various activities in rivers effectively. An example is where a regional plan directs dimensions and design specifications for culverts to avoid flooding or fish passage issues.
d. allow for installation of culverts below a certain length, to allow for livestock or vehicle crossing points, as a permitted activity with conditions to be met (such as minimum design standards proposed in the new fish passage policy).
e. not unnecessarily prevent or introduce additional consenting requirements on restoration actions that require the disturbance of the river bed. These actions are typically aimed at returning more 'natural' functions and processes to systems with a high degree of historic modification (eg, straightened and channelised streams. Where appropriate, a more lenient activity status could be applied to these activities.

Criterion	Option 3: Targeted regulation of damaging activities
Effectiveness	+ Likely to be more effective than status quo in councils where existing rules are inadequate for protecting stream habitat. There is a risk that councils will have less ability to impose stricter conditions.
Timeliness	++ Rules would come into effect quickly through a National Environmental Standard.
Fairness	++ This would apply to all councils and consent applications equally.
Efficiency	++ Activities that cause the most damage are targeted.
Principles of the Treaty of Waitangi	+ Would likely prevent further loss of waterways which would help protect them for cultural use (eg, mahinga kai).
Te Mana o te Wai	++ Councils are already required to give effect to te Mana o te Wai. The additional objectives and policies won't change these obligations. However, regulation of damaging activities will mean that the needs of the waterbody are given greater consideration in consenting decisions.
Overall Assessment	++ Likely to be better than status quo as will limit damaging activities without imposing additional plan amendments for councils.

Option 4: Offsetting and compensation

This option would amend policy to require offsetting of a particular adverse effect where the effect cannot be avoided, remedied, or mitigated, and require compensation where offsetting is not possible. The intent of this option is to address development proposals applying for resource consents under the RMA, and to provide high-level principles and a framework to improve consistency and environmental outcomes compared to the current situation.

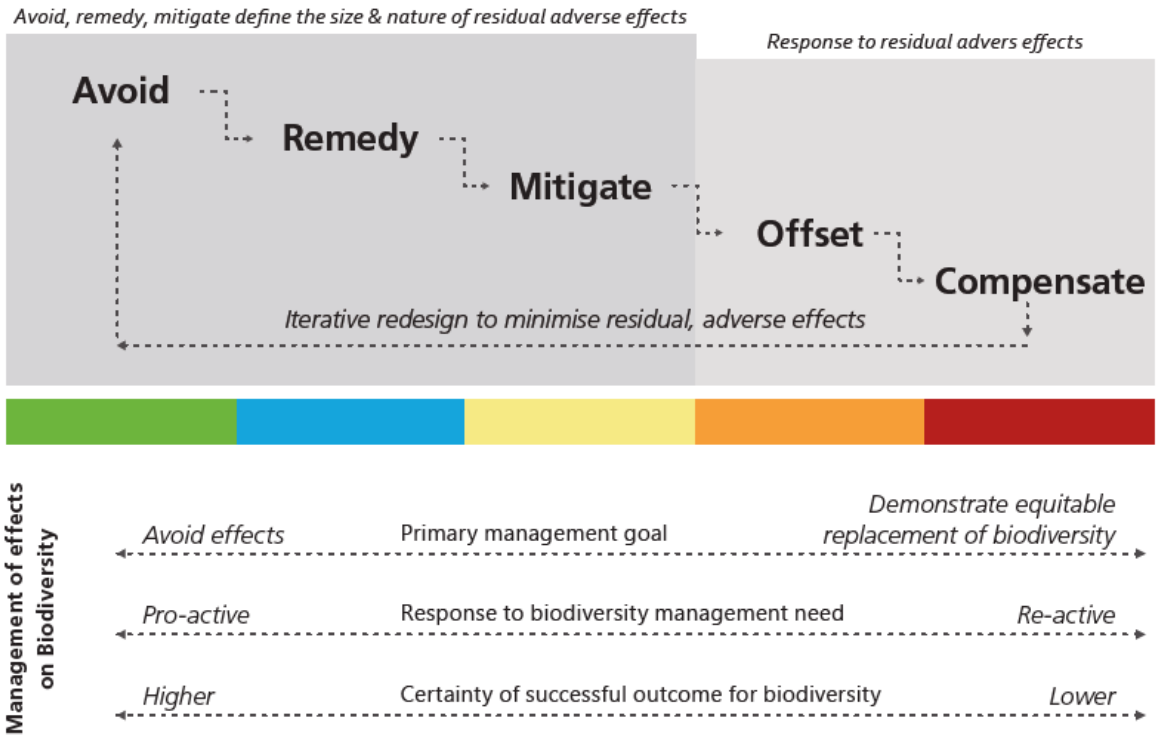
Biodiversity offsetting is "*measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate prevention and mitigation measures have been taken. The goal of biodiversity offsets is to achieve no net loss and preferably a net gain of biodiversity on the ground*".[31]

[31] BBOP, 2013. An overview of the BBOP programme. www.forest-trends.org

Offsetting is only appropriate to consider after all potential possibilities to avoid, remedy, or mitigate adverse effects of an activity on-site have been ruled out. We recommend that this is made clear in the policy. This is because *"It is more efficient and cost-effective to maintain existing indigenous ecosystems than to try and create new ecosystems. There are inherent difficulties and risks in seeking to recreate or reconstruct indigenous habitat in order to mitigate for continuing removal of indigenous habitat for development projects, and that mitigation may not result in an ecosystem of equivalent richness of function".*[32]

There are different options for specifying at what level offsetting should be applied. In relation to terrestrial habitats, some of the Biodiversity Collaborative Group recommended that "significant" is an appropriate level of adverse effect to focus offsetting and compensation measures on. Others considered that offsetting should apply to all more than- minor adverse effects. They note that the Guidance on Good Practice Biodiversity Offsetting[33] refers to 'significant' residual adverse effects but goes on to clarify that this means 'ecologically meaningful' rather than a 'significant effect' as used in the RMA.

Figure 1. The continuum of responses for the management of effects. Certainty about achieving successful outcomes for biodiversity decreases at each step along the continuum (moving left to right).[34]



[32] Biodiversity Collaborative Group. 2018. Report of the Biodiversity Collaborative Group. Biodiversity (Land and Freshwater) Stakeholder Trust. Wellington.

[33] New Zealand Government. 2014. Guidance on good practice biodiversity offsetting in New Zealand. New Zealand Government, Wellington.

34 Maseyk, F., Ussher, G., Kessels, G., Christensen, M., Brown, M. 2018. Biodiversity offsetting under the Resource Management Act: A guidance document. Prepared for the Biodiversity Working Group on behalf of the BioManagers Group.

This option will provide direction on what can and can't be offset, and will specify that the preferred approach is for like-for-like options to be defined on the basis of stream functions, ie, riparian planting is not adequate to offset all types of stream habitat loss.

There are also limits to what can be compensated. The Environment Court confirmed the proposed Otago Regional Policy Statement provisions to consider the offsetting of indigenous biological diversity offsetting under certain conditions.[35] Further, the Court directed Otago Regional Council to add a policy detailing limits to compensation (Additional Information 4).

This option is intended to be progressed together as a package with Options 2, 3, and 5. Policies on offsetting and compensation are not sufficient for halting decline on their own because they only deal with the residual effects of an activity and do not direct where certain activities are to be avoided.

There needs to be a robust method of ensuring the gains elsewhere are commensurate, so that the policy avoids facilitating further degradation. If this policy is progressed it will also be necessary to provide further guidance, which is detailed in Option 5 below.

Criterion	Option 4: Offsetting and compensation
Effectiveness	+ Only deals with residual effects after all options to avoid, remedy, or mitigate have been exhausted.
Timeliness	+ Depends on types of offsetting or compensation implemented. Time lags in restoration need to be accounted for at the planning stage.
Fairness	+ May lead to loss of ecosystems in one area and gains in other areas if not implemented strategically.
Efficiency	+ Creating policy guidance for offsetting and compensation will clarify expectations and reduce the need for negotiating offsetting and compensation requirements.
Principles of the Treaty of Waitangi	**0** Unlikely to change significantly from status quo where offsetting and compensation is already being carried out.
Te Mana o te Wai	**0** Unlikely to change significantly from status quo where offsetting and compensation is already being carried out.
Overall Assessment	+ Likely to be better than status quo but not effective at halting loss on its own.

Option 5: Produce guidance and review the Stream Ecological Valuation technique

To support national direction on preventing further stream loss, we intend to review the Stream Ecological Valuation (SEV) technique and prepare new technical guidance about calculating the amount of mitigation or offsetting required to compensate the adverse effects of human activities on rivers and streams.[36]

[35] Oceana Gold (New Zealand) Limited vs. Otago Regional Council [2019] NZEnvC41

[36] The SEV technique is the most widely used technique to determine the effects of stream habitat loss and the necessary measures to mitigate, remedy or offset that loss. It does not account for non-ecological values of stream habitats (such as cultural values, amenity or natural character), and does not take into account the rarity of species in the habitat. See Additional Information 2.

The first step of the project would be to review and evaluate current practises in terms of their effectiveness and adherence to established best practise biodiversity offsetting principles. The next step would be to develop a consistent, nationally mandated method for determining the amount of mitigation or offsetting required to compensate for adverse effects in streams and rivers, building and improving on existing approaches. The guidance developed would also be consistent with the Biophysical Ecosystem Health Framework which was developed in 2018 for MfE. [37]

The benefit of developing this guidance would be to encourage consistent and transparent mitigation and offsetting provisions that are targeted towards, and adequately address, the specific adverse effects of the activity.

Criterion	Option 5: Produce guidance and review the Stream Ecological Valuation technique
Effectiveness	++ Will improve outcomes at the local scale.
Timeliness	+ Guidance will take time to be developed but can be implemented immediately once complete.
Fairness	+ Development costs borne by central government.
Efficiency	+ Efficiency can be improved by making sure the new methods are taken up, eg by workshops.
Principles of the Treaty of Waitangi	**0** Unlikely to change significantly from status quo.
Te Mana o te Wai	**0** Unlikely to change significantly from status quo.
Overall Assessment	+ Likely to be better than status quo but not effective at halting loss on its own.

Options ruled out of scope, or not considered

One option considered was to direct councils to modify their plans to avoid stream loss entirely without any possibility of offsetting. This option would be the most protective of stream habitat, but was ruled out because it would have significant impacts in terms of loss of available land for housing and national infrastructure.

We also considered the issue of inadequate monitoring and compliance of consent conditions leading to the loss of stream habitat. However, this issue was ruled out of scope as the problem is not unique to streams and is a symptom of the wider resource management system, and is better dealt with by reforms at this level.

Recommendation

The Ministry recommends that options 2, 3, 4, 5 and 6 are progressed as a package.

The Ministry considers this combination of options provides the most practical, enforceable and timely way to prevent further degradation to stream habitat.

[37] Clapcott J, Young R, Sinner J, Wilcox M, Storey R, Quinn J, Daughney C, Canning A, 2018. Freshwater biophysical ecosystem health framework. Prepared for Ministry for the Environment. Cawthron Report No. 3194.

Implementing the options in isolation, or a sub-set, would be too uncertain (eg, amending the NPS-FM) or would not address the whole problem (eg, direction on offsetting and compensation), which would allow habitat loss.

These options progressed as a package will ensure that a minimum standard is applied, providing fair and consistent outcomes across the country. They will clarify the requirements for resource consent applications and minimise the time spent negotiating mitigation requirements, a process that can be costly and impose delays.

The recommended options are aimed to encourage a more holistic view of streams and rivers rather than focusing on water quality and quantity, consistent with direction in the Essential Freshwater package to consider all the components of ecosystem health.

What do stakeholders think?

Stakeholders were supportive of the policy intent to maintain the extent and ecosystem health of rivers.

The Land and Water Forum recommended preventing further loss of urban streams (unless the loss can be offset by improvements elsewhere in a freshwater management unit).

Fish & Game New Zealand provided Minister Parker with a redrafted NPS-FM on 4 May 2018, which recommended preventing net loss of streams.

The Freshwater Leaders Group supported direction to halt loss of stream habitat. The Science and Technical Advisory Group noted that habitat loss is a significant issue and major driver of decline in streams and rivers. In relation to offsetting and compensation, they noted that it's important to have guidance on how to quantify losses and gains, and that offsetting may not be appropriate for some types of ecosystems.

The Resource Manager's Group supported strong direction to avoid stream loss. They noted that redirection of streams was also potentially a damaging activity, as well as piping and infilling of streams. There are other modifications to river habitat that would not be dealt with by the proposed policy, such as river stop banks. They noted the need to align stream habitat loss policy with other central government policy.

Department of Conservation officials recommended that it was important to articulate that the policy should apply everywhere. They noted that the severity of the effect of piping will vary depending on catchment characteristics, species present and the amount of prior modification. They noted the importance of addressing the broader issue of how stream and river habitat is measured and managed; this is an area for further work.

The Biodiversity Collaborative Group (BCG) recommended:

> *"The BCG has not been able to draft and propose a policy to address impacts of human activities on indigenous freshwater fauna and their habitat and recognises this needs to be linked to the approach taken to identifying (and potentially separately managing) ecologically significant freshwater environments. It considers that such national policy direction is urgently required. An integrated approach to managing effects on indigenous freshwater biodiversity is required, taking into account the interplay between RMA functions, the NPS-FM's objectives, policies, and national values for freshwater, and fishery and biosecurity functions of councils and other agencies. The BCG expects that this will involve measures for inclusion in an NPS (either the NPSIB or NPS-FM), but may also*

include other complementary measures that may prove more effective in determining fishery management priorities or dealing with issues such as pest fish.

Recommendation 2. As a matter of priority the Ministry for the Environment, in conjunction with DOC, regional councils and freshwater ecology experts, should:

(a) Develop the policy needed to control adverse effects as necessary to protect section 6(c) matters and indigenous freshwater biodiversity more generally, and include such policy in the NPSIB or NPS-FM.

(b) When developing this policy focus on matters that are currently not controlled under the NPS-FM.

(c) Consider a range of options or mechanisms when developing policy.

(d) Consult with national stakeholders when developing this policy."[38]

Summary table of costs and benefits of the preferred approach

Affected parties *(identify)*	**Comment**: *nature of cost or benefit (eg ongoing, one-off), evidence and assumption (eg compliance rates), risks*	**Impact** *$m present value, for monetised impacts; high, medium or low for non-monetised impacts*	**Evidence certainty** *(High, medium or low)*
Additional costs of proposed approach, compared to taking no action			
Regulated parties	Increased costs / reduced returns for developers highly variable; varies with development design, topography of land, amount of streams present, ecological values that need to be offset.	Low	Low
Regulators	Will increase consenting, monitoring and compliance costs for some councils	Medium	Medium
Wider government	Minor one-off costs of improving guidance	Low	High
Other parties	N/A	N/A	N/A
Total Monetised Cost	N/A - varies based on design decisions	N/A	N/A
Non-monetised costs	Vary based on design decisions and stringency of current local regulations to councils with permissive regulations.	Medium	Low
Expected benefits of proposed approach, compared to taking no action			
Regulated parties	Will increase certainty for consent applicants	Low	Medium
Regulators	Will increase certainty for regulators assessing consent applications	Low	Medium

[38] Biodiversity Collaborative Group. 2018. Report of the Biodiversity Collaborative Group. Biodiversity (Land and Freshwater) Stakeholder Trust. Wellington.

Wider government	Potential benefits to Government's urban development and rural land use initiatives; encourages efficient use of land and infrastructure, and strategic consideration of locations for housing intensification.	Low	Medium
Other parties	Benefits to ecosystem health of maintaining habitat and connectivity (immediate effect; ongoing). Social and cultural benefits to general public (medium to long term)	High	Medium
Total Monetised Benefit	N/A – benefits of maintaining natural environments are difficult to quantify	N/A	N/A
Non-monetised benefits	Environmental, social, and economic benefits of retaining natural ecosystems	High	Medium

What other impacts is this approach likely to have?

We anticipate these proposals will have limited impact on rural land uses. Specific planning restrictions would also provide greater certainty to farmers about how to undertake future farm development. However, preventing urban stream loss is likely to have some impact on the profit margins of new urban developments.

Preventing the loss of an urban stream within a new development can reduce the amount of land available and result in less land being available for purchase (by land area). This could result in higher costs per property being passed on to purchasers, or a reduced return for the development as a whole, impacting decisions about the feasibility of the project.

The design of new development can mitigate these higher costs and reduced return. Incorporating stream corridors into green open space networks and reserves, providing more compact development using smaller lot sizes and higher density, and providing green alternatives to piped stormwater infrastructure can make urban development more cost-effective. These types of design approaches are consistent with the urban development outcomes the National Policy Statement for Urban Development (NPS-UD) is seeking to encourage.

Design-based solutions for development would be unlikely to mitigate the full cost impacts, and overall this policy would be likely to increase property prices in new greenfield developments where there are streams. Where housing yield cannot be maintained in a development (eg, through design or increased density) the reduction in land available could also mean that more land is required to accommodate the same number of dwellings.

Reduced return to developers could be mitigated in part by the premium that properties close to urban streams would be likely to attract due to the amenity provided by the stream; however this would further add to the cost passed on to property purchasers.

The costs would be mainly borne by developers and passed on to property purchasers, while benefits would mainly be enjoyed by the wider community and environment. They are likely to include amenity, shared space for recreation and active transport, resilience to natural hazard risk, reduced pressure on stormwater infrastructure outside of the development, improved water quality in downstream receiving environments, benefits for biodiversity and ecosystem health, and

opportunities for people to be better connected to the natural environment, and for tangata whenua to express kaitiakitanga. These benefits can be difficult to quantify in financial terms, and can be highly site-specific. However one Australian based study found that:

- the value of pollution reduction is estimated to be worth more than the lifecycle cost of water sensitive urban design assets.
- the potential avoided waterway rehabilitation life cycle costs are estimated to be worth around 70 percent of the lifecycle cost of water sensitive urban design assets
- the potential property premiums are estimated to be around 90 percent of the capital cost of water sensitive urban design assets
- the capital costs of implementing water sensitive urban design in residential developments are typically less than 1 percent of the cost of a new dwelling.[39]

Case Study: Greater Wellington Regional Council's Proposed Natural Resources Plan

Greater Wellington Regional Council (GWRC) recently introduced more specific direction on stream reclamation (infilling) in its proposed Natural Resources Plan (pNRP), with a rule specifying that the reclamation of the bed, or any part of the bed, of a river or lake, associated with the piping of a stream, is a non-complying activity.

A case study in the Greater Wellington region indicates that protecting urban streams from piping and infilling would be likely to reduce the number and/or the size of lots available in a new urban development, which can reduce income for developers. The study compared scenarios with (1) no development, (2) full urban development with all streams piped, and (3) full urban development with no streams piped. Scenarios 2 and 3 are at extreme ends of the spectrum, and therefore will over-estimate the lost profits, because it is unlikely in practice that all streams in a development would be piped.

The case study found that reduced profits for developers would be partly offset by reduced earthworks costs and increased values of properties close to streams, but could still be substantial (around $26,700 per 500m^2 section, based on a reduction in the number of sections from 3007 to 2572). This figure represents a worst case scenario because this study assumed a 15 m corridor around every stream (including ephemeral waterways). In this catchment, retaining ephemeral streams as well as permanent and intermittent streams would more than double the stream length that would require protection, compared to only retaining intermittent and permanent streams. This study did not consider the possibility of balancing the loss of available land by providing for more intensive development to provide additional house lots.

Using the cost of restoring a piped stream as a proxy for the ecosystem services provided, the Greater Wellington Regional Council study found around a 31 percent probability that social benefits to the community would outweigh the lost income of the developer.

The study above suggests that market forces on their own would be unlikely to provide sufficient incentive to protect urban streams. It also suggests that regulation that strongly discouraged stream loss, but didn't prohibit it entirely, would be appropriate. It is important to note that the reduction in potential area for construction will vary widely between sites.

It is possible to avoid the need to infill streams through the way urban developments are designed. A report commissioned by GWRC concluded that "requiring the retention of streams within urban

[39] http://pnrp.gw.govt.nz/assets/Uploads/HS5-ROR-Beds-of-Lakes-and-Rivers-Appendix-E-Stream-Retention-Report-13-July-2018.pdf

developments will not unduly hinder the provision of additional housing capacity within the Wellington Region". [40] The report reviewed two recent subdivision consent applications that resulted in stream loss, examining how a proposed policy change to avoid stream loss would affect housing lot yield. The report showed that it is possible to design subdivisions that incorporate alternative housing typologies that adapt to the topography, limit earthworks and the need to infill streams.

Case Study: Use of the Stream Ecological Valuation to offset the effects of stream infilling

This case study shows how in a typical resource consent for urban development under the current regulatory framework, riparian planting was used to compensate for infilling of a stream. See Additional Information 2 for information about the Stream Ecological Valuation technique.

> *"An original plan for a subdivision involved the establishment of 32 residential lots over the site. The proposal involved the infilling of part of a gully system and subsequent loss of a 106 metres of stream length, equating to 47 m^2 of stream area. Using the SEV model, the environmental compensation ratio determined that 726 m^2 of relatively high-quality stream area needed to be restored from an existing lower quality stream habitat to compensate for the loss of 47 m^2 of impacted stream. Allowing for a 5 m wide riparian buffer on each side of the stream an area 4840 m^2 of stream side vegetation would need to be rehabilitated. As a consequence, the developer agreed to yield a potential residential lot where an unaffected but degraded, part of the same stream and gully could be reserved and restored to achieve the offset area determined by the SEV analysis."*[41]

Case study: Earthworks, stream and wetland works consent, Auckland Council

Auckland Council specifies in their Unitary Plan that new reclamation (infilling) and drainage of a waterbody is a non-complying activity, and there is policy direction to avoid the reclamation and drainage of lakes, rivers, streams and wetlands unless conditions are met that would justify an exception. The plan also has provisions for offsetting of significant residual adverse effects when these cannot be avoided, remedied or mitigated.

A recent consent application for a residential development provides an example of how these policy provisions were applied. This example illustrates that it can be challenging to provide an adequate biodiversity offset within the property where the activity is taking place. This is particularly the case when riparian planting is the sole restoration action proposed.

The proposal was to fill in 135 lineal metres (41.15 m^2) of intermittent stream and 72 m^2 of wetland. The applicant developed the plan for the development to avoid the majority of the watercourses on site, showing that the infilling applied for could not practicably be avoided. An assessment using the SEV technique showed that an outcome of no net loss in ecological function could not be demonstrated by riparian planting of streams within the development. The applicant had not located a suitable restoration site outside the property to make up for the shortfall. It was considered that the residual impacts not accounted for would result in significant adverse effects, when taking into account the permanent nature of the impact being the complete loss of stream habitat. The

[40] Clarke, C., Burns, A., Thompson, N. 2018. Stream retention through subdivision design alternatives. Prepared for Greater Wellington Regional Council by Morphum Environmental Ltd, McIndoe Urban and Wraight + Associates

[41] Maseyk, F., Ussher, G., Kessels, G., Christensen, M., Brown, M. 2018. Biodiversity offsetting under the Resource Management Act: A guidance document. Prepared for the Biodiversity Working Group on behalf of the BioManagers Group.

conclusion was that these residual impacts would provide grounds for withholding consent for the development.

Examples such as the one described above can encourage the perception that there are not enough urban streams left to restore to offset for the effects of urban development. This is based on the assumption that riparian planting is the preferred and most straightforward method for offsetting or compensation. However, riparian planting does not address all drivers of stream degradation in urban catchments, such as flashy flows, and will not increase the amount of habitat available. To address these issues, Auckland Council provides an option for consent applicants to contribute funding towards council-led restoration projects that are aimed at addressing the specific causes of stream degradation at the site. An advantage of this approach is that restoration actions are carried out in accordance with best practice, and the gain in ecological value is likely to be higher compared to many small, isolated restoration projects.

Additional Information 1: Definitions

Artificial watercourses are constructed watercourses that contain no natural portions from their confluence with a river or stream to their headwaters.

Includes: canals that supply water to electricity power generation plants; farm drainage canals; irrigation canals; and water supply races. Excludes naturally occurring watercourses

Ephemeral streams only flow for brief periods following rainfall and do not have a defined bed or banks.

Intermittently flowing rivers may dry out occasionally but have a defined bed. We propose to adopt the Auckland Council definition which has been developed following extensive research on intermittent streams and their values:

> *Stream reaches that cease to flow for periods of the year because the bed is periodically above the water table. This category is defined by those stream reaches that do not meet the definition of permanent river or stream and meet at least three of the following criteria:*
>
> > *(a) it has natural pools;*
> >
> > *(b) it has a well-defined channel, such that the bed and banks can be distinguished;*
> >
> > *(c) it contains surface water more than 48 hours after a rain event which results in stream flow;*
> >
> > *(d) rooted terrestrial vegetation is not established across the entire cross-sectional width of the channel;*
> >
> > *(e) organic debris resulting from flood can be seen on the floodplain; or*
> >
> > *(f) there is evidence of substrate sorting process, including scour and deposition.*

Permanent streams and rivers have year-round continual flow or standing water.

Rivers are defined in the RMA as "a continually or intermittently flowing body of freshwater; and includes a stream and modified watercourse; but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation or farm drainage canal)". The NPS-FM uses the term 'rivers and streams'. Calling smaller watercourses rivers is contrary to common usage and could be misleading for the public, so here, we include rivers and streams in the definition.

Additional Information 2: Stream Ecological Valuation

The Stream Ecological Valuation (SEV) is a tool for offsetting ecological function, assessments of ecological effects, identifying streams of high natural value, prioritising streams for restoration works and identifying the most effective restoration actions[42].

The SEV is most often used as a tool for determining the amount of mitigation, offsetting or compensation required in resource consents. It is used in this way routinely in Auckland and Wellington, and sometimes in other regions. It is also used in State of the Environment monitoring in Auckland.

The SEV allows a function-based valuation of streams, to achieve "no net loss of area-weighted stream function". This is done by using a field and desktop assessment to calculate the amount of 'environmental compensation' required to account for the stream loss that will result from a future activity. This is a consistent, standardised approach that can be applied to any activity that will affect stream function. It allows for no net loss of stream function, emphasises "like-for-like" exchanges, and prioritises on-site offsetting.

There are caveats involved in applying the SEV method in certain locations and river types. If the method is used outside of Auckland, the user should collect reference data for the same stream type as the test sites. Caution is advised when using SEV in intermittent streams. SEV should not be used in stream with salt-water influence, or those that drain wetlands where the channel is not clearly defined. The used of SEV has not been evaluated in streams and rivers of fourth order or larger, or highly mobile gravel or cobble beds. Further work would be required to adapt SEV to such rivers.

[42] Storey RG, Neale MW, Rowe DK, Collier KJ, Hatton C, Joy MK, Maxted JR, Moore S, Parkyn SM, Phillips N, Quinn JM 2011. Stream Ecological Valuation (SEV): a method for assessing the ecological function of Auckland Streams. Prepared by NIWA for Auckland Council. Auckland Council Technical Report 2011/009.

Additional Information 3: Proposed National Policy Statement for Indigenous Biodiversity principles for biodiversity offsetting (extracts from draft as at March 2019)

Appendix 3 Principles for offsetting effects on indigenous biodiversity

The following sets out a framework of criteria for the use of **biodiversity offsets**. Criteria 1-12 *must* be adhered to for an action to qualify as a biodiversity offset, 13-14 *should* be adhered to. The framework is as follows:

1. **Adherence to mitigation hierarchy:** A **biodiversity offset** is a commitment to redress [more than minor] residual adverse impacts. It should only be contemplated after steps to avoid, remedy, and mitigate adverse effects have been demonstrated to have been sequentially exhausted, and thus applies only to residual **biodiversity** impacts.
2. **Limits to offsetting:** Many **biodiversity** values are not able to be offset, and if they are adversely affected then they will be permanently lost. These situations include where:
    a. residual adverse effects cannot be offset because of the irreplaceability or vulnerability of the **biodiversity** affected.
    b. there are no technically feasible or socially acceptable options by which to secure gains within acceptable timeframes.
    c. effects on indigenous **biodiversity** are uncertain, unknown, or little understood, but potential effects are significantly adverse.
    d. the offset cannot ensure there is no loss [of individuals] of indigenous taxa that are listed as Threatened, At Risk, or Data Deficient in the New Zealand Threat Classification System lists.

    In these situations, an offset would be inappropriate. This principle reflects a standard of acceptability for offsetting and should not be seen as a pathway to allow uncompensated losses.
3. **No-net-loss and preferably a net-gain:** The values to be lost through the activity to which the offset applies are counterbalanced by the proposed offsetting activity which is at least commensurate with the adverse effects on indigenous biodiversity so that the overall result is **no net loss**, and preferably a net gain in biodiversity. **No-net-loss** and net gain are measured by type, amount, and condition at the impact and offset site and requires an explicit loss and gain calculation.
4. **Additionality:** A **biodiversity offset** must achieve gains in **biodiversity** above and beyond gains that would have occurred anyway in the absence of the offset, including that gains are additional to any avoidance, remediation and mitigation actions undertaken in relation to the adverse effects of the activity. Offset design and implementation must avoid displacing activities harmful to **biodiversity** to other locations.
5. **Like-for-like:** The ecological values being gained at the offset site are the same as those being lost at the impact site across types of **biodiversity**, amount of **biodiversity** (including condition), over time, and spatial context. The delay between the loss of **biodiversity** through the proposal and the gain or functional maturity of the offset's **biodiversity** outcomes must be minimised.
6. **Landscape context: Biodiversity offset** actions must be undertaken where this will result in the best ecological outcome, preferably close to the location of development or within the same **ecological district** and must consider the landscape context of both the impact site and the offset site, taking into account interactions between species, **habitats**, and ecosystems, **connections**, and ecosystem function.
7. **Long term outcomes:** The **biodiversity offset** must be managed to secure outcomes of the activity that last at least as long as the impacts and preferably in perpetuity.

8. **Time Lags:** The delay between loss of **biodiversity** at the impact site and gain or maturity of **biodiversity** at the offset site must be minimised.
9. **Trading up:** When trading up forms part of an offset, the proposal must demonstrate that the **biodiversity** values gained are demonstrably of higher value than those lost and the values lost are not indigenous taxa that are listed as Threatened, At Risk, or Data Deficient' in the New Zealand Threat Classification System lists or otherwise considered vulnerable or irreplaceable.
10. **Offsets in advance:** An **biodiversity offset** developed in advance of an application for a resource consent must provide a clear link between the offset and the future effect. That is, the offset can be shown to have been created or commenced in anticipation of the specific effect and would not have occurred if that effect were not anticipated.
11. **Proposing a biodiversity offset:** A proposed **biodiversity offset** must include a specific biodiversity offset management plan.
12. **Science and mātauranga Māori:** The design and implementation of a **biodiversity offset** must be a documented process informed by science, including an appropriate consideration of **mātauranga Māori**.
13. **Stakeholder participation:** Opportunity for the effective participation of stakeholders should be demonstrated when planning for **biodiversity offsets**, including their evaluation, selection, design, implementation, and monitoring. Stakeholders are best engaged early in the offset consideration process.
14. **Transparency:** The design and implementation of a **biodiversity offset**, and communication of its results to the public, should be undertaken in a transparent and timely manner. This includes transparency of the loss and gain calculation and the data that informs a **biodiversity offset**.

New Appendix 4 Principles for compensating effects on indigenous biodiversity

The following sets out a framework of criteria for the use of **biodiversity compensation**. Criteria 1-11 *must* be adhered to for an action to qualify as biodiversity compensation and criteria 12-14 *should* be adhered to. The criteria are as follows:

1. **Adherence to mitigation hierarchy: biodiversity compensation** is a commitment to redress [more than minor] residual adverse impacts. It must only be contemplated after steps to avoid, remedy, mitigate, and offset adverse effects have been demonstrated to have been sequentially exhausted, and thus applies only to residual **biodiversity** impacts.
2. **[Limits to biodiversity compensation:** Many **biodiversity** values are not able to be compensated for because they are highly valued by society. These situations include proposed **biodiversity compensation** where:
    a. there are no technically feasible or socially acceptable options by which to secure proposed gains within acceptable timeframes.
    b. effects on indigenous **biodiversity** are uncertain, unknown, or little understood, but potential effects are significantly adverse.
    c. The loss of an indigenous taxon or of any ecosystem type from an **ecological district**.
    d. Removal or loss of viability of **habitat** of an indigenous taxon that is listed as Threatened, At Risk, or Data Deficient in the New Zealand Threat Classification System lists.
    e. Removal or loss of viability of a **naturally uncommon ecosystem** or uncommon ecosystem type that is associated with **indigenous vegetation** or **habitat** of indigenous fauna.

    In these situations, **biodiversity compensation** would be inappropriate. This principle reflects a standard of acceptability for **biodiversity compensation**.]
3. **Scale of biodiversity compensation:** The values to be lost through the activity to which the **biodiversity compensation** applies must be addressed by positive effects to indigenous **biodiversity** that are proportionate to the adverse effects on indigenous **biodiversity**.
4. **Additionality: biodiversity compensation** must achieve gains in **biodiversity** above and beyond gains that would not have occurred without the compensation, including that gains are additional to any avoidance, remediation, and mitigation actions undertaken in relation to the adverse effects of the activity. Compensation design and implementation must avoid displacing activities harmful to **biodiversity** to other locations.
5. **Landscape context: biodiversity compensation** actions must be undertaken where this will result in the best ecological outcome, preferably close to the location of development or within the same **ecological district** and must consider the landscape context of both the impact site and the compensation site, taking into account interactions between species, **habitats**, and ecosystems, **connections**, and ecosystem function.
6. **Long term outcomes:** The **biodiversity compensation** must be managed to secure outcomes of the activity that last at least as long as the impacts and preferably in perpetuity.
7. **Time Lags:** The delay between loss of **biodiversity** at the impact site and gain or maturity of **biodiversity** at the compensation site must be minimised.
8. **Trading up:** When trading up forms part of **biodiversity compensation**, the proposal must demonstrate that the **biodiversity** values gained are demonstrably of higher **biodiversity** value than those lost and the values lost are not indigenous taxa that are listed as Threatened, At Risk, or Data Deficient in the New Zealand Threat Classification System lists or otherwise considered vulnerable or irreplaceable.
9. **Financial contributions:** Financial contributions must only be considered when there is no demonstrably effective option available for delivering **biodiversity** gains on the ground and must be related to the **biodiversity** impact. When proposed, financial contributions must be directly linked to an intended **biodiversity** gain or benefit.

10. **Environmental compensation in advance: biodiversity compensation** developed in advance of an application for resource consent must provide a clear link between the compensation and the future effect. That is, the compensation can be shown to have been created or commenced in anticipation of the specific effect and would not have occurred if that effect were not anticipated.
11. **Time lags**: The delay between the loss of **biodiversity** through the proposal and the gain or functional maturity of the compensation's **biodiversity** outcomes must be minimised.
12. **Science and mātauranga Māori:** The design and implementation of **biodiversity compensation** should be a documented process informed by science, including an appropriate consideration of **mātauranga Māori**
13. **Stakeholder participation:** Opportunity for the effective participation of stakeholders should be demonstrated when planning for **biodiversity compensation**, including evaluation, selection, design, implementation, and monitoring. Stakeholders are best engaged early in the process.
14. **Transparency:** The design and implementation of **biodiversity compensation** and communication of its results to the public, should be undertaken in a transparent and timely manner.

Additional Information 4. Excerpt from Environment Court decision: Oceana Gold (New Zealand) Limited v Otago Regional Council [2019] NZEnvC41

DECISION

A: Under clause 16 of Schedule 1 and under section 290 of the Resource Management Act 1991 the Environment Court:

(1) confirms policy 5.4.6 of the proposed Otago Regional Policy Statement as follows:

Policy 5.4.6 Offsetting for indigenous biological diversity

Consider the offsetting of indigenous biological diversity offsetting, when:

(a) Adverse residual effects of activities cannot be avoided, remedied or mitigated;

(b) The offset achieves no net loss and preferably a net gain in indigenous biological diversity;

(c) The offset ensures there is no loss of individuals of rare or vulnerable species as defined in reports published prior to 14 January 2019 under the New Zealand Threat Classification System ("NZTCS");

(d) The offset is undertaken where it will result in the best ecological outcome, preferably:

  (i) Close to the location of development; or

  (ii) Within the same ecological district or coastal marine biogeographic region.

(e) The offset is applied so that the ecological values being achieved are the same or similar to those being lost;

(f) The positive ecological outcomes of the offset last at least as long as the impact of the activity, preferably in perpetuity;

(g) The offset will achieve biological diversity outcomes beyond results that would have occurred if the offset was not proposed;

(h) The delay between the loss of biological diversity through the proposal and the gain or maturation of the offset's biological diversity outcomes is minimised.

(2) directs that the Otago Regional Council amends its proposed Otago Regional Policy Statement by adding the following policy 5.4.6A (Limits to compensation):

5.4.6A Biological Diversity Compensation

Consider the use of biological diversity compensation:

(a) When:

(i) Adverse effects of activities cannot be avoided, remedied, mitigated or offset; and

(ii) The residual adverse effects will not result in:

(1) The loss of an indigenous taxon (excluding freshwater fauna and flora) or of any ecosystem type from an ecological district or coastal marine biogeographic region;

(2) Removal or loss of viability of habitat of a threatened or at risk indigenous species of fauna or flora under the New Zealand Threat Classification System (NZCTS);

(3) Removal or loss of viability of an originally rare or uncommon ecosystem type that is associated with indigenous vegetation or habitat of indigenous fauna;

(4) Worsening of the NZTCS conservation status of any threatened or at risk indigenous freshwater fauna[1].

(b) By applying the following criteria:

(i) the compensation is proportionate to the adverse effect;

(ii) the compensation is undertaken where it will result in the best practicable ecological outcome, preferably:

(1) close to the location of development;

(2) within the same ecological district or coastal marine biogeographic region;

(iii) the compensation will achieve positive biological diversity outcomes that would not have occurred without that compensation;

(iv) the positive ecological outcomes of the compensation last for at least as long as the adverse effects of the activity; and

(v) the delay between the loss of biological diversity through the proposal and the gain or maturation of the compensation's biological diversity outcomes is minimised.

(3) directs that the Otago Regional Council amends its proposed Otago Regional Policy Statement policy 5.4.8(d) by adding the underlined words as follows:

(d) … avoiding, remedying, or mitigating adverse effects on other values including highly valued natural features, landscapes and seascapes in order to maintain their high values …

Appendix 3: Directing clearer ecological outcomes for river flows and water levels

Context

Aside from water taken or dammed for hydroelectricity generation, most of the consented water allocation is for irrigation (51 percent in the 2013/14 year). The area of irrigated agricultural land almost doubled between 2002 and 2017, with the biggest increase in Canterbury. Water is also taken for household consumption, and industrial use.[43]

The National Policy Statement for Freshwater Management (NPS-FM) directs regional councils to set freshwater objectives and limits for the compulsory values and any other relevant values. One type of limit is "environmental flows and/or levels" which are defined as "an allocation limit and a minimum flow (or other flow/s)".[44]

Analysis of the current management approaches in regional plans shows that:

- the freshwater quantity objectives in regional plans are expressed generally in relation to life-supporting capacity or flow variability, rather than as a measureable in-stream environmental outcome as affected by the flow or water level
- all but some catchments in Otago, West Coast, Tasman and Hawke's Bay had minimum flows and allocation limits
- the methods councils are using to establish minimum flows and levels to safeguard ecosystem health in rivers are generally designed to retain a proportion of the historic flows or retain a proportion of habitat area for the most flow sensitive species (often trout). The minimum flows may be specific to the river or "rule-of-thumb" approaches[45]
- when minimum flows and levels to safeguard ecosystem health are updated in new rules, they are generally not applied to existing water permits, thus, those permit holders are not required to suspend takes or diversions at those updated flow thresholds
- councils are taking steps to avoid over-allocation (by classifying taking, damming or diverting water as a non-complying activity in regional plans) but many are yet to reduce allocation on resource consents in over-allocated water bodies.

The allocation limit is the maximum amount of water that can be taken or diverted from a freshwater management unit. A small allocation limit provides a high level of water security to the users because the flow will decrease slowly towards the minimum flow (where water takes and diversions must be suspended or restricted). A large allocation limit from rivers (where a lot of water can be taken at once), increases the rate of reduction in flow, and prolongs lowered flows for extended periods.

Minimum flows are triggered at flow recorders, which are located in stable areas of the river where, with the benefit of long periods of record, councils can establish relationships between rainfall and flow, and between water levels and flow. But flow levels and variations at the flow recorders may not be representative of flow variations throughout the catchment, particularly where multiple water

[43] Environment Aotearoa 2019.

[44] The direction to set an "environmental flow" predates the changes to the NPS-FM in 2014, when the compulsory values were added. Councils have the discretion to identify other values, for example fishing or hydro-electric power generation, if they consider it appropriate.

[45] An example of a "rule-of-thumb" approach is to use a percentage of a mean annual low flow as a "minimum" flow where water takes must cease.

takes are concentrated in a handful of tributaries. Thus, the restrictions on water users may not provide the habitat protection or flow variability sought.[46] In rivers without flow recorders, or where there is a short period of record, the council is reliant on rainfall and runoff modelling.

In addition to safeguarding ecosystem health, some regional plans (or consents for damming large volumes) have rules about flows set to protect recreational values of the river, and some have set multiple flow thresholds that apply to water permit holders in steps. These stepped programmes retain some of the natural flow variations needed for the ecology of the river, and provide staged levels of water security to the permit holders.

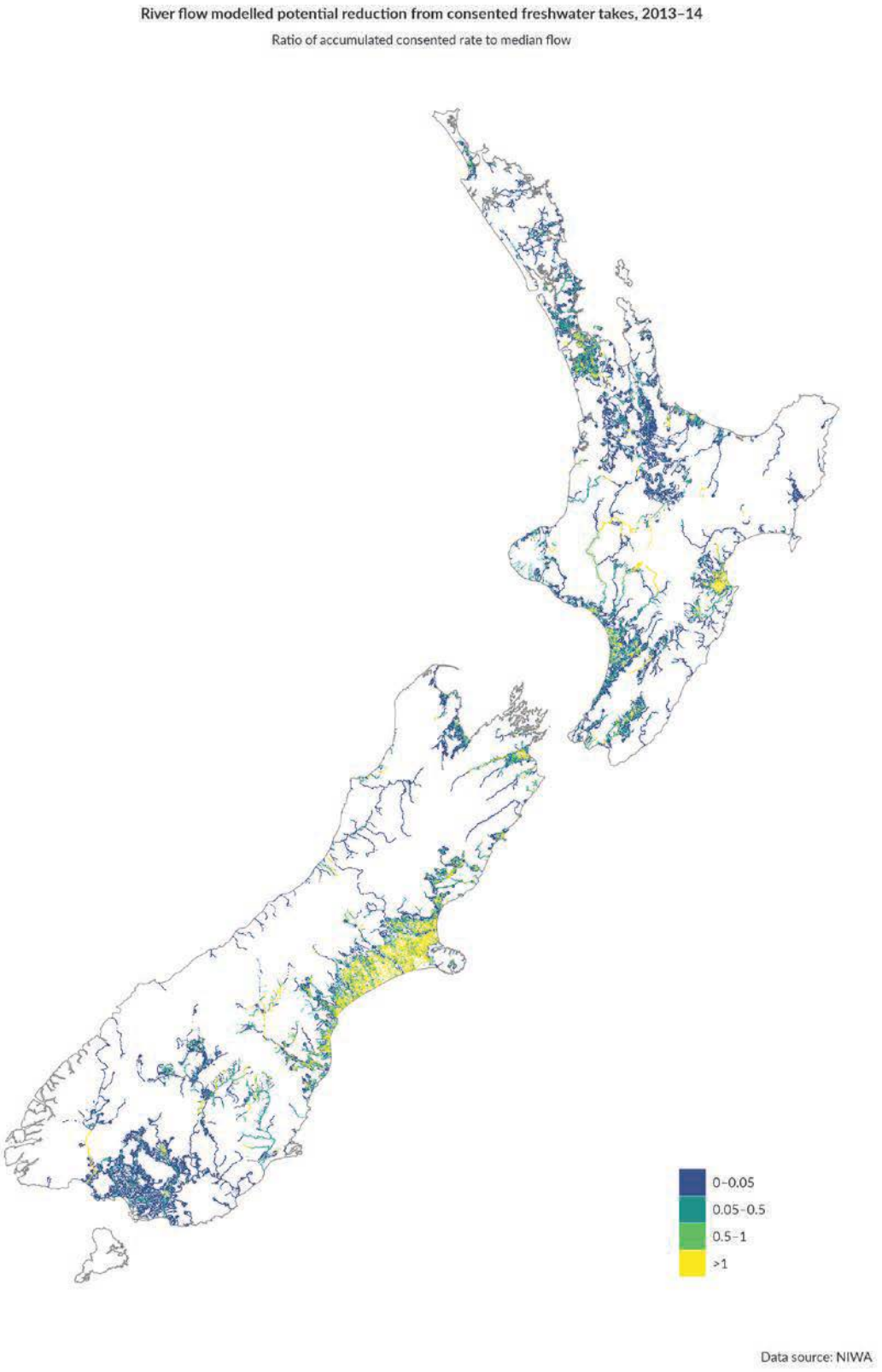
By requiring councils to set water quantity objectives for the two compulsory values, in addition to setting "environmental flows and/or levels", the NPS-FM creates some confusion about what constitutes a freshwater objective for water quantity. While the NPS-FM has attributes (such as nitrate and *E. coli*) for setting freshwater quality objectives, there is no corresponding attribute table for water quantity.

Climate change is predicted to exacerbate pressures on river flows when increased dry periods will decrease the availability of water and increase the need to take water. Some predicted effects are that there will be more rainfall in the west of the North and the South Island in winter and spring, and drier conditions in the east and north.

The effect of water takes on river flows as modelled from 2013-2014 data is shown in Figure 1 below. Widespread effects on downstream river flows is most noticeable in Canterbury and Hawke's Bay.

[46] Brooker et al (2014). Implementing water resource use limits: same rules different outcomes. Journal of Hydrology 53:129-151

Figure 1 Potential reduction in river flows - source Environment Aotearoa 2019



Summary of the problems

Poor freshwater objectives in regional plans: Regional plans have allocation limits and minimum flows for rivers, but few have freshwater objectives setting out the intended in-stream environmental outcomes of those limits in terms of the compulsory values or Te Mana o te Wai (in particular the concept that the first obligation is to the river). With increasing pressure on what will be scarcer resources in some regions, councils have no measurable outcome against which to test whether or not the limits they set are effective.

Restriction thresholds triggered at the flow recorder: Restrictions on taking, damming or diverting water in rivers are triggered by water levels at a flow recorder, but the value needs to be provided for throughout the catchment. In addition, in catchments where groundwater is connected to surface water, groundwater takes can sometimes continue despite measurable effects on river flow.

Water permits exercised without up-to-date flow restriction thresholds: Most regional plans do not require existing water permits to be reviewed to comply with new minimum flow rules. This means that permit holders can continue to take water according to the conditions on their permit, with potentially adverse effects on the water body. If the minimum flow is increased without decreasing the allocation limit in the regional plan and on water permits, the minimum flow will be reached more often, affecting the security of supply for existing users.

Constraints on the analysis

Regional councils use stream habitat assessment methods to assess habitat is streams[47] and are in the process of developing national protocol/s for monitoring aquatic biodiversity and productivity in rivers/streams for assessing effects of natural and altered flow regimes. Meanwhile, it is difficult to gauge how much the state of aquatic ecosystems is affected by flow variations as distinct from other pressures (poor water quality, altered stream habitat etc). This makes it hard to predict how specific changes in the management of water quantity in rivers, lakes and groundwater will improve outcomes for ecosystem health, except that reducing human-induced pressures, particularly during droughts is likely to be beneficial for the water body.

Water quantity is one of the five components of ecosystem health (the others are water quality, habitat, ecosystem processes, and aquatic life). The effects on ecosystem health from better objectives will depend on how councils manage water quality and freshwater habitat. Further, any analysis of the environmental effects is dominated by western science and overlooks approaches using Mātauranga Māori.

What do stakeholders think?

Fish and Game New Zealand

Fish and Game has a function under the Conservation Act to advocate about the management of sports fish and their habitat both generally and in any statutory planning process.

In May 2018, Fish and Game New Zealand provided Minister Parker with a redrafted NPS-FM. The redraft included water quantity limit setting methodologies. Fish and Game recommended that for all rivers, the interim flows proposed in the 2008 NES should apply, and for all water bodies, councils use the appropriate method from the technical support documents in the 2008 NES to set water quantity limits. This option was assessed and not progressed further (see below).

[47] Clapcott, J (2015). National rapid habitat assessment protocol development of streams and rivers. Cawthron.

Regional councils

In May 2018, regional council chief executives wrote to MfE describing nine areas for improving water policy implementation. They saw improving NPS-FM certainty and achieving confidence in models used in water management as immediate priorities.

At a workshop on 9 August 2018, regional council staff said that the 2008 NES provides context about suitable flow regimes and it has been useful in setting minimum flows to date, but the direction can continue to be achieved as guidance. Councils are now facing the challenge of monitoring the success of the limits that are in place, in particular, testing the impact of the abstraction restrictions on ecosystem health.

On 26 June 2019, the Regional Sector Water subgroup expressed "support in principle" for the recommended changes to the NPS-FM in relation to flows and levels, but said there are genuine limitations to what more councils can achieve at present given current data, data gaps, modelling, time and costs etc.

Technical experts

Technical experts felt that rule of thumb approaches would not be useful (or necessarily environmentally protective) in national regulation. They felt that there needs to be more work done on:

- The effects of existing restriction regimes on ecosystem health (this is also the view expressed by SWIM - the regional council Special Interest Group of technical experts)
- How to deal with the effects on flows in tributaries throughout an FMU or catchment when we set minimum flows at the flow recorders
- Calculating naturalised flow regimes
- Groundwater surface water interaction

Options

Summary assessment of four options considered

Criterion	Option 1(a) amend NPS for setting environmental outcomes	Option 1(b) amend NPS for whole of catchment approach	Option 1(c) amend NPS for groundwater surface water interaction	Option 2 guidance on methodologies for setting ecological flows etc.
Effectiveness	+	+	+	+
Timeliness	0	0	0	+
Fairness	0	+	+	+
Efficiency	+	+	+	+
Principles of the Treaty of Waitangi	0	0	0	+
Te Mana o te Wai	+ +	++	+	++
Overall assessment	+	+	+	++

Option 1 - Amending the NPS for Freshwater Management to provide more specific direction about setting and complying with ecological flows and levels

Possible amendments are:

a) improving the process for setting freshwater objectives for water quantity for the compulsory values (in line with the process for setting freshwater objectives for water quality)
b) adding policy direction for setting water quantity limits (flow(s), water levels and allocation limits) that deal with the effects of abstractions and diversions throughout the freshwater management unit, including on small streams
c) adding policy direction about restricting groundwater takes if the groundwater is connected to surface water and continuing abstractions are compromising freshwater objectives in the surface water bodies (as well as the groundwater)

Option 1(a) may be achieved by including an attribute able for water quantity so that councils set ecological flows and levels in rivers and groundwater with a clear ecological outcome in mind. A possible narrative attribute table is shown in Table 1 below.

Table 1 Possible attribute table for water quantity

Value	Ecosystem health
Water body	Rivers
Attribute	Habitat as affected by human induced flow variations
A	There is an abundance and diversity of habitat types to support the species assemblage and abundance that would be expected without water abstraction or diversion. There is sufficient natural flow variability to influence channel morphology and bed movement. The flow regime provides for all ecosystem processes.
B	There is some reduced habitat, but of short duration. Effects of abstractions or diversions can be mitigated (for example by shading or flow augmentation). There is a variety of flows needed to influence substrate movement. The flow regime provides for all ecosystem processes.
C	There is some reduced habitat of long duration, but still sufficient habitat to support the species populations. Variety of habitat is reduced.
D	Available abundance or diversity of habitat is inadequate to provide for the diversity of native flora and fauna. The remaining habitat cannot sustain populations long-term. Aquatic species are likely to be become stressed if the flow is maintained at this level for [period to be determined].
E	There is inadequate connectivity with other water bodies. Indigenous species are stressed by high temperatures and low dissolved oxygen in the water. There is insufficient food and space for the species that have lived there.

Alternatively, Option 1(a) could be achieved by amending the NPS to provide more direction about what a freshwater objective for water quantity must conform to. An assessment of this option is provided below.

Criterion	Option 1(a) improving the process for setting freshwater objectives for water quantity
Effectiveness	+ Setting out better direction in the NPS will partially addresses the problem of poor freshwater objectives for flows and levels. The level of detail needed to describe environmental outcomes that could apply to all NZ rivers is too complex to include in a table.

	This option will need to be supported with technical guidance.
Timeliness	**0** Relies on councils amending their regional plans, which will happen over the next ten years (objectives already apply to most FMUs; this direction can only apply to new plan changes)
Fairness	**0** All stakeholders treated equitably.
Efficiency	+ Improved objectives will provide better direction to what is needed for ecological flows and allocation limits. This will focus community effort on what is needed for the ecosystem, so that decisions about how to achieve that can be made with appropriate technical advice.
Principles of the Treaty of Waitangi	**0**
Te Mana o te Wai	++ Will put consideration of the water body at the forefront of decisions about objective setting, and drive decisions on what restrictions on flows and levels are necessary for the water body itself, before considering the needs of the water users.
Overall Assessment	+ Better than the status quo

Option 1(b) involves amending the NPS to provide policy direction for setting water quantity limits (flow(s), water levels and allocation limits) to deal with the effects of abstractions and diversions throughout the freshwater management unit, including on small streams. An assessment of this option is provided below.

Criterion	**Option 1 (b) policy direction for setting water quantity limits**
Effectiveness	+ Partially addresses the problem of minimum flows not explicitly considering ecosystem health impacts throughout the catchment. This option will need to be supported with technical guidance.
Timeliness	**0** Relies on councils amending their regional plans, which will happen over the next ten years (objectives already apply to most FMUs; this direction can only apply to new plan changes)
Fairness	+ All stakeholders treated equitably.
Efficiency	+ Communities have more informed discussions with technical people about what is needed for them in terms of allocation, while achieving the agreed objectives.
Principles of the Treaty of Waitangi	**0**
Te Mana o te Wai	+ + Decisions on limit-setting will be in accordance with what the water body can provide to people to meet their needs, rather than what can be accommodated by the water users.
Overall Assessment	+ Better than the status quo

Option 1(c) involves amending the NPS to provide increased direction about managing groundwater surface water interaction to reduce effects on surface water ecosystems. An assessment of this option is provided below.

Criterion	Option 1 (c) groundwater surface water interaction
Effectiveness	+ Partially addresses the problem of allocation limits in groundwater not explicitly considering ecosystem health impacts on connected water bodies. This option will need to be supported with technical guidance.
Timeliness	**0** Relies on councils amending their regional plans, which will happen over the next ten years (objectives already apply to most FMUs; this direction can only apply to new plan changes)
Fairness	+ All stakeholders treated equitably.
Efficiency	+ Improving consideration of surface water ecosystems in groundwater decisions should reduce instances of over-allocating groundwater and necessitating claw-backs.
Principles of the Treaty of Waitangi	**0**
Te Mana o te Wai	++ Recognising the natural interactions across all water bodies, and connections from the mountains to the sea, is fundamental to Te Mana o te Wai.
Overall Assessment	+ Better than the status quo

Option 2: Prepare guidance on appropriate methodologies for setting ecological flows, and other technical matters

The 2008 NES incorporated a methodology to be used as the basis for selecting and applying methods to determine ecological flows and water levels in regional plans.

This methodology is still draft, and could be updated to provide direction on:

- How to deal with the effects on flows in tributaries throughout an FMU or catchment based on minimum flow(s) set at the flow recorders
- How to measure the effects of existing restriction regimes on ecosystem health
- How to calculate naturalised flow regimes
- How to account for groundwater surface water interaction (so that allocation limits set for groundwater can achieve the objectives for connected surface water bodies)
- How to determine appropriate water levels in aquifers that are not connected to surface water
- How to take into account the reasonably foreseeable effects of climate change when setting flows, levels and allocation limits to achieve specified in-stream outcomes
- Approaches that use Mātauranga Māori.

Once this work is complete, it could be used to help councils review the effectiveness of their current approaches, and to inform any review of water permits.

Criterion	Option 2 Technical guidance and methodologies
Effectiveness	+ Essential to increasing the ability of technical advisors to assess and predict the effects of altered flows (both human-induced and from climate change) on freshwater ecosystems.
Timeliness	+ Can be used as soon as it is prepared to assess the effectiveness of existing regional plan provisions, and will lead to more effective regional plan provisions in the reviewed plans.
Fairness	+ All stakeholders treated equitably.
Efficiency	+ Will improve decision-making.
Principles of the Treaty of Waitangi	+ Guidance can be developed in relation to promoting and applying Mātauranga Māori in partnership with Māori
Te Mana o te Wai	++ Guidance on technical matters alongside approaches using Mātauranga Māori will help councils and communities fully appreciate the needs of the water body in the context of people and communities.
Overall Assessment	++ much better than the status quo

Options not considered further

Seven further options were evaluated but not considered feasible or sufficient to address the problems. These options and the reasons for not progressing them are described below.

Specifying default flow regimes for rivers in national environmental standard or the NPS-FM

In March 2008, the Government proposed a National Environmental Standard for ecological flows and levels. The proposed regulations were part of the wider water reforms that included a National Policy Statement for Freshwater Management, which was notified later that same year. The provisions in the proposed NES are summarised in Table 2 below.

Table 2 Summary of default interim limits proposed in the 2008 NES for ecological flows and levels

o	o Interim limits

o Rivers	o with mean flows ≤ 5 m3/s:
	• a minimum flow of 90% of the Mean Annual Low Flow; AND
	• an allocation limit of the greater of:
	  • 30% of Mean Annual Low Flow
	  • the total allocation from the catchment less any resource consents surrendered, lapsed, cancelled or not replaced.
	o with mean flows > 5 m3/s:
	• a minimum flow of 80% of Mean Annual Low Flow; AND
	• an allocation limit of, the greater of:
	  • 50% of Mean Annual Low Flow
	  • the total allocation from the catchment less any resource consents surrendered, lapsed, cancelled or not replaced.
	o

o Groundwater	o Shallow, coastal aquifers - the greater of: • 15% of the average annual recharge • total allocation from groundwater less any cancelled, surrendered or lapsed resource consents o Other aquifers - the greater of: • 35% of the average annual recharge

o		o	Interim limits
		•	total allocation from the groundwater less any cancelled, surrendered or lapsed resource consents
		o	
o	Wetlands	o	No change in water levels, beyond existing resource consents

The proposed NES has been on hold since 2009 while the Government has worked on the detail of the water quality aspects of the NPS-FM. The proposed NES was intended to address the increasing demands on water resources. The evidence shows that this problem still exists.[48]

Proceeding with the NES for ecological flows and levels in its current form would

a) put in place default flow regimes for all rivers and small streams currently without flow regimes set in a regional plan
b) incorporate methodologies to use to set flow regimes in streams / rivers[49]
c) set default allocation limits for rivers and groundwater
d) stop further wetland drainage

Additionally, a new NES could:

e) Direct councils to review existing consents that allow activities that contravene the NES

Using a national environmental standard was not progressed because there are few rivers without minimum flows and levels and allocation limits set in a regional plan, and there is no assurance that a rule-of-thumb approach would safeguard ecosystem health throughout those remaining FMUs. Further, the effectiveness of a flow regime in achieving an environmental outcome is also related to the allocation limit in that FMU, including the allocation limit for groundwater. There is no certainty that setting minimum flows and levels for all rivers in national direction would avoid over-allocation.

Alternatively, a flow methodology could be adopted in the NPS-FM. For example, an attribute table could be added with a default flow regime based on a percent deviation from the naturalised daily flow (the A state represents less than 10 percent deviation from the naturalised daily flow; the B state between 10 and 20 percent deviation, and the C state between 20 and 30 percent deviation, with the national bottom line set at 30 percent deviation).

The option was not pursued further because:

a) it would not be effective because it would not address the identified problems with the status quo. In particular, it doesn't set out a range in-stream environmental outcomes that are intended to be achieved
b) the methodology, which was developed as a way to maintain seasonal variation in American rivers, has not been assessed for its effectiveness in safeguarding ecosystem health in New Zealand rivers
c) calculating naturalised flows in gauged sites requires accurate information about water takes, but most councils only have information about consented takes
d) the uncertainty in calculating the naturalised daily flow would usually exceed 10 percent and may exceed 30 percent (even with actual abstraction data)

[48] Ministry for the Environment & Stats NZ (2017). *New Zealand's Environmental Reporting Series: Our fresh water 2017.*

[49] Draft Guidelines for the Selection of Methods to Determine Ecological Flows and Water Levels, Beca 2008

e) it is not clear how the methodology could be applied to ungauged sites, or to tributaries distant from the flow recorder
f) it is not clear what time period would be used to establish the naturalised daily flow and how it would be applied to each day (in terms of the deviation from the naturalised flow)
g) it is not clear how an allocation limit could be applied to permit holders in the FMU in a way that retained the allowable deviation from the naturalised flow throughout the FMU.

The Ministry is working on preparing new technical guidance to assist councils in this work. Until this is completed, there is no certainty that any methodology would be fit for purpose.

Default allocation limits for rivers and groundwater (in an NES or NPS)

As with setting default flows and levels in an NES or NPS, there are few rivers without allocation limits set in a regional plan, and there is no assurance that a rule-of-thumb approach would safeguard ecosystem health throughout all remaining FMUs.

Reviewing water permits (in an NES or NPS)

Addressing this problem is outside the scope of the Essential Freshwater programme because it will entail amending the Resource Management Act, or specific legislative reform. This is because national policy statements cannot override the statutory discretion councils have about whether rules in a regional plan affect the exercise of existing resource consents.

Stopping further wetland drainage (in an NES)

This policy work is being dealt with separately as part of a comprehensive wetland package.

When councils should issue water shortage directions (in an NPS)

Prescribing the circumstances when a council should consider issuing water shortage directions should increase the protection to water bodies where existing permits are not required to comply with limits set in regional plans. This would provide some immediate safeguards to those water bodies. This option was not considered further because it would override the statutory discretion of councils and could be disruptive to consent holders unless there is comprehensive consultation with communities.

Prioritising water for water supply (in an NPS)

As part of Te Mana o te Wai, the first obligation is to the water, and the second obligation is to the essential health needs of people. Direction on prioritising water for water supply is being assessed as part of the Te Mana o te Wai policy proposals.

Recommendation

All feasible options (options 1 and 2) meet the policy objectives and will help to address the problems of poor freshwater objectives for water quantity, and safeguarding ecosystem health and other values throughout the freshwater management unit.

In combination, the options will drive improved decision-making by requiring councils and communities to set out clear environmental outcomes in terms of the ecosystem and putting the water body at the forefront of their choices about minimum flows and allocation limits. The improvements will accrue over the next ten years while the councils review the effectiveness of their existing rules, and will provide a sound basis for proposing new objectives and limits.

The regional sector group initially opposed having extra direction in the NPS-FM in relation to managing flows and levels because they considered that their councils already do a good job with setting minimum flows and allocation limits. In June 2019 they revised this view and said that further

science and technical work is required to understand appropriate flows and variability and levels for ecosystem health.

The evidence shows that river flows in some regions are being depleted by abstractions, and many will be under increasing pressure from a combination of irrigation demand and climate change. The full extent of the adverse environmental effects experienced now because of inadequate minimum flows and allocation limits cannot be assessed without more detailed assessment by regional councils. This work is essential to drive those assessments, improve implementation of the NPS-FM, and prepare the necessary foundations for potential future work on water allocation.

Recommendation 1 (as per options 1(a), 1(b) and 1(c)): amend the NPS-FM to:

a) require freshwater quantity objectives for ecosystem health to set out the intended environmental outcome in the FMU
b) Specify that councils set or change minimum flows or water level regimes, and allocation limits to achieve the ecosystem health freshwater values, and other appropriate values by:
    i. providing for flow or level variability that meets the needs of the values
    ii. safeguarding ecosystem health from the effects of the allocation limit on the frequency and duration of lowered flows; and
    iii. providing for the life-cycle needs of aquatic life, including food production.
c) Specify that for aquifers connected to surface water, councils set water levels and allocation limits so that the freshwater objectives for surface water and the groundwater bodies are achieved.
d) Encourage councils to review existing water permits to comply with minimum flows and allocation limits that are set in a regional plan after 2020, and encourage the plan to set out how and when new rules would affect permit holders.

Recommendation 2 (as per option 2): prepare technical guidance on setting minimum flows using relevant methodologies that at least provide direction on:

- How to manage the effects of taking, damming and diverting water on flows in tributaries throughout an FMU based on water levels at the flow recorders
- How to measure the effects of restriction regimes on ecosystem health
- How to calculate naturalised flow regimes
- How to account for groundwater surface water interaction (so that allocation limits set for groundwater do not frustrate the objectives for connected surface water bodies)
- How to take into account the reasonably foreseeable effects of climate change when setting flows, levels and allocation limits to achieve specified in-stream outcomes
- Approaches that use Mātauranga Māori.

Summary table of costs and benefits of the preferred approach

Affected parties *(identify)*	Comment*: nature of cost or benefit (eg ongoing, one-off), evidence and assumption (eg compliance rates), risks*	Impact *$m present value, for monetised impacts; high, medium or low for non-monetised impacts*	Evidence certainty *(High, medium or low)*
Additional costs of proposed approach, compared to taking no action			

Regulated parties	There may be changes to minimum flows and allocation limits as a result of the more specific direction. In areas where access to water is already tight, clearer objectives may result in reductions in allocations and water permit holders may need to store water. On the other hand, the clearer objectives may allow larger allocations from some areas.	Impacts cannot be monetised, because the likely changes to restrictions on water takes and diversions cannot be predicted.	N/A
Regulators	Councils are already required to evaluate the effectiveness of their current approaches. The recommended approach may require increased monitoring of the ecosystem as affected by human-induced changes in water levels in rivers, lakes, and groundwater.	Low potential extra costs for regulators.	Low
Wider government	The largest cost is in preparing guidance.	$200,000 (approx.)	Medium
Other parties		No costs	
Total Monetised Cost		$200,000	
Non-monetised costs		Low	

Expected benefits of proposed approach, compared to taking no action			
Regulated parties	More certainty about their allocation.	Low	Medium
Regulators	More defensible decisions on minimum flows and allocation limits.	Low	Medium
Wider government	Better able to analyse the robustness of current water allocation, to prepare for future parts of the government work programme relating to water allocation.	Medium	Medium
Other parties	All parties involved in public processes for regional plan development will have a higher level of certainty for the process	Low	Medium
Total Monetised Benefit		None	
Non-monetised benefits		Low	Medium

What other impacts is this approach likely to have?

No other impacts have been identified.

Appendix 4: Nutrient attributes for managing ecosystem health

Context

Nutrients in rivers

Nitrogen and phosphorus are nutrients that are necessary for all plant growth and are present naturally at low levels in freshwater ecosystems. Excessive nutrients cause problematic growth of periphyton (slime) or macrophytes (rooted plants) when other conditions such as flow, substrate (the type of river bed) and sunlight are suitable. This impacts ecosystem health by causing adverse fluctuations in dissolved oxygen and pH, smothering habitat, and altering invertebrate communities. Excessive nutrients, through their effect on plant growth, are also associated with changes to water colour, odour, and alteration of the general appearance of the river bed, which have detrimental effects on human use values. The increase in nutrients and associated excessive productivity is referred to as eutrophication. Other than stimulating plant growth, high nutrient concentrations can affect the ways that microbes and invertebrates break down and recycle organic matter (such as leaf litter) in rivers, altering the way ecosystems function.

Nitrogen and phosphorus are present in different forms in our waterways and these can have different effects. Nitrate-nitrogen is commonly measured as an indicator of water quality in lakes, rivers and groundwater. It is easily dissolved in water, easily transported through groundwater and readily taken up by plants. It is toxic to aquatic animals and humans at very high concentrations. Ammonia is another toxic form of nitrogen; in most rivers it is present in much lower concentrations than nitrate and is typically found in human and animal waste. Total nitrogen incorporates dissolved nitrogen and nitrogen that is not dissolved in the water, such as the fraction that is contained within microscopic plant cells.

Phosphorus is typically measured as total phosphorus and dissolved reactive phosphorus (DRP). Most phosphorus in waterways is bound to sediment and not readily available for plant growth. The dissolved fraction is readily taken up by plants. Unlike some forms of nitrogen, phosphorus does not cause toxic effects in waterways.

Human activities have increased the nutrient concentrations in New Zealand's rivers, lakes and groundwater, both historically and on a continuing basis. Between 1998 and 2017, concentrations of nitrate-nitrogen worsened (increased) at many river monitoring sites (54.7 percent of sites), while the proportion of sites where dissolved reactive phosphorus concentrations worsened is lower (30.2 percent of sites).[50] Many studies at the national, catchment and river scale in New Zealand have shown that catchments with greater proportions of urban and agricultural land use show higher concentrations of nitrogen, phosphorus, fine sediment, and *E. coli*, and lower values of visual clarity and measures of macroinvertebrate and fish community health.[51] For context, in Canterbury (the region with the largest increases) nitrogen leaching from livestock increased 117 percent between 1990 and 2017 (from 15,000 to 33,000 tonnes).

[50] Ministry for the Environment & Stats NZ (2019). New Zealand's Environmental Reporting Series: Environment Aotearoa 2019. Available from www.mfe.govt.nz and www.stats.govt.nz.

[51] Larned, S., Booker, D., Dudley, B., Moores, J., Monaghan, R., Baillie, B., … Short, K. (2018a). Land-use impacts on freshwater and marine environments in New Zealand. NIWA Client Report No. 2018127CH. Christchurch, New Zealand. Retrieved from https://www.mfe.govt.nz/publications/

Figure 1. River nitrogen concentration trends, 1998-2007. Source: Environment Aotearoa 2019.

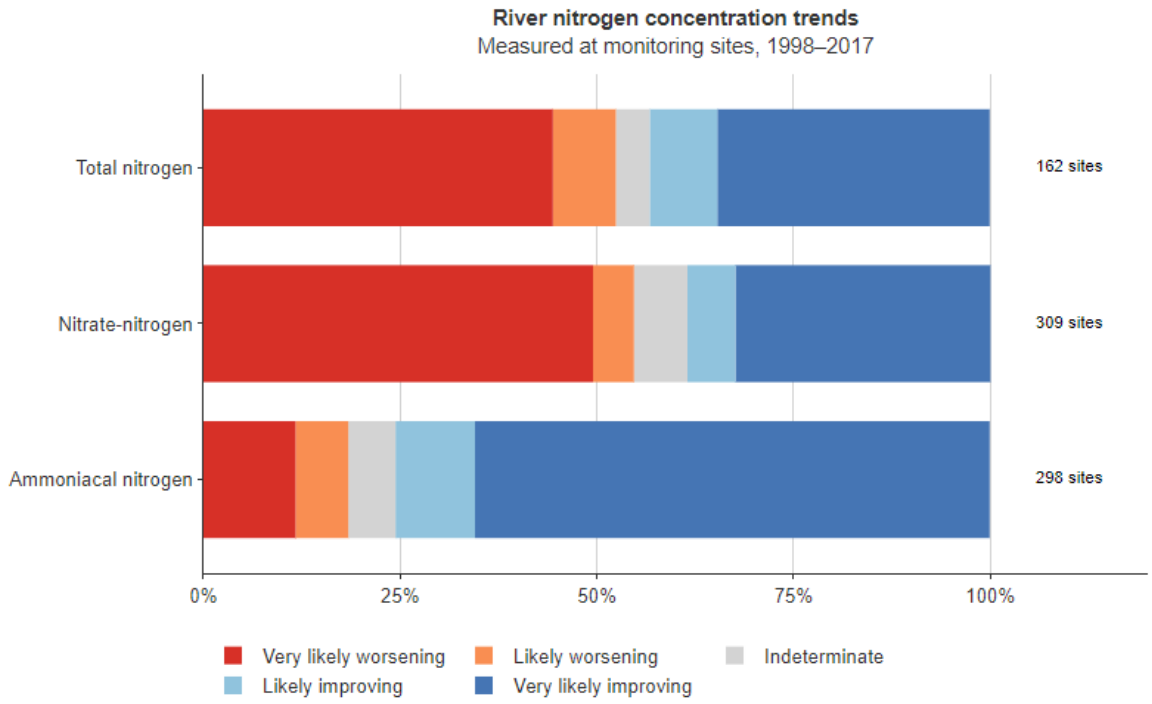
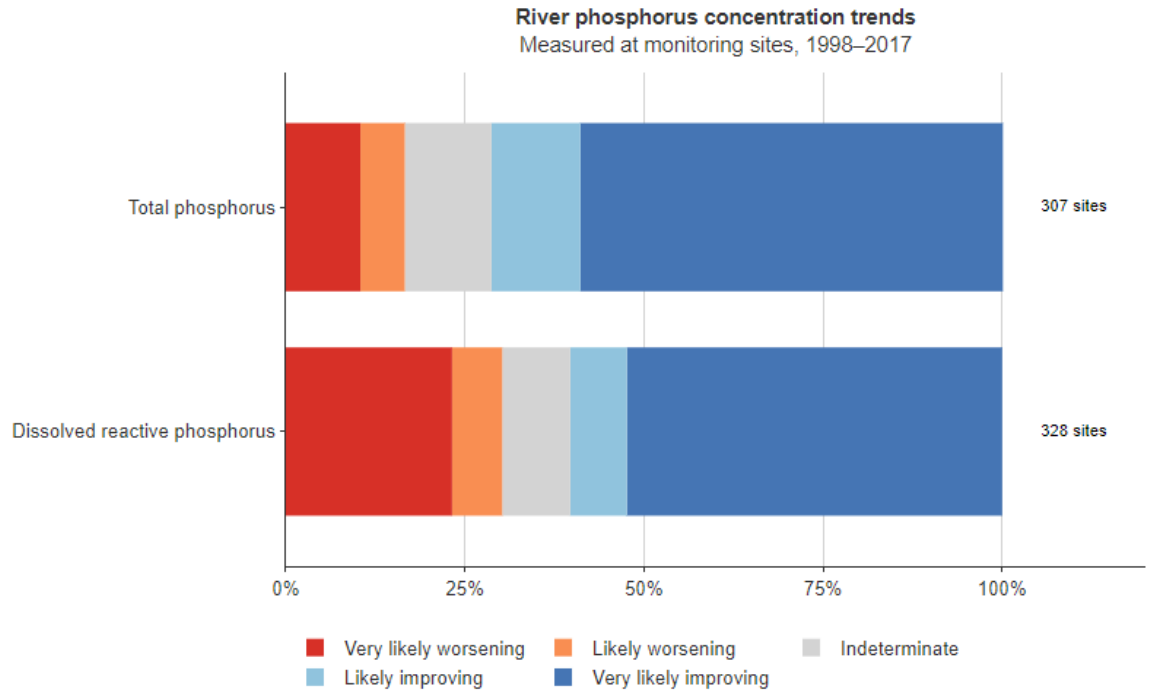


Figure 2. River phosphorus concentration trends, 1998-2007. Source: Environment Aotearoa 2019.



International and New Zealand-based research shows that there are many complex and interacting factors influencing ecosystem health in rivers. Elevated nutrient concentrations change the habitat conditions for macroinvertebrates and fish primarily by promoting plant growth, when other conditions are also suitable (eg, when flows are low and stable), and when the river channel is unshaded. Excessive accumulation of plant biomass causes changes in dissolved oxygen and pH. These effects can interact with other impacts of human activities that can reduce habitat quality and the capacity of the river to support aquatic life.

Status quo: management of nutrients in rivers

The NPS-FM directs councils to manage nutrients in rivers by setting objectives for ammonia and nitrate (in terms of toxic effects, rather than nutrient effects on plant growth), and for periphyton levels. Objectives for periphyton must be based on the levels of in-stream dissolved inorganic nitrogen (DIN) and dissolved reactive phosphorus (DRP) that affect periphyton growth, the levels of DIN and DRP that would affect the outcomes in nutrient sensitive downstream environments (such as a lake or estuary), or any other objectives for the river. [52]

In this way, the periphyton attribute in the NPS-FM requires councils to manage the negative effects of high nutrient concentrations, rather than the concentrations themselves. Flow regimes, temperature and stream shading (amongst other factors) will mean a given nutrient concentration will cause different amounts of periphyton accumulation in different locations, so the previous iteration of the NPS-FM decision making process decided that a one-size-fits-all national relationship between nutrients and periphyton would not be appropriate in every catchment.

Councils have not yet completed the objective and limit setting process under the current NPS-FM requirements. Most councils are focused on understanding and setting catchment limits for nitrogen, and understanding nutrient pathways and processes. Six regional councils have set nitrogen limits for some parts of their regions and others have draft plans in progress and will be proposing limits over time.

Councils have invested substantial resources implementing the 2014 periphyton attribute. For example, New Zealand now has around 170 sites where periphyton is monitored on a monthly basis; this has increased substantially since 2014. We are seeing high quality catchment-specific analysis on the drivers of periphyton utilising this new data. The process of deriving catchment specific nutrient objectives for periphyton is complex and can therefore be difficult for the public to scrutinise. Mitigating this, the models used to determine the appropriate nutrient limits for a catchment are published and open source, which promotes transparency.

Not all rivers have suitable physical conditions for the accumulation of conspicuous periphyton, particularly soft (ie, muddy or sandy) bottomed lowland streams and rivers. In these locations, the minimum requirement in the current NPS-FM is for only the nitrate and ammonia toxicity attributes to be applied, unless councils have set objectives necessary to provide for receiving environments downstream. The toxicity attributes are however not sufficient for providing for ecosystem health in all cases (as outlined in the Context section).

Overleaf is a summary of effects of excessive nitrogen concentrations in freshwater, their causes, policies to address them, and the impacts of the policies.

[52] Dissolved inorganic nitrogen is the sum of nitrate, nitrite and ammonia. In most New Zealand waterways DIN is approximated by the nitrate value (ie, nitrite and ammonia concentrations are very low).

Table 1. Summary of effects of excessive nitrogen concentrations in freshwater, their causes, policies to address them, and the impacts of the policies.

No.	Effect on freshwater ecosystems	Policy to address the effect	Impacts on land use
1	Direct toxic effects on fish and other aquatic animals.	Currently addressed by the nitrate toxicity bottom line of 6.9 mg N per litre. Bottom line is not designed to provide for ecosystem health.	Applies everywhere. Some small areas of Canterbury and Southland have nitrogen concentrations above bottom line levels. In the Hinds catchment in Canterbury it will cost 10 percent of aggregate farm profit or $32 million per annum.
2	Excessive growth of periphyton (algae attached to rocks), the periphyton in turn damages freshwater ecosystems by smothering habitat and changing dissolved oxygen levels.	Currently addressed by the periphyton bottom line of 200 mg chlorophyll *a* per square metre. The nitrogen concentrations required to achieve 200 mg chlorophyll *a* vary from 0.145 to 3.8 mg N per litre depending on the river type, flows, phosphorus concentrations, and water temperature.	Applies to stony rivers. Councils can choose how to meet bottom lines and the time frames for achieving them. New research shows if councils were to meet bottom lines only through nutrient reductions, extensive mitigations and land use change would be required. There is no economic analysis of the costs of this.
3	Excessive growth of algae floating in lakes.	Currently addressed by the lakes total nitrogen bottom lines of 0.8 and 0.75 mg N per litre (value depends on lake type).	Whether lakes, estuaries or rivers in the catchment impose the most stringent requirements will vary based on the techniques chosen for managing periphyton. Meeting bottom lines for lakes can require significant investment and time due to groundwater lag times. In Te Waihora/Lake Ellesmere, this will cost 80 percent of aggregate farm profit or $350 million per annum. No intensive land use can continue, the catchment is expected to be dominated by dryland sheep and beef grazing and forestry.
4	Excessive growth of all kinds of algae in receiving environments (eg, lakes and estuaries).	Currently addressed by the Periphyton Attribute. Note that requires councils to set nitrogen and phosphorus objectives that provide for desired outcomes in downstream lakes and estuaries.	As above.
5	Degradation of ecosystem health through other mechanisms (eg, altering the ways plant matter is recycled by microbes and invertebrates and how it is incorporated into food chains).	Not currently addressed in NPS-FM. The Science and Technical Advisory Group (STAG) proposed attribute tables would impose a bottom line of 1 mg N per litre to address this effect.	Relevant where there are no rocks for periphyton to attached to (eg, muddy bottom rivers like the Waikato), where there is no lake or estuary downstream Reductions in nitrogen loading over 50 percent required in some agriculturally dominated lowland catchments. In the Waikato/Waipa catchment, the cost of achieving this, beyond the current NPS, is estimated at 7 percent of aggregate catchment income or $60 million per annum.

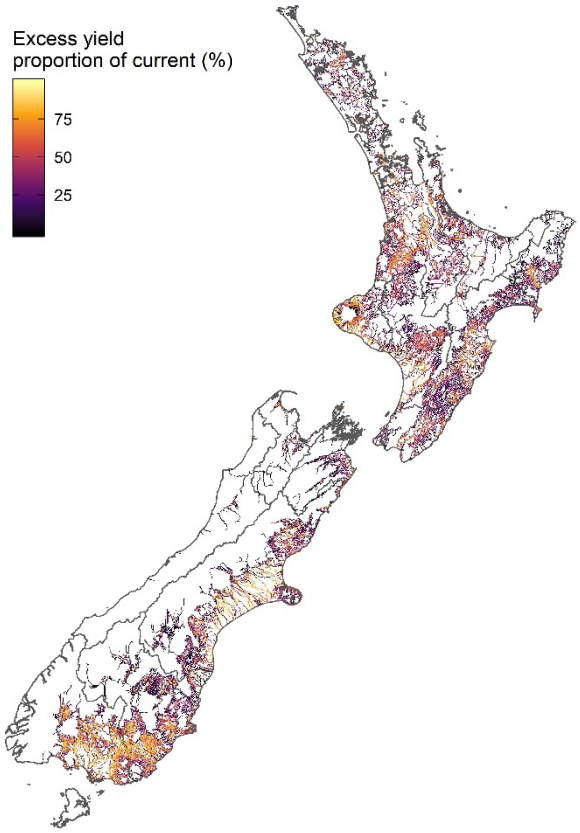


Figure 3. Indicative reduction in nitrogen load required to meet the requirements of the existing periphyton attribute in the NPS-FM. Areas in white indicate where no reduction is required

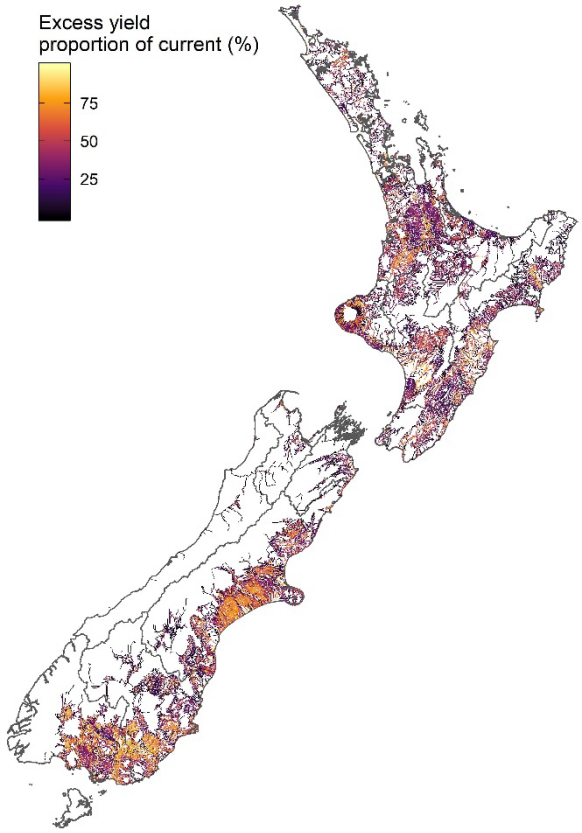


Figure 4. Indicative reduction in nitrogen load required to meet proposed dissolved inorganic nitrogen attribute (Option 2), not taking into account current NPS-FM provisions

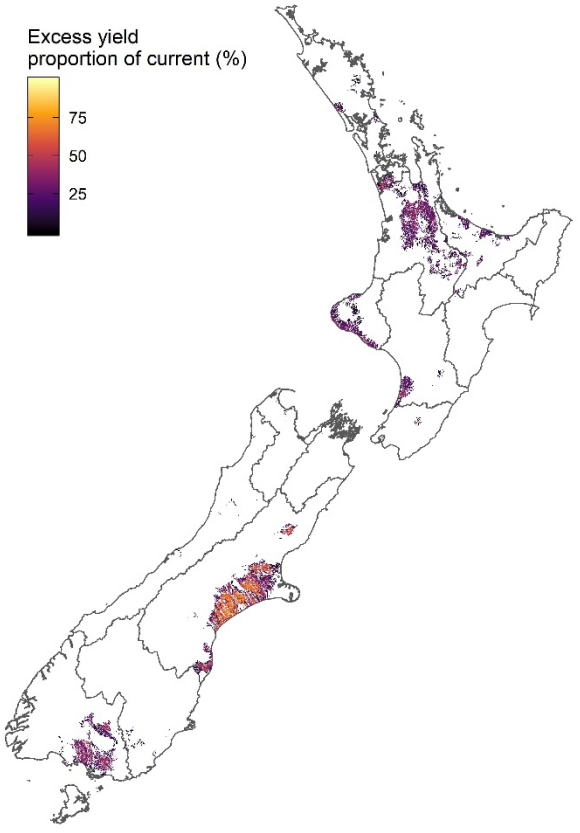


Figure 5. Indicative reduction in nitrogen load required to meet proposed dissolved inorganic nitrogen attribute (Option 2), beyond current NPS-FM provisions

The problem/opportunity

The existing national bottom lines for ammonia and nitrate toxicity are not sufficient for protecting ecosystem health, and there is a risk that they could be perceived as such.

There are concerns that the existing periphyton attribute could be inappropriately applied by setting incorrect in-stream nutrient concentrations. There are technically difficult and complex modelling calculations required to set these nutrient concentrations to provide for periphyton objectives. Because of this, council approaches may lack transparency and rigour, allowing room for actual or perceived misuse of modelling. These concerns could affect public confidence in councils' ability to maintain or improve water quality.

Essentially, the NPS-FM gives councils a lot of flexibility in terms of the levels at which they choose to set water quality objectives, to the extent that it is possible that they could be set in a way that doesn't support a healthy ecosystem. At this point we do not know the levels at which all councils will choose to set these objectives.

Constraints on the analysis

This draft regulatory impact analysis has been developed to support consultation and summarises work carried out to date. The analysis presented here was based upon national-scale modelled predictions of nutrient concentrations and is an indicative analysis to provide sufficient information so that members of the public are able to meaningfully engage with the proposal. During the consultation period, further analysis will be conducted to better understand, not only the economic and environmental impacts, but also the social and cultural costs and benefits. This will include analyses at the catchment and farm scale. Consultation is necessary to allow us to gather further information on the range of views held by the public and this will help us to understand the impact of the proposals. All of this information will be necessary to complete the final regulatory impact analysis that will accompany the Cabinet paper seeking final policy decisions.

Linkages

The options considered for nutrient attributes in this analysis may have relevance for the nutrient allocation work within the Essential Freshwater work programme, as adopting the attributes would have implications for objective and limit setting in catchments.

The Parliamentary Commissioner for the Environment has recommended that the ownership, use and development of catchment models should be reviewed, to ensure that water quality managers have access to the best possible understanding of nutrient transport and transformation. Such a review would assist council nutrient limit setting processes under the NPS-FM.

Options

The objective of this policy is to improve the transparency and effectiveness of nutrient objective setting under the NPS-FM.

Option 1: Status quo, with additional non-regulatory interventions

This option would involve retaining the NPS-FM provisions in their current state, as described in the Context section above. In addition, greater assistance would be provided to councils to set objectives and limits for managing periphyton and sensitive receiving environments.

The status quo requires councils to understand their catchments, and set site-specific objectives and criteria taking local conditions into account. The benefits of this approach are that it allows for flexibility in how the periphyton objectives will be achieved and for nutrient concentration criteria to be appropriate to local conditions as well as for sensitive downstream receiving environments. The

complication is that the process of setting nutrient criteria is technically difficult, and there is potential that the process will not be carried out or implemented properly. However, the knowledge base is rapidly growing, and there is guidance available detailing a step-by-step process.

This option does not address the issue that in soft-bottomed streams and rivers, the current nitrate toxicity bottom line does not adequately protect ecosystem health. However, improved non-regulatory guidance to inform objective setting for the periphyton attribute can help councils that want to set objectives using the periphyton attribute in an appropriate and transparent way. The recommended non-regulatory measures include:

a) resolve underlying science and modelling issues to provide confidence in the ecosystem health improvements that will be achieved
b) conduct further analysis, including costs and benefits of the status quo and of requiring stronger objectives for water quality
c) increase the transparency and rigour of the implementation of the current periphyton bottom line and improve guidance on the process that councils need to follow
d) progressing research into the drivers of ecosystem health of soft-bottomed rivers
e) publishing guidance on nutrient criteria required to meet periphyton biomass objectives in different river types. This would consist of a matrix table of National Objectives Framework (NOF) bands and river classes for each of total nitrogen and DRP. The tables were derived in a recent study that used models of periphyton biomass in 78 gravel-bed NZ rivers to derive concentration targets for total nitrogen and DRP. [53] This method provides risk-based criteria for achieving periphyton objectives defined by the NOF bands. The criteria define the total nitrogen and DRP concentrations that restrict the risk that a site will fail to achieve its nominated periphyton objective to either 10 percent or 20 percent (depending on the chosen spatial exceedance criteria). This approach to defining the criteria is a means to managing the uncertainty involved in specifying nutrient criteria to achieve periphyton biomass objectives.

This approach would have the advantage of reducing the burden on councils to derive their own nutrient criteria, or providing a sense check for councils who choose to derive their own criteria. It would have the potential disadvantage of disincentivising councils to derive criteria that are tailored to their local conditions. Publishing the nutrient criteria as guidance, rather than compulsory attribute tables, would preserve the incentive for councils to derive their own values for their ecosystems.

Option 2: Attribute tables for nitrogen and phosphorus to manage ecosystem health using limits on resource use[54]

This option is to introduce the STAG's proposed DIN and DRP attributes in the National Objectives Framework of the NPS-FM (Table 2; see also Additional Information 1). One table would apply nationally for both of DIN and DRP. The tables are based on an approach introduced by Death et al. (in prep)[55] and subsequently modified based on review and discussion by STAG. The suggested

[53] Snelder, T. 2018. Nutrient concentration targets to achieve periphyton biomass objectives incorporating uncertainties. GNS Science report; 2018/38. Prepared for GNS Science, Lower Hutt. doi:10.21420/ajsh-nw16.

[54] In line with the current definition of attributes in the NPS-FM.

[55] Death, R. G., Magierowski, R., Tonkin, J. D., and Canning, A. D. (in prep.). Clean But Not Green: A Weight-of-Evidence Approach for Setting Nutrient Criteria in New Zealand Rivers.

attribute tables have been developed based upon relationships with nutrients and macroinvertebrates, fish, periphyton and ecosystem metabolism, which have been combined in an approach that combines multiple lines of evidence. STAG have recommended that these attributes would apply only when they are more stringent than other attributes.

STAG's rationale for this approach is that it is difficult to model nutrient-periphyton relationships due to considerable natural variation in the natural characteristics of rivers and the complex interacting factors affecting periphyton growth and accumulation. Reducing DIN and DRP will contribute to improvements in ecosystem health by potentially reducing the prevalence of macrophytes and conspicuous and non-conspicuous periphyton, and by changing the ways in which organic matter is processed and recycled by microbes and invertebrates, the way energy is transferred through the food chain, and the types of fish and invertebrate communities that are present. While there may not always be a direct link and well-defined mechanistic models between nutrients and components of a healthy ecosystem, ecosystems are dominated by indirect and complex relationships that are difficult to accurately quantify.

The proposed attribute tables incorporate data across different trophic levels (ie, organisms with different functions in the food chain). To develop the proposed attributes, several datasets were compiled on links between nutrients and invertebrates, fish, periphyton and ecosystem metabolism. Each line of evidence is a regression between a national dataset of an ecosystem health metric and nutrient concentrations. Because broad-scale data has been used, it is inevitable that there will be site-specific variation in the nutrient concentrations that are associated with a given measure of ecosystem health (ie, there is scatter in the relationships). However, STAG advise that the multiple lines of evidence approach increases the robustness of the resulting attributes.

The effect of incorporating these tables would be a more stringent bottom line for DIN (compared to the nitrate toxicity attribute) and a new nationally applicable attribute for DRP, where there is none currently. Both DIN and DRP are proposed to be progressed as a package because both impact the structure and function of freshwater ecosystems. STAG have proposed that both the median and 95th percentile measurements would need to be met for a waterbody to fall within the specified attribute state.[56] If the DIN attribute is adopted, STAG have recommended that the nitrate and ammonia toxicity attributes in the NPS-FM would no longer be required.

Where there are multiple attributes for the same metric, the most stringent would apply. Therefore, the STAG attributes would have the most effect in soft-bottomed rivers that do not have a receiving environment downstream such as a lake or estuary, as these are the types of rivers where the nitrate toxicity attribute would currently be the minimum requirement. The proposed attribute tables would also apply where the nutrient concentrations to meet periphyton objectives are less stringent. See Impacts section for further information.

The predicted reference conditions (unaffected by adverse effects of humans) in all types of rivers are well within the thresholds proposed above. The median concentration of nitrate in rivers in reference condition was estimated to be below 0.15 mg/L in all categories of rivers in New Zealand (range: 0.007-0.143 mg/L; classified using the River Environment Classification).[57] Rivers with flows

[56] Based on monthly measurements. These give a long-term average indication of conditions and may not take into account larger nutrient loads delivered during high flow events.

[57] McDowell RW, Snelder TH, Cox N. 2013. Establishment of reference conditions and trigger values for chemical, physical and microbiological indicators in New Zealand streams and rivers. Prepared for Ministry for the Environment by Agresearch, Mosgiel.

originating in lowland areas had higher reference concentrations compared to rivers with other sources of flow (rivers flowing from lakes, hills, mountains, etc.).

Table 2. Proposed attributes for dissolved inorganic nitrogen and dissolved reactive phosphorus. See Additional Information 1 for full attribute tables.

	Dissolved Inorganic Nitrogen (mg/L)		Dissolved Reactive Phosphorus (mg/L)	
Attribute state	**Annual Median**	**95th percentile**	**Annual Median**	**95th percentile**
A	≤ 0.24	≤ 0.56	≤ 0.006	≤ 0.021
B	> 0.24 and ≤0.50	> 0.56 and ≤1.10	> 0.006 and ≤0.010	> 0.021 and ≤0.030
C	> 0.50 and ≤ 1.0	> 1.10 and ≤ 2.05	> 0.010 and ≤ 0.018	> 0.030 and ≤ 0.054
D	> 1.0	> 2.05	> 0.018	> 0.054

The proposed bottom line for DIN is the same as the current A band for 99 percent species protection from nitrate toxicity and consistent with a global literature review of effects of inorganic nitrogen pollution in rivers, which concluded that levels should be less than 0.5-1 mg/L to prevent eutrophication and protect against toxicity.[58]

STAG's proposed national nutrient concentration thresholds are not sufficiently stringent to achieve the periphyton bottom line in many parts of New Zealand. Therefore there is a risk of confusion that the DIN and DRP values are of themselves sufficient to achieve ecosystem health. On the other hand, introducing this option would prevent councils from specifying concentrations more permissive than the national DIN and DRP bottom lines. Guidance and assistance will need to be provided to help councils implement any new nutrient management mechanisms. A proposed flow chart showing the process is provided in Additional Information 5.

Option 3: Attribute tables for nitrogen and phosphorus to manage ecosystem health, using monitoring and Action Plans[59]

This option would be to introduce the bottom line thresholds in Option 2 above under an alternative mechanism to attributes with resource use limits. A possible mechanism would be to introduce the thresholds as attributes with action plan requirements (for details see Appendix 1: Recognising all components of ecosystem health). If DIN or DRP concentrations exceeded the bottom lines, this would trigger a requirement to investigate the causes of the exceedance and to put into place management actions to address it.

This approach has parallels with the current requirement in the NPS-FM to monitor macroinvertebrates and to put into place a management plan to address declining trends, or concentrations that were worse than the bottom line values. It could be perceived as adding additional complexity, as some nutrient attributes will need to be managed by resource use limits, and others by action plans.

[58] Camargo, J. A., & Alonso, Á. (2006). Ecological and toxicological effects of inorganic nitrogen pollution in aquatic ecosystems: A global assessment. Environment International, 32(6), 831–849.

[59] A new proposed mechanism for attributes based on adaptive management, see "managing all aspects of ecosystem health" section for further information

Option 4: Threshold for nitrate based on another toxicity threshold

An alternative for dealing with ecosystem risks associated with nitrogen is to adjust the nitrate toxicity national bottom line to provide a higher level of species protection. Note that the suggested bottom line for DIN in Option 2 is similar to the existing A/B band attribute state for nitrate toxicity (Additional Information 2 presents this table). The A/B band (1.0 mg/L) corresponds to a "high conservation value system. Unlikely to be effects even on sensitive species".

Setting the bottom line at a different level to that suggested in Option 2 would require a value based judgement, a balance between requiring improvements of water quality against potentially substantial land use change and nutrient use reduction required to meet the objectives. In terms of impact this proposal is similar to Option 2 (see Impacts section below).

The Regional Sector Water Subgroup has recommended reconsidering the nitrate toxicity bottom line. For example, this could be moved from the current bottom line set to protect 80 percent of species (6.9 mg/L nitrate-N), to 3.8 mg/L which provides for 90 percent species protection. Though more permissive than the threshold recommended by STAG, this would deal with the highest and most harmful concentrations of nitrogen.

The key benefit of this option is the evidence for and clarity of the ecological response to increased nitrate concentrations. The nitrate toxicity bottom line was identified via the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (formerly ANZECC 2000) derivation procedures, which are based on combining information on the effects on multiple species from laboratory trials. A criticism of this option is that it by relying on toxicity, it avoids setting objectives for all nutrient effects on ecosystem health and therefore does not directly address the problem statement.

Options ruled out of scope, or not considered

One option not considered would be to include a narrative attribute. This could be provided in a table with attribute states, or could be a planning objective which describes an aspirational outcome. For example: 'set nutrient criteria that provide for all components of ecosystem health'. The second report of the Land and Water Forum recommended narrative objectives for those that could not be set numerically. However, this was not progressed because it would be unlikely to cause a significant shift from the status quo.

Statement on criteria

We have used the below criteria in an additional analysis, based on criteria developed to assess potential attributes when the National Objectives Framework was developed. These were updated based on recent discussions with STAG. On the following page is a table assessing the options against the following criteria:

1. **Effectiveness** (ie, at protecting ecosystem health). How effective is the option for managing the negative effects of nutrient enrichment in rivers as well as in sensitive receiving environments such as lakes, wetlands and estuaries? Is the option fit for purpose for a wide range of different ecosystem types?
2. **Ease of implementation.** How much additional sampling, analysis and modelling will councils be required to do to implement this option? How long would it take? Is it easy to understand and explain to non-experts?
3. **Relationship to national value** (ie, ecosystem health). Does the option target a key indicator of ecosystem health? Will management using this method improve ecosystem health?

Table 3. Assessment of options

Option	Effectiveness (ie, at protecting ecosystem health)	Ease of implementation	Relationship to national value (ie, ecosystem health)
1. Status quo, with additional assistance to set objectives	(+) Site-specific objectives are being set taking local conditions into account (-) Potential for misuse, some have little confidence that it will be implemented properly (+) Guidance would encourage greater consistency among regions (-) Relationships between nutrients and periphyton are sometimes weak (ie, other factors such as temperature and flow are important), therefore setting limits for nutrients will not fully address the problem	(+) Guidance sets out steps to follow and assistance is available (-) Long and complex process – more work for councils to derive N and P concentrations in various circumstances (technically difficult and potentially costly) (-) Localised input data required, this takes time and money (+) Providing assistance with technical process would aid implementation	(+) Councils derive their own criteria relevant for their systems and conditions (+) Takes sensitive receiving environments such as lakes and estuaries into account (+) Periphyton is the negative effect to be managed (ie periphyton has a close relationship to impacts on ecosystem health)
2. Attribute tables for N and P applied nationally, and managed using limits on resource use (suggested by STAG)	(+) Removes ability to set objectives at current toxicity bottom line, introduces higher ecological objective to aim for (-) Criteria would be too stringent for managing trophic state of some ecosystems and too lenient in others. Important to note requirement to use most stringent criteria as per periphyton attribute (-) Ecological benefits of reducing nutrients in large, soft-bottomed rivers may be difficult to demonstrate at individual sites (-) Risks setting resource use limits that are too lenient to achieve periphyton objectives and that also may be too stringent in some circumstances	(+) Simple to understand and apply (+) Less specialised input data required than for periphyton attribute (+/-) Same monitoring and modelling requirements as status quo (+) May lead to faster implementation	(+) Based on relationships with multiple ecosystem components, not just periphyton (+) DIN attribute bottom line aligns with the existing A/B band for nitrate toxicity. Toxicity effects are straightforward and easily understood (-) Would be less accurate than detailed region or catchment specific investigations (-) May disincentivise councils to conduct their own investigations into drivers

Option	Effectiveness (ie, at protecting ecosystem health)	Ease of implementation	Relationship to national value (ie, ecosystem health)
3. Attribute tables for N and P applied nationally, managed using monitoring and Action Plans to address high or increasing concentrations	(-) Not proactive – Councils could wait until ecosystem already in decline or degraded before management plans were developed (-) Risks setting resource use limits that are too lenient to achieve periphyton objectives and that also may be too stringent in some circumstances	(+) N and P already monitored as part of council SOE monitoring. Detecting degraded states or worsening trends is technically feasible (+) Management plans can be prepared alongside other similar metrics (eg, macroinvertebrates) (+/-) Same modelling requirements as status quo	Same as (2) above
4. National bottom line for nitrate only based on current toxicity B/C band, or another threshold	(+) Removes ability to set objectives at current toxicity bottom line, introduces higher ecological objective to aim for (-) Would not change management of phosphorus (-) Risks setting resource use limits that are too lenient to achieve periphyton objectives and that also may be too stringent in some circumstances	(+) Simple to understand and apply; more transparent (+) Less specialised input data required than for periphyton attribute (+) May lead to faster implementation (-) Would not correspond with ecosystem health relationships (+/-) Same modelling requirements as status quo	(+) Based on established rationale (+) Physiological relationships apply everywhere (-) Would not change management of phosphorus (-) Would disincentivise councils to conduct their own investigations into drivers of periphyton growth and accumulation

Recommendation

Of the options presented above, the Ministry considers that there are two main options for consulting on nutrient management in the NPS-FM:

- **Option 1**: (a) enhanced status quo, with (b) improved guidance for councils
- **Option 2**: (a) Consult on STAG's proposed attribute tables for DIN and DRP. There is a choice to (a) include this as a firm Government proposal, or (b) note that further analysis is needed to understand its implications and achievability, and note that this is major decision with far-reaching consequences and Ministers will not take final decisions until this further analysis is available.

The Ministry recommends **Options 1 (b) and 2 (b)**, noting that further analysis is needed.

The table below presents the benefits and risks.

Table 4. Benefits and risks of main options

Option	Benefits	Risks
1. a) Do not consult on the options at this time.	More time to quantify costs and benefits.	Not a precautionary approach Relationship damage with advisory groups and ENGOs. Mitigated by other Essential Freshwater policy proposals.
1. b) (Preferred option) Carry out further work to resolve underlying technical issues and develop non-regulatory approaches to improve objective and limit setting.	Provides further information for final decisions.	
2. a) Consult on new attribute tables for DIN and DRP, as firm proposal.	As above.	Risk of creating confusion and eroding trust because the public will not have sufficient information to assess the costs and benefits.
2. b) (Preferred option). Consult on new attribute tables for DIN and DRP, note that further analysis is needed to understand its implications and achievability.	Allows for engagement with public and wider science community. Shows commitment to address identified issues with NPS-FM transparency. Highlights where significant improvements are required to meet current NPS-FM requirements.	We have only had the opportunity for initial modelling of both the ecosystem health outcomes and the impacts on land use. Complex technical arguments may make communication of different options difficult.

The Ministry considers that there is justification for introducing a more stringent bottom line or threshold for nitrate compared to the current nitrate toxicity bottom line to provide for ecosystem health, especially based on the new definition of ecosystem health and the consideration of Te Mana o te Wai. STAG have indicated that achieving the suggested bottom lines for DIN and DRP will contribute to improvements in ecosystem health through direct and indirect mechanisms. However,

Government only received finalised advice from the STAG on 24 June 2019. Up until then there had been considerable discussion on the evidence base for the attributes. More work is required to quantify the benefits and costs of the proposed options. Before final decisions are taken on the proposed attributes the Ministry recommends that further work is conducted to quantify the benefits to the specific ecosystems where the attributes would apply.

The proposal is that where there is more than one attribute directing nutrient objectives, the most stringent one would apply. STAG's proposed nutrient attributes will not be stringent enough to manage periphyton in all river systems; therefore STAG and the Ministry recommend that the existing periphyton attribute should remain. Councils will still need to set nutrient criteria to achieve objectives for periphyton and sensitive downstream receiving environments, or where the Freshwater Management Unit (FMU) does not support conspicuous periphyton, set criteria to achieve any other relevant freshwater objectives. In hard-bottomed rivers (eg, the Manuherikia River in Otago) managing nutrients to prevent excessive periphyton accumulation (as required in the current NPS-FM) would likely require tighter restrictions on nutrient runoff than the proposed new bottom lines.

Reaching these proposed bottom lines across the country would mean tighter restrictions on nutrient runoff in some lowland agriculturally-dominated areas. Councils can set a long timeframes to achieve bottom lines, but they will nonetheless be under pressure to set objectives and achieve them in reasonable timeframes.

Reducing nitrogen runoff from the land has benefits not only for water quality, but also for reducing emissions of nitrous oxide, a greenhouse gas produced by bacteria in the soil. Actions that will reduce both nitrous oxide emissions and nitrate leaching to waterways include better management of fertiliser, stock and effluent, afforestation, protection of soil and capture of animal excreta during periods of high risk of runoff, and stock exclusion from streams and wetlands.[60]

Regardless of whether the options are presented for consultation, we recommend a programme of work to further address the issues identified with the current NPS-FM provisions:

1. establish certainty over the best approach for setting new nutrient thresholds, this could include commissioning new science to clear up specific areas of contention
2. assess at a catchment and farm scale the benefits and impacts of the current NPS-FM provisions and new thresholds
3. increase the transparency and rigour of the implementation of the current periphyton bottom line and publish guidance on the process that councils need to follow
4. progress research to further our understanding of the influences on ecosystem health in soft bottomed rivers
5. publish guidance for councils with nutrient criteria to achieve periphyton biomass objectives in different types of rivers.

[60] Shepherd, M., Daigneault, A., Clothier, B., Devantier, B., Elliott, S., Greenhalgh, S., Harrison, D., Hock, B., Kerr, S., Lou, E., Lucci, G., Mackay, A., Monaghan, R., Müller, K., Murphy, L., Payn, T., Timar, L., Vibart, R., Wadhwa, S. & Wakelin, S. 2017. New Zealand's Freshwater Reforms: What are the Potential Impacts on Greenhouse Gas Emissions? Motu Economic and Public Policy Research.

What do stakeholders think?

Management of nutrients in the NPS-FM was not specifically on the Essential Freshwater work programme, but the STAG and FLG have recommended improvements to the way nutrients are managed in the NPS-FM to ensure that ecosystem health can be adequately maintained or improved.

Science and Technical Advisory Group

STAG has recommended (though not unanimously) amending the national framework for freshwater management to introduce numeric biophysical tables for dissolved inorganic nitrogen (DIN) and dissolved reactive phosphorus (DRP) and specifying national bottom lines of 1 mg/L DIN as an annual median (and 2.05 mg/L as a 95th percentile) and 0.018 mg/L DRP as an annual median (and 0.054 mg/L as a 95th percentile).

STAG were tasked with looking at the current provisions for nutrient management attributes in the NPS-FM, reviewing the need for additional measures and proposing alternatives. They considered a number of options.

- Non-regulatory methods, eg, guidance, to inform objective setting for the periphyton attribute
- New nutrient attribute tables for DIN and DRP – applicable nationally[61]
- Amending the nitrate toxicity attribute.

STAG's recommended attribute tables are attached (Additional Information 1), in summary their position is:

- "*Almost all members supported the introduction of attribute limits for nitrogen and phosphorus for ecosystem health protection as outlined above. This approach is attractive because it is difficult to model nutrient-periphyton (and other ecosystem components) relationships due to considerable variation in the natural characteristics of rivers and the complex interacting factors affecting periphyton growth. A periphyton biomass that is suitable for providing invertebrate and fish health at one site, for instance, may not be suitable at another because ecosystems are complex networks and there are multiple ways nutrients can affect ecosystems.*
- *One member expressed the view that, rather than introducing attribute limits for nitrogen and phosphorus for ecosystem health protection, the NPS-FM should be amended to clarify the process for setting nutrient limits for ecosystem health using existing attributes. This would require amendments to describe how to consider the ammonia toxicity, nitrate toxicity and periphyton requirements as well as those of downstream environments in a catchment or freshwater management unit.*"[62]

[61] Combining national relationships between nitrate and fish, macroinvertebrates, ecosystem metabolism and periphyton and averaging these to produce nitrate thresholds for management of ecosystem health.

[62] Freshwater Science and Technical Advisory Group. 2019. Report to the Minister for the Environment.

STAG have also recommend that:

- the existing periphyton attribute should remain. They noted that nutrient attributes on their own are not sufficient to provide for ecosystem health, and we must still account for downstream receiving environments (eg, lakes, estuaries)
- where there is more than one attribute for managing nutrients the more stringent one should apply.

On periphyton, STAG recommends amending national direction on freshwater management by changing the table specifying numeric biophysical values for periphyton (trophic state) to:

- remove the exclusion allowing rivers in the 'productive class' to exceed bottom lines 17 percent of the time, and
- require councils use the default nutrient criteria provided in the absence of robust, locally suitable, independently peer reviewed criteria.

Freshwater Leaders Group

In their first report (see excerpt in Additional Information 4) the FLG expressed support for DIN and DRP to be defined as attributes, based on STAG's initial recommendation to incorporate ecosystem health DIN and DRP attributes into the NPS-FM, with further work to answer outstanding questions.

Kahui Wai Māori

Kahui Wai Māori has not been able to consider the proposals in detail as a group, though the three KWM members on the Science and Technical Advisory Group are supportive of ecosystem health DIN and DRP attributes in the NPS-FM.

Regional Sector Water Subgroup

The Regional Sector Water Subgroup have raised strong concerns regarding the details of STAG's suggested new attributes for DIN and DRP. They do not support the proposals and consider there is a considerable risk that they will not result in better ecological health, while incurring significant cost to communities through land use change.

They note that environmental drivers of ecological health are complex. Predictive models have been developed in several regions (eg, Waikato, Horizons) and these tend to identify flow, habitat and sediment as the key drivers. In most cases, nutrients are of secondary importance for macroinvertebrate measures of ecosystem health (but are more important for periphyton).

They recommend that the Ministry considers an alternative approach that strengthens requirements for existing attributes (periphyton and nitrogen toxicity) and measures (eg, Macroinvertebrate Community Index). The Group has not discussed in detail where the national bottom line should be set at for an alternative approach that strengthens requirements for existing attributes. Their view is that this requires assessment of costs and benefits.

Previous advisory groups

The NOF Reference Group and the NOF Science Review panels had several discussions between 2015 and 2017 on the potential applicability of setting nutrient levels as attributes for Ecosystem Health in the NOF given the confusion over the nitrate and ammonium attribute tables that related to toxicity. These discussions were reported to the Land and Water Forum (LAWF) where further discussion and decisions were made. The outcome was to recommend the periphyton attribute.

Independent peer reviewer

Prof. David Hamilton, deputy director of the Australian Rivers Institute, conducted a review of the management of nutrients in rivers in the NPS-FM and the recommendations of the STAG. The main points raised in the review, and STAG's responses, are included in Additional Information 3. Prof. Hamilton concluded that the numerical values for the attribute states for DIN and DRP proposed by STAG "*match reasonably well with my own interpretation of whereabouts the concentrations would 'fall out.' There is strong evidence for additional attributes besides periphyton and nutrient toxicity to manage stream ecosystem health."* Prof. Hamilton made several recommendations to improve the analysis which were acted upon by STAG.

Impacts

Summary

Nutrient enrichment of fresh and marine waters can impose economic costs by impacting ecosystems, recreational and amenity benefits, spiritual values, and recreational and commercial fisheries. Drinking water contaminated with nitrogen is more costly to treat to a drinkable standard, and untreated water can have health impacts.[63] It is more cost effective to prevent degradation of waterways than to restore them after degradation has occurred, particularly in systems that have passed ecological 'tipping points' due to ongoing degradation.[64]

The options to change the nutrient attributes would all have a moderate impact on councils. If any of the options that involve changes to nutrient attributes were implemented, councils would need to incorporate amended nutrient objectives in the next iterations of their plans. The monitoring and modelling would not be substantially different from that required for existing NPS-FM processes, but due to the increased spatial coverage of nitrogen reduction required, greater effort would be required to plan and implement mitigation options and support communities through the transition to land uses with lower nitrogen leaching.

Although regional councils will have to make or amend regional plans to include target attributes states by 2025, they are able to determine the appropriate timeframes for achieving them. This means regional councils have the ability to mitigate cost impacts by spreading costs over time.

Timeframes will vary depending on the physical characteristics of catchments, the ambitions of communities, and the kind of changes that can actually be achieved. In some cases, significant improvements may take generations. For example, we know parts of the Waikato catchment experience significant lags between changes in groundwater quality (eg, from historic land use) and seeing a response in surface water quality – up to 75 years at some sites.[65] In this context, the Healthy Rivers Wai Ora plan change process has proposed an 80 year timeframe for achieving target attribute states in the Waikato and Waipa catchments. Interim plan changes between now and then will make stepped improvements, with the next plan change aiming to achieve a further 10 percent

[63] OECD. Publishing, & Organisation for Economic Co-operation and Development Staff. (2012). Water Quality and Agriculture: Meeting the Policy Challenge. OECD publishing.

[64] Rohr, J. R., E. Bernhardt, M. W. Cadotte, and W. Clements. (2018). The ecology and economics of restoration: when, what, where, and how to restore ecosystems. Ecology and Society 23(2):15.

[65] Estimated Age in Surface Water and Changes in Nitrogen Concentration in Groundwater in the Upper Waikato Catchment, Prepared for Ministry of Environment, September 2013: https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/aqualinc-surface-water-nitrogen-upper-waikato.pdf

improvement in water quality by 2026.[66] Although driven by local settlement legislation, this approach and timeframe is consistent with the NPS-FM.

Understanding the connections between the target attribute state and the changes needed to make improvements, will help communities make the right decisions in the interim (eg, targeting funding and interventions, and informing plan development or the application of rules).

Impact on land use and management practices

This section compares the catchment nitrogen load reductions required under the current NPS-FM provisions compared to the proposed DIN bottom line. Load reductions are a proxy for land use and management practices, as this is how they will be achieved.

Method

Modelling was used to estimate load reductions required to meet an in-stream nutrient concentration of 1.0 mg/L. This analysis was based upon national-scale modelled predictions of nutrient concentrations.[67] Zooming into smaller scales will introduce greater uncertainty.

The approach to defining nitrogen concentration targets by Snelder (2018) was based on a general estimate of the risk that a given biomass objective (in this case the bottom line) would not be met.[68] This estimate of risk means that if all locations comply with the nitrogen concentration target, a randomly drawn location will have a risk of 10 percent of exceeding the bottom line for periphyton.

A constraint of this analysis is that the analysis is based upon current concentrations and does not take into account the "load to come" from groundwater. The implication is that this analysis will potentially underestimate the reductions in loading required to meet the proposed bottom lines, depending on the time frame councils put in place for meeting the proposed bottom lines.

Where soft-bottom rivers discharge into nutrient sensitive lakes or estuaries, the NPS-FM requires that nitrogen and phosphorus loads and/or concentrations are set to achieve trophic objectives in the downstream receiving environment. The extent to which nitrogen and phosphorus loads and/or concentrations in rivers will need to be managed to achieve trophic state objectives in sensitive downstream receiving environments has not been evaluated in this analysis. The spatial assessment presented here therefore represents the maximum levels of DIN and DRP that are permissible under the current NPS-FM provisions.

This analysis also assumes that the effects of periphyton are managed solely by nutrient management and not by shading, flow manipulation, or other methods. This is a conservative assumption (ie, it maximises the impact of the current NPS-FM requirements) because measures other than nutrient concentration management could contribute to achieving periphyton objectives. The implications of this assumption will vary depending on the catchment in question.

Results of modelling

Compared to the existing attributes in the NPS-FM, the proposed DIN and DRP attributes would introduce stricter objectives in soft-bottomed rivers in some lowland agriculturally-dominated areas.

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[66] Proposed Waikato Regional Plan Change 1 – Waikato and Waipā River Catchments, Section 32 Evaluation Report: https://www.waikatoregion.govt.nz/assets/WRC/Council/Policy-and-Plans/HR/Dip-your-toes/Section32.pdf

[67] Whitehead, A., 2018. Spatial Modelling of River Water-Quality State. Incorporating Monitoring Data from 2013 to 2017. NIWA Client Report, NIWA, Christchurch, New Zealand.

[68] Snelder, T., 2018. Nutrient concentration targets to achieve periphyton biomass objectives incorporating uncertainties. GNS Science Report, Geological and Nuclear Sciences, Wellington, New Zealand.

Almost all locations (99.9 percent) are soft-bottomed rivers for which the worst case scenario would be that the objective would currently be defined by the nitrate-nitrogen toxicity attribute (because it is assumed the streams do not support conspicuous periphyton). Overall, it is estimated that approximately 27 percent of the length of stream and river in New Zealand is soft-bottomed and it is assumed that these locations do not support periphyton. STAG's proposed DIN and DRP attributes would not be relevant for many hard-bottomed rivers because in these rivers, the periphyton attribute would impose stricter nutrient objectives.

Under all options, the periphyton attribute will remain. Councils will still need to set nutrient criteria to achieve objectives for periphyton and sensitive downstream receiving environments. The key difference for the proposed attributes is that the highest acceptable objective for nitrogen will no longer be the current nitrate toxicity bottom line. For soft bottomed streams and rivers (where only the nitrate toxicity bottom line would currently apply) under Option 2 this is a change from DIN of 6.9 mg L^{-1} to 1.0 mg L^{-1}.

In summary the modelling shows:

- if councils choose to manage periphyton solely by limiting nutrients, the status quo requires significant mitigation and/or land use change to achieve the existing national bottom lines (refer to Figure 3 above)
- the proposed bottom line for DIN will introduce stricter objectives in some lowland agriculturally-dominated areas. The most affected regions would be Waikato, Canterbury and Southland, with large load reductions also required in some catchments in Manawatū-Whanganui and Taranaki. Reductions in yield of over 50 percent would be required in many catchments (refer to Figures 4 and 5 above)
- the proposed DRP bottom line will have limited spatial impact (approximately 0.1 percent of rivers), when excluding the rivers that would be naturally high in DRP (not shown in map). Catchments in Taranaki would require objectives to be set to meet the bottom lines.

Predicted nutrient reductions required under current NPS-FM provisions

This section provides some examples of the predicted reductions in nutrients required under the existing NPS-FM provisions, as a comparison to the yield reductions that would be required to meet the proposed STAG bottom lines. Methods and constraints are the same as the preceding section.

Mataura River catchment, Southland

Under the NPS-FM the estimated excess nitrogen yield at the bottom of the Mataura River catchment in the Southland region the same as under Option 2 (the STAG proposal). This is because, under both sets of scenarios, the excess yields at the bottom of the catchment are determined by the nitrogen criteria to achieve the periphyton bottom lines. Those criteria are more stringent than the STAG proposal of 1 mg DIN L^{-1}; being 0.3 mg TN L^{-1} and 0.8 mg TN L^{-1} respectively, depending on whether the risk of exceeding the periphyton criteria is set at 10 percent or 20 percent of sites.

However, there are areas within the catchment for which the STAG proposal has a potential impact. These locations can be seen by comparing the left- and right-hand maps in Figure 4. For example, there are large areas in the mid Mataura catchment that would not be required to reduce nitrogen loads under the existing NPS-FM but which have excess nitrogen yields of up to 10 kg ha yr^{-1} under the STAG proposal. These areas coincide with locations that are classified as fine bed substrates and are generally referred to as spring fed systems within the Mataura river catchment. Because these areas have fine substrates, the analysis has assumed that they do not support conspicuous periphyton and under the NPS-FM, the relevant nitrogen criterion is 6.9 mg NO^3-N L^{-1}. However, the

analysis has assumed that under the Essential Freshwater proposal, the nitrogen criterion is 1.0 mg DIN L^{-1}. Therefore, in situations where the current DIN concentration is greater than 1.0 mg DIN L^{-1}, the STAG proposal will have an impact.

The Mataura River analysis indicates that the STAG proposal has no effect on the excess nitrogen yield at the bottom of the catchment. However, Figure 6 indicates that there are large exceedances of the proposed nitrogen criteria at finer (sub-catchment) scales. It is likely that if these sub-catchment scale exceedances of the STAG proposal's nitrogen criteria were to be managed down to the bottom line (ie, 1.0 mg DIN L^{-1}) there would be significant local impacts. While the current NPS-FM requirements already imply these impacted locations would likely need to contribute to nitrogen reductions in the catchment as a whole, the imposition of the STAG proposal for nitrogen criteria likely represents additional constraints within the catchment and less flexibility, which would necessarily involve greater impact. The question then is whether these sub-catchment scale exceedances of the STAG proposal's nitrogen criteria will be 'caught' by implementation. The answer to that question is associated with the definition of Freshwater Management Units (FMUs). Defining more (fine-scaled) FMUs will increase the number of situations where locations are caught by the Essential Freshwater proposal's nitrogen criteria. However, because the definition of FMUs is not strongly specified by the NPS-FM, we are unable to assess the likely impact of the sub-catchment scale exceedances of the STAG proposal's nitrogen criteria.

Figure 6: Maps showing the accumulated excess yields in the Mataura River catchment in the Southland region under the NPS-FM and the STAG proposal. The location at the bottom of the catchment marked X is a soft bottomed segment.

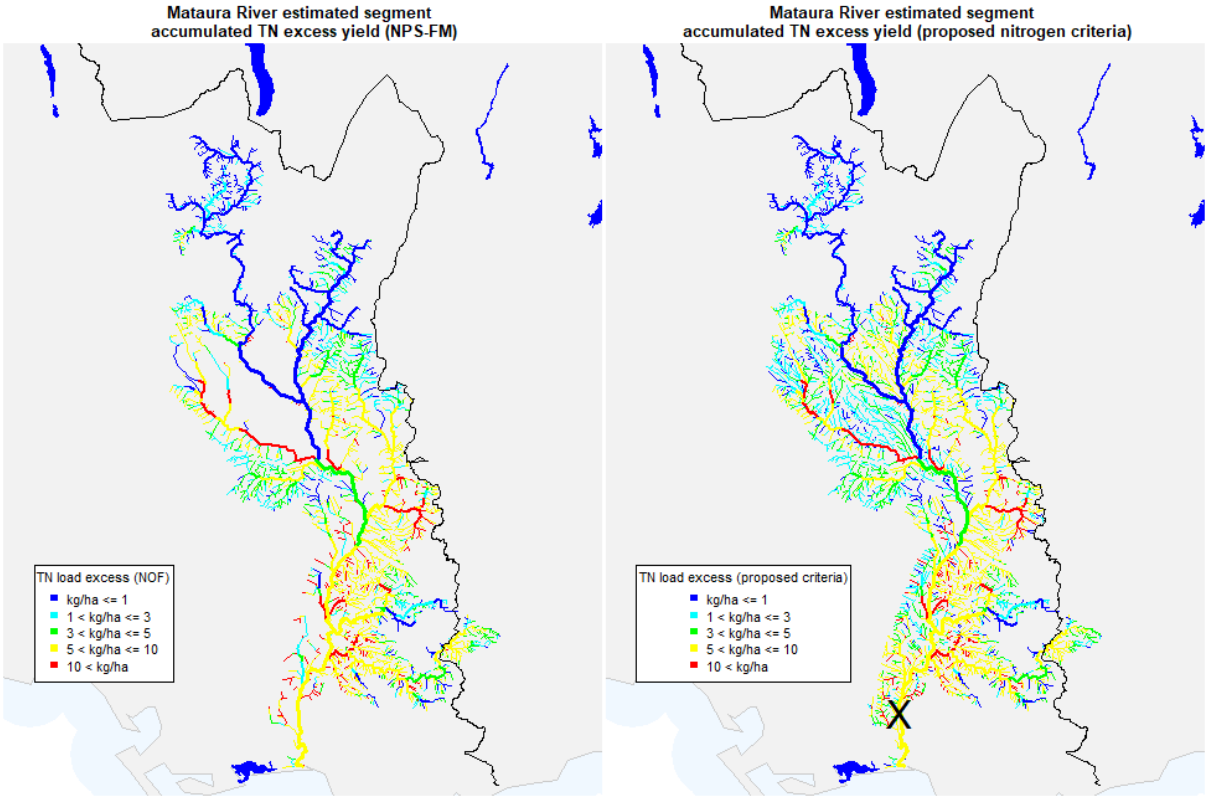
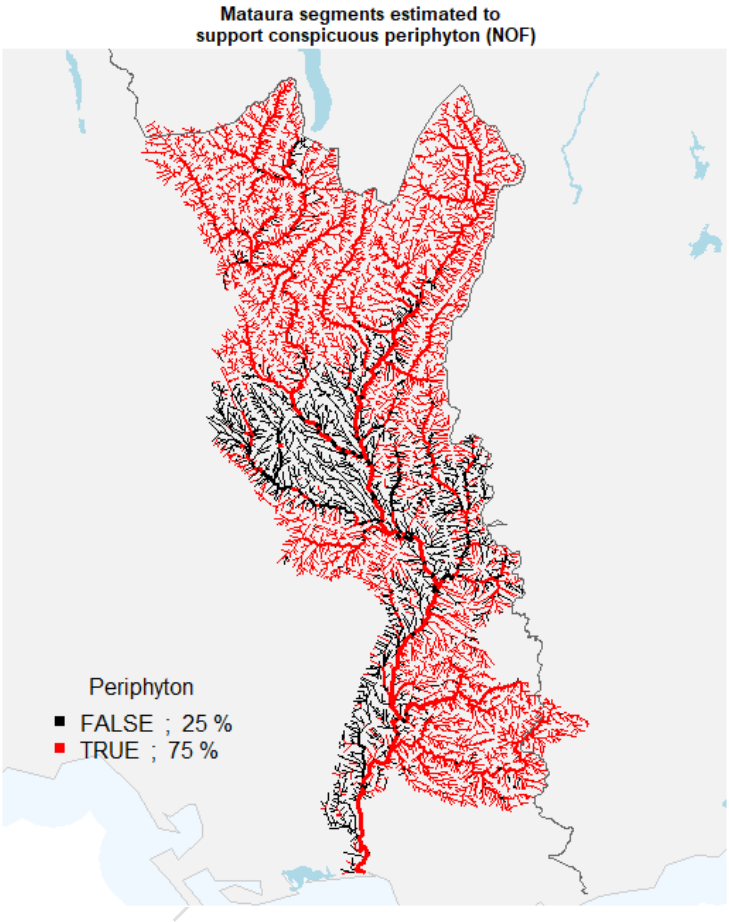


Figure 7: Map showing the Mataura River catchment classified according to whether the analysis has assumed the network segments can support conspicuous periphyton. The classification is based on coarse and fine bed substrates which are discriminated using substrate size index values of <3 and ≥3 respectively.



Hinds/Hekeao plains, Canterbury

In the Hinds/Hekeao plains freshwater management unit, targets were developed prior to the publication of the Periphyton Attribute Note and are based on the nitrate toxicity attribute. The NPS-FM currently requires catchment objectives to be set for periphyton by 2025. An estimated 30 percent nitrogen load reduction (from current land use) is required to meet an 80 percent species protection level in lowland streams and the Hinds River (C/D band for nitrate toxicity, 6.9 mg/L).[69] Additional water from alpine rivers needs to be released into rivers to meet these targets. The nitrogen load reduction required is predicted to increase to 45 percent after new irrigation is operational. Further reductions in nitrogen load will be required to meet the bottom line for the periphyton attribute.

The Hinds/Hekeao plains Freshwater Management Unit (FMU) in Canterbury comprises several intensively farmed catchments, the largest of which is the Hinds River. The Hinds River has its source in the Canterbury foothills and flows across the plains largely as a single thread gravel bed river.

[69] Daigneault, A., Samarasinghe, O., Lilburne, L. 2013. Modelling Economic Impacts of Nutrient Allocation Policies in Canterbury: Hinds Catchment. Prepared for Ministry for the Environment by Manaaki Whenua Landcare Research

Tributaries of the Hinds River and most of the other smaller catchments in the FMU are predominantly lowland low gradient systems with soft bottoms (ie, substrate index < 3) (Figure 8). The Hinds/Hekeao plains FMU has some of the highest surface water median nitrate-nitrogen concentrations in the country due to intensive agriculture and natural factors. The majority of the FMU has estimated median nitrate-nitrogen concentrations in excess of 1 mg L^{-1}.

Under the NPS-FM the estimated excess nitrogen yield at the bottom of the Hinds River catchment is 12 kg ha^{-1} $year^{-1}$ for a spatial exceedance criteria of 10 percent (Figure 9). The estimated excess nitrogen yield under the STAG proposal is the same as for the NPS-FM (Figure 9). This is because, in this analysis it has been assumed the Hinds River main stem would support conspicuous periphyton (Figure 8). Therefore, under both sets of scenarios, the excess yields at the bottom of the Hinds River catchment are determined by the nitrogen criteria to achieve the periphyton bottom lines. Those criteria are more stringent than the Essential Freshwater proposal of 1 mg DIN L^{-1}; being 0.3 mg TN L^{-1} for spatial exceedance criteria of 10 percent.

Mitigations

To meet the periphyton bottom line, the council may choose to employ any combination of mitigation methods. Examples might include managed aquifer recharge, constructed wetlands, shading, and limits on water takes. The combination of methods chosen would influence the reduction in nutrient loading required. The effect of the Essential Freshwater proposal would be to constrain the council's choice in how they meet the periphyton bottom line as the DIN bottom line would also have to be met.

In the wider Hinds/Hekeao plains FMU there are 40 individual waterways (including the Hinds River) that discharge to the coast. In this analysis it has been assumed that many of these smaller waterways would not support conspicuous periphyton (Figure 8). Therefore, the accumulated excess nitrogen loads for these waterways are evaluated as zero for the current NPS-FM scenarios (left-hand map; Figure 9). The STAG proposal, however, would require load reductions to meet the bottom line (ie, right-hand map; Figure 9). There is therefore a potentially large local impact of the STAG proposal in the FMU.

There is potential to achieve periphyton objectives by stream shading in many of the waterways within the FMU. The advantage of using shading to achieve periphyton objectives is sometimes only local because nutrients flow downstream to receiving environments such as wide lowland rivers that cannot be shaded. In these circumstances, reduction of in-stream nutrient concentrations is necessary to achieve periphyton objectives in the downstream receiving environments. However, in the Hinds/Hekeao plains FMU most of the waterways are relatively small (eg, 75 percent have catchments smaller than 12 km^2). It may therefore be possible to achieve periphyton objectives (where applicable) by shading along the entirety of the waterway and this would reduce the overall nitrogen load reductions required to achieve NPS-FM periphyton bottom lines. The assumption that periphyton objectives will be achieved purely by managing in-stream nitrate-nitrogen concentrations in the Hinds/Hekeao plains FMU is, therefore, likely conservative (ie, it maximises the assumed impact of the current NPS-FM requirements). In addition, this likely minimises our estimated impact of the STAG proposal in the FMU.

Figure 8. Maps showing the Hinds/Hekeao Plains Freshwater Management Unit classified according to whether the analysis has assumed the network segments can support conspicuous periphyton (left hand map). The right-hand map shows segments classified by estimated current median nitrate-nitrogen concentrations.

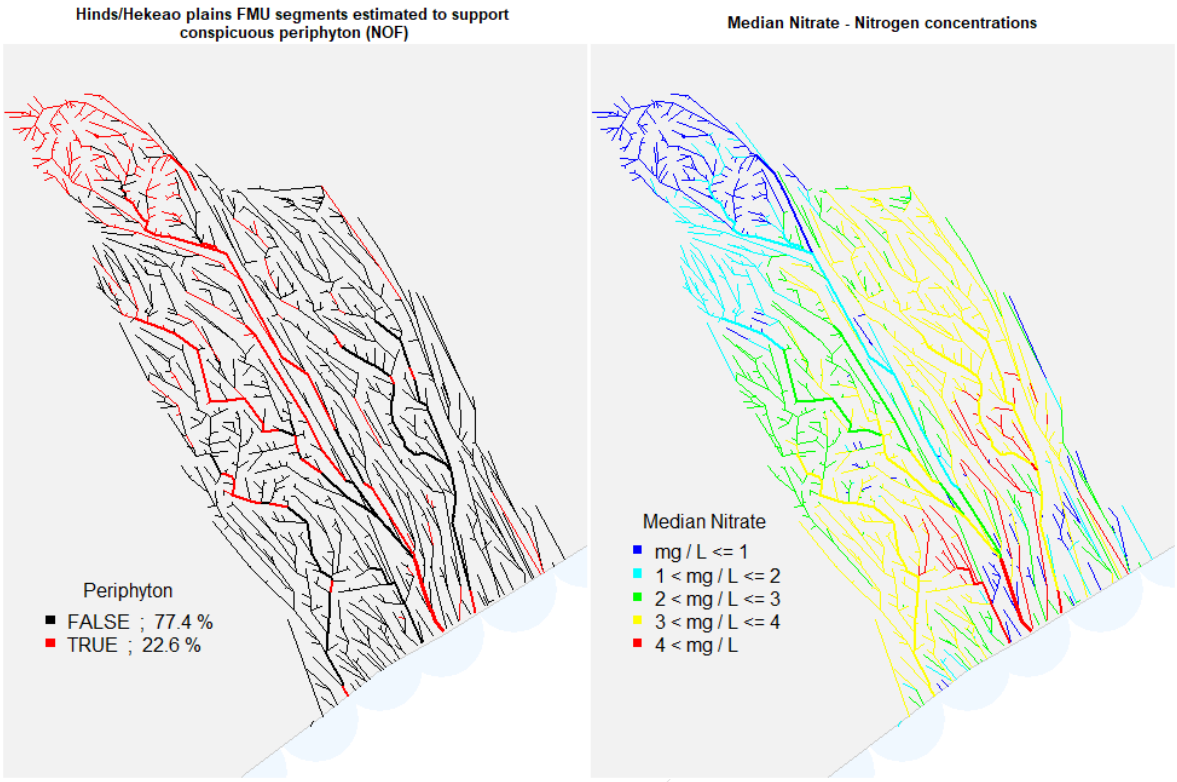
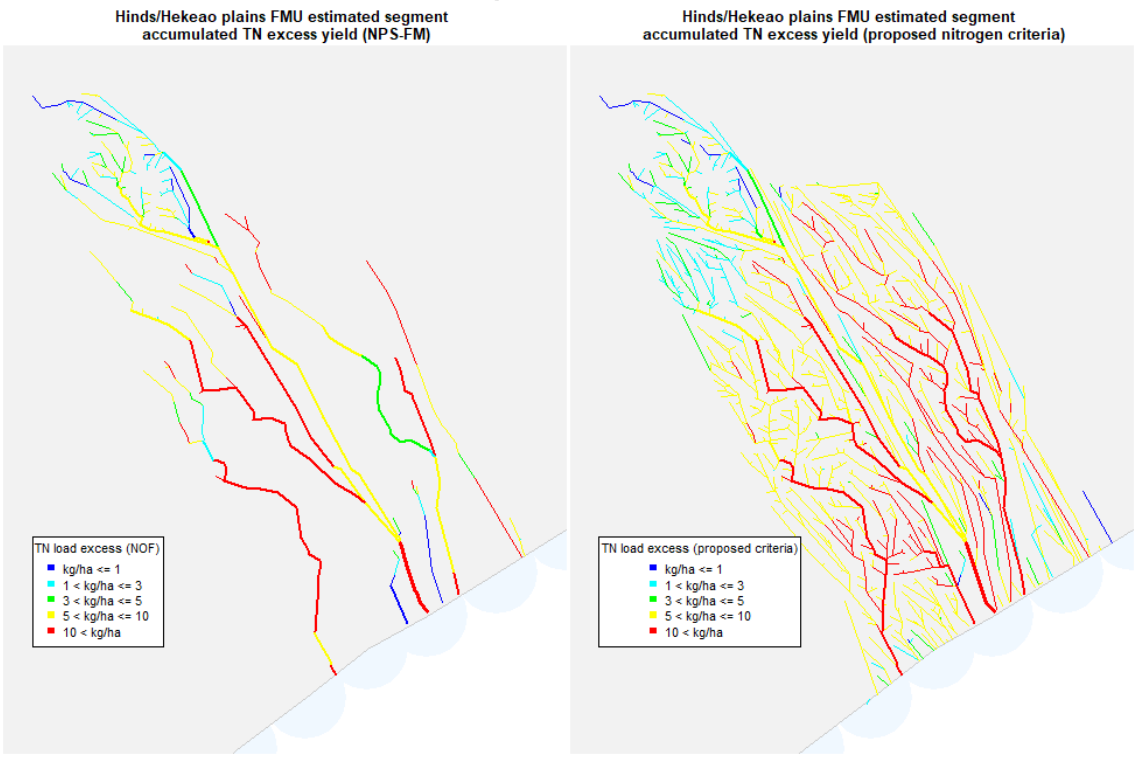


Figure 9. Maps showing the accumulated excess yields in the Hinds/Hekeao Plains Freshwater Management Unit in the Canterbury region under the existing NPS-FM provisions (left) and the STAG proposal (right).



Case studies of existing catchment objective setting processes

To meet the bottom line of the attribute for DIN in Option 2, the areas where the greatest reduction in catchment load is required go beyond the most stringent nitrogen reductions planned to date in regional processes. Two of the most stringent are the Hinds catchment in Canterbury which requires a 45 percent reduction (and managed aquifer recharge) and Rotorua Lakes catchment which requires a 42 percent reduction to meet in stream or lake water quality objectives. Economic modelling in Hinds and Rotorua Lakes for these reductions show a degree of land use change (dairy converting to lower intensity use) is required to meet these targets (more in Rotorua Lakes than Hinds).

Lake Rotorua

To achieve long term sustainable water quality at Lake Rotorua, analyses have been conducted to inform development of a nitrogen trading scheme to meet nitrogen load reduction targets.[70] Reducing leaching rates will require a combination of land-use change and on-farm mitigation in this catchment. Under a trading scheme, drystock farm profits benefit from the ability to sell N (to higher profit per kilogram of N businesses and the incentives fund). Dairy farm profits fall due to the need to acquire N in order to continue operating. In some cases, a reduction in nitrogen loss will result in farm profit increases through elimination of unprofitable inputs. This can occur in a number of different farm types. However, because the reduction in nutrients is so large, the mitigations required to meet the required nitrogen load reduction result in a net cost for most individual farms. De-intensification has some costs, but also has some benefits in that it lowers ongoing costs (eg, for additional feed) and frees up capital invested in fixed assets such as livestock or supplier shares. A reduction in capital land value was predicted across all land uses.

Tukituki River, Hawkes Bay

Targets were set in the Tukituki River catchment in Hawke's Bay to meet the existing requirements in the NPS-FM. To provide for maintenance or enhancement of the habitat and health of aquatic ecosystems, macroinvertebrates, native fish and trout, there is a DIN target of 0.8 mg/L in all zones, except the Upper Tukituki and Waipara rivers which is 0.150 mg/L.[71] To meet objectives for periphyton biomass and cover, the DRP target is 0.010 mg/L in mainstems and 0.015 mg/L in tributaries, except the Upper Tukituki and Waipara rivers which is 0.004 mg/L. To meet the DIN target an estimated 60 percent reduction in the nitrogen load from land use within the Tukituki catchment is required, involving extensive change in land practice and land use.[72] Two scenarios were tested: where a zone target reduction in N leached was not achieved through mitigation, land use was changed, with the final land use change modelled as either forestry or conservation land. The forestry and conservation land scenarios resulted in reductions of operating profit (after capital costs of transition) of $90 and $80 million per annum respectively.

Te Waihora/Lake Ellesmere, Canterbury

Te Waihora/Lake Ellesmere is an intermittently open and closed lake, which has implications for its management and vulnerability to human-induced stressors. An estimated 76 percent reduction in N and a 50 percent reduction in P loads would be required to meet NPS-FM bottom line objectives for

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[70] Parsons, O. J., Doole, G. J., Romera, A. J. 2015. On-farm effects of diverse allocation mechanisms in the Lake Rotorua catchment. Report for the Rotorua Stakeholder Advisory Group, August 2015.

[71] Hawke's Bay Regional Council. 2015. Plan Change 6 to Hawke's Bay Regional Resource Management Plan: Tukituki River catchment. HBRC Report No. SD 15-08 – 4767

[72] Harris Consulting Ltd (2012). Economic Impacts of Future Scenarios for the Tukituki River. Report prepared for Hawkes Bay Regional Council.

Te Waihora.[73] A business case commissioned by Environment Canterbury estimated that substantial land use change would be required to meet the nutrient load targets, with the catchment needing to be dominated by dryland sheep and beef grazing or forestry. Substantial costs were estimated for constructed wetlands as a mitigation method. The business case authors concluded that there would be widespread loss of operating surplus returns and equity, with resulting change in land ownership and loss of services and depopulation in rural areas. The authors noted that the scale of the changes required is outside the parameters of any modelled or real assessments of nutrient reductions in New Zealand.

Waikato-Waipa, Waikato

The Regional Sector Water Subgroup has conducted an analysis of the economic impacts of the STAG's proposed attributes (Option 2) based on an existing economic model set up to test the impacts of policy decisions relating to the Healthy Rivers/Wai Ora (Plan Change 1) process.[74] The model covers the Waikato-Waipa catchment, which is largely soft-bottomed, and was developed to estimate the change in land use profitability that would be expected in order to meet proposed environmental objectives.

The modelling analysis involved comparing a baseline scenario assuming "business as usual", ie, continuing linear increases in nitrogen leaching from dairy and drystock of 1.3 and 0.4 percent annually.[75] The status quo for comparison is therefore different to the baseline of compliance with existing NPS-FM provisions that is assumed elsewhere in this document.

The modelling results showed that land use change would likely be required to bring water quality up to the proposed DIN and DRP bottom lines, and the combination of changes arrived at by the model involved a decrease in drystock farming and dairy farming, with an increase in forestry. The costs of land use transition and profitability were estimated to be around $100 million per year in the Waikato/Waipa catchment (or around 11 percent of profits derived from land use in the catchment). As a comparison, the annual costs of the Healthy Rivers/Wai Ora plan change (based on current NPS-FM requirements) were estimated as four percent of profits derived from land use in the catchment.

It is noted that the economic impacts will depend on the time that councils and communities allow for achieving the bottom lines, and the management actions taken.

Indicative Social Impact

The options are likely to bring variable improvements to waterbodies depending on their degree of stringency, and with it, variable improvements to human health, wellbeing and cultural identity. This section outlines first the potential negative social impacts, and then the potential positive social impacts.

The proposed options are centred on western science principles and are unlikely to reflect Mātauranga Māori. There is a risk that any of the proposed options may not be perceived as

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[73] Harris, S., and Davie, T. 2017. Selwyn Te Waihora zone: Memorandum on the implications of meeting the National Policy Statement for Freshwater Management objectives for lake environments in Te Waihora. Prepared by Land & Water People for Environment Canterbury.

[74] Moran, E. and Keenan, B. 2019. Initial Economic Advisory Report on the Essential Freshwater Package. Prepared for the Local Government New Zealand Regional Sector Water Subgroup.

[75] Doole, G. J. 2016. Evaluation of scenarios for water quality improvement in the Waikato and Waipa River catchments: Business-as-usual assessment. Waikato Regional Council Technical Report 2018/49

providing a clearer role for partnership with Māori and iwi, and improving Māori and iwi's opportunity to express their kaitiakitanga role and improving their sense of cultural identity.[76]

Negative social impacts

Any of the options, enhanced status quo included, are likely to have some negative impacts on farmer wellbeing (anxiety/mental health):

- from the uncertainty about what action will be required by regional councils and the pace of change required
- if financial costs of implementing nutrient-reducing measures will, or are perceived to affect farm viability, especially if those measures require significant land-use change
- from financial and emotional costs if they choose to participate in the regional plan-making process to establish rules (submissions, hearings, appeals).[77]

Moderate reductions of nutrient leaching could be achieved at relatively low cost for farmers, and in some cases be associated with increasing profit.[78] On the other hand, models suggest that reductions above 50 percent would require land use change. In the shorter term, this is likely to negatively impact on the viability of some farms, and with it, on farmers' mental and physical health, and on the wider community if the farming workforce has less disposable income.

Any of the options that increase the stringency of nutrient attributes are likely to add to councils' workload, especially around compliance, monitoring and enforcement. There is employment legislation to protect staff from being overworked. Councils may increase rates in order to resource the extra workload, with potential negative impacts for wider communities.

A risk for all options is that a lack of fast improvement of freshwater quality, due for instance to time lag or compliance and enforcement challenges[79], may impact on New Zealand public's trust in government to 'do the right thing'.[80] It is unlikely to contribute to perceptions that the farming community are acting as stewards of the land / environment (social licence to operate)[81], which will likely be associated with low level of well-being, sense of self within the farming community.[82] Slow

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[76] Some councils and iwi have struggled to work together to give effect to the NPS-FM. See for example Ministry for the Environment. 2017. National Policy Statement for Freshwater Management – Implementation Review – National Themes Report https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/NPS-FM-implementation-review-national-themes-report.pdf

[77] Farmers' mental health: A review of the literature (2014) Report prepared for the Farmers' Mental Wellbeing Stakeholder Group by the Accident Compensation Corporation

[78] See Appendix 16: Reducing excessively high nitrogen leaching (nitrogen cap)

[79] *Independent Analysis of the 2017/2018 Compliance Monitoring and Enforcement Metrics for the Regional Sector*. 2018. Report prepared by The Catalyst Group for Local Government NZ

[80] The majority of surveyed New Zealanders in 2018 feel that it is very or extremely important to improve the quality of our water, and see government and farmers are responsible to make this change. Colmar Brunton. 2018. Environmental Attitudes Baseline. Commissioned by the Ministry for the Environment.

[81] P Clark-Hall, 2018, *How to Earn a Social Licence to Operate.* Report prepared for Ravensdown Ltd.

[82] Farmers' mental health: A review of the literature (ACC Policy Team, 2014) https://www.mentalhealth.org.nz/assets/ResourceFinder/wpc134609.pdf; Botha N, Roth H and Brown M 2013. '*The Adaptation of Pastoral Farmers to Environmental Policy Changes: A New Zealand Case Study*.' South African Journal of Agricultural Extension, Vol. 41: 16-25; Kennedy A, Maple MJ, McKay K, Brumby SA. 2014. Suicide and accidental death in Australia's rural farming communities: a review of the literature Rural and

improvements may also affect farmers' moral and willingness or enthusiasm to persevere in improving their farm practices.[83]

Positive social impacts

On the other hand, if the proposed policy is perceived by the New Zealand public and ENGOs as a robust tool to ensure change in farming practices and resulting in better environmental outcomes, and enough farmers and growers are able to comply with the proposed regulations and "do things right", this may have positive impact on the social cohesion of local communities, farmers' mental health (and as a result physical health), and overall satisfaction of life.[84]

The proposed policy could also result in a general perception of fairness by all or most parties as all agro-sectors are being targeted by the proposed policy.[85.]

There may be economic benefits for farmers able to leverage from "doing the right thing" (eg, sustainable branding).

The proposed policy is also likely to increase demand for a higher-skilled and larger rural professional workforce to help farmers and growers meeting the new thresholds, thus creating more job opportunity, especially in sectors with currently less rural advisors (ie, other than the dairy sector).

The positive social impacts associated with improved water quality and providing for Te Mana O Te Wai are likely to include reduced risk to human health (through improved drinking water quality), improve environmental amenity, increase access to valued natural resources, including for cultural purposes and recreational activities. This will likely contribute to improved physical and mental wellbeing, particularly at the local scale, and contribute to New Zealanders' cultural identity associated with high quality natural environment. These positive impacts are likely to be felt by New Zealanders at large, including Tangata Whenua and local farming communities.

The scale of these positive impacts will depend on the scale of freshwater quality improvement across the country.

Remote Health 14: 2517. http://dro.deakin.edu.au/eserv/DU:30062460/kennedy-suicideandaccidental-2014.pdf

[83] For example, Botha N, Roth H and Brown M 2013. '*The Adaptation of Pastoral Farmers to Environmental Policy Changes: A New Zealand Case Study*.' South African Journal of Agricultural Extension, Vol. 41: 16-25

[84] Farmers' mental health: A review of the literature (2014) Report prepared for the Farmers' Mental Wellbeing Stakeholder Group by the Accident Compensation Corporation

[85] P Clark-Hall, 2018, *How to Earn a Social Licence to Operate.* Report prepared for Ravensdown Ltd

Additional Information 1: STAG recommended attribute tables

Value	Ecosystem health		
Freshwater Body Type	Rivers [1]		
Attribute	Dissolved inorganic nitrogen		
Attribute Unit	DIN mg/L		
Attribute State	Numeric Attribute State[2]		Narrative Attribute State
	Median	95th percentile	Description
A	≤ 0.24	≤ 0.56	Ecological communities and ecosystem processes are similar to those of natural reference conditions. No adverse effects attributable to DIN enrichment are expected.
B	> 0.24 and ≤0.50	> 0.56 and ≤01.10	Ecological communities are slightly impacted by minor DIN elevation above natural reference conditions. If other conditions also favour eutrophication, sensitive ecosystems may experience additional algal and plant growth, loss of sensitive macroinvertebrate taxa, and higher respiration and decay rates.
C	> 0.5 and ≤ 1.0	> 1.10 and ≤ 2.05	Ecological communities are impacted by moderate DIN elevation above natural reference conditions, but sensitive species are not experiencing nitrate toxicity. If other conditions also favour eutrophication, DIN enrichment may cause increased algal and plant growth, loss of sensitive macroinvertebrate & fish taxa, and high rates of respiration and decay.
National Bottom Line	1.0	2.05	
D	>1.0	>2.05	Ecological communities impacted by substantial DIN elevation above natural reference conditions. In combination with other conditions favouring eutrophication, DIN enrichment drives excessive primary production and significant changes in macroinvertebrate and fish communities, as taxa sensitive to hypoxia and nitrate toxicity are lost.

1. Groundwater concentrations also need to be managed to ensure resurgence via springs and seepage does not degrade rivers through DIN enrichment.
2. Must be derived from the rolling median of monthly monitoring over five years.

Value	Ecosystem health		
Freshwater Body Type	Rivers		
Attribute	Dissolved reactive phosphorus		
Attribute Unit	DRP mg/L		
Attribute State	Numeric Attribute State[1]		Narrative Attribute State
	Median	95th percentile	Description
A	≤ 0.006	≤ 0.021	Ecological communities and ecosystem processes are similar to those of natural reference conditions. No adverse effects attributable to DRP enrichment are expected.
B	> 0.006 and ≤0.010	> 0.021 and ≤0.030	Ecological communities are slightly impacted by minor DRP elevation above natural reference conditions. If other conditions also favour eutrophication, sensitive ecosystems may experience additional algal and plant growth, loss of sensitive macroinvertebrate taxa, and higher respiration and decay rates.
C	> 0.010 and ≤ 0.018	> 0.030 and ≤ 0.054	Ecological communities are impacted by moderate DRP elevation above natural reference conditions. If other conditions also favour eutrophication, DRP enrichment may cause increased algal and plant growth, loss of sensitive macro-invertebrate & fish taxa, and high rates of respiration and decay.
National Bottom Line	0.018	0.054	
D	>0.018	>0.054	Ecological communities impacted by substantial DRP elevation above natural reference conditions. In combination with other conditions favouring eutrophication, DRP enrichment drives excessive primary production and significant changes in macroinvertebrate and fish communities, as taxa sensitive to hypoxia are lost.

1. Must be derived from the rolling median of monthly monitoring over five years.

Additional Information 2: Existing nitrate toxicity attribute

Value	Ecosystem health		
Freshwater Body Type	Rivers		
Attribute	Nitrate (Toxicity)		
Attribute Unit	mg NO_3-N/L (milligrams nitrate-nitrogen per litre)		
Attribute State	**Numeric Attribute State**		**Narrative Attribute State**
	Annual Median	**Annual 95th Percentile**	
A	≤1.0	≤1.5	High conservation value system. Unlikely to be effects even on sensitive species.
B	>1.0 and ≤2.4	>1.5 and ≤3.5	Some growth effect on up to 5% of species.
C	>2.4 and ≤6.9	>3.5 and ≤9.8	Growth effects on up to 20% of species (mainly sensitive species such as fish). No acute effects.
National Bottom Line	6.9	9.8	
D	>6.9	>9.8	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).

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.

Additional Information 3: STAG response to a review of the proposed nutrient attributes by Professor David Hamilton

Professor David Hamilton (Griffith University, Brisbane) conducted an independent review of the STAG's proposed nutrient attribute tables and associated documents outlining the statistical analysis undertaken to develop the attribute tables. In his review, Professor Hamilton concluded

> *'My opinion is that the numerical values of nutrient concentrations derived for supporting thresholds for different Attribute States (ie, A/B, B/C and C/D) given in the Death et al. (and/or Canning) reports match reasonably well with my own interpretation of whereabouts the concentrations would 'fall out'. There is strong evidence for additional attributes besides periphyton and nutrient toxicity to manage stream ecosystem health'* (DH review MfE stream nutrients (002).pdf)

Professor Hamilton made seven recommendations that he thought, if addressed, could provide a stronger evidence base for nutrient attributes. The STAG amended the nutrient attributes based on Professor Hamilton's review and responses to his recommendations are given below.

Recommendation 1*: Clarification could be sought that if nutrient attributes are introduced to manage eutrophication for ecosystem health purposes, then nutrient toxicity attributes would no longer be required.*

STAG response: The STAG clarifies that if nutrient attributes are introduced to manage for ecosystem health purposes, then nutrient toxicity attributes would no longer be required.

Recommendation 2: *There should be clear justification for using dissolved inorganic nutrients versus total nutrients as an attribute. Assessments using dissolved inorganic nutrients may need to consider the temporal and spatial variability of dissolved inorganic nutrients, for example associated with stream discharge.*

STAG response: The NPS-FM uses total nitrogen and total phosphorus to assess ecosystem health of lakes because these constituents are generally strongly correlated with phytoplankton chlorophyll a. In rivers, dissolved nutrients are more readily correlated with periphyton than totals and for this reason the STAG proceeded with examining dissolved nutrient guidelines. Stream discharge is addressed, in part, by the use of annual medians in exploring relationships with ecosystem health response variables.

Recommendation 3: *If dissolved inorganic nutrients are to be used in the attribute table, then consideration should be given to use of concentrations of dissolved inorganic nitrogen (DIN = NO3-N + NH4-N) as a nitrogen attribute in preference to NO3-N, to reflect the nitrogen supply available to aquatic primary producers.*

STAG response: The STAG recommends use of dissolved inorganic nitrogen (DIN).

Recommendation 4: *Consideration could be given whether it is valid to use different metrics of the same (or similar) indicator group to build weight-of-evidence for nutrient concentration thresholds.*

STAG response: The STAG proceeded with a multiple lines of evidence approach (as opposed to a weight of evidence approach) whereby each level of the food web as well as ecological processes were afforded equal weight in informing the nutrient thresholds.

Recommendation 5: *Consideration could be given to setting an acceptable (statistical) cut off for including an indicator to provide weight-of-evidence for establishing nutrient concentration thresholds. Levels of significance (p values) are irrelevant for many of the large data sets used for the weight-of-evidence approach.*

STAG response: The STAG explored how the inclusion or exclusion of models based on model strength could inform the nutrient attribute levels and concluded that there would be little effect on final values and therefore included all lines of evidence.

Recommendation 6*: Alignment of data sets used by scientists needs to be carried out urgently so that there is greater consistency of statistical information and analysis provided to the STAG. At the very least, a common example data set should be used to show that different statistical analyses are broadly in agreement.*

STAG response: The STAG conducted additional statistical analysis using consistent datasets including observed and modelled nutrients as well as regional and national calculations of ecosystem health metrics. This was done to reconcile the differences between initial independent analyses undertaken by Drs Snelder and Canning. The STAG incorporated consistent results into the multiple lines of evidence.

Recommendation 7: *Work by McDowell et al. (2013) and recently by Abell et al. (also with McDowell) should be re-examined by the STAG for the purpose of deriving spatial variations in stream reference nutrient concentrations across New Zealand.*

STAG response: The STAG explored reference site data and concluded that spatial variation of DIN was minimal (in terms of the effect on ecosystem health) and for DRP there was a 'north-south' deviation that could be effectively accounted for by a 'natural exceedances' exclusions attribute note.

Additional Information 4: Excerpt from the First Report of the Freshwater Leaders Group, April 2019

Making our waterways healthy within a generation

42. **To put in place the foundations for water quality improvements within a generation, significant improvements are needed to the NPS-FM.** These improvements will require regional councils to improve their regional plans, and have them in place and operative by 2025. This will position regional plans to drive long-term improvements to freshwater quality. This section sets out those improvements.

Recommendation

1. Amend the NPS-FM so that regional councils are to incorporate the relevant *Essential Freshwater* project changes into their regional plans, and have the plans in place and operative by 2025.

New and improved attributes in the NPS-FM

43. Clear and agreed scientific definitions of the attributes of water ecosystem health are critical to achieving the principles of Te Mana o te Wai and the objectives of *Essential Freshwater*, and underpin the NPS-FM's requirement to maintain or improve water quality. These must be appropriate at both a national and catchment level and used to determine the level of over-allocation of individual catchments, and the magnitude of change required to bring the waterbody back to a healthy state.

44. The NPS-FM needs to protect ecological health and human health. To achieve this, a wider set of clear and agreed scientific definitions of the attributes for water ecosystem health[86] should be included in the NPS-FM. These are critical. These attributes set a national bottom line for water quality, and are used:

    - by regional councils to set limits for contaminants and water takes, and
    - to identify the level of over-allocation[87] of individual catchments, and the magnitude of change required to bring the waterbody back to a healthy state.

45. Reaching agreement on the attributes and bottom lines is fundamental to the integrity of the entire regulatory framework. We have received advice from the Freshwater Science and Technical Advisory Group (STAG), and support:

    - Dissolved Inorganic Nitrogen (for ecosystem health) being defined as an attribute (which will also result in some desirable simplification of attribute tables in the National Objectives Framework (NOF)).
    - Dissolved Reactive Phosphorous being defined as an attribute for ecosystem health.

[86] This includes the freshwater habitat required for indigenous freshwater species, and for trout and salmon.

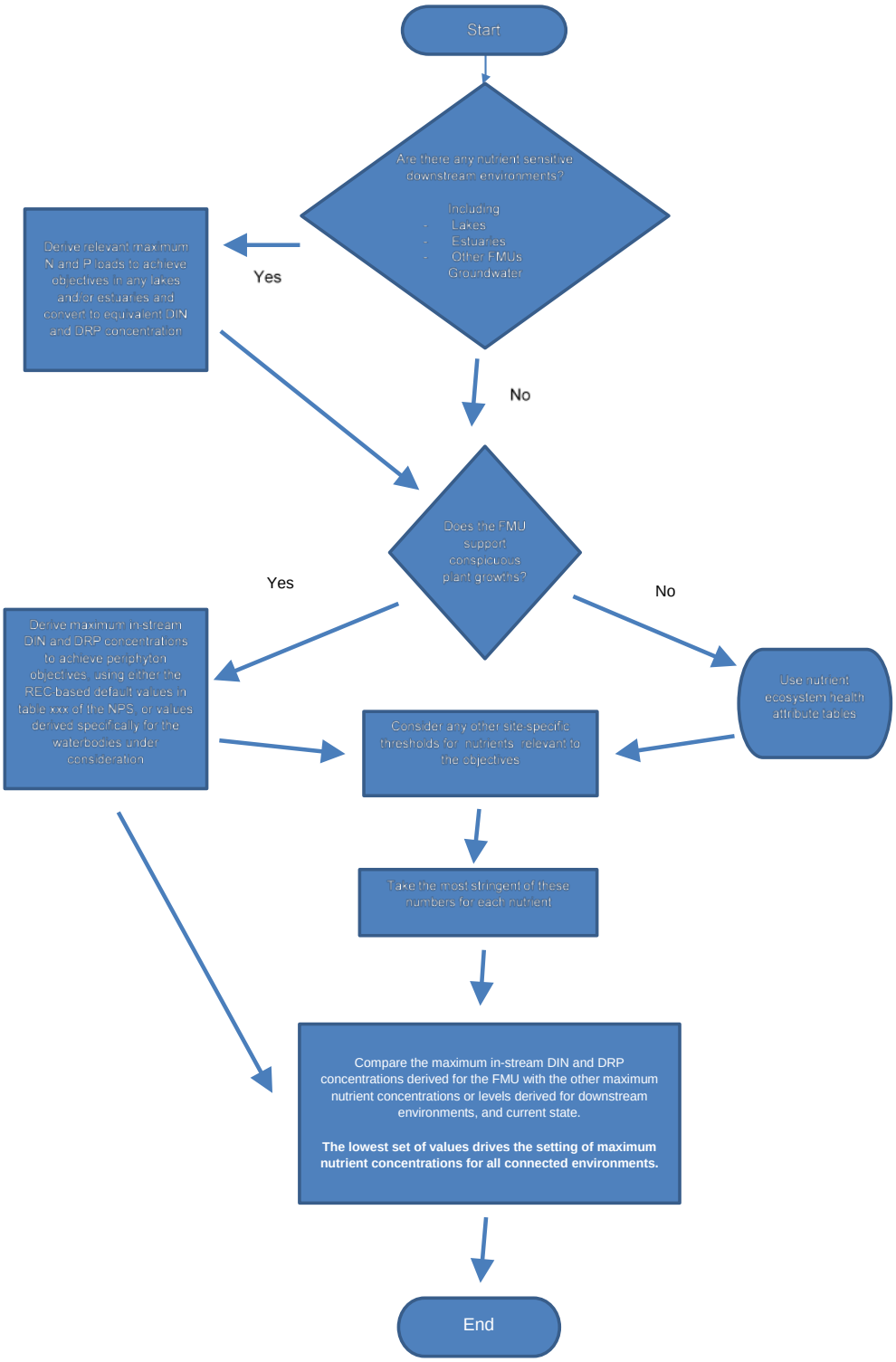
[87] Over-allocation and over-allocated is the situation where the resource (a) has been allocated to users beyond a limit; or (b) is being used to a point where a freshwater objective is no longer being met. This applies to quantity and quality.

- Dissolved Oxygen measures for all rivers and lakes.
- Several biotic indicators being included in the NOF – a fish index of biotic integrity, periphyton, and macroinvertebrates (including any improvements that can be made to the Macroinvertebrate Community Index measure currently in the NOF).
- Turbidity and deposited sediment being included as attributes in the NOF.

The investigation of ecosystem metabolism as a possible attribute to measure ecosystem health, and further work being carried out on habitat quality.

Additional Information 5: Flow chart of the process to determine maximum in-stream nutrient concentrations in a Freshwater Management Unit to support the periphyton and ecosystem health objectives

(Source: Freshwater Science and Technical Advisory Group: Report to the Minister for the Environment)



Appendix 5: Reporting on the five components of ecosystem health

Context

Status Quo

Our Freshwater 2017 indicated that the health of our freshwater ecosystems has declined nationally with three quarters of indigenous fish species threatened or at risk of extinction, reduced water quality, altered water flows, introduced pest species (eg koi carp), and modified or lost habitats or the connections to habitats. The report also identified gaps in the information available to describe the full state of ecosystem health nationally.

The RMA (s.35) requires Regional Councils to monitor the state of the whole or any part of the environment, and the effectiveness of its policies, rules and methods. They are required to review and make available to the public a compilation of their findings at least every five years. Consistent with this, the NPS-FM requires councils to establish methods to monitor the extent that they are providing for ecosystem heath, one of the key compulsory values they are required to manage.

To date, there has been limited direction as to how ecosystem health monitoring and reporting is to be achieved. As a result, there is a variety of information collected, and reporting approaches used. To date central national direction and local authority freshwater management effort has tended to be focussed on aspects of water quality and quantity. But ecosystem health has three other components – physical habitat, the presence (or absence) of aquatic life, and the interaction between all these components (ecosystem processes). All five components are necessary for healthy functioning ecosystems and the benefits people derive from them. This is the natural environment that councils must manage.

A qualitative search of regional council environmental reporting pages was undertaken to gauge how and what councils were reporting in terms of the five components of ecosystem health. Overall, there were gaps in reporting all 5 components of ecosystem health, and the gaps were not identified in a way that that would be apparent to the general public. In addition, the information was often difficult to find (ie, it was not discoverable even if it exists). Methods for reporting vary, but examples include annual report cards, technical reports, and online (such as LAWA or council websites).

What is expected if no further action is taken?

The current approach to reporting, when comparing between regions, is best described as ‘ad hoc’ in terms of style and content, resulting in a bias in the types of information being collected and reported, with a focus on a subset of some of the components that constitute ecosystem health, ie physico-chemical ‘water quality’ metrics. The main ecological and physical features (ie biological diversity, ecosystem processes, habitat quality) are commonly missing from the overall assessment of ecosystem health.

If the current approach to reporting remains unchanged, these issues with bias and inconsistency will continue in the immediate future, and efforts to resolve will be slow. This poses problems for policy making, and effective community participation in decision making.

The problem/opportunity

Current reporting on ecosystem health is inadequate to inform communities and planning decisions

There is broad recognition that measuring water quality alone is not enough to assess ecosystem health. If the fundamental state of ecosystem health is not adequately assessed or understood, it presents a problem for the policy and management cycle.

Systematic under-reporting of ecosystem health, and inability to communicate effectively where improvements or declines on overall ecosystem health have occurred limit the public to fully understand what management interventions are required to halt declines. This will impede the ability of communities to fully participate in decision making.

Councils need to be able to communicate an accurate and reliable story of the state of our environment. This will better inform why, where, and how we need to take action to halt declines in ecosystem health. Reporting on the five components of ecosystem health will mean that:

- Decisions about resourcing interventions are more easily supported by meaningful evidence based knowledge
- Effectiveness of policies to improve ecosystem health can be assessed; and
- The public better understands the extent that the information represents the freshwater ecosystem, and where information gaps exist.

Whilst several councils have taken steps to report data in more detailed annual report card styles, there are inconsistencies in how this is approached across regions. Meaningful steps to promote the use and uptake of national monitoring protocols/guidelines and reporting standards (via NEMS and LAWA) are slow.

To facilitate improvement and direct consistency, the Ministry proposes a shift to a reporting framework that is transparent about data gaps, starting with the requirement to report all monitoring data against the five defined components of ecosystem health. Where no information is available will also be reported. The chosen framework for doing this is set out in the Freshwater Biophysical Ecosystem Health Framework by Clapcott et al. 2018[88]. This report describes the current state of knowledge of best practice reporting systems internationally, and the approach recommended for New Zealand's freshwater environments.

Linkages

There are several key linkages to other components of the Essential Freshwater Package reforms:

- Expanded definition of ecosystem health (Providing for all aspects of ecosystem health in the NPS-FM)
- Additional metrics (Monitoring and responding to metrics for ecosystem health in the NPS-FM)
- Maintain and Improve – how to monitor improvements in a catchment & ensure declines are not approaching bottom thresholds within a management band.
- Te Mana o te Wai - this will also form information basis for how regional councils are moving towards a long-term trajectory for enhancing the mana of the water.

[88] https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/freshwater-ecosystem-health-framework.pdf

This proposal also directly offers co-benefits to other key environmental data reporting processes and obligations:

- Environmental Reporting (including the identification of reporting metrics)
- Environmental Monitoring and Reporting (EMaR) that directs Land Air Water Aotearoa (LAWA) and National Environment Monitoring Standards (NEMS)

Options

Option A: Status Quo

There are no changes to the current reporting regimes of councils. Councils will continue with current regionally based practices of data reporting and analysis.

Option B: Transparent reporting of five components of ecosystem health, recognising data gaps

Reporting will be immediately required for the five defined components of ecosystem health, in a way that is transparent about monitoring gaps and accessible to the public:

1. Require councils to report on routinely collected data from their established long term monitoring programmes annually, explicitly categorised under the five mandatory components of ecosystem health. Where there has been no data collected for a component or indicator, this must be shown.
2. Require councils to produce a synthesis report integrating the five components of ecosystem health as a single ecosystem health score. This will be produced, at a minimum, every five years. These should be publically accessible and understandable, and incorporate summary non-technical report cards.
3. Develop national guidance for councils to:
    a. Implement nationally consistent data management and analysis protocols (including data aggregation, standardisation, harmonisation, integration and weightings)
    b. Prioritise monitoring metrics, and
    c. Incorporate multiple lines of evidence in reporting on ecosystem health
4. Incorporate an interim review period after 5 years to track alignment of this policy with other national reporting programmes (eg Environmental Reporting, NEMS and LAWA), and also in light of any relevant RMA reforms and regional progress of NPS-FM implementation.

Option C: Immediate requirement to fill monitoring gaps, and report on compulsory metrics under all five components of ecosystem health

Councils will be required to immediately establish methods to monitor and report on overall ecosystem health as a single combined score. This will require councils to:

- Implement methods and protocols for monitoring and reporting on all metrics, including those that are not routinely monitored
- Immediately establish data management protocols and reporting templates to integrate data into a single ecosystem health reporting metric
- Report on overall ecosystem health across the region on an annual basis

Implementing Option C would require councils to undertake full scale monitoring of prescribed components of Ecosystem Health.

This poses several risks that go against the intent of the policy and other related policies:

1. Councils have uneven rating bases and environmental demands to manage, which presents a significant barrier for many to implement this policy. This is a systemic issue that may be best considered with wider reform of the resource management system
2. Councils will not have all the technical guidance in place necessary to ensure transparent and consistent reporting for all measures
3. Councils will not have the technical guidance for ensuring adequate data management protocols are tried and tested and are in place.

Overall Option C is ruled out as there are greater risks to setting out inefficiencies in national protocol development, and councils will not have sufficient time to prioritise monitoring resources against other policy needs. Implementing this policy without addressing the underlying systemic issues first would likely prove unmanageable for some councils, and have significant impacts on their ability to carry out their other required functions.

Impact Analysis

Criterion	Option A - Status Quo	Option B – Transparent Reporting	Option C Immediate monitoring and reporting
Effectiveness	**0**	++ The shift to transparent reporting allows councils, their communities and government to rapidly understand what the available information is telling them, and understand where the gaps are. This facilitates informed debate and decision making. Being transparent about gaps will encourage decisions on how to best prioritise monitoring to fill gaps, within budgets.	**0** Monitoring and reporting will continue without the desired national consistency required to link to other policies, and will not adequately link to other processes like Environmental Reporting, LAWA and NEMS.
Timeliness	**0**	+ The option provides a clear mechanism by which other policies and interventions can be assessed – thus overall supporting efforts to prevent further degradation of fresh water in New Zealand in a timely fashion.	**0** There will not be the mechanism, in place to identify further degradation of freshwater in a consistent way within and across regions.
Fairness	**0**	++ All councils in general will be able to immediately shift to transparent reporting within existing budgets, without the requirement to re-priorities resources and implement programme changes.	- - Councils are not treated equitably through this options, given the success of implementation depends on resource availability on science, policy, data management.
Efficiency	**0**	++ The shift to transparent reporting is accommodated under the current resources used for annual data reporting, and does not require councils to add additional metrics/data analytical steps to annual monitoring and reporting.	- - Option C does not achieve immediate cost benefits for councils, there are greater risks of wasted effort and funds that are not efficiently pooled or coordinated to achieve national protocols.
Principles of the Treaty of Waitangi	**0**	**0**	**0**
Te Mana o te Wai	**0**	++ Recognises Te Mana o Te Wai as a shift to a holistic way of reporting on ecosystem health.	**0**
Overall Assessment	**0**	++ The overall intent of the policy represents a fair and efficient process for all councils that will support other policy direction, and will support future monitoring and reporting demands.	**0**

Recommendation

The Ministry recommends implementing the immediate requirement for council to report all five components of ecosystem health (Option B). This will have the immediate effect improving transparency for the public of the data that is, and is not being collected and reported, and helps councils identify where gaps exist. The intent is not to impose additional mandatory monitoring requirements via this specific policy; as there are systemic issues that need to be addressed before this could happen.

This proposal is consistent with the framework and recommendations set out in the Ministry's commissioned report by Clapcott et al. 2018[89] that sets out the current state of knowledge of best practice reporting systems internationally, and the approach recommended for New Zealand's freshwater environments. The proposal is also consistent with the reporting practices currently adopted by several councils in New Zealand that currently produce detailed annual reports and summary report card style assessments of the regional state of freshwater and/or whole of catchment quality.

The regional sector has indicated support for the general direction for council to report on all five components, including reporting that no data is available. The intent of the proposal is also broadly supported by regional council freshwater experts; there is overall agreement that biotic and abiotic factors are critical components that make up Ecosystem Health, but are not reported in a consistent and transparent way. In addition, the proposal is consistent with the New Zealand River Ecosystem Health Report Card prototype currently being prepared for the Ministry for the Environment.

These amendments would support other direction in the Essential Freshwater package to:

- recognise Te Mana o Te Wai
- set out a transparent process, across both urban and rural settings, by which Ecosystem Health can be benchmarked across a region and also evaluate whether Ecosystem Heath has been maintained, improved or is in decline across relevant scales (in time and space)
- establish a robust reporting framework that could also inform other key programmes (eg Urban Water, identifying At Risk Catchments, and Environmental Reporting).

What do stakeholders think?

Stakeholders affected are regional councils. Overall these councils acknowledge the problem of current monitoring and reporting, as set out in the 'Regional Sector Water Subgroup feedback on Essential Freshwater Policy Proposals' document of 26 April 2019. This subgroup is a mix of elected Chairs, and non-elected Chief Executives and other senior staff employed by their regional councils. At the staff level, individual council scientists have indicated strong support for the inclusion of the policy with the provision that it is supported by clear technical guidance from the Ministry.

From the Local Government sector, comments include:

- Further work is required on the national reporting framework, and consideration needs to be given to the role of EMaR and LAWA.
- If the purpose is to address ecosystem health more comprehensively when implementing the NPS-FM, the preference would be to address this through objectives and policies and

[89] https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/freshwater-ecosystem-health-framework.pdf

requiring monitoring plans, rather than prescribing monitoring methods. There is concern that methods that councils do not use are not sufficiently advanced and tested.

There was clear support for the general direction of councils to report on all five components, including reporting that no data is available is appropriate.

Summary table of costs and benefits of the preferred approach

Affected parties *(identify)*	Comment*: nature of cost or benefit (eg ongoing, one-off), evidence and assumption (eg compliance rates), risks*	Impact *$m present value, for monetised impacts; high, medium or low for non-monetised impacts*	Evidence certainty *(High, medium or low)*
Additional costs of proposed approach, compared to taking no action			
Regional councils/unitary authority	No additional costs are anticipated- immediate changes can be implemented using existing resourcing - is a process of shifting current reporting practices for current monitoring programmes already in place, not additional monitoring to fill data gaps where identified. Any increase in costs will be.	-	High
MfE, DoC, MPI, MBIE	No additional costs.	-	High
Non-government groups (researchers, community groups)	No additional costs.	-	High
Total Monetised Cost	-	-	High
Non-monetised costs	None	*low*	High
Expected benefits of proposed approach, compared to taking no action			
Regional councils/unitary authority	Improved data transparency and ability to identify gaps, improved ability to report on components of ecosystem health.	-	High
MfE, DoC, MPI, MBIE	Improved ability to identify data gaps required to assess policy effectiveness.	-	High
Non-government groups (researchers, community groups)	Improved access to data, improved understanding of state of ecosystem health, improved ability to work collaboratively with local government.	-	High
Total Monetised Benefit	No additional costs.	-	High
Non-monetised benefits	Overall high benefits to local and central government for a range of reporting obligations, improved public	*low*	High

	understanding of council function and factors contributing to overall ecosystem health.		

What other impacts is this approach likely to have?

This approach recognises that councils cannot monitor everywhere, and are required to meet a variety of monitoring and reporting objectives. Thus there needs to be a process by which data can be appropriately grouped and reported in a consistent way, and that this is undertaken at meaningful time intervals. The proposal also recognises that it may not be appropriate or logistically possible to monitor all five components at a single site – monitoring effort may be spread across a wider spatial area depending on suitability for the particular metric of interest. Therefore a process to identify the scale at which to appropriately group data is required to be set out.

The proposal also recognises that similar ecosystem assessment frameworks have largely been developed internationally and nationally, and these can be progressively adapted for NZ needs in data management and reporting. In effect, regional councils will be required to either amend their existing reporting, or undertake new reporting to include the five components of ecosystem health. This may require updates to database templates, re-configuration of summary statistical outputs, re-configuration of graphical displays to convey the information into websites (eg LAWA) and annual report cards. Additional narrative will also be required to provide the context of information presentation and website linkages.

A National Report Card prototype is currently being set out. Following completion, this process will be further assessed to determine at what scale it is feasible and appropriate to define a single integrated measure of Ecosystem Health. Demonstrating the framework using New Zealand data is a critical step in shifting the current status quo of reporting to one that is flexible and transparent.

The risk of not shifting to this transparent process is that current issues of data management and reporting inconsistencies will remain; there will be an inability to effectively determine whether Ecosystem Health has been maintained or improved, and it will impede resource investment decisions and impede further policy development processes.

Central and local government potentially have several avenues for funding opportunities by which to co-develop practical and meaningful guidance and implementation. For example, the MBIE Envirolink grant is a route by which protocols and guidance tool could be funded. This mechanism is subject to conditions, and a successful application being submitted.

Appendix 6: Sediment

Environmental problem and context

Both deposited and suspended fine sediment (hereafter collectively described as sediment unless otherwise noted) are among the greatest stressors facing freshwater and coastal environments.[90] Sediment is a major driver of freshwater and marine biodiversity loss because it is a stressor in its own right, and it also exacerbates other biophysical chemical, physical, hydrological, biological, and ecological stressors on native flora and fauna.[91] For example, it can reduce available habitat for fish and macro-invertebrates or smother eggs.

Environmental Reporting shows that measured turbidity indicators over the 2008-2017 are improving in parts of Auckland, western Marlborough and Tasman, worsening in much of the central North Island, Canterbury Plains, Kaikoura and West Coast, and largely indeterminate or mixed in terms of improving and worsening in other areas.[92]

There is regional variability in the relative importance of sediment as an ecological stressor. However, research on freshwater fauna "ecological tipping points" related to sediment[93], coupled with reporting on current sediment indicators[94], shows that current in-stream sediment levels are high enough to breach those tipping points in some river reaches in every region in New Zealand.

Reducing sediment and the associated issue of improving erosion management are not new policy challenges in New Zealand. However, prior to the introduction of the Resource Management Act 1991 (RMA), the focus was primarily on erosion management for the purpose of reducing flood hazard risks and vulnerability, retaining land productivity, and to address municipal water supply concerns.

The legacy of historical primary sector subsidy and regulatory regimes, as well as urban development processes, frames modern erosion and sediment challenges. Until the 1980s, subsidies incentivised land clearance and pasture expansion in highly erosion-prone areas[95]. Hill country farming historically has had minimal oversight and recent shifts to consenting and rules-based frameworks are a marked departure and still uncommon across New Zealand.[96] Likewise, erosion and sediment problems have increased with urban development and expansion.

The overarching problem can be summarised as such: levels of deposited and suspended fine sediment in water bodies have reached ecological tipping points throughout New Zealand. Current natural resource management policy has proven inadequate to prevent ecosystem degradation due

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[90] *Our Freshwater* 2017; *Our Marine Environment* 2016

[91] Davies-Colley et al. 2015

[92] Statistics NZ water quality application

[93] Franklin et al 2019. Deriving potential fine sediment attribute thresholds for the National Objectives Framework. Prepared for Ministry for the Environment, June 2019. NIWA Client Report no. 2019039HN

[94] *Environment Aotearoa 2019*

[95] Tyler and Lattimore 1990. Assistance to agriculture. In: Sandrey and Reynolds (eds). Farming without subsidies: New Zealand's recent experience. Wellington: Government Print Books and Ministry of Agriculture and Fisheries.

[96] Ministry for the Environment 2018. *Regional council perspectives on soil erosion management: Current trends and emerging opportunities*. Wellington: Ministry for the Environment.

to excessive in-stream sediment. While some of the problem is due to historical practices and management approaches, current management is not sufficient to reduce ecosystem health degradation due to sediment. Further assessment of the policy, plan, and resource user context provides further refinement of this problem statement.

Policy problem and context

The RMA frames sediment and erosion management at a national level with local government responsible for implementing the legislation through planning processes. The National Policy Statement - Freshwater Management 2017 (NPS-FM) and the New Zealand Coastal Policy Statement 2010 (NZCPS) direct the contents in regional plans. The National Environmental Standard for Plantation Forestry (NESPF) introduced activity-specific regulations to improve erosion management within the forestry sector. Additional policies including the Building Act, the Local Government Act, as well as the National Policy Statement for Urban Development Capacity are relevant to infrastructure and urban development aspects of erosion management.

NPS-FM and NZCPS

Sediment levels and essential habitat needs of flora and fauna are matters to take into account for ecosystem health, which is a compulsory national value within the NPS-FM planning framework. The NPS-FM framework requires councils to follow a particular process for land and water management to provide for values:[97]

1. Identify the values the community holds for freshwater management units (FMU)
2. Identify the attributes that need to be managed to provide for those values
3. Formulate freshwater objectives using the attributes in Appendix 2 of the NPS-FM and any others the council considers necessary to achieve the values identified by the community for their water bodies
4. Establish limits on resource use and implement other methods to ensure the freshwater objectives are met.

There are no Appendix 2 attributes for sediment. Councils note that the absence of explicit direction reduces councillors' willingness to tackle sediment problems and weakens their ability to focus on sediment challenges and create and defend sediment-related plan provisions including rules in court.[98]

The 2017 NZCPS review[99] identified management of sedimentation (sediment deposition on the beds of waterbodies) as a core problem for coastal ecosystems and noted the lack of integration between freshwater and coastal management in how councils implement the NZCPS and NPS-FM. The review also found that regional councils have made implementation of the NPS-FM a priority over the NZCPS for their individual regions, often because of the specificity of the policy direction in the NPS-FM compared to the NZCPS.

As the principles applied by the Supreme Court in the *King Salmon* case state, "a requirement to give effect to a policy which is framed in a specific and unqualified way may, in a practical sense, be more

[97] MFE 2017

[98] MFE 2017a

[99] DOC 2017; DOC 2017a

prescriptive than a requirement to give effect to a policy which is worded at a higher level of abstraction".[100]

Regional plans

Regional councils use a mix of regulatory and non-regulatory methods for erosion and sediment management that can be grouped as follows: region-wide water quality or outcomes-based standards, activity controls and discharge standards, monitoring and information provision, provision of farmer extension services, funding of works, and area-specific rules and water quality standards. Regional councils approach erosion and sediment management in disparate ways. This reflects differences in natural environments, resourcing, and relationships between councils and resource users.

Most councils do not take region-wide approaches to in-stream sediment and instead focus on specific areas for management purposes such as for fish spawning habitat or drinking water supply areas. In relation to NPS-FM attributes, three councils (Gisborne, Wellington, Waikato) have proposed (but not yet operative) region-wide or FMU-specific sediment attributes. Several plans also require specific monitoring in order to develop attributes at future dates when adequate information exists to propose numeric thresholds.

In general, sediment point sources such as stormwater discharges, earthworks, and activities in river beds are regulated through consenting of specific activities and discharge and structural standards. Wider land use activities, if regulated at all, are controlled through catchment zoning and/or specific management conditions including farm plans. For agricultural erosion management, councils primarily rely on collaborative efforts with farmers, industry partnerships, and related non-regulatory methods.

At present, councils manage land and resource uses and activities that increase in-stream sediment without reference to in-stream thresholds. As such, they take piecemeal approaches, and these do not adequately address the cumulative effects of activities across time and space resulting in environmental degradation from excessive in-stream sediment.

Other policies

Regional councils and territorial authorities can use the following instruments to manage sediment generation in urban areas: The Local Government Act and local bylaws, regional and district plans, and development and engineering standards.

Stormwater bylaws assist territorial authorities in managing the network within resource consent conditions, typically through controlling service provision and inputs into the network. Discharges from stormwater networks are managed by regional plans and are either permitted activities or permitted through resource consents.

Earthworks and land clearance can be managed by rules in regional and district plans. District rules typically manage adverse effects on amenity issues (aesthetics, noise, traffic) and the council's stormwater network in conjunction with Stormwater Bylaw requirements. Larger developments will typically require earthworks consents under both the regional and district plan. District plan

[100] Environmental Defence Society Incorporated v The New Zealand King Salmon Company Limited [2014] NZSC 38 [17 April 2014] SC 82/2013 [2014] NZSC 38, paragraph 80.

provisions and consents cannot manage water quality alone, but they are important factors when managing sediment in urban areas.

Development and engineering standards set out technical requirements for land development, including in some cases the control of erosion and sedimentation (GD05[101] and GWRC Erosion and Sedimentation Control Guidelines).[102] These are important for determining what mitigation measures are adopted onsite though they are not statutory documents in their own right.

Iwi management plans

Erosion and sediment management is a common theme in iwi management plans across the country (69 of 95 examined) and particularly in those covering Southland, lowland areas of Canterbury, the Marlborough Sounds, the Waikato and its tributaries, Tauranga, the Hauraki Gulf, and Northland's rivers and estuaries. The fact that it is such a prominent theme in iwi management plans indicates that it is a critical objective for Māori across the country with particular relevance for specific iwi and hapū. Discussion of sediment issues in the plans is structured through four primary themes, within which there is significant overlap:

1. Location-specific (and more general) relationships between people, land, freshwater, and marine environments.
2. Relationship between erosion/sediment and ecosystem health degradation.
3. Contributing activities and/or controls (RMA-specific language)
4. Connections to Te Ao Māori

Iwi management plans discuss sediment and erosion with different objectives and purposes: some are more descriptive in relation to the issues that sedimentation causes to ecosystem health, cultural health, and Te Mana o te Wai; others are very prescriptive in terms of management objectives they seek – increased controls on specific activities.

Resource user context

From the perspective of resource users, several issues underlie challenges in effecting behaviour change for activities that contribute to erosion and sediment generation:

- Resource users, landowners, and private individuals and companies whose activities increase erosion and sediment generation do not bear the costs of connected externalities; they bear the cost of sediment/erosion mitigations, but in most cases do not directly realise their benefits.
- The complexity and scale of geological, climatic, land use and management factors make erosion management a major challenge.
- Sediment modelling at the site and catchment scale is technically demanding and subject to significant uncertainty, much like other types of natural resource and environmental modelling.

These drivers interact with policy frameworks to result in inadequate controls on inadequate consideration of, and controls on, high-risk sediment generation activities and erosion-prone areas in resource management decisions.

[101] GDO5

[102] GWRC Erosion and Sediment Control Guidelines

Synthesis

Given the above analysis of national legislation and direction, the resource user context, regional plans, and Māori rights and interests, the Ministry considers that national policy to address in-stream sediment should be specific, prescriptive, and unambiguous. The Ministry has identified a core policy gap in that councils do not require maintenance of specific in-stream sediment thresholds region-wide to provide for overall ecosystem health.

Objectives

The desired outcome is that regional councils require maintenance of in-stream sediment thresholds region-wide to provide for ecosystem health.

Options analysis

Options development and analysis occurred in two phases. The first phase was the generation and assessment of broad intervention typologies to address erosion management and sediment generation in general.

These option types were evaluated against a range of criteria and judged on whether they address the objective. Only one option type, planning system interventions, was able to address the problem and meet the objective, and only it was progressed to the second phase of options assessment.

The second phase included consideration of whether thresholds should be developed and implemented, and if so, by whom. These options were evaluated against the standard criteria described below.

Criteria

The standard evaluation criteria were used and were not modified.

Summary

Table 1 below shows that summary of the options analysis and the assessment's conclusion that Option B, central government develops thresholds and requires their implementation is the preferred option.

Table 3 - Summary of options analysis

Criterion	Option A (Status quo – local government has ability to develop and implement thresholds but is not required to do so)	Option B (Central government develops thresholds and requires their implementation)	Option C (Local government required to develop and implement thresholds)
Effectiveness	**0**	++	+
Timeliness	**0**	++	+
Fairness	**0**	+	**0**
Efficiency	**0**	++	--
Principles of the Treaty of Waitangi	**0**	+	+
Te Mana o te Wai	**0**	++	+
Overall Assessment	**0**	++	+

Options for development of thresholds

Option A: Status quo – local government has ability to develop and implement thresholds but is not required to do so

This option is to continue with the status quo in which regional councils have the ability to develop in-stream thresholds region wide for sediment but are not required to do so. At present, the NPS-FM provides a framework for development and implementation of thresholds. Whether councils develop thresholds or not, they are still required to provide for ecosystem health through NPS-FM obligations.

Table 4 - Summary of analysis for Option A - status quo; note the score key is the same as used for table 1

Criterion	Option A (Status quo – local government has the ability to develop and implement thresholds but is not required to do so)
Effectiveness	**0** A few councils have developed or signalled they are considering developing thresholds.
Timeliness	**0** Development of thresholds can be a timely and technically demanding endeavour, and not all councils will undertake it.
Fairness	**0** Costs for development of thresholds fall on local government; assessment of thresholds' impacts required.
Efficiency	**0** Multiple councils undertaking comparable developments.
Principles of the Treaty of Waitangi	**0** No change in the Crown's upholding of Treaty Principles.
Te Mana o te Wai	**0** No change in planning processes and so process to support Te Mana o te Wai is not affected.
Overall Assessment	**0** This option is a continuation of the status quo.

Option B: Central government develops thresholds and requires their implementation by regional councils

This option is for central government to develop thresholds for in-stream sediment to provide for ecosystem health and require their implementation. Threshold values for measures of water quality are commonly used in regulation, and they identify safe and dangerous levels of the indicator under consideration. These thresholds could be implemented through a range of policy instruments.

Table 5 - Summary of analysis for Option B - central government develops thresholds and requires their implementation; note the score key is the same as used for table 1

Criterion	Option B (Central government develops thresholds and requires their implementation by regional councils)
Effectiveness	**++** Central government is well-placed to undertake the development of thresholds for reasons of data availability, coordination role, and ecosystem health evaluation capacity. Regional councils can use existing freshwater policy planning mechanisms to implement the thresholds as appropriate for local conditions.

Timeliness	++ Central government development of thresholds can happen as a single process and is not reliant on existing planning processes. Regional councils will implement thresholds according to timeframes they develop in consultation with communities; it is expected that meeting bottom lines in some areas will take a long period of time (potentially inter-generational) due to the nature of possible interventions.
Fairness	+ Central government bears costs of threshold development; assessment of thresholds' impacts required. Regional councils bear the cost of policy implementation at the local level. Resource users, local government and central government will bear the costs of primary interventions, with the specific distribution of impacts dependent on future policy and funding choices.
Efficiency	++ Central government development of thresholds and incorporation in policy occurs as a single process. Regional councils will then update their plans through existing NPS-FM planning processes and will likely expand the range of methods (or increase the prominence of existing methods) used to implement freshwater plans.
Principles of the Treaty of Waitangi	+ Improved upholding of Treaty Principles, particularly in relation to the protection of taonga.
Te Mana o te Wai	++ Central government development of thresholds predicated on principles that support Te Mana o te Wai.
Overall Assessment	++ Central government is best placed to undertake the development of thresholds for reasons presented above.

Option C: Local government required to develop and implement thresholds

This option is for central government to require regional councils to develop and use in-stream sediment thresholds to provide for ecosystem health. A range of guidance for threshold values exists, such as the ANZECC and updated ANZG guidelines, and so this option would require councils either to conduct new research and development of thresholds or to adopt pre-existing threshold values. These thresholds could be implemented through a range of policy instruments.[103]

Table 4 - Summary analysis of Option C - local government required to develop and implement thresholds; note the score key is the same as used for table 1

Criterion	Option C (**Local government required to develop and implement thresholds)**
Effectiveness	+ Local government is able to undertake thresholds development with variable levels of research and resourcing.
Timeliness	+ Councils would develop thresholds over varying timeframes depending on where they are in the current planning cycle.
Fairness	**0** Costs for development of thresholds fall on local government; assessment of thresholds' impacts required.
Efficiency	-- Most councils undertake comparable research and development of thresholds at the same time using similar methods.

[103] ANZECC 2000, ANZG 2018.

Principles of the Treaty of Waitangi	+ Improved upholding of Treaty Principles, particularly in relation to the protection of taonga.
Te Mana o te Wai	+ Local government development of thresholds may be predicated on principles that support Te Mana o te Wai via resource management engagement with tangata whenua. This will be regionally variable.
Overall Assessment	+ Local government could develop thresholds, but this would entail delays, loss of efficiency, and likely variable thresholds and outcomes.

Decision on policy instrument and options not considered

The Ministry's analysis indicates that central government should develop and require implementation of in-stream sediment thresholds. This analysis is consistent with past evaluations of policy options proposed to strengthen sustainable water management for water quality characteristics that have definable quantitative relationships with ecosystem health impacts.[104]

The Ministry considers that the NPS-FM is the most appropriate instrument through which it should require local government to implement the developed thresholds. Other potential options would be through a National Environmental Standard, an RMA s360 regulation, or amendments to Schedule 3 and s69 of the RMA. The Regulatory Impact Statement (RIS) accompanying the 2014 amendments to the National Policy Statement for Freshwater Management thoroughly evaluated these policy options in relation to measurable characteristics of water quality and concluded that the NPS-FM was the preferable policy tool.[105]

NPS-FM mechanisms to implement threshold values

The NPS-FM currently provides two policy mechanisms through which thresholds may be defined and implemented: attributes and monitoring plan requirements. Attributes with national bottom lines and bands provide regulatory water quality thresholds that are implemented through pro-active planning processes. Monitoring plan requirements with specific threshold triggers for action that direct councils to undertake adaptive planning processes if thresholds are breached. In the proposed amended NPS-FM, aspects of ecosystem health with monitoring plan requirements are called "attributes with action plan requirements". This appendix uses the term "monitoring plan requirement" for consistency and clarity regarding the policy intent for councils.

The Ministry's analysis of which policy mechanism is most appropriate follows description of the thresholds the Ministry developed.

Development of thresholds and policy recommendations

The Ministry developed in-stream thresholds for suspended fine sediment and deposited fine sediment because the research suggested they should be assessed and managed independently. The proposed thresholds are based on the effect that elevated levels of suspended and deposited fine sediment have on freshwater fish and macroinvertebrates.[106]

The thresholds are incorporated within a spatial classification system defined by River Environment Classification's climate, topography, and geology groupings. This classification system ensures the

[104] 2011 RIS for the National Policy Statement for Freshwater Management

[105] 2014 RIS for the National Policy Statement for Freshwater Management

[106] Additional information (1) provides more detail on thresholds development and the classification system.

thresholds account for natural variability of in-stream sediment and ecological responses to it. NIWA developed an online application to view the proposed attributes spatially, and it is available here: http://shiny.niwa.co.nz/proposedNOFsediment/.

The Essential Freshwater Science and Technical Advisory Group agreed with the proposed threshold values and classification systems for both suspended and deposited fine sediment indicators.

Evaluation of suspended and deposited fine sediment indicators for suitability as NPS-FM attributes or monitoring plan requirements

The Ministry evaluated whether the suspended and deposited fine sediment thresholds could be included in the NPS-FM as attributes using criteria described in the 2014 and 2017 RIS.[107] In summary, the Ministry assessed both indicators in relation to their:

1.) link to ecosystem health
2.) measurement and threshold characteristics
3.) link to land use and management interventions
4.) ability to be evaluated nationally.

Suspended sediment meets all the relevant criteria and therefore can be progressed as an attribute. Deposited sediment does not meet all the criteria and therefore should be progressed as a monitoring plan requirement. Importantly, deposited sediment does not meet the criteria regarding the relationship between the indicator and management interventions at a wide scale.[108]

Recommendation 1: Suspended sediment attribute

The policy recommendation is to add a suspended sediment attribute to Appendix 2 of the NPS-FM. The proposed attribute is shown in Table 5. It includes bands A-D, with the C/D band threshold being the national bottom line.

This policy will result in local government using rules and methods to ensure that in-stream sediment levels reduce, or at least do not degrade further, as required. The bottom lines are based on ecological impacts. Therefore, where bottom lines currently are not breached, the policy will ensure that fish and macroinvertebrate communities do not suffer severe impacts from long-term suspended sediment levels by requiring at least maintenance of current state. Where bottom lines are currently breached, the policy will require improvements in water quality that will lead, over time, to improved ecological state.

The proposed attribute applies in all rivers and streams except for those affected by the following naturally occurring processes:

1. naturally highly coloured brown-water streams
2. glacial flour affected streams and rivers
3. selected lake-fed River Environment Classification (REC) classes (particularly warm climate classes), where high turbidity may reflect autochthonous phytoplankton production (as opposed to organic/inorganic sediment derived from the catchment).

[107] Additional information (2) provides more detail on this analysis.

[108] Hicks et al 2016; Hicks et al 2019. Sediment load reductions to meet suspended and deposited sediment thresholds. Prepared for the Ministry for the Environment, June 2019. NIWA Client Report No. 2019100CH.

When councils set objectives for streams that have these characteristics, they will not need to set the objective for water quality better than any national bottom line because these are "naturally occurring processes" in terms of NPS-FM Policy CA3(a).

Existing REC classes and other information can be used to highlight where these exceptions apply or at least are most likely to apply.

The attribute classification system is mapped in Figure 5 in the Additional information (1) section.

Recommendation 2: Deposited sediment monitoring plan requirement

The policy recommendation is to add a deposited sediment attribute with an action plan requirement in the NPS-FM. The requirement will be to monitor in-stream deposited sediment in wadeable streams using at least the following indicator: in-stream areal coverage of percent fine sediment (<2mm grain size) as determined through in-stream visual assessment. This is the SAM2 method.[109] Currently only wadeable streams can be monitored using this method.

The proposed policy will also include triggers for development of methods to address deposited sediment if monitoring trends are declining or indicators are below a specific threshold. Table 6 provides the thresholds per the classification system, which is shown in Figure 6 in the Additional information (1) section. Trends and threshold values will be based on a minimum record length of 24 observations (two years based on a monthly monitoring regime or longer for rivers where monitoring can only occur during the summer).

This policy will result in local government collecting information on deposited sediment levels in a standard manner over time. This will facilitate councils' evaluation of overarching ecosystem health parameters and potential needed interventions through an adaptive planning approach. It will also generate the information needed to assess drivers of deposited sediment levels and possible management actions to reduce them.

Stakeholder feedback on recommendations

Essential Freshwater Advisory Groups (FLG, KWM, and STAG)

The Ministry's stakeholder advisory groups for the Essential Freshwater work programme – which include individuals with private sector, scientific community, local government, Māori, and civil society interests – unanimously agree with the described environmental context. The FLG, STAG, and KWM support the recommended proposal for a suspended sediment attribute. The STAG was the only advisory group to discuss in depth the specific thresholds and classification system, and they supported them. The STAG was split between members who supported a deposited sediment attribute and a deposited sediment monitoring plan. FLG, in reference to all proposals in Essential Freshwater, generally preferred attributes to monitoring plan requirements. KWM did not provide specific comment on these recommendations.

Regional Councils

Overall, regional councils desire national direction on sediment policy. In a March 2019 letter to the Minister for the Environment, Local Government New Zealand stated that in-stream sediment is "widely accepted as a 'master stressor' in waterways and is a recognised gap in previous NPS-FM."

A working group of Resource Managers' Group (RMG) members focused on sediment policy issues consider that central government interventions to improve in-stream sediment outcomes are

[109] Clapcott et al 2014

warranted. The group considers that a range of regulatory and non-regulatory policy solutions will be required to solve the ultimate environmental problem and that, in general, specific thresholds of in-stream sediment will facilitate and direct planning to achieve that outcome.

A technical expert group of council staff has been involved in the research programme since 2015. This group has indicated that central government development of specific in-stream sediment thresholds for the provision of ecosystem health reduces the burden on councils of developing them on their own.

Both the RMG and technical expert groups had concerns about the specific suspended sediment attribute proposals. These concerns are described in more depth in Additional information section (4) and generally stem from the following themes: the complexity of the classification system and the precision of the band thresholds given monitoring limitations in different environments.

Other stakeholder groups

The Urban Water Working Group identified sediment as one of the stressors of primary concern in urban freshwater and coastal ecosystems. The Land and Water Forum called for sediment attributes to be included in the NPS-FM.[110]

Constraints on the analysis

Portions of this analysis have occurred at different times. As stated above, the options analysis presented here connects directly to broad analysis that underpins the Ministry's preference for central government development of water quality thresholds and local government implementation of them. The RIS evaluating the NPS-FM' introduction in 2011 and the introduction of the National Objectives Framework in the NPS-FM in 2014 assesses these issues in great depth.

The Ministry's research programme to develop sediment thresholds began in 2015 and was completed in early 2019. Since then, the Ministry has conducted analysis to assess their viability as attributes or monitoring plan requirements and to estimate the proposals' impacts.

[110] LAWF (2015); LAWF (2017); LAWF (2018).

Table 5 - Proposed suspended sediment attribute

Value	Ecosystem Health (water quality)											
Freshwater Body Type	Rivers and streams											
Attribute Unit	Turbidity (FNU) [1]											
Attribute State and narrative description	**Numeric attribute state by Suspended Sediment Class[2]**											
	1	2	3	4	5	6	7	8	9	10	11	12
A Minimal impact of suspended sediment on in-stream biota. Ecological communities are similar to those observed in natural reference conditions.	<2.0	<6.2	<1.3	<3.3	<7.5	<4.8	<2.3	<4.3	<1.2	<1.1	<1.1	<2.4
B Low to moderate impact of suspended sediment on in-stream biota. Abundance of sensitive fish species may be reduced.	<2.5	<7.9	<1.6	<3.9	<9.8	<6.3	<2.8	<5.2	<1.4	<1.3	<1.3	<2.7
C Moderate to high impact of suspended sediment on in-stream biota. Sensitive fish species may be lost.	<3.2	<10.5	<2.0	<4.8	<13.1	<8.3	<3.3	<6.4	<1.6	<1.5	<1.6	<3.1
National Bottom Line	3.2	10.5	2.0	4.8	13.1	8.3	3.3	6.4	1.6	1.5	1.6	3.1
D High impact of suspended sediment on in-stream biota. Ecological communities are significantly altered and sensitive fish and macroinvertebrate species are lost or at high risk of being lost.	>3.2	>10.5	>2.0	>4.8	>13.1	>8.3	>3.3	>6.4	>1.6	>1.5	>1.6	>3.1

[1] The minimum record length for grading a site is two years of at least monthly samples (at least 24 samples).

[2] See Table 11 for the definition of each suspended sediment class and its River Environment Classification composition.

Note: the attribute does not apply in the following rivers and streams due to naturally occurring processes:

1. Naturally highly coloured brown-water streams
2. Glacial flour affected streams and rivers
3. Selected lake-fed REC classes (particularly warm climate classes) where high turbidity may reflect autochthonous phytoplankton production (as opposed to organic/inorganic sediment derived from the catchment).

Table 6 - Proposed deposited sediment monitoring plan requirement

Value	Ecosystem Health (physical habitat)											
Freshwater Body Type	Wadeable rivers and streams											
Attribute Unit	% fine sediment cover[1,2]											
Attribute State and narrative description	**Numeric attribute state by Deposited Sediment Class[3]**											
	1	2	3	4	5	6	7	8	9	10	11	12
A Minimal impact of suspended sediment on in-stream biota. Ecological communities are similar to those observed in natural reference conditions.	<84	<9	<42	<12	<80	<30	<41	<22	<48	<15	<76	<27
B Low to moderate impact of suspended sediment on in-stream biota. Abundance of sensitive fish species may be reduced.	<90	<15	<50	<17	<86	<38	<48	<33	<54	<22	<82	<36
C Moderate to high impact of suspended sediment on in-stream biota. Sensitive fish species may be lost.	≤97	≤21	≤60	≤23	≤92	≤46	≤56	≤45	≤61	≤29	≤89	≤45
National Bottom Line	**97**	**21**	**60**	**23**	**92**	**46**	**56**	**45**	**61**	**29**	**89**	**45**
D High impact of suspended sediment on in-stream biota. Ecological communities are significantly altered and sensitive fish and macroinvertebrate species are lost or at high risk of being lost.	>97	>21	>60	>23	>92	>46	>56	>45	>61	>29	>89	>45

[1] [1]The indicator score is percentage cover of the streambed in a run habitat determined by the in-stream visual method, SAM2, and the monitoring method is defined in p. 17-20 of Clapcott et al. 2011[111]

[2] The minimum record length for grading a site is 24 samples taken over 2 years of monthly monitoring, or longer for sites where flow conditions only permit monthly monitoring seasonally.

[3] See Table 11 for the definition of each deposited sediment class and its River Environment Classification composition.

[111] Clapcott et al 2011

Impact analysis

The impacts analysis focuses on the suspended sediment attribute because it requires pro-active planning measures and will likely result in regulation of resource users. The additional impacts of the deposited sediment attribute with action plan requirement in the short- to medium-term are primarily the actual development and implementation of new monitoring programmes where they do not currently exist. If, over the long term, additional interventions are needed to improve deposited sediment, those interventions would entail additional costs and benefits and would include further reduction of in-stream suspended sediment.

The Ministry evaluated the anticipated impacts of the proposals by assessing:

1. the current state of sediment indicators in relation to the proposed thresholds
2. actions needed to implement the proposals, and the general costs of the status quo
3. case studies of urban development interactions with the proposed attribute indicators
4. national costs and benefits of possible hill country land management changes to meet bottom lines.

The monetised cost and benefit figures shown in Table 7 come from the national erosion and cost benefit assessment (CBA).[112] Estimated monetary benefits of the interventions outweigh costs over a 50-year period in all scenarios. The estimated monetary benefits to costs vary between approximately $31.2 billion : $7.1 billion (ratio of about 4.5 : 1) and approximately $5.4 billion : $5.3 (ratio of about 1.02 : 1), depending on the discount rate and carbon valuation measure used. Additionally, while the CBA is able to quantify what the Ministry considers to be the main types and magnitude of costs, it is unable to quantify numerous types of benefits and is therefore significantly underestimating the total magnitude of benefits in monetised values.

The CBA indicated that modelled interventions could improve water quality above catchment bottom lines in areas that cover the large majority of the country's land area.[113] With the exception of several catchments in Otago, Canterbury, and the West Coast, the large majority of the remaining catchments for which modelled interventions are inadequate to meet bottom lines are predominantly lowland or have little agricultural land. As such, they are not suitable for the modelled interventions. Those catchments would require a different mix of interventions than modelled in the CBA.

Modelled interventions were afforestation or erosion and sediment control treatments (whole farm plans) on farms in highly erodible areas. CBA results indicate interventions on roughly 600,000 ha would meet catchment bottom lines in "feasible" catchments, those that meet the bottom lines with the modelled interventions (see Figure 9), and an additional 400,000 ha in infeasible catchments, those that do not meet the bottom lines with the modelled interventions.

Model outputs indicate afforestation is the economically efficient intervention in most catchments even when assuming these forests are not harvested. However, whole farm plans alone are able to meet the bottom lines in almost all large catchments. The results, therefore, indicate there is not a need for widespread land-use change, and the ultimate implementation pathway will depend on councils' and landowners' choices about how best to meet the requirements.

[112] Neverman et al 2019. Impact testing of proposed sediment attribute: identifying erosion and sediment control interventions to meet proposed sediment attribute bottom lines and the costs and benefits of those interventions. Landcare Research Contract Report prepared for Ministry for the Environment.

[113] See Figure 9 in Additional information (8).

The Ministry considers the monetised costs shown in Table 7 to represent a significant component, and likely the majority, of the anticipated monetary costs of the proposals. These monetised figures do not include costs associated with regional councils' planning, research, monitoring, compliance, monitoring and enforcement (CME), or other activities, because they depend on the specific policy implementation pathway the council chooses. Nor do they include costs related to urban expansion or infrastructure development and operation. Table 7 describes these types of costs qualitatively as there is insufficient information available to assess them at the national level in a monetised fashion.

Regional councils and central government currently subsidise the development, and in some cases implementation, of erosion and sediment control plans in hill country farms. Regional councils spend ~$14.5million/year (not including staff time) on erosion-related goods and services.[114] National programmes such as the Hill Country Erosion Fund (over $35 million approved between 2019 and 2023) and One Billion Trees support development and implementation of measures to reduce erosion.[115]

As a result, who ultimately pays the costs of the proposals depends on future political choices on public spending. The assumption presented in Table 7 is that monetised costs (those stemming from the CBA results) constitute new spending that is split between regulated parties (landowners/farmers; 50 percent), regulators (regional councils; 25 percent) and central government (25 percent).

The Ministry considers that the monetised benefits shown represent a significant proportion, but not likely the majority, of the total benefits due to the inability to monetise a wide range of anticipated benefits. However, the Ministry discusses the type and scale of benefits anticipated from the proposals in detail in this section and in Additional information sections 6 and 8. The monetised and non-monetised benefits are primarily ongoing. This contrasts with the monetised costs, which are primarily up-front costs with some relatively small ongoing components.

Table 7 presents an overarching summary of the proposals' anticipated impacts. The monetised costs and benefits are shown as net present value using a 6 percent discount rate. The monetised benefits show the entire estimated range. Table 8 presents a summary of the proposals' indicative social impacts with a focus on well-being components.

[114] Robb, C. & Brown, I. 2018. Regional Sector Capacity and Capability - Erosion and sediment. Report commissioned by Resource Managers' Group.

[115] MPI 2019.

Table 7 - Summary assessment of proposals' costs and benefits

Affected parties	Comment	Impact[116] (CBA); other	Evidence certainty[117] (CBA); other
Additional costs of proposed approach, compared to taking no action			
Regulated parties (businesses, infrastructure operators, farmers, developers, general public, etc.)	Costs of implementing interventions in order to improve water quality above proposed thresholds such as afforestation costs, soil conservation components in freshwater modules in farm plans, enhanced erosion and sediment control works, staging earthworks for urban development, space-planting pasture hill-slopes, etc.	($2.5 billion); High	(Medium: modelling uncertainty); Low: highly catchment specific
Regulators (local government)	Implementation support subsidies and works that are not required by the regulation but are anticipated to be a major regional council response to it. Mandated new spend relates primarily to planning processes and monitoring and compliance programmes, which is expected to be significantly lower than the monetised cost figure.	($1.3 billion); Medium	(Low: depends on funding choices); Medium: variable by region
Wider government (central government and state-owned entities)	New spend in continued/expanded central government support measures like the Hill Country Erosion Fund beyond current mandate; changed practices required of state-owned entities like NZTA and 3 Waters operators.	($1.3 billion); Low apart from state-owned entities, which are included in "regulated parties"	(Low: depends on funding choices); Medium: depends on future policy implement-ation
Wider public, rural and urban communities	These effects are linked explicitly to impacts on regulated parties. Flow-on effects may include impacts on agricultural processors or social changes in hill country communities due to land use change, or effects on housing development costs with attendant impacts on urban communities. See Table 8	Medium (see Table 8)	Medium (see table 8)
Total Monetised Cost	Total figure stems from the CBA results. Cost estimates primarily reflect up-front costs, and these will be implemented over long (25 years+) timeframes.	($5.3 billion);	(Medium: value; low: distribution of costs)

[116] Costs in parentheses stem only from the CBA (Neverman et al 2019). Other costs represent a synthesis of the information presented in this section.

[117] The evidence certainty text in the parentheses relates solely to monetised costs provided by Neverman et al. 2019. Other text represents the other costs discussed.

Non-monetised costs	Non-monetised costs described above (everything except land-management and change interventions to achieve bottom lines per the CBA).	Very high	Low

Additional benefits of proposed approach, compared to taking no action[118]			
Regulated parties (as above)	Benefits primarily include ETS carbon credits, increased resilience to landslides and associated natural hazards; retention and, in some cases, increases of natural capital stocks; increases in ecosystem services flows (provisioning, regulating, and supporting services); increased recreational and cultural values; improved perception of "100 percent Pure" New Zealand brand image. (CBA, using 6 percent discount rates, shows NPV of $6.4 billion for ETS profits).	($6.4 billion); High	(Medium: uncertainty & inability to quantify or monetise some benefits); High
Regulators (as above)	Avoided costs of degradation and maintenance costs, primarily in relation to natural hazards.	High	Medium
Wider government (as above)	Improved critical infrastructure resilience to natural hazards (eg transport, energy, water); reduced infrastructure maintenance costs (eg port dredging, dam infill, road washout, flood damage); reduced infrastructure operation costs (eg water treatment).	High	Medium
Wider public, rural and urban communities	Reduced risk of flooding; less financial pressure on ratepayers given improved infrastructure resilience to natural hazards, and lower maintenance and operation costs; improved water quality for drinking and recreation (eg swimming and fishing); Improved perception of the farming community as stewards of the land; improved mauri of waterbodies; and more opportunities for food gathering/mahinga kai. The types of benefits accruing to different communities vary. For example, upstream communities may benefit more from avoided costs of infrastructure damage due to landsliding whereas downstream communities may benefit more from reduced flooding costs and biodiversity improvements. (CBA shows NPV of $334 million for benefit of improved visual clarity of waterbodies; $19-22 million for avoided dredging of hydropower	(excluding carbon benefits - $400-$500 million); Very high	Medium

[118] Benefits in parentheses stem from Neverman et al 2019. Other benefits represent a synthesis of the information presented in this section and table shown in Additional information (6).

	reservoirs, $51-154 million of erosion reduction, and carbon benefits ranging from $5-21 billion) .		
Total Monetised Benefit	Total figure stems entirely from the CBA estimates and the range is driven by the carbon valuation used. Using ETS profits, monetised benefits are approximately $6.8 to $6.9 billion.	($ 5.4 billion – 21. 4 billion)	Medium
Non-monetised benefits	Estimate stems from information in this section and Tables 15 and 16. Benefits are primarily ongoing.	Very high	High

Table 8 – Summary assessment of the proposals' impacts on wellbeing

Indicative costs to wellbeing		
Wellbeing dimension	**Description of impact**	**Scale; timeframe; and affected groups**
Income and consumption	Negative effect on some businesses and communities if the farming, forestry, and construction/development workforce has less disposable income as a result of interventions; financial costs if regulated parties choose to participate in regional plan-making processes (submissions, hearings, appeals).	Medium or High; Medium and long term; Primarily affects regulated parties and to a lesser extent wider public and communities
Health	Negative effect on wellbeing (anxiety/mental health) if financial costs of interventions affect, or are perceived to affect, farm viability, and if farmers are concerned they do not have the necessary skills to implement interventions or do not believe them to be effective and necessary.[119]	Small; Mainly in the short term and may decrease over time; Primarily affects regulated parties and to a lesser extent wider public and communities
Knowledge and skills	Change to some work/management practices will require re-training of some staff.	Small; Mainly in the short term and may decrease over time; Almost exclusively affects regulated parties
Environment	Risk of continued degradation of water quality in some areas prior to new regional provisions being implemented if the plan change process is lengthy.	Medium; Mainly in the short and medium term;

[119] Farmers' mental health: A review of the literature (ACC Policy Team, 2014); https://www.mentalhealth.org.nz/assets/ResourceFinder/wpc134609.pdf; Botha N, Roth H and Brown M 2013. '*The Adaptation of Pastoral Farmers to Environmental Policy Changes: A New Zealand Case Study*.' South African Journal of Agricultural Extension, Vol. 41: 16-25

		Affects all who receive benefits from the proposals
Indicative benefits to wellbeing		
Wellbeing dimension	**Description of impact**	**Scale; timeframe; and affected groups**
Income and consumption	After interventions have been implemented, reduced financial pressure on ratepayers due to improvements critical infrastructure resilience to natural hazards; reduced infrastructure maintenance costs (eg port dredging, dam infill, road washout, flood damage); Reduced infrastructure operation costs (eg water treatment); tourism sector benefits; improvements to "100% Pure NZ" brand image and flow-on benefits for image-reliant sectors.[120]	Medium; Over the long term; Primarily regulated parties and wider public and communities
Jobs	Increased opportunities for land managers and professionals with soil conservation skills.	Medium; On a continuous basis, but particularly on the short term; Wider public and communities
Health	Positive effect on primary sector wellbeing (sense of self/mental wellbeing) if changing practices build the primary sector's social licence to operate; Reduced risk to health by reducing sediment in waterways (improved water quality for drinking and recreation, and reduced risk of flooding).	Small; Medium and long term; Primarily wider public and communities, to a lesser extent regulated parties
Knowledge and skills	Higher-skilled workforce: • increased skill-base in primary sector, developers, and 3 waters • upskilled council staff where necessary, and additional jobs may result	Medium; Medium and long term; Primarily regulated parties and regulators
Environment	Retention and, in some cases, increases of natural capital stocks such as biodiversity; increases in ecosystem services flows (provisioning, regulating, and supporting services); Increased recreation/leisure opportunities as a result of reduced sediment impacts.[121]	Large; Medium and long term; Wider public and communities

[120] 10 years of 100% Pure

[121] Morrison et al 2014.

Cultural identity	Improved perception of the primary sector community as stewards of the land (social licence to operate).[122] Contributes to New Zealanders' cultural identity and values associated with high quality natural environment (particularly water resources);[123] Increased opportunities for food gathering / mahinga kai as a result of improved ecosystem health; Improved mauri of waterbodies and facilitate kaitiakitanga / stewardship roles.	Large; Medium and long term; Primarily wider public and communities, to a lesser extent regulated parties
Safety	Reduced flooding risk and vulnerability; increased societal resilience to natural hazards.	Large; Medium and long term; All parties

Current state of rivers in relation to the recommended thresholds

To evaluate the anticipated impacts of the proposals, it is necessary to understand the scale of change needed to improve water quality above bottom lines[124].

Suspended sediment attribute bottom lines

Predictive models estimate that water quality is worse than proposed bottom lines in 16.4 percent of segments in the New Zealand river network. These segments are in 627 catchments, which cover the majority of the country's land area (18.76 million of 26.70 million hectares). Figure 1 shows the estimated reduction of suspended sediment load needed to meet the attribute bottom line at a catchment average level, which is defined as the average load reduction of all segments in a catchment that has any river segment below the bottom line.[125]

Deposited sediment monitoring plan thresholds

Predictive models estimate that current deposited sediment levels are worse than the proposed monitoring plan thresholds in areas shown in Figure 2. There are relatively few monitoring sites with repeat, regular observations to compare with model predictions.

[122] Clark-Hall 2018.

[123] Stout Research Centre for New Zealand Studies, 2008.

[124] See Additional information (3) for more detail on the modelling undertaken by Hicks et al 2019 on which this sub-section is based.

[125] Hicks et al 2019.

Figure 1 - Predicted sediment load reduction required to meet suspended sediment bottom lines at catchment scale

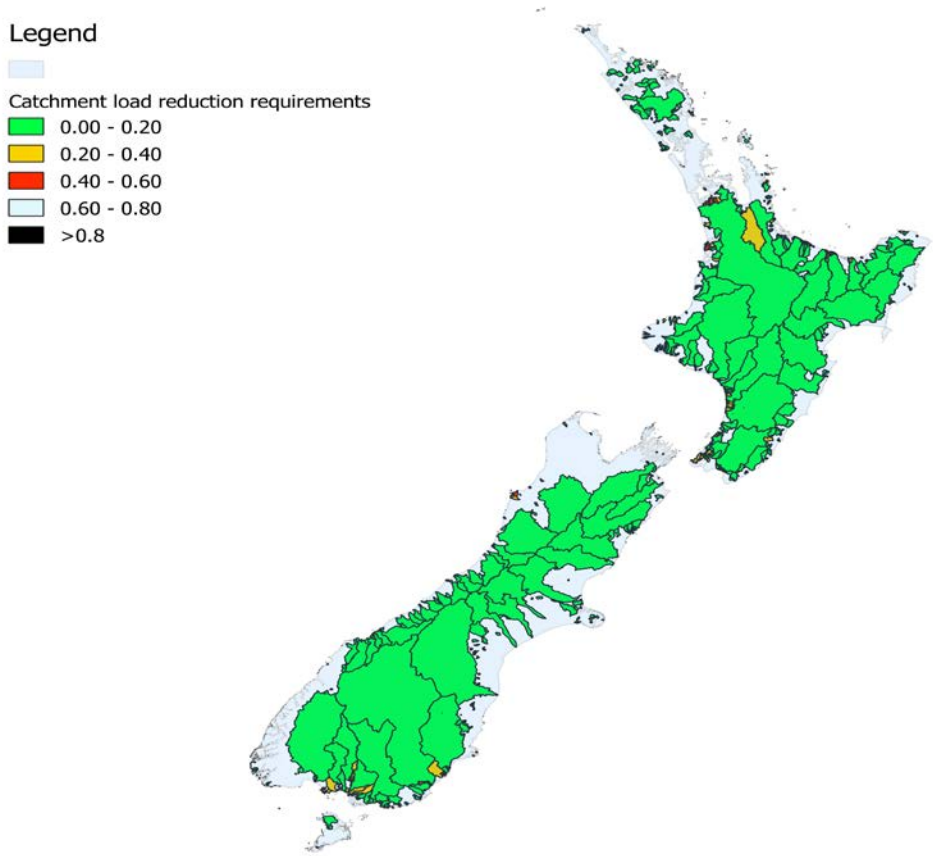
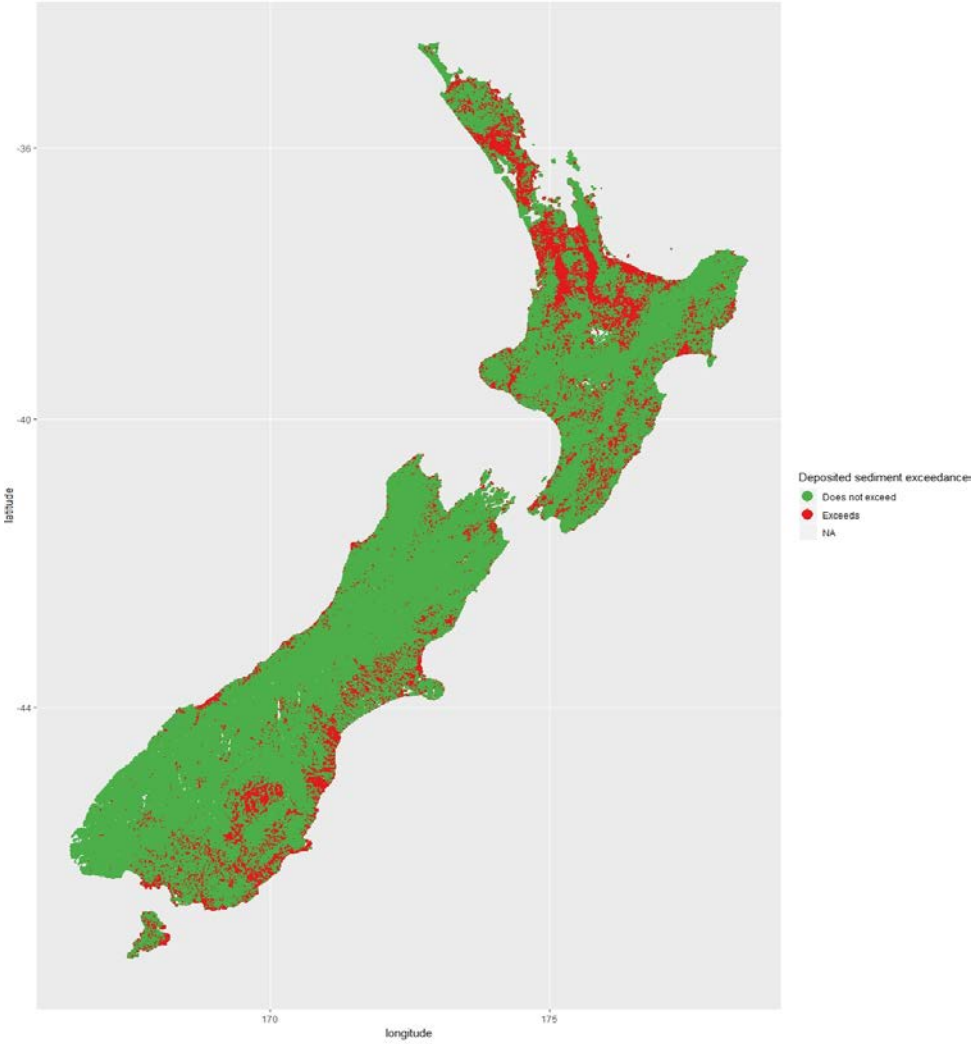


Figure 2 – Predicted exceedances of proposed deposited sediment thresholds at river reach scale



Actions needed to implement the proposals

This section describes what the proposals require of regional councils and also how they are likely to implement them. It then outlines resource user actions that may be required to implement the policies and provides a general description of the costs, benefits and co-benefits of those interventions.

Requirements of regional councils

Suspended sediment attribute

The proposals will require councils to undertake sediment objective and limit setting through NPS-FM planning and policy implementation processes. This will add cost to planning because it adds a new and complex component.

Business as usual (BAU) planning changes are subject to many constraints. The constraints that are of highest likelihood and highest consequence to affect implementation of current NPS requirements, in rough order of relevance, are: [126]

- legal and court challenges of plan provisions

[126] See Additional information (4) for a summary description of engagement with regional council staff throughout the policy development and evaluation process.

- mismatch in priorities of local, regional, and national government in relation to urban and infrastructure development and environmental outcomes
- size and scale of works to meet society's long-term water quality expectations
- social acceptance of proposals
- RMA timeframes.

The relative importance of these constraints change if new sediment attributes and/or monitoring plans are mandated. The most important changes relate to the following factors:

1. Capacity and capability: This includes both council and private sector capacity and capability in land management and councils' environmental science staff.
2. Size and scale of mitigation works: This includes both landscape interventions and policy planning components, both of which would expand.
3. Funding: This connected primarily to the administrative costs of planning as well as the development of the farm planning information and support structures necessary to implement the policies. Funding gaps depend on the specific role of council funding for farm plan development, and there will be significantly increased costs with compliance monitoring and enforcement of any new rules introduced through freshwater planning processes.
4. RMA processes: This depends on the restrictiveness of the regional rules; but where consenting regimes change, especially in the hill country, there will be a large CME component because there has been little CME on their permitted activities.

It is important to note that the primary BAU constraints noted do not lessen or disappear, they simply become less significant in comparison with the constraints noted in the proposed policy scenario. Also, it is important to note that if a threshold is incorporated through an attribute, the implications are much greater for councils compared to a monitoring plan requirement. Attributes require pro-active planning and management whereas monitoring plan requirements with thresholds provide for councils to undertake adaptive management as the need arises.

Deposited sediment monitoring

Several councils currently do not have a deposited sediment monitoring programme incorporating the proposed method: West Coast, Marlborough, Gisborne, Bay of Plenty, Auckland, and Northland. Taranaki is currently trialling a deposited sediment monitoring programme using the proposed method.

The proposed deposited sediment monitoring method requires two-person teams and takes approximately half an hour per site. It is likely that in most cases this would occur at existing state of the environment monitoring sites where they are wadeable. Therefore, the additional marginal cost of this monitoring requirement would be $110 per site per month (time costs c. 2013 estimate) as well as additional travel costs arising from the fact that fewer sites could be visited per day.[127]

Anticipated policy implementation costs for regional councils

The Ministry anticipates that the largest component of new regional council spending to implement the proposals would stem from council roles and work themes that are not explicitly mandated in the proposals but are costs inherent in carrying them out successfully. In particular, the Ministry anticipates that implementation of the policy proposals would require significantly increased council spending for goods and services (work programmes and research procurement), increased staff (capacity and

[127] Mcbride et al. (2013) Toward a nationally consistent and dependable surface water monitoring programme for New Zealand. Description and costs including quality assurance. NIWA Client Report Prepared for the Ministry for the Environment. NIWA Client Report No. HAM2013-024. May 2013.

capability development in land management and environmental science in addition to other themes), and consenting, monitoring and compliance regimes.

These costs are additional to the aforementioned planning and legal processes costs the proposals entail. These additional costs will vary but will be proportionally higher in areas with high erosion mitigation needs (such as Gisborne or Southland) and will be the most institutionally difficult for councils with minimal existing land management programmes and capacity.

Regional councils currently spend ~$14.5 million per annum on erosion-related goods and services (not counting staff) and employ ~107 full-time equivalent staff in active land management roles with a sediment and erosion control focus.[128] The staff number does not include staff with policy planning, monitoring and compliance, consenting, and other roles that relate indirectly to land management.

Councils are capable and have capacity and tools for prioritising erosion-prone land for action at the regional scale. When it comes to prioritising actions at a farm scale, though, there are a limited number of very experienced staff – many of whom are nearing retirement – who can provide farm-scale advice. Expanding capacity in this area will be difficult given the widely-described skills gap in this field.[129] Also, regional council scientific staff will have additional requirements to conduct environmental monitoring and likely modelling to support policy implementation.

City and district councils would need to build capability and capacity in water sensitive design (WSD) aspects, including consenting for WSD in relation to sediment control and for stormwater management. In many cases, this will require updating engineering standards so that approvals of WSD is efficient. It will also require a different approach to asset maintenance compared to grey infrastructure.

Anticipated policy implementation measures from regional councils

Regional councils will implement the proposals in different ways depending on local circumstances, communities' choices, and extent and source of current problems. However, the Ministry anticipates that they will introduce new or more comprehensive methods to regulate and incentivise activities undertaken in the primary sector, by developers and infrastructure operators, extractive industries, and others. The anticipated effects will cross sectors, with some regions focusing on specific sectors and activities more than others according to their own erosion and sediment-generation challenges. The overview of anticipated implementation measures presented here frames the discussion on likely effects of the proposals presented below.

Council staff indicate that the following methods of policy implementation will become increasingly important, and they are roughly shown in order of perceived increase (1st is far more important than present and 9th is slightly more important than present):

1. research and data collection
2. funding of activities and works
3. face to face advisory and land management support
4. compliance monitoring and enforcement activities
5. activity rules
6. farm planning
7. guidance and provision of information
8. activity status
9. areal zoning for activity rules and/or status.

[128] Robb & Brown 2018.

[129] Ministry for the Environment 2018.

Council staff identified via survey the following categories of activities they would focus on to implement NPS-FM sediment requirements in a survey.

Table 9 - Anticipated focus on activities by councils

Activity	Proportion of respondents	Top focus	Second focus	Third focus
Land disturbance	100	1	1	1
Land clearance	87.5	1	0	0
Vegetation clearance	87.5	0	0	0
Land use	87.5	1	0	1
Earthworks	75	1	0	2
Farm planning	75	2	2	1
Cultivation	62.5	0	0	2
Forestry	62.5	1	3	0
Discharges to water	50	1	1	0
Performance standards	50	0	0	1
Subdivision	50	0	1	0
In-stream water quality	37.5	0	0	0
Structural standards	25	0	0	0

Context on potential interventions

In-stream sediment results from erosion processes that occur across the landscape and in stream systems. There is not a "one-size fits all" solution for erosion and sediment management. Mitigations should be sector and site-specific because of the variability in erosion and sediment generation and delivery mechanisms. The proposals would require or incentivise regulated parties to undertake some mix of the interventions described below. When, where, and how specifically depends on the manner in which regional councils implement the proposed policies. Likewise, the costs and benefits of the proposals ultimately depend on what interventions occur.

This section describes potential interventions and broad themes of costs and benefits whereas the cost benefit analysis provides estimates of costs and benefits through a specific policy implementation pathway – one estimate of how meeting the bottom lines could occur and the costs and benefits therein.

Rural interventions

Management interventions can range in scale from wholesale land use change (such as reversion to indigenous vegetation or afforestation) to site-specific mitigations such as space-planting of trees on erosion-prone hillsides, silt fences, grazing or forest harvest regimes, or whole farm plans that focus on

erosion and sediment control. Research on intervention effectiveness and cost has primarily focused on the site-scale.[130]

However, more recent modelling has attempted to aggregate individual property interventions and evaluate their cumulative, catchment-wide effects. For example, research undertaken through the Our Land and Water Science Challenge indicates that from 1995 to 2015, an increasingly large number of farm-owners have developed whole farm plans that include erosion and sediment control practices.[131] Modelling shows that these plans will have led to significant reductions in suspended sediment load.

Another recent study evaluated observed water quality effects of Horizon's expansive erosion and sediment control programme, the Sustainable Land Use Initiative (SLUI). The review concluded the programme's impact on water quality trends showed:

> "weak but statistically significant associations between improving trends for all water quality variables [including suspended sediment indicators] and the proportion of catchment involved in SLUI farm plans. There were also significant associations between improving water quality and additional HRC initiatives associated with riparian planting and new fencing."[132]

These results have taken over a decade to achieve and $65 million roughly split between landowners, central government, and Horizons Regional Council. This indicates the scale and timeframe of the issues involved. Modelling estimates indicate that continuation of the SLUI programme into the future will result by 2043 in major overall sediment load reductions catchment-wide with several water management zones reducing suspended sediment loads by more than half. [133] However, interactions with climate change and especially increased precipitation volumes and event intensity may significantly reduce or even eliminate the anticipated total reduction in suspended sediment loads depending on what future meteorological patterns eventuate.

Examples from another region helps to illustrate the scale and timeframes involved. In Northland nearly half of pastoral land (245,000 ha) is classified as Highly Erodible Land. The cost of farm plan development in Northland has been estimated at $5,000 per farm up to 100 ha and $10/ha above that area, and plan implementation costs are estimated to be $250/ha.[134]

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[130] Tables 1 and 2 of Basher et al 2019. National modelling of impacts of proposed sediment attributes: literature review and feasibility study. Prepared for the Ministry for the Environment. Manaaki Whenua – Landcare Research Contract Report: LC3445. Note also that effectiveness of mitigations and issues of variability in effectiveness are discussed in Sections 5.2-5.4 of that report, and table 6 of that report presents a summary of intervention costs and some co-benefits.

[131] Monaghan et al (in prep). Report prepared as part of the Our Land and Water National Challenge.

[132] Snelder 2017.

[133] Basher et al 2017.

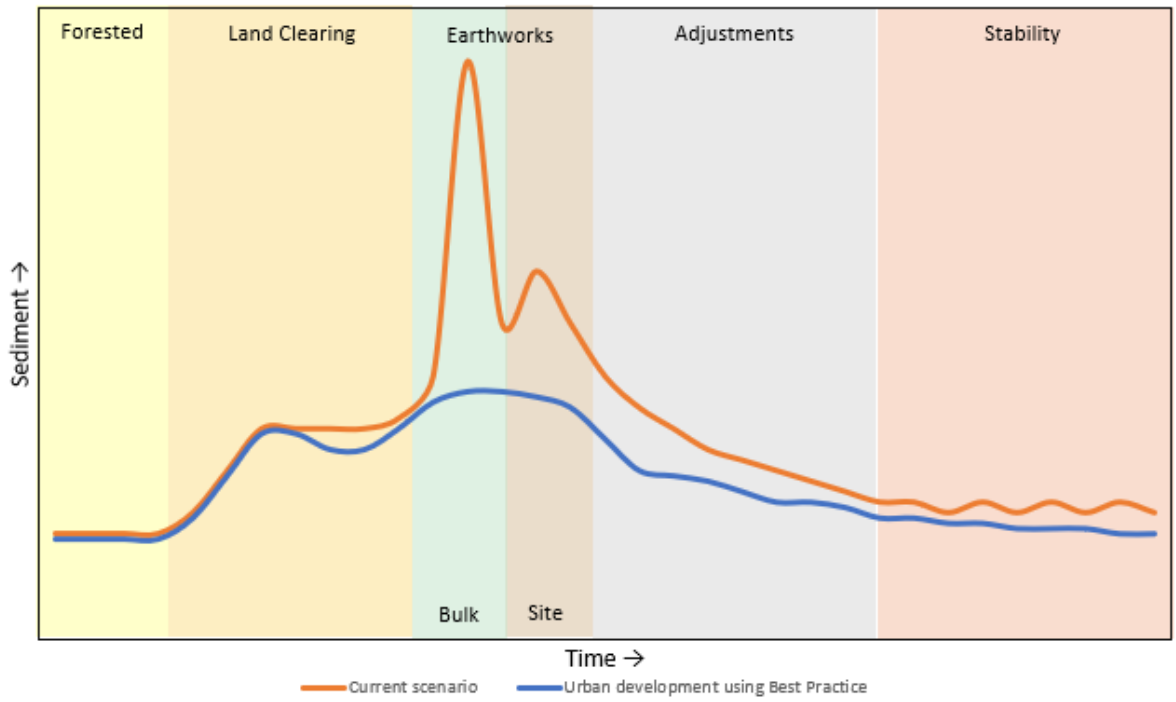
[134] Green, M.O. and Daigneault, A. 2018. Kaipara Harbour Sediment Mitigation Study: Summary. Report NRC1701–1 (minor revision), Streamlined Environmental, Hamilton, 64 pp.

Urban interventions

Like for the rural sectors, urban interventions can range from the broad scale to the site-specific. Examples of the former include stormwater network design and flood protection works, and examples of the latter include things like sediment retention ponds and chemical treatment of earthworks sites.[135]

The conceptual Figure 8 shown in the Additional information section 5 summarises how urban development interacts with natural processes to affect in-stream sediment. Figure 3 below shows a stylised sediment generation profile in an urbanising area and highlights how sediment loads increase as forest is converted to pasture, and then changes to urban land use creates major short-term sediment spikes followed either by long-term higher or lower averages depending on urban form and development patterns.

Figure 3 - Conceptual diagram of urban development and sediment generation over time[136]



Short-term development impacts on in-stream sediment (during the earthworks and construction phase), are most related to bulk and site earthworks and exposed bare earth. Erosion and sediment controls can be an effective means of reducing construction-induced sediment. However, they must be correctly installed and maintained for continual effectiveness.[137]

Long-term development impacts on in-stream sediment (following completion of earthworks and construction) primarily stem from changes to hydrology, impervious surface, and in-stream characteristics. The incorporation of low impact, water sensitive design (WSD) can minimise these long-term impacts.[138] Generally, WSD aims to reduce the use of grey infrastructure such as pipes and

[135] Morphum 2019. Sediment Attributes and Urban Development. Literature Review. Prepared by Morphum for the Ministry for the Environment; Basher et al 2016.

[136] Morhum 2019 drawing on Russell et al. 2017.

[137] Yaldin and Moores 2014.

[138] Moores et al 2016.

concrete channels in order to eliminate or reduce stormwater runoff flows and velocity. WSD instead attempts to use natural systems or processes, such as rain gardens, wetlands, swales, pervious paving, green roofs, etc., to accomplish these objectives.

New Zealand has very low uptake of WSD in urban developments compared to peer-group countries. There are multiple reasons for this connected to planning issues, perceptions of cost, and capacity and capability of both council staff and development sector firms and organisations.

- Planning issues: Many district council engineering standards have been written for grey infrastructure such as pipes, concrete channels, etc. This presents a barrier for WSD features which do not meet the exact specifications of the standards. In some cases, using current typical development methods, this can increase costs to the developer as designers are required to provide more material to support the design, or can result in the WSD features being removed from the development. However, in many cases, this is a perceived cost increase, and the international literature shows that cost decreases are common as the sector matures.[139]

- Capacity and capability: There is a skills shortage throughout the sector – from designers to contractors and consenting officers.

- Retro-fitting: Within established urban areas, and particularly central business districts, areas that already have grey infrastructure, retro-fits for upgrades maybe cost-prohibitive in the near-term.

In relation to costs, there is very little New Zealand-specific research to support cost-benefit assessments of WSD in urban developments. International studies show WSD is most often able to provide equal or better treatment and out-compete – or at least remain cost-competitive – with grey engineering infrastructure.[140] Compared to other national peer-groups, New Zealand WSD studies differ in several ways:

- New Zealand WSD cost-benefit assessments often do not include the co-benefits of WSD, avoided costs, or costs of environmental degradation
- WSD design and implementation is a mature market in Europe, North America and Australia whereas it is still emergent in New Zealand; costs here will decline over time as the market matures
- WSD in North America and Europe benefits from economies of scale unavailable in New Zealand
- WSD maintenance cycles are different than for grey infrastructure, and some councils have had poor experiences leading to high costs due to poor maintenance.

In relation to these factors, there will be sector-wide improvements in implementation costs as firms move along the learning curve and materials become more readily available.

Implementation of the policy proposals would likely require practice shifts, such as increased staging earthworks or more stringent erosion and sediment controls for development sites, as well as capability shifts across the urban development sector. Also, it will likely require shifts in product availability; at present, the materials required for WSD features such as permeable pavements are usually only a small part of the market and contractors may be unfamiliar with their correct installation and use and long

[139] Morphum (2019). Sediment Attributes and Urban Development. Literature Review. Prepared by Morphum for the Ministry for the Environment.

[140] Ibid.

term maintenance requirements. There are a growing numbers of practitioners that are developing these skills, but there would still be a sector-wide learning curve and expertise gap that would need to be addressed.

Context on costs, benefits, and co-benefits of mitigations

Improving water quality to meet the proposed bottom lines will incur costs on those who implement the necessary mitigations. In general, it is relatively straightforward to attribute the direct costs of mitigations and assess on whom they could fall. Costs of mitigations are evaluated explicitly for the policy proposals in the section presenting the CBA. Indirect costs, such as pasture productivity reduction due to space-planting for erosion reduction and consequent impacts on downstream market chain actors such as agriculture processers are less straightforward to estimate.

In contrast, the benefits of reduced erosion and in-stream sediment – and the co-benefits of interventions such as carbon sequestration or reduced nutrient discharges – are widespread and not as straightforward to estimate. Benefits of the policy proposals are evaluated, as far as possible, for the policy proposals in the section presenting the CBA and Additional information (6). For example, the treatment of erosion-prone land with space-planting of trees will reduce the likelihood of shallow landsliding and the area over which it occurs, which has long-term benefits for pasture productivity.[141] Likewise, the establishment of trees on farms may provide opportunities for income streams from carbon credits through the ETS, or sales of timber and honey.

Finally, it is notoriously difficult to establish the cost of the status quo of environmental degradation that results from current practices. This is a common theme in assessments of environmental management and particularly economic components in those assessments.[142]

Costs of the status quo

Estimating the environmental "costs of inaction" or "costs of degradation" inherent in the status quo is particularly important for environmental themes to assess the rationale for policy interventions. This is because many of the impacts of inaction are not reflected in markets.[143] Although costs of environmental degradation is not commonly evaluated as an explicit theme in New Zealand, there is enough research to provide a general qualitative assessment of the costs of degradation due to in-stream sediment.

There are strong correlations between the state of freshwater ecosystem attributes such as in-stream sediment and the state of values (ecological, cultural, social, economic) that flow from freshwater ecosystems. At present, there are high levels of degradation in many areas of the country, which means a high level of cost across all of those types of values. There are enough discrete and disparate examples of costs of degradation that in sum point to very high costs associated with the status quo across a range of locations and specific value types.[144]

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[141] Dominati and Mackay, 2013. An Ecosystem Services Approach to the Cost of Soil Erosion and Value of Soil Conservation. Report prepared for: Hawke's Bay Regional Council. AgResearch Report Number: RE500/2013/086.

[142] Doole, G 2019. A review of integrated assessment frameworks for environmental management. Report prepared for the Ministry for the Environment.

[143] OECD 2008; World Bank 2005.

[144] Dorner, Z 2019. A review of New Zealand studies into the cost of degradation of freshwater ecosystems in terms of ecological, cultural, social and economic values. Report prepared for the Ministry for the Environment.

Table 15 in Additional information section (6) provides numerous examples of costs of degradation as well as co-benefits of mitigations across a range of themes.

Avoided costs and co-benefits of erosion and sediment control mitigations

A 2001 study[145] estimated net annual costs of erosion and in-stream sediment at ~$192 million in 2019 dollars.[146] It evaluated whether costs are from damage (lost production, repair, etc.), in-stream sediment effects, or if they are avoided costs of expenditure. The study estimated 60 percent of costs were due to erosion damage, ~22 percent to in-stream sediment damage costs, and ~18 percent avoided expenditure.

However, the study notes that this is likely a significant under-estimation given that several major categories of costs could not be estimated: production losses due to increased flood severity, reduced water quality effects on recreation, habitat loss and other biological degradation, water storage infrastructure losses, road realignment, and others. Overall, damage costs have received the greatest research attention, which means direct damage costs and loss of pasture productivity after large storm events are best understood and the costs of in-stream sediment are not well understood.[147]

A 2015 study on the economic impact of shallow landslides due to storm events estimated annual costs to be ~$250-300 million. [148] The study used case studies of multiple types of storm events and analysis of datasets related to insurance claims and utility and infrastructure operators' expenditure. It primarily assessed damage to structural assets, deaths caused by landslides, primary sector production costs for large storm events only, did not include lost opportunity, and only incorporated some ecosystem services.

The range of monetary and qualitative values estimated in these studies indicates that the cost of erosion and sediment can only be generally and roughly assessed at the national scale. In short, it is not currently possible to produce comprehensive costs of all types of degradation due to erosion and in-stream sediment because of the paucity of data around many kinds of costs, and the fact that monetising many aspects of degradation requires locally-specific information. Likewise, many co-benefits of interventions can only be estimated coarsely.

These characterisations contextualise the policy-specific impacts described further in the cost benefit assessment and highlight the very high costs associated with the status quo on erosion and in-stream sediment issues. While the policy proposals will not eliminate the damage and degradation costs identified here, where implemented, interventions reduce erosion significantly and the benefits and avoided costs will be high.

Case studies of development interactions with proposed attributes and costs of risk reduction

This section summarises results from case studies of urban development interactions with proposed attributes and the cost of erosion risk reduction from conceptual modelling.

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[145] Krause et al 2001

[146] $126.7 million in 1998 dollars adjusted using CPI to 2019 dollars

[147] Jones et al 2008

[148] Page MJ 2015 Estimating the economic cost of landslides in New Zealand: an assessment using selected event case studies, and public utility and insurance cost data sets, GNS Science Internal Report 2014/13, p 40

Urban case studies

Data limitations preclude evaluation of the interactions between urban development activities and the proposed attribute on a broad scale and even most potential case studies.[149] Water quality data collected for urban development consent and activity monitoring and compliance purposes is primarily event-based. This means it captures information around high rainfall periods that are often responsible for the majority of overall sediment loading in a catchment but fails to capture development activities' impacts on longer-term medians, the proposed attribute indicator.

This is understandable as event-based sediment loading is often more important for receiving environments (estuaries, lakes, the coast) than long-term medians. However, this prevalence of event-based monitoring means there is scant information available to assess the relationship between individual developments and catchment-scale median turbidity using observed data, let alone to evaluate the cumulative effects of multiple developments. For this reason, the Ministry conducted a conceptual development modelling study, which is described in the section below.

Despite these limitations, the case study evaluations of development activities and assessment of urban water quality databases provide useful information on broad trends. [150] Overall, turbidity in urban areas is much higher than in rural areas.[151] Study findings indicate that development activities clearly increase turbidity levels in streams and that recorded turbidity levels downstream of development sites have a much greater range of values and higher peak values. High turbidity levels were primarily associated with rainfall events and primarily led to short-term effects. However, there was evidence from case studies that turbidity during normal flows increased during development, which could lead to changes in the attribute band state within freshwater management units.

Conceptual development model – sediment load and costs of remediation

Erosion modelling and economic assessment of a hypothetical Auckland development site indicated that staging earthworks and incorporation of erosion and sediment controls are a minor proportion of total land development costs and that their application provides major reductions in median annual sediment loading. [152] With staging and controls, annual median sediment loading can be under 30 percent of loading that would have resulted in their absence. The ultimate difference in sediment load reduction that staging and controls make depends on the variability and frequency of erosion events that is largely determined by precipitation, slope, and other development characteristics.

It should be noted that controls are standard practice in most parts of the country for larger sites whereas staging is not required in all areas. Therefore, in some cases incorporation of staging is built into standard development costs whereas in other locations it represents an increased marginal cost.

Typical costs of subdivided sections in Auckland are in the order $420,000 per section, with civil and infrastructure costs including earthworks in the order of $113,000-$126,000 per section for New

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[149] Morphum (2019) Sediment Attributes and Urban Development. Plan Compilation and Review. Prepared by Morphum for the Ministry for the Environment; Morphum (2019) Sediment Attributes and Urban Development. Analysis of Water Quality Effects. Prepared by Morphum for the Ministry for the Environment.

[150] See https://www.niwa.co.nz/information-services/urban-runoff-quality-information-system-urqis

[151] Hicks et al 2019

[152] Additional information (7) provides more detail on the modelling undertaken; Paradigm and Morphum (2019) Effect of Annual Variability and Land Disturbance during Construction on Predicted Sediment Yields. Continuous Simulation of Land Development Scenarios. Prepared by Paradigm Environmental and Morphum for the Ministry for the Environment.

Zealand cities.[153] This translates to finished section costs in the order of $4-6 million per hectare. Therefore, the estimated increase from no staging to a maximum of 25 percent of the site open at less than $40,000 per hectare is in the order of 1 percent of land supply costs for housing construction, though it is an increase of ~44 percent for earthworks costs. Earthworks treatment costs are less than 0.1 percent of total land development costs in all scenarios. Figure 4 shows indicative annual median sediment load in tons/hectare for each modelled scenario and Table 10 shows indicative costs of those scenarios in dollars/hectare of development.

Figure 4 - Median annual sediment load (Y-axis, tons/ha, using data from 2003-2017) for different development scenarios

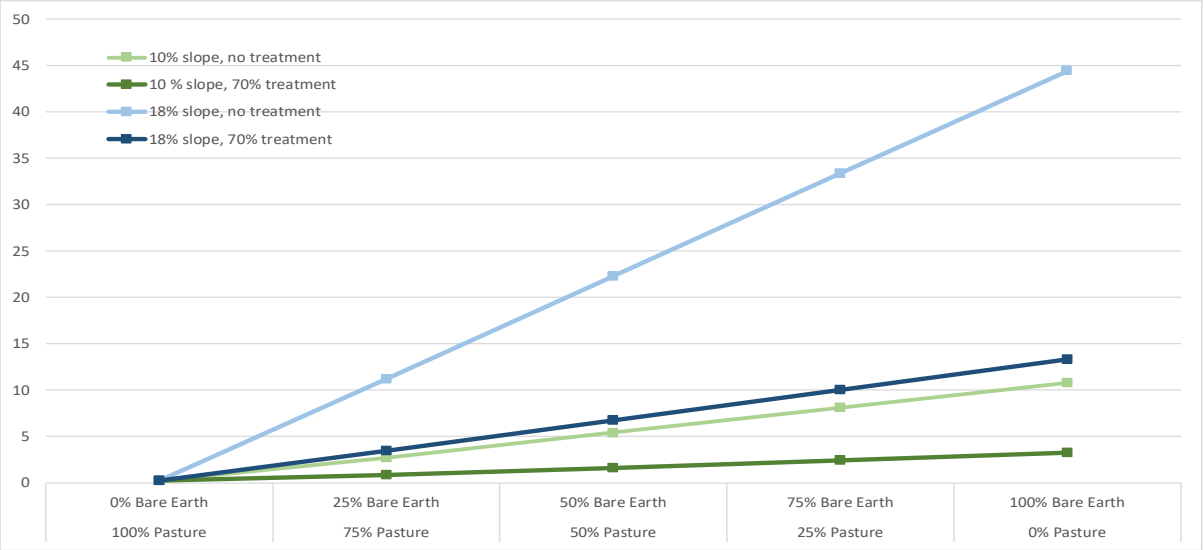

Table 10 - Estimated bulk earthworks cost comparison by modelled scenario (costs limited to main earthworks costs)

Scenario	Fixed Cost	Earthworks Cost	Time Cost	E and S Cost	Total Cost	$/ha
25% Bare Earth, No Treatment	$80,000	$4,260,000	$80,000	$239,740	$4,659,740	$116,494
25% Bare Earth, With Treatment	$80,000	$4,260,000	$80,000	$325,451	$4,745,451	$118,636
50% Bare Earth, No Treatment	$80,000	$3,600,000	$70,000	$270,940	$4,020,940	$100,524
50% Bare Earth, With Treatment	$80,000	$3,600,000	$70,000	$356,651	$4,106,651	$102,666
75% Bare Earth, No Treatment	$80,000	$3,220,000	$60,000	$205,553	$3,565,553	$89,139
75% Bare Earth, With Treatment	$80,000	$3,220,000	$60,000	$291,264	$3,651,264	$91,282
100% Bare Earth, No Treatment	$80,000	$2,840,000	$50,000	$228,035	$3,198,035	$79,951

[153] Deloitte Access Economics 2018

100% Bare Earth, With Treatment	$80,000	$2,840,000	$50,000	$313,746	$3,283,746	$82,094

In terms of interaction with the proposed attributes, these differences in sediment loading can be significant in the catchment context. The hydrological modelling that assessed the magnitude of attribute breaches indicates that 82 catchments have annual median sediment load reduction requirements under 100 tons to achieve the bottom lines at a catchment average.[154] The scenario results shown in Figure 4 indicate that use of staging and erosion and sediment controls for development activities can reduce sediment loading, depending on a range of factors, by tens of tons/ha/year. This scale of erosion reduction can therefore be a significant proportion of the total load reduction requirement to achieve bottom lines where water quality is currently below them.

The study also identified the following wellbeing benefits of staging and erosion and sediment controls:

- **Environmental Wellbeing:** Staged earthworks are more conducive to water sensitive urban and landscape design and retention of streams and natural areas. There is also potential for reduced compaction and greater preservation of infiltration capacity leading to reduced hydrological change and off-site erosion.
- **Cultural Wellbeing:** Environmental benefits and reduced discharges are likely to preserve tāngata whenua values such as the mauri of the water, the ability of waterbodies to provide for mahinga kai and rongoā, and increased opportunities for communities to interact with their local waterbodies. Staging also increases the likelihood of early identification of archaeological sites and reduces the likelihood of damage to them.
- **Social Wellbeing:** Staged earthworks can facilitate preservation of amenity and landscape features such as streams leading to improved sense of place and mental wellbeing. Added complexity of construction potentially provides greater employment and skill-building experience.
- **Economic Wellbeing:** Smaller earthworks scale associated with staging can have an increased labour component creating local benefits and utilise smaller equipment and potentially a wider range of suppliers increasing competitiveness of small businesses.

National erosion modelling and cost benefit assessment

This section presents summary CBA information.[155]

Erosion modelling

Modelled interventions for which economic optimisation was undertaken include development and implementation of whole farm plans and afforestation.[156] The model limited the application of interventions to land classified as grassland (high-producing, low-producing, or depleted) on Highly Erodible Land or land belonging to Land Use Capability (LUC) classes 8e, 7e, and 6e. This represents steep, erosion-prone land with the highest sediment yield. The model assumed erosion mitigation efficiency of 70 percent for whole farm plans and 90 percent for afforestation. The effectiveness of riparian exclusion for erosion reduction was evaluated at a catchment scale but not included in the economic optimisation due to limited knowledge of existing length and location of stream fencing, setbacks and riparian planting.

[154] Hicks et al 2019

[155] Neverman et al 2019.

[156] See Basher et al 2019 for further description of model interventions

Initial erosion modelling results indicate that 21 of the 627 catchments shown in Figure 1 are completely within the Department of Conservation estate and no mitigations are possible. These primarily occur in the southern and western Southern Alps. Therefore, only the 606 remaining catchments were included in the analysis.

Of these, erosion modelling estimates that 53 catchments, including several large catchments in the central North Island, will meet the catchment average bottom line by 2030 without further action as recently implemented farm plans mature. Many interventions in farm plans, such as space-planting trees on erosion-prone hillslopes, require time for tree growth and subsequent erosion mitigation. The remaining catchments, those shown in Figure 9, require further sediment load reductions to achieve bottom lines.

The catchments that are unable to achieve target thresholds under any mitigation scenario, with the exception of those in Otago and Canterbury, have relatively small catchment areas, relatively high reduction requirements, and limited "mitigable area" as defined by highly erodible land classes under pasture. Otago, Canterbury, West Coast, Southland, and Auckland have the greatest area of catchments not meeting sediment threshold targets under any mitigation scenario.

Economic modelling - costs

The study used the NZFARM model to evaluate the economically efficient mix of whole farm plan implementation and afforestation (assuming no harvest) necessary to meet catchment erosion reduction targets. Feasible catchments show mitigations implemented on approximately 600,000 ha of pasture in highly erodible areas, and further mitigations on an additional 400,000ha (primarily in the Clutha catchment) for infeasible catchments.

Results indicate that conversion to non-harvest forestry is the economically optimum avenue to meet the thresholds, and the erosion modelling makes clear that implementation of whole farm plans is adequate to meet the catchment bottom lines in the majority of catchment area. Thus, the erosion modelling answers the question of what implementation pathways are able to meet the requirements, and the economic modelling answers the question of what are the costs and benefits of meeting the catchment bottom lines through the economically efficient implementation pathway.

The model uses up-front and maintenance costs as well as changes to profit that are assessed and discounted over a 50-year timeframe. The costs associated with whole farm plan implementation are assumed to be primarily up-front, once-off capital costs (assumed to be $300/ha). In reality, these costs would occur over time given that whole farm plans are not implemented all at once, which would revise costs downwards as discounting would apply. There may also be some reduced pasture productivity or land retirement associated with whole farm plan implementation, which would lead to ongoing opportunity costs and revise costs upward. However, some interventions in whole farm plans, such as space planting, can lead to alternative income streams such as sale of wood from space-planted trees when they reach the end of their life.

The costs associated with afforestation include up-front costs of planting (assumed to be $1,000/ha), maintenance costs, foregone profits of former land use (a cost), and new profit (ETS) from carbon sequestration. As such, afforestation has both up-front and ongoing effects on profits.

Economic modelling – benefits

The CBA quantifies and monetises the proposals' direct benefits related to the following themes: hydroelectric facility impacts (dredging reservoirs), flood damage, water-based recreation, aesthetics, water-related non-use impacts, carbon impacts from erosion and sediment control practices as well as changes in production, and erosion reduction. The CBA also quantifies nutrient discharge reductions resulting from the modelled interventions, but those reductions were not monetised. Lastly, the

biodiversity-related benefits of the proposals are evaluated and quantified in great detail in Franklin et al 2019. Table 15 in Additional information (6) provides more detail on each of these themes, and Table 16 in Additional information (8) provides total cost and benefit estimates.

The benefits associated with the proposals are primarily ongoing and therefore discounting was used to estimate the NPV of benefits. All benefits were evaluated using four percent and six percent discount rates. Also, the study used a range of values for specific categories of benefits. For instance, the study used different social costs of carbon (2.5 percent, three percent and five percent).

Additional information (1) on the thresholds development research programme and proposed classification system:

The Ministry conducted a research programme to develop in-stream sediment thresholds for the protection of ecosystem health.[157] Preliminary reports evaluated in-stream sediment impacts on ecosystem health and assessed the indicators for which thresholds would be most appropriate in light of available data. The research concluded, and the Ministry concurred, that development of thresholds for in-stream suspended and deposited sediment is required. Further, turbidity and visual clarity are the most pertinent indicators for suspended sediment, and in-stream percent areal coverage of deposited fine (<2mm) sediment is the most pertinent indicator for deposited sediment.

In developing sediment thresholds and associated classification systems, the researchers adhered to a number of guiding principles including basing bottom lines on the least acceptable state for ecosystem health, avoiding potentially significant adverse ecosystem effects, and accounting for spatial patterns in both ecological distributions and natural sediment state.

The researchers developed a nested classification system based on the River Environment Classification's (REC) climate, topography, and geology characteristics. The Ministry concluded that spatially disaggregated systems with numerous classifications was preferable to spatially simple classifications with fewer groupings primarily in order to reduce the inherent bias incurred by grouping rivers with dissimilar in-stream sediment characteristics.

The analyses of ecological responses to in-stream sediment included evaluation of how fish and macroinvertebrate communities respond to various levels of turbidity, visual clarity, and deposited fine sediment as determined by areal coverage. The researchers used several methods that varied in terms of the spatial scale used to assess sediment effects on ecology, the type of ecological response, and how change points are assessed in ecological response.

The research team synthesised the analytical outputs through a modified weight-of-evidence process whereby they gave different methods' results different weighting and roles in the final determination of attribute thresholds.[158] They prioritised results according to the reliability of the methods and underlying data, relevance of the outputs, and suitability for different purposes such as setting bottom lines or bands. This research formed the basis of the Ministry's current proposals.[159]

The Ministry considered, and the STAG concurred, that in relation to suspended fine sediment, it would be redundant to progress thresholds for both turbidity and visual clarity since they are highly correlated in space and time and are both measures of optical characteristics of water quality. The Ministry considers it preferable to progress with thresholds based on turbidity only primarily because of the fact that turbidity is currently monitored continuously in several regions, and continuous measurement provides more immediately useful information for understanding the links between land use and management actions and resultant changes in water quality. No councils continuously monitor visual clarity, and it is far more expensive to do so.

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[157] Davies-Colley et al. 2015; Hicks et al 2016; Clapcott et al 2017; Depree 2017; Draft report – not finalised: Depree et al 2017. Development of ecosystem health thresholds for suspended and deposited sediment in New Zealand rivers and streams. Prepared for the Ministry for the Environment, June 2017. NIWA Client Report No. 2017076HN; Franklin et al 2019. Hicks et al 2019; Hicks et al 2019a. See Franklin et al 2019 for the primary research underpinning the policy proposals.

[158] US EPA 2016.

[159] Franklin et al 2019.

Figure 5 - Suspended sediment attribute classification (streams order 4 and above)

Figure 6 - Deposited sediment monitoring plan classification system (streams order 4 and above)

Table 11 - Suspended (left) and deposited sediment (right) classification system

Suspended sediment class	% of river network	CTG Classes	Deposited sediment class	% of river network	CTG Classes
1	7.05	WW_Low_VA; CW_Low_VA	1	1.88	WD_Low_VA; WD_Low_Al
2	1.42	WD_Low_Al	2	1.46	WW_Hill_HS; CW_Mount_VA
3	2.72	CD_Low_HS	3	4.68	CW_Lake_Any; CW_Low_Al; CD_Hill_SS
4	6.01	CW_Low_SS	4	1.95	CW_Mount_SS
5	10.81	WW_Low_SS; WD_Low_SS	5	3.05	WD_Low_SS
6	2.84	WW_Low_HS	6	13.32	WW_Low_VA; WW_Low_HS; CD_Low_VA; CD_Hill_Al; CD_Low_HS
7	10.92	CD_Low_Al; CW_Hill_VA	7	15.51	WW_Low_SS; CD_Low_SS; CD_Low_Al
8	3.61	CD_Low_SS	8	0.14	WW_Lake_Any
9	17.12	CW_Hill_HS; CD_Hill_HS; CW_Low_Al	9	0.36	WD_Low_HS
10	1.63	CW_Lake_Any	10	36.41	WW_Hill_VA; CW_Hill_HS; CW_Low_HS; CW_Mount_HS; CW_Hill_SS; CW_Hill_Al; CD_Mount_HS; CW_Mount_Al
11	2.03	CW_Low_HS	11	0.45	WW_Low_Al
12	22.37	CW_Mount_HS; CW_Hill_SS	12	19.73	CW_Hill_VA; CW_Low_VA; CW_Low_SS; CD_Hill_HS

Table 12 - Constituent REC groups

REC variable	Values	Comment on aggregation	Resultant CTG classes
Climate	Warm-Wet Warm-Extremely Wet Warm-Dry Cold-Wet Cold-Extremely Wet Cold-Dry	Wet and Extremely Wet were combined given these two climatic classes are both characterised by generally high runoff.	Warm-Wet (WW) Warm-Dry (WD) Cold-Wet (CW) Cold-Dry (CD)
Topography (SRC_OF_FLW)	Lowland Lakefed Hill Mountain Glacial Mountain	Mountain and Glacial Mountain classes were combined on the basis of them both being associated with rivers of high gradient, hence low sediment retention.	Lowland (Low) Lakefed (Lake) Hill (Hill) Mountain (Mount)
Geology	Soft Sedimentary Hard Sedimentary Alluvium Plutonic Volcanic Miscellaneous Volcanic Basic Volcanic Acidic	Plutonic Volcanic and Miscellaneous were aggregated with Soft Sedimentary based on exploration of the frequency histograms of sediment values within CTG classes, and consultation with expert geologists. Volcanic Basic and Volcanic Acidic combined to form Volcanic – geology resistant to erosion.	Soft Sedimentary (SS) Hard Sedimentary (HS) Alluvium (Al) Volcanic (VA)

Additional information (2) on thresholds' suitability for attributes or monitoring plan requirements

The Ministry used the following framework to consider whether the proposed indicators were appropriate for NPS-FM attributes or monitoring plan requirements. This framework guided the development of the National Objectives Framework and is described in the 2014 NPS-FM RIS[160].

Table 13 - Analysis of thresholds' suitability for attributes or monitoring plan requirements

Criteria	Guiding questions	Suspended sediment (turbidity)	Deposited sediment (percent areal coverage of deposited fines)
Link to the national value[161]	Is the attribute required to support the value?	Yes	Yes
	Does the attribute represent the value?	Yes, although it is a proxy measure	Yes
Measurement and band thresholds[162]	Are there established protocols for measurement of the attribute?	Yes, NEMS and ISO standards	Yes[163]
	Do experts agree on the summary statistic and associated time period?	Yes	Yes
	Do experts agree on thresholds for the numerical bands and associated band descriptors?	Yes	Yes
Relationship to limits and management[164]	Do we understand the drivers associated with the attribute?	Yes	General understanding
	Do we know what to do to manage this attribute?	Yes	In a limited and general sense, yes
	Do quantitative relationships link the attribute state to resource use limits and/or management interventions?	Yes	No
Evaluation of current state of the attribute on a national scale[165]	Can we adequately assess the current state of the attribute at a national scale, including the extent, magnitude and location of failures to meet the proposed bottom line for the attribute?	Yes	Yes
	Are the data of sufficient quality, quantity, and representativeness to assess the current state of the attribute on a national scale?	Yes	Weak – lack of repeated observations at site-scale in numerous regions

[160] See Section 11.3 of the 2014 RIS.

[161] Davies-Colley et al. 2015

[162] Clapcott et al 2017; Depree 2017; Franklin et al 2019

[163] Clapcott et al 2014

[164] Hicks et al 2016; Hicks et al 2019

[165] LAWA datasets; EA 2019

Additional information (3) on sediment load reduction requirements to meet proposed bottom lines

The Ministry evaluated the anticipated impacts of the proposals starting with current state of the indicator and the sediment load reduction over long term medians required to meet the proposed bottom lines for suspended sediment.[166] The Ministry was unable to evaluate the magnitude of deposited fine sediment exceedances within a management-focused analytical framework due to modelling limitations. This is a primary reason for the Ministry recommending to progress deposited sediment thresholds as monitoring plan requirements.

Extent and magnitude of river reaches with the attribute below the bottom line

265 of 847 (31.2 percent) observation sites had long term median turbidity below the proposed bottom lines indicating good concordance with model predictions, which showed 30.4 percent of sites with water quality worse than the threshold.[167] Predicted exceedances occur in 627 catchments that cover the majority of land outside of the DOC estate in both the North and South Islands.

The Ministry evaluated the magnitude of exceedances for suspended sediment bottom lines according to the analytical modelling framework linking turbidity median values (the proposed attribute indicator) to median suspended sediment loads. Results are reported first for river segments using the value R, which represents the proportional reduction in long-term suspended sediment load.[168] Thus, a reported R value of 0.4 means that for a given river segment to improve into the C band (better than the bottom line), it requires long-term median sediment load reduction of 40 percent at that segment.

To facilitate erosion and economic modelling, those segment-level results were aggregated to the catchment scale as shown in Figure 1, which reports the average of R values across all segments in the catchment. This catchment information forms the basis of the impact-testing described in the cost-benefit assessment section. Figure 7 below – which does not incorporate naturally occurring processes exceptions – reports the distribution of river segments that exceed the thresholds (segments with R>0) according to stream order (river size), the proposed classification system, and by region.

Model uncertainty

The models described are subject to significant uncertainty at the segment scale, which is systematic at the individual catchment scale but varies randomly between catchments. The model is more likely to predict false positives (a segment modelled as exceeding the threshold when, in fact, it does not) than false negatives (a segment modelled as meeting the threshold when, in fact, it does not). There is substantial risk of false positives until reported R values are greater than 0.56. Uncertainty on R values at the segment level are a factorial error (times or divided by 1.97), which is primarily due to factorial error of 1.95 for predicted median turbidity. However, aggregation of results for catchments across the national river network reduces proportional uncertainty.

The research estimates that the relative error on the mean R value across all catchments reduces to ± 2.7 percent. The Ministry considers, therefore, that the overall impacts of the proposed regulation can be described and assessed nationally to acceptable accuracy. However, the Ministry notes that there is relatively high uncertainty about the spatially explicit manifestation of that uncertainty, which can have

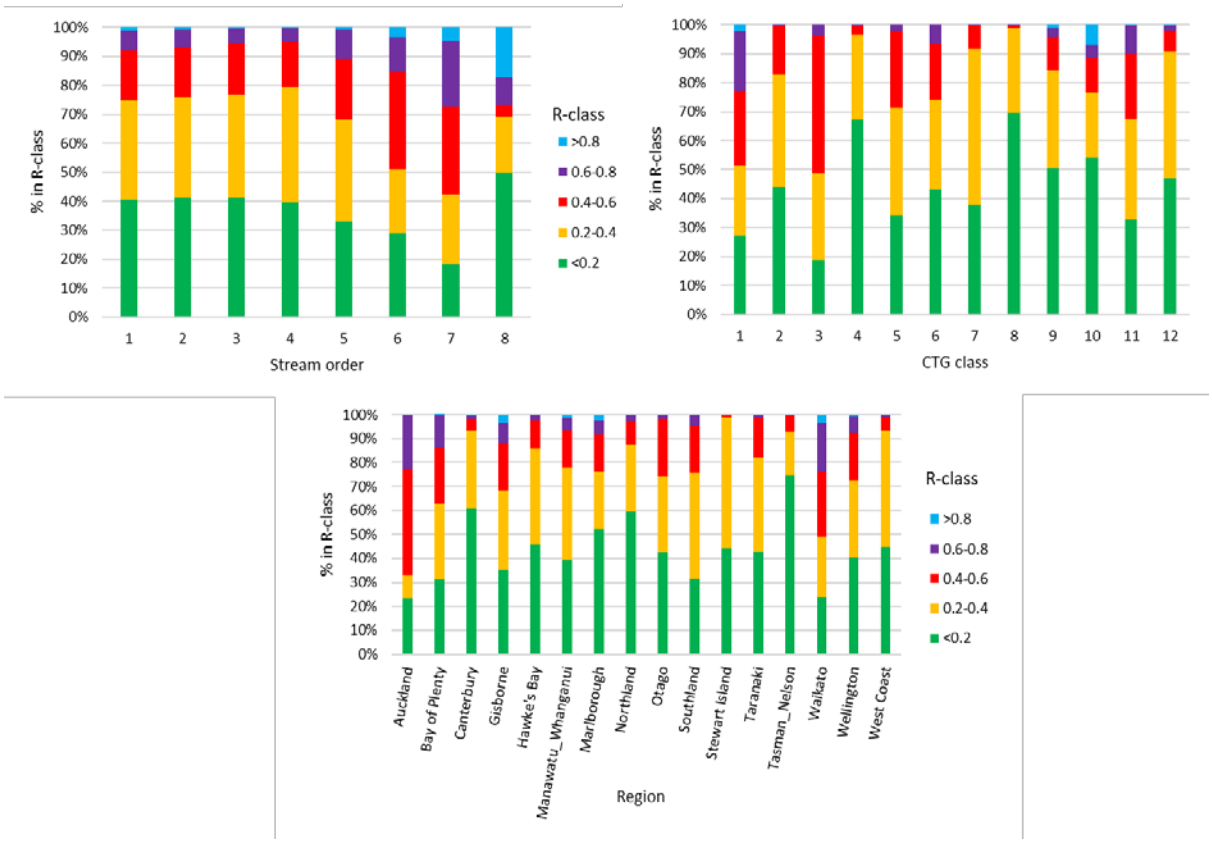
[166] Hicks et al 2016; Hicks et al 2019a; Hicks et al 2019.

[167] Note that for suspended sediment, this estimate of exceedance used the long-term median (all data for the site) rather than a 2-year median per the proposed attribute.

[168] Hicks et al 2019.

significant implications when discussing the distribution of costs and benefits of implementing the regulation. It is important to note that national scale modelling is subject to more uncertainty than modelling undertaken at the catchment level provided there is adequate observation data in that catchment.

Figure 7 - Predicted suspended sediment load reduction required to improve water quality above bottom lines (note that this map excludes glacial rivers incorporated within the proposed exceptions for naturally occurring processes)



Additional information (4) on engagement with regional councils and council staff concerns on proposals

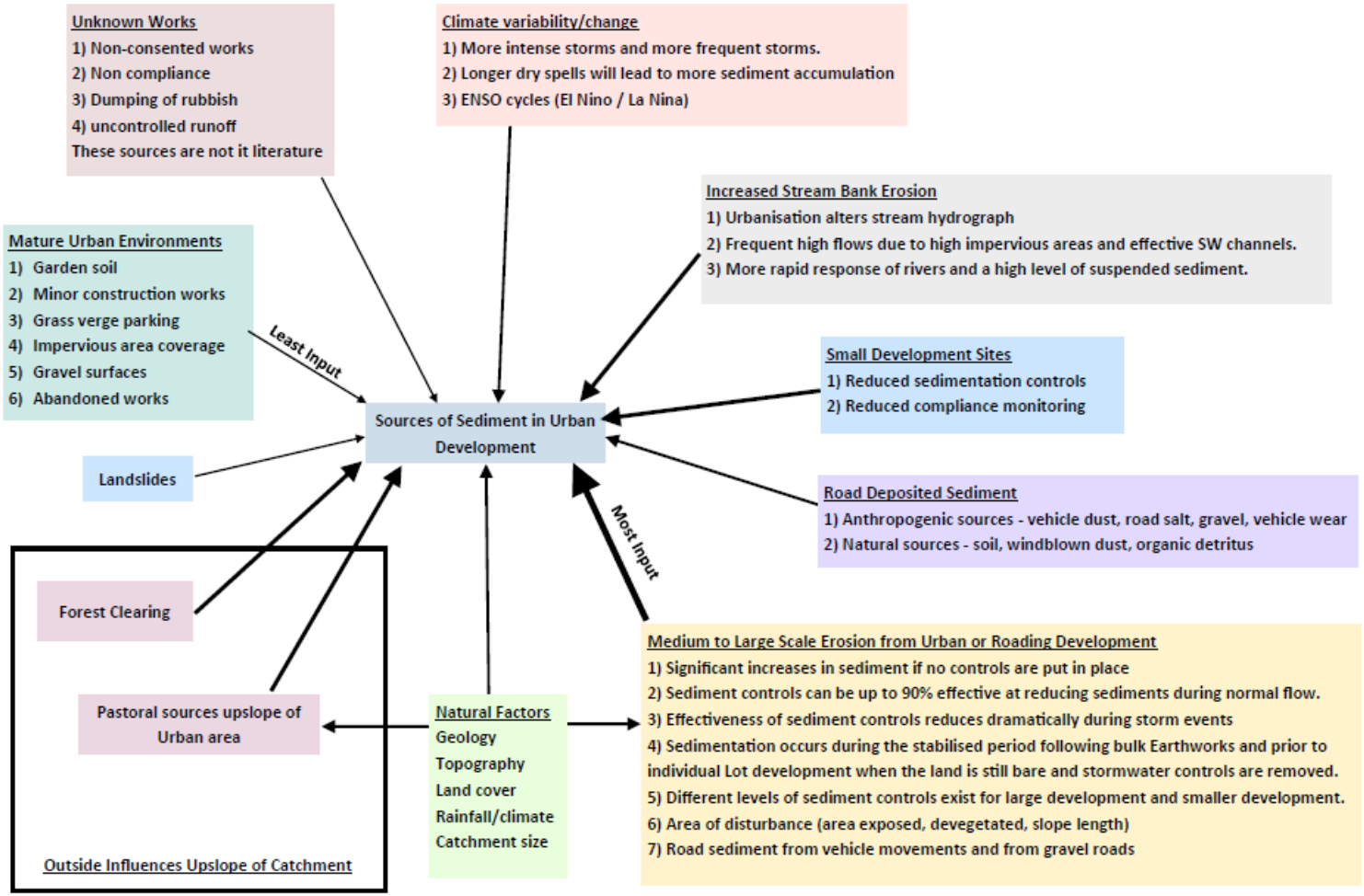
The Ministry engaged with a group of technical experts from councils on the sediment research programme between 2015 and 2019. This group provided feedback on results, next research steps, and policy proposals stemming from the research programme. The Ministry engaged with a group of regional council policy managers from the "Resource Managers Group" since mid-2018 to discuss the proposed policies and their implications for local government. The discussion in the section details actions needed to implement the proposals stems primarily from the conversations with this group on policy implementation pathways, and the results of the survey they facilitated. Also, Ministry staff undertook key informant interviews with 18 staff from 6 regions and ran a workshop with members of the land managers' special interest group focusing on erosion management and soil conservation issues. Council staff identified several concerns about the proposed attribute shown in Table 14 below.

Table 14 - Issues with proposals raised by council staff

Issue/concern identified by RMG	RMG view of consequences of having NOF attributes to manage sediment
The proposed 12 level clarification for attributes are too complex	• Complexity of planning will make implementation of the 12 level classification of attributes unachievable by 2025 • Poses resources issues for councils • Precludes inclusion of iwi, community groups, landowners
The proposed attribute bands are too narrow	Various technical implementation considerations that are yet to be resolved by the NEMS/EMAR processes (instrumentation variation, field variability, staff technical capacity.
The drivers of deposited sediment are poorly understood and quantified	This issue is further complicated by rapid land use changes in some catchments, or where land is undergoing urban development
The proposed attributes potentially shift councils away from the FMU/catchment planning approach	The FMU planning approach is the foundation of NPS-FM implementation – shifting to a complex classification for sediment limit setting may change this process and therefore may change the process of engagement and involvement with iwi and communities
Difficulty navigating multiple policy drivers	• Potential bias for one policy in regulation of activities such as urban development and related infrastructure such as roading. • Potential for conflict in policy interpretation and implementation between responsible agencies (TAs, RCs, and central government agencies)
The link to coastal/estuarine receiving environments is important	This is an important aspect of community values, and it is unclear how sediment attributes will explicitly address this and be fully integrated into the planning process for estuarine/coastal process management.
The setting of compulsory attributes may lock councils into work without addressing the issue of sediment loss	Concern that introduction of attributes or monitoring requirements will drive action in planning and monitoring spaces rather than implementation of tools to reduce sediment loss and regulate land use changes and practices on the ground

Additional information (5) on sources of sediment related to urban development[169]

Figure 8 - Sources of sediment related to urban development



Additional information (6) on proposals' benefits

Table 15 - Framework and examples of benefits related to the proposals[170]

Category of effect of sediment	Quantify	Monetise	Link to well-being dimensions	Description
Impacts on Navigational waterways	Harbour dredging – Ports of Auckland Limited holds consents to conduct maintenance dredging of up to 175,000m3 over 5 years (in some locations) and 70,000m3 over 5 years in other locations – this is part of regular operations and not dredging related to capital programmes.[171]	N/A	1, 2, 3, 9, 10	The accumulation of sediment in navigational channels and harbours can affect transport, shipping, fishing, and other uses.
Reservoir impacts		Could be evaluated in a comparable manner to hydroelectric facility impacts described below.	1, 2, 6, 9, 11, 12	Reservoirs and other water storage facilities provide drinking water, flood control, and other benefits. Sediment accumulation affects these abilities. An avoided cost approach could be used to monetise these effects, using the dredging costs as a proxy for the full effect.

[170] All categories (far-left column) in bold and with an * have monetised benefit values specific to the policy shown in bold and described in Net Present Value. Figures are from Neverman et al 2019. Other quantified and monetised values should be considered as ongoing costs of degradation that the proposals would reduce to some extent.

[171] Ports of Auckland 2018

Category of effect of sediment	Quantify	Monetise	Link to well-being dimensions	Description
Hydroelectric facility impacts*	For example, turbine replacement due to scouring from suspended sediment	**$ 19-31 million depending on the dredging cost and discount rate applied.**[172]	1, 2, 11	Sediment can impose additional treatment costs on hydroelectric facilities. These avoided costs could be used to measure impacts.
Drinking water treatment	Drinking water quality from lakes poor, declining[173]		1, 5, 6, 7, 8, 10, 11, 12	Sediment in the water can diminish water quality and hence increase the treatment costs to turn it into drinking water. These treatment costs could be used to estimate the impacts of improved water quality, and are an avoided cost.
Agricultural water uses		Sediment removal (10,000 m3/year) from one irrigation water scheme on the south island costs $160,000 per year	1, 2, 7, 11	If irrigation water is pulled from waterbodies with high sediment content, it can harm crops and reduce agricultural productivity.
Commercial fishing		$20 million in Marlborough paua fishery decline due to habitat loss, of which much is due to sediment deposition.[174]	1, 2, 7, 8, 10	Sediment in the water can have a negative impact on fish populations through impacts on aquatic habitat. This can affect commercial harvests. Quantification of this effect requires analysis of fishing harvest and sediment inputs.

[172] Neverman et al 2019

[173] Schallenberg et al 2015

[174] Larned et al 2018

Category of effect of sediment	Quantify	Monetise	Link to well-being dimensions	Description
Recreational fishing	Closure of recreational fishery in Kaipara due to sediment impacts on habitat and recruitment;[175] Noticeable decline in mahinga kai. Indicator of 0.29 (out of 1).[176]		1, 3, 4, 5, 7, 8, 10	Sediment-related reductions in water quality can affect the demand for recreational fishing, as well as the experience of recreational fishing. Recreation demand models could be used to monetise these impacts.
Flood damage		Direct damage costs can be significant, for example, the estimated national cost of direct erosion damage in New Zealand is $38.8 million (1998 dollars).[177]	6, 7, 8, 11, 12	Accumulating sediment in rivers and streams can increase the frequency and severity of floods. If a relationship could be established between floods and sediment, the reduced flood damages could be used to estimate impact.
Water-based recreation	Increase in skin and gut infections (could be monetised given further information).[178]	Recreational use value of the lower waitaki valued at $2 million per year. Preservation of current state of Rakaia and Waimakariri valued at mean of $42 to $43 per household per year.[179]	1, 2, 3, 4, 5, 6, 7, 8, 10, 11	Sediment can reduce the quality of water-based recreation. Stated preference surveys could be used to monetise these impacts.

[175] MPI 2018

[176] MPI 2014

[177] Krause et al 2001

[178] Field & Tunks 2011

[179] Sharp & Kerr 2005

Category of effect of sediment	Quantify	Monetise	Link to well-being dimensions	Description
Reduced aesthetics*		**$334 million (6% discount rate) or $504 million (4% discount rate)**	1, 2, 3, 4, 5, 6, 7, 8, 10, 11	Sediment-related water pollution can make rivers and streams less aesthetically appealing. Stated preference surveys could be used to monetise these impacts.
Water-related non-use impacts	Degradation of natural capital (due to erosion) has contributed to reduced cultural identity and expression.[180]	$4.13 for each 1% increase in proportion of waterbodies that achieve "moderate clarity".[181]	1, 2, 3, 4, 5, 6, 7, 8, 10, 11	People who do not directly recreate in the water may still hold values for clean water. They may value bequeathing good water to future generations, or simply value clean water or a healthy environment. Stated preference surveys could be used to monetise these impacts.
Biodiversity-related impacts	The policy is predicated on the preservation of ecosystem health as measured by in-stream sediment effects on macroinvertebrates and fish. See, for example, Appendices J and I in Franklin et al 2019 for information on the protection for specific taxa and species expected from achievement of proposed bottom lines and bands.		1, 2, 3, 4, 5, 6, 7, 8, 10	Water quality has a range of impacts on aquatic animal populations. People may hold non-use values for the preservation of species. Stated preference surveys could be used to monetise these impacts.
Carbon impacts from ESC practices*		**$5 billion – 31 billion depending on social cost of carbon, ETS price, or discount rate applied.**[182]	1, 2	The mix of ESC practices chosen for the policy option will cause changes in carbon. For example, riparian buffers or afforestation will deploy trees widely, which will reduce carbon.

[180] MPI 2012

[181] MPI 2016

[182] Neverman et al 2019

Category of effect of sediment	Quantify	Monetise	Link to well-being dimensions	Description
Carbon impacts from changes in production*		**CBA grouped this category with the one above.**	1, 2	The sediment policy may change the distribution and composition of producers, which can affect carbon emissions.
Reductions in erosion*		**$51 million to 226 million depending on the erosion cost and discount rate applied.**[183]		Erosion is associated with a range of negative outcomes, including reduced agricultural production, an increased risk of landslides, and increased risk of flooding.
Home price increases				Improvements in water quality can produce aesthetic benefits which can improve home prices.
Impacts on threatened and endangered species	See biodiversity-related impacts above			Habitat improvements may help threatened and endangered species. People hold additional values for these species.
Landslide impacts		Costs of shallow landsliding estimated at $250-300 million per annum.[184]		Sediment and erosion policies also decrease the probability of a landslide. This results in both a reduction in damage and a reduction in risk perception.
Health impacts		Death due to landslide is incorporated in the cost value above.		Primary contact recreation can result in illness. Improvements in water quality will decrease the likelihood of sickness.

[183] Neverman et al 2019

[184] Page 2015.

Additional information (7) on urban development erosion and economic modelling

The urban development modelling had two primary purposes:[185]

1. Evaluate the relative effect of staging land disturbance during construction ('earthworks') and erosion and sediment control structures on the generation of sediment.
2. Estimate cost differences for the specific scenarios.
3. Assess inter- and intra-annual variability in sediment generation using continuous simulation incorporating observed precipitation data.

The LSPC model used in the study builds on the Freshwater Management Tool under development for Auckland Council. The model estimates sediment yield at an hourly time step over the 15-minute simulation period for 10 percent and 18 percent slopes, for multiple scenarios of land development ranging from 100 percent pasture to 100 percent bare earth on the developed site in 25 percent change increments.

The weather time series boundary condition was extracted from a rainfall gage near Orewa (approximately 37km north of central Auckland), including a 15-minute rainfall time series between 1 Jan 2002 and 31 Dec 2017. The 10 and 18 percent slope bands were selected as a representation of typical development land slopes including having been the slope bands utilised for determination of increased sediment treatment pond sizing from two to three percent of catchment area under the prior Auckland Council TP90 (10 percent) and Auckland Council's (18 percent) land disturbing activity guidelines (GD05).

The modelling assumed erosion and sediment control efficacy of 70 percent, which the study indicates is a reasonable representation of common urban development sites sediment management using available guidelines for the Auckland Region for comparison of treated vs non-treated yields.

Consideration of cost variability incorporated a standard land development earthworks schedule with the following key variables expected to change between scenarios:

- Per m^3 earthworks rates: The largest portion of costs and most sensitive parameter. Costs used ranged from \$8-\$12 per m^3 of earthworks;
- Per m^3 topsoil stripping and reinstatement rates: These increase with staging similar to bulk earthworks rates.
- Time based overheads: Running costs for the development; these increase with staging. Earthworks durations were assumed to range from 25 to 40 weeks.
- Erosion and Sediment controls including costs per sediment retention pond and numbers of ponds: Cost of sediment control consistent across the staging scenarios, but binary between the untreated/treated scenarios.

Other variables included in the cost figures that are not expected to be sensitive to staging or erosion and sediment control costs include the scale of earthworks, off-site disposal of earthworks, geotechnical stabilisation measures, civil works including retaining and stream, and duration of earthworks.

The key factor in increasing costs reported in Table 10 is attributable to changes in earthworks rates due to assumed efficiency with larger sites where cut to fill operations are unimpeded by staging and allow for larger equipment to access the site. Staging earthworks is the adopted industry

[185] Paradigm and Morphum 2019.

standard practice in some parts of the country and therefore already built into the costs of land development and housing supply in some areas.

Figure 9. Catchments which are feasible and infeasible under the modelled mitigation scenarios. Note that all catchments which meet the proposed attribute bottom lines under Whole Farm Plans (WFPs) also meet under afforestation (Aff).

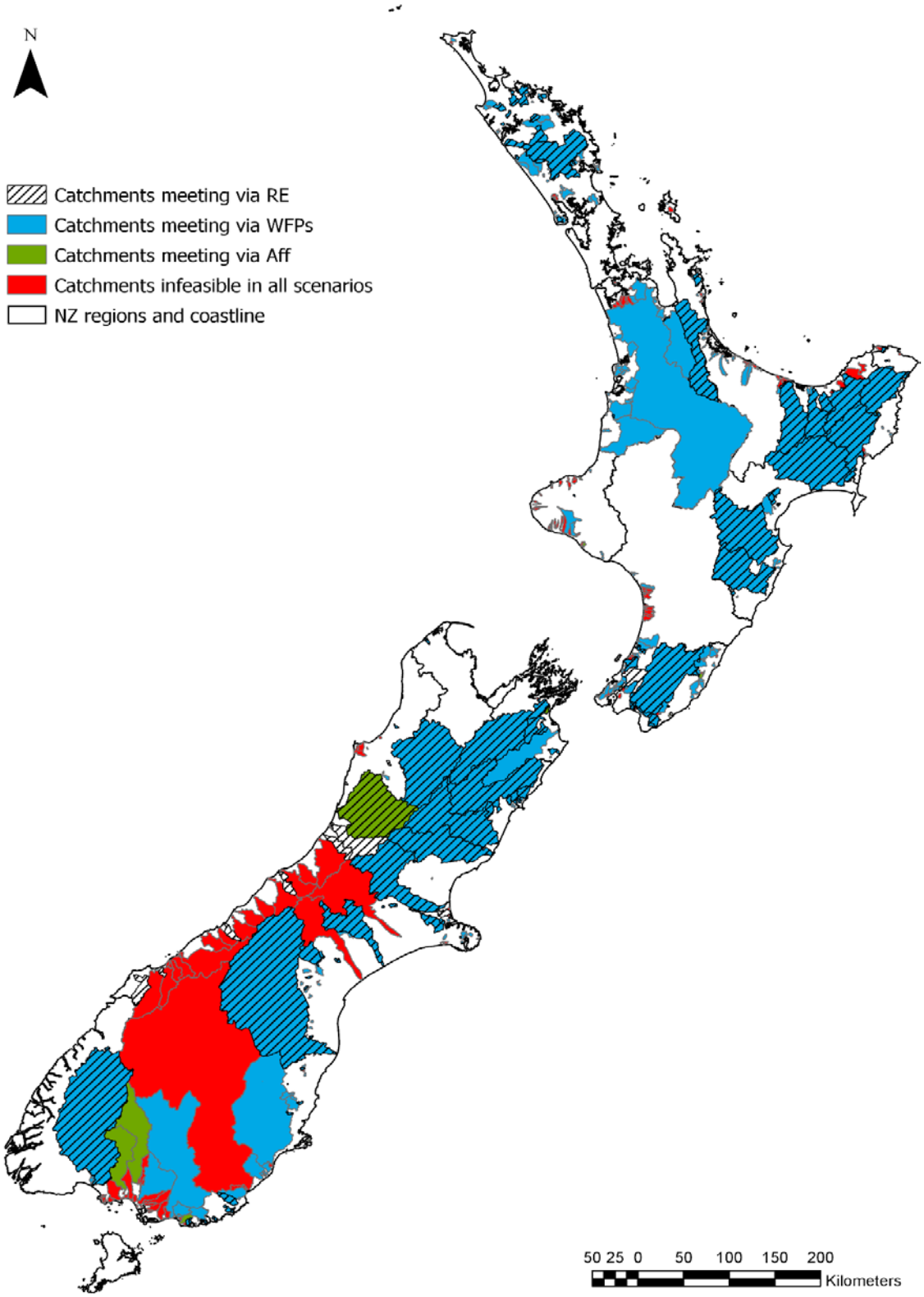


Table 16 – National monetised benefits and costs over 50 years – NPV (in $millions)

	4% Discount Rate	6% Discount Rate
Monetised Cost		
Lost Profit, Increased Costs	7,098	5,292
Monetised Benefits		
Avoided Cost of Dredging	27 – 31	19 - 22
Avoided Cost of Erosion	75 – 226	51 - 154
Carbon Benefits	8,000 – 31,000	5,000 – 21,000
Water Clarity Benefits	504	334
Not Monetised Benefits	***Expected Impact***	
Biodiversity Benefits	Increase	
Nutrient Benefits	Increase	
Water Regulating	Improve	
Coastal and marine water quality impacts	Increase	
Irrigation	Decrease (less water available)	
Habitat	Improve	
Threatened and Endangered Species	Increase	
Non-carbon air quality benefits	Increase	
Avoided illness	Improve	
Commercial and recreational fishing	Increase	
Home price changes	Increase	
Cultural benefits – including sense of place, aesthetics, cultural practices, among others	Increase	
Landslide reductions	Improve	
Water treatment costs	Decrease	

Appendix 7: Improving water for contact recreation

Context

Water quality data from 2008-2017 show that while Gisborne, Waikato, and Northland have many sites with improving *E. coli* trends, parts of Manawatu-Wanganui, Hawke's Bay, Taranaki, Wellington, Marlborough, Canterbury, and Southland have worsening *E. coli* trends. Using *E. coli* data from 2013-17, models indicate that 82 percent of the river length in pastoral farming areas was not suitable for activities such as swimming, based on the predicted average Campylobacter infection risk. River water quality in catchments dominated by urban land cover was even poorer.[186]

In 2017, 6482 cases of campylobacteriosis were notified to district health boards, which is similar to the previous ten years (except in 2016 when there was a water borne campylobacteriosis outbreak in Havelock North). The highest notification rates were in South Canterbury, Southland and Taranaki. There is a distinct seasonal pattern to the notifications, with an early summer peak and a winter trough. As with previous years, recreational water contact was the fourth most commonly cited risk factor (after consuming untreated water, contact with farm animals and consuming food from retail premises). Recreational water contact is also cited as a risk factor for salmonellosis (1,119 cases), giardiasis (1,648 cases), and cryptosporidiosis (1,192 cases).[187]

The number of notified cases of all illnesses is understood to be far lower than the actual number of cases (an acute gastrointestinal illness study during 2005–2007 estimated that only 0.4 percent of community cases result in a notification).[188]

There is ongoing public concern that people are at risk of getting sick from swimming in rivers and lakes and there is also wide-scale public confusion about what swimmable means and the actual risk to human health that contact with freshwater poses. A particular concern is that the threshold for "swimmable" water quality in the 2017 NPS-FM is lower than what was the "minimum acceptable state" for swimming in the 2014 NPS-FM, and is lower than the C/D threshold in the 2003 Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas (the 2003 guidelines),[189] with the result that current direction is not sufficient to lower the risk of people getting sick when they swim.

The NPS-FM requires the state of water quality in terms of *E. coli* to be improved everywhere, and for all regional councils to set a target for swimmable rivers and lakes in their regions that must contribute to achieving the national target for 90 percent of rivers and lakes to be swimmable. The national target applies to lakes with a perimeter of 1.5 km or more and "large" rivers – those that are fourth order and greater. For the purpose of the targets, swimmable means in the Blue, Green or Yellow class (see figure 1 below)[190] whereas the only the Blue class corresponds with a swimmable threshold in the 2003 guidelines.

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[186] Environment Aotearoa 2019. www.mfe.govt.nz/Environment-Aotearoa-2019-Summary.

[187] ESR 2019. Notifiable diseases in New Zealand Annual Report 2017.

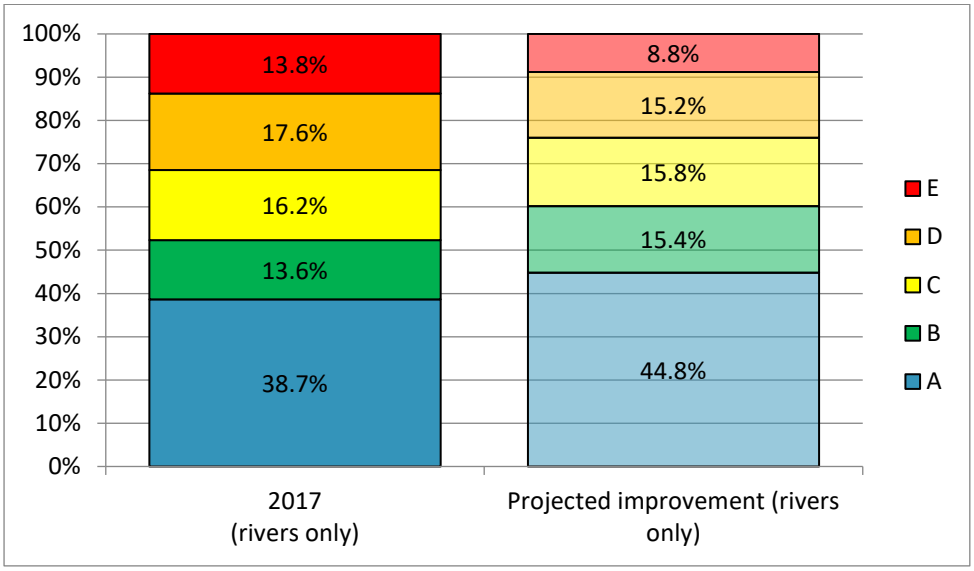
[188] ESR 2019. Notifiable diseases in New Zealand Annual Report 2017.

[189] Ministry for the Environment (2017). Submissions report and recommendations on proposed amendments to the National Policy Statement for Freshwater Management 2014. www.mfe.govt.nz/publications/fresh-water/submissions-report-and-recommendations-proposed-amendments-national-policy.

[190] National Policy Statement for Freshwater Management 2014 (as amended in 2017).

Apart from Marlborough and West Coast councils, which have draft regional targets, all regional councils have published final regional targets for swimmable lakes and rivers. In combination, the regional targets will not achieve the national target by 2040 (see Figure 1 below).

Figure 1: Projected improvement in water quality for swimming based on 2017 NPS thresholds for *E. coli* and on works proposed in 2016, including 2016 proposals for excluding stock from waterways, show that 24% of rivers would not be "swimmable"[191]



Problem

The high levels of *E. coli* in many rivers and lakes indicate that people who are in contact with the water, particularly where there is a high incidence of ingestion or inhalation of water and water vapour, have an unacceptable risk of infection or illness. This situation is getting worse in some rivers and current direction in regional plans and the NPS-FM is not driving sufficient improvements.

Constraints on the analysis

Reliability of the 2003 guidelines

The 2003 guidelines[192] are based on the risk of campylobacteriosis infection from primary contact recreation, which in turn is based on data collected in 1998-2000. Since 1998-2000 we have a better understanding of:

i. the role of direct-to-stream versus away-from-stream-water deposition by agricultural animals (the pathogen:indicator ratio has reduced over the last 20 years with fewer dairy farms discharging dairy shed effluent directly to rivers); and
ii. the role of wild bird faeces.

[191] Ministry for the Environment (March 2018). *Regional information for setting draft targets for swimmable lakes and rivers*. Published by the Ministry for the Environment on behalf of a joint taskforce of central and local government representatives.

[192] Ministry for the Environment, Ministry of Health. 2003. Microbiological water quality guidelines for marine and freshwater recreational areas

Both (i) and (ii) can be interpreted to imply that current Quantitative Microbial Risk Assessment models are over-estimating human health risk. On the other hand:

i. cycling of pathogens in animal stocks may have changed eg, a higher prevalence of Salmonellae in the nation's dairy herd;
ii. data from campylobacteriosis outbreaks among children and teachers on farm visits has indicated that children are much more susceptible to campylobacteriosis than adults; and
iii. Giardia and Cryptosporidium cysts were observed at very low levels in 1998-2000, and the incidence of these pathogens in the environment may have changed.

To test how the pathogen:indicator relationship stands up today, the Ministry for the Environment intends to commission a new microbiological risk assessment that could be completed in 2023-2024. In the meantime, the 1998-2000 study is still the best estimate of health risk for New Zealand lakes and rivers.

Impact testing (costs)

Modelling in 2016 indicated that improving fourth order rivers and bigger to the A band of the 2017 NPS-FM was not feasible with the "committed works" (eg, stock exclusion and improvements to sewage treatment). Estimates of costs ($2 billion) to reach the "swimmable" quality were based on scaling up costs of water quality improvements achieved in the Manawatu River.

Illness can impose significant costs to society. For example, the total economic costs to society from the campylobacteriosis outbreak in Havelock North in 2016 is estimated at around $21 million. Nearly 60 percent of the costs were due to the relatively high costs per household (around $2,440) for the 5,088 affected households. There are additional costs to government when people are hospitalised.[193]

The costs of Option 1 have been estimated by identifying:

a. the river and lake sites regional councils are currently monitoring for their suitability for swimming, and whether their current state is not meeting the recommended national bottom line
b. upstream sources of pathogens as indicated by *E. coli* (wastewater treatment plants and stock grazing as indicated by high producing pasture)
c. mitigation management likely to be needed (wastewater treatment plant upgrades, stock exclusion, and riparian planting).

Bathing sites and *E. coli*

The location of bathing sites and *E. coli* data were sourced from the LAWA website (accessed 18/04/19). This data file contained the Faecal Indicator Bacteria results from the 2015/16 - 2017/18 summer bathing seasons from monitored sites throughout New Zealand. Coastal sites were filtered out because the *E. coli* attribute would only apply to fresh water.

[193] Moore, D et al., 2017. The economic costs of the Havelock North August 2016 Waterborne Disease Outbreak (page 41)

Calculating 95th percentile

The 2003 guidelines follow World Health Organisation recommendations to use 95 percentiles of microbiological concentrations in samples to calculate health risk.[194] The 95th percentile for this analysis was calculated from *E. coli* observations during the bathing season (1 November - 31 March) recorded on LAWA. Usually to calculate a swimming grade a minimum of 60 samples are required, but this many samples were often not available so three "confidence band" statistics were created for n > 60, 40 >= n < 60, n < 40. Because less weight should be given to attribute state calculated from a low number of samples, sites with fewer than 40 sample results were excluded from the analysis.

Location of swimming sites

There are 292 sites in total, and 206 sites for which a 95th percentile was calculated. Of these, 169 were river sites, and 39 were lake sites. *E. coli* levels in 24 sites (11.5 percent) are in the "excellent" band of the guidelines, 28 (13.5 percent) are "good", and 47 (22.6 percent) are "fair". Approximately half the sites (109, 52.4 percent) are estimated to be "poor" (where the guidelines recommend the public is warned against swimming). All catchments upstream of sites that are "poor" have significant amounts (over 50 percent) of pastoral land use (see table below).

Wastewater treatment plants potentially contributing to *E. coli* levels

The Department of Internal Affairs supplied a spreadsheet with information about the locations, and various design parameters of wastewater treatment plants (WWTP).

There is a WWTP discharging to freshwater (either always or sometimes) upstream of 52 sites. In 26 of these sites, *E. coli* levels exceeded the recommended national bottom line.

Nearly 60 percent of all WWTPs nationally are currently going through, or will go through, a resource consenting process in the next 10 years. In general, improvements to wastewater treatment are being driven by community expectations rather than rules in regional plans. Thus, while plants upstream of WWTPs are likely to require improvements to reduce their *E. coli* contributions, the cost to do this (usually ultraviolet disinfection) is likely to be a small part of the overall cost. Costs to improve treatment to reduce nutrient contributions, or to completely remove treated sewage discharges to water, will be greater.[195]

Digital river network

The River Environment Classification (REC) version 2.4 was used for the purposes of calculating catchment and river length statistics. There is a total of 217,139 kilometres of stream above swimming sites nationwide. There are 2.07 million people living within 20 km of a site that is below the recommended national bottom line.

Conclusion on *E. coli* influences and costs of mitigation

Sites where *E. coli* levels exceeded the national bottom line are distributed throughout the country, but tended to occur more often in lowland sites. Manawatu-Whanganui, which has identified more

[194] The 95th percentile is the measure used in statistics indicating the value below which 95 percent of the results fall.

[195] Department of Internal Affairs, 2018. Three Waters Review – cost estimates for upgrading wastewater treatment plants to meet objectives in the NPS freshwater.

freshwater bathing sites than any other region and has more sampling data has 30 sites not meeting the recommended national bottom line. Other regions with more than five sites exceeding the national bottom line are Northland (11 sites), Bay of Plenty (20 sites), Taranaki (8 sites), Wellington (five sites), Canterbury (12 sites), and Southland (six sites).

Land uses in the affected catchment generating *E. coli* were assumed as those with high producing grassland and low producing grassland. Reducing *E. coli* levels from these land uses will mainly involve excluding stock and targeting runoff from areas like laneways (where stock walk to the milking sheds) and yards. If all streams in high and low producing grassland in catchments with swimming sites exceeding the recommended national bottom line are not currently fenced, there would be 52,782 kilometres of fencing required. This figure includes all river sizes, from headwater streams to large rivers. Some of these are already fenced (DairyNZ reports that by 2017 97.2 percent of 'Accord' water bodies (24,744km) had been fenced), and more of these are required to be fenced by regional rules, or will be fenced if the recommended stock exclusion regulations apply. Excluding rivers and streams with WWTP upstream, and those that could be covered by stock exclusion regulations, there are 31,861 km upstream of poor sites.

Estimates for fencing costs range from $2.91 to $24.88 per metre depending on stock type and land type.[196] Assuming half the remaining streams are fenced with electric 4-wire, and half with non-electric 8-wire, the total costs would be $654 million. Most of these costs would be in the Manawatu-Whanganui region, which has identified the highest number of bathing sites.

Actual costs will depend on the actions councils choose to take improve to water quality.

Fencing stock out of water bodies is only one approach to reducing the impact of stock on *E. coli* levels in water bodies – intercepting and reducing runoff from laneways and yards may be more effective. Choosing the most effective mitigation approach for each farm is something that can be directed through farm-specific farm environment plans. This has been demonstrated in improvements in water quality trends, including reductions in *E. coli* levels, in some Manawatu rivers.[197]

Impact testing (benefits)

Campylobacteriosis is New Zealand's most commonly notified disease, accounting for 36.2 percent of all notifications. Notifications follow an early summer peak and a winter trough. Since 2008, the number of notifications has been much lower than the previous decade, but has remained around 6,500 (except for 2016). Information from 2017 about campylobacteriosis and three other water-borne diseases notified is provided in the table below.[198]

[196] Ministry for the Environment, Ministry for Primary Industry. 2016. National Stock Exclusion Study, analysis of the costs and benefits of excluding stock from New Zealand waterways.

[197] Snelder, T (2018). Assessment of recent reductions in *E. coli* and sediment in rivers of the Manawatu-Whanganui region – including associations between water quality trends and management interventions

[198] ESR 2019. Notifiable diseases in New Zealand Annual Report 2017.

Summary of water borne notified diseases and contact with recreational water

Disease	Cases notified	Cases hospitalised	Contact with recreational water	District health board areas most affected
Campylobacteriosis	6,482	510	Between 427 and 4,512. Fourth most common risk factor	South Canterbury, Southland and Taranaki
Salmonellosis	1,119	220	Between 135 and 669. Fifth most common risk factor	Tairawhiti (Gisborne), South Canterbury, Canterbury, Northland
Cryptosporidiosis	1,192	66	Between 219 and 620. Third most common risk factor	South Canterbury, Nelson-Marlborough, Tairawhiti (Gisborne)
Giardiasis	1,648	37	Between 250 and 1,073. Fifth most common risk factor	Tairawhiti (Gisborne), Wairarapa, Bay of Plenty, Lakes, Northland
Total	10,441	833	1,031 – 6,874	

For most of the campylobacteriosis notifications in 2017 the risk factor was not stated but 427 notified cases were associated with recreational contact with water, and 1,970 were recorded as not associated with recreational water contact. Thus the number of notified campylobacteriosis cases with contact with recreational water as a risk factor is estimated at between 427 and 4,512. Adding salmonellosis, cryptosporidiosis and giardiasis, the number of notified cases with recreational water contact as a risk factor is estimated at between 1,031 and 6,874.

The actual number of cases could be ten times the notified number of cases because many people do not present to doctors (the number of people affected by the Havelock North campylobacteriosis outbreak in 2016 could have been as many as 7,326, but there were only 964 notifications). Thus, the number of people getting sick from campylobacteria annually after contact with recreational water, could be between 4,000 and 45,000, and the number of people getting a serious illness after recreational contact with water could be 10,000 to 70,000.

The total economic costs associated with the Havelock North campylobacteriosis outbreak in 2016 were estimated to be $21,029,288, for an estimated 5,088 households. The costs included costs to hospitals, households, and businesses.[199] Subtracting costs to local and central government and non-government organisations of responding to the outbreak ($4,774,233), and costs to households of buying or boiling water ($3,489,574) leaves a total cost of $12,765,481, or $2,509 per household.

The costs of the Havelock North campylobacteriosis outbreak suggest that illnesses caused by contact with recreational water could be costing New Zealand $25 million - $175 million annually. Some of these people may have been swimming in the sea, or in rivers not monitored by the councils. With nearly half of New Zealand's population living within 20 km of a monitored recreational site (2.2 million people), and assuming that this equates reasonably well with the proportion of people who have become sick after contact with recreational freshwater, the estimated benefits of reduced illness that would result from improving water quality in rivers and lakes as indicated by *E. coli* would be in the range of $10 million to $80 million annually.

[199] Moore, D et al., 2017. The economic costs of the Havelock North August 2016 Waterborne Disease Outbreak.

What do stakeholders think?

Throughout the consultation on the proposed amendments to the NPS-FM in 2013, the national bottom line for the human health for recreation value was the most contentious part of the amendments. Three-quarters of the 725 unique submissions and all 6,426 form submissions commented on setting the compulsory value for human health at the level of secondary contact recreation, with 84 percent of the unique submissions and all form submissions opposed. The most common request was for the compulsory value to be set at a level that would allow water to be suitable for swimming, with many also asking for fishing, food gathering and some for drinking water quality as a compulsory value.[200]

When the Government sought public feedback on its proposals for fresh water in early 2016, the public again asked that rivers and lakes should be swimmable, rather than wadeable.[201] To address these concerns, the Government proposed amending the NPS-FM so that water quality had to be improved everywhere in terms of its suitability for swimming, introduced a national target for swimmable rivers, and replaced the attribute table for *E. coli* with a new table where the grade varies according to the amount of time the water quality is 'swimmable', with no national bottom line.

Submissions from the Land and Water Forum, the majority of regional councils, research organisations and primary sector expressed support in principle for managing water towards primary contact recreation quality (rather than secondary) according to how often *E. coli* exceeds a given threshold (time-based management of *E. coli*). Nevertheless, submissions considered that the proposed attribute table would allow water quality to exceed a threshold that is too permissive, too often, while still being described as 'excellent'.[202] The proposed attribute table was retained in the amended NPS-FM.

Fish and Game

Fish and Game has a function under the Conservation Act to advocate for the management of sports fish and their habitat both generally and in any statutory planning process. Fish and Game felt that the NPS-FM does not adequately provide for human health in all rivers and lakes. During previous consultation on proposed changes to the NPS-FM, submissions from recreational fishers expressed significant concern about poor water quality and its effects on the health of fishers.

In May 2018, Fish and Game New Zealand provided Minister Parker with a redrafted NPS-FM. The redraft included a replacement attribute for *E. coli* that was in line with the 2003 guidelines and would apply to all surface water, all the time, and a new attribute table for benthic cyanobacteria based on guidelines prepared in 2009.

Freshwater Leaders Group

The Freshwater leaders Group said that setting limits for human health must be a priority within the Essential Freshwater Programme. In particular, they wanted the Government to review the adequacy of the existing *E. coli* and cyanobacteria attributes and how they are applied. The Group

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[200] Ministry for the Environment (2014). Report and recommendations on the proposed amendments to the National Policy Statement for Freshwater Management and public submissions.

[201] Ministry for the Environment. 2016. Next steps for fresh water: Summary of submissions.

[202] Ministry for the Environment. 2017. Regulatory Impact Statement: amendments to the National Policy Statement for Freshwater Management 2014.

said that the values for drinking water and mahinga kai should have the same weight as primary contact recreation.

The Group felt that future work programmes should look at developing further attributes for key pathogens not adequately indicated by *E.coli* and consider how the fresh water objectives for human health can be delivered, including integration with the Three Waters programme and the New Zealand Coastal Policy Statement.

Kahui Wai Māori and the Science and Technical Advisory Group

The groups did not discuss the options to improve water for swimming.

Regional councils

The Regional Sector Water Subgroup comprising senior managers in regional councils, supported a recommendation for the bar to be higher in places where people swim and that summer bathing water quality monitoring at popular bathing sites is appropriate. Their specific comments were that:

- having two attribute tables for *E. coli* is going to be confusing for the general public
- reviewing the 2003 guidelines should be brought forward and ideally done first (prior to amendments to the NPS-FM), given the *E. coli* attribute tables are based on these guidelines, and implementation will have costs. This work is critical as technology, data and knowledge have improved significantly since the original microbiological water quality guidelines were created, bringing the reliability of the guidelines into question.
- the definition of primary contact site should enable councils to determine which locations they monitor in a specified river or lake (particularly necessary where there are many swimming spots on specified river or lake).

Options

Maintain the status quo

Retaining the status quo would mean that councils set objectives for *E. coli* at a level that will contribute to a national target where 90 percent of large rivers and lakes are swimmable. Apart from Marlborough and West Coast councils, which have draft regional targets, all regional councils have published final targets for swimmable lakes and rivers. In combination, the regional targets will not achieve the national target by 2040.

Summary assessment of three options considered

Criterion	Option 1 new *E. coli* table for primary contact sites	Option 2 new *E. coli* table for all rivers and lakes year round	Option 3 Apply a national bottom line to the existing *E. coli* table
Effectiveness	+	-	+
Timeliness	+	-	+
Fairness	+	--	+
Efficiency	+ +	0	+
Principles of the Treaty of Waitangi	0	0	0
Te Mana o te Wai	+	+	+

Overall assessment	+	-	+

Option 1: Add an *E. coli* table with attribute states in line with the 2003 guidelines, and apply to bathing sites during the bathing season (retain the existing *E. coli* table for the remaining FMUs)

The national bottom line threshold in this option is similar to the A band for *E. coli* in the 2017 NPS-FM (the main difference is that the *E. coli* attribute table in the 2017 NPS-FM has four tests, including that for at least half the time *E. coli* is less than or equal to 130 *E. coli* per 100 ml).

According to LAWA, there are around 238 sites that councils monitor for their suitability for swimming. Councils would need to set objectives for *E. coli* above the national bottom line for all sites identified as primary contact sites. This may mean that these areas are nested within larger freshwater management units where freshwater objectives for *E. coli* would continue to be required, and these must be set to achieve an improvement from the existing state.

***E. coli* attribute table for Appendix 2 of the NPS-FM**

Value	Human health for recreation	
Freshwater Body Type	Primary contact sites in lakes and rivers (during the bathing season)	
Attribute	***Escherichia coli (E. coli)***	
Attribute Unit	95th percentile of E. coli/100 ml (number of *E. coli* per hundred millilitres)	
Attribute State	**Numeric Attribute State**	**Narrative Attribute State** Assuming '% of time' equals '% of samples'
Excellent	≤ 130	Estimated risk of Campylobacter infection has a < 0.1% occurrence, 95% of the time
Good	131 - 260	Estimated risk of Campylobacter infection has a 0.1 – 1.0% occurrence, 95% of the time
Fair	261 – 550	Estimated risk of Campylobacter infection has a 1 – 5% occurrence, 95% of the time
National bottom line	550	
Poor	> 550	Estimated risk of Campylobacter infection has a > 5% occurrence, at least 5% of the time

Assessment of option 1.

Criterion	Option 1: new attribute table in line with the 2003 guidelines, applied to bathing sites during the bathing season
Effectiveness	+ Will drive reductions in *E. coli* concentrations and improvement to a swimmable quality in those of the 238 recreational sites that are currently worse than "fair". It raises the bar at sites where people would otherwise be at a higher risk of infection. Requirements for all other water bodies to continue to improve.
Timeliness	+ The problem would be addressed over the next decade as councils amend their regional plans and then implement changes through decisions on resource consents.
Fairness	+ The improvements would be driven in places where people swim or want to swim, and so the mitigation measures needed would largely be required by people in the local communities. In rural communities, there could be a greater need for stock exclusion than would be required by stock exclusion regional rules or potential national regulation, as well as possible improvements to sewage treatment plants in small towns.
Efficiency	++ The health risk will be reduced in places where there would otherwise be a high exposure risk on a population basis. Option 1 is consistent with the 2003 guidelines, which apply to "well used" primary contact sites during the bathing season, and addresses the higher illness risk reported in summer.
Principles of the Treaty of Waitangi	**0** Provides for the relationship of Māori with water to some extent, but does not promote partnership or protect Māori rights/interests in freshwater.
Te Mana o te Wai	+ Addresses water bodies that are not providing for values today.
Overall Assessment	+ Better than the status quo and marginally better than option 3.

Option 2: Replace the existing table with a table that is in line with the 2003 guidelines

Add a new attribute table with attribute states in line with the 2003 guidelines, and apply the national bottom line for swimming to all rivers and lakes. This option would replace the existing *E. coli* table, and require regional councils to set objectives and limits for *E. coli* above the national bottom line, which would be set on the C/D threshold in the guidelines of 550 *E. coli* per 100 ml.

Assessment of Option 2.

Criterion	Option 2: new attribute table in line with the 2003 guidelines, applied to all rivers and lakes year round
Effectiveness	- There is a risk that councils would ask for all FMUs to be allowed transitional objectives below the national bottom line for the foreseeable future because analysis in 2016 showed that reducing *E. coli* concentrations everywhere to the extent needed to reach the current threshold was not possible.
Timeliness	-

Criterion	Option 2: new attribute table in line with the 2003 guidelines, applied to all rivers and lakes year round
	Councils may choose to set objectives with extremely long time frames or seek the ability to set objectives below the national bottom line by being listed in Appendix 4 of the NPS-FM because of the difficulty in achieving the reductions in *E. coli*.
Fairness	- Achieving this option may not be possible without significant changes in land use and de-stocking. If upcoming studies find the health risk associated with *E. coli* is lower than is currently determined (because of the current uncertainty around the reliability of the scale of the health risk), these significant changes could be found to have been unnecessary.
Efficiency	**0** Reducing *E. coli* concentrations everywhere could cause large economic impacts without major reductions in health risk because areas with high use would not be prioritised, and areas with lower levels of use may be improved without the greater public benefit.
Principles of the Treaty of Waitangi	**0** Provides for the relationship of Māori with water to some extent, but does not promote partnership or protect Māori rights/interests in freshwater.
Te Mana o te Wai	+ Addresses all water bodies that may not be providing for values today.
Overall Assessment	- Doesn't properly address the problem. Could be worse than the status quo if councils focus on applying for exceptions to the national bottom line instead of improving where possible.

Option 3: Set a national bottom line for swimming at the bottom of the A band of the existing *E. coli* attribute table and apply this national bottom line to primary contact sites

Primary contact sites could be nested within larger freshwater management units where freshwater objectives for *E. coli* must be set to achieve an improvement from the existing state.

Assessment of option 3.

Criterion	Option 3: Apply a national bottom line to the bottom of the A band of the existing *E. coli* attribute table
Effectiveness	+ The A state in the existing attribute table spans all three swimmable categories in the 2003 guidelines and so would not provide the visibility that the high quality of the "excellent" and "good" classes provides. This would not provide the granularity showing that some rivers and lakes have very high water quality that may be helpful for promoting tourism and trade.
Timeliness	+ The problem would be addressed over the next decade as councils amend their regional plans and then implement changes through decisions on resource consents.
Fairness	+ The improvements would be driven in places where people swim or want to swim, and so the mitigation measures needed would largely be required by people in the local communities. In rural communities, there could be a greater need for stock exclusion than would be required by stock exclusion regional rules or potential national regulation, as well as possible improvements to sewage treatment plants in small towns.

Criterion	Option 3: Apply a national bottom line to the bottom of the A band of the existing *E. coli* attribute table
Efficiency	+ It applies to places that councils will identify as places used for contact recreation, or want to use for contact recreation. This will reduce the health risk in places where there would otherwise be a high exposure risk on a population basis. It would not provide the granularity desired to show that some rivers and lakes have very high water quality and is not consistent with the 2003 guidelines.
Principles of the Treaty of Waitangi	**0** Provides for the relationship of Māori with water to some extent, but does not promote partnership or protect Māori rights/interests in freshwater.
Te Mana o te Wai	+ Addresses water bodies that are not providing for values today.
Overall Assessment	+ Better than the status quo but marginally worse than option 1.

Options ruled out of scope, or not considered

Two further options were considered to improve water quality for human health. These were to:

a. Adopt the *E. coli* attribute table from the 2014 NPS-FM, where the national bottom line was set at "boating or wading" and applied everywhere, with a minimum acceptable state set for swimming that applied to sites identified in regional plans, and
b. Adopt a new attribute table for benthic cyanobacteria (as suggested by Fish and Game).

Reverting to the attribute table in the 2014 NPS-FM was not considered further because it would not address the high public concern about the low national bottom line and would conflict with the existing requirement to improve water quality everywhere in respect of human health, not only in rivers below a boating and wading bottom line.

Adding a new attribute table for benthic cyanobacteria was not considered further because there is a significant amount of research required to finalise any attributes for benthic cyanobacteria.[203]

Recommendation

Option 1 is likely to best address the problems and deliver the highest benefits. This is to add an *E. coli* table with attribute states in line with the 2003 guidelines, and apply to bathing sites during the bathing season (retain the existing *E. coli* table for the remaining FMUs). One risk with this approach is that the current NPS-FM uses a threshold of 540 *E. coli* per 100 ml as the trigger for notifying the public that a site is unsuitable for swimming. This difference from the 2003 guidelines arose during earlier statistical analysis for national bottom lines for wading and boating (these were removed in 2017). To avoid a perception that the standard is lowered from 540 to 550 *E. coli* per 100 ml, the marginally more protective NPS-FM threshold of 540 *E. coli* per 100 ml should be used.

Given that option 1 focuses on where people swim, and the application of the new attribute table is in addition to the general requirement to improve water quality everywhere in terms of human health, the policy obligations for managing *E. coli* at places where people swim could be to require councils to develop action plans that target sources of microbiological contamination, for example,

[203] Wood SA, Hawes I, McBride G, Truman P, Dietrich D. 2015. Advice to inform the development of a benthic cyanobacteria attribute. Prepared for Ministry for the Environment. Cawthron Report No. 2752

critical source areas on farms, sewage overflows and wastewater treatment plant upgrades in towns and cities.

This option will need to be supported by policy direction to identify primary contact sites and set objectives/target states for those sites using this table. This could be assisted by the addition of a new value for primary contact as follows:

> **Primary contact** – A primary contact site is used, or would be used but for existing freshwater quality, for any recreational uses, including where there is a high incidence of ingestion or inhalation of water and water vapour such as swimming and kayaking.
>
> Primary contact sites must be managed for their risk to human health. Other matters to take into account are the presence of slippery or unpleasant weed growth, and the visual clarity of the water.

Option 1 delivers the highest net benefits by targeting effort at places where the highest number of people are exposed to a risk of infection and illness.

If councils choose to improve water quality so that it is above the recommended national bottom line by fencing streams upstream of swimming sites the costs could be as high as $654 million. Most of these costs would be in the Manawatu-Whanganui region, which has identified the highest number of bathing sites. This cost was calculated as a one-off capital expense for stock farmers (including sheep farmers) to fence streams not affected by existing rules (estimated from kilometres of rivers upstream in affected catchments with land uses that contribute *E. coli*).

But in practice, the direction to take targeted approaches in action plans would mean councils should identify where critical improvements can be made, such as encouraging farmers to intercept and reduce runoff from laneways (where stock walk to the milking sheds) and yards. Choosing the most effective mitigation approach for each farm is something that can be directed through farm-specific farm environment plans.

Councils can also direct other interventions such as reducing sewage overflows and wastewater treatment plant upgrades in towns and cities. Reductions in *E. coli* levels associated with improvements in wastewater treatment in the 26 catchments upstream of bathing sites currently not meeting the 2003 guidelines may provide significant improvements for low marginal costs in terms of their likely overall upgrade costs.

For this reason, the estimated costs of $654 million are likely to be at least double the more likely costs associated with actions directed in action plans and in farm environment plans.

Summary table of costs and benefits of the preferred approach

Affected parties *(identify)*	Comment*: nature of cost or benefit (eg ongoing, one-off), evidence and assumption (eg compliance rates), risks*	Impact *$m present value, for monetised impacts; high, medium or low for non-monetised impacts*	Evidence certainty *(High, medium or low)*
Additional costs of proposed approach, compared to taking no action			
Regulated parties	One-off capital expense for stock farmers (including sheep farmers) to	Approximately $300 million	Medium

	fence streams would be to $654 million, but this figure is halved to recognise that *E. coli* levels in at least half the rivers may be reduced as result of more strategic interventions at the farm level. Upgrade costs of wastewater treatment plants, plus ongoing treatment (unlikely to add significantly to costs)	Very low additional costs	Medium
Regulators	Monitoring costs the same (councils already monitor recreational sites during the bathing season)	None	High
Wider government	No impact		High
Other parties	None identified		High
Total Monetised Cost		Up to $654 million	
Non-monetised costs		Low	

Expected benefits of proposed approach, compared to taking no action			
Regulated parties	Benefits of better environmental ratings for farmers	Low	
Regulators			
Wider government	Reduced hospital costs from admissions	Low	Low
Other parties	Reduced costs on households affected by illness Increase in use of rivers and lakes for outdoor activities (swimming, kayaking etc, but also picnicking and tramping) Improved tourism reputation, particularly for international trout fishers.	Between $10 and $80 million annually Not quantified Not quantified	Low
Total Monetised Benefit		Between $10 and $80 million annually	
Non-monetised benefits		Low	

Appendix 8: Māori involvement in freshwater management: Māori values, measures of freshwater system health and mātauranga Māori in the NPS-FM

Context

Legislative context relating to Māori involvement in freshwater management

There is a significant mandate for Māori involvement in freshwater management in New Zealand based on the Treaty relationship and certain legislative provisions in the Resource Management Act 1991 (RMA)[204], Local Government Act 2002, various Treaty settlement legislation[205] and the NPS-FM. This legislative context is relevant to the development of all policy relating to freshwater management, and requires New Zealand's freshwater management system to provide for a sufficient level of Māori involvement.

The NPS-FM requires regional councils to provide for the involvement of iwi and hapū in the management of freshwater, and to identify and reflect tangata whenua values in the management of freshwater and decision-making regarding freshwater planning. This includes how all other objectives in the NPS-FM are given effect to, and clarifies the importance of identifying and reflecting Māori values in freshwater management.

The NPS-FM considers and recognises Te Mana o te Wai as an integral part of freshwater management. Te Mana o te Wai is the overarching concept of the NPS-FM, and provides an integrated, holistic and values-based approach to freshwater management. Currently, the NOF does not provide a comprehensive and nationally applicable mechanism for representing the full holistic and essential values of the waterbody (values pertaining to the water itself).

Policy CB1 requires regional councils to include mātauranga Māori in their monitoring plans.

Regional councils and hapū/iwi face resourcing issues

There is great variability in regional council capacity and capability and hapū/iwi capacity across New Zealand.[206] This creates difficulties for regional councils to implement the NPS-FM, and for hapū/iwi to participate in resource management processes. Regional councils also often have limited understanding about how to reflect and incorporate Māori values into freshwater planning

[204] Part 2 of the Resource Management Act 1991 includes provisions to recognise and provide for the relationship of Māori and their culture and traditions with their ancestral lands, water, sites, wāhi tapu, and other taonga; (s6(e)), Recognise and provide for the protection of protected customary rights;(s6(g)), Have particular regard to kaitiakitanga; (s7(a)), Take into account the principles of the Treaty of Waitangi (such as partnership and active protection) (s8);

[205] For example, Te Awa Tupua (Whanganui River Claims Settlement) Act 2017, and Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act 2010, Ngāti Tuwharetoa, Raukawa and Te Arawa River Iwi Waikato River Act 2010, and Ngā Wai o Maniapoto (Waipa River) Act 2012.

[206] National Monitoring System data for 2017/18 outlines that 54% of Local Authorities had a budgetary commitment to assist iwi/hapū participation in policy statement and plan-making processes. The 2012 Kaitiaki Survey run by Te Puni Kōkiri found that a large proportion of those surveyed do work that is mostly unpaid.

processes.[207] The full extent of capacity and capability gaps are still unknown and will be tested through consultation and targeted engagement with hapū/iwi and regional councils.

Many hapū/iwi have already identified freshwater values and attributes through iwi management plans and kaupapa-Māori assessment frameworks (for example the Cultural Health Index). A range of methods, frameworks and tools for hapū/iwi are summarised in a report by Hannah Rainforth and Garth Harmsworth.[208] This report was commissioned by regional councils in 2018 to assist regional councils with NPS-FM implementation. These resources provide a good starting point for hapū/iwi to develop their own values and attributes for freshwater health and to feed into regional freshwater planning.

The problem/opportunity

Overall New Zealand's freshwater management system, as directed by the NPS-FM, does not fully enable Māori to participate in freshwater management and freshwater planning processes. This is shown by Māori values and measures of health not being adequately identified, reflected or incorporated into regional freshwater planning processes, or considered a priority against other biophysical compulsory values or attributes.

The lack of incorporation of Māori values and attributes of freshwater health is caused by:

- the NPS-FM does not set strong enough requirements on regional councils to incorporate Māori values and measures of freshwater health into freshwater planning processes
- poor regional council implementation practice in some circumstances and an ad-hoc approach to involving Māori in freshwater management leads to Māori values and measures being excluded from regional freshwater planning processes
- national direction lacks clear guidance and implementation support, creating ambiguity and confusion for regional councils and hapū/iwi. The NPS-FM can be difficult for hapū/iwi to navigate, and regional councils lack understanding or mandate to identify Māori values and attributes
- a significant gap in council capacity and capability to involve and support hapū/iwi to participate in regional planning processes, and to understand and implement Māori outcomes for freshwater management
- the costs faced by hapū/iwi can be high, creating barriers to participation. There is also inconsistency in opportunities to obtain funding for participation.

Incorporating Māori values into freshwater management creates benefits for the entire community by improving outcomes for freshwater. By not reflecting Māori values in freshwater management practice, this means the freshwater management system is not delivering on Part 2 of the RMA nor is it consistent with the Treaty principles of active protection.

This problem is regionally variable and complex. The current lack of clarity and compulsion on regional councils is a limiting factor contributing to the problem, but this is coupled with the practical reality that many hapū/iwi are not resourced to engage fully in freshwater management, and some regional councils are significantly under-resourced, which practically impacts their ability

[207] Ministry for the Environment. 2017. National Policy Statement for Freshwater Management Implementation Review: National Themes Report. Wellington: Ministry for the Environment.

[208] Rainforth, H. J. & Harmsworth, G. R. (2019). Kaupapa Māori Freshwater Assessments: A summary of iwi and hapū-based tools, frameworks and methods for assessing freshwater environments. Perception Planning Ltd. 115 pp.

to implement the NPS-FM. Further work will be undertaken by the Ministry for the Environment to understand the causes, impacts and solutions to this resourcing issue.

Constraints on the analysis

The options outlined in this paper respond to the recommendations in the Kāhui Wai Māori's report that the Ministry develop mandatory Māori measures of wellbeing in the NOF within the NPSM. Policy development began shortly after the Minister for the Environment issued a response to Kāhui Wai Māori's report in June 2019. Due to these time constraints the policy options have not been fully impact-tested. Officials have not been able to talk to regional councils or hapū/iwi to understand the practicalities of implementing each option. Impacts testing will be undertaken through consultation with councils and hapū/iwi to understand:

- The benefits to hapū/iwi, the community and freshwater health.
- The costs involved for regional councils with implementing the NPS-FM, for the mandatory mahinga kai value, or meeting the NPS-FM requirements for any other tangata whenua value.
- The current capacity and capability of regional councils to undertake, and hapū/iwi to participate inNPS-FM processes
- Key barriers to participating in the NPS-FM for hapū/iwi
- The NPS-FM must be implemented by 2025. We need to understand whether to identify longer timeframes for implementation are required to avoid exacerbating capacity/capability shortages for regional councils and hapū/iwi.

Consulting on options also allows us hear from regional councils and hapū/iwi to understand whether the options are the most effective and efficient for addressing the problem, and what the practicalities of implementing the options will involve. This will result in more robust policy intervention.

We will continue to undertake further impacts testing through consultation and targeted engagement to inform the final RIS document.

Options analysis

Objectives

The overall objective of this policy change is to enhance Māori involvement in freshwater management and regional freshwater planning processes by providing stronger and clearer avenues for the incorporation of Māori values and attributes of freshwater health into freshwater planning.

Summary assessment

Criterion	1. Maintain the status quo	2: Provide non-regulatory implementation support	3. Amend the NPS-FM to elevate the status of mahinga kai from an 'other national value' to a 'compulsory national value' in the National Objectives Framework	4. Amend the NPS-FM to create a new 'tangata whenua' value category in the NOF
Effectiveness	-	-	+	+
Timeliness	0	++	0	0
Fairness	-	++	+	+

Efficiency	-	+	+	-
Principles of the Treaty of Waitangi	-	+	+	++
Te Mana o te Wai	-	+	++	+
Overall Assessment	-	+	+	+

Note that Option 2, in conjunction with option 3 and/or 4 will increase points for effectiveness

Options

The following four options have been identified:

1. Maintain the status quo
2. Provide non-regulatory implementation support
3. Amend the NPS-FM to elevate the status of mahinga kai from an 'other national value' to a 'compulsory national value' in the National Objectives Framework
4. Amend the NPS-FM to create a new 'tangata whenua' value category in the NOF

Options 2, 3 and 4 are not necessarily exclusive, and could work in combination.

Option 1: maintain the status quo (as defined in the problem definition)

This option requires no action and is not recommended as it will not address the problem. Currently, there is little guidance or clear direction setting central government's expectations for regional councils to incorporate Māori values and attributes of freshwater health in regional freshwater planning processes, and how to undertake these processes.

There are existing RMA mechanisms to promote Māori involvement in resource management (eg, transfer of powers, or joint management agreements) but these are not mandatory. Uptake is generally based on the goodwill of councils, and regional council and hapū/iwi capacity and capability. For these reasons, the current status quo is unlikely to resolve itself.

Option 2: Provide non-regulatory implementation support

This option includes central government providing non-regulatory support for regional councils and hapū/iwi to implement the NPS-FM. Types of non-regulatory support includes:

- producing a package of guidance to support Part D, implementation of the NOF in the NPS-FM (identifying Māori values, attributes, target attribute states, management requirements), and Policy CB1 (monitoring plans needing to incorporate mātauranga Māori)
- the Crown taking a strategic approach to investing in hapū/iwi and regional council capacity and capability to implement the NPS-FM.

The costs to hapū/iwi can be high, creating barriers for participation. This option responds to the barriers that prevent hapū/iwi participating effectively in regional freshwater planning processes. There is an inconsistency with funding opportunities for Māori participation in freshwater management, which often means Māori either work voluntarily, or pay for their own participation.[209] There is also a significant gap in regional council capacity and capability to involve and finance hapū/iwi to participate in regional planning processes, and to understand and implement desired outcomes for freshwater management.

[209] Te Puni Kokiri. Kaitiaki Survey 2012 report.

This option alone does not address the problem. Even if more funding was provided, incorporating Māori values into regional freshwater planning is not mandatory, and there is currently a lack of clarity or direction for regional councils about how to implement part D, and policy CB1 (monitoring requirements). This option does not strengthen existing requirements in the NPS-FM, and does not meet the policy intent or address the problem.

Option 3: Amend the NPS-FM to elevate the status of mahinga kai from an 'other national value' to a 'compulsory national value' in the National Objectives Framework

This option would involve consolidating the two existing mahinga kai 'other national values'[210] into one compulsory value in the NOF. This would be a new compulsory value that is equivalent to ecosystem health and human health for recreation. This option will compel regional councils to incorporate a Māori value into regional freshwater planning, providing the appropriate level of regulatory strength in order to contribute to providing for Māori rights and interests through the NPS-FM.

Progressing mahinga kai as a proposed compulsory value, as opposed to another Māori value (ie, mauri), is likely to be the most efficient option because regional councils are already familiar with mahinga kai in the current NOF. Mahinga kai is also widely applicable across the country, and a number of hapū/iwi have already identified mahinga kai values and attributes in iwi management plans, regional planning documents and kaupapa Māori assessment frameworks, which could reduce expected implementation costs.

Regional councils are required to identify values for each FMU, which must include the compulsory values. A mahinga kai value will require attributes and target attribute states to be set in every FMU. Attributes will differ regionally based on geography, and local whakapapa, history, tikanga and mātauranga. Officials will seek feedback on the most effective and appropriate process for determining attributes through the Essential Freshwater public consultation on national direction and targeted engagement. Costs would be different depending on whether attributes are set nationally, or locally (or a mix of both).

The costs associated with a local process for determining attributes are currently unknown. We intend to consult on implementation costs and benefits through the Essential Freshwater public consultation on national direction and targeted engagement.

This option does not solve the lack of capacity and capability faced by regional councils and hapū/iwi. Making mahinga kai a compulsory value could influence regional councils to direct their resources through their long-term planning towards funding Māori participation to identify attributes for mahinga kai, and then to meet the target attribute states to provide for the value.

Option 3 significantly strengthens existing regulatory provisions for incorporating Māori values into freshwater planning. There will be implementation costs associated with Option 3 to develop guidance and provide support to regional councils and hapū/iwi to implement this option.

[210] Mahinga kai is included twice in Appendix 1 of the NPS-FM as "kai are safe to harvest and eat" and "kei te ora te mauri – the mauri of the place is intact".

Criterion	Option C: Amend the NPS-FM to elevate the status of mahinga kai from an 'other national value' to a 'compulsory national value' in the National Objectives Framework
Effectiveness	+ Provides strong direction to regional councils and compels regional councils to incorporate at least one Māori value (mahinga kai) into regional freshwater planning. However, there are significant resources shortages which could impact the ability of hapū/iwi to participate in the process, and effective implementation for regional councils. The scale of this impact is unknown and will be tested further through consultation.
Timeliness	0 Provides greater certainty about the process required for implementing the NPS-FM. Implementation may be resource intensive.
Fairness	+ Improves the ability of Māori to input their mahinga kai values into regional freshwater planning processes. This will mean that mahinga kai is managed for and monitored. This addresses part of the problem that biophysical measures are often prioritised over Māori measures, which improves fairness by increasing Māori involvement in freshwater management.
Efficiency	+ Regional Councils are often uncertain about how to incorporate, reflect and measure Māori values and mātauranga Māori. Providing direction and outlining central government expectations for engagement to councils in this area will improve efficiency. This option is likely to increase costs associated with engagement, capacity and capability and overall resourcing.
Principles of the Treaty of Waitangi	+ Promotes greater participation of Māori in freshwater management. Greater involvement allows for Māori to provide input and inform councils about their values, measures of wellbeing and mātauranga, which is critical to actively protect Māori interests.
Te Mana o te Wai	++ Enables greater opportunity for Māori to inform freshwater care and management. Māori exercise kaitiakitanga which includes the obligation to put the water first, therefore greater Māori involvement in the care of freshwater is part of putting the water first. Mātauranga Māori is more widely utilised and regional councils understand how it can inform freshwater management, planning and decision-making.
Overall Assessment	+ Overall, this option would be an improvement to the status quo. While the costs associated with implementing the NPS-FM are technically high, councils should have been engaging with Māori since the RMA included s6(e)

Option 4: Amend the NPS-FM to provide for a 'tangata whenua freshwater values' category of value in the NOF

This option proposes to create a new category of value within the NOF for 'tangata whenua freshwater values', alongside ecosystem health and human health for recreation. The policy intent is to maintain flexibility to take a local approach to freshwater management, and provide clearer and stronger direction to regional councils about how to work with hapū and iwi to identify and incorporate tangata whenua values into freshwater planning. Tangata whenua freshwater values will be determined locally by iwi and hapū, and supported by regional councils.

Part D of the NPS-FM currently sets out a process for involving Māori in freshwater management and planning by requiring regional councils to identify Māori values and interests and reflect them in freshwater planning. This process currently sits outside of the NOF and creates uncertainty for regional councils and hapū/iwi about how to integrate these processes. The intent of this option is to integrate Part D requirements directly into the NOF, and to strengthen existing requirements.

This option will not solve the capacity and capability issues faced by regional councils and hapū/iwi. The costs of implementation will relate to the development of guidance and other financial non-regulatory implementation support in order to address the problem. The Ministry is currently developing a plan to support implementation, further details will be known in time for the final RIS.

Below is a summary of how this option will be implemented based on existing provisions within the NPS-FM. We seek to test its effectiveness through the Essential Freshwater consultation.

Summary of how this option would work in practice:

1. regional councils are required to engage with hapū/iwi to identify values for freshwater health[211]
2. the NPS-FM requires that attributes and target states are identified for all values. Management requirements to achieve these states must be established to provide for the values. Regional councils will be required to support hapū/iwi to identify and develop this information
3. regional councils will be required to incorporate the outcome of bullet-point 1 and 2 into regional planning processes and documents, subject to the RMA.

A clear process and guidance will need to be developed and officials will need to test the kind of support regional councils will need to provide to hapū/iwi in order to meet the NPS-FM requirements, within the parameters of the NPS-FM itself.

We will test the potential costs and benefits of this option through the Essential Freshwater public consultation on national direction and targeted engagement.

What values will be in scope of this new value category?

Having a broad scope for 'tangata whenua values for freshwater health' is likely to cause uncertainty for regional councils, and cause difficulties for implementation. To provide greater certainty, this value category could be framed in light of Te Mana o te Wai and relevant provisions within Part 2 of the RMA:

- recognise and provide for the relationship of Māori and their culture and traditions with their ancestral lands, water, sites, wāhi tapu, and other taonga (s6(e))
- recognise and provide for the protection of protected customary rights (s6(g))
- have particular regard to kaitiakitanga (s7(a))
- take into account the principles of the Treaty of Waitangi (such as partnership and active protection) (s8).

We will consult on whether or not this is an appropriate scope for framing this value category. Note that 'Appendix 1' of the NPS-FM still allows for any value to be identified, including extractive values.

Elements of this option need to be tested further, and the consultation document for the Essential Freshwater consultation and targeted consultation will include questions specific to these matters:

- timeframes for implementation – particularly the 'planning how to satisfy the NOF requirements' route
- how these processes will be resourced to address the scarce-resources faced by hapū/iwi and regional councils
- The practicalities of implementing this option.

[211] Part D of the current NPS-FM and through Te Mana o te Wai.

Criterion	Option 4: Amend the NPS-FM to provide for a 'tangata whenua freshwater values' category of value in the NOF
Effectiveness	+ Provides a clear mechanism for incorporating Māori values into freshwater planning processes. This also sets a clear expectation that regional councils must incorporate Māori values into regional freshwater planning processes, where hapū/iwi have identified values and are able to develop the information required by the NPS-FM. Flexibility may reduce effectiveness where there are resourcing shortages, and cause ambiguity.
Timeliness	0 Timeliness will depend on local priorities and the development of information to satisfy the NPS-FM requirements.
Fairness	+ Improves the ability of Māori to input their values into regional freshwater planning processes. This addresses part of the problem that biophysical measures are often prioritised over Māori measures, which improves fairness by enabling better uptake of Māori values informing freshwater management.
Efficiency	- This option provides for a wider range of Māori values, and regional councils may be unsure of how to incorporate these values into regional planning. Flexibility may also increase uncertainty. Providing direction and outlining central government expectations for engagement to councils in this area will improve efficiency.
Principles of the Treaty of Waitangi	+ Promotes greater participation of Māori in freshwater management. Greater involvement allows for Māori to provide input and inform councils about their values, measures of wellbeing and mātauranga, which is critical to actively protect Māori interests.
Te Mana o te Wai	+ Enables greater opportunity for Māori to inform freshwater care and management. Māori exercise kaitiakitanga which includes the obligation to put the water first, therefore greater Māori involvement in the care of freshwater is part of putting the water first. Mātauranga Māori is more widely utilised and regional councils understand how it can inform freshwater management, planning and decision-making.
Overall Assessment	+ Overall, this option would be an improvement to the status quo. While the costs associated with implementing the NPS-FM are technically high, councils should have been engaging with Māori since the RMA included s6(e).

Recommended option:

We recommend Option 3 and Option 4, and to consult on both options through the Essential Freshwater public consultation on national direction. Either option would need to be coupled with non-regulatory implementation support to assist with the capacity and capability issues faced by regional councils and hapū/iwi.

This will allow us to test how best to address the problem, receive feedback on why/why not these options are supported, and identify how these options could be modified or expanded on. This will allow for a more robust policy intervention.

Options ruled out of scope, or not considered

1. Amend the RMA

Amending the RMA is an option because it would lead to more systemic change, and could address wider issues related to governance and decision-making. However, this option would operate on a longer time-frame, and is not within the scope of the Essential Freshwater package.

What do stakeholders think?

Kahui Wai Māori – The Kāhui Wai Māori (the Kāhui) was established to enable collaborative development and analysis of freshwater policy options for issues of particular relevance to Māori. Officials have worked with the Kāhui to test and develop some of the proposals in this section of the Regulatory Impact Statement (Appendix 8). A key recommendation from the Kāhui is to provide for a mandatory measure of freshwater health in the NPS-FM through a compulsory value. They have also provided recommendations that are relevant to implementation, such as investing in science - mātauranga, and building capacity and capability. The Kāhui strongly support amending the NPS-FM to make mahinga kai a compulsory value in the NOF (option 3). The Kāhui recommends local attributes and do not support pre-determined mahinga kai attributes and bands at a national-level because these values are catchment specific and must align to the relevant species and methods for individual catchments.

Freshwater Leaders Group (FLG) – the FLG support a compulsory mahinga kai value.

Science and Technical Advisory Group (STAG) – the STAG recommended that the Ministry amend the national direction in freshwater management to better bring mātauranga Māori into the management framework by supporting the development of mātauranga-based indicators and facilitating better engagement between scientists and kaitiaki in freshwater monitoring and management. This relates to the compulsory value policy which will involve greater use of mātauranga Māori in implementation of the NPS-FM.

National level Māori organisations – Improving water quality and increasing Māori participation in freshwater management is a common theme raised by many national level Māori organisations. The New Zealand Māori Council, for example, identified a number of matters in its closing submissions to the Wai 2358 inquiry[212] that it wishes to be progressed, including:

- proprietary redress, including reverse grandparenting (reduction and re-allocation to Māori of rights to take and discharge over time); a quota management system involving a percentage of allocation to Māori for takes and discharges; ongoing royalties or taxes for commercial uses of water; and/or compensation
- governance and co-management rights at a local, regional and national level
- appropriate levels of notification and consultation with Māori, including 'super' consultation (demonstrating the effect and effectiveness of consultation) in areas where there is a Treaty right or interest
- sufficient funding to enable meaningful participation in governance and management.[213]

The Freshwater Iwi Leaders Group has recently reinforced that it wishes to work with the Crown to ensure Māori rangatiratanga and proprietary rights and responsibilities of iwi and hapū in relation to freshwater are given effect to, while at the same time meeting the needs and aspirations of existing users and the wider community. Its immediate priorities over the next twelve months are:

- the Three Waters policy;
- discharges to freshwater;
- fresh water for marae, papakainga and communities

[212] National Waitangi Tribunal inquiry into freshwater and geothermal resources.

[213] Wai 2358, #3.3.33

- access to freshwater for underutilised lands
- activating RMA (including Te Mana Whakahono) and settlement redress instruments.[214]

While many of these matters go beyond the scope of what can be achieved in the NPS-FM, they nevertheless reinforce the importance of doing what we can to strengthen the incorporation of Māori freshwater values and attributes in the NPS-FM.

Local authorities– The regional sector will be charged with implementing these changes. They are looking for greater clarity and direction in terms of how to incorporate mātauranga Māori into regional planning processes and decision making. We intend to consult through the Essential Freshwater consultation and targeted engagement with regional councils to understand the practicalities of implementing either option, and identifying what the key barriers for implementation are.

Hapū/iwi – The Crown has a relationship and responsibility to engage with hapū/iwi as the Treaty partner, and to actively protect Māori rights and interests. The Ministry has heard that resourcing is a major issue faced by hapū/iwi that inhibits their ability to participate in freshwater planning processes. We intend to consult with hapū/iwi to understand how this problem may be best addressed, whether our options are supported, and to allow for feedback to expand on these options. Summary table of costs and benefits of the preferred approach

Affected parties *(identify)*	**Comment***: nature of cost or benefit (eg ongoing, one-off), evidence and assumption (eg compliance rates), risks*	**Impact** *$m present value, for monetised impacts; high, medium or low for non-monetised impacts*	**Evidence certainty** *(High, medium or low)*
Additional costs of proposed approach (options 3 and 4), compared to taking no action			
Iwi	Option 3: The costs could increase if a local process is required to develop attributes in every FMU. We will do more impact-testing to understand the costs and benefits associated with this approach. The costs could be lower if national attributes were set, including a menu of attributes (there are risks associated with this approach). Option 4: Regional councils must incorporate 'tangata whenua values for freshwater health' that meets the NPS-FM requirements. This option will have medium implementation costs because regional councils will still need to engage, and implement values when hapū/iwi have developed this information. We do	We can estimate some costs for implementing Option 3 or 4 based on the costs of developing kaupapa-Māori based frameworks. These frameworks provide the information required to satisfy the NOF requirements (identifying values, attributes, target attribute states, management requirements and monitoring methods) Developing a kaupapa-Māori monitoring framework could cost between 40-80k, per iwi or hapū. (note these costs could inform Option 2 and could be borne by central government, further information will be provided for the final RIS)	Medium (Note that some of this work is currently underway, further information will be needed)

[214] Letter from the Freshwater Iwi Leaders Groups to the Prime Minister and Minister Parker, 5 April 2019

	not know the full extent of the impacts for this option. There is variability in current capacity to participate in freshwater planning processes, we will test this through consultation to understand what the costs would look like.	Undertaking monitoring (to measure the attributes identified at a regular interval) is likely to cost between 30-50k annually. These cost estimates are based on data provided from regional councils. We do not know the full extent of these costs but will consult to understand this further, and will undertake further impact-testing to inform the final RIS.	
Regulators	Regional councils will incur costs to implement Option 3 and/or 4. Increased engagement is expected. The full extent of these costs are not known, but we will test these impacts for the final RIS. We will test the practicalities of implementation through public consultation.	To implement either option 3 or 4 regional councils will likely need to employ more staff/kaupapa Māori specialists. Costs could range from $90– 200k for internal capacity. It is likely that 1-2 FTE will be required per regional council to implement either option. Costs for engagement relating to NPS-FM implementation could range from 200 – 400k. This is dependent on the number of hapū and iwi, and FMU's in a region. Note, engagement should be occurring anyway, per current requirements. The costs will fall on regional councils who do not undertake sufficient approaches already. Additional meetings above the current baseline could cost $1-4k per meeting, or $35k per iwi.	Medium (exact costs not known due to complexity of the landscape)
Wider government	A national approach providing non-regulatory implementation support through funding, guidance and other tools (ie training)to support options 3 and 4) would require contributions from budget 2019. The extent of these impacts will be known for incorporation into the final RIS.	Budget 2019 has already been allocated, including a sustainable land use package to support the Essential Freshwater proposals. Implementation support has been factored into this budget. Any other costs would come out of the Ministry's baseline.	Medium
Other parties	These changes would not impact existing users as they would only apply to future plan changes.	None identified	Low
Total Monetised Cost	Potentially medium-high	Further impact-testing will be undertaken which will outline the costs expected to implement the	These are rough estimates

		final option. This will be provided in the final RIS.	Medium
Non-monetised costs	Low	Low	Low

Expected benefits of proposed approach, compared to taking no action			
Iwi	Improved involvement in freshwater management. This provides wider benefits to the community as Māori approaches to freshwater management are exemplars of integrated, holistic, and intergenerational management approaches to fit the needs and aspirations of hapū/iwi. Funding would improve capacity and capability for hapū/iwi, leading to more effective participation in freshwater management. An active role in monitoring could Improve connections to freshwater, and the transfer of knowledge between generations. These options would better incorporate mātauranga Māori into the management framework by supporting the development of mātauranga Māori based indicators.	High	High
Regulators	Clearer direction will provide greater certainty to councils, which enables them to implement obligations more effectively. Improved decisions and actions relating to freshwater management. Regional councils will have improved capability to understand how to utilise mātauranga Māori, and involve Māori in local processes for freshwater management. This could improve relationships between Māori and local government.	Medium – high	Medium – high
Wider government	Links can be made across agencies within the natural resource sector to improve efficiencies, and build capacity and capability. Provides an opportunity for the government to enable a fairer freshwater management system, and to build	Medium – high	Medium – high

	stronger relationships with the Treaty partner.		
Other parties	Greater understanding of different worldviews, knowledge systems and perspectives will be fostered amongst the community. This could lead to improved relationships, and greater results for collaborative management and action. These options could lead to better engagement between scientists and kaitiaki in freshwater monitoring and management.	Medium	Medium
Total Monetised Benefit	N/A	N/A	N/A
Non-monetised benefits	Medium – high	Medium – high	Medium – high

What other impacts is this approach likely to have?

Greater involvement of Māori in freshwater management aligns with the approach associated with Te Mana o te Wai. It promotes stronger, more collaborative relationships with the waterbodies in a catchment, and within communities. The sharing of knowledge strengthens understanding, which is positive for fostering relationships.

What are the impacts on people likely to be? Quick overview

The recommended approach will have a positive social impact leading to:

- Reconnecting with the environment
- Greater understanding of the Māori worldview within communities
- Collaborative approaches to management
- Intergenerational knowledge transfer.

Māori values and approaches to resource management bring a holistic, long-term and intergenerational perspective, which is valuable. Low Māori participation means our freshwater management system loses the benefit of a Māori perspective. The Crown also has a duty to ensure that the overarching regulatory system is consistent with the principles of the Treaty. While the NPS-FM's catchment level management approach is intended to ensure varied and local approaches to resource management, Māori participation and involvement in freshwater management should be consistent across the country.

Our freshwater is in a serious state of decline, which significantly impacts on Māori relationships to their ancestral freshwater taonga, and their ability to use these resources. Māori have strong whakapapa-based relationships with freshwater. Degraded freshwater environments prevent important activities from occurring, like harvesting traditional food sources. This also significantly impacts the generation of mātauranga Māori through observation and interaction with the environment, and the intergenerational transfer of this knowledge

Involving Māori in freshwater management will improve mātauranga-Māori based freshwater data, which is difficult to source due to ad-hoc approaches to data collection based on available funding.

These measures could antagonise relationships amongst hapū/iwi, between Māori and local government, and between Māori and central government, if not designed appropriately. For example, there could be competing values between hapū/iwi in an FMU, or different attributes for mahinga kai identified within an FMU, which could put regional councils in the middle of these disputes.

Appendix 9: Te Mana o te Wai in the NPS-FM

Context

Te Mana o te Wai in the NPS-FM

Te Mana o te Wai was incorporated into the NPS-FM in 2014 and clarified and strengthened in the NPS-FM 2014 (2017 amendments). This work was a result of numerous discussions between the Iwi Leaders Group (ILG) and the Ministry and involved significant wider consultation.

Te Mana o te Wai was first introduced into the NPS-FM in 2014 in response to feedback from iwi throughout the country that the NPS-FM did not give Te Mana o te Wai sufficient weight and concerns that without recognition in the NPS-FM, there would be potential that the concept would not follow through in regional plans[215]. Te Mana o te Wai was incorporated into the NPS-FM in 2014 in the 'national significance of freshwater and Te Mana o te Wai' section[216]:

> This national policy statement is about recognising the national significance of fresh water for all New Zealanders and Te Mana o te Wai.
>
> A range of community and tāngata whenua values, including those identified as appropriate from Appendix 1, may collectively recognise the national significance of fresh water and Te Mana o te Wai as a whole. The aggregation of community and tāngata whenua values and the ability of fresh water to provide for them over time recognises the national significance of fresh water and Te Mana o te Wai. [217]

While these amendments added recognition to Te Mana o te Wai and more clearly articulated tāngata whenua values[218], there remained a significant degree of uncertainty regarding the meaning of Te Mana o te Wai and its linkages to implementation[219]. Te Mana o te Wai was subsequently further clarified in the 'national significance of fresh water and Te Mana o te Wai' section and incorporated into an objective in the NPS-FM 2014 (2017 amendments). The objective required regional councils to 'consider and recognise Te Mana o te Wai in the management of fresh water'.[220]

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[215] Ministry for the Environment. 2013. Proposed amendments to the National Policy Statement for Freshwater Management 2011: A discussion document. Wellington: Ministry for the Environment. https://www.mfe.govt.nz/sites/default/files/proposed-amendments-nps-freshwater-management.pdf

[216] New Zealand Government. 2017. National Policy Statement for Freshwater Management 2014. https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/nps-freshwater-ameneded-2017_0.pdf

[217] New Zealand Government. 2014. National Policy Statement for Freshwater Management 2014. https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/nps-freshwater-management-jul-14_0.pdf

[218] Ministry for the Environment. 2013. Proposed amendments to the National Policy Statement for Freshwater Management 2011: A discussion document. Wellington: Ministry for the Environment. https://www.mfe.govt.nz/sites/default/files/proposed-amendments-nps-freshwater-management.pdf

[219] Ministry for the Environment. 2017. National Policy Statement for Freshwater Management Implementation Review: National Themes Report. Wellington: Ministry for the Environment. https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/NPS-FM-implementation-review-national-themes-report.pdf

[220] For further detail, see New Zealand Government. 2017. National Policy Statement for Freshwater Management 2014. https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/nps-freshwater-ameneded-2017_0.pdf

Te Mana o te Wai as a concept and framework for freshwater management

Ministry officials and KWM have worked together to establish a common understanding of Te Mana o te Wai and what it could require in practice, building on previous work on Te Mana o te Wai in the NPS-FM by the ILG and the Ministry.

This involved working with some members of KWM on policy development. Considerations for this work included how Te Mana o te Wai could be clarified and strengthened in the NPS-FM. It also involved considerations that were broader than matters that could be directed in the NPS-FM. This work also involved discussions on how Te Mana o te Wai could inform the Essential Freshwater work programme, and how Te Mana o te Wai could potentially be further embedded now and in the future.

The Ministry and members of the KWM broadly described Te Mana o te Wai through a set of principles, a hierarchy of obligations, and five underpinning components. The principles and the hierarchy described the roles and responsibilities of all New Zealanders in caring for fresh water. The purpose of the five underpinning components were to describe the different elements that may be required in practice and policy in relation to Te Mana o te Wai.

Principles:

- Kaitiakitanga/stewardship
- Manaakitanga/care and respect
- Mana whakahaere/governance.

Hierarchy of obligations:

- the first obligation is to protect the health and wellbeing of the water
- the second obligation is to provide for essential human health needs (such as drinking water)
- the third obligation is to enable other consumptive use.

Five underpinning components:

- Protecting and sustainably managing the needs of the water first
- Ensuring a values-based approach to freshwater care
- Enabling different systems of knowledge for freshwater care, and enabling wider aspects of water health to be cared for
- Adopting a holistic and integrated approach to freshwater management
- Te Tiriti o Waitangi upholds Te Mana o te Wai.

This narrative provided a useful basis for further policy development, and in particular increased clarity of the different actions that could be required for Te Mana o te Wai to be put in practice. KWM have also presented their official understanding and framing of Te Mana o te Wai in their report.[221]

The problem/opportunity

Following the 2017 amendments to the NPS-FM, through our engagement with the advisory groups and discussions with regional councils representatives, we have heard that some regional councils

[221] Kāhui Wai Māori. 2019. Te Mana o te Wai, the health of our wai, the health of our Nation. Kāhui Wai Māori Report to Hon Minister David Parker.

continue to be uncertain about what is expected for freshwater management with regards to Te Mana o te Wai. While many of the NPS-FM provisions contribute to upholding Te Mana o te Wai, these connections are not clear. Some councils have also expressed concern that the role of Te Mana o te Wai and how it relates to, or adds to, other requirements in the NPS-FM is ambiguous.

There are many benefits that Te Mana o te Wai could bring to freshwater management and how we can care for our freshwater, in particular as a framework that prioritises the health and wellbeing of water over other uses that we have for the water.

There is an opportunity through the Essential Freshwater work programme to strengthen and clarify the role of Te Mana o te Wai in the NPS-FM, through working with the advisory groups, and in particular Kāhui Wai Māori.

Linkages

There are several key linkages to other components of the Essential Freshwater Package reforms that will support these proposals, including:

- expanded definition of ecosystem health (better providing for ecosystem health in the NPS-FM)
- Māori values of freshwater health
- reporting on ecosystem health
- ecological flows and levels.

Constraints on the analysis

The table below lists topics that were considered and not considered:

Topics not considered in this analysis	Where topics are considered
Options to address roles and responsibilities in relation to mana whakahaere or governance (one of the principles of Te Mana o te Wai).	Not in scope of the Essential Freshwater work programme.
Options to strengthen provisions to manage for ecosystem health.	Explored in managing for all aspects for freshwater ecosystem health and other associated proposals of the NPS-FM.
Options to strengthen Māori measures of freshwater system health.	Explored in work stream on mandatory measures of freshwater system health.

There are data limitations for determining the problem and analysing the impacts of the last changes due to Te Mana o te Wai being a relatively new requirement in freshwater management regulation and the NPS-FM 2017 amendments being recent. The Ministry has not fully assessed how Te Mana o te Wai has been recognised in freshwater management since the more recent amendments.

Our evidence has been gathered through discussions with stakeholders and advisory groups and analysis of regional planning documents. We expect to gain further understanding of process of implementation to date through the consultation process.

The purpose of this work stream was also to gain a further understanding at the Ministry of what we would expect to see in practice, to be able to more clearly articulate that in the regulation, and to be able to then better assess implementation going forward.

Due to time constraints, we have not conducted a thorough analysis of impacts, and cannot determine with certainty the extent of the costs and benefits of these proposals. We intend to conduct further impact analysis (including social and cultural) on the impact of these proposals during and after consultation to better understand the costs and benefits. We anticipate that methods for gathering this information would include a mix of qualitative and quantitative research, conducted either alongside other proposals or in separate research studies. Information gathered during consultation will also be key to contributing to this research and impact analysis.

Options

Objective

The objective of this proposal is to provide meaningful direction to regional councils on how Te Mana o te Wai can inform freshwater management that prioritises the overall health and wellbeing of waterbodies.

Summary assessment

Criterion	Option A - Maintain status quo	Option B- Amend the NPS-FM to clarify the role of Te Mana o te Wai in freshwater management, maintaining current requirement to *consider and recognise* Te Mana o te Wai	Option C - Amend the NPS-FM to direct regional councils to *recognise and provide for* or *give effect to* Te Mana o te Wai in freshwater management	Option D - Reframing Te Mana o te Wai in the current NPS-FM
Effectiveness	**0**	**0/ +**	**-**	**+**
Timeliness	**0**	**0**	**0/+**	**+**
Fairness	**0**	**0**	**0/+**	**0/+**
Efficiency	**0**	**0**	**-**	**+**
Principles of the Treaty of Waitangi	**0**	**0/+**	**+**	**+**
Overall Assessment	**0**	**0**	**0/+**	**+**

Note on Te Mana o te Wai criterion: given that this proposal discusses Te Mana o te Wai in the NPS-FM, this criterion has been removed for this workstream and the Ministry has not assessed the option against this criterion. This workstream has been assessed against the criterion listed above. These criterion have been interpreted as they have been described in the 'Statement on Detailed Analysis' section of this document.

Option A: Maintain Status Quo

This option proposes to make no changes to the NPS-FM with regards to provisions for Te Mana o te Wai. Regional councils would continue to be required to *consider and recognise* Te Mana o te Wai in freshwater management. Retaining the current provisions for Te Mana o te Wai in the NPS-FM would result in continued ambiguity of what is expected in practice. This may mean potential delays for implementation and variations in implementation across the regions.

The Ministry does not recommend this option as it would not add the necessary clarity or direction that is currently lacking.

Option B: Amend the NPS-FM to clarify the role of Te Mana o te Wai in freshwater management, maintaining current requirement to *consider and recognise* Te Mana o te Wai

This option proposes to amend the NPS-FM by:

1. Clarifying the descriptor of Te Mana o te Wai. This descriptor would be informed by the work of KWM and the Ministry, and the existing structure and wording of the NPS-FM 2014 (2017 amendments).
2. Providing more specific policies to support regional councils to *consider and recognise* Te Mana o te Wai in freshwater management. These policies would be informed by the narrative and framework of Te Mana o te Wai outlined above.
3. Clarify in the NPS-FM how and where the objective-setting framework (currently CA2) relates to Te Mana o te Wai.

This option does not amend the legal obligation on regional councils, but seeks to clarify the different components of Te Mana o te Wai and further incorporate them as policies under the objective.

This option would reduce some ambiguity that currently exists with Te Mana o te Wai requirements in the present NPS-FM. It would also retain the flexibility for it to be interpreted and applied locally as appropriate.

However, the Ministry considers that this option would not provide sufficient clarity for regional councils to understand when they have given effect to the requirements or how they are expected to meet the requirements. This option would also not add the necessary compulsion to ensure Te Mana o te Wai is applied in freshwater management.

We have not conducted a thorough impact assessment of this option and cannot currently determine the extent of the costs and benefits with certainty.

The Ministry does not recommend this option.

Criterion	**Option B Amend the NPS-FM to clarify the role of Te Mana o te Wai in freshwater management, maintaining current requirement to *consider and recognise* Te Mana o te Wai**
Effectiveness	**0/+** This option would add some clarity in relation to Te Mana o te Wai and retain the flexibility for it to be applied locally. However, it would not add the sufficient direction to ensure Te Mana o te Wai is applied in freshwater management or that an approach to protect the health and wellbeing of the water is taken. This option may not have a much different effect during implementation than the current requirements.
Timeliness	**0** Preventing degradation of fresh water in New Zealand would not be a direct result of this option.

Fairness	**0** This option would have no direct impact in relation to fairness.
Efficiency	**0** There would continue to be some costs to regional councils to assess how they can meet their requirements. While this option may enable social, cultural and environmental benefits to emerge, this is not certain and will depend on the steps taken locally.
Principles of the Treaty of Waitangi	**0/+** The principles of the Treaty of a Waitangi are a key component of Te Mana o te Wai. This option may result in greater engagement with tangata whenua to interpret Te Mana o te Wai. However, this option does not specifically provide for an opportunity for partnership or active protection.
Overall Assessment	**0** Overall, this option would not impose significant additional requirements. This option may not have a much different effect during implementation than what is currently required.

Option C: Amend the NPS-FM to direct regional councils to *recognise and provide for* or *give effect to* Te Mana o te Wai in freshwater management

This option proposes to strengthen the legal requirement of regional councils by:

1. Clarifying the descriptor of Te Mana o te Wai. This descriptor would be informed by the work of KWM and the Ministry, and the existing structure and wording of the NPS-FM 2014 (2017 amendments).
2. Requiring regional councils to *recognise and provide for* or *give effect to* Te Mana o te Wai.
3. Providing more specific policies to support regional councils to *recognise and provide for* or *give effect to* Te Mana o te Wai in freshwater management. These policies would be informed by the narrative and framework of Te Mana o te Wai outlined above.
4. Clarify in the NPS-FM how and where the objective-setting framework (currently CA2) relates to Te Mana o te Wai.

Similar to the option above, this option would reduce some ambiguity that currently exists with the Te Mana o te Wai requirements in the present NPS-FM, while adding further compulsion for regional councils to apply the framework of Te Mana o te Wai.

However, the Ministry considers that this option may also increase risks and costs to regional councils, particularly in cases where tangata whenua and communities are concerned that Te Mana o te Wai has not been provided for or given effect to. This option does also not add sufficient clarify for when regional councils have achieved the requirement or 'provided for' Te Mana o te Wai.

Although these risks could be mitigated through more directive and specific policies that indicate how Te Mana o te Wai is to be 'provided for' or 'given effect to', more directive and specific policies would risk limiting and prescribing a concept that should be interpreted and applied locally. Stronger nationally set policies may also not reflect everyone's interpretations of Te Mana o te Wai and understandings of how it should be applied.

In addition, under the RMA, regional councils are required to give effect to National Policy Statements. Directing regional councils to *give effect to* Te Mana o te Wai would not necessarily impose additional requirements to regional councils, but may also not add the specificity required. There may, however, be a perception that wording such as *provide for* or *give effect to* is elevating Te Mana o te Wai to a higher legal importance.

We have not conducted a thorough impact assessment of this option and cannot determine the extent of the costs and benefits with certainty at this stage. Further impact assessment will be conducted to assess the impact of this option during consultation.

The Ministry does not recommend this option.

Criterion	**Option C Amend the NPS-FM to direct regional councils to *recognise and provide for* or *give effect to* Te Mana o te Wai in freshwater management.**
Effectiveness	- It is unclear as to what the impacts would be on the ground and whether this option would be sufficient to meet the objective and address the problems. This option carries a lot of uncertainty and may create additional risks, costs and problems, which may undermine the benefits.
Timeliness	**0/+** This option provides stronger direction and an indication that a demonstrable outcome for Te Mana o te Wai is expected. In particular, it would direct an expectation that regional councils adopt a freshwater management approach that puts the water first. The impact of this option would depend on conversations with communities and tangata whenua and what they value for the water itself. It will also depend on how these values are applied to the local context. This option could result in more environmentally conservative limits to protect the water and the environment, which would contribute to halting the degradation of water.
Fairness	**0/+** This option may involve additional costs to regional councils as they would be expected to determine an outcome or objective for Te Mana o te Wai. This option does not impose direct requirements on other stakeholders. However, this option, when implemented, may result in potential more environmentally conservative limits which may result in costs to stakeholders. However, the impact on stakeholders cannot be determined with certainty and could vary in different regions depending on how this option is implemented.
Efficiency	- This option would add greater significance to Te Mana o te Wai in the NPS-FM and reduce some ambiguity, which may address some of the issues to date and could result in greater environmental, social and cultural benefits on communities and tangata whenua. However, in practice, this option may also impose additional risks, costs and uncertainty which could outweigh the benefits.
Principles of the Treaty of Waitangi	+ The principles of the Treaty of a Waitangi are a key component of Te Mana o te Wai. This option could result in greater engagement with tangata whenua and recognition of values held by tangata whenua and the role of mātauranga Māori in fresh water management. This option may also result in more conservative environmental limits that protect freshwater taonga and the environment.
Overall Assessment	**0/+** Overall, this option may be an improvement to the status quo and would add significance to Te Mana o te Wai in freshwater management. However, this option may also impose new risks and uncertainty, resulting in additional costs to regional councils. This option may not have the desired effect during implementation.

Option D: Reframing Te Mana o to Wai in the current NPS-FM (recommended option)

This option proposes to reframe Te Mana o to Wai in the current NPS-FM by clarifying current provisions, further embedding the concept and requiring an approach that prioritises the essential value, health, and wellbeing of the waterbody.

This option does not consider legal wording such as *consider and recognise* or *recognise and provide for*, but seeks to add further certainty as to how the framework of Te Mana o te Wai can be applied in freshwater management, and in particular in the context of the NPS-FM.

We propose the following amendments to the NPS-FM:

1. Clarify the descriptor of Te Mana o te Wai so that it more clearly underpins the whole framework of the regulation. Since expanding the description of the concept in 2017, we've been working further to understand better how the concept fits within the overall NPS-FM.
2. Clarify how new and existing components of the NPS-FM relate to Te Mana o te Wai.
3. In addition to managing freshwater in a way that is consistent with Te Mana o te Wai, regional councils will be required to, in discussions with communities and tangata whenua:
    a) Determine local understanding of Te Mana o te Wai for local waterbodies.
    b) Establish a long-term vision and trajectory (ie multi-generational) for the waterbody to be articulated in regional policy statements. This step would involve:
        1. Understanding what communities and tangata whenua want their waterbodies to look like in the future.
        2. Understanding of the history of and current pressures on local waterbodies.
        3. Assessing whether the waterbodies can sustain current pressures and meet the aspirations communities and tangata whenua hold for the water.
    c) Report on whether freshwater management (including freshwater objectives and limits) is moving towards the long-term trajectory established by communities and tangata whenua.

We anticipate this option will impose some costs on regional councils to meet their requirements, and will result in social, cultural and environmental benefits in the short-term and long-term.

The analysis has been conducted in-house and we do not know the full extent of the costs and possible benefits of this option. We intend to gather further information on this option through consultation and to conduct further analysis of the impacts of this option.

Possible range of costs for additional engagement with hapū and iwi above baseline requirements have been identified in the 'Māori involvement for freshwater management: providing for Māori values of freshwater health' work stream (see Section 8 of this document). Further research is required to identify costs for engagement with communities, and additional requirements for reporting.

The Ministry recommends this option as the most effective option to meet the objectives and address the problems. The Ministry also assesses that this is the fairest and most efficient option that could result in the most benefits.

Criterion	**Option D Reframing Te Mana o te Wai, in the NPS-FM**
Effectiveness	+ This option would add further clarity and certainty to regional councils in terms of how they should give effect to the NPS-FM and Te Mana o te Wai requirements. This option would also be more effective in addressing the problems and meeting the objective of this work stream. It does also not carry the same risks, costs and ambiguity associated with option B and C.
Timeliness	+ This option may result in more environmentally conservative freshwater objectives and limits in plans that protect freshwater bodies and halt degradation. This option may also encourage more

	restoration efforts if communities and regional councils identify that the water will not be able to sustain current pressures on the water.
Fairness	**0/+** This option may involve some additional costs to regional councils when giving effect to the proposed additional requirements as a result of new steps requiring further engagement with communities and tangata whenua. However, we assess that these costs would be minimal and build on current requirements for engagement. This option does not impose direct requirements on other stakeholders, however when implemented, may result in costs to users if more environmentally conservative measures are required as a result of these proposals.
Efficiency	+ There would be additional costs to regional councils through greater expectations for engagement and reporting back to the community, which may also further impact regional council capability and capacity. Although we expect these costs to be low as these requirements build on current requirements to engage with communities in the NPS-FM. These additional requirements may also impact on the ability of regional councils to meet the 2025 timeframes, however, this risk could be mitigated through additional guidance and support from central government. This option could also result in immediate and future social, cultural and environmental benefits, in particular in relation to civic engagement, subjective wellbeing and cultural identity.
Principles of the Treaty of Waitangi	+ The principles of the Treaty of Waitangi are a key component of Te Mana o te Wai. This option would signal a greater recognition of the role of tangata whenua in freshwater management, as well as enabling a more integrated and holistic approach to managing freshwater. In combination with recommendations for better incorporation and recognition of Māori measures and values of freshwater system health, we anticipate that this option would enable broader values such as mahinga kai to be managed now and in the future. This option could also result in greater recognition of tangata whenua values and more conservative environmental limits to provide for the essential value of fresh water itself for the present and the future.
Overall Assessment	+ This option would help address the problems and meet the objective. The additional clarity reduces the risks that could arise as described in option B and C, while it has kept the flexibility that enables communities and tangata whenua to have a more active role in freshwater management and for their values to be recognised. It also has the additional benefit of ensuring communities and tangata whenua are informed on the state of their waterbodies. These amendments will also ensure an approach that prioritises the broader essential values of fresh water and that looks at the long-term, rather than focusing on the immediate. We anticipate cultural, social and environmental benefits to emerge as a result. However, we cannot assess the full extent of these benefits at this time. Further impact analysis will be conducted to assess possible benefits, as well as the costs.

These proposals are intended to be supported by the options to strengthen Māori values and measures in the NPS-FM. The assessment above is on the basis that options in that work stream are adopted. There are risks that without strengthening Māori values and measures in the NPS-FM, this may impact the way in which Te Mana o te Wai is applied and may impact the benefits that would emerge as a result of these options. Strengthening Māori values and measures in the NPS-FM would further support these proposals for Te Mana o te Wai.

Some of these risks may be mitigated through further work to strengthen capability and capacity for local government and tangata whenua to engage in freshwater management, as well as further guidance and support from central government.

We also identify a risk that 'exceptions' and 'maintain or improve' proposals in the NPS-FM may be in conflict with the concept of Te Mana o te Wai.

Options ruled out of scope, or not considered

Capacity and capability support

We also considered developing capacity and capability for regional councils to give effect to the NPS-FM requirements with regards to Te Mana o te Wai. While this is an important issue that needs to be addressed, we identified that amendments to the NPS-FM and new guidance for implementing the NPS-FM (and Te Mana o te Wai) is required at this stage.

Removing Te Mana o te Wai from the NPS-FM

This option was not considered as it would not be effective in meeting the objectives and opportunities of this policy.

Incorporate Te Mana o te Wai as part of the National Monitoring System (NMS)

The Ministry has considered incorporating a requirement for regional councils to report back on how Te Mana o te Wai provisions of the NPS-FM have been given effect to.

Although this option would increase accountability to regional councils to give effect to those provisions, this approach would not be effective to address ambiguity that currently exists in the NPS-FM or addressing the problem at this stage.

Incorporate Te Mana o te Wai into the National Planning Standards

The National Planning Standards are a new RMA tool to direct the use of a standardised structure of local RMA plans. The Ministry has ruled this out of scope as the planning standards will take up to seven years to implement. In addition we assess that directing regional councils to include an objective in their plans for Te Mana o te Wai would not be an effective mechanism to ensure the concept is upheld or given effect to meaningfully in freshwater management.

Amending the RMA to incorporate all principles of Te Mana o te Wai

This has not been considered as part of the Essential Freshwater work programme.

Recommendation

The Ministry recommends **Option D Reframing Te Mana o to Wai in the current NPS-FM**. The Ministry assesses that this option is the most practical, does not impose significant additional risks and costs to regional councils, and is most likely to result in social, environmental and cultural benefits in the long-term. Other options are either unclear or uncertain and there is a risk that, during implementation, they may not address the problems or meet our objective.

What do stakeholders think?

During the course of policy development, Te Mana o te Wai in the context of the NPS-FM and as a broader concept has been discussed with Kāhui Wai Māori (KWM), Regional Manager Group (RMG) and Local Government New Zealand (LGNZ), Science and Technical Advisory Group (STAG), Regional Sector Water Subgroup (RSWS), and the Freshwater Leaders Group (FLG). Discussions with the different groups were essential to identifying the problem, scoping potential options, and determining what we would like to achieve. These discussions were central to the shaping of the recommended option.

Kāhui Wai Māori

In particular, the Ministry worked with KWM on scoping different options for Te Mana o te Wai in the NPS-FM and developing a common understanding of Te Mana o te Wai for the purpose of the

Essential Freshwater work programme policy. This collaboration was fundamental to the understanding of Te Mana o te Wai and the development of these proposals.

Policy development with KWM was an iterative process whereby Ministry officials worked with members of KWM on different documents and discussed approaches directly with KWM. KWM provided the Ministry with their refined policy position in July 2019. This highlighted some differences between the Ministry's policy approach and KWM's policy approach, as well as some opportunities that could be further explored in the next stages. KWM are not currently convinced that the Ministry's recommended option meets their expectations. While they have broadly agreed with the policies in option D, they have recommended some amendments. The Ministry has reflected aspects of KWM's policy recommendations where possible. Other components were not included at this stage due to constraints on time to conduct the further analysis required, and due to some possible risks associated with aspects of their preferred approach. The Ministry is interested in further discussing KWM's recommendations through the consultation period.

KWM's official position and framing of Te Mana o te Wai is expressed in their report[222], and there is a high-level analysis of some of KWM's key recommendations in the table below. Where the Ministry does not currently agree or agrees in part, we intend to work with KWM through the consultation period to further explore their recommendations.

KWM key recommendations	The Ministry's current position and approach
Amending the descriptor of the narrative to reflect the principles and hierarchy of obligations described in their report.	The Ministry **agrees** in part. The Ministry agrees that the descriptor should include some principles and hierarchy of obligations to further clarify the framework in the context of freshwater management. However the Ministry considers that the descriptor should also contain some additional detail to assist regional councils with understanding and applying Te Mana o te Wai in the context of the NPS-FM, including descriptive components that more clearly point to tools in the NPS-FM.
Including a primary objective in the NPS-FM requiring councils to give effect to Te Mana o te Wai.	The Ministry **does not currently agree.** The Ministry has identified possible risks associated with requiring councils to give effect to Te Mana o te Wai without providing more sufficient and clear indications as to how councils are expected to give effect to Te Mana o te Wai. Analysis on the use of these terms is described in Option B. However, further analysis would need to be conducted to fully assess the impact of the amendment KWM are proposing.
Requiring that Te Mana o te Wai be used to inform the interpretation and implementation of the NPS-FM.	The Ministry **agrees** and this has been reflected in the draft NPS-FM.

[222] Kāhui Wai Māori. 2019. Te Mana o te Wai, the health of our wai, the health of our Nation. Kāhui Wai Māori Report to Hon Minister David Parker.

Reflecting the hierarchy of obligations in the objective of the NPS-FM.	The Ministry **agrees** and this has been reflected in the draft NPS-FM.
Directing councils to undertake immediate actions to implement Te Mana o te Wai to mitigate the risk that it would appear that there is a finite list of things councils must do in relation to Te Mana o te Wai.	The Ministry **agrees in part**. The Ministry does not want to risk giving the impression that there is a finite list of actions councils would need to take in relation to Te Mana o te Wai. However, the Ministry wants to find a balance between keeping Te Mana o te Wai flexible, but also adding sufficient certainty.

High-level comments

Broadly, all groups are supportive with the concept of Te Mana o te Wai as the framework for freshwater management.

Stakeholders	Views on Te Mana o te Wai problem and proposals
KWM	• KWM have recommended a long-term effort to embed Te Mana o te Wai across freshwater management, including in the NPS-FM but not limited to the regulation.
STAG	• STAG have identified Te Mana o te Wai as a framework for taking a more holistic and integrated approach to managing freshwater, and a framework that requires a better understanding of the relationships between Māori attributes of freshwater health and the numberic biophysical attribute states.
RMG	• Members of the Regional Managers Group agreed that Te Mana o te Wai was unclear in the NPS-FM, and that regional councils were uncertain how they were expected to meet the requirements on top of other requirements. • Some members were in support of Te Mana o te Wai as a framework for giving priority to the water itself. • Some also raised concerns of the 'newness' of Te Mana o te Wai in the NPS-FM. • Members also raised concerns of capacity and capability issues for regional councils and iwi and hapū to engage in the process.
RSWS	• The RSWS support the concept of Te Mana o te Wai as the overall framework for managing freshwater resources. • Some regional council members also raised that there was some uncertainty locally as to what was expected in the management of freshwater and how Te Mana o te Wai should be given effect to. • RSWS expressed that there is likely to be debate regarding which water uses are included and excluded in the second tier of the hierarchy (essential needs of people), and a further definition may be required.
FLG	• The Freshwater Leaders Group is supportive of Te Mana o te Wai as an integral part of the freshwater management framework. • In particular FLG support the hierarchy of obligation that the health of the water comes first, essential human needs come next, and only then can freshwater be allocated for economic use. • FLG also recommend that the development of better tools and regulation for governance and management practice should aim towards Te Mana o te Wai.

LGNZ	• LGNZ have identified that Te Mana o te Wai aligns with outcomes-based integrated catchment planning. • The proposed option reinforces that link by requiring regional councils to consider the long-term vision for local waterbodies.

Summary table of costs and benefits of the preferred approach

Affected parties *(identify)*	Comment*: nature of cost or benefit (eg ongoing, one-off), evidence and assumption (eg compliance rates), risks*	Impact *$m present value, for monetised impacts; high, medium or low for non-monetised impacts*	Evidence certainty *(High, medium or low)*
Additional costs of proposed approach, compared to taking no action			
Regulated parties	There is potential that this option could result in ongoing costs to regulated parties where more conservative limits are set for the water. This may also reduce supply of water to users, or require users to adopt innovative management methods that minimise impacts on the health of the waterbody (land use changes). This may have other associated social and economic impacts on businesses and landowners. We do not currently have the costs of these impacts. While we will attempt to identify these costs in future impact analysis, estimating these costs will be challenging as these policies would not have a direct or immediate impact on regulated parties.	Low/Medium. (this estimate is over the long-term) The impacts on users or regulated parties are uncertain, and will depend on the long-term trajectory identified locally, and on the management approaches and rules (or freshwater objectives and limits) set by regional councils to prioritise the water.	Low
Regulators	These proposals may add costs to the regulators to give effect to new policies. However, these are expected to be low. These proposals build on current direction in the NPS-FM. Regional councils are already expected to engage with communities and set objectives. We expect that these proposals would also mitigate costs to implement through clarifying current requirements and amending guidance.	Low	Low
Wider government	There will be costs to central government to amend existing guidance on Te Mana o te Wai that will support	Low	Low

	new proposals and amendments to the NPS-FM.		
Other parties	There may be long-term costs as a result of this option, particularly if more environmentally conservative limits or restoration efforts are required. These could have associated impacts on the economy, including job availability and people's income and consumption levels in the regions. However, these impacts are expected to be gradual over time as communities, tangata whenua and regional councils work together towards achieving healthier waterbodies in their regions.	Low/Medium (this estimate is over the long-term) However, it is difficult to assess what the costs may be in the longer term and would depend on how Te Mana o te Wai requirements are given effect to on the ground. It is also important to note that long-term costs and impacts would not be the sole result of Te Mana o te Wai, but an accumulation of the impacts from the overall Essential Freshwater work programme.	Low/ Medium
Non-monetised costs	Low	Low	Low

Expected benefits of proposed approach, compared to taking no action			
Regulated parties	The Ministry expects there would not be significant benefits to regulated parties.	Low	Low
Regulators	This option would add greater certainty for what is expected in relation to requirements of Te Mana o te Wai.	Low	Low
Wider government		Low	Low
Other parties	It is expected that this option would have short-term and long-term benefits to community and the environment overall and holistic wellbeing, that are difficult to put a monetary value on, but are significant. These include: - Improved civic engagement and governance as a result of greater	Medium	Medium

	engagement with communities in decision-making for and management of fresh water, greater information available to communities with regards to the state of their waterbodies, as well as more accountability and transparency requirements. - Cultural identity is reflected in freshwater management decision-making through greater recognition of what communities and tangata whenua value for their waterbodies. This could include more proactive management or protection of significant cultural sites, or efforts to restore the natural form and character of a waterbody, or to enhance the mauri of a waterbody. -Improved environmental state - It is also expected that waterbodies and the health of the water itself will be given priority, which could result in more conservative environmental limits that help manage and contribute to enhancing the health of the waterbody and its associated environments. In the longer-term, these proposals are expected to have associated benefits to people's subjective well-being and reconnect people back to their waterbodies.		
Total Monetised Benefit	Uncertain		
Non-monetised benefits	Medium	Medium	Medium

Appendix 10: Providing for Hydro-electricity Generation Infrastructure

Context

The NPS-FM requires regional councils to set freshwater objectives above any national bottom line given in Appendix 2. In freshwater management units where water quality is currently below a national bottom line, the interventions to achieve an objective above a national bottom line may restrict resource use because water users will be required to function within limits and methods to achieve freshwater objectives over time. For example, objectives to achieve nutrient levels in water could be achieved by restricting land use (eg limiting nitrogen discharges through consent conditions). The limits on resource use required to meet freshwater objectives may impact on the social, cultural, and economic benefits derived from them.

Although water quality must meet or exceed the national bottom lines, regional councils and communities can determine the pathway and timeframes for doing this. National bottom lines are not standards that must be achieved immediately.

Policy CA3(b) allows regional councils to set an objective below a national bottom line if there is existing significant infrastructure listed in Appendix 3. This policy recognises that the benefits derived from some infrastructure can be so great that they may justify freshwater objectives being set below a national bottom line.

Hydroelectricity Generation

New Zealand derives significant benefits from hydro-electricity generation in terms of security of electricity supply and renewable energy generation. However, damming water for generation storage also prevents natural flushing flows from occurring and can mean that aspects of water quality are affected. For example, periphyton will grow in response to the right combination of nitrogen, phosphorus, light, and temperature. The conditions that promote periphyton growth are complicated and dynamic, but in the right conditions periphyton will generally continue growing until there is a flushing flow.

Electricity is generated at about 100 sites nationwide but is dominated by large power stations like Manapouri.[223] Some of our major river systems like the Clutha, Waikato, and Waitaki have multiple dams. Hydroelectricity generation now provides 55–60 percent of New Zealand's electricity.[224] This renewable energy lessens our reliance on fossil fuels and contributes to reductions in our greenhouse gas emissions.

The first hydroelectricity schemes were built in the early 1880s. New schemes continued in the 20th century, including after World World II in response to a shortage of energy. The 1950s, '60s and '70s saw dams built on the Waikato, Waitaki, and Rangitāiki rivers. In 1990, a dam was built at Clyde on the Clutha River. No new large hydroelectric dams have been built since the 1990s.[225]

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[223] MBIE, *Energy in New Zealand* 2018. Wellington, New Zealand. Retrieved from https://www.mbie.govt.nz/document-library/

[224] Ibid.

[225] Martin, J. (2010). Hydroelectricity – Hydro, 19th and early 20th centuries. Retrieved March 4, 2019, from https://teara.govt.nz/en/ hydroelectricity/page-1

Dams also alter river flows and can affect the ecology of river systems.[226] The impacts of larger dams may extend hundreds of kilometres downstream.[227] Dams on the Waitaki River, for example, have reduced the variability of river flows and reduced the frequency of floods, which has caused more vegetation to grow in the river channel, altered the movement of sediment, and reduced the quality of habitat for sensitive aquatic species.[228] In some cases this can lead to negative cultural impacts for iwi with affiliations to these water bodies.

In many cases regional councils and communities must make decisions about competing values for their fresh water. For example, they may need to choose whether the benefits of holding back water for electricity generation better meets the purpose of the RMA than releasing water to improve water quality.

Policy CA3 of the NPS-FM provides regional councils with the option of recognising regional and local circumstances within the context of national values. The policy is intended to apply where councils have decided to provide for the national value of "hydro-electric power generation" in a freshwater management unit (an FMU) and have established that it isn't effective and/or efficient to improve water quality to meet a national bottom line without loss of significant economic and social benefits derived from existing infrastructure, including meeting international obligations for reducing greenhouse gases.

"Policy CA3

By every regional council ensuring that freshwater objectives for the compulsory values are set at or above the national bottom lines for all freshwater management units, unless the existing freshwater quality of the freshwater management unit is already below the national bottom line for an attribute or attributes and the regional council considers it appropriate to set the freshwater objective below the national bottom line for an attribute or attributes because:

a) the existing freshwater quality is caused by naturally occurring processes; or

b) any of the existing significant infrastructure (that was operational on 1 August 2014) listed in Appendix 3 contributes to the existing freshwater quality; and

> ***i) it is necessary to realise the benefits provided by the listed infrastructure; and***
>
> ***ii) it applies only to the waterbody, water bodies or any part of a waterbody, where the listed infrastructure contributes to the existing water quality."***[229]

Even if Policy CA3 applies, regional councils—

- must still set freshwater objectives; and
- are not required to set them below national bottom lines.

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[226] Nilsson, C., & Berggren, K. (2000). Alterations of riparian ecosystems caused by river regulation. BioScience, 50(9), 783–792. https:// academic.oup.com/bioscience/article/50/9/783/269505

[227] Schmidt, J., & Wilcock, P. (2008). Metrics for assessing the downstream effects of dams. Water Resources Research, 44(4), 19. https://doi. org/10.1029/2006WR005092

[228] Tal, M., Gran, K., Murray, A., Paola, C., & Hicks, D. (2003). Riparian vegetation as a primary control on channel characteristics in multithread rivers. In Bennet, S., & Simon, A. (Eds.), Riparian Vegetation and Fluvial Geomorphology (pp. 43–58). Washington D.C. American Geophysical Union.

[229] National Policy Statement for Freshwater Management 2014 (amended 2017), Policy CA3.

Policy CA3 gives regional councils the *option* to set a freshwater objective below a national bottom line where infrastructure is listed in Appendix 3 and other aspects of the policy apply. It is then up to regional councils to determine whether it is necessary to set freshwater objectives below national bottom lines under Policy CA3 to secure the benefits of existing infrastructure, while achieving the Act's purpose of sustainable management.

The exceptions framework therefore has two distinct parts:

- Central government discretion about what significant infrastructure should be listed in Appendix 3 (defining the outer bounds of where exceptions can apply)
- Regional council discretion about whether to apply exceptions within those bounds (if all other elements of the policy are satisfied).

The problem/opportunity

Regional councils need further guidance and direction from central Government to properly implement the NPS-FM. Although amendments to the NPS-FM in 2014 created the exceptions policy, they did not define where exceptions could apply by listing infrastructure in Appendix 3. The exceptions framework – an essential part of setting freshwater objectives – cannot be implemented.

Regional councils face public and political pressure to implement the NPS-FM and set freshwater objectives. The majority of regional councils will have final plan changes completed by 2022, including their freshwater objectives.

There is a risk that without listing any infrastructure in Appendix 3, these freshwater objectives will have to be set above national bottom lines regardless of whether Policy CA3(b) could apply. There could also be associated impacts on resource users if limits and methods are set to meet those higher freshwater objectives.

Listing infrastructure in Appendix 3 will not completely remove the risk that meeting freshwater objectives will require limits on resource use. Regional councils must make that decision based on the combined direction in the NPS-FM, other national policy instruments, their regional plan, and the RMA.

Objectives

The desired outcome is that regional councils are able to secure the benefits derived from existing infrastructure, and can balance national and regional benefits while working towards achieving desired environmental outcomes over time.

The primary benefits derived from hydro-electricity generation infrastructure are security of New Zealand's electricity supply, and renewable energy generation.

Options

Objectives

Ensure that the existing ambiguity is resolved. Strike an appropriate and sustainable balance between the competing interests of New Zealand's climate change obligations and the maintenance and improvement of freshwater quality and ecosystem health around New Zealand.

Criterion	Option B1: Populate Appendix 3 with hydro-electricity generation infrastructure by listing only New Zealand's six largest hydro-electricity schemes by generating capacity	Option B2: Modify CA3 to apply to all renewable electricity generation infrastructure	Option C: Rely on Transitional Exceptions under Policy CA4
Effectiveness	++	+	-
Timeliness	+	+	+
Fairness	0	+	-
Efficiency	++	++	-
Principles of the Treaty of Waitangi	-	-	+
Te Mana o te Wai	-	- -	0
Overall Assessment	++	+	0

Option A: Maintain the status quo

No infrastructure is listed in Appendix 3.

In FMUs where infrastructure is contributing to water quality being below a national bottom line, regional councils would have to set objectives above the national bottom line, and work with water users to determine how to achieve those objectives. This may include requiring more frequent flushing flows in rivers, and decreases in nutrient loadings to the river. Regional councils would have no additional options to secure the benefits derived from existing infrastructure, or to balance national and regional benefits while working towards desired environmental outcomes.

Potential costs under the status quo are:

- national bottom lines drive regional councils to set limits or implement methods that impact on the operations of in-stream infrastructure like hydro-electric power generation dams, and
- exceptions are not available to avoid or mitigate those impacts because Appendix 3 is empty.

Modelling[230] has identified potential impacts of setting objectives above national bottom lines in all FMUs containing a significant infrastructure that include:

- increases to the marginal cost of generating electricity and electricity consumer bills;
- lost revenue to the owners of hydro-electricity generation infrastructure;
- increase in costs arising from non-hydro replacement generation (eg coal and gas), including fuel, capital and operating costs, and increased CO_2 emissions.

[230] Halliburton T (2015) Assessment of the Impact of Flow Alterations on Electricity Generation. Prepared for the Ministry for the Environment and the Ministry for Primary Industries, 13 March 2015, Energy Modeling Consultants Ltd.

These can occur if there is:

- **Absolute loss of hydro-electricity generation output** across the year due to reduced diversions and increased spill (ie less water overall is stored and/or generated from); and/or

- **Loss of flexibility** from reduced ability for hydro generators to store water at low value times for use at high value times (ie more water will be released at time of low electricity demand/value, or more water will be held back in storage to ensure minimum flow requirements can be met). The impact of lost flexibility is far less pronounced than an absolute loss.

For example, the above could occur if a regional councils increases minimum flow requirements downstream of a hydro scheme, or requires the scheme to release additional flushing flows to mitigate downstream water quality effects. These are only two of many possible management options available to regional councils and communities to meet national bottom lines.

Potential impacts cannot be fully tested until regional councils define their freshwater management units, establish existing water quality, and decide on their freshwater objectives, including the limits and methods to achieve them over time. Ultimately impacts on the hydroelectricity generation sector, if any, will depend on the decisions regional councils and communities make.

Likelihood of potential impacts on hydro-electricity generation infrastructure

Although potential impacts can be significant, water quality will be above national bottom lines in most places. This means that potential impacts under the status quo may not eventuate.

Option B1: Populate Appendix 3 with significant hydro-electricity generation infrastructure by listing New Zealand's six largest hydro-electricity schemes by generating capacity

Option B2: Amend Policy CA3 to apply to all hydroelectric infrastructure

Infrastructure as 'schemes'

This option considers the population of Appendix 3 with 'schemes'. Although schemes are made up of a number of individual pieces of infrastructure (ie dams, diversions, and penstocks), the interdependent nature of all infrastructure within a scheme means that any benefits or impacts must be understood in terms of the whole scheme.

Both of these options to apply policy CA3 perform similarly against the defined criteria, providing additional certainty and flexibility to varying degrees:

- **Certainty** – listing a scheme in Appendix 3, or using a broad definition in Policy CA3, gives regional councils and communities certainty as to where Policy CA3(b) can apply and where freshwater objectives can be set below a national bottom line. This also gives hydro-electricity generators some certainty in that national bottom lines may not drive impacts on that scheme if a regional council chooses to apply an exception; and
- **Flexibility** – listing a scheme, or creating a broad definition, will mean councils have discretion to set a freshwater objective below a national bottom line in that instance.

However there are strong risks associated with increased flexibility:

- **A perception risk** – that Policy CA3(b) is perceived to enable regional councils to set freshwater objectives below a national bottom line for all FMUs listed in Appendix 3. This perception may undermine stakeholder confidence in the NPS-FM. For example, the Kahui Wai Māori have indicated a strong preference for exceptions to be kept to a minimum.

- **Administrative burden/delays** – regional councils may face additional costs in amending their regional plans if they have to consider setting freshwater objectives below national bottom lines under Policy CA3(b) in more instances. More discretion means they lose some of the benefit of the national direction to set all objectives above national bottom lines, and could increase the risk of legal challenge

NOTE: Under the existing Policy CA3(b) a regional council cannot set a freshwater objective below a national bottom line unless 1) existing water quality is already below that national bottom line when objectives are set, and 2) a listed scheme contributes to that existing water quality.

Policy CA3(b) only gives regional councils the **option** to set a freshwater objective below a national bottom line, and any decision to do so must comply with the RMA generally, and their regional plan in particular. A regional council together with the community can still choose to set a freshwater objective above a national bottom line even if Policy CA3(b) applies.

Include cross-reference to the National Policy Statement for Renewable Electricity Generation

As part of both options B1 and B2, it is desirable to ensure that all of our national direction works well together to ensure a smooth implementation of all of the instruments. For this reason, we have included in our analysis, further policy changes designed to more clearly define the relationship between the NPS-FM and the National Policy Statement for Renewable Electricity Generation (NPS-REG).

We recommend ensuring that regional councils consider their obligations to give effect to the NPS-REG while setting freshwater objectives for freshwater management units which contain hydroelectricity generation infrastructure by including a specific reference to the NPS-REG. This will not change the legal obligations faced by a Regional Council, it will simply remind them of their existing obligations. For this reason, this particular change, while assisting implementation should not have any additional impacts when compared with the status quo.

In addition to this and to make national direction more coherent, as part of both options we recommend including reference to the benefits of hydroelectric electricity generation under Policy CA2(f) as a matter that regional councils must consider when developing freshwater objectives for freshwater management units. We consider that this addition will also have minimal effect.

Ensuring an appropriate balance between water quality and the protection of New Zealand's hydroelectricity generation assets

It is vital to strike the appropriate balance the requirement to sustainably manage resources under the RMA, and New Zealand's international obligations to reduce our emissions. This translates into a balancing act between water quality, ecosystem health and the protection of New Zealand's hydroelectricity generation assets. The text of policy CA3 could usefully be clarified so that it is clear what must be protected if infrastructure is listed in Appendix 3. Policy CA3 could be amended to enable regional councils to set freshwater objectives for freshwater management units below national bottom lines in order **to avoid adversely impacting the generation capacity and responsiveness** of (either existing hydroelectricity generation infrastructure or infrastructure belonging to the six biggest schemes). Objectives cannot be set below the current state of the water quality. This change would clarify what CA3 requires of a regional council. The impact of this particular clarification will be considered as part of the impact of options B1 and B2 as a whole.

To mitigate the risk of regional councils not seeking to improve water quality on the basis of not being required to meet a national bottom line, add a new policy directing regional councils to consider whether it is possible to still improve water quality, while avoiding adversely impacting the generation capacity and responsiveness of existing hydroelectricity generation infrastructure. This would drive improvements in water quality.

Option B1: List New Zealand's six largest hydro-electricity schemes by generating capacity in Appendix 3

Criterion	Option B1: Populate Appendix 3 with hydro-electricity generation infrastructure by listing only New Zealand's six largest hydro-electricity schemes by generating capacity
Effectiveness	++ Protects 89 percent of NZ's hydro storage, ensures that bottom lines are still expected to apply in most catchments.
Timeliness	+ Provides immediate certainty for Regional Councils.
Fairness	**0** Meets both climate and water objectives, though provides unequal treatment of generators.
Efficiency	++ Through greater certainty, and stronger national direction favouring renewable energy this will make it easier for Regional Councils to make decisions in this area saving expense.
Principles of the Treaty of Waitangi	- This option seeks to balance the interests of climate change with freshwater quality. Māori have a strong connection with freshwater, though New Zealand has many climate dependent industries and cultural assets.
Te Mana o te Wai	-Objectives for Te Mana o te Wai may be undermined in catchments where objectives are set below national bottom lines.
Overall Assessment	++ Provides a balance between competing objectives of freshwater and climate change.

The six largest hydro-electricity schemes in New Zealand are the:

- Waitaki Scheme (including infrastructure operated by both Meridian Energy and Genesis), in the Canterbury Region;
- Waikato Scheme in the Waikato Region;
- Manapouri Scheme in the Southland Region;
- Clutha Scheme in the Canterbury Region;
- Tongariro Scheme in the Manawatū/Whanganui, and Waikato Regions; and
- Waikaremoana Scheme in the Hawkes Bay Region.

Together these schemes make up approximately 89 percent of New Zealand's hydro-electricity generation capacity.

This also means that the risks associated with increased flexibility would be further limited, while still enabling regional councils to set freshwater objectives below national bottom lines to secure the benefits of 89 percent of New Zealand's hydro-electricity generation capacity under Policy CA3(b).

Option B2: Amend CA3 to apply to all hydroelectricity generation infrastructure

Criterion	Option B2: Modify CA3 to apply to all renewable electricity generation infrastructure
Effectiveness	+ Provides significant protection for NZ hydro but opens up more FMUs to having objectives set below a national bottom line.
Timeliness	+ Provides immediate certainty for Regional Councils.
Fairness	+ Treats all generators equally.
Efficiency	++ Through greater certainty, and stronger national direction favouring renewable energy this will make it easier for Regional Councils to make decisions in this area saving expense.
Principles of the Treaty of Waitangi	- This option seeks to balance the interests of climate change with freshwater quality. Māori have a strong connection with freshwater.
Te Mana o te Wai	- - Similar to Option B1 except potentially more objectives will be set below national bottom. lines
Overall Assessment	**0** Prioritises climate change goals over freshwater.

This option, in effect, lists all hydroelectric schemes. Policy CA3 can be extended so that exceptions can apply to the whole class of infrastructure – without listing individual schemes. This would maximise regional councils' flexibility by enabling them to set freshwater objectives below national bottom lines in any situations where Policy CA3(b) applies. Unlike option B1, this would include a lot of smaller schemes.

This option has the benefit in that in has no market-distorting effect and treats all generators equally. However, these smaller schemes are unlikely to need exceptions because:

- It is difficult to justify that securing smaller amounts of generation outweigh the benefits of improving water quality to at least national bottom lines. A scheme's contribution to security of supply and renewable energy generation is proportional to its generation output – the smallest 90 percent of schemes make up only 11 percent of New Zealand's total hydro-electricity generation capacity.
- Feedback from regional councils indicates that they are reluctant to use exceptions, preferring instead to work towards objectives over time.
- Smaller schemes, particularly those with limited storage capacity, are less likely to contribute to existing water quality. In many cases these schemes are 'run of river' and cannot physically contribute to water quality at all.[231] This means that they are not an

[231] Hydro-electricity schemes generally have a limited interaction with water quality because they do not introduce contaminants (eg Nitrogen and Phosphorus). A scheme affects water quality through changes in flow regimes. For example, a large dam may contribute to Periphyton growth by reducing high flows and holding water back for storage. Although other sources like nutrient supply, light and temperature lead to increases in Periphyton, high flows are needed to tear or abrade Periphyton from the stream bed. Smaller schemes that have limited storage capacity are less likely to affect water quality within a freshwater management unit, because they unable to hold back significant amounts of water and alter the flow regime.

effective solution for managing water quality issues, and regional councils are unlikely to set limits, methods and targets that impact on them.

This option also maximises the risks associated with increased flexibility (ie perceptions risk and administrative burden as described above).

Option C: Remove Policy CA3 altogether and rely on Transitional Exceptions under Policy CA4

Criterion	Option C: Rely on Transitional Exceptions under Policy CA4
Effectiveness	- Resolves ambiguity, yet provides no protection for hydro schemes, hydro schemes would potentially have reduced capacity.
Timeliness	+ Provides immediate certainty for Regional Councils.
Fairness	- May require either land use change affecting resource users, or the diminished ability of a hydro scheme to operate.
Efficiency	- Applications to central government for listing in appendix 4 would be costly and time consuming.
Principles of the Treaty of Waitangi	+ Any transitional exceptions are decided with greater oversight on a case by case basis.
Te Mana o te Wai	**0** Similar to status quo.
Overall Assessment	**0** Prioritises freshwater at the expense of climate change priorities.

This option would see Appendix 3 removed from the NPS-FM and Policy CA3 amended. If a regional council considers that a freshwater objective above a national bottom line in a particular waterbody cannot be met because of the contribution of existing significant infrastructure, they may apply to Central Government to have the waterbody listed in Appendix 4, so that an objective can be set below the national bottom line for a transitional period.

Appendix 4 and Policy CA4 allow a regional council to set a freshwater objective below a national bottom line for a particular fresh water body for a specified period of time. No waterbodies have yet been included in Appendix 4.

Listing infrastructure in Appendix 4, rather than Appendix 3, better aligns with the policy intent of the NPS-FM – that regional councils should strive to meet national bottom lines in all water bodies across New Zealand. If a time period listed in Appendix 4 is going to expire and the regional council can still not establish a realistic set of targets to meet a bottom line for a water body, the regional council may apply to relist the water body.

This option does not send a strong signal from Central Government of the importance of renewable electricity generation. Further, it may not be possible for those affected water bodies to ever achieve a national bottom line during the life of the infrastructure, meaning that the option is not a real option.

One of the major difficulties with this option would be the time taken to review applications and to amend the NPS-FM. The NPS-FM would need to be amended every time an application was successful (though these would likely be timed with further amendments to the NPS-FM). Central Government would also have to undertake analysis on the catchment and proposed infrastructure, this would be time-consuming, costly and may require additional resourcing.

Options not considered

Delay listing infrastructure in Appendix 3

There are limited benefits to delaying and the problem becomes more contracted as the implementation deadline for the NPS-FM nears. This analysis considers the option to delay as part of maintaining the status quo. Any delay in populating Appendix 3 effectively maintains the status quo and its associated impacts until other options to populate the appendix are implemented.

Recommendation

Option A, to maintain the status quo does not achieve the stated objectives, performs poorly against the assessed criteria, and risks potentially significant (albeit unlikely) impacts on hydro-electricity generation. For these reasons we do not recommend maintaining the status quo.

Options B1 and B2 perform similarly against the assessed criteria. These options only vary in the number of schemes that would ultimately be listed, and the amount of flexibility they would provide to regional councils. **Option B1 (listing the six largest hydro-electricity schemes in Appendix 3) is considered the most balanced.** It achieves the stated objectives by giving regional councils options to use exceptions to secure the benefits of 89 percent of all hydro-electricity generation, while limiting the identified risks associated with too much regional flexibility.

Option C did not perform as well as the other options and, while providing legal certainty, does not meaningfully resolve the policy problem.

What do stakeholders think?

We conducted a series of workshops with the major generators (Meridian Energy, Mercury, Contact Energy, Genesis Energy & Trustpower) between November 2018 and April 2019. All generators want the existing ambiguity in the NPS-FM resolved through the inclusion of an exceptions regime and want the existing National Policy Statement for Renewable Electricity Generation (the NPSREG) strengthened. They stated that "the relationship between the NPS-FM and the NPSREG is not clearly articulated. The absence of clear direction could result in perverse outcomes where NPS-FM policies are unintentionally employed to constrain the ongoing operation of existing renewable electricity generation activities, contrary to the direction of the NPSREG."

An exceptions framework received mixed feedback from the Freshwater Leaders Group. Some members of the group were opposed to introducing a policy that would prioritise particular industries. However, other members of the group were more supportive and thought that the policy was justifiable on the basis of our climate change commitments.

The Kahui Wai Māori advisory group were strongly opposed to any exceptions framework. All members felt that national direction should treat all industries equally and that no industry should be prioritised over others. This perspective was taken into account and is reflected in the preferred option – that option being a compromise that extends the use of exceptions to only the six major schemes, thereby significantly limiting the number of waterbodies where objectives may be set below a national bottom line.

Summary table of costs and benefits of the preferred approach

Affected parties	Comment	Impact	Evidence certainty
Additional costs of proposed approach, compared to taking no action			
Regulated parties	N/A		
Regulators	N/A		
Wider government	The changes to the NPS-FM are already occurring.	Low	Low
Other parties	N/A		
Total Monetised Cost	Low	Low	Low
Non-monetised costs	Low	Low	Low
Expected benefits of proposed approach, compared to taking no action			
Regulated parties	The major generators will have certainty about their existing generation capacity and ability to respond Other resource users may not face significant restrictions on their current resource use if a Regional Council sets an objective below a national bottom line	Medium Low	Medium Low
Regulators	Regional Councils will have greater certainty and be able to more effectively set objectives in accordance with the NPS-FM	Medium	Medium
Wider government	N/A		
Other parties	Consumers will not face higher electricity prices	Medium	Medium
Total Monetised Benefit	Difficult to accurately quantify as dependent on decisions of Regional Council	N/A	N/A
Non-monetised benefits	High	High	Medium

Appendix 11: Maintaining or improving water quality

This document summarises the impacts associated with several options to address problems associated with existing NPS-FM requirements to maintain or improve water quality.

After analysing options, this document recommends progressing with Options B, D and E – that is, amending the NPS-FM to require regional councils to set more specific, measureable and time bound objectives, maintain the current state of water quality from a specified date, and provide more detailed direction on how they should report on whether water quality has been maintained over time.

Status quo

The NPS-FM currently requires regional councils to maintain or improve overall water quality within a freshwater management unit.[232] This is a minimum requirement; regional councils and communities can still choose to improve water quality.

In practice, this will be reflected in the freshwater objectives (desired outcomes in terms of specific measures of water quality called "attributes") and limits on resource use to achieve those.[233] When setting freshwater objectives, maintaining water quality means setting those objectives within the same attribute band (a defined range for attributes defined in Appendix 2 of the NPS-FM) as existing freshwater quality, or if bands are not defined, so that the value the attribute supports will not be worse off.[234]

In some situations, regional councils have to improve water quality and cannot maintain it. They will have to improve water quality if it is below a national bottom line (a specific concentration/level for attributes defined in Appendix 2 of the NPS-FM), or when managing *E. coli* (which must always be improved), unless an exception applies. Local requirements may also require improvement. For example, in the Waikato and Waipa rivers, settlement legislation and the resulting Vision and Strategy require improvement in water quality.[235]

'Existing freshwater quality' is defined as the quality of fresh water at the time a regional council sets objectives and limits – ie, a future plan change to implement the NPS-FM. Councils must implement the NPS-FM as soon as practicable, and no later than 2025 (or 2030, in limited circumstances).[236]

Problem

There are two problems associated with the status quo. Regional councils can allow water quality to decline in some circumstances, which directly contradicts the Government's objectives of halting declines and may lead to a net loss of value for New Zealand. There is also insufficient direction on how to demonstrate whether water quality has been maintained over time, which is contributing to

[232] Objective A2 of the National Policy Statement for Freshwater Management.

[233] Policy CA2 of the National Policy Statement for Freshwater Management.

[234] Policy CA2(e)(iia) of the National Policy Statement for Freshwater Management.

[235] Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act 2010; Ngati Tuwharetoa, Raukawa, and Te Arawa River Iwi Waikato River Act 2010; Note that both Acts provide that the Vision and Strategy has the status of a regional policy statement (which regional plans must give effect to) and prevails over a national policy statement if there is a conflict.

[236] Policy E1(b) and (ba) of the National Policy Statement for Freshwater Management.

uncertainty and may lead to unnecessary debate and litigation – and associated delays to regional planning.

Regional plans can currently permit freshwater quality to decline by:

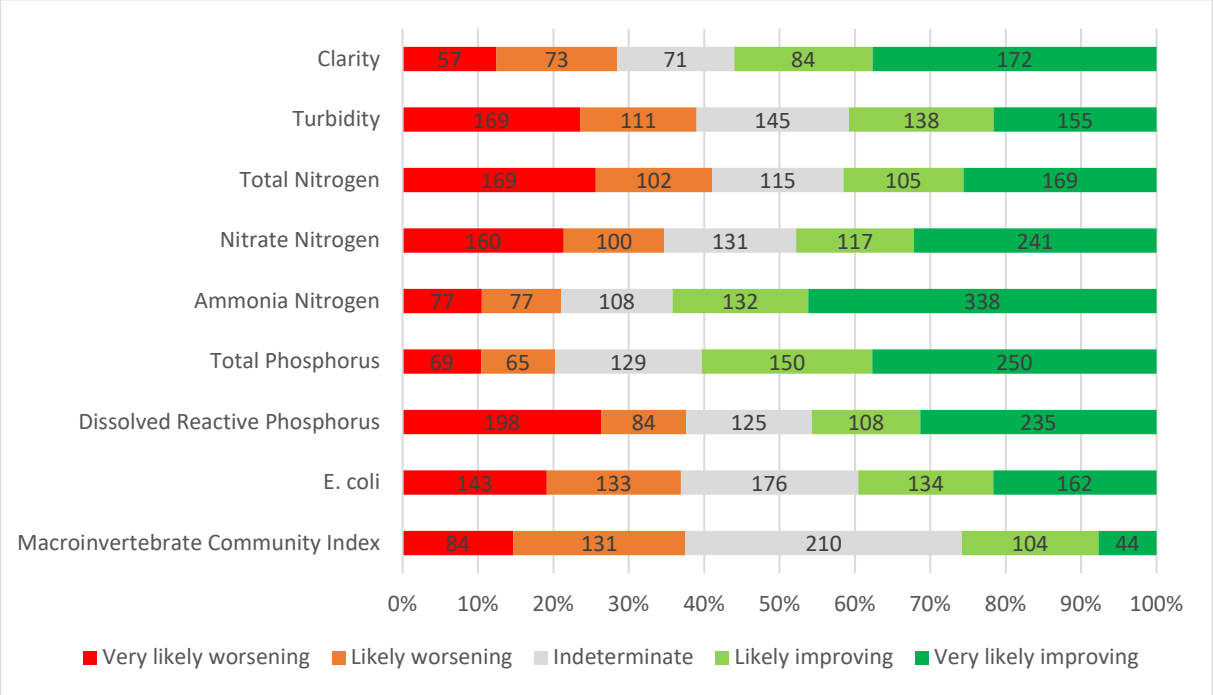
(a) Setting freshwater objectives that allow for declines within attribute bands; and
(b) Allowing water quality to decline prior to setting freshwater objectives in their regional plan. Any declines prior to setting freshwater objectives can be locked in by maintaining from a future state that is more degraded.

Feedback from the STAG indicates it is unclear how to demonstrate whether water quality has been maintained over time. This was also a common theme during submissions on amendments to the NPS-FM in 2017.[237]

What is the scale of the problem?

The Ministry for the Environment and Statistics NZ publish data for the current state of water quality as part of reporting under the Environmental Reporting Act 2015.[238] Figure 1 below illustrates trends at monitored sites, and whether they are degrading or improving with varying levels of confidence.

Figure 1: River water quality trends at monitored sites (2008 to 2017)



This information represents historic changes in water quality, and without more information should not be used to predict future performance. However, it does demonstrate that a significant portion

[237] Submissions report and recommendations on proposed amendments to the National Policy Statement for Freshwater Management 2014: http://www.mfe.govt.nz/publications/fresh-water/submissions-report-and-recommendations-proposed-amendments-national-policy

[238] https://data.mfe.govt.nz/data/category/environmental-reporting/

of monitored sites have experienced declining trends – in principle, these declines *could* continue and become 'locked in' as freshwater objectives are set.

Water quality data is also regularly published by regional councils on Land Air Water Aotearoa at: https://www.lawa.org.nz/.

How is ecosystem health affected under the status quo?

Feedback from the Science and Technical Advisory Group indicates that declines within attribute bands would represent real harm for ecosystem health. This is consistent with feedback from the New Zealand Freshwater Sciences Society and NIWA during 2017 amendments to the NPS-FM.

Narrative descriptions for attribute bands included in Appendix 2 provide straightforward descriptions about how ecosystem health and human health are impacted in different attribute bands. As water quality declines within a band those impacts increase in severity, for example:

(a) periphyton blooms can become more frequent, and last longer reflecting increased nutrient enrichment and/or alteration of natural flow regimes or habitat
(b) ammonia concentrations can increase leading to a greater proportion of species suffering toxic effects (reduced growth, death, etc)
(c) Dissolved oxygen levels can reduce leading to increased stress on, and reduced abundance of aquatic species.

The NPS-FM currently defines nine attributes that provide for ecosystem health and human health, with a total of 38 bands. Please refer to Appendix 2 of the NPS-FM for a complete list.

Who is affected and how under the status quo?

Declines in water quality negatively impact on the benefits we all derive from a healthy ecosystem – called 'ecosystem services'. These include *provisioning services* such as food and water; *regulating services* that affect climate, floods, waste, etc; *cultural services* that provide recreational, aesthetic, and spiritual benefits; and *supporting services* such as nutrient cycling.[239]

Ecosystem services have not been comprehensively valued in New Zealand – the Ministry for the Environment commissioned a review of New Zealand studies into the cost of degradation of freshwater ecosystems in terms of ecological, cultural, social and economic values.[240] However, valuations undertaken at smaller scales can provide an indication of their nature and scale.

For example, Lake Taupo provides tourism and recreation services attracting some 3.4 million visitors each year, contributing $414 million to the economy; its trout fishery is world renowned and is estimated to bring around $3.7 million into the local economy; it provides habitat for a wide range of birds, as well as indigenous fish and plants and at least 12 nationally listed threatened or at risk species; it stores up to 862,400,000 m^3 of water for hydroelectric generation on the Waikato River; contributes approximately 19,177,830 m^3 per year for domestic, agricultural and industrial uses;

[239] Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC – https://www.millenniumassessment.org/documents/document.356.aspx.pdf

[240] Dorner, Z. 2019, *A review of New Zealand studies into the cost of degradation of freshwater ecosystems* prepared for the Ministry for the Environment, and available on the MfE publications website.

waste water from several small townships around the lake as well as numerous farms is filtered through the lake after treatment or irrigation on to land.[241]

Declines in water quality can dramatically alter the value of services like this by reducing tourism appeal, affecting the abundance of trout and native species, increased algal growth creating costs for hydro-electric generation, requiring treatment of drinking water, etc.

A database produced by The Economics of Ecosystems and Biodiversity (TEEB), and referenced by OECD studies provides generic values for ecosystem services collected from a large number of studies – see Figure 2 below for average values relating to freshwater ecosystem services.[242] While these figures are not actual valuations of New Zealand's ecosystem services, they provide an indication of their potential scale.

Figure 2: Average monetary values for ecosystem services (USD/ha/year, 2007 price levels)[243]

	Coastal systems	Coastal wetlands	Inland wetlands	Fresh water (rivers/lakes)
Provisioning services	2396	2998	1659	1914
Regulating services	25847	171515	17364	187
Habitat services	375	17138	2455	0
Cultural services	300	2193	4203	2166
Total economic value	28917	193845	25682	4267

Permitting water quality to decline within attribute bands can also benefit individuals who derive value from a river or lake's capacity to transport/assimilate contaminants. However, this alters the flows and value of other services such as the provision of food and water, or ability to swim etc, and may represent a net loss of value.

Constraints on the analysis

Timeframes for policy development mean that:

(a) In-depth revision of existing attribute bands is not possible. For this reason, Option C is not considered feasible, although it is still described for completeness (see out of scope options below); and

(b) Impact analysis has been conducted using already available information. This means some impacts have not been quantified, and examples have been used to illustrate the nature and scale. Consultation will be used to assess these impacts in more detail (eg, costs imposed on regional councils).

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[241] Project summary report – Fresh water Ecosystem Services Project – Phase 1, Waikato Regional Council: https://www.waikatoregion.govt.nz/assets/WRC/Services/publications/technical-reports/2017/tr201704.pdf

[242] The TEEB Valuation Database, overview of structure, data and results, https://www.es-partnership.org/wp-content/uploads/2016/06/ESVD.-TEEB_Database_Report.pdf; The Economic Feedbacks of Loss of Biodiversity and Ecosystems Services, OECD Environment Working Papers No. 93: https://www.oecd-ilibrary.org/the-economic-feedbacks-of-loss-of-biodiversity-and-ecosystems-services_5jrqgv610fg6.pdf?itemId=%2Fcontent%2Fpaper%2F5jrqgv610fg6-en&mimeType=pdf

[243] As above.

Other options being considered in this package include the addition of new attributes. These will have additional impacts in terms of maintaining water quality, and is assessed in other sections of this document. Timeframes for implementing the NPS-FM have implications for maintaining water quality under the status quo (ie, potential for declines in water quality to be locked in).

Objectives

The objective of this analysis is to ensure that regional planning will maintain fresh water's ability to provide for ecosystem health (and other values that people derive from it).

Options

Options considered are not exclusive – in many cases they are designed to address different aspects for the problem, and are complimentary in nature. The table below summarises the relationship between options, and is followed by more detailed descriptions of each option and its impacts.

	Option B: Require regional councils to set more specific, measurable and time bound freshwater objectives at or above current state (rather than within a band)	**Option C:** Require regional councils to maintain the extent to which values are provided for	**Option D:** Direct regional councils to regularly report on specific matters that indicate whether water quality is, or is likely to be, maintained	**Option E:** Define 'existing freshwater quality' as at the date the redrafted NPS-FM is proposed (expected in July 2019)
Option B	[redacted]	**Alternatives**. Options B and C are exclusive, they are different approaches to the same aspect of the problem (setting plan objectives that will maintain).	**Complimentary**. Options B and D address different aspects of the problem (planning, and demonstrating water quality has been maintained over time).	**Complimentary**. Options B and E address different aspects of the problem (setting plan objectives that will maintain, and supporting this with an objective benchmark for maintaining.)
Option C	**Alternatives**. Options B and C are exclusive, they are different approaches to the same aspect of the problem (setting plan objectives that will maintain).	[redacted]	**Complimentary**. Options C and D address different aspects of the problem (planning, and demonstrating water quality has been maintained over time).	**Complimentary**. Options C and E address different aspects of the problem (setting plan objectives that will maintain, and supporting this with an objective benchmark for maintaining.)
Option D	**Complimentary**. Options B and D address different aspects of the problem (planning, and demonstrating water quality has been maintained over time).	**Complimentary**. Options C and D address different aspects of the problem (planning, and demonstrating water quality has been maintained over time).	[redacted]	**Complimentary**. Options D and E address different aspects of the problem (planning, and demonstrating water quality has been maintained over time).
Option E	**Complimentary**. Options B and E address different aspects of the problem (setting plan objectives that will maintain, and creating an objective benchmark against which to compare those.)	**Complimentary**. Options C and E address different aspects of the problem (setting plan objectives that will maintain, and supporting this with an objective benchmark for maintaining.)	**Complimentary**. Options D and E address different aspects of the problem (planning, and demonstrating water quality has been maintained over time).	[redacted]

The table below summarises how all options performed against criteria – this is expanded on in more detail for each option in the following sections.

Criterion	Option B (maintaining current state)	Option C (maintaining so that values are not worse off)	Option D (assessing and reporting on whether water quality has been maintained)	Option E (fix definition of existing freshwater quality to 2019)
Effectiveness	++	+	++	++
Timeliness	0	0	0	0
Fairness	0	0	0	0
Efficiency	+	0	+	+
Principles of the Treaty of Waitangi	0	0	0	0
Te Mana o te Wai	+	0	++	+
Overall Assessment	++	0	++	++

Option A: Status quo

This option would retain the NPS-FM as is, and is not considered effective as the identified problem will persist. Regional plans could permit water quality to decline within a band and may lock in declines that occur prior to implementation of the NPS-FM. The NPS-FM would continue to provide limited direction on how regional councils should demonstrate whether water quality has been maintained.

Associated impacts (described under the status quo and problem on pages 3 and 4) could continue, and result in a net loss of ecosystem services.

Option B: Require regional councils to set more specific, measurable and time bound freshwater objectives at or above current state (rather than within a band)

This option would amend the policy direction within the NPS-FM, directing regional councils to set freshwater objectives that are:

(a) set at or above the current state of water quality (rather than within the same attribute band)
(b) explicit about the site/s they apply to
(c) explicit about when they will be achieved
(d) explicit about how success will be measured (ie, sampling requirements, statistical methods and any models used).

The option is considered effective as it would ensure that regional councils cannot permit water quality to decline within attribute bands. To the extent that this would prevent negative impacts on ecosystem health, it would also contribute to Te Mana o te Wai (acknowledging that it may not be sufficient to maintain water quality).

It would also mean freshwater objectives better enable/clarify how regional councils should assess whether water quality has been maintained by being more specific, measurable and time bound from the outset. However, discussions with the STAG have made it clear that simply assessing whether freshwater objectives have been met is not sufficient to assess whether water quality has been maintained in a meaningful way – see Option D which complements this option to increase efficacy in this regard.

This option would also delete the word "overall" from Objective A2. This is intended to avoid situations where the objective is interpreted as regional councils to disregard or deviate from the above direction (eg, by intentionally allowing some sites or attributes to decline while improving others).

It is also important to note this option, while stricter than the status quo, recognises that some variability in water quality is unavoidable:

(a) Water quality is inevitably monitored at a finite number of sites that represent areas/parts of a catchment within which water quality will vary.
(b) The current state of water quality is subject to sampling error and represents range that will vary depending on the desired level of confidence and available data.
(c) The current state of water quality is determined according the relevant attribute statistic, generally a median or other percentile measures over a longer term (eg, annual median), and water quality will vary within these periods.
(d) Freshwater objectives need to be translated into resource use limits, and do not by themselves imply any restriction. There is significant flexibility in how regional councils choose to maintain water quality at current state (eg, which activities are restricted and how).

Implementation would rely on regional planning timeframes

To have a concrete effect on water quality, the NPS-FM must be implemented through regional planning. This is often a time-consuming and costly process and this option, by itself, does not perform well against the timeliness criteria.[244] However, this option should not be seen in isolation of other proposals in this package designed to regulate resource use and avoid declines in water quality in a more direct and timely manner (see appendices 14 to 21).

The Government is also progressing amendments to the Resource Management Act 1991, to enable faster implementation of the NPS-FM.

Opportunity costs

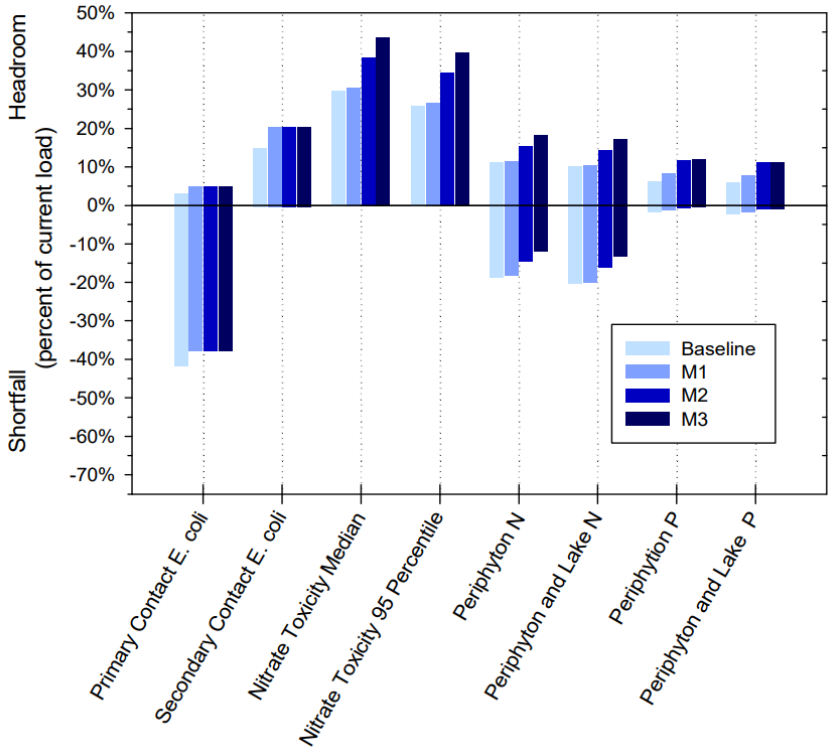
The option is considered efficient. We anticipate it will lead to regional plans that restrict or prevent future resource use – it does not impose real costs on individuals, although it does create opportunity costs (eg, additional discharges or land-use intensification could only occur if they do not degrade water quality, this can be achieved through mitigations that carry an additional cost that would not otherwise be incurred).

[244] The Ministry for the Environment maintains a National Monitoring System that collects data on plan-making processes, and is published on the Ministry's website: http://www.mfe.govt.nz/rma/rma-monitoring/about-national-monitoring-system.

National modelling illustrates 'headroom' or 'shortfall' associated with current water quality relative to attribute bands and national bottom lines (Figure 3 below).[245] 'Headroom' is expressed as the potential increase in contaminant loads if water quality is currently partway between attribute bands. 'Shortfall' is expressed as the necessary reduction in load needed to achieve a national bottom line if water quality is currently below it. Headroom can be further increased through mitigations, eg, on-farm practices or changes in infrastructure management that reduce in-stream concentrations of a contaminant. Figure 3 illustrates national-scale modelling results. Headroom and shortfall vary significantly by contaminant and region. The full report is available on the Ministry for the Environment's website and provides a more detailed breakdown.

Note the above modelling considers each attribute in isolation, and Figure 3 must be interpreted with care. Headroom illustrated for Nitrate Toxicity should be discounted as, in most cases, Nitrogen concentrations needed to achieve periphyton outcomes will be more constraining (except in rivers that do not support periphyton growth).

Figure 2: Modelled headroom and shortfall of contaminant loads if maintaining water quality within a band (including if mitigations are applied).



In any case, it is important to note that the requirement to maintain water quality already exists, and any impacts (whether they are real or opportunity costs) are marginal. National modelling indicates that the reduction in headroom is between 0.8-6.4 percent of current load for most attributes (ie,

[245] Modelling national land-use capacity: Exploring bottom lines and headroom under the NPS-FM 2014: http://www.mfe.govt.nz/publications/fresh-water/modelling-national-land-use-capacity-exploring-bottom-lines-and-headroom

the ability to increase discharges compared to current levels).[246] Impacts must also be further discounted for the following:

(a) In many situations freshwater quality is already below the national bottom line and must improve – and maintaining water quality is not an option.
(b) Maintaining *E. coli* concentrations is not an option and the NPS-FM already requires continuous improvement in *E. coli* concentrations over time.
(c) Proposals will have limited impact in the Waikato and Waipa catchment, where Treaty settlement legislation and the resulting Vision and Strategy for the catchment take precedence over the NPS-FM and already requires improvement.
(d) Headroom does not imply that individuals can, or will, intensify land use. Land use change is the result of many drivers and barriers, including biophysical constraints, economics, societal pressures, and personal factors – all of which interact in complex ways.[247]
(e) Other proposals will also constrain intensification of land use, and any costs should not be double-counted.

Risk of lag effects creating real costs

In some circumstances, delayed impacts on water quality (eg, from historic and existing land use, and complex interactions between surface and ground water) may mean that maintaining water quality actually requires reduction in existing discharges and/or changes in land use. This is sometime referred to as a 'lag effect' or 'the load to come' where water quality is expected to get worse before it gets better. While this is extremely difficult to predict, we acknowledge it is a possibility can impose real costs on resource users.[248]

Lag effects still represent a decline in water quality and the benefits we derive from it. We consider that they can be addressed through freshwater objectives with longer timeframes for achievement, providing sufficient time to implement restrictions on resource use if necessary, and achieve improvements in water quality of over realistic timeframes. This may be politically difficult for regional councils and require intergenerational effort, and reporting requirements described under Option D would provide an opportunity to communicate this to communities.

Performance against criteria

Criterion	Option B (maintaining current state)
Effectiveness	**++**
Timeliness	**0**

[246] Modelling national land-use capacity: Exploring bottom lines and headroom under the NPS-FM 2014: http://www.mfe.govt.nz/publications/fresh-water/modelling-national-land-use-capacity-exploring-bottom-lines-and-headroom; Note that headroom reductions in headroom appear higher for the N Toxicity attribute, however this figure should be disregarded as the N levels to achieve Periphyton outcomes will be more constraining.

[247] Analysis of drivers and barriers to land use change, A report prepared for the Ministry for Primary Industries: https://www.mpi.govt.nz/news-and-resources/science-and-research/land-use-change-report/

[248] Estimation of lag time of water and nitrate flow through the vadose zone: Waikato and Waipa River catchments, Waikato Regional Council Technical Report 2018/31: http://www.waikatoregion.govt.nz/assets/WRC/Services/publications/technical-reports/HRWO-trs/TR201831.pdf. This report presents a methodology and results for predicting the time taken for nitrate to travel from the land surface, though the unsaturated (vadose) zone and into shallow groundwater.

Fairness	**0**
Efficiency	**+**
Principles of the Treaty of Waitangi	**0**
Te Mana o te Wai	**+**
Overall Assessment	**++**

Option C: Require regional councils to maintain the extent to which values are provided for

Where attribute bands are not defined (eg, any attributes regional councils identify locally), the NPS-FM currently directs regional councils to set freshwater objectives *so that the values they provide for will not be worse off compared to existing freshwater quality*. This is referred to as the 'values test'.

This option would seek to apply the values test to all freshwater objectives to maintain water quality, and remove existing direction that they should be set within the same attribute band as existing freshwater quality. This is an alternative to Option B.

This option is not considered effective. In practice, it is likely to mean that regional councils have to justify allowing any declines in water quality from current state. But it implies that some level of change in water quality is acceptable, while providing limited direction on what that is (ie, only that changes are acceptable if ecosystem health and other values are not worse off). There is a risk this will lead to inappropriate freshwater objectives and declines in water quality, and continued uncertainty about how regional councils should assess whether water quality has been maintained.

This option is also not considered efficient. The relationship between water quality and the values it provides for is complex and difficult to prove. This option would require regional councils to make significant judgments about how much change in water quality is acceptable without clear evidence to support those decisions, which is likely to contribute to unnecessary debate and litigation (and associated costs), and delays in implementation.

Performance against criteria

Criterion	Option C (maintaining so that values are not worse off)
Effectiveness	**+**
Timeliness	**0**
Fairness	**0**
Efficiency	**0**
Principles of the Treaty of Waitangi	**0**
Te Mana o te Wai	**0**
Overall Assessment	**0**

Option D: Direct regional councils to regularly report on specific matters that indicate whether water quality is, or is likely to be, maintained

This option would require regional councils to regularly report on whether water quality has been maintained or improved in the following two ways:

(a) A narrow assessment of whether freshwater objectives have been achieved (ie, assessing performance against specific freshwater objectives for individual attributes and sites).
(b) A broader assessment of whether water quality has been, or is likely to be, maintained having regard to:
    i. **The overall state of ecosystem health and other identified values** in a catchment.
    ii. **Changes in states** and trends across multiple attributes and sites, including for any other measures (eg, of ecosystem health) required under the NPS-FM (see appendix one for a discussion of ecosystem health metrics).
    iii. **Changes in pressures** on ecosystem health and other identified values, including changes in takes and sources of contaminants, as well as natural processes and climate influences.
    iv. **Predicted changes** in any of the above, both in terms of human activity and natural processes.
    v. **Responses and actions** to address any of the above, including implementation progress.

    and recognising that regional councils must exercise judgment about what this information means.

Advice from the STAG has made it clear that Option A, by itself, will not be sufficient to understand whether water quality has been maintained in a meaningful way. In practice, water quality information for individual attributes and sites is unlikely to provide a clear answer, for example because it may be too early to tell if freshwater objectives will be achieved (because they are set to be achieved at a future date). Information about changes in pressures/inputs, implementation progress, and predicted changes in quality can help understand whether freshwater objectives are likely to be achieved and whether planning is on track.

States and trends are likely to be mixed between different attributes and sites in a catchment. Additional information and analysis of similar information (to the above) will be needed to understand what this means for ecosystem health (and other values) and the catchment as a whole.

Reporting would be required at intervals of not more than five years, to align with reporting on the state of the environment and efficacy of regional plans required under s35 of the Resource Management Act 1991.

Note that the NPS-FM already requires regional councils to report on:

- progress towards achieving freshwater objectives
- the extent to which values are being provided
- mandatory monitoring methods (eg, MCI)
- accounting of all takes and sources of contaminants
- implementation progress.

This option would rationalise existing reporting requirements into a single part of the NPS-FM, and make it clear that they need to be considered in the context of reporting on whether water quality has been maintained.

This option is considered effective as it clarifies how regional councils should demonstrate whether water quality has been maintained, ie, via a reporting requirement that must contain specific information. It requires an objective assessment of whether freshwater objectives to maintain have been achieved. It also acknowledges this will not be sufficient to know whether water quality has

been maintained in a meaningful way, and directs regional councils to consider specific types of additional information and exercise judgment about what that means.

To the extent that reporting has regard to a broad range of information (not just water quality data for individual attributes and sites), and is focussed on the extent to which ecosystem health and other identified values are provided for, it will contribute to Te Mana o te Wai, which is itself a boarder concept than physio-chemical measures of water quality.

This option is expected to create some additional costs for regional councils, to undertake additional analysis and production of reports. This cost has not been assessed at this stage, and further analysis of the costs will be needed following consultation.

Performance against criteria

Criterion	Option D (assessing and reporting on whether water quality has been maintained)
Effectiveness	++
Timeliness	0
Fairness	0
Efficiency	+
Principles of the Treaty of Waitangi	0
Te Mana o te Wai	++
Overall Assessment	++

Option E: Define 'existing freshwater quality' as at the date the redrafted NPS-FM is proposed (expected in July 2019)

The current definition of 'existing freshwater quality' means that it is assessed at the time of setting freshwater objectives and limits, and again as part of future plan reviews. Any decline in water quality before that can be locked in, in that water quality could be maintained from a degraded state.

This option would create a fixed definition of 'existing freshwater quality', which would mean the better of:

(a) freshwater quality at the date the redrafted NPS-FM is proposed; or
(b) freshwater quality at the time a regional councils sets freshwater objectives and limits.

Freshwater quality in this context is better if it provides for ecosystem health or other identified values to a greater extent. Where identified values conflict (eg, communities identify extractive/human use values such as the ability to irrigate), ecosystem health and human health prevail.

Regional councils would have to maintain water quality at that state, regardless of any declines before setting freshwater objectives and limits – these would only necessitate improvements. If water quality has improved since 2017, regional councils would need to maintain water quality from that point.

This option is complimentary to Options B or C (note B is preferred).

This option is considered effective, in that it eliminates the possibility of regional plans locking in declines in water quality if they occur prior to implementation of the NPS-FM. To the extent that this would prevent negative impacts on ecosystem health, it would also contribute to Te Mana o te Wai (acknowledging that it may not be sufficient to maintain water quality).

Risk of insufficient information to know water quality as at 2019

There is a risk that regional councils currently have insufficient data to assess water quality as at 2019. In some cases (eg, dissolved oxygen, sediment) requirements to monitor and manage attributes are novel, and it is unlikely that regional councils have sufficient data. This may contribute to additional debate, litigation and delays (and the associated costs).

However, this risk is not unique to the option being considered. Regional councils are already required to set freshwater objectives and limits by 2025 (or 2030 in some circumstances), regardless of the monitoring data available to them. Regional councils will inevitably have to model or estimate water quality where monitoring data is insufficient, and some level of debate and litigation is unavoidable.

In any case, uncertainty about the state of water quality in 2019 would be short-term. Once a baseline has been set, future planning will not have to revisit these issues.

Performance against criteria

Criterion	Option E (fix definition of existing freshwater quality to 2019)
Effectiveness	++
Timeliness	0
Fairness	0
Efficiency	+
Principles of the Treaty of Waitangi	0
Te Mana o te Wai	+
Overall Assessment	++

Options ruled out of scope, or not considered

Revising attribute bands

This is an alternative to Options B or C, but has not been explored in detail due to time constraints.

The option would look to revise existing attribute bands to ensure that declines within a band do not represent real harm to ecosystem health or human health (ie, the values that they provide for). In principle, attribute bands could be changed (eg, additional narrower bands added) to ensure ecosystem health or human health is not worse off if water quality declines within a band, while still allowing for some variability in water quality. This has the potential to be more efficient than Option B, if it would avoid unnecessary constraints on resource management.

However, developing new attribute bands would require analysis of all attributes and the sensitivity of ecosystem health and human health to changes in state. This analysis has not been undertaken and there may be no difference between this and Option B (eg, if revised bands are so narrow that they are not practically different to current state).

Statement on criteria

All options have been assessed against the following criteria, with key differences discussed in the description of options above.

(a) **Effectiveness**: The option provides a solution to the problem. The problem has been completely addressed.
(b) **Timeliness**: The option prevents further degradation of fresh water in New Zealand in a timely fashion.
(c) **Fairness:** The option treats all stakeholders (rural, urban, future and current generations) equitably. The costs fall on those that contribute to the problem and not other parties (ie, on central or local Government).
(d) **Efficiency:** The option is cost-effective. The option achieves maximum benefits with minimum wasted effort or expense.
(e) **Principles of the Treaty of Waitangi:** The option appropriately provides for the principles of the Treaty of Waitangi. The option promotes partnership and protects Māori rights/interests and relationships with their taonga. You can read about the principles of the Treaty here: https://www.waitangitribunal.govt.nz/treaty-of-waitangi/principles-of-the-treaty/.
(f) **Te Mana o Te Wai:** The option puts the well-being of the water first, and promotes values-based (based on the needs of the community), holistic management to sustain the wellbeing of the people. The option acknowledges mātauranga Māori.

Recommendation

The Ministry for the Environment recommends progressing Option B, D and E. We consider that this combination of options will effectively address the risk of water quality declining, and provide regional councils with appropriate direction on how to determine whether water quality has been maintained.

We note the combination of options still requires regional councils to exercise judgment and this may contribute debate, litigation and delays. However, these risks are not materially different from those of the status quo, and are inherent in New Zealand's devolved system of regional decisions making in resource management. We consider the recommended options are still an efficient way to address the identified problems when compared to the status quo.

All options perform the same as the status quo in terms of fairness and the principles of the Treaty of Waitangi. They treat all stakeholders equally and without distinction, and do not materially impact on the Crown's obligations under the Treaty of Waitangi when compared to the status quo.

However this should not be taken to mean that proposals have no significance in terms of the principles of the Treaty of Waitangi. We note the management of water and constraints on resource use are significant issues for Māori, and this is a much larger policy problem than that considered here.

Summary table of costs and benefits of the preferred approach

Affected parties *(identify)*	**Comment**: *nature of cost or benefit (eg ongoing, one-off), evidence and assumption (eg compliance rates), risks*	**Impact** *$m present value, for monetised impacts; high, medium or low for non-monetised impacts*	**Evidence certainty** *(High, medium or low)*
Additional costs of proposed approach, compared to taking no action			
Regional councils	Administrative costs involved in analysis and production of reports (eg, analysing monitoring results, statistical analysis, procuring relevant expertise, etc).	Unknown, subject to consultation.	Low
Resource users	Opportunity cost, additional discharges and intensification of land use can only occur with mitigations that mean water quality will not decline. Note this is currently an un-costed externality.	Low, 0.8-6.4 percent reduction in headroom for additional contaminant loads – a marginal change from status quo as scope for additional discharges and intensification of land use is already limited.	Medium
Total Monetised Cost	This has not been quantified, and is unlikely to be helpful when considering the changes proposed here in isolation. For a better indication of monetised impacts, readers should refer to analysis of including new attributes (which must then be maintained) as well as historic analysis of including the existing attributes. Further impact testing of the package as a whole is also likely to provide more information, and will be completed following consultation.	-	-
Non-monetised costs		Low	Low
Expected benefits of proposed approach, compared to taking no action			
Public	Avoided declines in water quality, which may result in loss of ecosystem services.	High, although not quantified we note ecosystem services for non-protected wetlands on fertile lands are estimated at ~$1.5b alone (see appendix 13).	Low
Total Monetised Benefit	This has not been quantified, and is unlikely to be helpful when considering	-	-

	the changes proposed here in isolation. For a better indication of monetised impacts, readers should refer to analysis of including new attributes (which must then be maintained) as well as historic analysis of including the existing attributes. Further impact testing of the package as a whole is also likely to provide more info, and will be completed following consultation.		
Non-monetised benefits		High	Low

Appendix 12: Direction to Territorial Authorities to Support Integrated Management

Context

Regional and district roles under the RMA in relation to freshwater management

Regional councils have primary responsibility for managing freshwater, set out in Section 30 of the RMA. Their functions include:

- the control of the use of land for the purpose of:
    - the maintenance and enhancement of the quality of water in water bodies and coastal water
    - the maintenance of the quantity of water in water bodies and coastal water
- the control of discharges of contaminants into or onto land, air, or water and discharges of water into water.

City and district councils (collectively called Territorial Authorities/TAs) have a more limited role in relation to water. Their functions are set out in section 31 of the RMA and include the control of the effects of the use, development, or protection of land. However, they have a wider function of integrated management of the effects of land use on natural and physical resources.

Current direction under the NPS-FM

The NPS-FM currently contains the following policies relating to integrated management across regional council and territorial authority functions:

- *Policy C1: By every regional council…. b) managing fresh water and land use and development in catchments in an integrated and sustainable way to avoid, remedy or mitigate adverse effects, including cumulative effects*
- *Policy C2: By every regional council making or changing regional policy statements to the extent needed to provide for the integrated management of the effects of the use and development of: a) land on fresh water, including encouraging the co-ordination and sequencing of regional and/or urban growth, land use and development and the provision of infrastructure.*

The requirements are specific to regional councils. The NPS-FM contains no explicit direction to territorial authorities (other than Part D on engagement with Māori, which applies to all local authorities).

Current practice in relation to managing effects of land use on urban water

Regional councils set objectives, policies and rules in their regional policy statements and plans in relation to discharges to water. In urban areas, this largely relates to discharges from wastewater and stormwater networks. In general, TAs are required to apply for consents from regional councils for these activities (other than for smaller scale discharges in some regions), and the consents can set relevant conditions. Historically, the spatial extent and conditions of these discharge consents has varied greatly, making the management of cumulative effects very difficult – especially in relation to managing diffuse pollution from stormwater discharges. As a result, there is a clear trend toward councils issuing 'global' consents that cover an entire stormwater network or sub-catchment, which lend themselves to improved integrated catchment planning.

Beyond this, current practice in terms of directing the management of stormwater, and effects of urban development on freshwater bodies, is variable. Regional councils are able to direct other

district plan content through their regional policy statements, but this function is not widely used for managing the effects of urban development on freshwater bodies.

Some regional councils provide additional direction to TAs through their regional policy statements or guidance about managing the effects of urban development on water, including encouraging the development of stormwater management plans that sit within an integrated catchment planning framework. In some cases, stormwater plans are required under regional plans, but in others they are encouraged rather than required.

Similarly, good practice to reduce the impacts of land-use related discharges (eg, water sensitive urban design or low impact design) is encouraged through regional plans in some regions, but generally is not required.

Several regional councils also provide support to TAs to carry out non-compulsory good practice, including by:

- providing design guides and other guidance
- forming cross-council stormwater groups
- providing input into district stormwater management planning
- providing assistance and advice to TAs.

Some TAs already take a proactive approach to managing the effects of urban development on fresh water, for example through applying water sensitive design and using green infrastructure. This is becoming more widespread, and is considered on a development-by-development basis. However this is not compulsory and is not undertaken by all TAs.

The problem/opportunity

Although urban water bodies make up a small fraction of freshwater in New Zealand, they are highly valued ecosystems that offer refuge to some of our most threatened species. Unfortunately, these waterbodies are also some of our most degraded. Freshwater ecosystems, and the values derived from freshwater, are negatively impacted by a range of land-use activities in the urban environment, including increased pollution and unnatural flows off of impervious surfaces and the degradation of stream channel habitat. This is a multifaceted problem and there are a number of work programmes looking at different related challenges and how to address them.

This RIS looks at one particular aspect of the problem: a lack of integration between decision-making by regional councils (with whom primarily responsibility for environmental management of water rests) and territorial authorities (with whom primarily responsibility for managing land use for urban development rests).

This lack of integration between regional council and territorial authority functions under the RMA is the result of several factors:

- although integrated management of natural and physical resources is part of the functions of both regional councils and territorial authorities under the RMA, the RMA does not provide any direction about how territorial authorities should provide for this integration in relation to water[249]

[249] Other than a general requirement for district plans to give effect to regional policy statements, and not be inconsistent with regional plans in relation to functions under Section 30(1).

- both have land use functions but regional councils rarely exercise this function in urban areas, for example to limit impervious surfaces for managing the effects on freshwater bodies
- the requirements of the NPS-FM focus on regional councils; for integrated management they focus on regional councils amending regional policy statements (RPSs)
- regional councils can direct district plans through their RPS, but this isn't always reflected well in district plans because of the time lag between an RPS becoming operative and the subsequent district plan change giving effect to it
- many of the levers available to territorial authorities that may have the potential to have the greatest positive effect for freshwater management (eg, infrastructure provision, investment, and matters regulated under the building code) are not regulated under the RMA
- territorial authorities often have competing priorities, including providing for urban development, which create an incentive for them to deprioritise water in favour of those matters.

An outcome of this lack of integration is that city and district councils view their role in freshwater management as limited to complying with water and discharge permits, leaving the bulk of the responsibility to plan for, and manage effects on urban water bodies with regional councils.

City and district councils are however uniquely placed to promote better integrated catchment management, particularly in urban areas, due to their role in managing infrastructure and land use activities. Enabling city and district councils to play a more proactive role in integrated catchment management would mean that land-use and infrastructure development planning would increasingly consider impacts related to Te Mana o Te Wai and the community's values for the health of downstream receiving environments. Ensuring that TAs have clear responsibilities for contributing to meeting regional freshwater objectives will likely increase scrutiny over planned or existing urban land use and hasten the application of best practice in urban development and the design of the built environment. This will be critical to achieving positive outcomes under the NPS-FM.

Some of the types of measures that can help manage the effects of urban development on water quality are:

- protection of streams and stream habitat, or restoration where degradation has already occurred
- use of best practice 'Water Sensitive Urban Design' or 'Low Impact Design' techniques, including regulating impervious surface cover, requiring on-site infiltration, and provision of green infrastructure for stormwater management (this can be promoted through guidelines or by working closely with land developers during initial structure planning and design phases)
- using zoning/designations to avoid all, or certain types of development in areas where the effects on fresh water could not be adequately managed (eg, where sensitive receiving environments exist, such as wetlands or areas for mahinga kai).

These solutions are generally highly site-specific, which makes blanket national or regional rules difficult. Many of these decisions may be most appropriately made at the structure planning or consent level, and need to be made alongside decisions on infrastructure which would be made by TAs under the Local Government Act. This means that in many cases, TAs are most appropriately

placed to make this decision as part of a holistic process of determining the form and function of a new development.

When used appropriately these measures are likely to help avoid, remedy or mitigate adverse effects on freshwater ecosystems.

Constraints on the analysis

This analysis focuses on options available through the proposed amendments to the NPS-FM and creation of an NES for freshwater. It does not include options that sit outside of national direction (eg, options that would require amendments to the RMA or LGA), although these options could be considered in the future.

The analysis also did not look at specifically which methods might be used to manage the effects of urban development on fresh water. This is because the best approaches to manage effects of urban development on fresh water are likely to be context specific.

Connections/interdependencies to ongoing work include:

- **Three Waters Review:** The Three Waters Review is looking at the regulatory and service delivery system in relation to three waters infrastructure (drinking water, wastewater and stormwater services). This includes the environmental regulation of wastewater and stormwater services.
- **National Policy Statement for Urban Development (NPS-UD):** The proposed NPS-UD will provide direction about decision-making for both regional councils and territorial authorities in relation to urban development. In many cases, decisions made by councils will need to balance the need to provide for urban development with the need to maintain or improve water quality.
- **RMA Reform:** The RMA Reform programme will look comprehensively at the RM planning system. Although this work has a longer term focus and delivery timeframe, it will be important that the direction provided now sets councils on a trajectory that is largely consistent with what emerges from the reform programme.

The description of impacts for the preferred option is limited in the extent to which it quantifies the costs and benefits. This is largely because the costs and benefits would vary significantly based on the types of planning responses a TA chooses to give effect to the policy – both in terms of what types of analysis would be necessary in the planning process, and in terms of the effects it may have on urban development. This is also because the capacity and capability requirements would vary across different councils based on existing capability.

We intend to use the consultation process as an opportunity to find out more about the expected impacts for local government and urban land developers.

Options

The following table provides a summary comparison of the three options considered.

Two additional criteria have been added in addition to the standard criteria:

1. **Does the option support the implementation of the Urban Water Principles[250]?** This criterion has been added because the Ministry for the Environment has supported the independent Urban Water Working Group to develop the Urban Water Principles – a set of ten directives that this expert group has recommended will be needed to uphold Te Mana o te Wai in urban water environments. Although the Principles are not Government policy they are a useful lens for examining whether a proposal is in line with what urban water experts consider to be good practice.
2. **Does the option optimise benefits in relation to the Living Standards Framework?** This criterion has been added because, aside from the direct problem we are seeking to address, better management of urban water has the potential to achieve a range of cultural and social benefits.

Criterion	Option 1: Clarify the existing roles and responsibilities of territorial authorities and signal the importance of aligning district plans with wider planning documents	Option 2: Require territorial authorities to manage the effects of land use for urban development on fresh water in their district plans	Option 3: Require regional councils to direct district plans in their regional policy statements to manage the effects of land use for urban development on fresh water
Effectiveness	+	++	++
Timeliness	0	+	-
Fairness	0	+	+
Efficiency	0	-	0
Principles of the Treaty of Waitangi	0	0	0
Te Mana o te Wai	+	++	+
Does the option support the implementation of the Urban Water Principles?	+	++	+
Does the option optimise benefits in relation to the Living Standards Framework?	+	++	++
Overall Assessment	0	+	+

[250] The Urban Water Principles are available at https://www.mfe.govt.nz/publications/fresh-water/urban-water-principles-recommendation-of-urban-water-working-group

Maintain status quo

Maintaining the status quo would mean the NPS-FM would not provide any direction to TAs or give any additional direction on how to achieve integrated management between TAs and regional councils.

Regional councils could still direct district plans through their regional policy statements, but would not be required to do so. They could still continue to set discharge consents that TAs would need to comply with.

Option 1: Clarify the existing roles and responsibilities of territorial authorities and signal the importance of aligning district plans with wider planning documents

This option would involve adding content to the NPS-FM that seeks to clarify the existing RMA requirements (ie, by being specific that district plan provisions need to give effect to regional policy statements and not be inconsistent with district plans.) Changes to the NPS-FM could also provide wording to encourage TAs to more closely align their district plan provisions with regional policy statement and regional plan provisions on fresh water.

This option would not add any specific requirements beyond what is already in the NPS-FM – it would merely clarify them. Regional councils could still direct district plans through their regional policy statements, but would not be required to do so. They could still continue to set discharge consents that TAs would need to comply with.

Criterion	**Option 1: Clarify the existing roles and responsibilities of territorial authorities and signal the importance of aligning district plans with wider planning documents**
Effectiveness	+ The NPS would only clarify expectations rather than setting any binding direction. This means that although it may drive more proactive management of urban development it would not necessarily have any significant effect.
Timeliness	**0** The timeframe for managing effects of urban development would be the same as the normal district plan timeframes.
Fairness	**0** This would not change existing requirements for councils, so would be as fair as the status quo.
Efficiency	**0** This would not change existing requirements for councils, so would be as efficient as the status quo.
Principles of the Treaty of Waitangi	**0** This option would not result in any changes relating to how the Government gives effect to Treaty Principles.
Te Mana o te Wai	+ This option would encourage, and signal the importance of, integrated management and aligning decision-making. It may result in more integrated decision-making, ki uta ki tai.
Does the option support the implementation of the Urban Water Principles?	+ This option supports several of the Urban Water Principles, in particular 1-3, 5-7 and 9.
Does the option optimise benefits in relation to the	+ The extent to which this option optimises benefits would depend on the approach used by the TA. It would be expected that this option would likely lead to improvements in terms of natural capital (through improved ecosystem and

Living Standards Framework?	biodiversity outcomes), human capital (in terms of opportunities for recreation and connection to the natural environment) and physical capital (in terms of the use of green infrastructure in subdivision design).
Overall Assessment	**0** This option would be largely similar to the status quo, other than signalling an non-binding expectation for TAs to be more proactive in integrating land use decisions with freshwater management.

Option 2: Require territorial authorities to manage the effects of land use for urban development on fresh water in their district plans

This option would involve adding provisions to the NPS-FM stating that TAs have a responsibility for contributing to the integrated management of fresh water and the use and development of land. The policy would direct TAs to manage the effects of land use from urban development or redevelopment on fresh water in their district plans.

This would widen the scope of the NPS-FM to direct both regional councils and TAs, where up until now it has only directed regional councils. It would create an obligation for TAs to use district plans (eg, through objectives, policies, rules, consent conditions, or other methods) to manage the effects of urban development on fresh water.

This option would not provide specific direction about what approaches TAs should use to manage the effects of urban development on fresh water (eg, requirements to implement Water Sensitive Urban Design, limit impervious surfaces, or restrict land use). The approaches would be left to TAs to determine.

This option could be supported by a corresponding provision inserted directly into regional policy statements through Section 55 of the RMA. This would maintain the existing hierarchy of RMA documents, in which regional policy statements direct regional and district plans.

Criterion	**Option 2: Require territorial authorities to manage the effects of land use for urban development on fresh water in their district plans**
Effectiveness	**++** Requiring action from TAs directly would remove any ambiguity about the responsibilities of TAs, in the absence of specific regional council direction. It means that decisions about managing urban water would be made in the context of other decisions on urban development, which means there would be opportunities for TAs to look at the most effective ways of achieving multiple objectives.
Timeliness	**+** The timeframe for managing effects of urban development would be the same as the normal district plan timeframes. This is faster than the status quo as regional councils would first needed to undertake a planning process to introduce provisions into regional policy statements, which would then need to be reflected in district plans through the district planning process.
Fairness	**+** Any increases to the cost of planning would likely fall on TAs, as they would need to carry out the necessary analysis to justify their chosen district plan provisions during the development of their district plans. The initial plan change following this regulatory change would likely incur the most cost as TAs adapt to the new expectations. Resourcing may be required for regional councils to support TAs in planning. Assuming this policy drives more proactive management of urban water

	through district plans, the specific provisions chosen would need to be justified in terms of who would bear the costs (ie, property developers vs ratepayers).
Efficiency	- This would potentially create some overlap in functions, which could cause some confusion or conflict if not carefully managed between the TAs and RCs. It potentially duplicates some effort and knowledge between TAs and RCs, and TAs would require support from RCs.
Principles of the Treaty of Waitangi	**0** As the NPS-FM provides direction on engagement with tangata whenua on freshwater decision-making, this direction would apply to TAs the same way it does to RCs.
Te Mana o te Wai	++ This option would provide for decisions about urban water to be made in the context of wider decisions about how communities are developed (eg, decisions about open space, amenity, infrastructure, transport and housing). It would also result in more integrated decision-making, ki uta ki tai.
Does the option support the implementation of the Urban Water Principles?	++ This option supports several of the Urban Water Principles, in particular 1-3, 5-7 and 9. The option is directive which means it would be more supportive of the Principles than Option 1.
Does the option optimise benefits in relation to the Living Standards Framework?	++ The extent to which this option optimises benefits would depend on the approach used by the TA. It would be expected that this option would likely lead to improvements in terms of natural capital (through improved ecosystem and biodiversity outcomes), human capital (in terms of opportunities for recreation and connection to the natural environment) and physical capital (in terms of the use of green infrastructure in subdivision design). This option would be more directive than Option 1.
Overall Assessment	+ This option would likely drive more integrated management of the effects of urban land use on fresh water than exists under the status quo. It would be achieved faster than Option 3 but could create confusion over roles and responsibilities if not carefully managed.

Option 3: Require regional councils to direct district plans in their regional policy statements and/or regional plans

This option would require regional councils to ensure that their regional policy statements specifically direct district plans in matters relating to the effects of urban development on fresh water. This is something that regional councils can already do, but seldom do in relation to managing fresh water through urban design.

It would involve adding provisions to the NPS-FM stating that regional councils need to include specific direction about what TAs need to do in their district plans to manage the effects on freshwater of land use from urban development or redevelopment.

It would mean that rather than putting responsibility on TAs to determine the most appropriate interventions in their district plans, it would require regional councils to determine the most appropriate interventions and put these in their regional policy statements, which would then put an obligation on TAs to comply.

Criterion	Option 3: Require regional councils to direct district plans in their regional policy statements about how to manage the effects of land use for urban development on fresh water
Effectiveness	++ Requiring RCs to direct district plans would increase the extent to which their existing ability to do so is used. It also means that the direction would be consistent with the wider regional decisions the RC makes.
Timeliness	- Two planning processes would need to occur before any provisions came into effect, as the RPS would need to be changed first, and would have no effect until the next district plan change. This is the status quo in situations where a RC directs a district plan already.
Fairness	+ Any increases to the cost of planning would likely fall on regional councils, who would need to carry out the necessary analysis to justify their chosen district plan provisions. Assuming this policy drives more proactive management of urban water through district plans, the specific provisions chosen would need to be justified in terms of who would bear the costs (ie, property developers vs ratepayers).
Efficiency	**0** The process used by RCs would be the same as the status quo.
Principles of the Treaty of Waitangi	**0** This option would not result in any changes relating to how the Government gives effect to Treaty Principles
Te Mana o te Wai	+ This option would ensure regional councils are regulating a full range of factors that affect urban water quality, and doing so holistically and cohesively.
Does the option support the implementation of the Urban Water Principles?	+ This option supports several of the Urban Water Principles, in particular 1-3, 5-7 and 9. Because this option would be directive to RCs rather than TAs, it would be likely to result in TAs tending to follow RC direction rather than determine the best solutions at a local community scale.
Does the option optimise benefits in relation to the Living Standards Framework?	++ The extent to which this option optimises benefits would depend on the approach used by the TA. It would be expected that this option would likely lead to improvements in terms of natural capital (through improved ecosystem and biodiversity outcomes), human capital (in terms of opportunities for recreation and connection to the natural environment) and physical capital (in terms of the use of green infrastructure in subdivision design).
Overall Assessment	+ This option would likely drive more integrated management of the effects of urban land use on freshwater than exists under the status quo. It would be the most consistent with the way roles and responsibilities for freshwater management are currently understood, but has the potential to be slow in its implementation and might be less likely to lead to the development of site-specific solutions.

Options ruled out of scope, or not considered

Options relating to proactive integrated catchment planning were originally considered but have not been progressed. If this proposal had progressed, there may have been options for more explicitly linking the requirements for TAs with the requirements for the proactive catchment planning process. However as this proposal did not progress, these options have not been included. There are also a wide range of options related to creating new incentives and supporting implementation that could be considered to partially resolve some of the stated environmental problems, however

because these options fall out of the scope of amending national direction and improving alignment under the RMA these have not been included.

Recommendation

Option 2 – requiring territorial authorities to manage the effects of land use for urban development on fresh water in their district plans – is recommended, as it is assessed at being:

- equally as effective as option 3, (ie, an explicit requirement for TAs or an explicit requirement for RCs to direct TAs would each achieve a similar outcome)
- the most timely option, as it would not require a two-stage process of amending regional policy statements and then subsequently amending district plans.

The main concerns expressed about this option are the potential for uncertainty in overlapping functions, which could lead to inefficiency or inaction. This is because while TAs have a general responsibility for the integrated management of the effects of land use and natural and physical resources, regional councils have specific requirements for freshwater management.

It is assumed that these overlaps in regional and district council functions could likely be clarified. This is an area where we intend to seek detailed feedback on workability through the consultation process. This feedback will inform amendment as necessary to the final NPS-FM.

What do stakeholders think?

Freshwater Leaders Group

Freshwater Leaders Group were supportive of provisions that would better align the role of TAs with other decision-making under the RMA.

Regional Sector Group

The Regional Sector Group supported in principle a recommendation to use the NPS-FM to direct TAs to manage the effects of urban development on fresh water. They agreed there is potential to improve urban freshwater outcomes by ensuring they are appropriately provided for through district planning processes for new urban development and redevelopment of land.

They stressed the need to carefully integrate this proposal and not duplicate regional and district functions and plans. They said they thought there was some potential this may require changes to the RMA as well as NPS-FM. Our analysis indicates this is not likely to be necessary, but it highlights the importance of ensuring through the consultation that the roles and responsibilities are clear, and that unintended consequences are identified and addressed.

Urban Water Working Group

The Urban Water Working Group sub-group on policy development were broadly supportive of the preferred option (providing direction to TAs). However they raised some potential issues:

- regional councils would need to provide support to TAs to manage the effects of urban development on water, and the impact of this in terms of resourcing could be significant
- regional councils can currently set land use rules in relation to freshwater, so by extending that requirement to TAs it would create a degree of overlap which would need to be clarified
- the overlap in functions, and/or disagreements over the most appropriate means of managing effects of urban development on water, could create conflict or confusion between regional councils and TAs that could add to the complexity and timeframes of planning processes.

Some members of the group suggested that workshopping the proposal with a targeted group of TAs and regional councils would be of benefit to tease out any tensions. This is something we intend to do as part of the consulation process.

Summary table of costs and benefits of the preferred approach

Direct costs and benefits for local government

The costs and benefits of the preferred approach would be highly variable, because they would depend on what types of planning provisions TAs chose to use to give effect to the policy.

The costs would be made up of increased analysis requirements for TAs (eg, section 32 analysis) and potential for increased costs if plan provisions were appealed to the Environment Court.

The management of the effects of land use on water is required under the RMA, and the implementation of methods to achieve freshwater objectives and limits is required under the existing NPS-FM. Therefore the costs associated with planning processes to achieve this are already expected under the current regulatory settings (the proposed policy just influences the extent to which they would fall on TAs rather than regional councils). However as the effects of urban development on water are not being managed to the extent that they should, making this requirement clearer would be likely to increase costs beyond what are currently being incurred.

It would also mean that where capacity and capability does not currently exist within TAs (eg, in terms of knowledge of freshwater management) this would need to be developed. For some TAs already undertaking good practice in urban water management (eg, in particular larger city councils) this may not be significant. For other TAs, however, this may present a significant resource.

Some TAs (in particular in larger cities) have existing capability and already undertake a range of initiatives to require good practice water management in urban design.

Indirect costs and benefits for urban development

There would be a range of indirect costs and benefits of the proposed option, and again these would depend on the types of planning provisions TAs chose to use to give effect to the policy.

The proposed policy involves placing a broad requirement on TAs to manage the effects of land use for urban development on water bodies, rather than directing specific approaches that must be used.

However, it is expected that in general TAs would respond to this requirement with some combination of:

- protection of streams, lakes, estuaries etc. and related habitats, or restoration where degradation has already occurred
- use of best practice Water Sensitive Urban Design or Low Impact Design techniques, including regulating impervious surface cover, requiring on-site infiltration, and provision of green infrastructure for stormwater management (this can be promoted through guidelines or by working closely with land developers during initial structure planning and design phases).

The benefits of water sensitive design are site-specific, and rely heavily on determining the most appropriate solution for the individual development project. Water sensitive design solutions have been shown to be cheaper than piped stormwater infrastructure in some cases: a number of recent New Zealand examples have been identified where the construction cost of water sensitive design

approaches have been 14-28 percent less expensive than piped stormwater solutions.[251] However these approaches also have the potential to add to development costs, especially when looked at over their entire life cycle: while overseas examples often show significant savings across the life cycle of water sensitive design assets, Australasian examples have shown they can be around 33.2 percent more expensive.[252]

The available evidence indicates that the cost of water sensitive design approaches can be highly variable based on the specific methods adopted, and the particular circumstances of the development.

Water sensitive design can have a range of environmental and community benefits. These are likely to include shared space for recreation and active transport, resilience to natural hazard risk, reduced pressure on stormwater infrastructure outside of the development, improved water quality in downstream receiving environments, benefits for biodiversity and ecosystem health, opportunities for people to be better connected to the natural environment and express kaitiakitanga, and generally improved amenity. Some of these benefits can even been linked to wider social and community benefits such as improved mental and physical wellbeing. These benefits can be difficult to quantify in financial terms, and are highly site-specific. However one Australian based study found that:

- the value of pollution reduction is estimated to be worth more than the lifecycle cost of WSUD assets
- the potential avoided waterway rehabilitation life cycle costs are estimated to be worth around 70 percent of the lifecycle cost of WSUD assets
- the potential property premiums are estimated to be around 90 percent of the capital cost of WSUD assets
- the capital costs of implementing WSUD in residential developments are typically less than one percent of the cost of a new dwelling.[253]

While water sensitive design approaches are the main response envisaged by this policy, the policy is deliberately broad and non-prescriptive to enable TAs to respond in the most appropriate way for their circumstances. Another potential response could be to use zoning/designations to avoid all, or certain types of development in areas where the effects on fresh water could not be adequately managed (eg where sensitive receiving environments exist, such as wetlands or areas for mahinga kai).

Any responses adopted by TAs in response to this policy would already be anticipated by the existing NPS-FM. Freshwater is already required to be managed in urban areas to meet freshwater objectives

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[251] Roa, A; Carter, R; Heijs, J. 2015. Kirimoko Park Development, Wanaka – A Living Example of Integrated WSD. SHAVER, E., 2009. Low Impact Design Versus Conventional Development: Literature Review of Developer-related Costs and Profit Margins. Prepared by Aqua Terra International Ltd. for Auckland Regional Council. Auckland Regional Council Technical Report 2009/045.

[252] S. J. T. Ira, C.J. Batstone and J. P. Moores. 2015. Does Water Sensitive Design Deliver Beneficial Net Economic Outcomes?

[253] Wellington Subdivision Design Review: Stream Retention Through Subdivision Design Alternatives. Prepared for Greater Wellington Regional Council by Morphum Environmental Ltd, McIndoe Urban and Wraight + Associates July 2018

and limits that are set for freshwater bodies. This policy is intended to make it more likely that these requirements would be met, by ensuring that:

- when urban growth occurs it is accompanied by decisions about how to manage the effects of that growth
- this can still occur in the absence of specific direction from regional councils through regional policy statements, or regional plan provisions.

Affected parties *(identify)*	**Comment**: *nature of cost or benefit (eg ongoing, one-off), evidence and assumption (eg compliance rates), risks*	**Impact** *$m present value, for monetised impacts; high, medium or low for non-monetised impacts*	**Evidence certainty** *(High, medium or low)*
Additional costs of proposed approach, compared to taking no action			
Territorial authorities	Additional complexity in planning and consenting processes, requiring additional capability and additional cost for analysis and environment court costs.	Not valued (expected to be medium)	Low
Regional councils	Support required for TAs, which would require resourcing.	Not valued (expected to be low)	Low
Regulated parties	The costs on regulated parties would be variable. The policy incurs no direct cost for regulated parties, but the way a TA chose to give effect to the policy would potentially impose costs on urban development and infrastructure provision. There may be situations that incur no additional cost (and provide cost savings compared to the status quo), or there could be cost increases ranging from 0-33 percent total life cycle costs of infrastructure in new urban developments.	Not valued(expected to be medium)	
Total Monetised Cost		Not valued (expected to be medium)	Low
Non-monetised costs		Not valued (expected to be medium)	Low
Expected benefits of proposed approach, compared to taking no action			
Regulated parties	Avoided costs to remediate degraded water bodies (poor urban land use planning often results in near-irreversible	Not valued (expected to be high)	Low

	damage, making remediation to meet NPS targets a difficult and expensive task).		
Regulators	Improved water outcomes against NPS-FM bottom lines and targets	Not valued (expected to be medium)	Low
Wider government	Improving alignment with central government direction at the local level strengthens the effectiveness and relevance of the national policy framework.	Not valued (expected to be low)	Low
Other parties	The benefits for communities would be variable. The policy incurs no direct benefit to regulated parties, but the way a TA chose to give effect to the policy would potentially improve the quality of development and relatedly, the resilience, amenity, and liveability of urban environments. This range of benefits linked to ecosystem services leads to improvements in general well-being. This could also potentially benefit the conservation of native taonga species through significant improvements in habitat protection near urban areas.	Not valued (expected to be high)	Low
Total Monetised Benefit		Not valued (expected to be medium)	Low
Non-monetised benefits		Not valued (expected to be medium)	Low

Appendix 13: Wetlands

Context

Wetlands are an important part of New Zealand's natural heritage, although historical and current rates of loss has endangered these critical ecosystems. The objective of this proposal is to stop the further loss and degradation of our remaining wetlands.

Worldwide, wetlands are recognised as one of the most valuable ecosystems which provide a very high level of diverse ecosystem services. These include: habitat and ecological community services, food and water provisioning, filtering of contaminants, erosion control, carbon sequestration, buffering of floods and coastal storm surges, and cultural and recreational services.

New Zealand wetlands provide essential habitat for a highly diverse range of flora and fauna (some of which are unique to wetlands). Wetlands also support a high proportion of threatened species including: 67 percent of freshwater and estuarine fish species, 13 percent of nationally threatened plant species,[254] and nationally critically endangered birds such as the Australasian bittern/matuku and white heron/kōtuku.

Māori have strong links with both inland and coastal wetlands which are regarded as taonga with historical, cultural, economic, and spiritual significance.[255]

A recent global study gives an indicative value of ecosystem services for inland wetlands to be approximately $25,600 (2007 USD) per hectare (ha) per year and approximately $193,800 (2007 USD) per ha per year for coastal wetlands.[256] These values have been adjusted for inflation and converted to 2019 NZD[257] to give approximate values of $48,640 per ha per year for inland wetlands and $368,220 per ha per year for coastal wetlands.

Status quo

Inland wetlands

Today less than 10 percent of New Zealand's original inland wetlands remain; that is some 250,000 ha in 2008 of approximately 2.4 million ha pre-settlement.[258] This historical destruction affected all inland wetland types, although the impact on swamps was greatest, mainly because they were most prevalent prior to settlement and typically occurred on fertile lowlands.

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[254] Clarkson, B., Ausseil A-G., Gerbeaux, P. (2013). Wetland ecosystem services. In Dymond JR ed. Ecosystem services in New Zealand – conditions and trends. Manaaki Whenua Press, Lincoln, New Zealand.

[255] Waikato Raupatu Trust and Manaaki Whenua (2017) Te Reo o te Repo – The Voice of the Wetland: connections, understandings and learnings for the restoration of our wetlands. Edited by Taura, Y., Van Schravendijk-Goodman, C. Clarkson, B. Published by Waikato Raupatu Trust and Manaaki Whenua, Hamilton.

[256] Costanza, R., de Groot, R., Sutton, P., Sander van der Ploeg, S., Anderson, S.J., Kubiszewski, I., Farber, S., Turner, K. (2014). Changes in the global value of ecosystem services. Global Environmental Change 26 (2014) 152–158.

[257] Using a multiplier of 1.9, where $1 (2017 USD) = $1.23 (2019 USD) and $1.23 (2019 USD) = $1.9 (2019 NZD)

[258] Ausseil, A-GE, Chadderton, WL, Gerbeaux, P, Theo Stephens, RT & Leathwick, JR (2011). Applying systematic conservation planning principles to palustrine and inland saline wetlands of New Zealand. Freshwater Biology Vol. 56, No 1, pp. 142-161.

The loss of indigenous biodiversity associated with inland wetland loss has been dramatic. As reported in 2008, 15 wetland bird species had become extinct, with a further 10 bird species and 52 plant taxa classified as threatened, and the decline of many indigenous fish and bird species is also attributed to wetland loss and degradation.[259]

Recent studies show that the extent of New Zealand's remaining inland wetlands are continuing to decline despite national direction encouraging their protection. For example, a national study using 2001 – 2016 data shows a total of 214 wetlands (nearly 1,250 ha) were lost, with a further 746 wetlands declining in size.[260]

More refined regional studies also illustrate relatively high levels of recent inland wetland loss that are comparable to global wetland rates of loss (0.6 percent per year post 1990),[261] for example: Southland 1.0 percent per year on private land (1990 – 2012);[262] Taranaki 0.6 percent per year (2001 – 2007);[263] and Canterbury 0.2 percent per year (1990 – 2008).[264]

There are challenges in quantifying rates of loss nationally, especially for small inland wetlands on private land. The Freshwater Ecosystems of New Zealand database (FENZ) national map used for reporting is derived from combining several modelled databases with limited field checking and has a reasonably coarse resolution (ie, minimum wetland size of >0.5 – 1 ha) and does not cover ephemeral wetland types. FENZ results are therefore considered to be underestimates. For example Auckland Council recently remapped the regions wetlands[265] and calculated the total inland wetland area to be 5,980 ha compared to the FENZ estimate of 2,500 ha.

The decline in the extent of inland wetlands is caused by direct disturbance from earthworks, vegetation clearance and/or altered hydrological regimes including drainage to convert to other land uses. The decline in the health (ecological condition) of remaining wetlands is caused by wetland loss and fragmentation, and impacts such as stock trampling and grazing, over sowing, spraying, contaminants, waste dumping, sedimentation, earthworks, drainage, and invasive plants and

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259 Ausseil A., P. Gerbeaux, L Chadderton, R. Theo Stephens, D. Brown and J. Leathwick. (2008). Wetland ecosystems of national importance for biodiversity: Criteria, methods and candidate list of nationally important inland wetlands. Discussion document for Department of Conservation.

260 Belliss et al. (2017) Belliss, S., Shepherd, J., Newsome, P., Dymond, J. (2017). An analysis of wetland loss between 2001/02 and 2015/16. Landcare Research Contract Report LC2798 prepared for the Ministry for the Environment. Landcare https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/analysis-of-wetland-loss.pdf

261 Davidson, N. (2014). How much wetland has the world lost? Long-term and recent trends in global wetland area. Marine and Freshwater Research 65: 934-941. (includes both freshwater and coastal wetlands)

262 Robertson, H., Ausseil, A-G., Rance, B. Betts, H., Pomeroy, E. (2019) Loss of wetlands since 1990 in Southland, New Zealand. New Zealand Journal of Ecology (2019) 43(1):3355.

263 Newsome P.F.J., Wilde R.H. and Willoughby E.J. (2000). Land Resource Information System Spatial Data Layers: Volume 1: 'Label Format'. Landcare Research Contract Report.

264 Pompei and Grove (2010) referred to in Robertson et al. (2019)

265 Lawrence, Grant and Bishop, Craig (2017). Remapping the extent of Auckland's wetlands: methods and summary. Auckland Council technical report, TR2017/024 http://knowledgeauckland.org.nz/assets/publications/TR2017-024-Remapping-the-extent-of-Aucklands-wetlands.pdf

animals. Small wetlands are more susceptible to the above pressures because there is little to buffer them from adverse effects.

The NPS-FM requires that the 'significant values of wetlands' be protected in terms of both water quality and quantity but remains silent on what the significant values of wetlands are, leaving interpretation up to councils. The current drafting appears in some cases to be interpreted by councils as focusing only on 'significant wetlands', meaning that other wetlands remain subject to ongoing wetland loss. Policies within the NPS-FM that could offer protection to wetlands are relatively weak and relate to only a few activities that affect wetlands.

The policies, objectives and rules regarding inland wetlands differ across regional councils. A 2013 review of the strength of protection for inland wetlands provided by regional/local plans observed that provisions varied considerably between local councils around New Zealand[266]. This is because plans are disparate in what activities they permit or limit (eg, use, drainage, discharge, water take/ diversion/ damming and stock exclusion) and are inconsistent in whether provisions apply to all inland wetlands or a subset of variously defined 'significant' wetlands.

Coastal wetlands

Historically estuaries have played a key role in New Zealand's settlement and development, and many coastal wetlands along their margins have been filled in or drained for urban development or agriculture.[267] For example, in Auckland thousands of hectares of saltmarshes (including mangroves and saltmeadows) have been reclaimed or modified.[268]

The FENZ dataset does not cover coastal wetlands, therefore we have no national data on the historical or current loss of coastal wetland extent. Many regional councils have datasets but these have not been collated nationally.

It is estimated from current available datasets that there is approximately 45,900 ha of coastal wetlands nationally.[269] However, this area is considered an underestimate as it is based on the vegetation extent of saltmarsh and mangroves only, and not the wider coastal wetland habitat.

Mangroves are only found in northern New Zealand, extending as far south as Kawhia (Waikato) and Opotiki (Bay of Plenty).[270] The extent of mangroves is rapidly expanding (~19,350 ha in 1980 to

[266] Myers, S., Clarkson, B. R., Reeves, P., Clarkson, B.D. (2013) Wetland management in New Zealand: Are current approaches and policies sustaining wetland ecosystems In agricultural landscapes? Ecological Engineering 56 (2013) 107-120.

[267] Department of Conservation (2019) Department of Conservation. (2019). About estuaries. Accessed 16 May 2019 from https://www.doc.govt.nz/nature/habitats/estuaries/about-estuaries/

[268] Auckland Council (2019) Auckland Council (2019) Coastal wetlands, saltmarshes and estuaries factsheet. Accessed 16 May 2019 from https://www.aucklandcouncil.govt.nz/environment/plants-animals/plant-for-your-ecosystem/docscoastalplantingguides/coastal-wetlands-salt-marshes-estuaries-planting-guide.pdf

[269] Taken from global saltmarsh extent (2017) and New Zealand mangrove extent (2018)

[270] Thrush, S., Townshend, M., Hewitt, J., Davies, K., Lohrer, A., Lundquist, C., Cartner, K. (2013). The Many Uses and Values Of Estuarine Ecosystems. In Dymond JR ed. Ecosystem services in New Zealand – conditions and trends. Manaaki Whenua Press, Lincoln, New Zealand.

26,050 ha by 2010)[271,272] as environmental factors such as increased nutrients, sediment, and structures changing estuarine hydrodynamics encourage their growth.[273]

Attitudes to mangroves are contentious. While they have many ecosystem services and values, their expansion can in some situations displace other ecosystems such as intertidal flats, cockle beds, and saltmarsh. Various sectors find them unsightly and/or a hindrance to access, navigation, and boat moorings.

Land-use change and development pressures further degrade coastal wetlands through alterations to natural flushing processes, stock trampling, invasive plants and animals, vegetation clearance, and contaminant runoff into these receiving environments. Sea level rise will also contribute to loss of coastal wetlands where infrastructure prevents them from migrating inland and therefore habitat is effectively drowned.

The New Zealand Coastal Policy Statement 2010 (NZCPS), which is the responsibility of the Department of Conservation (DOC), also includes national direction for wetlands in the coastal marine area (CMA). NZCPS objectives require that, *inter alia,* intertidal areas and estuaries are safeguarded, but also enables appropriate development within appropriate limits. There are no separate policies in the NZCPS for coastal wetlands, rather, policies more inclusive to the coastal environment. However, the directive policies tend to be stronger (ie, use the term avoid) than the NPS-FM, as such this may result in a differentiated approach to the management of wetlands in the coastal environment and those found inland.[274]

Similar to inland wetlands the rules regarding coastal wetlands differ across regional councils where some are more stringent than others. In addition, there may be different levels of protection for coastal wetlands within a plan depending on their values. For example, the activity status for most activities (including disturbance and reclamation) in the proposed West Coast Coastal Plan is discretionary, whereas the Auckland Unitary Plan earthworks is non-complying or discretionary depending on the volume of sediment and level of significance of the marine area.

The problem/opportunity

The extensive historic and ongoing loss and degradation of New Zealand's wetlands has resulted in the loss of unique biodiversity and ecosystem services.

This has occurred because historically the value of wetlands was not recognised and their large-scale drainage to create 'productive land' was incentivised, especially in the lowlands.

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[271] Nature Conservation Council. (1984). Strategies for the management of mangrove forests in New Zealand. A discussion document prepared by a Task Force of the Nature Conservation Council.

[272] Horstman, E., Lundquist, C., Bryan, K., Bulmer, R., Mullarney, J., Stokes, D. (2018) The dynamics of Expanding Mangroves in New Zealand. Chapter 2 In Threats to Mangrove Forests Makowski, C. Finkl, C. coastal research Library 25. Accessed 20 May 2019 from https://books.google.co.nz/books?hl=en&lr=&id=nqZWDwAAQBAJ&oi=fnd&pg=PA23&ots=VkpFGqo3k7&sig=2QZYfGVR_e9pa6Z8opQiWgOrHc8&redir_esc=y#v=onepage&q&f=false

[273] Lundquist, C., Carter, K., Hailes, S., Bulmer, R. (2017) Guidelines for Managing Mangroves (Mānawa) Expansion in New Zealand. NIWA Information Series No. 85. National Institute of Water & Atmospheric Research Ltd. http://www.niwa.co.nz/managingmangroveguide

[274] Department of Conservation. (2019b). NZCPS 2010 guidance note Policy 11: Indigenous biological diversity (biodiversity). Accessed 16 May 2016 from https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/coastal-management/guidance/policy-11.pdf

Multiple factors drive the continued loss and degradation of wetlands including: economic and land use pressures and activities; general neglect and ignorance of their values; insufficient or competing national legislation with different policy objectives; inconsistent or inadequate regional or district plans; and insufficient mapping, monitoring, compliance and enforcement.

Current national objectives and policies have proven to be ambiguous and inadequate for inland wetlands and consequently the strength of plans vary considerably between local councils. Therefore, the Essential Freshwater package seeks to strengthen and clarify national direction so that local plans become consistent in their approach to halt the loss and degradation of all of our remaining natural inland wetlands.

Development pressures continue to affect coastal wetlands from catchment runoff and encroachment. There are presently no plans to amend the NZCPS so there is no comparable approach to halt the loss and degradation of coastal wetlands (although there is an active community of interest engaged in their restoration).[275]

Why is this really a problem?

Currently around 60 percent (by area) of remaining inland wetlands are on public conservation land (PCL), although the majority of these are within areas classified as Stewardship Land, which has a relatively low level of protection compared to Nature Reserves or Scientific Reserves. A preliminary exercise, carried out by the DOC, indicates there are approximately 100 estuarine areas with some form of protection and a further 200 which are part of Stewardship Areas. The area of protected estuarine habitats (including intertidal and shallow subtidal areas) is approximately 16,460 ha.

While these wetlands are legally protected they are not necessarily protected from degradation caused by adjacent land use and wider catchment pressures which can have significant impacts on many wetlands administered as conservation areas. For example, Whangamarino wetland (Waikato), Kaimaumau wetland (Northland), Awarua wetland-Waituna Lagoon (Southland), and Okura Estuary (Auckland).

The majority of New Zealand's smaller inland wetlands (under 100 ha in size) are on private land. Approximately 10,157 ha (10 percent of inland wetlands left on private land) are on Māori land nationwide,[276] predominantly in the North Island.

These small inland wetlands are critical for freshwater management in New Zealand as they reduce sediment and nutrient runoff into downstream environments, they also support mobile, rare and threatened species and contribute to diversity of lowland ecosystems.

Some privately owned inland wetlands are, however, protected through various avenues. For example: approximately 4036 ha of wetlands have QEII covenants, approximately 123 ha are within DOC registered covenants, and approximately 3500 ha are owned or administered by Fish and Game. Nga Whenua Rāhui kawenata also include a considerable area of protected wetlands although specific figures are difficult to establish.

[275] Our Estuaries Hub restoration page https://www.doc.govt.nz/nature/habitats/estuaries/restoring-estuaries-map/

[276] Māori Land Court data

There is concern about the deteriorating condition of inland and coastal wetlands resulting from loss of extent and buffers, fragmentation, water quality and quantity issues, stock access and invasive species. However, little is known about the condition of most remaining wetlands.[277]

Methods for assessing inland wetland condition exist and are being used by some councils, although no consistent monitoring is being applied nationally. Therefore, with the lack of monitoring programmes it is difficult to determine trends in their extent or condition across the country, which impedes their protection and national reporting on their state.[278] Some councils also have extensive estuaries monitoring datasets. In terms of coastal wetlands this includes mapping the extent of habitat types every 10 years but few studies have specifically looked at the condition of the vegetated coastal wetland margins.[279]

Constraints on the analysis

The scope of the wetland policies in the NPS-FM amendments of the Essential Freshwater package includes inland wetlands only because policies for wetlands within the coastal marine area are the domain of the NZCPS. However, the scope of the rules in the proposed NES of the Essential Freshwater package could also extend to coastal wetlands because NESs are not bound by topic specific policy domains.

The scope of the Essential Freshwater package does not include geothermal wetlands because geothermal systems are complex and dynamic and it does not make sense to separate the aquatic from terrestrial components. More work is required to identify better-suited options for these ecosystems.

The analysis for the wetlands problem and options has focussed mainly on natural inland wetlands as we have the most data for these. Analysis has been restricted to current national datasets and broad estimates of the value of ecosystem services for inland and coastal wetlands.

There is one main link with the proposed National Policy Statement for Indigenous Biodiversity (NPSIB), which includes a policy to encourage the restoration of wetlands, alongside the restoration of important terrestrial biodiversity. The Ministry has worked closely with officials from the Department of Conservation (DOC) to consider the best way to address, package and align wetland management across national policy instruments.

The National Environmental Standard for Plantation Forestry (NESPF) also includes rules that apply to wetlands which are more permissive than our recommended approach.[280] We are working with Te Uru Rakau on the contents of their review of the NESPF, and how best to develop a consistent approach.

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[277] Ministry for the Environment and Stats NZ (2019) New Zealand's Environmental Reporting Series: Environment Aotearoa 2019. Available from www.mfe.govt.nz and www.stats.govt.nz. Published in April 2019 by Ministry for the Environment and Stats NZ Publication number: ME 1416.

[278] Ewans, R. (2016). Environment Southland Wetland Inventory Project: Monitoring wetland extent on non-public conservation land in the Southland region - Interim report for 2016. Prepared for: Environment Southland.

[279] Our Estuaries Hub monitoring page https://www.doc.govt.nz/nature/habitats/estuaries/monitoring-estuaries-map/

[280] eg, NESPF Rule 97(2) and wetland identification requirements

Options assessment

Objective

This proposal's objective is to protect natural wetlands by providing clear policy direction that no further wetland loss or degradation is permitted and rules to be applied consistently across the country for those activities most destructive to wetlands.

The options considered to address the problem of ongoing loss and degradation of wetlands were:

1. maintain status quo
2. include inland wetland attributes within the NPS-FM
3. amend the NPS-FM to strengthen inland wetland policies
4. develop NES rules to apply to inland and coastal wetlands.

Summary assessment

Criterion	Option 2 Wetland attributes	Option 3* Amend NPS-FM	Option 4* Develop NES rules
Effectiveness	+	++	++
Holding the line	+	++	++
Fairness	0	+	+
Costs	-	-	-
Principles of the Treaty of Waitangi	+	+	+
Te Mana o Te Wai	+	++	++
Co-Benefits	+	++	++
Overall Assessment	0	++	++

***Note: Options 3 and 4 intended as a package**

Option 1: Maintain status quo

This option would require no change to the current policy or management requirements for inland wetlands. The status quo as described above would continue and we would expect inland wetland loss and degradation to continue, especially those in areas with non-protected wetlands on fertile land, weak regional rules, and insufficient monitoring and rule enforcement.

Option 2: Include inland wetland extent attribute in the NPS-FM

This option would include appendix 2 attributes to help provide for the ecosystem health of inland wetlands within the NPS-FM.

The NPS-FM requires regional councils to use the appendix 2 attributes to establish their freshwater objectives then set limits which are enforced by rules in the regional plan in order to achieve those objectives. The attribute states (A-D bands) are to help councils (and communities) set numeric freshwater objectives. Numeric freshwater objectives are the basis for defining limits and management actions. Collectively the freshwater attributes, limits and methods ensure what is valued about a water body is maintained (or improved). The process for setting objectives is set to be completed by 2025, but the time allowed for achieving the aspirational freshwater objectives (ie, where improvement is required) is more openended.

Two potential inland wetland attributes were considered:

1. the wetland condition index (WCI) as recommended by Fish and Game, and
2. wetland extent.

The WCI is a measure of inland wetland condition (health) which scores: hydrology; physiochemical parameters; ecosystem intactness; dominance of native plants; animal browsing and predation; and harvesting regimes within a wetland. This attribute would introduce the requirement to lift the WCI score to at least 10 (the national bottom line) or maintain the condition where the score is greater than this.

While monitoring wetland condition is a good idea it was considered that as an attribute alone it would take too long to implement to halt the loss and degradation of our remaining wetlands. Additionally, there is also limited ability under the RMA for councils to enter private land for monitoring purposes other than for compliance and enforcement. This means that setting WCI as an attribute would be to require councils to do something they do not presently have the powers to undertake in some circumstances.

Inland wetland condition is highly correlated to wetland extent remaining.[281] Ecological health is considered to be adversely affected if more than 30 percent of the historic extent of an individual wetland has been drained and would represent a national bottom line. Given the extent of historic and ongoing wetland loss, many of the remaining natural wetlands would be well below bottom line under this scenario and would require major restoration to achieve higher attribute bands.

It is difficult to compel restoration under the RMA, which essentially focuses on effects management. Therefore, it was considered that a strong and explicit wetland policy would be more effective to halt the loss and degradation of wetlands and build on the expectation of maintain and improve.

This attribute option is assessed against the Essential Freshwater criteria below.

Criterion	Option 2: Wetland attributes
Effectiveness	+ More effective than doing nothing but can only be applied in some places. RMA tools have limited ability to require the increase of inland wetland extent on private land, or access to private land to monitor condition. Difficult to apply to all wetlands or monitor progress under current national maps.
Timeliness	+ Will take time to take effect as councils have until 2025 for objectives to be set and potentially much longer to be implemented through the limit setting process.
Fairness	**0** Practical implementation would fall unevenly across councils and landowners because of distribution of remaining inland wetlands. Would set councils up to fail as they would be unlikely to be able to restore wetland area to meet national bottom lines.
Efficiency	- Objective setting costs fall to local government, reconstruction costs to meet at least bottom lines would fall on councils and landowners. Costs for restoring the required wetland extent would be significant.

[281] Clarkson, B., Overton, J., Ausseil, A-G. (2015). Towards quantitative limits to maintain the ecological integrity of freshwater wetlands: Interim report. Landcare Research report LC1933 prepared for the Department of Conservation.

Principles of the Treaty of Waitangi	+ Preventing further loss would protect remaining wetlands which are considered taonga.
Te Mana o te Wai	+ Recognises that inland wetlands are taonga and need to be protected.
Overall Assessment	**0** was not considered as effective as other options in terms of holding the line in a timely manner.

Option 3: Amend the NPS-FM to strengthen inland wetland policies

This option would amend the NPS-FM to:

i. provide direction to avoid the loss or degradation of the extent, function, values, or quality of any natural inland wetland (inserted directly into regional plans (without using the schedule 1 plan change process) through s55 of the RMA
ii. include direction to help manage wetlands:
   - require identification, mapping and maintenance of an inventory of inland wetlands >0.05 ha (plus those naturally < 0.05ha or known to contain nationally threatened species), including the use of a supplied method for cases of uncertainty or dispute
   - provide for activities necessary for the intended purpose of constructed wetlands
   - monitor inland wetland condition (including at a minimum extent, vegetation, hydrology and nutrients)
   - encourage inland wetland restoration.

This suite of policies takes a 'no loss' of natural inland wetlands approach. However, where it crosses other government priorities eg, nationally significant infrastructure and renewable energy this approach may be too restrictive or in conflict. Where nationally significant infrastructure affected a wetland the cascade of avoid significant adverse effects, and avoid, remedy, mitigate, offset other adverse effects cascade would apply.[282]

Offsetting is only appropriate to consider after all potential possibilities to avoid, remedy, or mitigate adverse effects of an activity on-site have been ruled out. The policy would expect a 'net gain' approach for nationally significant infrastructure (ie, require developers to replace or offset more wetland than they destroy) because there are inherent difficulties in recreating the indigenous species habitat and functioning of wetlands in a like for like manner.

The avoid policy would also likely be too restrictive for some activities that are necessary for the purpose of restoration, education and recreation. Therefore the avoid policy would not apply in these cases as long as adverse effects are temporary and reversible, or the activity is consistent with achieving the long term restoration aims for the wetland.

This option is assessed against the Essential Freshwater criteria below.

Criterion	Option 3:Amend NPFSM
Effectiveness	++ This option would make councils change their plans to take a consistent approach to protect all wetlands regardless of their significance. 'Avoid' policies provide clear direction that the loss and degradation of wetlands is unacceptable. Requiring the mapping and monitoring of natural inland wetlands will increase our knowledge to better manage them, and by providing a method to help define and identify inland

[282] This is used in the NZCPS

	wetlands will remove avenue for appeal. Providing for the management of constructed wetlands to their intended purpose differentiates them from natural inland wetlands so as not to subject them stringent regulation and potentially discourage their use. Councils may need help to implement these requirements.
Timeliness	++ The avoid policies would come into effect within the time it would practically take to amend plans if inserted directly through s55. This requires council to amend their regional policy statements to include the specific policy and give effect to that policy as soon as practicable or as specified by the NPS. The other policies would take longer to be implemented (ie, through the next plan change) which will give councils time to set up monitoring and mapping schedules.
Fairness	+ All natural inland wetlands are treated in a consistent manner regardless of their significance. This may disadvantage some landowners who have not previously developed their land where others already have. Landowners and the wider community benefit ecosystem services. Some councils are better equipped than others to map and monitor.
Efficiency	- Costs to improve wetland mapping and monitoring will fall on local government and potentially landowners, although cost to society for lost ecosystem services will be higher if loss continues.
Principles of the Treaty of Waitangi	+ Preventing further loss of wetlands or degradation of wetlands protects habitat for taonga species. However, avoid policies may reduce options for Māori landowners who want to develop on their wetlands.
Te Mana o te Wai	++ Applies to all natural inland wetlands. Recognises that wetlands are taonga and need to be protected. Monitoring could include mātauranga Māori approaches.
Overall Assessment	++ Considered effective but will take time to implement in full.

Option 4: Develop National Environmental Standard (NES) rules to apply to inland and coastal wetlands

This option would provide rules to be applied nationally that set activity statuses for the activities deemed to be the most destructive to natural wetlands as prohibited or non-complying in the first instance then provide exceptions where more lenient activity statuses might be appropriate.[283] The targeted activities include:

i. new drainage – prohibited within wetland and non-complying within 100 m
ii. alterations of wetland water levels >0.1 m through, draining, damming, diversion, and water takes – non-complying
iii. earthworks (ie, reclamation or disturbance of the wetland bed) – non-complying within 10 m
iv. clearance of significant indigenous vegetation – non-complying within 10 m.

A non-complying activity status sets a high test whereby the adverse effect of the activity on the environment is deemed no more than minor or the activity is not contrary to the objectives and policies of the relevant plan or proposed plan. The avoidance of inland wetland loss and degradation (as set out in Option C) sets this strong policy direction if inserted into plans using RMA s55. In addition, clarity on what constitutes a more than minor effect on wetlands may also be required.

[283] This is a similar approach to the NES on Air Quality

The NES is not intended to inhibit the gathering of traditional materials and kai, conducting cultural ceremonies. It is also not intended to obstruct activities necessary for wetland restoration or an appropriate level of recreation and education in the wetland (ie, boardwalks, bird watching and/or hunting). Where appropriate these would be cases for more lenient activity statuses such as permitted, controlled or discretionary as some council oversight may be required.

Offsetting will be expected given for nationally significant infrastructure (as explained above) and special provisions regarding water level changes and operational requirements given for wetlands associated with current hydro-generation schemes and flood control schemes in existence at the date of gazettal. Current flood and drainage board schemes will also be considered for special provisions.

This option is assessed against the Essential Freshwater criteria below.

Criterion	Option 4: Develop NES rules
Effectiveness	++ This option provides a stringent approach to controlling activities that are most damaging to wetlands. Drainage and earthworks reclaiming wetlands will in most cases irreversibly destroy wetland ecosystem function and habitat provision. Altering the natural water levels in wetlands can cause vegetation dieback, compromise plant communities and allow weeds to invade, reduce the extent or flood the wetland, and reduce available habitat for indigenous biodiversity.[284] Clearance of indigenous vegetation alters natural vegetation assemblages and associated habitat. The advantage of an NES is it prevents 'reinvention of the wheel' region-by-region. Using one standard from central government also cuts through the local political difficulties faced by regional councils faced with tough decisions. The downside of an NES is it may be a relatively blunt tool unsuited to local variations.
Timeliness	++ Rules in an NES come into effect quickly through an NES.
Fairness	+ The NES rules will apply equally to everyone and all natural inland and coastal wetlands treated in a consistent manner, regardless of their significance. This may disadvantage some landowners who have not previously developed their land where others already have. Landowners and the wider community benefit ecosystem services.
Efficiency	- Costs of consenting and enforcement will fall on local councils. Ongoing monitoring of wetland condition to assess the effects of the activity will fall on the developer. The cost to society for lost ecosystem services will be higher if loss continues.
Principles of the Treaty of Waitangi	+ Preventing certain activities in and around wetlands protects habitat for taonga species. However, these rules may reduce options for Māori landowners who want to develop on their wetlands.
Te Mana o te Wai	++ Applies to all natural inland and coastal wetlands. Recognises that wetlands are taonga and need to be protected.
Overall Assessment	++ Considered effective in the short term but may be a blunt approach to apply nationally

[284] Greater Wellington Regional Council (2015) Section 32 Report: Wetlands for the Proposed Natural Resources Plan for the Wellington Region.

Options ruled out of scope, or not considered in depth

The following other options were briefly considered but rejected as a solution to the problem or ruled out of scope. Some options could be used as supplementary measures or considered further in the future.

The government funds many restoration efforts for waterways including wetland projects across New Zealand through various avenues such as: Arawai Kākāriki programme (DOC); Freshwater Improvement Fund and Community Environment Fund (MfE), Living Water Partnership (Fonterra/DOC), and Sustainable Farming Fund and Primary Growth Partnership investments (MPI). We have not considered the option of increasing available funding to achieve wetland restoration across New Zealand in depth because of other budget priorities, although increased funding in this area would help opportunities for wetland rehabilitation. This is especially the case with coastal wetlands as many of the existing funds have a predominantly inland wetland focus.

The government buying all the wetlands to ensure their protection was not considered as the anticipated costs were prohibitive, and this would not necessarily protect wetlands from degradation from wider catchment impacts.

Tax breaks for landowners that voluntarily fence and protect their wetlands has not been explored in detail at this stage as it cannot be implemented through the NPS-FM, but it has not been ruled out and can be considered alongside national direction in the future.

Links to the nitrogen allocation work has not been explored in detail at this stage as a public discussion document is being released at the same time as the wider Essential Freshwater package seeking public/stakeholder views on a future allocation regime. The use of wetlands as a component for this work stream has not been ruled out and can be considered in more detail in the future. However, care must be taken in accounting for natural wetlands because while they are effective at attenuating nutrients they are also sensitive to nutrient overloading which can cause degradation. Constructed wetlands are considered a better tool in this regard.

Recommendation

We recommend progressing Options 3 and 4 as a package for best effect.

This package is superior to the others because it provides the most immediate and nationally consistent regulations for our remaining natural wetlands. It is also very restrictive, representing a ‘no loss’ approach to preserving natural wetlands regardless of its ecological state.

There is, however, a tension with this package with allowing for some ambiguity in plans to allow for local circumstances that cannot be predicted at a national scale (ie, NPS-FM provisions), versus, the risk of being overly prescriptive in rules (ie, the NES-FM provisions) which could be relatively blunt and result in confining councils to ill-suited decisions in some cases.

The Ministry considers that immediate regulation is important because: critically few remain; it is difficult to recreate the function and value of lost wetlands; and wetlands that appear degraded often retain values and ecosystem services (such as biodiversity, natural flood retention and natural denitrification), and can be restored in the future.

The avoid policies in the NPS-FM do not conflict with the more permissive NES rules allowing for activities to be undertaken in circumstances such as nationally significant infrastructure and restoration, education and recreation as these have particular leniency as explained in Option 3.

The Ministry considers local council implementation and monitoring efforts will require additional support from central government. Assistance with mapping wetlands to a higher resolution, technical guidance on ecological risk associated with wetlands including water level variation (including "coastal squeeze" impacts on coastal wetlands from sea-level rise), training in methods for wetland identification and health monitoring, and other non-regulatory approaches and support are likely to be required, subject to budget availability.

What do stakeholders think?

The Land and Water Forum (LAWF) recommended amending the NPS-FM to provide that there is no further loss or degradation of wetlands.[285] They also recommended setting a nationally consistent identification process for spatially defining the extent of wetlands, and criteria for defining and assessing their significant values.

Fish and Game (F&G) provided recommended policies for wetland protection among others within their proposed 'New NPS-FM' sent to Minister Parker in July 2018.[286]

The stakeholder-led Biodiversity Collaborative Group (BCG) delivered a draft National Policy Statement for Indigenous Biodiversity (NPSIB) to Minister Mahuta in October 2018, which included direction on wetland protection and restoration.[287]

The recommendations from the LAWF, F&G, and the BCG have overall similarities in their recommendations for wetland protection which can be summarised into five common themes.

- Clarify wetland objectives
- Provide for no further wetland loss
- Provide for no further wetland degradation
- Develop criteria for wetland identification and delineation
- Provide for wetland restoration/ reconstruction.

Through the development of options to address wetland management we have sought the views of various groups including Kahui Wai Māori (KWM), Freshwater Leaders Group (FLG), the Science and Technical Advisory Group (STAG), the Resource Managers Group (RMG), and the regional council Land Managers and Special Interest Group, and members of the hydro generation sector. The Regional Sector Water Subgroup has also provided feedback on Essential freshwater proposals.

Including coastal wetlands into the NES rules was not discussed with these groups. Therefore, we would need to test the general agreement and implications of this through the discussion document when going out to public consultation.

We received general support for proposals around inland wetland protection from the RMG and the STAG through the development phase. In late June the STAG gave particular recommendations for identifying the extent of wetlands and evaluate their condition of existing wetlands using the WCI as an attribute. The minimum monitoring requirements proposed as part of Option 3 above cover most of the content of the WCI (rather than stipulating the use of the particular method or attribute in

[285] Advice to Ministers (May 2018) http://www.landandwater.org.nz/

[286] Proposed 'New NPS-FM' to Minister Parker (July 2018)

[287] Draft National Policy Statement for Indigenous Biodiversity (NPS-IB) to Minister Mahuta (October 2018) https://www.biodiversitynz.org/uploads/1/0/7/9/107923093/report_of_the_biodiversity_collaborative_group.pdf

regulation). This is because the WCI methodology was published in 2004, and some councils use more recent iterations of it adapted especially for their regions, it is currently unclear which version would prevail at a national scale. In addition, there is limited ability under the RMA for councils to enter private land for monitoring purposes other than compliance and enforcement.

The FLG see the protection of inland wetlands as essential and recommend very strong regulations for their protection, eg, all NES rule activity statuses to be prohibited in the first instance, and a 'no loss' or a 'net gain' approach to apply to nationally significant infrastructure. The Ministry consider non-complying is appropriate as it leaves room for situations that we cannot anticipate or regulate for nationally, provided policies to protect wetlands and definitions of adverse effects are sufficiently clear. We do not think that 'no loss' approach is pragmatic for nationally significant infrastructure where government priorities clash, we would prefer a 'net gain' approach.

The hydro generators group were concerned that some rules could affect the day to day running of their schemes and wanted exceptions to polices and rules where this would occur.

The Regional Sector Water Subgroup support directive policies for protecting wetlands from loss and degradation and consider clear provisions for the circumstances in which remedying or mitigating adverse effects are necessary. They note, however, there are a number of challenges to address in the development of regulatory tools and ensuring compliance for example defining and mapping wetlands, and monitoring and enforcement. They prefer managing wetlands through Farm Environment Plans and other mechanisms until these are resolved.

The Land Managers SIG expressed concern that Farm Environment Plans were being targeted for so many things that they would become unwieldy. Concern was also raised on dealing with weeds and maintaining wetlands once they were fenced.

Summary of impacts, costs and benefits of the preferred approach

Wetlands are highly valuable ecosystems that provide greater benefits to wider society than is likely gained by developing them for other purposes. There is a low percentage of non-protected wetlands on the land most likely to be developed, therefore the costs of these regulations to landowners are likely to be minimal.

The value of our remaining wetlands

Table 7 presents results from a 2013 geospatial analysis[288] of the extent of non-protected inland wetlands (as at 2008) on fertile land classes (ie, Land Use Capability (LUC) classes 1-5)[289](as at 2000). Results show that the total area of non-protected wetlands on fertile land is approximately 28,930 ha, compared to the > 6.5 million ha of fertile land that occurs across NZ. However, the 28,933 ha of wetlands indicated as affected by the recommended regulation options is likely to be an overestimate because in many regions some of the 'non-protected' wetlands would be classified as significant already be subjected to some form of protective rules in current plans.[290]

[288] Robertson, H., Warren, P. Brown, D., Miller, R. (2013) Inclusion of Wetland Extent as an attribute in the National Objectives Framework: Impact assessment relating to wetland drainage. Department of Conservation analysis provided to Ministry for the Environment.

[289] Newsome P.F.J., Wilde R.H. and Willoughby E.J. (2000). Land Resource Information System Spatial Data Layers: Volume 1: 'Label Format'. Landcare Research Contract Report.

[290] Robertson et al. (2013)

Using the converted estimated value of ecosystem services of $48,640 per hectare per year (2019 NZD)[291] the annual value of the ecosystem services associated with these non-protected wetlands on fertile land is in the order of $1.4 billion /year nationally, with a median of $72.7 million/year across the regions. However, some of the costs and benefits may be unbalanced across landowners and the wider community and some regions as the remaining wetlands are not evenly spread across the country.

Table 8 presents the analysis of complete inland wetland loss of 214 wetlands across the regions from 2001 to 2016[292] (note this study does not differentiate wetlands on fertile or protected land). The value of the lost ecosystem services associated with this complete wetland loss is in the order of $60.7 million per year (2019 NZD) nationally. The wide range of value lost across the regions reflects the varying degrees of wetland loss around the country. However, this estimated value of lost ecosystem services is likely to be underestimated, as it does not account for partial wetland loss which will also represent a significant loss of ecosystem services.

Using the estimated value of ecosystem services of $368,220 (2019 NZD)[293] per ha per year for estuarine ecosystems

Table 9 shows the total annual value of New Zealand's coastal wetlands is in the order of $16.9 billion / year. We do not have data for the areas of protected coastal wetlands vegetation and therefore cannot give the area or value of wetlands that are unprotected.

Where will regulations most affect

Those regions with the most non-protected inland wetlands on fertile land classes are within the Canterbury, West Coast, Otago, Southland, and Waikato regions. Councils and landowners in these regions will likely be more affected by the new regulations, although these regions also reap the benefits of the ecosystem services provided by these wetlands.

The majority of coastal wetland area lies within the Northland and Auckland regions, while Taranaki, Manawatu-Whanganui and Wellington have comparatively little. Therefore, similar to inland wetlands, the costs and benefits of the NES rules for coastal will be unbalanced across the regions for both councils and landowners.

Cost of regulations

Wetlands in agricultural areas have been lost through systematic drainage/earthworks, and vegetation clearance, or from unsustainable water takes. This is likely to be mostly undertaken using available farm equipment and labour to achieve and the costs are unknown. Wetland loss due to other landuses such as roading or urban development would be achieved through the associated earthworks and incorporated into the full development costs. No detailed economic analysis has been undertaken as specific costs associated with wetland drainage or destruction are unknown.

However, given that for all regions less than 1 percent (except West Coast at 1.4 percent) of fertile land is likely to be affected by the recommended inland wetland regulations nationally with a median <1,500 ha on fertile land in each region (Table 7), it can be read that impacts on future development will be minimal.

[291] Based on converted estimated value of inland wetland ecosystem services from Constanza (2014)

[292] Belliss et al. (2017)

[293] Based on converted estimated value of coastal wetland ecosystem services from Constanza (2014)

Table 1 - Area of remaining inland wetlands and fertile land classes (ie, LUC classes 1 – 5) in each region.[294] Shows the area and percentage of non-protected wetlands remaining on fertile land and their estimated value of ecosystem services.

Region	Historic wetland area[295] (ha)	Current wetland area[296] (ha) (2008)	Total area of fertile land (ha) (LUC 1 – 5)	Remaining wetland area on fertile land (ha)	Non-protected wetland area on fertile land[297] (ha)	Per centage of fertile land that is non-protected wetland (%)	Estimated annual value of ecosystem services provided by non-protected wetlands[298] on fertile land ($)	
Northland	258451	14136	420360	3827	1874	0.45	91,151,360	
Auckland	57851	2626	201144	1174	897	0.45	43,630,080	
Waikato	356516	28254	894353	4756	2979	0.33	144,898,560	#
Bay of Plenty	43089	3320	298121	1674	1191	0.40	57,930,240	
Hawke's Bay & Gisborne	180371	3426	392321	1287	1195	0.30	58,124,800	
Taranaki	40278	3047	284333	892	463	0.16	22,520,320	
Manawatu-Wanganui	264511	7105	522508	3533	2332	0.45	113,428,480	
Wellington	122804	2791	169945	671	356	0.21	17,315,840	
Tasman & Nelson	27339	1544	89935	490	447	0.50	21,742,080	
Marlborough	12785	5259	102598	639	384	0.37	18,677,760	
West Coast	358182	84482	128268	5508	1794	1.40	87,260,160	#
Canterbury	187115	19868	1348396	9013	7485	0.56	364,070,400	#
Otago	110804	27183	840842	4675	3808	0.45	185,221,120	#
Southland	450984	47512	832571	6994	3729	0.45	181,378,560	#
New Zealand	**2471080**	**250553**	**6525695**	**45133**	**28934**	**0.44**	**1,407,349,760**	

Wetland estimates are based on 2008 estimates, these regions have endured ongoing further reduction to wetland extent since then (see Table 8) although proportion of this recent loss on non-protected fertile land has not been analysed.

[294] Robertson et al. (2013)

[295] Historic wetland area taken from FENZ database

[296] Current wetland area taken from FENZ database

[297] Non-protected wetlands are wetlands outside of PCL, QEII covenants, vested reserves, Nga Whenua Rahui, etc. and generally located on freehold land.

[298] Based on converted estimated value of inland wetland ecosystem services of approximately $48,640 /ha/yr (2019 NZD) from Constanza (2014)

Table 2 – Recent loss of inland wetland extent in each region from 2001 to 2016 and estimated value of lost ecosystem services.[299]

Region	Estimated percentage wetland remaining (%) (pre-human - 2008)	Number of recent wetland complete loss (2001-2016)	Estimated area recent wetland complete loss (2001 - 2016) (ha)	Estimated annual value of lost ecosystem services for complete wetland loss (2001 - 2016) ($)	Number of recent wetland partial loss (2001-2016)
Northland	5.5	5	11	510,720	33
Auckland	4.6	43	7	330,752	51
Waikato	7.9	9	329	15,983,104	57
Bay of Plenty	7.7	3	6	311,296	14
Gisborne	1.4	6	12	603,136	20
Hawke's Bay	2.2	1	1	38,912	17
Taranaki	7.6	5	12	573,952	11
Manawatu-Wanganui	2.6	6	14	671,232	46
Wellington	2.3	2	5	243,200	18
Tasman	19.6	9	24	1,147,904	29
Nelson	0.8	0	0	-	0
Marlborough	12.1	6	50	2,451,456	28
West Coast	23.6	38	308	14,966,528	97
Canterbury	10.6	42	104	5,068,288	189
Otago	24.4	12	81	3,954,432	66
Southland	10.5	27	284	13,823,488	70
New Zealand	**10.1**	**214**	**1248**	**60,678,400**	**746**

[299] Based on converted estimated value of inland wetland ecosystem services of approximately $48,640 /ha/yr (2019 NZD) from Constanza (2014)

Table 3 – Area of coastal wetland vegetation in each region[300] and the estimated value of ecosystem services.[301]

Region	Estimated coastal wetland vegetation area (ha)	Estimated annual value of ecosystem services provided by coastal wetlands ($)	
Northland	17360	6,392,299,200	#
Auckland	10272	3,782,355,840	#
Waikato	4516	1,662,881,520	#
Bay of Plenty	2252	829,231,440	#
Hawke's Bay & Gisborne	1112	409,460,640	
Taranaki	7	2,577,540	
Manawatu-Wanganui	51	18,779,220	
Wellington	49	18,042,780	
Tasman & Nelson	1705	627,815,100	
Marlborough	1185	436,340,700	
West Coast	1612	593,570,640	
Canterbury	3823	1,407,705,060	
Otago	784	288,684,480	
Southland	1183	435,604,260	
New Zealand	**45910**	**16,904,980,200**	

Regions where mangroves are present

[300] Estimated from the only available datasets - global saltmarsh (2017) and New Zealand mangroves (2018). This is an underestimate as it calculates only estuarine vegetation and not the wider coastal wetland habitat which includes intertidal and shallow subtidal habitats.

[301] Based on estimated value of wetland ecosystem services of approximately $368,220 /ha/yr (2019 NZD) from Constanza (2014)

Benefits of retaining our remaining wetlands

Retention of wetlands in the lowlands is also likely to have direct economic benefits, from fisheries productivity (eg, eel, whitebait, mullet and flounder), amenity values (eg, tourism, bird watching and hunting), and reducing the financial costs for nutrient and sediment management elsewhere. Often ecosystem services for wetlands in lowland areas are greater in value than the return per hectare in terms of agricultural production[302] or urban development. Particularly when considering the services lowland wetlands provide for flood protection and water quality. Given the high estimated annual value of ecosystem services attributed to inland and coastal wetlands the cost of not protecting these valuable ecosystems could outweigh any individual landowners benefit to develop them.

Wetlands are effective at attenuating contaminants such as nutrients and sediment which impact freshwater and coastal values. The uptake of constructed wetlands for these purposes is increasing and can have the added benefit of increasing biodiversity to farms and regions. However, studies have found that often in agricultural areas the most viable sites for constructed wetlands were areas of former natural wetlands that have been drained. The costs of constructing or reconstructing wetlands for nutrient attenuation purposes is estimated to be $100,000 to $200,000 (2015 NZD) per ha depending on the size, with ongoing implementation costs of approximately $2,000 - $5,000 (2015 NZD) per ha of farmed catchment, depending on the purpose.[303] Therefore, the cost of reinstating constructed wetlands to achieve the ecosystem service benefit of nutrient attenuation is likely to be far greater than the opportunity cost of protecting remaining wetlands. The costs of minor earthworks or installation of a weir to maintain water levels for wetlands restoration purposes would be much lower.

Costs of implementation

Costs to identify and monitor inland wetlands are already a responsibility of councils. All councils have access to national inland wetland maps (which are at a reasonably coarse resolution), but not national coastal wetland maps. Some councils are actively working to achieve more refined maps through various methods. Two councils are currently tackling high resolution mapping by different methods. The costs involved with these methods vary considerably the most technical approach to the highest resolution of 10-20m² costs approximately $2.5 million for the region[304], and a more systematic mapping approach using aerial photography to a resolution of ~100m² costs approximately $450,000 over 10 years.

Of those councils that have an ongoing inland wetland condition monitoring programmes the costs involved with monitoring a selection of their wetlands range between $50,000 - $100,000 per year for contractors alone. These programmes generally select a range of representative wetlands across the region and revisit them on a 5-yearly basis. Costs would increase accordingly if the number of wetlands monitored were higher.

Over all the proposed NES rules would incorporate a more stringent and consistent approach on regional coastal plans than is currently the case.

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[302] Russi D., ten Brink P., Farmer A., Badura T., Coates D., Förster J., Kumar R. and Davidson N. (2013). The Economics of Ecosystems and Biodiversity for Water and Wetlands. IEEP, London and Brussels; Ramsar Secretariat, Gland.

[303] Tanner, C., Sukias, J., Burger, D. (2015). Realising the value of remnant farm wetlands as attenuation assets. https://www.massey.ac.nz/~flrc/workshops/15/Manuscripts/Paper_Tanner_2015.pdf

[304] The underlying radio metric survey can also be used for other purposes.

The impacts of the NES rules on coastal wetlands would likely affect the renewal of consents for the existing management of lagoons and coastal lakes level regimes including river mouth and coastal lagoon openings (ie, rules around natural water level regimes). If mangroves were to be included in the NES vegetation clearance rules local management of mangrove areas would be affected. Existing ports would operate under existing consents; however, port reclamation such as Northland Forestry Port (Marsden Point) could be affected if it is not considered Nationally Significant Infrastructure; as would any local roading or other potential infrastructure extending out into tidal flats. Expansion or development of marinas, which are generally located on intertidal flats and saltmarsh areas, would also be affected.

Summary table of costs and benefits of the preferred approach

Affected parties *(identify)*	**Comment***: nature of cost or benefit (eg ongoing, one-off), evidence and assumption (eg compliance rates), risks*	**Impact** *$m present value, for monetised impacts; high, medium or low for non-monetised impacts*	**Evidence certainty** *(High, medium or low)*
Additional costs of proposed approach, compared to taking no action			
Regulated parties	Consenting costs including proving activities are not degrading to wetlands and wetland identification where necessary – would depend on size of development, proposed activity, and consultant's time. Opportunity cost to landowners of not developing wetland area, taking water etc overall generally low nationally due to small percentage of privately owned non-protected wetlands to be affected by policies and rules. Many landowners enjoy the positive effects of the amenity wetlands provide such as bird watching/ hunting etc.	Unknown potential costs to landowners but not expected to be low/medium	Low
Regulators	Cost of implementation including monitoring and mapping requirements and maintaining a register. Costs of processing applications for exceptions.	Monitoring – approx. $100k/y per council, although this will differ between councils depending on percent of natural wetlands remaining. Inland mapping – med/high depending on method used high resolution costs ranged $0.5 – $2.5 m (although cheaper methods could also be used)	Medium Medium

		Coastal mapping – unknown Register – low	Low Low
Wider government	Complementary measures – such as wetland mapping methodology, guidance on water level variations, drainage setbacks etc Continued restoration funding	Approx. $550k initially If central govt provided updated high- resolution national map additional costs could be high High	Medium
Other parties		No costs	Low
Total Monetised Cost		Not possible to aggregate cost due to uncertainty of costs to landowners. Medium	Medium
Non-monetised costs		Medium	

Expected benefits of proposed approach, compared to taking no action			
Regulated parties	More certainty as all wetlands treated the same. Better water quality and retention of other ecosystem services and amenity for retaining wetlands on property.	Medium Values included in national values below.	Low
Regulators	More certainty for decision making through nationally consistent approach to wetlands. Wetland delineation tool removes debate and avenue for appeal. Better understanding of extent and values of wetlands in regions.	Medium High High	Medium
Wider government	Better able to analyse and report on wetland extent and health. Increased ability to support international agreements (ie, Ramsar Convention). Benefits to government's biodiversity enhancement objectives.	High	Medium
Other parties	Wider community benefits from retaining ecosystem services of inland and coastal wetlands. Increased protection of habitat for indigenous biodiversity.	Non-protected Inland wetlands on fertile land ~$1.4 b/yr nationally All coastal wetlands ~$16.9 b/yr nationally	Medium

Total Monetised Benefit		In the order of ~18.3 b/yr for retaining ecosystem services of inland and coastal wetlands nationally	Medium
Non-monetised benefits		High	Medium

Appendix 14: Improving water quality through better farm practice

Context

There is an extensive set of applied research and modelled data to indicate the water quality improvements that would flow from the adoption of improved farming practice. For example Environment Canterbury's substantive Matrix of Good Management modelling exercise found that dairy farm nitrogen losses would fall by 22 percent and phosphorus losses by 15 percent; sheep, beef and deer farms' nitrogen losses would fall by 16 percent; and cropping farm nitrogen losses by 16 percent.[305]

As described below, there is increasing interest in using freshwater modules in farm plans (FW-FPs)[306] to address a range of environmental issues. While water quality is the initial focus, there is also discussion of using FW-FPs to assist with climate change and biodiversity challenges. In addition, MPI is leading a project looking at the role of farm plans more generally (e.g including areas such as animal welfare and business planning); and promoting effective integration across different aspects of farm planning.

Note: This RIS focuses on the role of FW-FPs as part of Option 1 (national level regulation) of the discussion document for improving farm practices. The discussion document also includes an alternative approach to implementation of FW-FPs and the proposals considered in Appendices 15-18, which is summarised in section 4.21 of the Summary RIS document.

Status quo including regulatory systems in place

Currently a range of approaches are being taken to improve farm practice in relation to water quality. Councils use regional rules, information/advice and (in some cases) part-funding for improved practice. Sector organisations publish good management guidelines and codes of practice and offer varying degrees of extension support to their constituents. The dairy sector has implemented the Dairying and Clean Streams Accord and its successor, the Sustainable Dairy: Water Accord to address particular practices such as stock exclusion from waterways.

Adoption of improved practice is patchy, and mostly undocumented. The dairy accords have been reasonably successful with significant improvements in the identified practices documented and audited. A 2015 Federated Farmers/Dairy NZ survey revealed an estimated farmer spend of over $1 billion on protecting and improving the environment over the previous five years.

Increasingly, regional councils, processors and sector organisations are taking a farm-system and risk management-based approach to improving farm practice through the use of FW-FPs that are tailored to the specific water quality risks on each farm. This tailored approach is viewed by the primary sector and regional councils as a useful way to improve freshwater outcomes and can also work in tandem with more prescriptive controls over farming activities. FW-FPs are required for many farms under Environment Canterbury's regional rules; Horizons' One Plan rules; and in the

[305] Environment Canterbury (2015). *Overview report: Canterbury matrix of good management practices*

[306] Also called Land and Environment Plans in the drystock sectors, and Farm Environment Management Plans by some councils. Typically these plans cover a range of environmental risks and not just those to water quality eg, biodiversity. In addition, these plans are part of an even broader set of plans the farm may hold including financial planning, animal welfare plans, health and safety plans etc. Throughout this document we have used the term Farm Environment Plan to refer to what is essentially the *water quality module* of what may be a much broader plan, or which may stand alone.

Tukituki catchment in Hawke's Bay. FW-FPs are also proposed under Waikato's Plan Change 1; Bay of Plenty Regional Council's Plan Change 10 for the Rotorua lakes; and Southland's Water and Land Plan. Northland's proposed regional plan requires erosion control plans for high sediment yielding land. A number of councils also support voluntary up-take of FW-FPs.

Sector organisations also have strategic targets for the adoption of FW-FPs by all their levy payers. The targets below illustrate that the primary sector views FW-FPs as a useful way to help farmers and growers improve their environmental performance (and in so doing potentially help promote higher value products and improve the social licence of farmers and growers).

- Beef+ Lamb NZ's Environment Strategy commits to all sheep and beef farmers having a farm environment plan by 2021.
- The dairy sector's Dairy Tomorrow Strategy includes a target for every dairy farmer to have a farm plan by 2025.
- The deer industry is aiming for every deer farmer to have a farm plan by 2020
- Horticulture NZ and the Foundation of Arable Research are signatories to the Good Farming Practice: Action Plan for Water Quality that includes a commitment to all farms having an FW-FP by 2030

How is the situation expected to develop if no further action is taken?

Uptake of improved practice will continue to be patchy as there will be insufficient incentives for adoption by all farmers and growers. Some farmers will continue to operate with high levels of environmental performance. However, significant barriers to adoption of improved practices exist. These include a lack of awareness about what good practice is; need for greater one-on-one support from skilled individuals for helping build farmer confidence to implement changed and improved practices; and actual or perceived cost barriers.

The use of FW-FPs is however expected to increase. Given current trends, it is likely that over time most regional councils will include an FW-FP requirement for at least some of the farmers in their region; and sector organisations will continue to promote the use of FW-FPs.

If the actions in FW-FPs appropriately target water quality risks and are implemented, improved water quality will result. Implementation of FW-FPs will be higher if councils (or an independent third party) monitor and enforce FW-FP implementation. The voluntary nature of FW-FPs under sector initiatives mean that willing farmers will adopt and implement FW-FPs, while the unwilling will not, and there is unlikely to be focussed effort on helping poor performers improve their practices.

With no further action, there will also be little national consistency in the templates and data systems for FW-FPs; and implementation support will be patchy. MPI's Integrated Farm Planning project that covers the complete set of plans that farmers may be required or choose to use will provide guidelines eg, for data standards to help improve national consistency. However, there will likely be missed opportunities to gather meaningful data that can inform evaluation and improvement of FW-FPs.

The problem/opportunity

Water quality is degrading in many rural catchments. One significant contributing factor is that not all farmers are adopting practices to reduce water quality impacts from their farms, or are not doing so fast enough. While progress is being made, anecdotal evidence and perspectives from conversations with individuals involved in farm planning initiatives indicate scope for on-going

improvement. In addition, the most recent Manaaki Whenua/Landcare Research survey of rural decision makers[307] found 51 percent of respondents were implementing practices to manage erosion and sediment; 62 percent of those with farms prone to pugging were implementing practices to reduce pugging; and 78 percent of those with stock and streams/wetlands were restricting stock from waterways.

To be most effective, the practices adopted need to address the particular risks to water quality on each farm. A FW-FP (whether voluntary or mandatory) is a tool to promote improved practices tailored to the specific water quality risks on each farm.

Reasons for non-adoption of good practices are multi-factorial and vary from case to case, as described above. An additional problem is that water quality degradation may have little direct cost for the farmer generating contaminant discharges, but has effects on those downstream and on the health of the waterway.

There is significant opportunity for reductions in water quality impacts from farms without the need for land use or system change. For example, in the Horizons region, dairy farmers seeking land use consents worked with consultants to reduce nitrate discharges; with modelled reductions of 5 to 20 percent able to be achieved while retaining farm viability.[308] Sediment loss reductions of 47-70 percent from hill country farms implementing FW-FPs have been modelled for the Horizons and Waikato regions respectively.[309] Reductions of this scale would make a significant contribution to achieving the overall objectives of Essential Freshwater.[310]

Additional constraints on the analysis

The analysis covers farming and horticulture (including vegetable growing and viticulture). Forestry is covered by the NES Plantation Forestry; and urban water quality issues are dealt with in a separate stream of work.

The analysis focuses on practices to improve water quality rather than broader environmental goals. However, the goal is to make the potential approaches consistent with achieving other environmental outcomes. MPI's Integrated Farm Planning work provides an umbrella framework within which an FW-FP could fit. A water quality module of an FW-FP could be integrated with modules for greenhouse gas mitigation, biodiversity enhancement and water-use efficiency.

This FW-FP component forms a foundation across all farms, with high-risk land-use activities, stock exclusion and high nitrogen components also involving or potentially involving use of FW-FPs. The Fair Allocation work stream may develop proposals that also involve FW-FPs. For example, auditing of FW-FPs could provide a basis for assessing whether discharges are compliant with nutrient discharge allowances allocated; or as a basis for charging for discharges. In addition FW-FPs may be

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[307] https://www.landcareresearch.co.nz/science/portfolios/enhancing-policy-effectiveness/srdm/srdm2017

[308] Parminter, T., 2015: Selecting farm practices and preparing farm plans for land-use consents in the Manawatu- Wanganui region. In "Proceedings of the 77th Annual Grassland Conference".

[309] Doole, G. J. (2015). Description of mitigation options defined within the economic model for Healthy Rivers Wai Ora Project: description of options and sensitivity analysis; Snelder, 1 (2018). Assessment of recent reductions in *E.coli* and sediment in rivers of the Manawatu-Whanganui Region: Including associations between water quality trends and management interventions

[310] It is important to acknowledge that FEPs are not the sole tool for delivering on catchment limits. In many cases additional measures will be required.

used in parallel with an allocation regime for nitrogen, with the FW-FP used to ensure good management of other contaminants such as sediment and pathogens.

Finally, there is an interdependency between the FW-FP options in this component and the Sustainable Land use package in Budget 2019. . This $229 fund will help develop the capacity and capability to certify and audit farm plans and, more broadly, assist the primary sector to transition to more sustainable land-use practices. This will help ensure farmers, councils and the agribusiness sectors are able to successfully implement the mandatory FW-FP option and other related government proposals.

Options Assessment

Objective

Our policy intent is to promote the up-take of farm management practices that will help improve water quality.

Summary Assessment

Criterion	Option A: strengthen support for voluntary adoption of improved practices and freshwater modules of farm plans	Option B: Prescribe comprehensive good practice requirements in National Environmental Standard	Option C: Mandatory Farm Environment Plans
Effectiveness	+	+	++
Timeliness	+	0	+
Fairness	0	-	+
Efficiency	+	0	++
Principles of the Treaty of Waitangi	0	+	+
Te Mana o te Wai	+	0	++
Overall Assessment	+	0	++

Baseline option: Maintain Status Quo

Continuing the status quo will result in ongoing patchy adoption of improved practice and FW-FPs. It will not accelerate the adoption of practices to the extent needed to halt degradation and deliver improved water quality in five years. This option will also not drive a significant improvement in the numbers of people undertaking training to be able to provide professional services in farmer extension and delivery of FW-FPs. For these reasons this option is not favoured.

If the status quo continues, FW-FPs will likely be required by an increasing number of regional councils, and will continue to be promoted by sectors and processors/exporters. However, this is likely to happen over an extended period as regional plans are developed and renewed. It is likely that some councils will continue with a voluntary approach to FW-FPs and that regions with FW-FP requirements may target them to particular catchments only. Processor/exporter requirements are dependent on market drivers and the nature of the industry. Processors targeting top-end consumer

markets are more likely to require assurances of good environmental practice of their suppliers to support the brand.

The voluntary nature of FW-FPs under sector initiatives mean that willing farmers will adopt and implement FW-FPs, while the unwilling will not. And with implementation support likely to be patchy, the quality of FW-FPs and implementation of actions in them may be variable and monitoring and reporting may be ad hoc. And while MPI's Integrated Farm Planning project will provide guidelines for data standards there will be lost opportunities to drive national consistency in the templates, training and information systems for FW-FPs.

Indicative Social Impact

The status quo is unlikely to impact on farming communities' day-to-day work, and to bring strong incentives for vast numbers of farmers and growers to become early adopters of sustainable practices, as farmers and growers 'wait and see' for regulations as well as for research to demonstrate visible benefits.[311]

Any social benefits associated with the status quo (improvements to health, recreation opportunities, amenity, cultural values) are likely to occur slowly and variably across the country, limited to those areas where regional rules require FW-FPs or where and when farmers develop and implement voluntary FW-FPs.

There may be economic benefits for farmers able to leverage from "doing the right thing" (eg, sustainable branding).

The status quo is also unlikely to markedly contribute to perceptions that the farming community are acting as stewards of the land / environment (social licence to operate),[312] which will likely be associated with low level of well-being, sense of self within the farming community.[313]

Other social costs are likely to include decrease in New Zealand public's trust in government to 'do the right thing',[314] as the water quality of waterbodies valued by the community potentially decline.

Treaty of Waitangi – There is currently no clear role for partnership with Māori and iwi. The status quo is unlikely to improve Māori and iwi's opportunity to express their kaitiakitanga role and improve their sense of cultural identity.

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[311] Botha N, Roth H and Brown M 2013. '*The Adaptation of Pastoral Farmers to Environmental Policy Changes: A New Zealand Case Study*.' South African Journal of Agricultural Extension, Vol. 41: 16-25

[312] P Clark-Hall, 2018, *How to Earn a Social Licence to Operate*

[313] Farmers' mental health: A review of the literature (ACC Policy Team, 2014) https://www.mentalhealth.org.nz/assets/ResourceFinder/wpc134609.pdf; Botha N, Roth H and Brown M 2013. '*The Adaptation of Pastoral Farmers to Environmental Policy Changes: A New Zealand Case Study*.' South African Journal of Agricultural Extension, Vol. 41: 16-25; Kennedy A, Maple MJ, McKay K, Brumby SA. 2014. Suicide and accidental death in Australia's rural farming communities: a review of the literature Rural and Remote Health 14: 2517. http://dro.deakin.edu.au/eserv/DU:30062460/kennedy-suicideandaccidental-2014.pdf

[314] The majority of surveyed New Zealanders in 2018 feel that it is very or extremely important to improve the quality of our water, and see government and farmers are responsible to make this change. Colmar Brunton. 2018. Environmental Attitudes Baseline. Commissioned by the Ministry for the Environment.

Option A: Strengthen support for voluntary adoption of freshwater modules in farm plans and improved farm practices (support package)

This option of a voluntary approach to FW-FPs would give increased central government priority and publicity to supporting the successful implementation of the *Good Farming Practice: Action Plan for Water Quality* developed by the primary sector in partnership with regional councils and government. Greater attention would also be given to related industry strategies and farm plan commitments. This would increase the adoption of FW-FPs, beginning in priority catchments, with FW-FPs and good practice adoption intended to be in place everywhere by 2030, with commitment to on-going improvement in line with changing technologies and new information. On-going reporting on progress on Action Plan implementation is also proposed.

Subject to Budget provision, this would be underpinned by strengthened support for extension programmes, good practice and FW-FP guidance, catchment group initiatives, training of farm plan advisors, and on-going work on efficacy of good practices.

This option provides the primary sector with opportunity to demonstrate leadership in promoting improved performance. Over time this support package would result in increased uptake of FW-FPs beyond that achieved in the status quo, especially amongst willing farmers. Unwilling farmers would be less likely to adopt and/or implement FW-FPs and an industry-led process may be less trusted or sen as independent. A significant risk with this option is that some of the least willing farmers may also be the most damaging to water quality. In addition, lack of a mandatory national requirement is likely to lessen Government focus, commitment and resources supporting effective FW-FPs and improved practice adoption.

Criterion	Option A: strengthen support for voluntary adoption of improved practices and farm plans
Effectiveness	+ Over time many farmers will develop and implement an FW-FP with actions to address specific risks to water quality on their farm, but uptake will be patchy and incomplete.
Timeliness	+ Central Government support for councils and sectors would increase voluntary adoption of FW-FPs amongst the willing, and likely accelerate the development of regional plan rules requiring FW-FPs.
Fairness	**0** Costs to address water quality impacts would fall on those who choose to develop an FW-FP, but not on those who choose not to. Where FW-FPs and improved practices are not adopted, the costs continue to fall externally to the community/the water itself.
Efficiency	+ Adoption of FW-FPs would be greater than under the status quo, enabling selection of least-cost ways of reducing discharges from these farms. However, some farmers will not adopt FW-FPs, so some of these least-cost approaches will not be implemented, and the benefits for water quality not achieved.
Principles of the Treaty of Waitangi	**0** Aims to reduce the water quality impacts from farms, contributing to protection of water quality. However FW-FP adoption would be incomplete. Catchment-scale information including that relating to mahinga kai values should assist in farm planning but there is not a clear role for partnership with Māori in developing FW-FPs with farmers or requirements for Māori involvement in compliance monitoring.

Te Mana o te Wai	+ This option would make a contribution to protecting the health and mauri of water. It would also enable farmers who adopt FW-FPs to better exercise kaitiakitanga or stewardship over the resources in their care
Overall Assessment	+ Will help and is needed. On its own won't be enough to make a significant contribution to improving water quality

Indicative Social Impact:

The indicative social impacts are likely to be similar to those associated with the status quo, with any social benefits (improvements to health, recreation opportunities, amenity, cultural values) likely to occur slowly and variably across the country where those voluntary programmes are successful.

The success of those voluntary programmes to bring effective change will depend on effective design and good farmer engagement (eg, working with the landowners' goals; creating a sense of responsibility; research demonstrating visible benefits of the alternative practice).[315]

Option B: National regulation prescribing good practice standards

Under this option, minimum good practice standards would be prescribed in a national instrument. (These standards would be in addition to any national standards that are proposed for high risk land use activities and exclusion of stock from waterways). To be most effective such standards should be clear and enforceable.

This approach is similar to that developed in the NES Plantation Forestry (NES-PF), which sets out good practice. However the NES-PF also includes a requirement for risk-based management plans for a range of activities. These plans are tailored to the specific forest, recognising that not all practices can be specified in a national instrument. Developing a similar set of practices for the wide range of agricultural and horticultural land uses would take considerable time (with farming and growing activities far more heterogeneous than forestry). And there would likely also be a need to fall back on the use of risk-based management plans for many aspects of farm operations.

Most councils already reference a small number of industry codes of practice in their plans, such as the Farm Dairy Effluent (FDE) Design Code of Practice and Standards and irrigation efficiency requirements. Such requirements are generally applicable everywhere and amenable to national prescription. And, as described elsewhere, minimum standards are being proposed for specified high risk activities.

Criterion	Option B: Prescribe good practice requirements in NES
Effectiveness	+ Will improve practice in the areas specified in the regulations, but will not be tailored to individual farm risks and attention may be diverted away from managing more significant risks to water quality.
Timeliness	**0** The complexity of the task of developing and gazetting a comprehensive set of regulations could take one-two years.

[315] Botha N, Roth H and Brown M 2013. '*The Adaptation of Pastoral Farmers to Environmental Policy Changes: A New Zealand Case Study*.' South African Journal of Agricultural Extension, Vol. 41: 16-25; Finlayson, K. 2018. Bridging the gap: Linking farm plans to every day farming practice. PhD. Otago University, New Zealand.

Fairness	- The bluntness of a national instrument would result in some inequities eg, some farmers would be required to comply with costly regulations for a low-risk practice and others would continue with more risky practices that have not been identified in the regulations.
Efficiency	**0** Blunt regulatory approach would not take account of variation in farm types and environmental conditions, and would not be tailored to the risks on each farm, imposing additional and unnecessary costs. In some cases, it would be less efficient than the status quo.
Principles of the Treaty of Waitangi	+ Aims to reduce the water quality impacts from farms, but as this approach is relatively ineffective, it would achieve less that options A and C in this regard. This option could provide for partnership in developing the national standards.
Te Mana o te Wai	**0** This option would make a lesser contribution to protecting the health and mauri of water than the other options, and would delay action until the regulations are developed.
Overall Assessment	**0** May have perverse outcomes from focusing on actions that are more amenable to prescriptive regulation but may be high cost and not the ones that will make the most difference to water quality

Indicative Social Impact

This option is likely to produce impractical and inefficient standards and may negatively impact farmer wellbeing (anxiety/mental health):

- if financial costs of implementing the standards will, or are perceived to affect farm viability;
- if farmers are concerned they do not have the necessary skills to implement the standards;
- and/or they do not believe the standards are correct, relevant, or necessary.[316]

The potential costs on farms viability of implementing the standards could also negatively impact on the wider community if the farming workforce has less disposable income.

Other social costs are likely to include decrease in New Zealand public's trust in government to 'do the right thing',[317] if the water quality of waterbodies valued by the community decline.

The positive social impacts associated with improved water quality are likely to include reduced risk to human health (through improved drinking water quality), improve amenity, increase access to valued natural resources, including for recreational activities, and contribute to New Zealanders' cultural identity associated with a high quality natural environment. These positive impacts are likely to be felt by New Zealanders at large, including Māori and the farming community.

[316] Farmers' mental health: A review of the literature (ACC Policy Team, 2014) https://www.mentalhealth.org.nz/assets/ResourceFinder/wpc134609.pdf , Botha N, Roth H and Brown M 2013. '*The Adaptation of Pastoral Farmers to Environmental Policy Changes: A New Zealand Case Study*.' South African Journal of Agricultural Extension, Vol. 41: 16-25

[317] The majority of surveyed New Zealanders in 2018 feel that it is very or extremely important to improve the quality of our water, and see government and farmers are responsible to make this change. Colmar Brunton. 2018. Environmental Attitudes Baseline. Commissioned by the Ministry for the Environment.

Additionally, successful standards may help improve public's perception of the farming community as stewards of the land to some extent.

New national standards is also likely to increase demand for a higher-skilled and larger rural professional workforce, thus creating more job opportunity.

The scale of these positive impacts will depend on the scale of freshwater quality improvement across the country.

Treaty of Waitangi – There is currently no clear role for partnership with Māori and iwi. The status quo is unlikely to improve Māori and iwi's opportunity to express their kaitiakitanga role and improve their sense of cultural identity.

Option C: Mandatory Farm Environmental Plans

Under this option, a regulation in a national environmental standard (NES) would require all farmers and growers above a size threshold (proposed to be 20 hectares, with a lower threshold of 5 hectares for horticulture) to have a FW-FP no later than 2025 or 2030 to address property and catchment-specific risks to water quality.

This technical NES standard would:

- set minimum specifications for FW-FP content
- require all famers and growers to have an FW-FP by the date specified in the NES, with requirements phased in to provide time for building the capability and capacity of farm advisors and developing supporting institutional arrangements and data systems.
- require all farmers and growers to have their FW-FP certified by a suitably qualified and experienced person (defined in the NES) as meeting the requirements set out in the NES and provide notification of this to the relevant regional council by the due date for the FW-FP
- require farmers and growers to have their FW-FP reviewed and up-dated with a suitably qualified and experienced practitioner at regular intervals, and provide confirmation of these audits to the relevant regional council

Requiring all FW-FPs to be completed by 2030 rather than an earlier timeframe like 2025 is less ambitious but reduce the risks of timeframes not being met and more importantly lower quality and poorly implemented FW-FPs. Prioritising FW-FP roll-out over time allows time for the FW-FP and extension support work force to build up, and to build supporting data systems. On the ground implementation will suffer if there is insufficient extension support and resources for compliance, monitoring and enforcement. Option A is therefore required in tandem with mandatory FW-FPs.

The first tranche of FW-FPs could be completed by 2022. It is proposed that this tranche cover all farming enterprises in three "exemplar catchments", all commercial vegetable growers and higher priority activities where consent may be required (see high risk activities section). This is ambitious, and in addition FW-FPs will also be required under the managing intensification policies and are being considered under the policy to target high N leaching farmers. The consultation process may therefore see some refinement to what is included in tranche one. A second FW-FP tranche would likely prioritise catchments, with targeting linked to catchment vulnerability and water quality risks, and would be completed by 2025. The remainder would be required to be completed by 2030.

Where a council already requires FW-FPs (see page one) those FW-FPs will be recognised under the new system. In the event that any requirements differ, transitional provisions will provide time for the council requirements (and associated industry farm plan programmes) to be aligned with the minimum requirements over time, likely by 2030.

Compliance monitoring and enforcement is a challenge, particularly as councils cannot recover costs for monitoring unless FW-FPs are required as part of consent process. It is likely to be most problematic for the second and third FW-FP tranches, as these will capture more enterprises that individually have lower environmental risks meaning councils may not require consent. Experience in implementing the first tranche of FW-FPs will help determine whether RMA amendments to allow councils to cost recover for compliance monitoring of FW-FPs need to be considered.

Criterion	Option C: Mandatory Farm Environment Plans
Effectiveness	++ Requires all farmers to develop and implement a tailored FW-FP, with actions to address specific risks to water quality on their farm. If supported by an implementation package this will provide farmers with the skills, knowledge and one on one support to continuously improve management practices. Enforcement action for non-compliance of actions in an FW-FP will be more successful where there are minimum standards for high risk activities and/or consent requirements.
Timeliness	+ All farms over a de minimus size will have an FW-FP by 2030, with first tranche farms by 2022. This will increase the adoption of better practices and encourage continuous improvement over time. Actions in FW-FPs will be implemented over time. Time will be needed to build the institutional capacity (eg suitably qualified farm planners) to deliver quality FW-FPs.
Fairness	+ All farmers would be required to address their water quality impacts through an FW-FP, rather than just the willing and those required to by councils. FW-FP actions will be proportionate to the farm's water quality risks, so higher costs fall on the bigger dischargers. Cost of FW-FP preparation and auditing fall on farmers, and the benefits fall widely across the community. The way the costs fall is not related to ability to pay, so some low-profit farms may face high costs; affecting their viability. Implementation support would mean that farmers would not be being asked to do something they do not have the knowledge and skills to perform. Some agri-sectors are likely to be more impacted than others (with the dairy sector being the most advanced in terms of numbers, and quality of FW-FP already done, and number of rural advisors).
Efficiency	++ Additional costs would be imposed on farmers, councils, government and industry bodies, but the risk-based and tailored nature of FW-FPs mean that they can identify the most efficient method of reducing discharges from an individual farm. However, FW-FPs do not identify the most efficient method of reducing discharges across a whole catchment in order to meet a limit. Additional catchment-scale planning approaches would enable these efficiencies to be captured.
Principles of the Treaty of Waitangi	+ Proposal aims to reduce the water quality impacts from every farm, contributing to protection of water quality, and if implemented well should provide a significant on-going contribution to improving water quality. The option does not provide a clear role for partnership with Māori in developing/enforcing FW-FPs for all farms, and does not require the adoption of Mātauranga Māori. However, the development of the FW-FP involves an advisor chosen by the farmer, who works in partnership with the farmer to develop a mutually agreed FW-FP. For Māori-owned farms, this ensures that the farmer's aspirations and knowledge (including Mātauranga Māori) are incorporated into the FW-FP; and farmers retain rangatiratanga over their farm resources.

Te Mana o te Wai	++ This option would make a stronger contribution to protecting the health and mauri of water than the other options. It also enables farmers to better exercise kaitiakitanga or stewardship over the resources in their care.
Overall Assessment	++ If well-resourced could deliver significant improvement in water quality and promote continuous improvements in farming practice across a range of environmental parameters.

Indicative Social Impact

This option may negatively impact farmer wellbeing (anxiety/mental health):

- if financial costs of developing and implementing FW-FPs will, or are perceived to affect farm viability;
- if farmers are concerned they do not have the necessary skills to implement the standards;
- and/or they do not believe FW-FPs are correct, relevant, or necessary.[318]

Costs of preparing plans, implementing the actions in FW-FPs (including paying for advice), and auditing of FW-FPs could be significant and the reductions in disposable income could impact on wider rural communities as well as the individual farmers. Some primary sectors are likely to be more affected than others.[319]

The proposed policy will add to councils' workload, which may de-prioritise other projects/programmes to resource the implementation of the proposed policy. This may create some dissatisfaction for council staff. Inversely, if councils are not able to de-prioritise enough other programmes, this may result in overworked staff with associated impact on physical and mental health or simply the work not being done. Councils may increase rates in order to resource the extra workload, with potential negative impacts for wider communities.

If FW-FP are perceived by the New Zealand public and ENGOs as a robust tool to ensure change in farming practices and resulting in better environmental outcomes, this could improve farmers' social licence to farm, and improve their well-being and sense self. However, there is some scepticism from ENGOs about FW-FPs, so involvement of independent people in the FW-FP process and transparent monitoring and reporting will be important.

The proposed policy could also result in a general perception of fairness by all or most parties as all agri-sectors are being targeted by the proposed policy.[320]

If FW-FP are perceived overseas as a robust assurance for environmentally sustainable products, this option could provide positive economic impacts for farmers able to leverage from their sustainable practices.

[318] Farmers' mental health: A review of the literature (ACC Policy Team, 2014) https://www.mentalhealth.org.nz/assets/ResourceFinder/wpc134609.pdf , Botha N, Roth H and Brown M 2013. '*The Adaptation of Pastoral Farmers to Environmental Policy Changes: A New Zealand Case Study*.' South African Journal of Agricultural Extension, Vol. 41: 16-25

[319] With the Dairy sector being the most advanced in terms of number and quality of FEP already done, and number of rural professionals to advise dairy farmers

[320] P Clark-Hall, 2018, *How to Earn a Social Licence to Operate*

The proposed policy is also likely to increase demand for a higher-skilled and larger rural professional workforce, thus creating more job opportunity, especially in sectors with currently less rural advisors (ie, other than the dairy sector) and in regions where few FW-FPs have been developed.

Also on the positive side, going through the process of developing an FW-FP (especially with tailored one-on-one support) may improve some farmers' wellbeing through helping them feel more equipped and resilient in facing the environmental challenges ahead and confident in their role as an environmental stewards. This will depend on the adequate supporting structure being put in place (eg, courses; peer-to-peer support) and (this is especially true for farmers) with FW-FP being seen by farmers and growers as a learning tool before a compliance tool.

The positive social impacts associated with improved water quality are likely to include reduced risk to human health (through improved drinking water quality), improve amenity, increase access to valued natural resources, including for recreational activities, and contribute to New Zealanders' cultural identity associated with a high quality natural environment. These positive impacts are likely to be felt by New Zealanders at large, including Māori and the farming community.

Treaty of Waitangi – There is currently no clear role for partnership with Māori and iwi. The status quo is unlikely to improve Māori and iwi's opportunity to express their kaitiakitanga role and improve their sense of cultural identity.

Options ruled out of scope, or not considered

A further option considered was to establish a national body to administer an FW-FP regime, rather than regional councils. This option could be suited to achieving a broader range of national outcomes including "Brand New Zealand" assurances on environmental performance, natural resource use charges, and management of greenhouse gas emissions from the primary sectors. While this option could be part of the longer term architecture of environmental management in New Zealand, it was not considered further because of the lack of a suitable national institution currently.

Recommendation

Option C: Mandatory FW-FPs for all farms (over a di-minimus size threshold) is the favoured option that is most likely to deliver on the policy objectives and result in greater up-take of management practices that will deliver improved water quality. The inclusion of an auditing process and the involvement of skilled people in delivering the initial FW-FP (tailored to the farm in question) are key elements of driving this change.

However, to be successful (rather than a box ticking exercise), a mandatory FW-FP will require high level of government investment and support and the roll out of FW-FPs will need to be phased in. For this reason, Option A support package is also recommended. The public consultation process also includes the option of relying on a voluntary approach to FW-FPs. The consultation process will assist in providing further information on how best to support effective FW-FP implementation and ensure roll out time frames for a mandatory FW-FP regime are appropriateStress levels are likely to be high on farmers and growers, particularly those who may feel overwhelmed by the large number of government regulatory requirements coming at them and who already face challenges such as high debt levels. On the positive side, going through the process of developing an FW-FP (especially with tailored one-on-one support) may also promote some farmers' wellbeing through helping them feel more equipped and resilient in facing the environmental challenges ahead and confident in their

role as an environmental stewards, and potentially improve the social licence of farmers and growers.

Summary table of costs and benefits of the preferred approach

Affected parties *(identify)*	**Comment**: *nature of cost or benefit (eg ongoing, one-off), evidence and assumption (eg compliance rates), risks*	**Impact** *$m present value, for monetised impacts; high, medium or low for non-monetised impacts*	**Evidence certainty** *(High, medium or low)*
Additional costs of proposed approach, compared to taking no action			
Regulated Parties	Financial costs to farmers and growers of preparing an FW-FP. This will vary depending on the complexity of the farm system and will essentially be a one-off cost. Costs should reduce if Government supports improved and more accessible farm-scale mapping of soils etc. The cost will fall on farmers, essentially as a cost of doing business, as is the case currently where FW-FPs are required by councils	Medium-High Assume $3500 on average. If assume 28000 more farms need FW-FPs = $100M *An agricultural consultancy charged an average of $4700 (range $2200-$7500) for FW-FPs in the Waikato (taking an average of 25 hours and a range of 8-48 hours). Fonterra average 14 hours for preparing an FW-FP (range 11-17 hours)* *Irrigation schemes in Canterbury costed their FW-FPs at $1000-2000.*	Medium
	Costs of implementing actions in FW-FP also vary depending on what is required. Irrigation schemes in Canterbury suggest farmers are budgeting $10-$30 K per annum for FW-FP implementation. This excludes one-off infrastructure investments (eg, effluent treatment system upgrade ($100K) may be required irrespective of the FW-FP Policy).	Medium-High Suggest average on-going cost of $15,000 per annum per farm. Cost and impact will be variable, and for some costs may be high relative to profit and size of operation. If assume 50K farms then = $750M over 10 years *Note some duplication with other parts of rural package (and existing council requirements)*	Medium

	Cost of auditing FW-FPs	Medium-High ECAN experience is that audit take 6+ hours and average around $1500 (range $1200-$2000) $1500 * say 50,000 farms* 0.5 (if assume audits every two years on average) $38M	Medium
	Poor audit grade (if grading system used) is likely to reduce value of property/selling price and ability to borrow money (Canterbury evidence)	Low But potential high impact on small number of farmers	Low
	Potential negative effect on farmer wellbeing (anxiety/mental health) if financial costs of preparing and implementing FW-FPs will, or are perceived, to affect farm viability and/or if farmers are concerned they do not have the necessary skills to prepare and implement FW-FPs and/or do not believe the requirements are relevant or correct[321]		
Regulators *(covered central government in section below)*	Costs to regional councils to administer the FW-FP regime will be significant, including CME costs. Monitoring costs can be recovered where consents are used, which should pick up many of the FW-FPs in first tranche (2022). However, other monitoring costs will fall on ratepayers. Also significant costs associated with administration, data management, farmer extension, education, reporting; and primary industry and central government liaison. Councils may de-prioritise other projects/programmes to resource FW-FP implementation; or not be able to adequately resource programme role out which may result in overworked staff with associated impacts on physical and mental health.	Medium-High Councils very concerned about their ability to effectively implement an FW-FP regime particularly when combined with other pending environmental policy initiatives and shortage of appropriately skilled staff. The consultation process should help provide further clarity on the impact of the FW-FP and related proposals on regional government. Effective monitoring and enforcement critical to	Medium-High

[321] *Farmers' mental health: A review of the literature* (ACC Policy Team, 2014) https://www.mentalhealth.org.nz/assets/ResourceFinder/wpc134609.pdf , Botha N, Roth H and Brown M 2013. '*The Adaptation of Pastoral Farmers to Environmental Policy Changes: A New Zealand Case Study*.' South African Journal of Agricultural Extension, Vol. 41: 16-25 (emailed as an attachment)

		delivering successful programme	
Wider Government	Building institutions for recognition and training of FW-FP writers and auditors. Work on data standards and alignment of farm planning approaches is also needed to help promote integrated farm planning. Underpinning work continues to be needed on science of efficacy of different management practices; helping get new technologies tested and proven; and supporting effective CME	High Mandatory regime will require government investment in capability building. More generally, without Government support implementation will fail. Option A is therefore critical as well. Some of this work is already happening (eg, as part of the national science challenge) but much more is needed.	Medium
		The $229 Sustainable Land use package in Budget 2019 will provide some funding to assist with developing the capacity and capability to certify and audit farm plans and, more broadly, assist the primary sector to transition to more sustainable land-use practices. Future bids will likely be used to seek more funding for this broader purpose.	
Māori/ Iwi	No clear role for partnership with Māori or participation, which is likely to increase Māori frustration and disillusion with government to adequately give effect to the Treaty.		
Wider community	Potential negative effects on some business owners and their staff if the farming workforce has less disposable income.		
Total Monetised Cost	Costs will be high for the primary sector, regional and central government, particularly when combined with other parts of the rural package and Government's wider environmental agenda. To be effective significant government support with be required.	High	High

	Capability and capacity building of farmers and rural professionals is particularly important		
Non-monetised costs		High	High

Expected benefits of proposed approach, compared to taking no action			
Regulated Parties	A good FW-FP process (with commitment to adequate extension programmes) should help farmers be more resilient and able to tackle other environmental challenges and opportunities. May also help identify new business opportunities. Demonstrating improved environmental performance is important for building the social licence of the primary sector and an FW-FP regime has the ability to assist in this respect. In some cases FW-FP process may identify farm system changes that may improve profitability and provide environmental benefits (eg, soil testing could suggest less fertiliser is needed).	Medium-High	Medium
	Potential for market access or market premium benefits by linking FW-FP to an assurance programme.	Medium Limited evidence of widespread consumer willingness to pay premium. Synlait and Miraka do offer small premium for high environmental performance and brands like Taupo Beef show there can be a premium. Good environmental performance is increasingly what consumers expect for all and FW-FPs could help demonstrate this performance.	Medium
	Evidence from Canterbury is that good farm plan audit results can make it easier to borrow money and impact positively on property values (converse for poor audit grades).	Low-Medium	Medium

Regulators – local government	FW-FPs should help deliver on council RMA obligations and contribute to better environmental outcomes in region and enhanced ability to provide for cultural and recreational values of citizens More information on farming activities in their region, including who is involved where and potential for improved working relationships with farmers; and greater ability to target extension programmes to where can have biggest impact.	Medium-High	Medium
Wider government	FW-FP framework has potential to be used for other priority environmental areas (eg, GHG, biodiversity) promoting co-benefits (integrated farm planning). Tailored 1-1 approach of farm planning with follow up/auditing, should help drive capability building and continuous improvement. FW-FP process and associated capability building may help catalyse improved farm business planning and more sustainable and resilient farm businesses. No clear role for partnership with Māori or participation is likely to result in decrease in Māori's trust in government to give effect to the Treaty of Waitangi	High Will depends on implementation support from central government and continued industry leadership	Medium
Other parties	Public – better water quality; ability to better deliver on recreational values; mahinga kai; public health etc Brand NZ contribution – tourism, market access benefits; pride. And contribution to New Zealanders' cultural identify and values associated with high quality natural environment Industry bodies – reporting from FW-FP implementation will help; in targeting extension support and capability building Increased opportunities for rural advisors (professionals suitably qualified to prepare and audit FW-FPs) and allied roles like farmer extension; new/expanded opportunities for agricultural training providers to deliver appropriate FW-FP courses	HIgh	Medium-High

Total Monetised Benefit			
Non-monetised benefits	If FW-FP delivery is well -resourced the policy has potential to provide significant benefits not only in contributing to improved water quality, but also building a more sustainable and resilient primary sector	High	Medium

What do stakeholders think?

FLG say that FW-FPs (or Land and Environment Plans as they prefer them to be called), properly constructed, are a useful tool for farmers to manage their activities to limits set by regional plans and to help farmers plan for improvement. They should be based on a robust stock-take of the farm's natural resources and their opportunities and limitations, and require paddock scale land use capability mapping. The majority of the FLG do not support FW-FPs as a regulatory tool and see significant risk from a regulatory regime that uses them. Some members agree with officials that they should be mandatory and can be used as a regulatory tool.

Kāhui Wai Māori acknowledge FW-FPs are a useful voluntary tool but care is required in implementing FW-FPs that this does not create any expectation regarding the long-term viability of any particular activity.

The Regional Sector Water Subgroup indicate very strong support for FW-FPs and note that there are implementation issues to resolve and that industry will be critical in FW-FP roll-out. The sector support a national requirement for FW-FPs, staged across time based on risk, starting with risk activities that are to be regulated and existing requirements to deliver FW-FPs in the regions.

The views of these stakeholder groups have been incorporated into the discussion document consideration of proposals for FW-FPs, which includes the option of voluntary FW-FPs are favoured by the FLG and Kāhui Wai Māori.

What other impacts is this approach likely to have?

A mandatory FW-FP regime has significant capacity and capability challenges with time needed to build up people with skills in farm planning and auditing, and extension.

The number of qualified rural advisors / farm advisors able to provide good advice on FW-FP development are limited [322] and time will be needed to allow the workforce to build up. It also takes some time for new people to complete the relevant training and most importantly get the practical experience on on-job learning before being fully competent and able to work independently. On-going professional development is also required. Development of a certification regime for farm environment planners (for water quality module of farm plans) is underway; and an auditing regime will also be required.

The number of qualified rural advisors that are able to provide good advice on the development of FW-FP's is currently very limited, and it will take time to build this capacity in the sector. Given that

the development of FW-FP's is a relatively new business area, existing companies in the market will struggle to recruit capable advisors initially.

Using existing suitably qualified industry staff would assist in delivering on the FW-FP requirements. It is proposed that suitable independently-audited programmes could deliver aspects of the regime, provided they meet the specifications in the NES, including a requirement to report to councils. Canterbury experience is that the auditing process is critical for driving practice change on the ground.

In a 2018 NZIPIM[323] survey of the rural profession, 26.2 percent of all respondents (from 370 responses received) identified themselves as farm consultants (Independent consultants; Consultancy firm).

Not all consultants will choose to develop FW-FP for farmers. NZIPI estimate that there are currently between 75-100 consultants that could develop Farm Environmental Plans, and over the next 2-3 years they expect this will increase to over 150. If we assume an FW-FP takes an average of 25 hours to develop then an individual farm environment planner working full time solely on farm environment planning could complete no more than 1-2 FW-FPs per week on average. If assume 75 FW-FP planners work half their time on certifying/preparing FW-FPs for water quality, then 1 FW-FP per week at very most. Assume 45 working week per year = 45 plans per person. * 75 people = 3375 plans per year. A similar skill set would be needed for on-going auditing and related roles such as farmer extension so there is a significant workforce gap that will take to build up.

Implementation

As identified above, a mandatory FW-FP regime has significant capacity and capability challenges with time needed to build up people with skills in farm planning and auditing, and extension. For this reason a phased in approach to FW-FP is proposed. The first tranche of FW-FPs is proposed to be completed by 2022 and to cover all farming enterprises in three "exemplar catchments", all commercial vegetable growers and higher priority activities where consent may be required (see high risk activities section). This is ambitious, and in addition FW-FPs will also be required under the managing intensification policies and are being considered under the policy to target high N leaching farmers. The second FW-FP tranche would likely prioritise catchments, with targeting linked to catchment vulnerability and water quality risks (and consideration of capacity), and would be completed by 2025. The remainder would be required to be completed by 2025 or 2030.

Guidance will be developed to support the effective implementation of the mandatory FW-FP policy. Effective farmer extension support will also be critical. The 2019 Sustainable Land Use budget funding will assist the primary sector in transitioning to more sustainable and resilient land use practices. It is likely that a case will be made for further funding bids in future years to support this transition and the delivery of the Essential Freshwater objectives, including those involving FW-FPs and measures to improve farm practices.

[323] NZIPIM (NZ Institute of Primary Industry Management) is a voluntary membership organisation with approximately 1050 members. It believes approximately 70-80% of all full-time consultants practicing in the primary industry are members of NZIPIM.

Appendix 15: Reducing excessively high nitrogen leaching (nitrogen cap)

Context

Nitrate has been an increasing problem in many New Zealand waterways during the last two decades. High nitrogen levels in rivers are associated with a range of adverse effects on the ecological health of waterways, with potential adverse impacts on the suitability of water for recreation and as a drinking water source for humans and livestock.[324]

Nitrate concentrations increased in 55 percent of monitored river sites (1994-2013) with the most significant increases in Waikato, Canterbury, Otago and Southland.[325] Livestock waste is the primary source, followed by fertiliser.[326]

Nitrogen losses to water arise from both leaching and overland flow. Nitrogen losses are generally highest under intensive dairy and some irrigated sheep and beef and vegetable cropping. Use of nitrogen fertiliser has increased more than six-fold over the period 1990 –2015.

Regulatory systems in place and expected changes over time

Many regional councils are already addressing high nitrogen leaching through their regional rules. Horizons, Hawkes Bay (Tukituki catchment), Waikato (Taupo catchment, and proposed for the Waikato/Waipa catchment), Bay of Plenty (proposed for the Rotorua catchment in Plan Change 10) and Canterbury have set per hectare nitrogen caps under an allocation regime, in order to meet water quality limits. In many cases, the nitrogen cap set by these councils is lower than current discharge rates, eg, in the Selwyn-Waihora zone, dairy farm discharges must fall by 30 percent by 2022. Waikato's Plan Change 1 proposes that the highest dischargers (over the 75th percentile) must reduce discharges to the 75th percentile by July 2026.

As outlined in the Farm Environment Plan RIS, a number of councils have introduced Farm Environment Plan rules that require farmers to prepare and implement plans that show how they will reduce discharges to meet a cap (eg, Canterbury, Horizons, Tukituki).

The problem/opportunity

This interim policy is intended to address very high nitrogen losses caused by poor on-farm practice, in the period ahead of longer term provisions that will be developed through council limit and rule-setting processes and the Fair Allocation work programme. It therefore needs to be a fast acting, interim measure, and is not intended to achieve the larger, more widespread structural or land-use change that may be required to improve water quality.

This policy is targeted to where the highest impact is occurring from nitrogen losses. It does not set out to determine the sustainable level of nitrogen, nor the catchment objectives/nitrogen catchment load limit. It is simply targeting nitrogen losses well beyond the realm of good practice.

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[324] http://www.ehinz.ac.nz/indicators/recreational-water/about-recreational-water-quality-and-health/

[325] Our Fresh Water 2017. Environment Aotearoa includes more recent trend data (2008-17) which indicates that in pastoral catchments, more river water quality monitoring sites had improving trends for nitrate and ammoniacal-nitrogen than deteriorating (Environment Aotearoa, Fig 10).

[326] Environment Aotearoa 2019, p. 58.

Poor practice

Not all farmers are managing nitrogen losses efficiently, with some generating much higher per hectare discharges per kg of output from the farm (low nitrogen efficiency); with a disproportionately high impact on water quality in receiving water bodies.

Recent research has illustrated that there is opportunity for high-leaching farms to reduce the amount of nitrogen lost.[327] These changes did not necessarily result in reduced production, and may increase profitability in some cases.

It has been known for some time that nitrogen leaching can be reduced at relatively low cost[328], and that in some very intensive dairy systems, reductions can be made while increasing profit.[329] However farmers do not always make the changes required, for a range of reasons, including lack of knowledge or skills, farmer goals for maximising production, or the cost of reducing nitrogen losses. In addition there may be structural impediments to reducing nitrogen losses including contracts for supply of winter milk or vegetables.

A range of policy instruments are therefore needed to change the incentives facing farmers to reduce excessive nitrogen discharges. Regulation can form part of this change in incentives along with supporting non-regulatory measures needed to bridge the likely knowledge and/or skills gap, and to change social norms.

Constraints on the analysis

Scope of this component

This proposal was initiated in response to a recommendation by the Freshwater Leaders Group (FLG). The context of the nitrogen-cap (N-cap) discussion at FLG was neighbouring properties with similar land uses but vastly different nitrate discharges due to differences in management practices, although discussion also covered land uses in the "wrong place" eg nitrogen-intensive land uses on high leaching soils. This analysis covers the first aspect ie, management practice. Consideration of land uses in the "wrong place" is outside scope, and will be considered as part of Council limit-setting decisions, and through the *Fair Allocation* workstream of Essential Freshwater. Accordingly, this component of the rural package is focused on improving practice on high nitrogen-loss farms, rather than land use change. This also avoids unnecessary land use change ahead of the final regime that will be implemented through council regional plans and/or the *Fair Allocation* policies.

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[327] A comparison of the N budgets of five Canterbury monitor farms in the Forages for Reduced Nitrate Leaching programme (FRNL) showed their relatively high N fertiliser and supplement inputs resulted in high production, but also in relatively high N surplus. During the FRNL programme, these farms implemented changes to reduce N leaching, eg establishing plantain in pasture, reducing N fertiliser use and swapping high-N supplements (Palm Kernel Expeller or PKE, pasture silage) to low-N feeds (maize and fodder beet

[328] For example in the Horizons region, dairy farms seeking land use consents worked with consultants to reduce nitrate discharges; modelled reductions of 5 to 20 percent were able to be achieved while retaining farm viability (Parminter, T., 2015: Selecting farm practices and preparing farm plans for land-use consents in the Manawatu- Wanganui region. In "Proceedings of the 77th Annual Grassland Conference".)

[329] MacDonald et al, 2001. Farm systems – Impact of stocking rate on dairy farm efficiency. Proceedings of the New Zealand Grassland Association 63: 223–227. More recently: Allen, J; 2019. Statement of evidence of James Kenneth Allen for Fonterra Cooperative Group Ltd (at the hearing of submissions on proposed Plan Change 1 and variation 1 to the Waikato Regional Plan (Healthy Rivers); summarised the impacts on 10 case study farms of reducing discharges to the 75th percentile as ranging from +$106 to -$541/ha.

Options

Objective

The proposal's objective is to contribute to water quality improvements in catchments where nitrogen pressures are high, by reducing nitrogen losses from farms that are caused by poor practice. The policy is to be effective in the interim period before councils give effect to the NPS-FM and a new nitrogen allocation management system is in place.

Summary Assessment

Criterion	Option 1 Nationally applicable N cap	Option 2 Government-sector agreements plus an information campaign	Option 3 NES Linking N-surplus thresholds to Farm Environment Plans roll-out	Option 4 NES with targeted Overseer N-caps	Option 5 NES with FEPs/Overseer, no N cap thresholds set	Option 6 NES setting fertiliser caps
Effectiveness (including whether the policy would be implemented by 2022)	**0**	**0/+**	**+**	**++**	**+**	**0**
Timeliness	**+**	**+**	**++**	**+**	**+**	**++**
Fairness	**- -**	**-**	**++**	**+**	**+**	**+**
Efficiency	**0**	**+**	**+**	**++**	**+**	**+**
Principles of the Treaty of Waitangi[330]	**0**	**0**	**0**	**0**	**0**	**0**
Te Mana o te Wai[331]	**0**	**0/+**	**+**	**++**	**+**	**0**
Overall Assessment	**0**	**0**	**+**	**++**	**+/0**	**+**

[330] Principles of the Treaty of Waitangi - the options can make a contribution to protecting the taonga of water quality to the degree to which they are effective in improving water quality. In terms of partnership and participation, none of the options provide a clear role for partnership with Māori in developing/enforcing the initiatives.

[331] Te Mana o Te Wai – these scores match those in the effectiveness row – the options can make a contribution to protecting the health and mauri of water to the degree to which they are effective in improving water quality.

Status Quo

Over the five years 2020 to 2025, councils will progressively establish limits and regional rules for achieving them. Fair Allocation proposals are expected to be phased in after 2025.

Indicative Social Impact

Maintaining the status quo may negatively impact farmer wellbeing (anxiety/mental health):

- uncertainty about what action will be required by regional councils and by when;
- decisions about whether to increase farming intensity are complicated by concerns about the economic impact and lost capital investment if decreases in discharges are required in the future;
- concerns about the financial costs of implementing potential future nitrogen-reducing measures perceived to affect farm viability;
- financial and emotional costs if farmers choose to participate in the regional plan-making process to establish rules (submissions, hearings, appeals).[332]

The status quo is also unlikely to markedly contribute to perceptions that the farming community are acting as stewards of the land/environment, potentially reducing their social licence to operate.[333] This will likely be associated with low levels of well-being and sense of self within the farming community.[334.]

Other social costs are likely to include decrease in New Zealand public's trust in government to 'do the right thing' to improve freshwater quality.[335]

The status quo is unlikely to improve Māori and iwi's opportunity to partner with the Crown, or express their kaitiakitanga role in relation to excessive nitrogen discharges.

The status quo is likely to bring limited and slow/variable improvements to waterbodies in the interim period before limits are set, and with it, slow/variable improvements to human health, wellbeing and cultural identity.

Option 1: National N-cap

This option would cover the entire country. It would place a single cap or threshold on nitrogen at a point where it is determined to be excessive for all land types and land uses across the country. Any

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[332] Farmers' mental health: A review of the literature (ACC Policy Team, 2014) https://www.mentalhealth.org.nz/assets/ResourceFinder/wpc134609.pdf , Botha N, Roth H and Brown M 2013. '*The Adaptation of Pastoral Farmers to Environmental Policy Changes: A New Zealand Case Study*.' South African Journal of Agricultural Extension, Vol. 41: 16-25

[333] P Clark-Hall, 2018, *How to Earn a Social Licence to Operate*

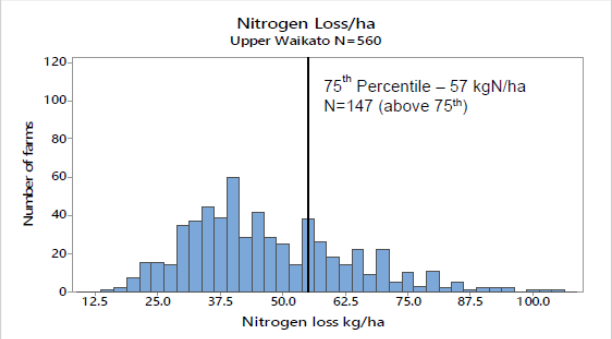
[334] Farmers' mental health: A review of the literature (ACC Policy Team, 2014) https://www.mentalhealth.org.nz/assets/ResourceFinder/wpc134609.pdf; Botha N, Roth H and Brown M 2013. '*The Adaptation of Pastoral Farmers to Environmental Policy Changes: A New Zealand Case Study*.' South African Journal of Agricultural Extension, Vol. 41: 16-25; Kennedy A, Maple MJ, McKay K, Brumby SA. 2014. Suicide and accidental death in Australia's rural farming communities: a review of the literature Rural and Remote Health 14: 2517. http://dro.deakin.edu.au/eserv/DU:30062460/kennedy-suicideandaccidental-2014.pdf

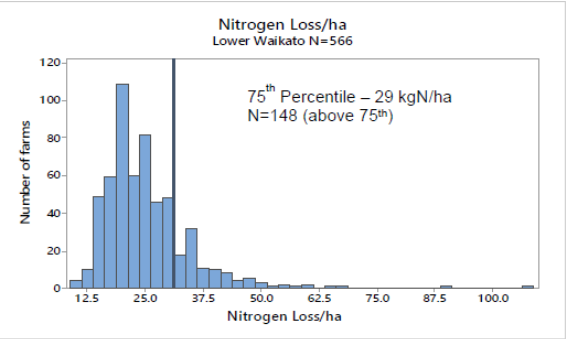
[335] The majority of surveyed New Zealanders in 2018 feel that it is very or extremely important to improve the quality of our water, and see government and farmers are responsible to make this change. Colmar Brunton. 2018. Environmental Attitudes Baseline. Commissioned by the Ministry for the Environment.

areas of a land use class on farms that are leaching beyond this cap would be required to reduce to the cap in a set time period.

This would have to be set high, so for many land types and land uses it would not have any effect (though it could be a lower cap if vegetable growing was excluded). It would only capture a proportion of vegetable growing and some very intensive dairy farming. As the underlying land leaching characteristics are not taken into account it would capture land use on the leakiest soils along with those with the poorest practices. This policy is not intended to target those undertaking good practice (even when on leaky soils) ahead of the wider limit setting and allocation work.

The difficulty of setting a nationally applicable cap that captures poor practice rather than leaky soils, is illustrated in the following graphs[336]; where the 75th percentile varies from 57 kg/ha to 29 kg/ha in two sub-catchments of the Waikato River.





Criterion	Option 1 - National N cap
Effectiveness (including whether the policy would be implemented by 2022)	**0** Would be faster to put in place than catchment based N cap but would be ineffective.
Timeliness	+
Fairness	--
Efficiency	**0**
Principles of the Treaty of Waitangi[337]	**0**

[336] Source: Statement of evidence of James Kenneth Allen for Fonterra Co-operative Group Ltd, in the Hearing of submissions on Proposed Plan Change 1 and Variation 1 to the Waikato Regional Plan (Healthy Rivers), 3 May 2019.

[337] Principles of the Treaty of Waitangi - the options can make a contribution to protecting the taonga of water quality to the degree to which they are effective in improving water quality. In terms of partnership and

Te Mana o te Wai[338]	**0** Does not provide for the needs of the water, takes no account of the needs of people
Overall Assessment	**0** This would impact some sectors (and regions) very severely resulting in wide-spread disruption and shutdown, whilst not addressing high leaching in other regions or sectors where there is a problem.

Indicative Social Impact:

If the threshold was set very high, some farmers with excessive leaching would not be impacted, sending the wrong signal about leaching levels. It would not prepare them for the coming reductions likely to be required through limit setting and allocation. The impact on some high-discharging sectors such as vegetable growing would cause widespread disruption to the sector.

This option is unlikely to improve Māori and iwi's opportunity to partner with the Crown, or express their kaitiakitanga role in relation to excessive nitrogen discharges.

Improvements to waterbodies, human health, wellbeing and cultural identity would be limited.

While this option is likely to have lower costs on councils (staff and resources) compared to the work involved to establish catchment-based caps, it would impact more widely, and so would potentially have an overall higher consenting requirement and affect more councils than options 3 and 4.

Option 2: Government-Sector Accords plus an information campaign

This option would involve Central Government negotiating Accords with processors and sector organisations to identify high dischargers in their sector/suppliers in high N-impact catchments, and work with these dischargers to bring them down through Farm Environment Plans (FEPs) or other approaches. The agreements would specify targets to be achieved and audited reports to be provided to Government, councils and the public on progress towards the targets. This approach would build on the existing Sustainable Dairy: Water Accord in the dairy sector. It would be informed by experience with the Voluntary Agreements between industries and the Government in the 1990s, to reduce greenhouse gas emissions. Central Government would support this through an information/social marketing campaign and fund training for farmers. This option would be effective in addressing knowledge, skills and social barriers to change, but not so effective at generating change where costs are high and/or there are structural impediments to change.

Criterion	Option 2 - Government-sector agreements plus an information campaign
Effectiveness (including whether the policy would be implemented by 2022)	**0/+** Could be kicked off immediately without waiting for an NES, but effectiveness is limited because high nitrogen dischargers would have an incentive not to participate in any sector initiative
Timeliness	**+**

participation, none of the options provide a clear role for partnership with Māori in developing/enforcing the initiatives.

[338] Te Mana o Te Wai – these scores match those in the effectiveness row – the options can make a contribution to protecting the health and mauri of water to the degree to which they are effective in improving water quality.

Fairness	- Only conscientious farmers would participate, and other high nitrogen dischargers would avoid compliance
Efficiency	+ Sectors would likely seek the least-cost to achieve outcomes but effectiveness is limited.
Principles of the Treaty of Waitangi[339]	**0**
Te Mana o te Wai[340]	**0** Provides insufficient emphasis on putting the needs of the water first
Overall Assessment	**0/+** The target group of farmers with very high nitrogen leaching due to poor practice, will be least likely to change. Insufficient on its own

Indicative Social Impact:

This option is likely to bring the least change to farmers' day-to-day work compared to the status quo. Impacts will vary depending on where and who the accords will apply to.

Individual farmers' and growers' well-being may benefit from not being regulated and feeling in control of how they farm. However, this option may not improve farmers' social license to farm, unless the accords are widely adopted and accepted by communities as indicative of good practice.

Unless adequate support is provided to farmers and growers beyond an awareness campaign (eg, targeted advice; research demonstrating visible benefits of alternatives practices; peer-to-peer support), this option is unlikely to result in widespread change.

With the right support, this option may increase the skill-base amongst the farming community by working directly with farmers, processors and the sector.

There may be economic benefits for farmers from "doing the right thing" (eg, sustainable branding).

This option is unlikely to improve Māori and iwi's opportunity to partner with the Crown, or express their kaitiakitanga role in relation to excessive nitrogen discharges.

Variable improvements to waterbodies will bring variable improvements to human health, wellbeing and cultural identity.

This option is likely to have the least cost on councils' staff and resources (with the exception of the status quo). However, with the risk of government being perceived as hands-off, this option is likely to impact on New Zealand public's trust in government to 'do the right thing'.[341]

[339] Principles of the Treaty of Waitangi - the options can make a contribution to protecting the taonga of water quality to the degree to which they are effective in improving water quality. In terms of partnership and participation, none of the options provide a clear role for partnership with Māori in developing/enforcing the initiatives.

[340] Te Mana o Te Wai – these scores match those in the effectiveness row – the options can make a contribution to protecting the health and mauri of water to the degree to which they are effective in improving water quality.

[341] The majority of surveyed New Zealanders in 2018 feel that it is very or extremely important to improve the quality of our water, and see government and farmers are responsible to make this change. Colmar Brunton. 2018. Environmental Attitudes Baseline. Commissioned by the Ministry for the Environment.

Option 3: Nitrogen caps set using nitrogen surplus thresholds (though a Farm Environment Plan (FEP))

This approach would utilise the proposed NES provisions for FEPs. Tranche 1 of the FEP rollout (FEPs required by 2022) would include identified high nitrogen-impacted catchments, with a requirement in these catchments to: (1) include a nitrogen-surplus (N-Surplus) calculation in the FEP, and (2) measures to reduce the levels to a specified threshold (set nationally for each major sector) within a specified timeframe. This option would be lower cost than option 4 as Overseer budgets and consents would not be required; but is higher cost that option 2.[342] It would require obtaining an FEP as well as implementing the required changes would apply across all farmers in high N-impacted catchments.

Evidence for how N surplus works is provided in Table 1.[343] The N-surplus is the difference between nitrogen inputs and nitrogen outputs,[344] and does not include other factors that affect leaching (soil, climate); but it is highly correlated with nitrogen leaching *at the farm-scale* ie improvements in N-surplus on an individual farm will reduce the nitrogen lost.

Table 1. Summary of 2015/16 Overseer N budget data from 382 farms participating in the DairyBase Baseline project

	Milksolids (kg MS/ha)	Fertiliser	Biological fixation	Supplements	Removed product	Removed atmospheric	Removed water	N surplus	MS/kg N surplus
Median	1143	115	90	28	68	66	37	180	6
Q1	970	67	62	13	53	53	27	139	5
Q3	1362	177	122	51	81	87	51	224	8

Data in kg N/ha unless stated otherwise. NCE = N conversion efficiency; median = 50% of the farms have a value greater or smaller than the value given; Q1 = first quartile (25% of farms have a value below the value given); Q3 = third quartile (25% of farms have a value greater than the value given).

The N-surplus calculation is simpler than calculating nitrogen lost using Overseer. N-surplus is independent of soil and climate factors, and could be set as a national threshold (rather than sub-catchment by sub-catchment).[345] N-surplus is used as the basis for some overseas policies to reduce nitrate leaching (eg, the Netherlands). However N-surplus does not automatically account for infrastructure (eg, the use of feed pads with well-managed effluent treatment systems and composting barns reduce nitrogen leaching). It would not generate Overseer results on affected farms – these may be needed for the Fair Allocation proposals. This would mean two systems for addressing nitrogen losses would need to be learned by farmers, and two types of information collected, adding complexity without building towards the likely allocation regime data needs.

[342] Overseer is nutrient budgeting software which (inter alia) estimates nitrogen losses from a farm

[343] Source: Pinxterhuis et al, 2019. N Surplus shows performance. https://www.dairynz.co.nz/news/latest-news/n-surplus-shows-performance/

[344] The work by Pinxterhuis et al focuses on purchased sources of N and does not incorporate N supplied by legumes in pasture.

[345] Pinxterhuis et al, 2019. N Surplus shows performance. https://www.dairynz.co.nz/news/latest-news/n-surplus-shows-performance/

Criterion	Option 3 NES Linking N-surplus thresholds to Farm Environment Plans roll-out
Effectiveness (including whether the policy would be implemented by 2022)	+ Linking to FEP rollout and not consents, could increase acceptance but make enforcement harder. All FEPs would target reducing nitrogen losses, avoiding erosion of water quality gains from nitrogen reductions made by dischargers over the threshold. Including high N-impacted catchments in the first tranche means FEPs would be completed and beginning to be implemented by 2022.
Timeliness	++
Fairness	++ All farmers would be expected to reduce discharges, not just the high N-leachers, but those over the threshold would have to reduce more, and face greater scrutiny.
Efficiency	+ The FEP process seeks the most cost-effective way for a farmer to achieve the desired outcome.
Principles of the Treaty of Waitangi[346]	**0**
Te Mana o te Wai[347]	+ Provides a good balance between putting the needs of the water first and taking into account the needs of people.
Overall Assessment	+ The main drawback with this approach is that it does not use Overseer and therefore does not set landowners or the council up for the future allocation regime and achieving limits.

Indicative Social Impact

This option will add to councils' workload, although the extra work is not as great as for Option 4. Some councils have adequate policy and methods in place to address high nitrogen losses and would not be impacted by this policy

This option may negatively impact on farmer wellbeing (anxiety/mental health) if:

- financial costs of calculating N-surplus and implementing changes will, or are perceived to affect farm viability

[346] Principles of the Treaty of Waitangi - the options can make a contribution to protecting the taonga of water quality to the degree to which they are effective in improving water quality. In terms of partnership and participation, none of the options provide a clear role for partnership with Māori in developing/enforcing the initiatives.

[347] Te Mana o Te Wai – these scores match those in the effectiveness row – the options can make a contribution to protecting the health and mauri of water to the degree to which they are effective in improving water quality.

- farmers are concerned they do not have the necessary skills to implement this option and/or do not believe the suggested provisions are correct, relevant, necessary.[348] This could be addressed through the implementation support package.

The potential costs on farms' viability of implementing option 3 could also negatively impact on the wider community if the farming workforce has less disposable income.

On the other hand, "doing things right" might increase farmers' social licence to farm. This may have positive impact in the social cohesion of local communities, farmers' mental health (and as a result physical health), and overall satisfaction of life[349].

The positive social impacts associated with improved water quality are likely to include reduced risk to human health (through improved drinking water quality), improved amenity, and increased access to valued natural resources, including for recreational activities. It may contribute to New Zealanders' cultural identity associated with a high quality natural environment. These positive impacts are likely to be felt by New Zealanders at large, including Māori and the farming community.

The option is unlikely to improve Māori and iwi's opportunity to partner with the Crown, or express their kaitiakitanga role in relation to excessive nitrogen discharges.

Option 4: Regulated catchment-based N-caps, using Overseer (preferred option)

For this option, a threshold would be set in the NES over which discharges must be reduced in high N-impact catchments (eg, 75th percentile).[350],[351] Farmers with pastoral land uses on low-slope land[352] would be required to submit Overseer results for a base year (or years) to the regional council so that the percentile threshold can be converted to a leaching rate-threshold for each major land use and catchment or sub-catchment. Higher thresholds could be enabled for farms engaged in producing essential winter food supplies such as fresh milk. Consideration was given to including

[348] Farmers' mental health: A review of the literature (ACC Policy Team, 2014) https://www.mentalhealth.org.nz/assets/ResourceFinder/wpc134609.pdf , Botha N, Roth H and Brown M 2013. '*The Adaptation of Pastoral Farmers to Environmental Policy Changes: A New Zealand Case Study*.' South African Journal of Agricultural Extension, Vol. 41: 16-25 (emailed as an attachment)

[349] Farmers' mental health: A review of the literature (ACC Policy Team, 2014) https://www.mentalhealth.org.nz/assets/ResourceFinder/wpc134609.pdf; Botha N, Roth H and Brown M 2013. '*The Adaptation of Pastoral Farmers to Environmental Policy Changes: A New Zealand Case Study*.' South African Journal of Agricultural Extension, Vol. 41: 16-25; Kennedy A, Maple MJ, McKay K, Brumby SA. 2014. Suicide and accidental death in Australia's rural farming communities: a review of the literature Rural and Remote Health 14: 2517. http://dro.deakin.edu.au/eserv/DU:30062460/kennedy-suicideandaccidental-2014.pdf

[350] Waikato Regional Council's Plan Change 1 takes a similar approach, described as follows: "A 75th percent nitrogen leaching value will be calculated for every [Freshwater Management Unit] (FMU) based on the [Nitrogen reference Points] (NRPs) from all dairy farms in that FMU. The 75th percentile means that if you were to calculate the nitrogen leaching value from 100 dairy farms, and then put those numbers in order from lowest to highest, the 75th percentile would be the nitrogen leaching loss from farm number 75. All farms that have a NRP above the 75th percentile will need to take steps to reduce their nitrogen leaching. https://www.waikatoregion.govt.nz/council/policy-and-plans/plans-under-development/healthy-rivers-plan-for-change/infosheets/nitrogen-reference-points/

[351] The Integrated Advisory Group proposed that the percentile could be between 70 and 90 percent.

[352] Low-slope land has been defined and mapped as part of the Stock Exclusion proposals. Low-slope is used here as a proxy for more intensive land use.

farms engaged in vegetable and arable crop production but defining a percentile that would reflect good management for these activities would be infeasible, due to the small number of such enterprises in most catchments, the range of crops grown, and the variation in discharges between crop types.

Those farms above the threshold would be required to apply for a controlled consent with an FEP outlining the practices that will be adopted to achieve the threshold value within a specified time period, and annual Overseer estimates, as conditions of the consent. A relatively short period of time would be specified for making the required reductions eg, five years. Because the aim of the policy is to improve practice rather than force land-use change, a fall-back discretionary activity status would be required for those farms unable to meet the threshold within the specified timeframe. These consents would be time-limited (five years) and also require an FEP and annual Overseer reports.

Target catchments

This is an interim measure targeted at those catchments where a significant benefit can be gained through a quick-acting instrument – high nitrogen-Impacted catchments. We have considered two options: using data from water quality monitoring sites; and using an approach[353] that compares the actual load in the catchment with the acceptable load to meet NOF nitrogen concentration bottom-lines, and takes account of the sensitivity of the receiving environment (eg, residence times in estuaries). The latter approach was initially preferred as it would better target the proposed intervention where nitrate reductions matter the most for the health of waterbody, and takes account of the most up-to-date scientific knowledge available. However, the results of the modelling were tested with regional councils, and it proved insufficiently accurate at the catchment scale. The former approach was therefore used to establish an initial set of catchments, using a threshold value for total nitrogen concentrations in monitoring data. The set of target catchments has been further refined by removing those where council limits and rules are already in place or proposed to reduce high nitrogen discharges, and those where the major source of nitrogen is from horticultural and arable land uses. A further filtering process is still underway to remove small catchments (where there are too few farms to carry out a robust percentile analysis), and to target the proposal into those sub-catchments where nitrogen levels are high and the major sources are pastoral farming activities (rather than point sources such as wastewater and industrial discharges).

Determining which farms will be targeted

This targets those low-slope pastoral farms that are over the threshold currently, or who cross the threshold in the interim period in which the proposed policy would apply. This avoids imposing unnecessary costs on low-discharging farms and land uses. There is a risk with this policy that lower-discharging land uses could increase discharges up to the threshold, eroding the gains achieved by reducing discharges from farms over the threshold. Not all these increases would be constrained by the Intensification proposals. Requiring FEPs from those under the threshold is proposed, as this will tend to reduce nitrogen discharges across the catchment, as farmers implement actions in FEPs. However, some farms may choose to intensify and increase discharges up to the threshold, for example by increasing stocking rate, while undertaking good practice as set out in their FEP.

Determining which farmers are over the N-cap

[353] Developed by the Our Land and Water Science Challenge in a project led by NIWA.

As outlined in the scope above, the proposal is focused on aspects that the individual farmer can control on their farm (ie, farm practices, rather than soil or climate). This can be achieved by using Overseer to estimate discharges and set a cap within a "cohort" (ie, farmers with similar land uses, climate and soils (generating a series of sub-catchment thresholds)). By setting thresholds at a cohort-scale, the proposal targets poor practice rather than soil/rainfall factors.

Regulated catchment-based N-caps, using Overseer

Criterion	Option 4 – Regulated catchment-based N-caps using Overseer
Effectiveness (including whether the policy would be implemented by 2022)	++ High N-leachers over the threshold would be required to reduce discharges. Those under the threshold undertaking the specified land-uses would need to have a farm environment plan. Non-specified land uses could increase discharges provided they do not trigger the intensification constraint proposals eg change land use. These non-specified land uses are relatively low leaching on average, and the extent to which discharges would increase is limited provided land use does not change.
Timeliness	+ Collection of Overseer returns and the catchment distribution would take considerable time and then the consents process would need to be completed before on-farm actions are implemented.
Fairness	+ Only high N-leachers over the threshold would be required to reduce discharges. Those under the threshold undertaking the specified land-uses would need to have a farm environment plan. Vegetable growers may consider that Overseer results do not provide a fair estimate of discharges for their sector, and the cost of generating an Overseer discharge estimate is likely to be higher for the vegetable sector.
Efficiency	++ Extra costs imposed (Overseer runs, consent processes, FEP).
Principles of the Treaty of Waitangi[354]	**0**
Te Mana o te Wai[355]	++ Provides a good balance between putting the needs of the water first and taking into account the needs of people.
Overall Assessment	++ This policy would require central government support to ensure it could be rolled out with speed. The necessary systems and data collection would require support. However if risks were addressed and with sufficient support, this policy has the greatest overall positive impact on water quality and would provide valuable groundwork for future allocation decisions (for landowners) and councils (in data, systems).

[354] Principles of the Treaty of Waitangi - the options can make a contribution to protecting the taonga of water quality to the degree to which they are effective in improving water quality. In terms of partnership and participation, none of the options provide a clear role for partnership with Māori in developing/enforcing the initiatives.

[355] Te Mana o Te Wai – these scores match those in the effectiveness row – the options can make a contribution to protecting the health and mauri of water to the degree to which they are effective in improving water quality.

Indicative Social Impact:

Option 4 is associated with similar social impacts to option 3, but with a considerably higher workload for affected councils, to collate the Overseer data and implement the consent regime. Central government support would be required to assist councils, to ensure data collection and accounting systems are robust. However, the burden is limited to high N-impacted catchments (which are likely to be few in number). Some councils have adequate policy and methods in place to address high nitrogen losses and would not be impacted by this policy.

Negative impacts on farmers may be more severe than Option 3 because of the financial costs of running Overseer, and the financial and emotional costs associated with the resource consent process (particularly if hearings are involved). Such financial costs on farms viability may in turn negatively impact the wider community if the farming workforce has less disposable income.

Like options 1 and 3, option 4 is likely to increase demand for rural professionals with Overseer and FEP expertise, thus creating some job opportunities.[356]

This option would be higher cost than previous options for individual farmers (obtaining an Overseer run, a consent and an FEP, as well as implementing the required changes), but would be less effective in addressing knowledge, skills and social barriers to change (although the FEP is a useful vehicle to allow conversations and learnings and provide generic bespoke advice). It would provide an additional regulatory incentive for change when implementation costs are high, with greater compliance monitoring and enforcement action by regional councils.

Option 5: NES with FEPs/Overseer, no N-cap thresholds set (baseline data option)

All farms in the catchment would be required to provide an annual Overseer return to the regional council, and to have an FEP focused on identifying and addressing nitrogen-related risks. Like option 4, this option would provide baseline data for councils in preparation for setting and managing to nitrogen limits set under the NPS-FM.

Criterion	Option 5 – Baseline data option (NES with Overseer and FEPs, no thresholds set)
Effectiveness (including whether the policy would be implemented by 2022)	+ As for option 4 but without the stringency provided by the threshold.
Timeliness	+
Fairness	+ All farmers would be expected to reduce nitrogen losses, however the FEP process would identify more actions on farms with higher nitrogen losses due to poor practice.
Efficiency	+

[356] A 2018 report estimates that 45% of New Zealanders farms do not use Overseer. Andrew Barber1, Henry Stenning, James Allen, Phil Journeaux, Jeremy Hunt, Dave Lucock. 2018. "Overseer – Valuation of the Benefits" prepared for Overseer.

Principles of the Treaty of Waitangi[357]	**0**
Te Mana o te Wai[358]	+ Provides insufficient emphasis on putting the needs of the water first
Overall Assessment	**+/0** This option is not targeted at high discharges caused by poor practice. Without the stringency of a threshold and consent framework, the level of reductions achieved may not be as great as in option 4.. An important co-benefit is the provision of baseline Overseer data (and advice through the FEP) which would build support and systems for the limits and allocation in the future.

Indicative Social Impact:

Option 5 is associated with similar impacts to option 4 in terms of the nature of impacts and populations impacted. However, the magnitude of impacts will be much lower for those at the higher end of the leaching distribution, as no mandatory reduction and consent will be required.

Development of Overseer reports will help with farm planning and farmer preparedness for managing under a limits-based regime. It will also provide councils with useful information for regional limit setting and preparation of new regional plan rules.

Option 5 is likely to increase demand[359] for rural professionals with Overseer and FEP expertise, possibly creating more job opportunities, especially in sectors with few rural advisors (ie, other than the dairy sector) and in regions where few FEPs have been developed.

Option 6: Fertiliser cap thresholds – nationally applied

The NES would set a national threshold for total nitrogen applied in fertiliser, with a higher threshold set for some crops and essential industries (high nitrogen-demanding crops and winter production of essential food supplies for example, vegetables, fresh milk). This would apply everywhere in New Zealand. All farms and horticultural producers would be required to use less than the threshold amount of nitrogen in fertiliser per hectare. A consent would be required if fertiliser use is over the threshold. Compliance with the threshold would be monitored through Farm Environment Plan audits, and councils could also check compliance (eg, where exceedances are likely).

Whilst there are advantages with regard to this being a relatively fast and simple option; there are also some disadvantages with this approach:

- Fertiliser rate is not the only input affecting nitrogen losses, and there could be an incentive to substitute bought-in feed for fertiliser in some cases. Such substitution would reduce the effectiveness of this policy in some cases.

[357] Principles of the Treaty of Waitangi - the options can make a contribution to protecting the taonga of water quality to the degree to which they are effective in improving water quality. In terms of partnership and participation, none of the options provide a clear role for partnership with Māori in developing/enforcing the initiatives.

[358] Te Mana o Te Wai – these scores match those in the effectiveness row – the options can make a contribution to protecting the health and mauri of water to the degree to which they are effective in improving water quality.

[359] A 2018 report estimates that 45% of New Zealanders farms do not use Overseer. Andrew Barber, Henry Stenning, James Allen, Phil Journeaux, Jeremy Hunt, Dave Lucock. 2018. "Overseer – Valuation of the Benefits" prepared for Overseer.

- It takes no account of timing (winter applications leach more than summer applications) nor of the number of applications (little and often leaches less than applying the fertiliser in a single dressing), nor of advanced fertiliser application methods such as fertigation and Spikey®. However, constraining application amounts may provide incentives for more precision application.

Criterion	Option 6 - NES setting fertiliser caps
Effectiveness (including whether the policy would be implemented by 2022)	**0**/+ Reducing nitrogen fertiliser use could reduce nitrogen losses but farmers can substitute other inputs for fertiliser, with potentially little net gain
Timeliness	++
Fairness	+ Applies to all but does not recognise farmers undertaking good practice such as split dressings or precision fertiliser application
Efficiency	+ Possible perverse outcomes likely with substitution of other inputs for fertiliser at extra cost. Some incentive for more efficient use of fertiliser but reduces flexibility of land use and potential innovation by limiting inputs rather than outputs. Possible solution would be to cap feed as well (avoiding possible animal welfare issues would require careful design)
Principles of the Treaty of Waitangi[360]	**0**
Te Mana o te Wai[361]	**0**/+ Does not put sufficient emphasis on putting the needs of the water first, takes insufficient account of the needs of people
Overall Assessment	**0**/+ This is likely to result in some reductions in nitrogen fertiliser use which in turn could lead to reductions in stocking/intensive grazing and nitrogen outputs from these sources. Fertiliser is estimated at 15 percent of nitrogen discharges so this is targeting only part of the problem – albeit a significant part. There are potential problems with substitution that would need to be analysed including looking at regimes internationally. This would not provide baseline data for a future limit setting exercise or allocation regime.

Indicative Social Impact:

The proposed policy could result in a general perception of fairness by many parties as all agri-sectors and all catchments are being targeted by the proposed policy.[362] However the lack of

[360] Principles of the Treaty of Waitangi - the options can make a contribution to protecting the taonga of water quality to the degree to which they are effective in improving water quality. In terms of partnership and participation, none of the options provide a clear role for partnership with Māori in developing/enforcing the initiatives.

[361] Te Mana o Te Wai – these scores match those in the effectiveness row – the options can make a contribution to protecting the health and mauri of water to the degree to which they are effective in improving water quality.

[362] P Clark-Hall, 2018, *How to Earn a Social Licence to Operate*

recognition for good fertiliser practice, and the tenuous link to nitrogen discharges, would undermine that perception amongst farmers.

This option is likely to negatively impact on farmer wellbeing (anxiety/mental health), especially producers relying on large amounts of fertiliser (eg, some horticulture farms, intensive farming systems) if:

- financial costs of implementing changes will, or are perceived to affect farm viability
- farmers are concerned they do not have the necessary skills to implement this option and/or do not believe the suggested provisions are correct, relevant, or necessary.[363]
- good farming practices implemented on the farm are not accounted for by the regulation.

The potential costs on farms viability of implementing option 5 could also negatively impact on the wider community if the farming workforce has less disposable income.

Some improvements in the quality of waterbodies could be expected, but improvements are unlikely to be as great as that which would be achieved with options 3 and 4 in highly nitrogen-impacted catchments.

This option does not provide a clear role for partnership with Māori and iwi. This option is unlikely to improve Māori and iwi's opportunity to express their kaitiakitanga role and improve their sense of cultural identity.

Options ruled out of scope, or not considered

We did not include consideration of amending the NPS-FM to set nitrogen caps in place. The reason for this is that the policy needs to be quickly implemented to address the regulatory gap while councils set limits and make plan changes; and is therefore better suited to an NES.

A section 360 regulation would be quick to implement but there is currently no suitable provision in the section to base a regulation on.

Recommendation

We recommend options 4 (NES, N-cap with Overseer) and 6 (a fertiliser cap).

Feedback on option 3 (N-surplus) indicates that it is not acceptable to a number of stakeholder groups.

Option 4 applies a nitrogen-cap in specified catchments, and lays the groundwork for limit setting and regional rules or allocation, by collecting Overseer data on nitrogen losses. Care will be needed to signal that the proposal does not imply that "grand-parenting with good practice" is the preferred option being considered under the allocation work programme.

Option 6 is included as it would apply nationally, and may be seen as preferable to an Overseer-based policy by the horticulture sector.

[363] Farmers' mental health: A review of the literature (ACC Policy Team, 2014) https://www.mentalhealth.org.nz/assets/ResourceFinder/wpc134609.pdf , Botha N, Roth H and Brown M 2013. '*The Adaptation of Pastoral Farmers to Environmental Policy Changes: A New Zealand Case Study*.' South African Journal of Agricultural Extension, Vol. 41: 16-25 (emailed as an attachment)

Advisory Groups[364] commented as follows:

- This proposal arose as a result of feedback from the Freshwater Leaders Group. The Group considers that extra short-term (to 2025) measures are needed to address excessive nitrogen losses to water. Some group members thought a single figure should be set nationally, others that a regional and FMU nitrogen loss profiles should be established to set an upper quartile threshold. The Group were "not yet convinced that the proposal by officials is sufficient" (option 4) in their June 2019 report.
- All advisory groups agree there is a need to reduce nitrogen losses. There is support in principle for rapid action in highly-impacted catchments. This and other proposals are seen as sending a clear signal to farmers that they need to start now on reducing the environmental impact of their farming practices. The groups note that in some highly impacted catchments, it will take more than improving practices to achieve ecosystem health, and some land use change will be required.
- The regional sector group notes the fertiliser cap is a new proposal and sees lots of difficulties with defining the nitrogen in different forms of nutrient inputs (eg, effluent application to land, compost) across land use types. They also note that where there are already detailed nitrogen allocation and management frameworks in place (operative or proposed) the nitrogen threshold should not apply. The group has previously noted the matters of detail in this proposal are very important in terms of how this will be targeted and implemented. Regional Councils have offered technical advice on this.

What do stakeholders think?

Farmers, processors and primary sector organisations are increasingly recognising the issues around high nitrogen losses, and the need for practice change to reduce discharges. For example, a number of primary sector organisations co-funded the Forages for Reduced Nitrogen Leaching research programme, and have produced guidance on how to reduce nitrogen discharges. However primary sector organisations, processors and farmers may not agree that a regulatory response is needed.

ENGOs have expressed strong views that farming needs to reduce contaminant discharges, including nitrogen, and frequently state that dairy cow numbers should be reduced. A strong regulatory response is preferred by some ENGOs.

Consultation on the problem and potential solutions has been limited, because this policy proposal was late in being introduced into the package.

Summary table of costs and benefits of option 4

For Option 4 the threshold percentile will need to be chosen and included in an NES. The exact percentile has not been decided on yet and may range from the top 10 – 30th percentile.

[364] The Freshwater leaders Group, Te Kāhui Wai Māori, the Freshwater Science and Technical Advisory Group and the Regional Sector Water Subgroup.

Affected parties *(identify)*	**Comment**: *nature of cost or benefit (eg ongoing, one-off), evidence and assumption (eg compliance rates), risks*	**Impact** *$m present value, for monetised impacts; high, medium or low for non-monetised impacts*	**Evidence certainty** *(High, medium or low)*
Additional costs of proposed approach, compared to taking no action			
Regulated parties	Limited data available. Impact will be restricted to the selected high N-impacted catchments and only for the 5 years from 2020 to 2025. An ongoing reduction in profitability for farms over the threshold is likely on average (see summary of modelling results included in Appendix 1), although some may improve profitability.[365] However, the policy is short-term (5 years) until regional rules kick in; so the policy analysis assumes that the costs imposed are the same as those that would be imposed by council rules, but brings them forward by up to 5 years[366]. The cost of Overseer runs (costs around $5000 to $8000 for pastoral farms), consents, and FEPs (preparation costs around $2000 to $7500) will fall on farmers. A controlled or discretionary activity resource consent cost would also need to be factored in if this approach is used. Social costs are also likely, including potential falls in employment as a result of reduced profitability; and farmers' whose goals include high production per hectare may have achievement of these goals constrained by the policy. *Placeholder: Number of catchments and farms affected* [Until high N-impact catchments are chosen, the number of farmers affected is unknown].	Medium (on average) for affected farmers, although a small proportion may increase profit through greater nitrogen use efficiency. These profit reductions would be brought forward by up to 5 years from status quo.	Low (with respect to the size of the impact, medium with respect to the direction)

[365] MacDonald et al, 2001. Farm systems – Impact of stocking rate on dairy farm efficiency. Proceedings of the New Zealand Grassland Association 63: 223–227. Allen, J; 2019. Statement of evidence of James Kenneth Allen for Fonterra Cooperative Group Ltd (at the hearing of submissions on proposed Plan Change 1 and variation 1 to the Waikato Regional Plan (Healthy Rivers); summarised the impacts on 10 case study farms of reducing discharges to the 75th percentile as ranging from +$106 to -$541/ha.

[366] Under the NPS-FM, limits must be in place by 2025, but some councils will have limits in place before then

Regulators	In high-N-impacted catchments additional costs to develop thresholds, issue and monitor consents.	Medium	Med
Wider government	Support for councils in assessing thresholds There is potential need for greater scrutiny of Provincial Growth Fund applications in high nitrogen-impacted catchments eg where the application implies an increase in nitrogen discharges.	Low	Medium
Other parties	The Ruamahanga catchment modelling (Appendix 1) modelled that if the threshold is set at 30 kg N/ha, 10 percent of the catchment would be affected, regional output would fall by 7 percent, and employment by over 5 percent	Medium	Low (with respect to the size of the impact, medium with respect to the direction)
Total Monetised Cost	*Not assessed*		
Non-monetised costs	*Costs fall mainly on affected farmers*	*Medium*	Low

Expected benefits of proposed approach, compared to taking no action			
Regulated parties	A proportion of farms will be able to reduce nitrogen discharges and increase profits Provides a strong signal that grandparenting of high leaching activities will not be part of future allocation regimes. This should help avoid very "hard landings" for high nitrogen dischargers under any future nitrogen allocation scheme.	Low	Medium
Regulators	The data generated from the N-cap calculations will assist with catchment accounting, limit setting and development of regional rules. Affected regional councils are likely to face lower planning costs as they set limits and regional rules in place, because high nitrogen dischargers are already reducing their discharges	Low	High
Wider government	Not assessed		

Other parties	Improving farm practices will reduce nitrogen discharges to water but the benefits will take some time to be expressed in water quality outcomes, due to long lag times in some catchments.[367] The Ruamahanga modelling indicated that the reductions in nitrogen discharges depend on the stringency of the cap, with less stringent caps having very little impact on nitrogen leaching across the catchment, and the most stringent cap resulted in a 7 percent drop in nitrogen leaching. The main beneficiary will be the waterways themselves (Te Mana o te Wai). Ecological health of water ways will increase. In high N-impact catchments, recreational water users such as swimmers will benefit over the long term due to reduced periphyton. Note that at least some of these benefits would have been achieved without intervention, but delayed 1-5 years, as a result of regional plan measures	Medium in high N-impacted catchments (brought forward 1-5 years)	Medium
Total Monetised Benefit	*Not assessed*		
Non-monetised benefits		*Medium in high-N impacted catchments*	

Summary table of costs and benefits of Option 6

Note that due to the late insertion of this option, no impact testing has been done, nor has a literature review been completed to discover existing research findings on the topic. As a result we have little information about the costs and benefits.

There is potential interaction with the Government's proposal to reduce agricultural greenhouse gas emissions by applying a price on emissions from fertiliser from 2021.[368]

[367] Wilcock et al, 2013. Trends in water quality of five dairy farming streams in response to adoption of best practice and benefits of long-term monitoring at the catchment scale. *Marine and Freshwater Research*, 64, 401–412

[368] MfE, 2019. *Action on agriculture: our proposals, your views*. https://www.mfe.govt.nz/sites/default/files/media/Climate%20Change/action-on-agricultural-emissions-discussion-document.pdf

Affected parties	Comment:	Impact	Evidence certainty

Additional costs of proposed approach, compared to taking no action			
Regulated parties	*Number of catchments and farms affected* All catchments and all farms (above a de minimus threshold) Additional costs: unknown. Likely reduction in production (one UK estimate is that a 20 percent reduction in fertiliser use would reduce production between 0 and 10 percent[369]) impact on profits unclear. Substitution of more expensive bought-in feed to meet stock requirements may increase costs.	Unknown.	
Regulators	Costs to monitor and enforce fertiliser cap	Unknown	
Wider government	Cost to develop national caps	Low	med
Other parties	Fertiliser companies may face reduced sales and profits	Unknown	
Total Monetised Cost	*Not assessed*		
Non-monetised costs	Costs fall mainly on affected farmers	*Unknown*	

Expected benefits of proposed approach, compared to taking no action			
Regulated parties	Saving in fertiliser costs (but may be eroded if additional expenditure on substitutes such as supplementary feed)	Proportionate to the reduction required	
Regulators	No known benefits		
Wider government	No known benefits		
Other parties	Unknown	Unknown	
Total Monetised Benefit	Not assessed		
Non-monetised benefits	Not assessed	*Unknown*	

[369] Fezzi et al; 2008. Estimating the range of economic impacts on farms of nutrient leaching reduction policies. *Agricultural Economics* 39(2) 197-205, online: https://onlinelibrary.wiley.com/doi/full/10.1111/j.1574-0862.2008.00323.x

Additional Information: Modelling Results

Three modelling exercises were commissioned by MfE to assess the impact of the proposed N-cap policy, two at farm scale and one at catchment scale. The results are summarised below along with a third farm-scale assessment which reviewed the farm-scale impact of the 75th percentile policy in Waikato Regional Council Plan Change 1, as this proposal is close to Option 3 in the Options Table; and actual data on the nature of the distribution of nitrogen leaching across dairy farms in the Waikato-Waipa catchments.

Farm-scale modelling and data:

1. Draft results from modelling the impacts on four Canterbury farms found:[370]
    - Hill country farm and arable farm – no impact (the nitrogen discharges of 19 kg/ha and 25 kg/ha respectively were below the threshold set for the modelling; note that the arable farm had no commercial fresh or process vegetables in the rotation)
    - 300 ha irrigated dairy farm with 10 ha in fodder crop – reduction in nitrogen discharges from 66 kg/ha to 59 kg/ha resulted in modelled gross income falling by 3 percent, EBIT by 7 percent, and disposable surplus (after depreciation, interest, and tax) by 24 percent. Disposable surplus for the farm fell from just over $200,000 to just over $150,000. Farm changes were: culling a month early and reduced nitrogen fertiliser especially in Autumn.
    - 460 ha partly-irrigated dairy support farm with substantial areas of forage crops – reduction in nitrogen discharges from 68 kg/ha to 59 kg/ha resulted in modelled gross income falling by 5 percent, EBIT by 8 percent and disposable surplus by 86 percent. Disposable farm surplus fell from around $40,000 to around $5,500.

    The difference between the results for the dairy farm and the dairy support farm reflect the overall lower baseline profitability of the dairy support farm, and the higher baseline nitrogen discharges per hectare. Both the modelled dairy farms had significant debt (dairy support $5 million in term debt).
2. Modelling the impacts on a single Waikato dairy farm currently leaching 76 kg N/ha, costed the impacts of reducing discharges to 60, 50 and 40 kg/ha resulted in reductions in EBIT[371] of +14 percent, -13 percent and -26 percent respectively.[372] The results may not be interpreted as typical, as the farm had a significant pasture renewal programme with an expensive and very high-leaching forage cropping component. This could be discontinued with a saving in costs as well as reducing nitrogen leaching, by using an alternative approach to pasture renewal. The modelling also reduced nitrogen fertiliser applications, supplementary feed purchased, and stock numbers. The author of the report notes that at national average debt servicing levels of $25/kg of milk solids, the farm could not service the debt at the EBIT results modelled for the reductions to 50 and 40 kg N/ha. This highlights that the impact on

[370] MRB 2019; *Impact of possible environmental policy interventions on case study farms*; interim report to MfE. (The predicted cost estimates in this report are being peer reviewed and may change as a result.)

[371] The author of the report terms this Cash Farm Surplus but uses the same definition for the surplus as the MRB report uses for EBIT (ie gross farm revenue less farm working expenses, needed to cover debt servicing, depreciation, tax and farm development).

[372] Journeaux, P; 2019. Modelling of Mitigation Strategies on farm profitability: testing Ag Package Regulations on farm. Report provided to MfE.

farms of an N-cap policy varies significantly, depending on the scale of the reduction in nitrogen discharges required, and the farm debt level.

3. Modelling case-study data from10 dairy farms in the Waikato-Waipa catchments which was undertaken to assess the impact of Waikato Regional Council's Plan Change 1 proposal to reduce high N-dischargers back to the 75th percentile (similar to option 3) found that profitability changes averaged -$143/ha, ranging from an increase in profit of $106 to a reduction of $514.[373], [374] Similar results were found in a 2013 study of the drystock sector - 6 case study farms were evaluated, and 5-10 percent reductions in nitrogen loss/ha were possible without system-change, with a reduction in profitability of 1-12 percent.[375]
4. Fonterra data[376] indicates that almost 400 Waikato-Waipa farms would be over the 75th percentile (out of a total pool of just over 1900 Fonterra suppliers – this is not exactly 25 percent as the distributions vary across the four sub-catchments analysed). The discharge profiles for Fonterra suppliers in 4 sub-catchments indicate a skewed distribution, with a longer tail at the upper end of the distribution than the lower.

Catchment Scale Modelling:

5. Landcare research used their NZFARM model to model the impacts of an N-cap set at 30, 50 or 70 kg N/ha/year, using the least-cost bundle of mitigations. *The modelling is based on a very limited set of farm models, which is particularly important for this proposal (since it is targeted at the top end of leaching by sector), so the results should be interpreted with caution*.

   The results found that as less than one percent of the total catchment area was leaching at higher than 50 kg N/ha, the latter two scenarios would have little impact on regional economic indicators, employment and contaminant losses.

   However if the threshold is set at 30 kg N/ha, about ten percent of the catchment area would be affected, mainly dairy farming and mixed arable farming, and net revenue in the region would fall by over six percent, regional output would fall by seven percent,

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[373] Ledgard et al; 2017. Understanding nutrient losses on Waikato case study farms and effectiveness of selected mitigation options. AgResearch report for Fonterra and Dairy NZ, cited in Allen, J; 2019. Statement of evidence of James Kenneth Allen for Fonterra Cooperative Group Ltd (at the hearing of submissions on proposed Plan Change 1 and variation 1 to the Waikato Regional Plan (Healthy Rivers).

[374] National average business profit before tax for an owner-operator farm in 2016/17 was $555/ha, when the dairy payout was $5.79/kg milksolids, whereas MPI's forecast price for 2018/19 is $6.41, and slighter higher for 2019/20. If dairy prices remain at current levels, theimpact on profitability may not be as significant as it would have been in 2016/17. Sources: DairyNZ Economic Survey 2016-17; and Situation and Outlook for the Primary Industries, 2019. Note that the impact on sharemilkers is more difficult to assess due to the split in farm revenue and costs between sharemilker and owner.

[375] Perrin Ag, 2013. Upper Waikato Drystock Nutrient Efficiency Study. Online https://www.waikatoregion.govt.nz/assets/PageFiles/19396/Upper_Waikato_Drystock_Nutrient_Study_April_2013.pdf

[376] Allen, J; 2019. Statement of evidence of James Kenneth Allen for Fonterra Cooperative Group Ltd (at the hearing of submissions on proposed Plan Change 1 and variation 1 to the Waikato Regional Plan (Healthy Rivers)

employment by over five percent and nitrogen loss[377] would fall by almost seven percent. The impacts on other contaminants is low – phosphorus loss from the root zone would fall by less than two percent and sediment by less than 1 percent.

This modelling indicates that setting the threshold at a very high level would have little impact on water quality in the Ruamahanga catchment. It is not clear how the 30 kg/ha threshold relates to the current distribution of leaching profiles in the catchment. As the modelling is based on a very limited set of farm models, it is unlikely to be fully representative.

[377] This figure is for nitrogen lost from the root zone. The impact on water quality depends on the attenuation that occurs between the root zone and the receiving waters.

Appendix 16: Stock Holding Areas and Feedlots

Context

One of the causes of water quality degradation is high risk land use activities, which can increase effluent, nutrient and sediment discharge and if not controlled, lead to poor water quality and soil degradation.

Two of the high risk land uses identified are intensive stock holding areas and feed lots. This paper provides analysis on regulation options for stock holding areas and feedlots which are longer term and are part of the hold the line measures in the *Essential Freshwater* package.

Stock holding areas is an umbrella term referring to a group of intensive farming practices commonly used on beef, dairy, sheep and other livestock farms for farm pasture management and supplementary feeding of livestock. Stock holding practices included in this definition are feed pads, wintering pads, standoff pads, loafing pads and sacrifice paddocks. Stock handling areas such as stock yards, milking sheds, shearing sheds and woolsheds are not included in the stock holding definition.

Feedlots are farming system where stock are held for an extensive period of time and fed almost exclusively on feedlots. This intensive livestock farming could be considered a type of more intensive stock holding area. Feedlots are uncommon in New Zealand; approximately five are estimated to exist.

The Problems/Opportunities

Stock holding areas are a commonly used farming practice in the dairy and red meat sectors that can economically benefit farms by improving productivity, but present a high-risk to water quality degradation if inappropriately designed and/or managed. Feedlots are much less common but involve increased risks due to holding stock for longer periods of time and at higher stocking rates.

The environmental issues caused by feedlots and stock holding areas largely result from the volume and intensity of effluent accumulating from holding animals in a confined space, resulting in point source pollution to water from contaminant discharges if badly designed, managed and/or inappropriately sited. Additionally, confinement of animals at high densities can result in soil damage, leading to soil compaction and erosion.

There are a number of measures that can be implemented by the operators of stock holding areas and feedlots to reduce the risks of water quality degradation. Industry groups have developed guidance for farmers to help them implement such measures voluntarily. However, as the cost to water quality is external to the operator, there may be little incentive for operators to invest in these measures.

When risks are managed appropriately, stock holding areas can also be a useful tool for reducing farm-scale contaminant discharges to water, as contaminant discharges can be reduced to a lower level than other high-risk farming land use practices (eg, intensive winter grazing on forage crops). However, reducing the water quality impacts of stock holding areas could have perverse incentives if the cost of risk management discourages their use, driving farmers to engage in alternative practices to manage stock that actually pose a higher risk to water quality.

Some regional councils have regulated the use of land for, or the contaminant discharge from, these activities under the Resource Management Act 1991 (RMA). However there are significant gaps. Only two out of 16 regional councils (Environment Canterbury and Hawkes Bay) directly regulate the

use of land for stock holding areas/ feedlots. There is also a lack of consistency in definitions and approaches, and significant gaps exist in ensuring that nationally these activities are operated in a way that pose a low risk to water quality degradation.

Constraints on the analysis

Proposed regulations for stock holding areas and feedlots are part of the provisions to address water degradation in the *Essential Freshwater* package with strong links to the proposed Fresh Water Farm Environment Plans[378] and regulations for addressing intensive winter grazing on forage crops.[379]

Wider negative environmental impacts such as noise, odour and aesthetic values have also been associated with stock holding areas and feedlots. The scope of this work is limited to water quality impacts. However, any policy intervention should consider wider environmental issues to ensure policy alignment.

Animal welfare issues have also been raised as an area of concern with regards to these activities. The Ministry for Primary Industries and the Royal New Zealand Society for the Prevention of Cruelty to Animals (the RNZSPCA) jointly enforce the Animal Welfare Act and Biosecurity Act which specify the obligations of people in charge of animals. The proposed policy intervention is unable to manage these concerns directly, as it is not a matter for Resource Management Act controls. However, as there is a linkage between animal grazing, feed systems and animal health, we propose that this connection is made explicit through regulation guidance.

Options

Options Objective

The proposals objective is to stop further water quality degradation by constraining contaminant discharges to waterways through the provision of controls and minimum standards for intensive stock holding areas and feedlots.

	Option 2 **National Environmental Standard with consent requirements and technical standards for land use, supported by adoption of Farm Environment Plans**	**Option 3** **National Environmental Standard with consent requirements and technical standards for containment discharge**
Effectiveness	+	**0**
Timeliness	++	**0**
Fairness	++	**0**
Efficiency	+	**-**
Principles of the Treaty of Waitangi	+	+
Te Mana o te Wai	++	++
Overall Assessment	++	**0**

[378] Refer to Fresh Water Farm Environment Plans RIS

[379] Refer to Intensive Winter Grazing on Forage Crops RIS

Option 1: Status Quo

Under the status quo option it is likely that where regional council rules do not already exist, stock holding areas and feedlots will continue to be operated in a manner that presents a high risk to water quality until regional councils develop rules that give full effect to the NPS-FM. This will potentially result in patchy adoption of good practice and will not accelerate the adoption of practices to the extent needed to halt degradation and deliver improved water quality impacts in five years.

This would likely increase contaminant discharges to waterways, worsening degradation of water quality. Which will also negatively impact human, animal and ecosystem health, and cultural and recreational values of water.

The use of stock holding areas and feedlots does however enable intensification of farming, which increases productive gains and profit on farms.

The status quo option would not give effect to Te Mana o te Wai, as private economic gain would continue to take precedence over the health and wellbeing of the water.

Option 2: National Environmental Standard with consent requirements and technical standards for land use, supported by the adoption of Fresh Water Farm Environmental Plans

Under this option, NES regulations would set consent requirements and permitted activity standards for land use. In addition to support implementation and compliance, it is proposed that to meet the requirement or standards of practice the assessment and actions are incorporated into the proposed freshwater modules in farm plans.

This option would also specify definitions, which is a necessary first step in regulating these activities, as the current variability in definitions contributes to difficulties in determining the extent and impact of them.

We have worked with government agencies and industry bodies (including Ministry for Primary Industry, Environment Canterbury, and Beef and Lamb) to develop definitions that reflect the activities we are trying to capture with this regulation. These are as follows:

Stock Holding Area: An area of land in which the construction of the holding area or stocking density precludes maintenance of pasture or vegetative groundcover, and livestock are confined for more than 30, 24 hour cumulative days in any 12 month period or for more than 10 consecutive 24-hour days at any time. These can be covered or uncovered areas.

To assist interpretation of NES, stock holding currently includes management practices such as feed pads, wintering pads, standoff pads, loafing pads and sacrifice paddocks. It does not include stock handling areas such as stock yards, milking sheds, shearing sheds or woolsheds.

Feedlot: An area of land in which the construction of the holding area or stocking density precludes maintenance of pasture or vegetative groundcover, and livestock are confined for more than 80 days in a six month period, and are completely hand fed or mechanically-fed. This includes both covered and uncovered areas.

A National Environmental Standard (NES) can set standards, rules, activity status and other requirements for land use. The NES could specify definitions for these activities, establish permitted activity standards, resource consent requirements, classes and conditions for the activity. A NES can establish consent requirements that enable site specific constraints and opportunities to be addressed in conditions of the consent, whilst still enabling the activity for the benefit of farmers.

The high level of risk associated with these activities means both monitoring and compliance of stock holding areas and feedlots is enabled by clear and specific permitted activity standards or consent requirement rather than relying on voluntary adoption of mitigation measures, or through a less prescriptive approach.

The consent requirement for stock holding areas and feedlots will impose restrictions on the use of land. Addressing land use would allow for up-front reductions in contaminant discharges, without the cost and complexity of having to develop national standards for contaminant discharges. Design and management measures for land use are available and relatively easy to implement, and consent conditions could be designed to ensure that these measures are implemented.

The NES would be prescriptive in setting activity classes and consent conditions. This would provide clarity to regional councils and stakeholders as it does not rely on council interpretation. The prescribed permitted activity and consent conditions should codify proven good design/management practices to reduce the risk of undertaking these activities, so that risks are mitigated as a matter of course.

Stock holding areas would be designated as a permitted activity provided minimum standards are met and require consent as a restricted discretionary activity if the minimum standards are not met. If a consent is granted, the applicant must comply with minimum standards set in the NES and any conditions imposed by the resource consent. The NES would set matters for restricting discretion.

Feedlots would be designated as a discretionary activity and if granted, must comply with minimum standards set in the NES.

The minimum standards should be as follows:

a. The base of the area must be sealed to a permeability standard of 1 millimetre per day.
b. The area must be sited at least 50m away from water bodies, water abstraction bores, drains, and/or costal marine areas.
c. All animal effluent or water containing animal effluent or bedding material containing effluent must be collected, stored and removed under an authorisation in accordance with section 15 of the Resource Management Act 1991.

The NES would specify that regional councils could recover costs for compliance, monitoring and enforcement of permitted activities. Costs of consenting are imposed on the applicant. Implementation of the NES would likely increase the work load burden to councils as greater resource will be needed to process resource consents and management of permitted activities

Implementation of this option would be supported by initiatives such as:

a. Working with industry and councils to progress good practice guidelines for meeting minimum standard requirements;
b. Providing guidance to councils on streamlining and bundling farm consent applications; and
c. Fresh Water Farm Plans (FW – FP)[380] which can provide a useful tool for farmers to plan for improvement, align their activity to the proposed regulatory limits, and meet consent requirements for stock holding areas and feedlots.

[380] Refer to Farm environment Plans RIS

	Option 2 (National Environmental Standard with consent requirements and technical standards for land use, supported by the adoption of Farm Environment Plans)
Effectiveness	+ Will require that risks to water quality are mitigated up front by reducing contaminant discharges as a matter of course by requiring minimum standards for design and operation are met. Targeted at specified activities with measurable and enforceable performance measures. Effectiveness will depend on compliance, monitoring and enforcement by regional councils. Farm Environment Plans will assist this. NES could be too inflexible to account for differences in local circumstances. This would be mitigated by taking a 'minimum standards approach', working on the presumption that there are risk mitigation measures that are applicable regardless of location. This would be reflected in the permitted activity standards for stock holding areas and by (a) consent conditions where consent is required and (b) allowing regional councils to be more stringent in regional rules than the NES regulations for stock holding areas and Feedlots.
Timeliness	++ Rules will come into force on NES gazettal. This option would assist councils to address the effects of these activities and allow more time for regional planning processes to enable consideration of more stringent rules to be put in place to meet local and regional requirements.
Fairness	++ The costs of reducing risks to water quality are transferred to those undertaking the activities and receiving direct economic benefit from them. Enables the continued use within appropriate constraints. It allows community value-setting processes under the NPS-FM to supersede the rules once in place. Provides certainty and clarity to farmers and councils. Builds on the existing work of industry and councils in developing good practice.
Efficiency	+ Imposing land-use controls on the operators of the activities is efficient as it requires that risks are mitigated by those undertaking the activities. Monitoring permitted activities and consenting regime requires time and resource investments by regional councils. This adds a layer of bureaucracy and additional cost to anyone carrying out the activity. Efficiencies will be achieved with standardisation of definitions and regulation of high risk activities, removing costly litigation through schedule 1 processes and providing certainty and clarity to councils, industry, farmers and communities.
Principles of the Treaty of Waitangi	+ Protection: Improvements in water quality will have a positive impact on Māori cultural values associated with water. Partnership: the development of the NES has been developed with input by the Kāhui Wai Māori. Feedback from Iwi and Māori wll be incorporated following consultation. Participation: This option could provide for participation in developing further standards (beyond the minimum). However, this would be achieved through regional council processes to implement the NPS-FM, as it would need to be conducted at the local level (rather than national).
Te Mana o te Wai	++ Restrictions on land use puts water quality impacts ahead of economic development.

Overall Assessment	++

Option 3: National Environmental Standard with consent requirements and technical standards for contaminant discharges

This option is similar in approach to option 2, however the focus is on consent requirements for discharge of contaminants from stock holding areas and feedlots, rather than land use.

Requiring a mandatory resource consent and specifying activity classes would establish controls over the amount and management of contaminant that can be discharged from these activities.

	Option 3 (National Environmental Standard with consent requirements and technical standards for contaminant discharges)
Effectiveness	**0** Would require that contaminant discharges to water are reduced to an appropriate level. It would require baseline data about the nature of the discharges to both groundwater and to surface water, and establishing minimum quality standards. Baseline data is difficult to obtain for a number of farms as we don't have a monitoring system that provides the information at an attribution level. Overseer has potential but is not adopted by all farmers and ongoing monitoring would place an additional burden on farmers and councils. Overseer is also considered more reliable for estimating discharges for dairy farms, and to a lesser extent sheep and beef operations. Therefore, effectiveness will be limited by the lack of baseline data for contaminant discharges and the need for all relevant farms to adopt a monitoring system such as Overseer. Discharge controls are difficult to set appropriately at a national scale, and are better addressed through regional planning processes. Direct measurement of contaminant discharges would be inefficient making the option impracticable.
Timeliness	**0** Rules will come into force on NES gazettal, improving management ahead of regional planning processes for implementing the NPS-FM. However, it will take significant time for baseline information to be gathered and Overseer to be adopted by all relevant farms. With the real possibility that regional planning processes would occur more quickly than the policy intervention.
Fairness	**0** The costs of reducing risks to water quality are transferred to those undertaking the activities and receiving direct economic benefit from them. Controls on contaminant discharges are better addressed through regional planning processes as national scale regulation is likely to be difficult and costly to determine, and will not reflect local situations and decision making. This approach would be considered more equitable, as it would tie the regulation directly to the amount of discharge produce, incentivising lower discharge levels and penalising higher discharge levels.
Efficiency	- Imposing discharge controls leaves the method of control up to the land operator. Whilst this may allow for innovation, it also lacks clarity and relies heavily on compliance, monitoring and enforcement. The need for Overseer adoption will add time and cost. A consenting regime requires time and resource investments by regional councils. This adds a layer of bureaucracy and additional cost to the process. Rules set through an NES can be somewhat inflexible in allowing for local circumstances and decisions about contaminant discharge management and limits are

	complex decisions that are more appropriately and efficiently made at the local scale, through regional councils implementing the NPS-FM.
Principles of the Treaty of Waitangi	+ Protection: Improvements in water quality will have a positive impact on Māori cultural values associated with water. Partnership: This option does not provide a clear role for partnership, as it will be implemented and enforced through regional councils. Participation: This option could provide for participation in developing the minimum standards. However, this would be achieved through regional council processes to implement the NPS-FM, as it would need to be conducted at the local level (rather than national).
Te Mana o te Wai	++ Restrictions on discharges puts water quality impacts ahead of economic development.
Overall Assessment	**0**

Options ruled out of scope, or not considered

Guidance and direct support to councils

Guidance and direct support as a standalone intervention was ruled out of scope as the focus of this proposal is to achieve better management in a timely manner. We consider the outcome of guidance (which is voluntary) or support (eg, by helping councils through planning process) will rely strongly on influencing and uptake of better management can't be guaranteed. A regulatory approach is required to achieve the desired outcomes quickly.

Note this does not rule out direct support to councils as part of the wider implementation support package for *Essential Freshwater* initiatives.

Recommendation

We recommend option 2 National Environmental Standard with, consent requirements and permitted activity standards for land use, supported by the adoption of Farm Environment Plans.

We consider this option provides clear direction and a pathway for farmers and councils, to manage water quality risks from stock holding areas and feed lots. It builds on the existing good work of councils and industry in developing minimum standards. This means that where good practice is already adopted, there will not be an undue burden to the farmer.

An NES can be applied nationally and has an immediate effect on resource management decision making, allowing the water quality impacts to be addressed in a timely manner.

The NES allows for the establishment of permitted activity standards and consent requirements so that site specific constraint and opportunities can be addressed through conditions of consent where permitted activity standards cannot be met.

In contrast, the status quo relies on individual farmer, community and council commitment to manage water quality risks from stock holding areas and feed lots. This option is a low cost approach but will not meet our expectation for a timely, effective and consistent approach. Only two regional councils directly regulate the use of land for stock holding areas/feedlots. There is also a lack of consistency in definitions and approaches, and significant gaps exist in ensuring that nationally, these activities are operated in a way that pose a low risk to water quality degradation.

While option three, NES with consent requirements and technical standards for contaminant discharges, provides a similar pathway to option 2, it is limited by the lack of baseline data for contaminant discharges and the need for all relevant farms to adopt monitoring systems that provide the information at an attribution level. Overseer has potential to do this but is not adopted by all farmers, and ongoing monitoring would place an additional burden on farmers and councils. This makes option three extremely costly and difficult to set appropriately at a national scale. It would also require more time to implement and technical support to navigate the complexity of this option.

What do stakeholders think?

Broadly speaking, stakeholders agree there is a need to address the water degradation consequences of stock holding areas and feedlots. However, there are differing views about the best way to achieve this.

Kahui Wai Māori support taking a more regulative and active approach due to the potential of these activities detrimental impact on water quality. The preferred proposal, although it includes a regulatory approach, is not as stringent as the proposed Kahui Wai Māori recommendation.

The Freshwater Leaders' Group have proposed that implementation of any policy is risk-based and use a farm systems approach. They also consider that it should not apply to areas with rules already in place. The preferred option takes a risk based approach into consideration by setting minimum standards and consenting processes where rules are not in place. The farm system approach, though, is outside our mandate and lead by Ministry for Primary Industries.

Some industry groups recommend a more guidance-based approach, while environmental non-government organisations (NGOs) tended to prefer stronger regulation, and regulatory 'teeth' to manage high risk land use activities. We have taken both approaches into consideration with regulation as the basis for our approach and guidance to support councils.

The Regional Sector has highlighted that policy intervention under the RMA could create significant burdens for regional councils in terms of consenting, compliance, monitoring and enforcement. We note this concern and will work with the regional sector to identify solutions that support implementation of the preferred option.

Both regional sector and industry groups support the importance of clear and unambiguous definitions. This has been included as a critical part of the work to develop a NES.

Summary table of costs and benefits of the preferred approach

Affected parties *(identify)*	**Comment**: *nature of cost or benefit (eg, ongoing, one-off), evidence and assumption (eg, compliance rates), risks*	**Impact** *$m present value, for monetised impacts; high, medium or low for non-monetised impacts*	**Evidence certainty** *(High, medium or low)*
Additional costs of proposed approach, compared to taking no action			
Regulated parties	Cost to obtain a resource consent from any operator requiring consent.	Approximately $3000 per consent	High
	Infrastructure costs to those not already meeting minimum standards.	Approximately $72 per cow per year[381]	High
	The complexities for farmers (especially dairy farmers) in deciding on appropriate farm systems that account for production and economic aims, particularly where debt is a key issue, environmental objectives, animal welfare, biosecurity and other drivers and the prospect of new regulations addressing climate change will be significant and may impact on, on-going commitment to farming.	Medium	Medium
	Burden of complex decision making could have consequences for social health and wellbeing or farmers, whanau and communities.	Medium	Medium
	Landowners will over-invest in infrastructure that becomes a stranded asset if a subsequent regional plan, or other legislation, requires land-use change in order to meet water quality, or other environmental objectives.	low	low
	Compliance costs may result in farmers choosing lowest cost option, rather than one which delivers the better environmental outcome.	Medium	Medium
	Increased costs may result in intensification in the farming system in order to offset these costs. This could	Low	low

[381] Ruamahunga impact analysis used costings based on costs in this. Estimate $72 per cow: http://www.massey.ac.nz/~flrc/workshops/16/Manuscripts/Paper_Chrystal_1_2016.pdf

	result in increased contaminant discharges to water quality.		
	Risks of perverse outcomes where increased costs of compliance result in farmers undertaking more risky practices in order to avoid costs.	Medium	low
	Increased need for technical support	High	Medium
Regulators	Increased compliance, monitoring and enforcement burden to regional councils.	Medium	Medium
	There are wider environmental implications and negative public perceptions around HRLUAs that go beyond water quality (eg, adverse noise, odour and amenity or landscape issues). By prescribing minimum, rather than comprehensive standards, we leave these issues to be addressed by regional councils.	Medium	Medium
Wider government	Development of implementation support and interpretation guidance.	Medium	Medium
Other parties	Primary industry extension services require support and development.	Low	low
Total Monetised Cost	*Costs will be dependent on requirement for consenting application and any requirements to meet minimum standards for both permitted activities and consent conditions.*	$3000 per consent $72 per animal proxy estimate	Medium
Non-monetised costs	Most significant cost will be to councils to monitor compliance with regulations.	High	Medium

Affected parties	**Comment***:*	**Impact**	**Evidence certainty**
Expected benefits of proposed approach, compared to taking no action			
Regulated parties	Standards provide clarity and certainty about obligations to reduce contaminant loss risks.	High	Medium
	Wider farm-scale improvements to productivity and discharge rates due to good quality stock holding areas.	Medium	Medium
Regulators	It allows community value-setting processes under the NPS-FM to supersede	High	Medium

	the rules in place **only if** they are more stringent than those set out in NES.		
	Bottom line performance standards enable better compliance responses by councils where plans do not yet address the risks form these activities.	Medium	low
	Providing national specification and definitions reduces inconsistencies between councils, reduce risk of litigation as regional plans are produced and reinforce the need to follow industry good practice.	Medium	Medium
	Will help deliver on RMA obligations – better environmental outcomes in region and ability to prove for cultural and recreational values.	Medium	Medium
Wider government	Sends a strong signal around government expectations for high risk land use activities.	Medium	High
	Contributes to government objectives to improving water quality.	Medium	High
Other parties	Contribution to halting water quality degradation, and possibly improving water quality.	low	Medium
	Economic benefits could be realised by industries that support farmers to meet minimum standards.	Medium	Medium
	Increased demand for a higher-skilled and larger rural professional workforce to support farmers to meet minimum standards.	Medium	Medium
	Places greater protection on water quality with benefits for human health, animal health, ecosystem health, cultural values, recreational values, and long term economic values.	low	Medium
	Internalises external costs – more equitable.	low	low
Total Monetised Benefit	*To be determined as scope and scale of intensive Stock Holding Area is unknown at this stage.* *Costs to meet minimum requirements may not translate into economic benefits in the short term for farmers.*		

Non-monetised benefits	Contributes to holding the line on water quality degradation and improved water quality for future generations. Proposal Is in line with aspirations to support Iwi whānau Māori kaitaiaki responsibilities. Provides a pathway for farmers and councils to demonstrate they are collectively looking after water and the environment.	*Medium*	low

What other impacts is this approach likely to have?

Imposing restrictions on the operation of feedlots and stock holding areas will likely increase costs to farmers to meet the minimum standards (where those standards are not already being met), and the cost of obtaining a resource consent. Implementation of minimum standards may also require up-skilling and time spent on management of these activities, and the skills needed. Increased costs may impact on farm profitability and impact the ability to sustain jobs. Flow on effects from this may be increased difficulty for sustaining rural communities and services.

These factors could result in stress, financial hardship for farmers and their communities. However, increased demand for experts in order to advise/implement minimum standards could lead to increased job growth in support industries, with flow on positive effects for communities.

Improved management of environmental effects could result in improved social licence for farmers, particularly where current practice results in visually unpleasant impacts (eg, stock in mud, visible sedimentation in rivers). This increase support from communities could enhance community cohesion, and increase feelings of environmental stewardship and responsibility.

The magnitude of these effects will depend on the amount of transitional time allowed for meeting the minimum standards / obtaining a consent.

Appendix 17: Intensive Winter Grazing on Forage Crops

Context

Intensive winter grazing on forage crops is one factor contributing to water quality degradation. This farming practice can increase the discharge of nutrients, sediment and microbial pathogens (contaminants) into surface water and groundwater, by stripping the land of its vegetative cover and causing pugging damage to soil integrity in wet weather.

Furthermore, compared to pasture grazing, intensive winter grazing has significantly higher contaminant loss to water as the higher feed value of forage crops means that more stock can be grazed per hectare, and the types of plant grazed mean the soil is exposed sometimes for long periods.

The prevalence of this activity has increased in the last ten years with an increase in stock feed demands and technology solutions such as helicopter spraying making the planting of winter forage crops a possibility on steeper sloped land.

Over the last few decades, New Zealand has experienced significant agricultural intensification and as a result the demand for livestock feed has also increased. Catchments with a high proportion of agriculture and associated contaminant discharges will require some restrictions on land-use activities to give effect to the Freshwater National Policy Statement (NPS) and meet community-set freshwater objectives and limits.

The process for giving effect to the NPS-FM is long and complex. Part CA directs councils to set freshwater objectives and limits, which requires input from multiple disciplines and community engagement to reconcile local environmental, economic, social and cultural values.

Councils are currently expected to complete this process and meet other requirements of the NPS-FM by 31 December 2025 or 2030 if they cannot complete the process to sufficient quality. There is currently a proposal to change this to 2025 (ie, remove the ability to complete by 2030) which is being considered as part of an RMA amendment.

The Problems/Opportunities

Intensive winter grazing on forage crops in this context is defined as on paddock grazing by farm animals where stock are grazed in situ between May to September (inclusive) on an annual forage crop where supplementary feed may also be fed to stock. Annual forage crops include brassicas, beets, and root crops and excludes perennial pasture and cereal crops.

Winter forage crops are an important part of the pastoral farm production system and profitability. Not only do they provide feed when there is no or low pasture growth, they contribute to pasture renewal rotations for improved production, provide weed and pest control and enable market premiums to be targeted. Meeting feed demands from increased stock numbers (both dairy and beef), have meant stock grazing systems are increasingly intensive and reliant on forage crops in both summer and winter.

Research from Waikato found that farmers make decisions about on-farm grazing and forage crops, infrastructure for feeding and holding stock in severe weather and for feed production according to proneness to pugging, stock density and available feed supplies.[382] The main drivers do not expressly

[382] Kaine G (2013) Farm context and winter grazing practices in the Waikato dairy industry.

include environmental outcomes unless there is a specific nitrogen loss limit imposed through a council plan.

Regional forage brassica planting are illustrated in Table One below with Otago, Southland and Canterbury being the most active regions making up about 80 percent of the winter grazing in 2018. While winter grazing of forage crops is a relatively recent farming practice, trends nationally are that it is increasingly being used where farms are intensifying.

Table One: Forage Brassica hectares planted in year ending June 2018[383]

Region	Forage brassicas (Hectares during the year ended 30 June 2018)	Region	Forage brassicas (Hectares during the year ended 30 June 2018)
Northland Region	2225	Wellington Region	6357
Auckland Region	724	West Coast Region	3480
Waikato Region	15368	Canterbury Region	77133
Bay of Plenty Region	2850	Otago Region	52860
Gisborne Region	1458	Southland Region	43658
Hawke's Bay Region	10716	Tasman Region	1379
Taranaki Region	3923	Nelson Region	3
Manawatu-Wanganui Region	16168	Marlborough Region	1574
Total New Zealand			**239,875**

Environmental consequences for water quality

Intensive winter grazing on forage crops is a high profile activity with concern expressed about the environmental consequences of contaminant losses.[384]

The contaminant losses from leaching to groundwater,

On a per hectare basis, nitrogen leaching losses from grazed winter forage crops are approximately two to five times greater than losses measured under pasture on equivalent soil types and landscapes (Laurensen et al 2018). These losses make a disproportionately large contribution to total farm system losses relative to the area occupied by winter forage crops**.**

Contaminant losses of sediment, phosphorous and pathogens to surface water and estuaries via overland run-off.

In general, the literature shows that sediment loads increase markedly after a 20 percent bare ground threshold. Bare ground is the main risk driver for soil loss, but is exacerbated by high rainfall, steep and long slopes, and poorly drained soils. Further Monaghan et al. (2017) reported sediment and Phosphorus losses from grazed forage crop paddocks in South Otago that were 37 and 14-fold

[383] Data from Agricultural Production Survey June 2018 (Statistics NZ 2019); https://tepuna.mfe.govt.nz/otcs/cs.dll?func=ll&objaction=overview&objid=12109939

[384] For example; https://www.nzherald.co.nz/the-country/news/article.cfm?c_id=16&objectid=12180124; https://www.odt.co.nz/rural-life/dairy/vets-open-pan-industry-initiative-grazing; Belliss et al. 2019 Manaaki Whenua Landcare Identification of high-risk agricultural activities: national mapping of the location, scale and extent of winter forage cropping and intensive grazing on hill country land paragraphs 9 -16

greater, respectively, than estimated losses from sheep-grazed pasture. In the Manawatu, a study found sediment losses were five to eleven times higher than pasture grazing in the previous winter.

Erosion from the bare paddocks following intensive winter grazing

Erosion modelling indicates that winter forage cropping leads to erosion equivalent to 2.6 – 3.5 percent of predicted winter sediment loads in rivers in South Island regions where this activity is most prevalent. While not a significant amount in total, it can be significant at a local or smaller catchment scale.

Soil compaction and impacts on run off

Intensive winter grazing of forage crops is linked to pugging of the soil. In wet weather soil compaction from pugging has high potential for soil damage, and when frequent and severe, impacts on subsequent land production. It also increases the likelihood of overland flow where there are high levels of soil compaction.

While there is minimal research about the connection between level of pugging damage and how it changes levels of contamination in run-off, there is a link between winter grazing with increased losses of contaminants, especially from hill slopes, where soil is compacted and when there is bare ground.

Impacts on animal health

There is concern about the impacts of this farming practice on animal health, and that in some cases livestock are standing in mud up to their waists[385]. Animal health is outside the Ministry for Environment (MFE) mandate but improving practices for intensive grazing regimes that lead to better environmental outcomes are expected to result in better animal welfare outcomes.

Development of regulatory controls

While many councils are progressing plans to give effect to the NPS-FM, some are making better progress than others.[386] To date, only a handful of catchments have developed objectives, limits and rules following the process set out in part CA of the NPS-FM. Others have developed interim regimes that at least partly address water quality issues (including intensive winter grazing on forage crops) while they carry out the full process. Implementation of the NPS-FM will be 6 years away. A new and fairer allocation system is also at least 6 years away. Without objectives, limits and rules in place, intensive winter grazing will continue to contribute to further water quality degradation.

Regional plans are gradually being improved as councils give effect to the NPS-FM but plan preparation processes can be slow and subject to extensive debate about minimum performance standards and thresholds for management. In some catchments, where modelling to establish nutrient load limits is progressing and property nutrient discharge allowances are introduced, some winter grazing may be further affected because of its proportionally greater effect on nitrogen loss compared to extensive pasture.

Limited national and regional level regulation

The use of winter forage crops has occurred in the absence of national regulation or consistent regional controls that would have managed both localised impacts of winter grazing and the more insidious contribution of winter grazing to catchment nutrient loads. At a regional level, significant

[385] For example; https://www.nzherald.co.nz/the-country/news/article.cfm?c_id=16&objectid=12180124

[386] For information on council progress see National Policy Statement for Freshwater Management implementation review.

variation exists in current and developing regulations for winter grazing and hill country cropping in terms of definitions, land use or discharge rules and minimum standards for management. This is likely to be partly in relation to the scale of winter forage cropping and hill country pasture renewal currently being carried out in the different regions.

While rules imposing constraints on ground-based cultivation are common across all council plans, hardly any plans have controls over hill country cropping where no-tillage aerial methods are used. In addition, only four recent plans (Gisborne, Southland, Canterbury and Wellington) regulate winter forage grazing during winter in any targeted way.

The Benefits of Better Management

There are a range of benefits associated with better management of grazing winter forage crops.

These include:

- better public acceptance of high profile farming practices carried out with good practice[387]
- protection for farmers and the farming industry where good practice is well articulated and widely adopted
- adopting a flexible and responsive approach to development of good industry practice that responds to changing technology
- adopting targeted and consistent regulatory approaches and reduce litigation.

Adoption of good practice measures can result in improved water quality. Monaghan et al. (2017) concluded that overland flow was the most important pathway of loss for contaminants, and that when critical source areas of paddocks are protected during grazing, this could decrease total estimated fluxes of phosphorous in overland flow and subsurface drainage by 67 percent, and sediment by 80 percent. Where treading damage (pugging) increases overland flow it can be reasonably concluded that reduction in pugging damage will also reduce contaminant loss (though this would only be relevant where there is overland flow and most of the supporting data is anecdotal and).

Any decision to establish forage crops for grazing in situ (either as a pasture renewal system or simply to provide additional winter feed) must be done with the knowledge and understanding of the risks involved, both at establishment and during and after subsequent grazing. This information is only now being collated and research underway to determine effective mitigation measures with the development of better decision support tools.[388]

Constraints on the Analysis

There are some inter-dependencies between different elements of the NES regulatory proposals. They include:

- stock holding areas regulation: avoiding non-compliance with technical standards for winter grazing may mean more reliance on off-paddock grazing and increase stock holding area

[387] Described in The Good Farming Practice: Action Plan for Water Quality 2018 as an evolving suite of practical measures that can be put in place at a land use, sector and industry level to assist in achieving community agreed outcomes. Important to note that what is good practice will continually evolve, in tandem with new technologies and changing societal expectations.

[388] AgResearch noted that a 'ready reckoner' guide is being developed to help guide how risk practices can be identified and appropriate mitigations implemented.

activities (proposed new regulations and standards will ensure that where this occurs these activities are undertaken to a suitable standards of practice)

- land use change and intensification regulation: The intensification control sets a baseline for winter grazing based on crop areas from 2013-2018. The permitted level of winter grazing is currently set at up to [30ha] 50ha. This affects consent burdens for both councils and landowners, but also impacts on the level of intensification being provided for
- stock exclusion regulation: proposals include an average 5m setback requirement in lowland and intensively farmed non-lowland areas. Timing for the winter forage crop regulations and stock exclusion may vary for the same property – where there is an overlap in the area that these regulations apply to, the shortest timeframe will apply
- Fresh Water Farm Plans (FW-FP) regulation: and how they provide for risk assessment and identification of mitigation measures for winter forage cropping
- the nitrogen threshold regulation proposal could also result in changes to winter grazing management in order to reduce nitrogen loss, though if relevant this would likely result on a reduction in the grazing of winter forage crops rather than an increase.

Not in Scope

The analysis does not consider:

- winter grazing of perennial crops as they are not as damaging to the soil when grazed;
- property scale nutrient allocations;
- animal welfare; where stock are compelled to stand for long periods in mud or water it causes significant animal welfare problems. Animal welfare is managed under separate legislation, but improving practices for intensive grazing regimes that lead to better environmental outcomes are expected to result in better animal welfare outcomes and farm profitability as animal health costs may reduce.

Options Assessment

Objective

This proposal's objective is to help stop further degradation and loss by constraining further contaminant discharges to waterways caused by intensive winter grazing on forage in the period before councils give effect to the NPS-FM and a new allocation system is in place (ie, 2025 or earlier).

Criterion	Option 2 (voluntary measures)	Option 3 (Council direction)	Option 4 (NES)
Effectiveness	**0**	**+**	**++**
Timeliness	**0**	**+**	**++**
Fairness	**0**	**0**	**+**
Efficiency	**-**	**+**	**++**
Principles of the Treaty of Waitangi	**0**	**0 or +**	**++**
Te mana o te wai	**0**	**+**	**++**
Overall Assessment	**-**	**+**	**++**

Option 1: Status Quo

Without a national intervention, this activity will be unregulated over much of New Zealand until regional plans are developed to address it. This will take up to 6 years to complete. All plans may not develop targeted rules for this activity and even where they do, without national technical standards and definitions provided through regulation, there is increased likelihood of continuing debate and associated costs of determining acceptable minimum standards. Councils may address this activity in an ad hoc and inconsistent fashion and plan processes are generally lengthy resulting in delays before this activity is subject to regulatory control over all New Zealand.

It is also likely that the farming community will take longer to address adverse effects of intensive winter grazing as each council tackles this issue progressively. In the interim, some councils will not be able to take timely enforcement action where a landowner is not following good practice.

Option 2: Non-regulatory/ voluntary good practice

This option relies on regional plans having rules to support good practice. Good practice in this context is an evolving suite of practical measures that can be put in place at a land use, sector and industry level to assist in achieving community agreed outcomes.[389] It would see farmers encouraged or incentivised to adopt good practice by the government and national industry sector groups. It could include monitoring, auditing and reporting on performance of the good practice actions by either Council or sector organisations.

Criterion	Option 2: non-regulatory/good practice
Effectiveness	**0** Unlikely to have significant additional effect than option 1 on how winter grazing is managed Enforcement of voluntary measures is problematic and ensuring compliance virtually impossible where there is resistance to the good practice measures. Without regulation, there are few incentives for landowners to comply with this approach, particularly where it means costs are imposed or changes to farm practice are required.
Timeliness	**0** Unlikely to hold the line any more effectively than option 1
Fairness	**0** Uneven regulatory approaches under option 1 may mean uneven support through advice and guidance programmes Costs of such an approach are likely to fall largely on Councils
Efficiency	- Low cost option as it saves consent and (some) planning costs, but reliance on voluntary methods likely to lead to uneven management. Some farmers may have costs associated with adopting good practice. Industry sector groups are already developing good practice information about winter forage cropping but currently do not have tools to enforce compliance with minimum standards.
Principles of the Treaty of Waitangi	**0** Need for measures to improve water quality consistent with Treaty, but voluntary measures likely to be too slow in achieving purposes of Act and Treaty obligations for clean water
Te Mana o te Wai	**0** Progress towards meeting freshwater objectives and improving ecosystem health, including mauri likely to be slow. There is no evidence about levels of agricultural practice by Māori land owners for high risk activities

[389] The Good Farming Practice: Action Plan for Water Quality 2018.

Overall Assessment	**0** Slow and uneven progress being made in the management of these activities.

Option 3: National Policy Statement supporting Regulation by Council

National direction will support Councils to develop policies and make rules in regional plans to manage intensive winter grazing. This could be achieved either by an amendment to the NPS-FM or through a direction by the Minister to a regional council to prepare regional plan provisions.

The direction would be for councils to address management of high risk activities such as intensive winter grazing of forage crops. It would not include technical content as this would be left to councils to develop in a way that is relevant to local issues and circumstances. Although guidance on good practice standards would be provided to councils as part of this option.

Criterion	Option 3: Direction for Councils to regulate
Effectiveness	+ Could be effective but variable approaches might be taken It does not address issues relating to litigation about agreed performance standards as each Council addresses the issue individually.
Timeliness	++ Could assist in managing at risk activities depending on plan processes and local issues for managing cumulative effects. Any such local rules will be subject to potentially lengthy RMA schedule 1 processes. The regional plan submissions hearings and appeals processes can be lengthy where there is debate between parties about consent thresholds and minimum standards. although proposals to shorten timeframes are being developed.
Fairness	**0** Costs to council similar to option 1, as they must already give effect to NPS-FM Activities are not necessarily defined or managed in a consistent way and this may cause inequities within and between industries and may lead to inconsistent management of similar effects between councils.
Efficiency	+ Targeted regulation for risk activity introduced, but in places where cumulative effects are significant, it may take some time to develop comprehensive regulatory responses.
Principles of the Treaty of Waitangi	**0** or + Development of measures to improve water quality and manage adverse effects is consistent with Treaty
Te Mana o te Wai	+ Progress towards meeting freshwater objectives and improving ecosystem health, including mauri likely to be variable. There is no evidence about levels of agricultural practice by Māori land owners for high risk activities.
Overall Assessment	+ Uneven progress being made in the management of these activities. Litigation may still occur over definitions and minimum standards. Complexity involved in managing the cumulative forage crop contributions to nitrogen leaching and catchment loads and slows regulatory management of this activity.

Option 4: National Environmental Standard (NES) (preferred option)

Intensive winter grazing on forage crops is defined as on paddock grazing by farm animals where stock are grazed in situ between May to September (inclusive) on an annual forage crop where supplementary feed may also be feed to stock. Annual forage crops includes brassicas, beets, and root crops and excludes perennial pasture and cereal crops.

An NES can include enabling higher technical standards to be imposed either as permitted activity conditions or as consent conditions whereby establishing thresholds for resource consents permitted activity conditions cannot be complied with or where the risks are higher, including in relation to catchment loads and limits. The proposed national regulation will permit intensive winter grazing on forage crops subject to conditions that are based on technical standards and level of risk. If the conditions cannot be met, the activity will be subject to enforcement action by councils or a consent may be required to be applied for.

A national regulation will enable the activity to continue to be carried out, but ensure it is carried out according to specified and enforceable minimum good practice[390] as technical standards. These technical standards look at the scale and location of the activity and have been selected as interventions that will hold the line on water degradation as they limit containment loss from grazing on winter forage crops and include;

a) A slope threshold impacts on the integrity of the soil.
b) A threshold for the permitted scale/size of the activity
c) Setbacks from waterways
d) Grazing management requirements
e) Treading damage thresholds

These are discussed more fully in the section below

Technical Standard Conditions

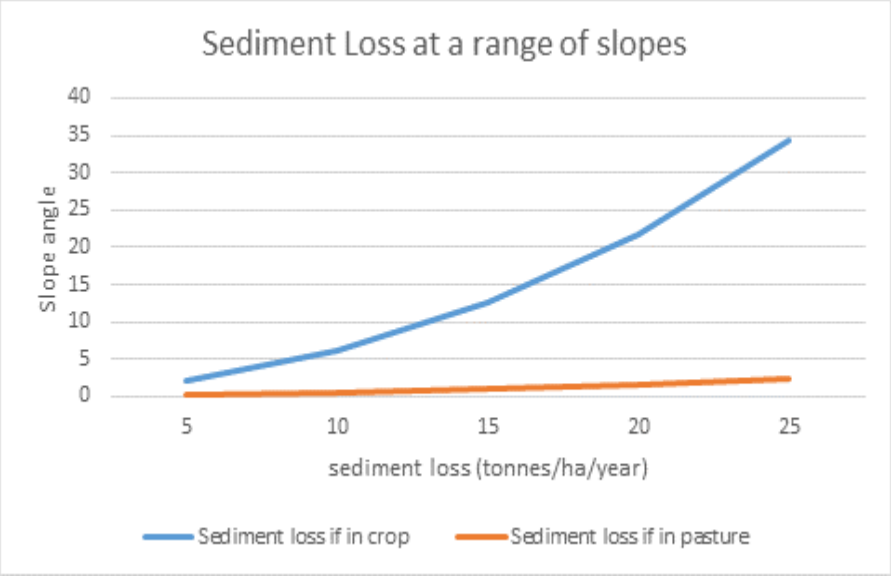
The intensive winter grazing on forage crops activity will be permitted subject to a number of technical standard conditions which are described in more detail below.

a) **Slope:** The proposal requires any part of the paddock that is over the slope specified to be subject to a consent oversight because of the additional risks of contaminant loss. **As the steeper the slope the more risk of contaminant loss, especially during rain events.** Sediment losses increase at an increasing rate with slope. For example on an imperfectly drained loam soil in South Canterbury, a square 1 hectare site would lose 6 tonnes of sediment, if the slope is 10 degrees, 13 tonnes if the slope is 15 degrees and 22 tonnes if the slope is 20 degrees. Longer slopes lose proportionately more sediment than short slopes, so increases in losses also tend to

[390] Good practice is an evolving suite of practical measures that can be put in place at a land use, sector and industry level to assist in achieving community agreed outcome. The standards/conditions for winter grazing are intended to be suitable for national application and are informed by industry good practice advice such as those developed by Beef+Lamb NZ. Eg https://beeflambnz.com/wintergrazing

increase at an increasing rate as the area in crop increases. Graph One illustrates the sediment loss from a square one hectare block of winter crop in South Canterbury.[391]

Graph One: Sediment loss at a range of slopes



The regulation proposes a 10 degree slope threshold. We are also consulting on a 15 degree slope threshold as part of the consultation. If the activity is carried out on slopes above this, a consent would be required. Concerns about enforceability led to consideration of mapping the areas to which the NES would apply. Mapping information is not always sufficiently detailed at a property scale for it to be used to identify whether the regulation applies or not. However we can rely on readily available technology, including apps on mobile phones that allows slopes to be measured on farm. Modern precision agriculture technology, especially aerial technology for steeper slopes enables very precise application of seed and fertiliser including according to slope restrictions.

Most councils have a slope or contour limit or have an erosion prone area limitation for ground-based cultivation (13 out of 16 councils). Where there are slope limits they range from 15 degrees to 25 degrees. The number of paddocks by slope for land over seven degrees is set out in Table Two.

Table 2; Number of paddocks by slope class for land over 7 degrees winter 2018[392]

Slope class	Hectares	Number of Paddocks
7 - 10 degrees	19312	3882
10 to 15 degrees	11673	2592

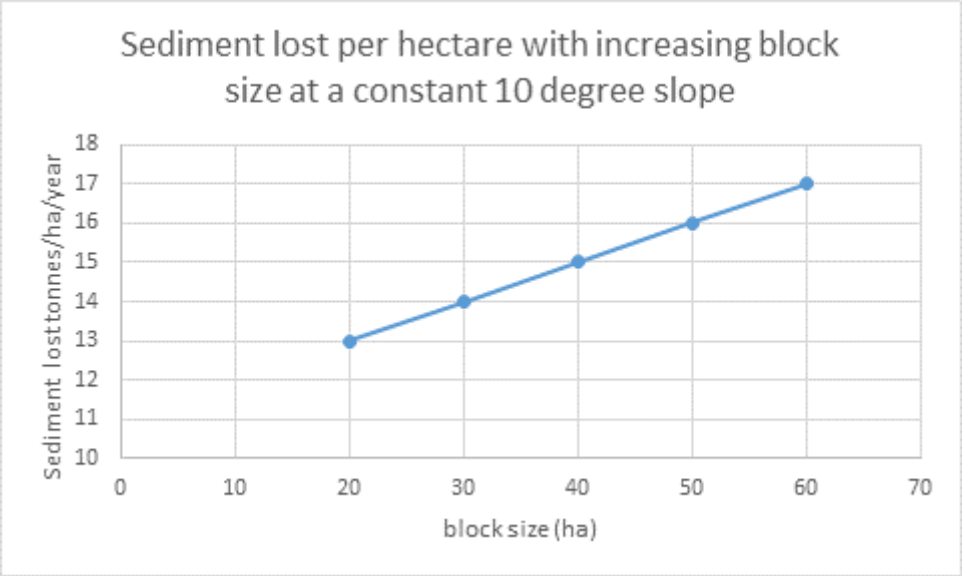
[391] Universal Soil Loss Equation as the source of the estimates of sediment lost.

[392] Sourced from mapping data supplied by Manaaki Whenua:Landcare 2019 on winter forage cropping 2018.

15-20 degrees	1320	399
> 20 degrees	88	37
Total	42,081	9,044

b) **Scale:** regulating the scale of the activity will limit the potential impact on soil and containment loss. Graph Two illustrates that the larger the area the greater the sedimentation loss. (Using the same illustrative site as graph one South Canterbury, loam soil, imperfectly drained, and is a square block in each case and holding the slope at 10 degrees. Increasing block size results in increasing the per hectare losses of soil and containment loss.

Graph Two: Sediment lost per hectare with increasing block size



The regulation proposes a threshold of 30ha or a maximum of 5 percent per property. We are also consulting on a 50ha or maximum 10 percent per property.[393] Table Three shows the number of properties where winter grazing is over 50ha on land over 7 degree slope is 11 with a total area of 717ha. In contrast this increases to 44 properties with a total area of 1882ha when the scale is reduced to 30ha and over.

Table 3: Number of paddocks by total area per property for land over 7degrees winter 2018[394]

Paddock Size Class	Hectares	Number of Paddocks
<10 hectares	22283	6309

[393] (*Data is still being collated about the impact of a threshold on maximum percentage 5% or 10% winter crop per property).*

[394] Sourced from mapping data supplied by Manaaki Whenua:Landcare 2019 on winter forage cropping 2018.

10 to 25 hectares	7463	528
25 – 30 hectares	799	29
30 – 50 hectares	1165	33
50 – 100 hectares-	717	11
Total	32383	6910

Further New Zealand data for brassica crops is provided in Table Four below.[395] These totals include brassica crops grown outside the winter risk period being addressed in this proposal so numbers may be an over estimate for winter forage cropping.

Table 4; Number of properties by area of winter crop (2018 Agriculture Production Survey)

Region	Less than 5 hectares	5 to < 20 hectares	20 to <50 hectares	50 to <100 hectares	100 and over hectares	Total
Northland	63	102	21	3	3	192
Auckland	45	24	15	0	0	84
Waikato	315	471	117	33	18	954
Bay of Plenty	30	54	24	3	3	114
Gisborne	12	33	9	0	3	57
Hawke's Bay	39	165	141	30	18	393
Taranaki	276	246	18	9	0	549
Manawatu-Wanganui	261	567	165	39	15	1,047
Wellington	54	123	90	30	3	300
West Coast	30	105	33	18	3	189
Canterbury	273	834	723	366	102	2,298
Otago	141	510	408	180	99	1,338
Southland	270	747	432	84	78	1,611
Tasman	42	48	12	6	0	108
Nelson	3	0	0	0	0	3
Marlborough	12	78	12	6	0	108

[395] Data from Agricultural Production Survey June 2018 (Statistics NZ 2019); https://tepuna.mfe.govt.nz/otcs/cs.dll?func=ll&objaction=overview&objid=12109939

Total New Zealand	**1,866**	**4,107**	**2,220**	**807**	**345**	**9,345**

All regions will require consents but the greatest consenting requirements will be in Southland, Otago and Canterbury. The maximum area on a property of 30 or 50 hectares being proposed is smaller than that included in recent Southland and Canterbury plan change processes of 100 hectares. Winter crop limit as a percentage of the property has been included in the Southland (15 percent) and Canterbury (10 percent) regional plans. The percentage area is largely based on the sheep beef sector forage crop requirements for on-farm feed production, not including dairy support and is relevant to Southland conditions.[396]

The impacts of the combination of slope and area thresholds on consenting burdens and the extent to which winter grazing varies between councils. About 80 percent of winter forage crop grazing over 7 degrees occurs in Southland, Otago and Canterbury. In addition Statics NZ Agriculture Production Survey indicates a total of about 56 percent of winter grazing is carried out in these three regions. However, indications are that winter forage cropping is also increasing in areas such as Waikato and Hawkes Bay.

c) **Setback from water bodies**: A 5m setback is consistent with the stock exclusion proposal and supported by data that shows this distance is an effective buffer between stock and water bodies. In some cases (especially on more sloping land) a wider buffer could be more appropriate and will be assessed against regional council rules and or development of fresh water farm plan. The necessity for a wider setback can be considered through a resource consent where intensive winter grazing exceeds the slope threshold of a 10 [15] degrees.

This proposal does not require permanent stock exclusion, but the stock exclusion proposal overlaps in lowland areas and the more stringent requirement will apply. Depending on farm type, stock exclusion may not be required for some years while a setback would apply immediately.

d) **Grazing management** restriction includes requiring the progressive downslope grazing, and the protection of critical source areas from stock access and resewing bare ground as soon as practical. Costs associated with these good practice measures are expected to be low.

Good grazing management practice such as following a grazed fodder crop, with a winter-sown catch crop of oats substantially reduces soil mineral nitrogen and nitrate leaching from simulated urine patches. One research trial in Canterbury showed sequence cropping with kale/oats reduced nitrogen leaching loss by 25 – 30 percent compared with a kale only system.

e) Treading damage (Pugging) Control

We propose pugging control to a depth of 20cm or more does not occur over more than 50 percent of the paddock. Suggestions of 5cm to 20 cm depth will be tested as part of the consultation process for this regulation. The extent of bare land is a key risk factor in relation to sediment loss. The number of hectares and paddocks affected in 2018 is set out in Table Five

[396] The Southland Economic Project; Agriculture and Forestry. https://contentapi.datacomsphere.com.au/v1/h:es/repository/libraries/id:1tkqd22dp17q9stkk8gh/hierarchy/Scientific%20reports/Agriculture%20and%20Forestry%20Report.pdf

illustrating that 4792 hectares have more than 50 percent bare land in contrast to 14,638 hectares with more than 25 percent bare land.

Table 5; Distribution of bare land for winter forage crops over 7 degrees for winter 2018[397]

Bare class	Hectares	Paddocks
< 25% bare	17,781	3580
25 to 50% bare	9810	2162
50 to 75% bare	4,051	926
75 to 100% bare	777	242
Total	32382	6910

This proposal to manage pugging damage is untested and not currently included in any council rules. While there is minimal research about the connection between levels of treading damage and how it changes levels of contamination in run-off, there is, however, evidence linking winter grazing with increased losses of contaminants, especially from hill slopes, where soil is compacted and when there is bare ground. The connection between compaction and risk of resulting run-off and the increasing risks of runoff from bare land support the introduction of rules to control pugging damage to soil.

A pugging control is likely to drive changes to grazing management as currently there are no regulations relating to this aspect of winter forage crop grazing. The proposed standard still enables winter grazing without a significant resource consent burden, but will require changes to grazing practice in winter in order to avoid severe pugging for some farmers. This is likely to change stock management and grazing systems for some farmers as current practice can include using a forage crop paddock while protecting other pasture from treading damage and 'saving' grass for spring feed.

This standard has the added advantage of providing protection for animal health, although there are currently no clear pugging thresholds that apply to protection of animal health[398] Pasture and crop production, soil quality and soil ecosystem services are also provided with protection as frequent and severe pugging reduces soil health and farm production. Research also indicates that greenhouse gas NO2 emissions can also increase where there is severe pugging.

Pugging effects can be reversed over time with good pasture and grazing management.

Other standards conditions considered

There is currently no specific **sediment control standard**. As currently proposed, the combination of the slope and area thresholds will capture a significant proportion of all winter grazing, especially on

[397] Sourced from mapping data supplied by Manaaki Whenua:Landcare 2019 on winter forage cropping 2018

[398] Further advice yet to come from MPI on this aspect

hill slopes and will allow site specific sediment controls to be imposed via consent conditions where that is necessary.

Exclusion for **vulnerable soils.** The potential to restrict intensive winter grazing on vulnerable soils such as free draining gravelly soils or soils where tile drainage is used was considered but discounted because of the lack of robust information to map land where tile drains are used. Both poorly drained and well drained soils have contaminant loss risks associated with them. A regulation targeting either one may have the effect of pushing the activity to other potentially vulnerable areas.

Timing

The national regulation can be gazetted and take effect rapidly –and could apply as soon as winter grazing in 2020. However, as planning for winter (including seed purchase and contracting services) commences well in advance of the winter season, it is recommended that farmers be given a year (ie implementation in 2021) to become familiar with the new regulations to enable them to plan ahead to meet them.

Council implications

Councils are able to be more stringent than the NES or develop additional discharge activity rules that might be more stringent. This approach means councils will be able to recover costs of monitoring the activity (a National Environmental Standard may empower local authorities to charge for monitoring any specified permitted activities in the standard). Compliance will be by regional councils and enforcement action may be taken or consents required.

Direct support to councils as part of the wider implementation support package for *Essential Freshwater* initiatives would support this option.

Criterion	Option 4: NES
Effectiveness	++ Likely to be effective as it is targeted to specified activities with measurable and enforceable performance measures.
Timeliness	++ Will assist in managing contaminant losses from the high risk activities and holding line against further degradation of water quality. An NES for intensive winter forage cropping allows rapid control to be developed for a high risk land use activity as it can take effect much sooner than a regional plan provision.
Fairness	+ Some councils and landowners affected more than others. Reflects pattern of winter forage cropping across NZ. Performance standards and rules the same for similar activities reduces inequity between and within industries. Additional consenting, enforcement and compliance costs are higher for some councils. Could be immediate impact on landowners adopting winter forage crop grazing systems Transition is part of council discretion through resource consent conditions where there are significant mitigation costs.. Extent of cost impact will be site and farm dependent.
Efficiency	++ Very targeted and specific activity control through NES so likely to be efficient. Based primarily on already existing industry good practice.
Principles of the Treaty of Waitangi	++ Measures to improve water quality consistent with Treaty. Winter forage crops still able to be undertaken on Māori land, but are subject to good practice management measures to reduce contaminant losses. There is no evidence about levels of agricultural practice by Māori land owners for high risk activities.
Te Mana o te Wai	++ Progress towards meeting needs of values of water and improving ecosystem health, including mauri likely to be fast as regulations take effect immediately.

Overall Assessment	++ Closes regulatory gap in managing adverse effects of high risk activities including until more robust limits set to meet limits. Potentially high cost for councils and some landowners offset by potential reduction in plan preparation costs and faster progress towards adoption of good land management practice. Consenting and compliance requirements may divert council action from other priority programmes or require greater resourcing. May require Councils to incorporate NES requirements into Plan rules.

Options ruled out of scope, or not considered.

National Planning Standards

National Planning Standards (planning standards) are a new RMA tool that aims to standardise the structure and format of RMA plans and provide some standard content. We have ruled these out of scope as the first set of standards focus mostly on plan structure and definitions (rather than plan content), and will take up to 7 years to implement.

Central government sets interim discharge limits

In its third report in 2012 the Land and Water Forum (LAWF) recommended regional councils set interim discharge limits and targets to help manage water quality prior to the full, community-focused objective and limit setting process required by the NPS-FM.

In its May 2018 report, LAWF decided that in the current freshwater planning context, setting interim limits would be impractical when full limits are required by 2025, and that councils are better investing in the full limit setting process.

LAWF also ruled out recommending central government set national discharge limits for similar reasons. For this reason we have ruled out setting national limits (eg, via an NES).

Recommendation

We recommend Option 4: an NES with specified technical standards. We consider this option provides the most practical, enforceable and timely way to prevent further degradation to surface and ground water bodies from intensive winter grazing of forage crops.

Option 2 and 3 requires time for the development of national quality standards, training, capability development and support for farmers and councils. The primary industry groups Beef and Lamb NZ, Dairy NZ and Fonterra recognise that some practices are unacceptable and that there is a need to specify minimum standards. They have developed extensive education and extension material about how winter grazing should be managed. But it has not had the widespread adoption required to halt further degradation of fresh water. Option 1 and 3 rely on councils developing interim rules which will also take time to fully implement, by which time water quality may degrade further.

Option 4 establishes interim technical standards for the high risk activity intensive grazing winter on forage crops. Where risks are greater, higher standards may be required to manage the risk of contaminant loss.

Control of the adverse effects of grazing hill country forage crops may be achieved by addressing risks related to slope rather than by controlling hill country cropping *per se*. Circumstances where hill country pasture renewal does not include a forage crop in the rotation would not be captured by this approach.

In summary, the proposed regulation:

a. can be applied nationally and has an immediate effect on resource management decision making, allowing high risk activities to be addressed in a timely manner
b. provides clear direction to councils and farmers about environmentally acceptable management practices for intensive winter grazing
c. provides minimum standards, rules and activity statuses, but can allow for councils to be more stringent if the local situation requires it, reflecting local decision making where plans are already in place, including where limits are established at a local scale
d. establishes a consent requirement for high risk situations so that site specific constraints and opportunities can be addressed through conditions of the consent
e. can be monitored through mapping and satellite imagery
f. provides interim rules while councils fully implement the NPS-FM
g. will support councils and farmer with guidelines.

What do stakeholders think?

Prior to consultation, we engaged with a range of stakeholder groups, including the Minister-appointed advisory groups.

Broadly speaking, these advisory groups agree there is a need to manage the contaminant generated by intensive winter grazing. However, there is some debate about the thresholds for consent and the detail of the technical standards that ought to be imposed. The advisory group's commentary will be included in the consultation process.

While Kāhui Wai Māori have not commented specifically on this part of the package, this proposal does assist in protecting waterbodies from further degradation and establishes consistent and effective good practice with industry groups.

The recommended approach aligns with the FLG recommendations for targeted management of high risk activities, though there is some debate about the level of the technical standards and wanted more stringent rules. These are included in the options discussion as a range, for example the 10 degrees or 15 degrees slope technical standard. The FLG has supported early implementation of regulations to limit the practice of high risk land use activities. There is some debate about whether the regulations should apply as either a regional or national regulation and will be included in the discussion documents for consultation.

The freshwater leaders group also sough further regulations for management of irrigation and winter grazing in some vulnerable locations. They noted that despite development of industry good practice by industry bodies, muddy paddocks during winter are seen as a normal part of farming, particularly of cattle. A change to how stock are managed on muddy paddocks will be a significant change for some farmers and stakeholder organisations.

The regional sector have concerns about the consenting burden and cost implications for ensuring compliance with the proposed technical standards. They are concerned about enforceability and the clarity of definitions. They are also concerned about the information limitations in respect of the 2013-1028 baseline that will support the proposal for managing land use change and intensification. This is noted in the recommendations section where we acknowledge monitoring the level of forage cropping through regular satellite imagery.

Summary table of costs and benefits of the preferred approach (Option 4)

Affected parties *(identify)*	**Comment**: *nature of cost or benefit (eg ongoing, one-off), evidence and assumption (eg compliance rates), risks*	**Impact** *$m present value, for monetised impacts; high, medium or low for non-monetised impacts*	**Evidence certainty** *(High, medium or low)*
Additional costs of proposed approach, compared to taking no action			
Regulated parties Consenting requirements	Approximately $3000 per consent application. Approximately 11 properties subject to the 50ha scale threshold. 44 properties subject to the 30ha scale threshold.[399] Approximately 436 paddocks in 284 properties on slopes above 15 degrees.[400] And 3028 paddocks in 1420 properties on slopes over 10 degrees. The extent to which the consent requirements are overlapping is low.	Medium (it is possible that properties just over the thresholds will reduce areas to avoid triggering consent requirements).	High .
Regulated parties Mitigation measures	Variable mitigation costs per farm: • 5 m setback[401] and critical source areas[402] • Changes to paddock grazing management • Changes to stock feeding supplementary feed, silage etc) • Consequential need for run-off/lease land • infrastructure construction Costs of mitigation may result in less winter forage crop grown and fewer stock (meat and milk production potential affected).	Variable impacts low to high: • $/m^2 loss area grazed (low) • Low • Variable • Medium • High (where required) Unknown level of impact.	• Low / medium • High • Low • Low • Low • Low

[399] Based on Statistics NZ Agricultural Survey 2018

[400] From the Landcare Satellite data Winter 2018

[401] Refer to stock exclusion RIS for details and costings

[402] The impact of this opportunity cost was not tested. One recent study (SFF Heli-cropping study) for hill country cropping estimated the value (based on live weight gains in cattle) at $3.12/m^2.

	Costs of mitigation may result in further intensification (higher stock numbers) to pay for mitigations. There may be additional monitoring costs.	Unknown level of impact.	• Low
Regulated parties Other costs	Increased need for technical support to manage complex stock grazing and feeding and stock holding options. Consultant costs.	High impact for some farmer.s Medium/low for most farmers.	Medium Medium
Regulators	Processing and staffing costs[403] for new consent requirements (much of it recoverable from applicants). Compliance and monitoring activity standards - cost recovery included current proposal.	Medium to high impact on Southland Otago and Canterbury Councils, medium/ low elsewhere. Medium to high impact.	High Medium
Wider government	Development of implementation support and interpretation materials.	Medium impact	High
Other parties	Primary industry extension services require support and development. Impacts on processing companies if meat and milk production decreases.	Medium impact Unknown impact	Medium Low
Total Monetised Cost		Medium	Medium
Non-monetised costs		Medium	Medium

Affected parties	**Comment***:*	**Impact**	**Evidence certainty**
Expected benefits of proposed approach, compared to taking no action			
Regulated parties	Associated farm production and animal health benefits. Supports good stewardship decision making and supports social licence.	Medium Medium	Medium Medium
Regulators	Less costs and litigation involved in plan preparation to manage specific activity.	Medium Low/Medium	Low/medium Medium

[403] Can we get additional FTE estimates as part of consultation? (costs would be recovered from industry)

	Consistent approach to management of activity common across NZ.		
Wider government	Targeted regulation to address high profile activity that support objectives for clean water.	Medium	Medium/high
Other parties	Confidence that adverse effects of targeted activities properly managed. Contribution to meeting water quality objectives supported.	High Medium	High High
Total Monetised Benefit		Medium	Medium
Non-monetised benefits		Medium	Medium

What other impacts is this approach likely to have?

The extent to which the regulations will cause increases in stock numbers, and any relationship between increases in contaminant losses from wider impacts on farm systems to off-set costs of mitigation measures is unknown (there may be stock number increases to off-set costs of infrastructure for example).

There is a relationship between winter forage crop grazing and grazing of pasture during winter (except where councils have specific winter grazing controls). The effect of intensively grazed animals on pasture may in some cases be similar to that of winter forage crop grazing, particularly if supplementary feed is being fed out in the grazed area. Some farmers choose to use a winter crop area to save pasture from pugging damage for later grazing and reduce overall pasture or soil damage.

Imposing restrictions on intensive winter grazing on forage crops will likely increase costs to farmers to meet the technical standards (where those standards are not already being met), and the cost of obtaining a resource consent. Increased costs may impact on farm profitability and impact the ability to sustain jobs.

These factors could result in stress, financial hardship for farmers and their communities. However, increased demand for experts in order to advise/implement technical standards could lead to increased job growth in support industries, with flow on positive effects for communities.

Improved management of environmental effects could result in improved social licence for farmers, particularly where current practice results in visually unpleasant impacts (eg, stock in mud, visible sedimentation in rivers). This increase support from communities could enhance community cohesion, and increase feelings of environmental stewardship and responsibility.

The magnitude of these effects will depend on the amount of transitional time allowed for meeting the technical standards and obtaining a consent.

Appendix 18: Agricultural intensification

Context

Intensification of agricultural land-use is one factor contributing to water quality degradation.[404] Agricultural intensification can increase the discharge of nutrients, sediment and microbial pathogens into surface water and groundwater. This comes from increased livestock urine and excrement, increased application of fertiliser containing nitrogen and phosphorus, and is exacerbated by the adoption of farming practices (such as irrigation) that allow land to hold more stock, or that strip the land of its vegetative cover (eg, intensive winter grazing on forage cropping).

In recent decades, New Zealand has experienced significant agricultural intensification. Catchments with a high proportion of agriculture and associated contaminant discharges will require some restrictions on land-use intensity to give effect to the NPS-FM and meet community-set freshwater objectives and limits.

The process for giving effect to the NPS-FM is long and complex. Part CA directs councils to set freshwater objectives and limits, which requires input from multiple disciplines and community engagement to reconcile local environmental, economic, social and cultural values.

Councils are currently expected to complete this process and meet other requirements of the NPS-FM by 31 December 2025 or 2030 if they cannot complete the process to sufficient quality.

There is currently a proposal to change this to 2025 (ie, remove the ability to complete by 2030) in the NPS-FM. In addition, a new fairer system for allocating nitrogen discharges (also due by 2025) will also limit the extent to which agriculture is able to intensify, by better allocating the amount of nutrients individual land users can discharge within their catchment.

The problem/opportunity

While many councils are progressing plans to give effect to the NPS-FM, some are making better progress than others.[405] To date, only a handful of catchments have developed objectives, limits and rules following the process set out in part CA of the NPS-FM. Others have developed interim regimes that at least partly address water quality issues (including intensification) while they carry out the full process. Many councils do not have interim or long-term intensification rules.

Full implementation of the NPS-FM will be 6 years away. A new and fairer allocation system is also at least 6 years away. Without objectives, limits and rules in place, intensification may continue over this period, leading to further water quality degradation and ecosystem loss.

Additional constraints on the analysis

There are data limitations for measuring this proposal's impact. The proposed intervention will restrict options for future behaviour, rather than impose immediate direct costs. Benefits (ie, to water quality) will be in the form of future costs avoided (ie, further water quality degradation).

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[404] Agriculture (encompassing pastoral, arable, and horticultural production) is intensifying when inputs (eg, stock, fertiliser, crop area) increase per hectare of land. This may be through changing to a higher intensity land use (eg, from sheep and beef farming to dairy farming or commercial vegetable production), or through intensification of an existing land use (eg, increasing the number of stock units per hectare, fertiliser use, or the number of crops grown on the same ground per year).

[405] For information on council progress see National Policy Statement for Freshwater Management implementation review.

Estimating the actual or opportunity costs/benefits of the intervention therefore depends on understanding what future behaviour will be. This is heavily influenced by commodity prices and a range of other factors (including other Government policies affecting farmers).

In addition, water quality benefits are generally estimated by assessing the discharges of an activity (eg, in kg/ha discharged per year). Discharges are usually modelled via Overseer, which provides estimates for nutrients (including nitrogen, phosphorus) and greenhouse gas discharges/emissions, but not sediment or *E.coli*. Further to this, Overseer has a lower level of certainty for estimates of phosphorus discharges compared with nitrogen discharge estimates. Overseer is also considered more reliable/accurate for estimating discharges for dairy farms, and to a lesser extent sheep and beef operations, but not as reliable for horticulture.

Options assessment

Objective

This proposal's objective is to help stop further degradation and loss by constraining further contaminant discharges to waterways caused by increased farm inputs (intensification) in the period before councils give effect to the NPS-FM and a new allocation system is in place (ie, 2025 or earlier).

Summary assessment

Each option is assessed relative to the status quo. Option 1 (status quo) is not included in the table. Timeliness has been a key consideration for this proposal, due to the interim nature of the intervention.

Criterion	2: Moratorium	3: NES regulations	4: Amend the NPS-FM	5: Ministerial intervention
Effectiveness	++	+	+	-
Timeliness	**0**	++	-	-
Fairness	-	-	**0**	**0**
Efficiency	-	**0**	-	- -
Principles of the Treaty of Waitangi	-	-	**0**	**0**
Te Mana o te Wai	**0**	**0**	**0**	**0**
Overall Assessment	**0**	+	**0**	-

Option 1: maintain status quo

Under the status quo, councils would eventually develop rules to manage the effects of intensification as part of the objective and limit setting process required by part CA of the NPS-FM. This will take up to 6 years to complete. Some councils may choose to develop interim rules to manage intensification as part of this and others may not. It is likely that further agricultural intensification will continue in some places during this interim period if not adequately controlled, leading to further freshwater degradation and ecosystem loss, and potentially making the limit setting process more difficult to complete due to a greater need for fundamental land-use change.

Indicative Social Impacts

Health[406]

- Maintaining the status quo would likely have a negative impact on the health of farmers and wider rural communities including:
    - continued risk of sickness from contaminated water in areas where intensification occurs, both from drinking and swimming
    - potential physical and/or mental health impacts from reduced recreation opportunities (eg, swimming and fishing).[407]

Environment

- As valued waterbodies are degraded from intensification, negative social impacts are likely to occur, primarily through loss of local recreation and leisure opportunities.

Cultural identity and social connections

- Continued degradation of water quality would lead to public perceptions that the farming community are not acting as stewards of the land/environment (social licence to operate).

Option 2: moratorium

In 2001 the RMA was amended to impose a moratorium on new aquaculture operations. The purpose was to give councils time to amend regional coastal plans to include provisions that better manage aquaculture activities.

A similar approach could be used to impose a moratorium on agricultural intensification.

Te Kāhui Wai Māori (Te Kāhui) recommended "an immediate moratorium on further water takes[408] and any further intensification of land use that will increase discharges to water."[409]

Such a moratorium would prohibit further intensification that increases contaminant discharges to water for 10 years. Regional councils would not be able to issue further consents that allow increased contaminant discharges to waterways.

Criterion	Option 2: moratorium
Effectiveness	**++** Would include all increases in discharges associated with agricultural intensification. It would send a strong signal to land owners that further intensification (and its associated effect on water quality) cannot take place while improvements are being made to the freshwater management system. This would halt further degradation of waterways caused by agricultural intensification (but would not reduce contaminant discharges).
Timeliness	**0** Would take time to gather baseline discharge information necessary to monitor compliance. Experience in collecting this information at catchment scale (eg, in Canterbury, Waikato, Bay of Plenty) suggests this could take years. Requires an RMA

[406] Examples that outline links between agricultural practices, water quality and human health: *Water Quality in New Zealand, Understanding the Science* (PCE, 2012), *Update report - Water quality in New Zealand: Land use and nutrient pollution* (PCE, 2015), Farm practices and stream health, NIWA

[407] About recreational water quality and health, EIANZ

[408] The effects of intensification on water consumption is out of scope for this analysis.

[409] Te Mana o te Wai, 2019, Kāhui Wai Māori.

	amendment which may take significant time to pass. In the meantime, councils will be closer to finalising their objective and limit setting processes.
Fairness	- Land users with high existing discharges would have greater flexibility in how they use their land than those with lower existing discharges.
Efficiency	- There would be significant costs to councils and land users to gather the baseline discharge data needed to monitor compliance, and to periodically report and monitor discharges.
Principles of the Treaty of Waitangi	- Preventing further contaminant discharges into waterways would help protect them for cultural use (eg, mahinga kai). However, an outright prohibition on further discharges would reduce development options for Māori land-owners with undeveloped land over the short-medium term.
Te Mana o te Wai	**0** Would put the wellbeing of the water above further agricultural use, and allow space for Te Mana o te Wai to be more fully recognised in freshwater planning processes, but wouldn't necessarily improve implementation of Te Mana o te Wai beyond status quo.
Overall Assessment	**0** This option has the potential for significant benefits for water quality. However, it would take a long time to implement and therefore is unlikely to materially improve the status quo before council objective and limit setting processes are completed.

Indicative Social Impacts

Income and consumption

- This may have a negative effect on some farmers' ability to earn an income if long-term farm viability depends on plans to intensify over the moratorium period.
- It may negatively impact some business owners and their staff if the farming workforce has less disposable income.

Health

- Farmer wellbeing (anxiety/mental health) may be negatively affected if the moratorium affects farm viability or is perceived to affect farm viability.
- Would avoid future health risks by limiting future degradation of waterways, but would not reverse damage to already affected waterways.

Environment

- The positive impact of this option on environment would be variable and uncertain depending on whether current levels of intensity are negatively affecting water quality (no restoration of already affected waterbodies would occur).

Cultural identity and social connections

- Would not significantly enhance social licence to operate as it would simply entail a 'provisionally on-hold' period. It would add no clear role for partnership with Māori or participation.

Option 3: interim NES regulations (preferred option)

A new NES for freshwater management could include regulations that set activity status requiring resource consent for some key intensification activities, with conditions attached to manage the activities' environmental effects. Activities to regulate are set out in table 1 below.

Table 1: Summary of agricultural intensification regulations

Activity	Requirements (resource consent not issued if standard not met)
Discretionary: Increase in the area of land in irrigated pastoral, arable or horticultural production if total change is above 10ha since NES comes into force.	Must have a Freshwater Module in a Farm Plan (FW-FP). No increase in nitrogen, phosphorus, sediment and microbial pathogen discharges above a 2017/2018 baseline (average for this period).
Discretionary: Increase in intensive winter grazing, if the applicant wishes to exceed: • Their highest use 2017/2018 footprint (ie, the maximum consented under the intensive winter grazing regulations); or • the 50ha/10 percent[410] threshold if the applicant did not carry out intensive winter grazing above the threshold in 2017/2018 (see appendix 17).[411]	
Discretionary: High-risk land-use changes if total change is above 10ha since NES comes into force from: • arable, deer, sheep, beef to dairy support • arable, deer, dairy support, sheep, or beef to dairy • woody vegetation or forestry to any pastoral use.	
Discretionary: Any land-use change to commercial vegetable growing, if the activity would increase the applicant's net area in commercial vegetable growing in the sub-catchment above the highest total area from 2013 – 2018.	Discussion document will include two options: Option 1: • FW-FP • Operating above good management practice Option 2: • FW-FP • No increase in nitrogen, phosphorus, sediment or microbial pathogen discharges above a 2013-2018 baseline (average for this period).

The onus would be on the consent applicant to demonstrate that they comply with the requirements set by the NES. The applicant would need to use a combination of farm records and expert assessment to prove they comply. If they cannot provide the necessary information then the council would be unable to grant resource consent.

The regulations would only apply to areas that do not have fully operative provisions (objectives, limits/targets and rules) giving full effect to Part CA of the current (ie, 2017) version of the NPS-FM (or the 2020 equivalent). Section 360 (2) of the RMA allows the Minister for the Environment to apply the regulations to specific areas in the country.

[410] Note: we will consult on different numbers for this threshold – see appendix 17 for more details.

[411] Under these proposals, it will be a permitted activity for farms to carry out intensive winter grazing so long as it is less than 50ha or 10% of their property (whichever is smaller).

The NES would specify what the exact requirements are with reference to the relevant sections of NPS-FM, so that the requirements are clear to councils. In practice, regional councils would need to inform the Minister that the plan is fully operative in (they are required to provide a copy of the operative plan under Schedule 1, section 20 of the RMA).

Once these requirements are met in a Freshwater Management Unit (FMU) or entire region, the Minister (likely following advice from officials) would specify in *the Gazette* that the regulations no longer apply to that FMU or region.

The newly developed regional rules would then manage intensification in line with community objectives and limits. This would make the regulations interim until councils develop rules giving full effect to the NPS-FM, which we expect to be completed by 2025.

Resource consents would be time-limited to 2030 at the latest, so that the activities are not consented in perpetuity (section 123 of the RMA allows this for land-use consents). This avoids the possibility that new land-uses are consented in over-allocated catchments (without adding further contamination) where wholesale land-use change is required. Limiting consents allows the new regional rules to take precedence and determine regional land use after the regulations no longer apply to an area.

Criterion	Option 3: NES regulations (preferred option)
Effectiveness	+ This option would address key intensification activities, ensuring rules are in place to stop increases in contaminant discharges from certain intensification activities. However, it would not capture difficult to monitor forms of intensification (such as increases in feed brought onto the property and fertiliser use). Councils would be able to have more stringent rules than the NES regulations.
Timeliness	++ NES regulations have immediate effect on gazettal and would not take long to develop.
Fairness	- Land users with high existing discharges would have greater flexibility in how they use their land than those with lower existing discharges.
Efficiency	**0** There would be significant costs to councils to enforce, and an opportunity cost for farmers wishing to intensify who no longer can due to the regulations (or have to do so at lower profitability). However, these costs would be off-set by cost-savings for future objective and limit setting, and reversing declining trend in water quality.
Principles of the Treaty of Waitangi	- Preventing further contaminant discharges into waterways would help protect them for cultural use (eg, mahinga kai). However, an outright prohibition on further discharges would reduce development options for Māori land-owners with undeveloped land over the short-term.
Te Mana o te Wai	**0** Would put the wellbeing of the water above further agricultural use, and allow space for Te Mana o te Wai to be more fully recognised in freshwater planning processes, but wouldn't necessarily improve implementation of Te Mana o te Wai beyond status quo.
Overall Assessment	+ Likely to improve status quo by putting in rules relatively quickly and preventing further water quality degradation while councils develop longer-term solutions through the community objective and limit setting process.

Indicative Social Impacts

Health

- Reduced risk to human health (improved drinking water quality) by reducing/avoiding contaminants in waterways where the NES will apply.
- For farmers wishing to intensify there may be a negative effect on farmer wellbeing (anxiety/mental health), if financial costs of the resource consent process and/or constraints on intensification affect farm viability or are perceived to affect viability.[412]

Environment

- Maintained amenity/pleasantness of valued resources (quality rivers and lakes doesn't deteriorate) and opportunities for food gathering, including fishing, in those areas where the NES will apply.
- It is likely to increase opportunities for recreation/leisure in the local area where the NES will apply (eg, fishing, swimming).

Cultural identity and social connection

- Contributes to New Zealanders' cultural identity and values associated with high quality natural environment (particularly water resources).
- May improve perceptions of the farming community as stewards of the land (building a social licence to operate as stated above).
- Will benefit the mauri of waterbodies where the NES will apply, and prioritising waterbodies ahead of further agricultural intensification.
- Better enable farmers to exercise kaitiakitanga/stewardship.
- Current opportunities for food gathering / mahinga kai remain as a result of maintained ecosystem health.

Option 4: amend the NPS-FM

The NPS-FM sets objectives and policies that provide clarity around how Regional Councils must manage fresh water under the RMA. As explained above, Councils give effect to the NPS-FM by including provisions in their regional plans.

Under this option, the NPS-FM would be amended to provide more clarity to regional councils on how to manage intensification. This would link with the proposal for all councils to give full effect to the NPS-FM by 2025 by including explicit objectives and policies requiring councils to develop interim rules to manage intensification and guiding consenting decisions for new or intensified agricultural activities, as they go through the objective and limit setting process. Some of these objectives and policies could be inserted directly into regional plans (without using the usual schedule 1 plan change process) through section 55 of the RMA. Table 6 assesses this option against the *Essential Freshwater* criteria below.

Criterion	Option 4: amend the NPS-FM
Effectiveness	+ Depends on the specific rules regional councils put in place. Likely to provide some additional benefit beyond status quo once rules are developed.
Timeliness	- It will take time for councils to develop interim rules which would require a plan change using the schedule 1 process. Proposed rules would likely be subject to appeal and legal challenge before they become operative, as happened in Southland and Horizons. However, section 86B (3)(a) of the RMA allows a proposed rule to have immediate legal

[412] Farmers' mental health: A review of the literature (ACC Policy Team, 2014)

	effect if the rule protects or relates to water. This is likely to be slower than the status quo, and may divert council resources from setting longer-term limits and objectives.
Fairness	**0** This would apply to all councils, and allow councils to develop rules that align with local circumstances. However, it would largely depend on the interim rules put in place.
Efficiency	- Would be a flexible approach to rule setting (councils would be able to develop rules that suit local circumstances), but would likely divert council resources away from the objective and limit setting process, which would make it more difficult to meet the 2025 implementation deadline.
Principles of the Treaty of Waitangi	**0** Depends on how councils chose to implement the objectives and policies. However, would likely prevent further contaminant discharges into waterways which would help protect them for cultural use (eg, mahinga kai), but also potential to restrict development of Māori-owned land.
Te Mana o te Wai	**0** Councils are already required to give effect to te Mana o te Wai. The additional objectives and policies won't change these obligations. However, interim rules may allow space for Te Mana o te Wai to be more fully recognised in freshwater planning processes.
Overall Assessment	**0** Unlikely to be much better or worse than status quo, may divert councils from objective and limit setting process to develop new rules.

Indicative Social Impacts

Health

- Difficult to assess: likely similar or marginally better than option 1 (status quo).

Environment

- Difficult to assess: likely similar or marginally better than option 1 (status quo).

Cultural identity and social connection

- Difficult to assess: likely similar or marginally better than option 1 (status quo).

Option 5: Ministerial involvement in council planning processes

The Minister for the Environment has a number of intervention and collaboration tools available under the RMA, including:

- the streamlined planning process (council initiated, Schedule 1, subpart 5)
- providing feedback on a plan pre-notification (Schedule 1 clause 3(a))
- submitting on a plan(s149ZA, Schedule 1, clause 6)
- direct a plan change (s25A)
- direct a plan review (s25B).

Under this option, these tools would be used to influence council planning processes to ensure they include interim rules to manage intensification. The specific intervention tool would depend on the specific situation.

Criterion	Option 5: Ministerial intervention
Effectiveness	- This option allows for bespoke intervention that can take into account local circumstances. However, it may not solve the issue as the outcome of these interventions are not guaranteed. They all require some form of plan change under schedule 1 of the RMA (involving a public submissions and hearing process) meaning the outcome of any proposed intervention is variable and unknown.

Timeliness	- Will likely slow down councils' existing objective and limit setting process by diverting council resources. Multiple processes with multiple councils will take central Government time to complete.
Fairness	**0** Depends on outcome of intervention, but allows for local and individual circumstances to be heard through schedule 1 process, so may result in fairer outcome.
Efficiency	- - Will likely slow down councils' existing objective and limit setting process by diverting council resources. Multiple processes with multiple councils will be inefficient for central Government.
Principles of the Treaty of Waitangi	**0** Depends on the outcome of the process. However, would likely prevent further contaminant discharges into waterways which would help protect them for cultural use (eg, mahinga kai), but also potential to restrict development of Māori-owned land.
Te Mana o te Wai	**0** Depends on the outcome of the process. However, may allow space for Te Mana o te Wai to be more fully recognised in freshwater planning processes.
Overall Assessment	- Likely to be worse than status quo as will divert council resources away from objective and limit setting process, and require significant central government resources for an uncertain outcome.

Indicative Social Impacts

Health

- Difficult to assess: likely similar or marginally better than option 1 (status quo).

Environment

- Difficult to assess: likely similar or marginally better than option 1 (status quo).

Cultural identity and social connection

- Difficult to assess: likely similar or marginally better than option 1 (status quo).

Options ruled out of scope, or not considered

Central government sets interim discharge limits

In its third report in 2012 the Land and Water Forum (LAWF) recommended regional councils set interim discharge limits and targets to help manage water quality prior to the full, community-focused objective and limit setting process required by the NPS-FM.

In its May 2018 report, LAWF decided that in the current freshwater planning context, setting interim limits would be impractical when full limits are required by 2025, and that councils are better investing in the full limit setting process.

LAWF also ruled out recommending central government set national discharge limits for similar reasons.

Option 4 (amending the NPS-FM) is silent on what type of interim rules councils would be required to set (this would be up to the council) and therefore wouldn't preclude a regional council setting interim limits. However, we agree with LAWF's assessment, and for this reason have ruled out setting national limits (eg, via an NES).

Guidance and direct support to councils

Guidance and direct support was ruled out of scope as the focus of this proposal is to provide a regulatory framework to manage intensification. We consider the outcome of guidance (which is

voluntary) or support (eg by helping councils through planning process) will not have the regulatory teeth required to improve intensification management in the meantime.

This does not rule out direct support to councils as part of the wider implementation support package for *Essential Freshwater* initiatives. This is discussed elsewhere in the regulatory impact analysis.

National Planning Standards

National Planning Standards (planning standards) are a new RMA tool that aims to standardise the structure and format of RMA plans and provide some standard content. We have ruled these out of scope as the first set of standards focus mostly on plan structure and definitions (rather than plan content), and will take up to 7 years to implement.

Recommendation

We recommend Option 3: Regulations in an NES.

We consider this option provides the most practical, enforceable and timely way to prevent further degradation to surface and ground water bodies from increased contamination caused by agricultural intensification.

Other options are either too uncertain (amending the NPS-FM and Ministerial intervention) or will take too long to fully implement (all other options), by which time water quality may degrade further.

Stakeholder views

The recommended approach partly aligns with the Freshwater Leaders Group's recommended approach to either prohibit or require non-complying consent for land use change in over-allocated catchments. It goes further than the FLG recommendations by applying to a larger area of the country and including more activities, but does not set as high a bar as the FLG recommendation as the proposed land use change regulations set a discretionary rather than non-complying activity status.

We consider the recommended approach covers a broader range of intensification activities than those proposed by the FLG, and that by having a greater coverage it will reduce the risk of agricultural intensification avoiding regulation, by targeting areas outside of over-allocated catchments which may be a perverse outcome of the FLG proposal.

The Regional Sector Water Subgroup has raised concerns that this approach will be difficult for councils to monitor compliance with, and that for land-owners applying for consent will be challenging as it will be difficult to model changes in all contaminant discharges. We will explore how we might address these issues through the public consultation.

Kāhui Wai Māori favour the moratorium option. As demonstrated in the above analysis, we consider a moratorium would likely be effective at preventing further intensification once implemented, but would take too long to implement due to the need to pass legislation to amend the RMA and collect the discharge information necessary to ensure compliance with the moratorium.

Some industry groups recommend more of a guidance-based approach, while environmental non-government organisations (NGOs) tended to prefer stronger regulation, and regulatory 'teeth' to manage agricultural intensification.

Summary table of costs and benefits of the preferred approach

Note: The costs and benefits in this analysis are mostly *opportunity* costs and benefits. Costs are largely in the form of future *benefits foregone* (ie, revenue from a higher intensity operation) and benefits are largely in the form of future *costs avoided* (ie, further contaminant discharges from more intense agriculture).

This will differ slightly to the costs and benefits assessed for other proposals, many of which will be direct costs to individuals/organisations/the wider public.

Affected parties *(identify)*	**Comment***: nature of cost or benefit (eg ongoing, one-off), evidence and assumption (eg compliance rates), risks*	**Impact** *$m present value, for monetised impacts; high, medium or low for non-monetised impacts*	**Evidence certainty** *(High, medium or low)*
Additional costs of proposed approach, compared to taking no action			
Regulated parties	No direct costs imposed on farmers wishing to continue farming at current intensity	Low	High
	Additional costs to intensify: • resource consent • cost to obtain discharge data and/or expert opinion/assessment • mitigation costs to keep discharges at current level (eg, improving farm infrastructure, or practices).	~$3000 for individual consent, plus ~$2000 to run Overseer, and additional cost for expert assessments ($000s) but depends on existing level of discharge information. Could be tens of thousands per consent. Total costs across the country will depend on number of consents applied for. Mitigation costs will depend on the type of mitigation.	High
	There are opportunity costs for farmers planning to intensify that now can't – the cost is bigger for farms with lower existing discharges. This will result in income forgone for the entire country.	Income foregone across the entire country is difficult to quantify. It depends on how many farms are intending to intensify and long–term commodity prices –	Medium

		likely to be in hundreds of millions of dollars. Modelling in the Ruamāhanga catchment[413] (Wellington region) shows that conversions can still go ahead for some of the proposed changes (but not others). The opportunity cost (in net revenue) for the catchment is: • **All sheep and beef farms convert to dairy:** $20 million (9 percent) lower with regulations in place, but still about 10 percent more than current net revenue • **All dairy support farms convert to dairy:** $14 million (7 percent) lower with regulations in place, but about the same as current revenue • **All forestry converts to dairy:** $15 million (8 percent) lower with regulations in place (unable to convert to realise gains) • **All forestry converts to sheep and beef:** no change (higher revenue from existing forestry not converting) The opportunity cost to an individual farm	

[413] Although this is a highly rural catchment, we cannot assume that a single catchment is representative of all catchments across New Zealand.

	depends on whether it is intending to intensify, and the production potential of the farm. Modelling for a single sheep and beef farm converting to dairy showed that with the regulations in place: • Earnings before interest and tax (EBIT) would be about $250/ha lower (~$74,000 for the entire farm) (due to lower milk solid production and additional mitigation costs) but still much higher than if it had stayed in sheep and beef (~$2,000/ha vs. ~$600/ha) • The net present value (NPV) of the farm after 20 years would be ~$1million lower (~$500,000 compared to ~$1.5 million) • The internal rate of return (IRR) would still be attractive at 6.8 percent (compared to 8.3 percent). Note: that despite the positive outcome in this scenario – it would still likely require significant debt to finance the conversion, which comes with a certain level of risk (the analysis assumes a consistent	

		dairy pay out, for example).	
	For farmers wishing to intensify there may be a negative effect on general wellbeing (anxiety/mental health), if financial costs of the resource consent process (hearing, appeals, meeting consent conditions) and/or constraints on intensification will affect farm viability or are perceived to affect viability.	Medium	Medium
Regulators	Costs to regional councils to monitor compliance with regulations.	Medium – compliance monitoring would be in the tens of thousands per investigation.	Low
	Costs to regional councils to process resource consents (depends on number of consents) but we anticipate that this regulation will dis-incentivise conversion in the short-term due to the additional costs associated with converting within current discharge limits. Therefore consents to convert within limits would not be significant, unless there was a significant increase in commodity prices.	Low – assume cost covered by application fee.	High
	Costs to regional councils to amend plans to ensure consistency with regulations.	Low	High
	Cost to central government to develop and implement NES regulations.	Low	High
Wider government	May reduce economic development opportunities for provincial growth fund.	High	Low
Other parties			
Total Monetised Cost			

Non-monetised costs	The most significant direct costs will be to regional councils to monitor compliance with the regulations. There will be significant opportunity costs for farmers wanting to intensify.	Medium-high	Medium

Expected benefits of proposed approach, compared to taking no action			
Regulated parties	Prevents lost investment in unsustainable intensification that has to be reversed/abandoned after freshwater objectives and limits set.	Low	Low
	May improve perceptions of the farming community as stewards of the land (building a social licence to operate as stated above).	Low	Low
Regulators	Will make objective and limit setting process less complex/costly as water quality in waterways will be preserved as this process is carried out. Limit setting process will be more difficult, fraught and litigated the more over-allocated a catchment becomes.	Medium	Low
Wider government	Potential benefits to Government's climate change initiatives by preventing further greenhouse gas emissions from increased cattle.	Low	Medium
Other parties	General public benefits from contaminant discharges not increasing as a result of land-use changes, increases in the area of irrigated land and increases in forage cropping (water quality does not degrade further).	Modelling in Ruamāhanga catchment shows the benefits for water quality are: • **All sheep and beef farms convert to dairy:** Nitrogen loss 7 percent lower with regulations in place, phosphorus loss 2 percent lower, minimal difference to sediment • **All dairy support farms convert to dairy:** Nitrogen loss 6 percent lower with regulations in place, phosphorus loss 2	Medium

		percent lower, minimal difference to sediment • **All forestry converts to sheep and beef:** Nitrogen loss 6 percent lower with regulations in place, phosphorus loss 3 percent lower, sediment loss 20 percent lower • **All forestry converts to dairy:** Nitrogen loss 3 percent lower with regulations in place, phosphorus loss 4 percent lower, sediment loss 20 percent lower At a farm level, modelling of a sheep and beef conversion to dairy showed that with the regulations in place the nitrogen discharges avoided were about 7kg/ha (17kg/ha for the farm with the regulations in place, compared with 24/kg/ha without) or about 2 tonnes of nitrogen per year (290ha farm) avoided.	High
	Rural communities (including regulated parties) benefit from increased amenity / pleasantness of valued resources (cleaner rivers and lakes) and increase opportunities for recreation/leisure (eg, fishing, swimming) in the local area where the NES will apply.	Medium	High
	Benefits to cultural identity and social connection in line with New Zealanders' cultural identity and values. Option would benefit the mauri of waterbodies	Medium	High

	where the NES will apply, would better enable farmers to exercise kaitiakitanga/stewardship, would provide increased opportunities for food gathering / mahinga kai as a result of improved ecosystem health.		
Total Monetised Benefit			
Non-monetised benefits	The benefits are largely 'avoided costs' in the form of contaminant discharges to waterways no longer increasing as a result of intensification activities. These benefits are difficult to quantify nationally (eg, X tonnes of nitrogen loss avoided) as it depends on an accurate prediction of future intensification.	Medium	Low

What other impacts is this approach likely to have?

There's potential for the proposed regulations to restrict the rural sectors' ability to adapt to technological, climatic and market changes, particularly for lower-discharging land owners, who will have fewer options for land-use change.

We consider this risk is minimised by the interim nature of the regulations, and that over the longer term, once objectives and limits are set and a new, fairer allocation system is in place, land owners will have the flexibility needed to adapt to these changes. The proposed regulations also allow land-use change within limits, and therefore do provide some flexibility.

Appendix 19: Updating the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010 to require real-time reporting of water use

Context

The Resource Management (Measurement and Reporting of Water Takes) Regulations 2010 established a nationally consistent regime for measuring water use.

As of November 2016, water consent[414] holders for every consumptive[415] consented water take over 5 litres per second are required to:

- have an appropriate measuring device (almost always a water meter) installed;
- have the measuring device independently verified by an accredited company (usually an irrigation engineering firm) to ensure the water meter is calibrated to meet the accuracy requirements in the Regulations; and
- provide a continuous record of water use data to their regional council. This data must be provided at least annually in hard copy or electronic formats.

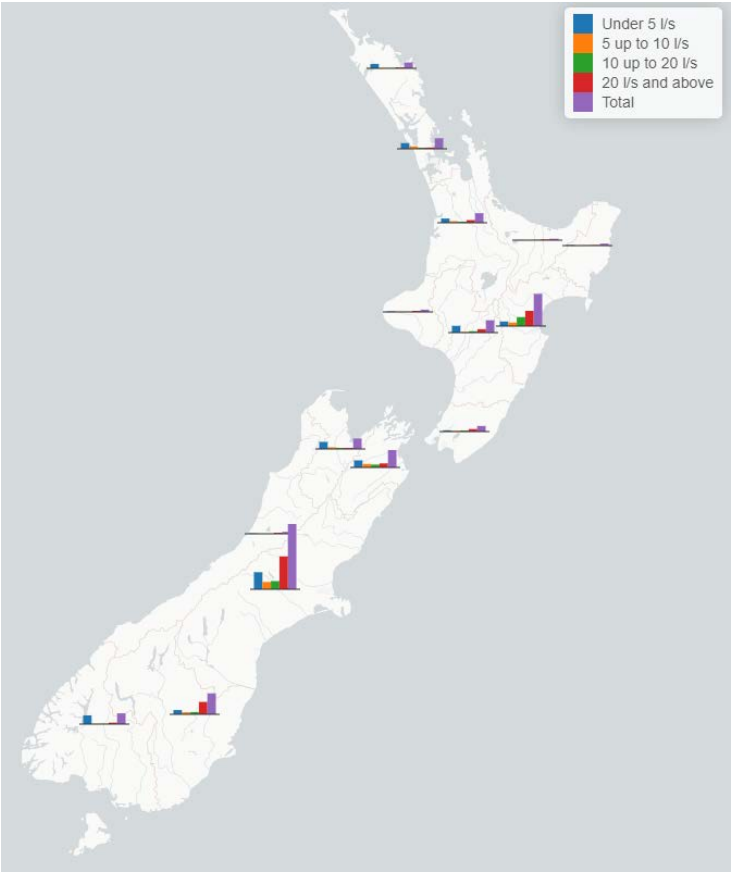
The Regulations provided for a staged implementation to manage demand for water meters and verification services. The Regulations came into effect for water takes of 20 litres per second or more in November 2012, for takes from 10 up to 20 litres per second in November 2014, and for takes from 5 up to 10 litres per second in November 2016.

The geographic distribution of the consents captured by the Regulations is notable. Almost seven in ten consents (69 percent) of 5 l/s or more are found in Canterbury, Hawke's Bay or Otago. These regions all have similar characteristics. They are located on the drier east coast of New Zealand, and have significant groundwater resources that enables intensive land uses such as dairy farming, orcharding and market gardening. This distribution is illustrated in the map below.

[414] Also called water permits interchangeably.

[415] The Regulations exclude non-consumptive consented uses of water, which are defined in Section 4(2). Non-consumptive uses include most hydroelectric electricity generation, as water is not extracted from the source and so remains available downstream.

Distribution of water consents with known rate of take by region[416]



Source: lawa.org.nz, February 2018 extract. For a more complete breakdown of this data, see 'Summary Information on Water Consents' at the end of this section.

Some regions reported slow initial compliance with the Regulations.[417] This was primarily because of the lack of accredited companies available for both the installation and verification of meters. While this issue appears to have been mostly resolved, meter installation and verification is not seen as lucrative by industry. This means that while a level of service is available, it can be slow in areas with minimal competition between providers.

We consider that the level of service for installation and verification is now acceptable, and meets the intent of the Regulations. However, the data water users are providing to councils is not of sufficient quality to meet the intent of the Regulations. Data is also not currently provided in a timely fashion. These issues need to be addressed.

The problem/opportunity

The Regulations are relatively permissive in terms of reporting water use to the relevant regional council. While they require a continuous record of water use (expressed usually as a daily total), they only require this data to be reported to the council once a year at minimum. Most councils require more frequent reporting for compliance monitoring of water use, generally for their larger consents.

[416] Data for Bay of Plenty is known to be incorrect, with approximately 1,300 consents known but not captured through lawa.org.nz. This is being addressed.

[417] This is described well by the Auditor-General's May 2018 report: https://www.oag.govt.nz/2018/irrigation/part2.htm

In addition, the Regulations allow for a range of methods of reporting, and these records can be in either hard copy or electronic formats. In practice, reporting ranges from hand-written records being posted to the council, to excel spreadsheets being emailed, to real-time time data being sent electronically directly to councils.

Experience from councils show that data quality and timeliness is a key issue. Missing water use records, suspicious looking totals (eg, exactly the same amount of water being taken every day) and tardiness of reporting from some users have all been identified as issues. These issues reduce the ability of councils to use this data effectively for compliance, monitoring and enforcement (CME) work and for the management of minimum flows in rivers and groundwater levels affected by water use.

At a national level, New Zealand lacks reliable national estimates of water use. Through the Environmental Reporting programme, the Ministry and Stats NZ currently report on how much water has been consented to be used. However, data collected under the Regulations is not of sufficient quality to provide robust national estimates of actual water use. This is a significant knowledge gap for water management and policy, especially in light of increasing demand for water. For example, irrigation currently accounts for around two-thirds of water extracted for use in New Zealand. The area of irrigated agricultural land in New Zealand almost doubled between 2002 and 2017, from 384,000ha to 747,000ha, an increase of 94 percent.[418]

In their May 2018 report *Monitoring how water is used for irrigation*, the Auditor-General made four recommendations, the first of which refers directly to the data quality and timeliness issues identified above.[419] Specifically, the Auditor-General stated "There are opportunities for councils to improve the quality of their data. Electronically collected and telemetered data (data that is transmitted from a sensor to, for example, a computer server) can be timely and less costly to process than data that is collected or sent to councils manually. Although progress has been made, councils need to work closely with permit holders to improve the reliability of water meter data. It would be useful to review the Regulations to encourage permit holders to provide timely and complete data to councils to assist with their monitoring of water takes."

The Ministry agrees with the assessment of the Auditor-General. The preferred option in this regulatory impact analysis addresses this first, main recommendation regarding telemetry. In addition, the preferred option sets up the Ministry and regional councils to address the remaining recommendations. These recommendations relate to improved timeliness and completeness of water use records, improved use of these records for compliance monitoring, and evaluating how water use is influenced by metering.[420]

Constraints on the analysis

Purpose of this Regulatory Impact Analysis (RIA)

This RIA is designed to demonstrate policy analysis to date, and to establish an information base for the Essential Freshwater consultation process. Limitations in the analysis around the impact of the

[418] https://www.stats.govt.nz/indicators/irrigated-land

[419] The OAG Recommendation 1 is as follows: "the Ministry for the Environment review the part of the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010 that allows for manual data collection and annual data provision, and work with councils that have oversight of water metering, to ensure that people and organisations holding water permits regularly submit accurate data using automated processes" https://www.oag.govt.nz/2018/irrigation/our-recommendations

[420] https://www.oag.govt.nz/2018/irrigation/our-recommendations

proposed option are intended to be remedied through information gathering from submitters in the consultation process, and then subsequent, detailed workshopping with regional councils.

Data, information and impact analysis limitations

There is currently insufficient information about current telemetry practices nationwide to provide a comprehensive marginal cost analysis for the proposed option. Analysis to date shows there is a clear trend that the costs of meters, telemetry units, data transmission and storage are falling, often quite rapidly. Uptake of telemetry also appears to be increasingly driven by councils at consent renewal, but it is not clear if the quality of this telemetry would meet the requirements of the preferred option. This dynamic operating marginal costs to users and councils are unclear. As a result, this analysis adopts conservative estimates based on all consents, instead of those not already telemetered. In addition, our estimate of the number of users not currently covered by cellular network (and so requiring more expensive options like wireless or satellite internet to meet the proposed option) is particularly cautious.

Minister's views

On 25 October 2018 we briefed the Minister for the Environment on our preference for updating the Regulations, primarily by requiring real-time electronic reporting of data from the meter to councils for all consents currently captured by the Regulations. Responding to the brief, the Minister queried whether a focus on largest category of takes (20 l/s and above) could be the only category to have mandatory telemetry. We have included this option in our analysis.

Wider work programme linkages

This proposal complements the CME work programme at the Ministry for the Environment.[421] Amending the Regulations will assist councils improving their monitoring practices by enhancing the ability for transparent monitoring of water use.

In addition, the preferred option supports the freshwater accounting and limit setting requirements under the National Policy Statement for Freshwater Management[422] and will provide robust water use estimates for Environmental Reporting.

Options

Objective

This proposal's objective is to help improve the quality and timeliness of water use data for use in water management, regional and national policy and environmental reporting, and for enhancing compliance, monitoring and enforcement related to water takes.

Summary assessment

Criterion	Option A: Apply mandatory telemetry only to all water consents 5l/s or more	Option B: Apply mandatory telemetry to all water consents of 20 l/s or more
Effectiveness	+	0
Timeliness	+	++

[421] http://www.mfe.govt.nz/rma/compliance-monitoring-and-enforcement

[422] Section CC and Policy B1 respectively, found here: http://www.mfe.govt.nz/publications/fresh-water/national-policy-statement-freshwater-management-2014-amended-2017

Fairness	+	-
Efficiency	++	+
Principles of the Treaty of Waitangi	**0**	**0**
Te Mana o te Wai	+	**0**
Overall Assessment	+	**0**

Option A: Apply mandatory telemetry only to all water consents 5l/s or more (proposed)

This option would mandate electronic transmission of data (telemetry) for all water take consents captured by the current Regulations.

Specifically, it would require that the Regulations be amended to mandate that: measurements of water takes must occur every fifteen minutes (or daily via written council approval); water take records be kept in a form suitable for electronic transmission and storage; consent holders must provide daily electronic records to the council that granted the consent; and these daily electronic records must be provided to the council no later than one day after the end of the day in which the water was taken.

In addition, the requirement for daily electronic record transmission would be staggered, being required for consents of 20 l/s or more two years after the Regulations come into force; required for consents of 10 l/s up to 20 l/s four years after the Regulations come into force; and required for consents of 5 l/s up to 10 l/s six years after the regulations come into force.

This staggered approach will provide time for regional councils, water users and industry providers to adapt and manage the demand for the installation of telemetry units and manage other implementation issues that will arise. Ministry and council experience shows that staggered implementation of the 2010 Regulations proved an effective tool in their initial implementation, managing costs and risks fairly effectively for the installation and verification of water measurement devices.

Once the Regulations are in force for a particular consent, the data must be recorded by the water measuring device, then the record transmitted electronically to the regional council who issued the permit. This transmission may occur via a third-party provider who handles the data on behalf of the consent holder and regional council. It is envisaged the Ministry for the Environment would provide guidance documents for ensuring quality of transmission and storage of data to regional councils and industry telemetry providers. These guidance and standards would focus on ensuring the recorded data is auditable, which is required in Section 6(5). This guidance would complement industry accreditation for water meter installation and management run by Irrigation NZ.[423]

How this option will improve data quality and timeliness

This option will mean that all water consents currently captured by the Regulations will, by default, report water use automatically electronically. This will remove paper-based or manual electronic reporting that can currently be used to submit metered data to councils. The Auditor-General states that:

"3.10 Manually collected or submitted data also causes significant issues with data quality. Although more water meters, such as telemeters, enable automated data collection, there are still many

[423] https://www.irrigationnz.co.nz/Category?Action=View&Category_id=240

instances where data is collected manually. This can include handwritten meter readings that are submitted electronically and information recorded and submitted in spreadsheets. This can lead to poor quality data, for example, if handwritten meter readings are misread.

3.11 Other errors, such as misreading meters, can also contribute to poor-quality data. In our view, manual data collection is an issue that affects councils' administrative costs and the quality of data and how it is used to analyse consumption and monitor and enforce compliance." [424]

Telemetered data has the ability to be queried and checked for errors in near real-time. These data are able to audited in a way that manual records are unable to be. In addition, telemetered data is by nature more timely than manual reporting. The metered data is sent automatically, rather than requiring a water user to physically check the meter, then send the record of the amount metered. We estimate telemetry will save water users on average 30 minutes a week in checking and sending water use records to their council.

This improved quality and timeliness increases the confidence in the data, which in turn means it can be used for a much wider range of purposes. For councils and central government, it can be used for compliance monitoring, resource limit setting, environmental policy setting and for state of environment reporting. For water users, applications like enhanced irrigation scheduling can occur when used in conjunction with real-time soil moisture probes. This can reduce electricity costs from pumping water, prevent over-irrigation of land (and so reduce nutrient leaching), and save the water user from using their allocation up when not required. This last point is especially important for irrigators with weekly or monthly consented water use limits, as it may enable them to irrigate on days where they would have normally run out of water, having met their limit earlier in the week or month.

Technologies to support telemetry of water use data

The specific methods by which data can be sent cannot be prescribed, as Section 360(1)(d) RMA regulations preclude this level of specificity. In any case, too much specificity also precludes technological advances that may not be able to be anticipated.

While specific technologies cannot be specified in the Regulations, there are three main data transmission technologies that can, and have, been deployed to enable telemetry from water meters in New Zealand. These technologies are outlined below, alongside emerging IoT (Internet of Things) technologies. When analysed together, there are sufficient options currently available, or in development, that mean all consent holders should be able to transmit their water use records electronically. For this analysis we have conservatively assumed a need for 5mb/day of water use data per telemetry unit. This is at the top end of data requirements based on our discussions with councils to date.

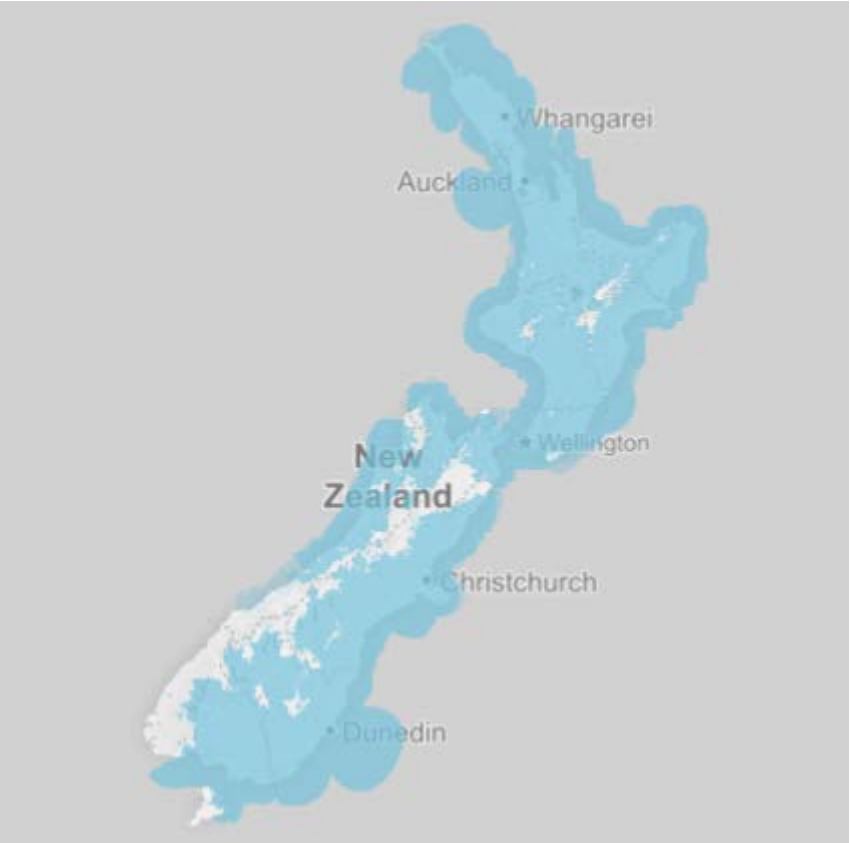
Wireless

Wireless, also known as Fixed Wireless, uses radio waves to transmit data. Users need an antenna somewhere on their property that has line of sight to a provider's radio mast. Establishing if a user can get Wireless can be complex because there are many local features that may obstruct the signal. For example tall buildings or trees can block the line of sight needed. Nevertheless, Wireless is commonly used in rural areas, and coverage issues have been overcome due to the demand for quality internet access in rural and remote areas.

[424] https://www.oag.govt.nz/2018/irrigation/part3.htm

Internet NZ states there is already significant deployment of Wireless internet, covering most of New Zealand. There is also further planned supplemental extensions of coverage, mostly into remote river valleys and coastal areas with particularly steep topography. This deployed and planned coverage is shown in the map below.

Deployed and planned fixed wireless internet coverage in New Zealand



Source: https://broadbandmap.nz, 3 May 2019

Wireless internet connections vary significantly in their installation costs for users, especially if a new aerial is required. Horizons Regional Council estimate that a new aerial can cost around $3,000 to install, though this can service many users. We do not have firm installation costs available for this analysis for individual water users, but if these exceed $1,500, then Satellite Internet (discussed below), which is available nationwide, likely becomes cheaper. Monthly charges for wireless broadband are currently approximately $40 for the mid-range low data use plans.

Cellular

Cellular broadband is how mobile phones access the Internet, using third or fourth generation (3G/4G) standardised mobile communication technologies. Most current telemetry systems use 3G or 4G to transmit data, so installation costs are negligible compared to other options. Nationally, 3G is well established, and 4G is in the process of being rolled out across the country. The main limitation with the cellular network is coverage in rural areas. Adequate 3G coverage for data transmission covers 97 percent of the New Zealand population, but only approximately 50 percent of New Zealand's landmass, with remote rural or wilderness areas having the poorest coverage.

Monthly costs are approximately $20-$30 per month on current plans, though this is likely to continue to decrease as it has over the past decade.

Satellite

Satellite broadband internet uses a fixed dish that talks to a satellite in orbit around the Earth. It functions like a terrestrial broadband connection but as with all satellite communication it is subject to a delay called 'latency' as the information travels to and from the satellite. This type of connection has noticeable delays (0.6 seconds or so) with voice or video conversations. Some satellite connections can also be affected by adverse weather conditions. For telemetry, latency is not a significant issue, as the data packets are relatively small and do not require fast response times.

Satellite broadband works like television products Sky HD or Freeview HD, which both report near 100 percent coverage of New Zealand. Internet NZ states that if a property can get satellite TV then it should normally be able to get satellite internet.

Satellite broadband is the most expensive option, due to high installation costs (around $1,500 currently) and monthly fees for data (at least $99 for 10GB of data). However, these costs are expected to fall, and improved coverage by other technologies may mean that satellite broadband may be superseded as the most cost-effective for remote water users.

Other emerging technologies – the 'Internet of Things' networks

The development of 'Internet of Things' (IoT) networks is a new and rapidly evolving option. IoT networks use long-wave length, low power bandwidths to send small packets of data when needed. This is analogous to AM radio. While of lower quality, longer wavelengths can navigate around buildings, trees and steep topography more easily than FM radio can. Further analysis is required on IoT applicability to water metering, as coverage is limited to urban and adjacent rural areas currently. However, this coverage will expand in the next 2 to 5 years, and could mean a significant cost reduction for water users using this technology. It is understood that application for telemetering water use is already developing, specifically for irrigators wanting to know about water use at multiple points on their farm.

The IoT low power, long range functionality will come standard to the eventual upgrade of New Zealand's cellular network to 5G. No roll-out timetable is currently available, but indications are that within the next decade IoT coverage on the 5G network will be widely available in New Zealand.

Summary of available and upcoming technologies to support mandatory telemetry of water use records

The number of technologies and coverage currently available to support telemetry is sufficient to cover water-use consents in New Zealand. The major risks of high costs to users or councils will be mitigated with a staggered implementation of the Regulations from larger to smaller consents. Experience with 2010 Regulations showed that focussing on larger consents earlier helped the water metering industry to establish and bed in. This helped smooth out systems and reduce costs for water users with smaller consents. In the case of telemetry, there is the added advantage that larger consents (those 20 l/s+) tend to be on flat areas with good wireless or cellular coverage, and so have access to the widest range of telemetry.

Regional Impacts

The alluvial plains of Canterbury and Hawke's Bay are relatively flat, and so have good cellular coverage currently. Otago has more varied topography, with significant areas lacking cellular coverage. However, Otago has relatively high use of telemetry currently (around 60 percent of active consents), indicating that coverage through wireless, cellular or satellite technologies is sufficient.

Gisborne, Northland, Bay of Plenty and West Coast cover a significant area, yet have relatively few consents that are captured by the Regulations. Without the economies of scale available due to

relatively few water users, these regions may find it difficult to implement the Regulations without assistance via collaboration with other regions.

In addition, the Ministry agrees with the Auditor-General's comment that 'there are opportunities for councils to use data and work together to support permit holders to change to more efficient forms of water use'. The Ministry intends to co-ordinate knowledge and sharing practices among regional councils with a view to reduce costs for councils with less experience in this matter, and ultimately to promote an overall more efficient use of freshwater across New Zealand.

Criterion	Option A: Apply mandatory telemetry only to all water consents 5l/s or more
Effectiveness	+ This option strikes a good balance between costs on users, and providing enough information to calculate total impact on consumptive takes on water bodies for regional and national needs. Ideally, all consented and permitted takes would be metered, but the costs, impacts and benefits of doing so cannot be adequately assessed at this stage.
Timeliness	+ A staggered implementation of daily electronic reporting will mean a longer lead-in time, but will help reduce the risk of high inital costs on remote users with limited ability to transmit water use records electronically.
Fairness	+ This option is relatively fair as it applies to all water users currently captured by the Regulations, but gives more time to smaller takes to adapt to telemetry. Council experience with the original Regulations has shown that the staggered implementation of meter installation and verification mean that costs lessened over time as the installer market matured and became more efficient.
Efficiency	++ The rapid reduction in the cost of water meters, telemetry units, data transmission and data storage in the past decade means that costs are now reasonable for the private benefit derived from access to the publicly managed water resource.
Principles of the Treaty of Waitangi	**0** This option appears relatively neutral in regard to the Principles of the Treaty of Waitangi. Māori interest in promoting Te Mana o te Wai seems more applicable in this instance.
Te Mana o te Wai	+ Having timely, good quality information on water use will enhance our ability to achieve Te Mana o te Wai. Without good data, we will not know the real-time pressure on the water resource and aquatic ecosystems.
Overall Assessment	+ Amending the Regulations will see their original policy intent met. Not covering smaller consented takes (ie those less than 5 l/s) and unconsented permitted takes is a limitation in terms of a complete view of water use. However, information is too sparse on these smaller takes to adequately assess the impact of extending the Regulations to these takes.

Option B: Apply mandatory telemetry to all water consents of 20 l/s or more (rejected)

Option B works identically to Option A but only applies to the largest category of consents, those with consents of 20 l/s or more. While this covers the majority (60 percent) of current consents 5/ls and over, it will only provide patchy coverage of consents in many catchments outside of Canterbury, Hawke's Bay, Otago and the Manawatu plains. At best, this option provides a partial analysis of water

use pressures. Modelling commissioned by the Ministry shows that environmental context, or where water is taken from, is important. Many smaller water takes are on small streams, and can potentially have a large effect during low flows.[425]

It should be noted that telemetry is already used for some very small takes (1 l/s) in some councils as it is considered a cost effective measure to ensure that consent conditions are met.[426] By mandating telemetry to the current scope of the Regulations, this help create a norm amongst water users that consented water is metered and telemetered. This norm can therefore be applied, with proper council officer judgement, to takes currently outside the current Regulations (permitted takes and consented takes under 5 l/s).

Criterion	Option B: Apply mandatory telemetry to all water consents of 20 l/s or more
Effectiveness	**0** In some regions many of their largest consents are already telemetered, but by focussing on these larger consents, the overall pressure on a water body is difficult to calculate. This limitation makes the effectiveness of this option approximately equal to the status quo.
Timeliness	**++** This option can be implemented quickly, within 2 years of the Regulation coming into effect.
Fairness	**-** Targeting only the largest takes may be seen as unfair. The relative cut-off of whether metering or telemetry was queried by the Minister for Climate Change at Environment Select Committee in February 2019.
Efficiency	**+** Many of the largest consents already have telemetry. It is likely that this change would therefore mop-up the final larger consents. These are likely to be in regions where telemetry is not widely used already.
Principles of the Treaty of Waitangi	**0** This option appears relatively neutral in regard to the Principles of the Treaty of Waitangi. Māori interest in promoting Te Mana o te Wai seems more applicable in this instance.
Te Mana o te Wai	**0** Having good but patchy information on water use will only enhance our ability to achieve Te Mana o te Wai where water resources are impacted by predominantly larger water takes.
Overall Assessment	**0** Requiring only the largest of water takes to be telemetered will provide some slight improvements to the Regulations. However, it will possibly reinforce the data quality issues currently faced, with takes of less than 20 l/s still with highly variable data quality.

[425] http://www.mfe.govt.nz/publications/fresh-water/national-water-allocation-statistics-environmental-reporting

[426] This is now standard practice at Waikato Regional Council for new consents. Water users are given the option to install telemetry to meet consent conditions for any sized water take. The significant majority are doing so as it reduces the compliance burden on the water user having the reporting done automatically.

Options ruled out of scope, or not considered

We have not considered an option that explicitly includes permitted takes for this analysis. Permitted takes are defined as those for reasonable domestic use, or for animal drinking water.[427] Permitted takes do not require consents, though some councils choose to consent permitted takes as a matter of regional policy. Unconsented permitted takes fall outside of the current Regulations. Too little consistent national information exists on these takes for robust analysis to be undertaken to assess the impacts on water users, councils and the environment. Because of these reasons, analysis of permitted takes has been deemed out of scope.

We have also not considered expanding the scope of the Regulations to consented takes of less than the 5 l/s threshold. While some councils would like to see this threshold lowered, discussions with other councils indicate this would increase council staff costs substantially for benefits that would be difficult to quantify.[428] During the August 2018 Irrigation NZ Water Meter Telemetry Master Class there was general consensus that 5 l/s is currently around the right level to impose metering requirements on consented takes.[429] It was also noted that with falling costs, this threshold be reviewed after telemetry has been applied to all currently metered takes. This review would therefore take place 6 years after the the updated Regulations come into force.

Overall, the relative impact of permitted takes and consented takes under 5l/s is unknown nationally. There have been some regional analyses, and anecdotal evidence to suggest the environmental impact of these takes are significant in some areas. However, with relatively poor information available, we are not able to adequately assess widening the scope of the Regulations at this time without significant assumptions. More research is required to fill this knowledge gap, and the six year staggered implementation in the proposed option provides a sufficient amount of time to undertake the analysis required.

Recommendation

We recommend Option A, as it is likely to best address the problem of poor data quality impeding good water use management and policy development. It will meet the original policy objectives of the Regulations as intended in 2010. Option A will deliver the highest net benefits, providing the quality of data required for a wide range of policy, management, reporting and research needs.

Option B is superior to the other options analysed. We have medium to high confidence in the assumptions made and evidence we have to hand.

What do stakeholders think?

Stakeholders consulted to date have unanimously supported changing the Regulations to mandate telemetry. Any queries or concerns have been on technical matters, not on the overall policy intent. Through the post-consultation policy development process, these technical matters can be addressed. Open-ended questions about technical matters will be included in the consultation process for technical matters to be raised.

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[427] http://www.legislation.govt.nz/act/public/1991/0069/latest/DLM231973.html

[428] Marlborough has explicitly stated so with an estimated 40% of its consented takes below 5l/s

[429] https://www.irrigationnz.co.nz/Event?Action=View&Event_id=86

Water users and Industry Bodies: Two-thirds of consents are for irrigation in New Zealand.[430] The main stakeholder group identified is Irrigation NZ, the peak body for the irrigation industry. Irrigation NZ supports the proposed changes, and considers further changes around tamper-proofing of water meters could also be warranted.

The remaining major users, domestic and industrial users, are predominantly not directly captured by the Regulations. This is because the majority of water is supplied for these uses through the local municipal supply resource consent, so one meter captures many hundreds or thousands of users. These very large takes have stringent monitoring and reporting requirements, consistent with but beyond what the Regulations require. Approximately 87 percent of New Zealanders are on a municipal supply for drinking water.[431] The percentage of industrial users on a municipal supply is unavailable, as industrial users may use both water from the municipal supply and their own consented takes for different purposes.

Approximately 95 percent of affected water sue consents have been individually identified through data held by the Ministry for the Environment, which is publicly available.[432]

Domestic and industrial users not connected to a municipal supply make up 8 percent and 5 percent of consents respectively. The remaining 21 percent of consents are categorised as 'Other' use. 'Other' use comprises consents for stock watering, frost protection, combined/mix, not specified, or other. Further analysis shows that most 'Other' use consents are for agricultural purposes.

It should be noted that RMA Section 14(3)(b) specifically does not prohibit the taking of water for "(i) an individual's reasonable domestic needs; or (ii) the reasonable needs of a person's animals for drinking water". The Regulations to not apply to these takes, as they are generally less than 5l/s and do not specifically require a resource consent.

Regional Councils: There is overall support from regional councils for mandatory telemetry. Feedback from the August 2018 Irrigation NZ Water Meter Telemetry Master Class was supportive, and mostly focussed on technical issues or clarifications if mandatory telemetry was in place. In addition, we have discussed the changes with three regional councils directly - Marlborough District Council, Horizons Regional Council and Greater Wellington Regional Council. There was agreement from all about that mandatory telemetry is a sensible next step for the Regulations. We also have drawn from the Auditor-General's discussions about telemetry. These councils are Northland Regional Council, Hawke's Bay Regional Council, Otago Regional Council, Bay of Plenty Regional Council and Environment Canterbury.

Central government agencies: The Department of Conservation and the Ministry for Primary Industries are supportive of the introduction of mandatory telemetry. The Electricity Authority support the changes, and go further, recommending open data, monitoring flow sites alongside water takes, and centralising data management systems for telemetered water use data.

Environment Select Committee: On 21 February 2018 the Ministry presented to the Environment Select Committee, responding to the recommendations of the *Monitoring how water is used for*

[430] http://archive.stats.govt.nz/browse_for_stats/environment/environmental-reporting-series/environmental-indicators/Home/Fresh%20water/consented-freshwater-takes.aspx

[431] https://www.oag.govt.nz/2010/water/part1.htm

[432] https://data.mfe.govt.nz/table/53613-primary-use-and-source-of-consented-freshwater-takes-201314/

irrigation report.[433] The Committee was supportive of the approach proposed by the Ministry, querying only the fairness of imposing telemetry on consented but not non-consented water users (Hon. James Shaw, Green Party) and the potential costs on water users (Hon. Todd Muller, National Party).

Essential Freshwater working groups: Freshwater Leaders Group is supportive of the proposed changes. The Integration Group expressed a view that an annual volume as well as an instantaneous rate should be used for assessing whether the Regulation apply, so that water users who take a lot of water but at a low rate should be required to have telemetered water meters. Kahui Wai Māori have been informed of the changes and have not provided specific comment. However, mandatory telemetry is consistent with their views on how consumptive water should be used and managed.[434]

Summary table of costs and benefits of the preferred approach

Please refer to the constraints section for the reasoning behind the conservative costs estimate provided below, which is likely to be at the upper end of costs. Through consultation, we will gather further information to refine these estimates so marginal costs can be calculated.

Affected parties	Comment:	Impact	Evidence certainty
Additional costs of proposed approach, compared to taking no action			
Regulated parties	**Users with cellular coverage (assumed to be approx. 80 percent of users)** Total users ~8,000 to 9,500 The cost of telemetry installation and calibration currently ranges from $600 to $1800 per telemetry unit for users with current 3G/4G cellular access. Assume telemetry units are replaced every five years. The monthly cost of transmission amounts to $20-$30 month (ie, $300/year on average).	Approximately $1350 per user for an upper-quartile cost telemetry unit, or $270 per year over 5 years Approximately $300/year per user Upper bound estimate = $570 per annum for 8750 users Annual costs = ~$5 million	High

[433] https://www.facebook.com/environmentSCNZ/videos/581622295635298/

[434] Paragraph 67, Te Mana o te Wai: The Health of our Wai, The Health of our Nation - Kahui Wai Māori Report to Hon Minister David Parker, April 2019

	Users with insufficient cellular coverage (assumed to be approx. 20 percent of users) Assume the use of satellite internet at current prices. Total users ~2,000 to 3,500 With almost guaranteed coverage satellite internet represents the upper end of costs for water users. Currently satellite internet costing $1499 to install and $99 monthly for data. Conservative assumption that this only applies to the meter, though this is unlikely. Assuming the same cost for unit installed and calibrated amounts to $1350 or $270 a year over 5 years, as above. Satellite installation currently costs $1,500 to install. Assume this over a five-year period. The cheapest satellite internet currently costs $99 per month	Approximately $1350 per user for an upper-quartile cost telemetry unit, or $270 per year over 5 years $300 per year $1188 per year Upper bound estimate = $1758 for 2,750 users = ~$4.8 million annually Total annual costs of telemetry for all water users = ~$9.8m annually	
Regulators	Regional councils already incur significant costs in compliance visits to water meters and management of water use data. The relative marginal cost of adding telemetry to their current system may be mostly related to managing third-party data service providers, and to managing data transmitted. In the case of Horizons this costs approximately $180,000 annually. Further information to be gathered through consultation is required to adequately cost the impact of mandatory telemetry.	As Horizons accounts for 4.1 percent of consents, applying this costs structure to all of New Zealand would incur a total cost of ~$4.4m annually	Low/ Medium
Wider government	Costs of analysis and dissemination of data	$100,000 annually	High

Total Monetised Cost	*Total costs to water user (conservative, upper bound estimate)*	$14.3 million annually	
Non-monetised costs	*No non-monetised costs*	*(High, medium or low)*	

Expected benefits of proposed approach, compared to taking no action			
Regulated parties	Greater accuracy in the monitoring of water takes is likely to enable some water users to use more of their consented water, as they will know when they are closer to their daily cut-off. Mandatory telemetry will contribute to greater reliability of access, particularly important during periods when supply is short. These periods are likely to increase in frequency as a result of climate change. Mandatory telemetry for groups of people rather than individuals. This would enable water sharing, improving reliability of supply. Evidence from current New Zealand water user groups shows this also enhances social regulation of resource use in rural communities, and contributes to a stronger cultural identity based on stewardship of natural resources.	Non-monetised	Medium
Regulators	It is understood from regional councils with extensive use of telemetry that this option provides the most benefits in terms of: • water use efficiency • setting allocation and low flow restriction policies and operational practices • efficient use of council resources, particularly regarding compliance, monitoring and enforcement • greater ability for integrated surface and groundwater management.	Non-monetised	High

Wider government	Robust data on actual water use available for policy and environmental reporting.	Non-monetised	High
Total Monetised Benefit	Not identified in this analysis	-	-
Non-monetised benefits	Better quality and coverage of information on water use that will benefit both water users and water managers/regulators.	-	High

What other impacts is this approach likely to have?

No other specific impacts have been identified as part of this analysis.

Summary Information on Water Consents

Active Water Take Consents by Rate of Take By Region, 2018/19								
Region	Under 5 l/s	5 up to 10 l/s	10 up to 20 l/s	20 l/s and above	Total	Percentage of national metered consents	Total 5 l/s+ requiring metering	Estimated percentage of consents 5 l/s+ currently telemetered
Northland	350	38	23	60	471	1.1%	121	10%
Auckland	457	194	92	102	845	3.4%	388	9%
Waikato	339	126	88	213	766	3.7%	427	24%
Bay of Plenty*	Not reported				1,379	6.3%	720	16%
Gisborne	62	29	26	43	160	0.9%	98	32%
Taranaki	56	28	15	84	183	1.1%	127	63%
Manawatu-Wanganui	544	61	109	274	988	3.9%	444	46%
Hawke's Bay	366	280	718	1,221	2,585	19.4%	2,219	41%
Greater Wellington	98	62	90	200	450	3.1%	352	43%
Tasman	568	130	69	68	835	2.3%	267	19%
Marlborough	569	277	227	325	1,398	7.2%	829	61%
WestCoast	48	19	10	77	154	0.9%	106	Not reported
Canterbury	1,366	582	651	2,628	5,227	33.7%	3,861	69%
Otago	344	162	182	992	1,680	11.7%	1,336	80%
Southland	703	25	18	116	862	1.4%	159	78%
Total	5,870	2,013	2,318	6,403	17,983	100.0%	11,454	~53%
Source www.lawa.org.nz (February 2018) and Regional Council Estimates (April 2019)								
* sourced directly from BOPRC. LAWA Data incorrect. Only some data available								

Appendix 20: Stock exclusion

Context

In November 2015 the Land and Water Forum (the Forum) responded to the then Government's request to provide recommendations on the design of a stock exclusion regulation.[435] The Government consulted on proposed regulations for stock exclusion in early 2017.[436]

Ultimately the regulations were not progressed because of concerns from the primary sector about the workability of the regulation, mainly in respect of the three slope categories and how they applied to various stock and water bodies.

In 2018, the current Government announced its freshwater reform programme (Essential Freshwater - October 2018) where it signalled that stock exclusion would again be considered as part of improving freshwater.

The problem

The state of water bodies in terms of sediment, nutrients and *E. coli* (an indicator for the likely presence of pathogens) is described in section 2.

Livestock entering water bodies contaminate the water directly, and damage the banks of the water body. This is particularly serious with heavy livestock (cattle and deer) and pigs. Stock defecate and urinate directly in the water and onto the stream beds. Dung contains pathogens (these are disease-causing organisms such as campylobacter, salmonella, giardia and cryptosporidium), which present risks to human health. Dung and urine both contain nutrients, which promote weed growth, and decrease the waterbody's ability to support a healthy ecosystem. Stock trample and pug the banks and beds of the water body causing soil loss and increased levels of sediment in the water body. Sediment reduces water clarity and smothers the stream and lake beds. Loss of stream bank vegetation allows contaminants in the paddocks to be more easily washed in the water body.

These environmental effects have social, cultural and economic impacts. New Zealanders value being able to use water bodies for recreation and mahinga kai (food gathering) and stock access to water bodies compromises the mauri of those water bodies. Declining water quality in dairy catchments and stock in rivers has created a negative perception of the primary sector industry among the New Zealand public, and spurred the development of the Dairying and Clean Stream Accord launched in 2003.[437] Some of New Zealand's international markets for primary produce are now demanding higher environmental standards.

The status quo

Regional plans have stock exclusion requirements but these are highly variable in scope and effectiveness (see Table 17). Of the sixteen regional councils, 12 have current or proposed stock exclusion rules that require resource consent for stock access. Where councils do have these types of rules, they often only apply in certain situations (eg, priority water bodies only).

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[435] Land and Water Forum (2015). The Fourth Report of the Land and Water Forum

[436] Ministry for the Environment (2017). Clean water: 90% of rivers and lakes swimmable by 2040.

[437] Holland, Phil. The dirty dairy campaign and the clean streams accord. Lincoln planning review 6(1-2) (2014) 63-69.

Figure 1 Example of stock damage to a river bank in the Kaipara catchment, Northland, August 2016 (photo: Millan Ruka)

Some councils take an effects-based approach, whereby stock access is a permitted activity subject to conditions that specified adverse effects on water bodies do not occur (for example, in Otago this includes a noticeable change in the clarity or colour of the water). Some councils (for example Canterbury) use both rules requiring consent and effects-based rules depending on the values/priority of the water body. Relying on compliance with permitted activity conditions is not effective because the effects are generally more than minor and enforcing compliance requires a comprehensive monitoring programme, most of which is paid for out of the general rates, rather than by the people undertaking the activity.

Stock exclusion requirements are also in some primary sector agreements (see Table 1 below). As a result of these regulatory and industry measures, stock exclusion requirements and their effectiveness, vary across regions and across primary sectors. Also, a significant amount of the impact stock have on water bodies is on the smaller streams, which are not generally addressed by industry agreements but which flow into the larger streams.

Table 1 Summary of key industry initiatives

Industry/initiative	Commitment	Progress
Dairy - Sustainable Dairy Water Accord **Most New Zealand dairy companies are signatories to the Accord meaning it applies to over 90 percent of dairy farms.**	Exclude 100 percent of dairy cattle (on milking platforms[438]) from permanent waterways over 1 metre wide and 30 centimetres deep, and regionally significant wetlands, by 2017. Applies to dairy cattle grazing on all land owned or leased by the dairy farmer (include land beyond the milking platform) but land of a third party used for dairy grazing remains excluded.	DairyNZ reports that by 2017, 97.2 percent of 'Accord' water bodies (24,744km) had been fenced. In addition, Fonterra reports that at least 10,900km of 'non Accord' streams and drains (waterways smaller than captured by the Accord) on its supplier dairy farms have been fenced.
Drystock and Deer	*Stock exclusion promoted through Land environment plans*	The *Survey of Rural Decision Makers* (Brown, 2015) reported approximately 52 percent of sheep and beef farmers (of the respondents) had fenced all streams over 1 metre wide in 2015, with 77 percent having installed some fencing. Of deer farmers responding to the survey, around 54 percent had fenced all streams over 1 metre wide, with 89 percent having fenced some streams over 1 metre wide. This is self-reported and not independently verified.

Achieving a high uptake of stock exclusion voluntarily is difficult because the costs and benefits are borne by different parties; farmers bear the costs (installing fences, bridging streams, and alternative drinking water supplies) while the benefits are mostly public goods (that is, benefit all water users).

In areas where there are no stock exclusion rules, or rules do not apply to their farm, many farmers are choosing not to exclude stock. The Survey of Rural Decision-Makers (Brown 2015) asked farmers for their reasons for not excluding stock from waterways (there were 4,500 respondents from around New Zealand). Common reasons included lack of finances; not perceiving that there are environmental benefits; and perceiving that the costs are greater than the benefits. But against these expectations, more farmers who fenced their streams reported a positive effect on farm performance than the expected effects estimated by those who had not fenced their streams.[439]

Thus, except where there are strong industry or regulatory drivers, there is low uptake of stock exclusion practices and stock entering water bodies continues to be a pressure on water quality. Most costs of stock entering water bodies are borne by the public (in terms of increased health risks,

[438] The areas of a dairy farm where cattle are kept on a daily basis during the milking season.

[439] https://www.landcareresearch.co.nz/science/portfolios/enhancing-policy-effectiveness/srdm/srdm2017/summary-of-results-2017

inability to fully use water bodies for recreational or cultural use) and by ecosystems in terms of degraded habitat.

The status quo also presents costs and lost opportunities to individual farmers, which can affect their profitability. Stock prefer to drink clean palatable water and will drink more from water troughs, with associated gains in productivity, than from streams.[440] Unfenced rivers can result in stock losses through drowning (particularly new born and young stock).

Feedback on the 2017 stock exclusion proposals

In the 2017 consultation on stock exclusion (as part of "Clean water: 90 percent of rivers and lakes swimmable by 2040"), there were 4251 submissions on the proposed stock exclusion regulation, representing the views of 6038 people (some campaign submissions presented collected views of supporters). Submissions raised eight key themes; timeframes for implementing the regulations, assessing land gradient or slope, types of stock, types of waterbodies, alternatives to exclusion, fines, stock crossings, and setbacks.[441]

There were 52 submissions on terrain/slope. Submitters commented that a clear method was needed to define slope where an area of land contains more than one slope category. For example, Beef and Lamb noted that paddocks in the hill and high country can be large and have a range of slope classes.

Submitters were concerned that the proposal was overcomplicated with different timeframes for different stock types over different slopes and this would be confusing for farmers and council staff. Northland Regional Council, Greater Wellington Regional Council and Dairy New Zealand recommended simplifying the proposal by combining plains (0-3 degrees) and rolling land (>3-15 degrees) categories into one slope category. This approach would be better aligned with some regional plans.

Despite the 2017 proposal having no requirements relating to setbacks, 113 people or organisations commented on setbacks and riparian buffers. Most were individuals (86) including some farmers. Over a third of environmental or community groups (16/54) commented. The concerns from individuals, environmental or community groups, Iwi, and science organisations were similar in their submissions that riparian planting within required setbacks should be required or supported with guidance and/or funding. The reasons given covered:

- The benefits to reducing erosion and overland flow of sediment
- Riparian buffers are needed to protect inanga and other whitebait spawning areas
- Riparian buffers improve terrestrial biodiversity and water quality outcomes.

Suggestions for setback widths ranged from 1 to 30 metres, with five metres being the most commonly suggested distance. A default setback of five metres was recommended by the Cawthron Institute on the basis that scientific studies show that this would ensure that most waterways would

[440] Beef and Lamb Fact sheet, July 2018, Stock exclusion – managing stock around waterways. Available at https://beeflambnz.com/knowledge-hub/PDF/stock-exclusion-managing-stock-around-waterways

[441] Ministry for the Environment, May 2017. Analysis of submissions and recommendations on the proposed stock exclusion regulation.

benefit. The Forest Owners Association also requested a five metre setback to be consistent with national requirements on their industry.

The Land and Water Forum, along with many environmental or community groups and some individuals, expressed concern about the lack of reference to riparian management given the Forum made three recommendations about this in its fourth report. Specifically LAWF wanted appropriate setback distances determined by on-farm assessments required as part of Good Management Practice schemes.

The Environmental Defence Society and other environmental groups submitted that central government should commission a review of existing riparian management and setback assessment tools to produce a new tool with mandatory national application. Until the tool is developed they want a minimum five metre buffer setback required. Others wanted planted buffers required now because this would be cost-effective and the job would be done once, and done properly.

Three regional councils commented on this matter, with mixed views. Taranaki felt regional councils are better placed to tailor riparian management to local circumstances and so was concerned about regulating stock exclusion nationally. Waikato and Greater Wellington requested national guidance on riparian management best practice and submitted that mandatory buffers were needed on rolling and steep land, and on land where stock are break feeding.

Federated Farmers was the only organisation clearly opposed to riparian management being referred to as best practice because it's not always needed on both sides of a waterway and tall trees shade out grass which would otherwise intercept sediment. The Rangitikei District Council and some individuals were concerned that riparian planting needed to be supported with weed control.

The concerns raised in those submissions have been considered in the options developed below.

Constraints on the analysis

There is a large number of properties potentially affected by stock exclusion requirements, and a lack of record for how many lakes, rivers and wetlands are actually already fenced, and with what setback. This makes it difficult to establish with accuracy the total cost of any proposed regulations.

This problem was addressed by making an assumption that all farms on the low-slope land exclude their stock, and no farms on the other land do to arrive at an estimated cost to farmers nationally. Also, the average costs to representative farm types was modelled so that individual farmers can understand potential consequences. In practice the costs and benefits will vary depending on the number of water bodies on a property, the extent of existing fencing, whether the farm would trigger other regulatory obligations and the nature of the farming system adopted.

Options assessment

Objective

> To halt, as quickly as is feasible, current and future degradation of freshwater caused by livestock accessing water bodies.

Options ruled out of scope, or not considered

The option developed to draft Regulation stage in 2017 (but not progressed past draft regulation stage) of having land slope (assessed at paddock scale) to determine whether stock exclusion obligations apply, has been ruled out of consideration given the feedback previously received about

the workability of that proposal. That feedback and lessons from that process have been taken into account in the development of further options for consideration.

Forms of national intervention other than regulation have not been considered because past experience over a considerable period has indicated that they are not capable of delivering on the objective. Although there has been success in terms of the dairy industry's voluntary action, and small-scale council and community scale initiatives, there is no indication that a continuing reliance on voluntary industry action and patchy regional plan regulation will achieve the objective.

The use of a farm environment plan (FW-FP) to manage stock exclusion (without an associated consent or underpinning national stock exclusion regulation) has not been considered because it is likely that such an approach would provide those preparing FW-FPs with too much discretion and could constitute an unlawful delegation.[442] Also, while voluntary processes have made many improvements in protecting water bodies from stock, more work is clearly needed to complete the job.

Design of a stock exclusion regulation

The variables considered in designing the scope and nature of stock exclusion regulation include:

- What **water bodies** should the regulation apply to (all, or just the larger permanent ones that have more visibility)?
- What **intensity** of farm should be caught (all, or just those above a stocking rate that presents high risk of stock damage to water bodies)?
- What **terrain** should the regulation apply to (all, or just flatter lowland areas that are more practical and less costly to fence)?
- What **stock** should excluded (all farmed livestock, or just those particularly attracted to water)?
- Should **setbacks** be required (and if so how large and should they be planted)?
- What type of regulation (national environmental standard or section 360 of the RMA)?

Water bodies to include – small streams

While there is little doubt about the value of excluding stock from lakes, wetlands, and large rivers (>1m wide, as in the Sustainable Dairying: Water Accord), smaller streams and intermittently flowing streams have been less commonly targeted for stock exclusion by industry initiatives or regional rules. That may be changing as Table 17 indicates - see Southland, Waikato and Canterbury plans.

That past practice has generally been because the increase scale of the task associated with excluding stock from smaller and intermittently flowing streams increases the cost. Auckland Council, for example, estimates there are 16,500 km of permanent rivers in the Auckland region, and a further 11,590 km of intermittent and ephemeral rivers.

[442] Although it is anticipated that FEPs will record what stock exclusion obligations apply on the farm given location and intensity.

However, small streams account for an average 77 percent of the national nutrient load of the total river catchment. [443] Also, small streams and intermittent streams can have very high biodiversity values (being critical for certain life stages of certain species), often greater than in larger streams.

There are also issues of practicality to consider. Intermittently flowing streams and rivers can contain water for large parts of the year and during that time stock access represents a considerable risk to values. Whether a stream is intermittent or permanent will often only be known to the landowner (and may vary year to year).

Not including small and intermittent streams would mean that any national regulation is only partially addressing the problem. Furthermore it can lead to implementation and interpretation challenges.

Water bodies to include – drains

Drains can be a major source of contaminants into natural water bodies. They can take a variety of forms and in some landscapes may be indistinguishable from modified (channelised) natural rivers (a modified watercourse is included in the Resource Management Act's definition of "river"). Some drains, however, are shallow and only contain water after heavy rain events. It will generally be impractical to exclude stock from those shallow drains.

Although there is little data on existing fencing of drains, a common practice in many landscapes is for drains to form the boundaries of paddocks and for at least one side to be fenced. Where banks are highly erodible and drains are critical to pasture management, both sides of drains are commonly fenced to protect the integrity of the drain. However, there are many thousands of kilometres of drains that are currently unfenced.

Drains are included in regional stock exclusion rules over much of Canterbury and in the Waikato River catchment.

Terrain

The total length of rivers flowing through low-slope (less than or equal to 5 degrees on average across a land parcel) and non-low-slope (more than 5 degrees) land parcels with grassland and annual cropland calculated from GIS mapping is shown in Table 2 below. The regional proportion of major streams with existing riparian exclusion is estimated from the Survey of Rural Decision-makers in 2015.[444]

[443] *Assessing the Yield and Load of Contaminants with Stream Order: Would Policy Requiring Livestock to be Fenced Out of High-Order Streams Decrease Catchment Contaminant Loads*, McDowell, R.W, Cox, N and Snelder T.H. Journal of Environmental Quality, September 2017.

[444] 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.

Table 2 Regional breakdown of land potentially affected and existing regional rules

Region	Low-slope river length (km)	Non-low-slope river length (m)	% of major streams fenced	Regional rules applying
Auckland	765	1,929	64.2	Intensive stock excluded by 2021 for lakes, wetlands and permanently flowing rivers/streams, and 2026 for intermittent rivers/streams (operative).
Bay of Plenty	1,328	2,252	83.3	Priority water bodies (operative).
Canterbury	12,928	14,270	62.2	Intensively farmed stock and priority areas (operative).
Gisborne	292	3,993	28.7	Winter intensive grazing by 2017 (riparian setbacks also required) (proposed).
Hawke's Bay	1,263	8,134	45.1	Stock access is a permitted activity subject to performance conditions (except for Tukituki catchment where stock must be excluded by 2020) (operative).
Manawatu-Whanganui	3,822	13,543	62.2	New intensive farming or existing intensive farming in priority areas (operative).
Marlborough	437	2,554	33.5	Intensively farmed stock, by 2022 (proposed).
Nelson	15	62	--	Stock access is a permitted activity subject to performance conditions (operative).
Northland	1,997	5,884	71.4	Dairy cows and pigs from streams >1m (from stream <1m by 2023). Beef cattle, dairy support and deer from lowland rivers and wetlands from 2025 (from streams <1m by 2023). From lakes >1ha now (proposed).
Otago	4,521	15,997	47.5	Stock access is a permitted activity subject to performance conditions (operative).
Southland	6,881	6,612	75.9	Current rules: Winter intensive grazing and priority water bodies (in force) Dairy cattle (on milking platforms) and pigs from rivers >1m by 2017 (<1m by 2020). Dairy support, beef cattle and deer by later dates varying by land slope and stocking rate (proposed).
Taranaki	2,647	3,517	77.3	Intensively farmed stock, by 2020 (riparian planting also required) (draft).

Region	Low-slope river length (km)	Non-low-slope river length (m)	% of major streams fenced	Regional rules applying
Tasman	458	1,428	59.0	Stock access is a permitted activity subject to performance conditions (except at Te Waikoropupu Springs where stock access is a non-complying activity) (operative).
Waikato	6,113	12,135	79.8	Priority water bodies (in force) Cattle, horse, deer and pigs from all rivers and drains that continually contain water (various commencement dates). Setbacks 1m to 3m depending on slope.
Greater Wellington	1,454	3,512	51.6	Cattle, deer and pigs excluded from rivers >1m wide (containing water) from 2022 (proposed).
West Coast	1,630	568	64.6	Stock access is a permitted activity subject to performance conditions (except for Lake Brunner catchment or scheduled wetland). Stock exclusion is required in association with some land development practices) (operative).
Grand Total	**46,552**	**96,389**		

Set-backs

There are multiple potential benefits from providing a setback from the stream bed when fences are installed. These include:

a. Prevention of de-vegetation, trampling and pugging near the river, thus further reducing soil loss and sediment inputs compared to fencing alone

b. Allowance for some natural movement of stream channels without loss of effective stock exclusion

c. Fences are less likely to be damaged by flooding

d. Filtration of overland flows, and slowing the velocity of flow (allowing for greater deposition) reducing inputs of sediment and contaminants directly to water. Even a dense grass sward can be an effective filter.

When setbacks are planted there can be additional benefits including:

e. Uptake of excess nutrients from surface and subsurface flows

f. Increased organic matter inputs to streams (via leaves and woody debris), increasing the diversity of both food resources and habitats/refuges for aquatic life

g. Vegetation providing shade, which keeps water temperatures more stable, providing a more suitable environment for aquatic species, including fish and invertebrates

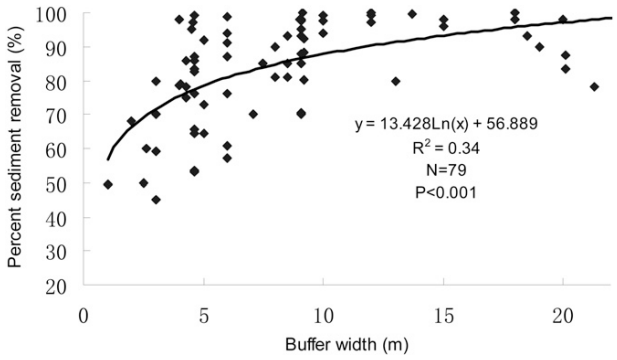
h. Shade also reduces growth of algae in water bodies. Some freshwater algae (cyanobacteria) can be toxic to humans, pets, livestock and wildlife. Algal mats also reduce light penetration and oxygen concentrations, reducing the life-supporting capability of fresh water

i. Habitat and refuges for aquatic life (invertebrates and fish). Stable, vegetated banks offer a greater range and quality of habitats (and refuges) for aquatic life.

The realisation of these benefits, however, is dependent on the local circumstances. The effectiveness of buffers depends on a range of site-specific biophysical factors including, in particular, the steepness of adjacent land (and banks), rainfall and soil drainage. This makes setting a nationally consistent buffer width that is equally effective everywhere challenging. Most research on the benefits of buffers has been undertaken on setbacks of at least five metres. While wider buffers do generally offer greater benefits, they come with significantly greater costs.

The effectiveness of the width of a buffer zone in removing sediment increases significantly as the width increases between one and five metres, and flattens off beyond 15 metres.[445]

Figure 2 Sediment removal in relation to stream buffer width (Liu et al 2008)



In general, the steeper and longer the slope is that feeds into the waterway, the wider a grass riparian margin needs to be to reduce contaminant input to the waterbody. For gently rolling land, widths of one to three metres per 100 metres of slope feeding into the water body may be sufficient. In areas with steeper slopes and poorly draining soils, a grass margin of 10 to 15 metres per 100 metres of the adjacent slope may be needed. Often runoff flows in defined channels across paddocks to reach water bodies. On hill country farms with long slopes, wide margins are most effective across drainage channels.

Requiring a setback now could disadvantage the early adopters who have already installed fences without setbacks. However, allowing existing fences to remain in place indefinitely while others face the cost of setbacks would undermine the effectiveness of the regulation. Furthermore, although relocating fences involves costs and effort, the majority of existing riparian fencing is on dairy farms.

[445] Liu, et al (2008) Major factors influencing the efficacy of vegetated buffers on sediment trapping: a review and analysis

Dairy fences (generally two-wire electric) are the least costly to relocate. Allowing a reasonable transition period that recognises the efforts of early adopters, particularly those that have sought to take a responsible approach, would mitigate these adverse effects.

Setbacks and their effectiveness in mitigating the effects of sediment

Excluding stock from waterways with an associated setback buffer decreases sediment input to streams by reducing streambank erosion and surface erosion near the stream.

Streambank erosion

Streambank erosion is a significant, highly variable, and poorly understood component of overall suspended sediment loads in New Zealand catchments. It is particularly problematic as a cause of fine sediment deposition in streambeds, which has significant negative ecological impacts. In the flat lowlands, streambank erosion is the most important erosion process.

A recent study reviewed quantitative estimates of bank erosion's contribution to suspended sediment loads, and found that the contribution ranges from nearly zero percent to 100 percent as shown in the table below.[446] The same study concluded that bankside erosion contributes approximately 60 percent of the sediment in Waikato tributaries. Regional-scale erosion modelling using SedNetNZ estimates that, on average across catchments in Hawke's Bay, Waikato, Northland, and Manawatu-Whanganui, streambank erosion contributes 18 percent of total suspended sediment loads.[447]

Table 2-1: Estimates from New Zealand catchments of the proportional contribution of bank erosion to catchment sediment yield.

Proportion of bank erosion to catchment sediment yield (%)	Location	Study
~60%	Mangaotama Stream, Waikato	De Rose (1999)
0 – 100%	Waiokura catchment, Taranaki	McDowell and Wilcock (2007)
28%	Pohangina River, Manawatu	Rosser et al. (2008)
~1%	Waipaoa River, East Coast	De Rose and Basher (2011)
64% and 94% (2 sites)	Waituna Catchment, Southland	McDowell et al. (2013)
>90%	Kopurererua Stream, BoP	Hughes and Hoyle (2014)

Reduced surface erosion and delivery to streams

Riparian setbacks influence near-stream erosion and sediment transport processes. Pugging and de-vegetation of riparian margins, a common result of stock access to waterways, cause bare soil, soil compaction, and other problems that increase erosion and sediment delivery. Multiple studies

[446] Hughes, A. 2015 Waikato River suspended sediment: loads, sources, and sinks Information to inform economic modelling for the Healthy Rivers Wai Ora Project. May 2015.

[447] Dymond JR, Herzig A, Basher L, Betts HD, Marden M, Phillips CJ, Ausseil A-G, Palmer DJ, Clark M, Roygard J 2016. Development of a New Zealand SedNet model for assessment of catchment-wide soil-conservation works. Geomorphology 257: 85–93

highlight the effectiveness of livestock exclusion from streams in reducing streambank erosion and also delivery of sediment to streams.[448]

A recent continuous simulation study using observed precipitation rates and 15-minute time-steps estimated that land with a slope of 10 percent and 25 percent bare soil had, on average, 10 times greater sediment generation compared to land with full pasture cover.[449]

Vegetation provides a protective cover which helps to absorb the forces exerted by flowing water. It also influences the mechanical strength of bank material, because plant roots increase the shear strength of the soil (Watson and Marden 2004). Plant evapotranspiration can contribute to better drained and drier bank conditions. The height of the stream bank in relation to rooting depth can be critical. With low banks roots are likely to cross any potential slide plane and provide reinforcement. If bank height is greater than the rooting depth, any potential slide plane is likely to pass below the rooted layer and undercutting of the lower unrooted layer may promote cantilever type failures (Environment Agency 1999). Trees and shrubs leaning over the water may lead to failure of steep banks if they fall and dislodge soil as they uproot.

High levels of trampling by stock and vehicle usage may damage vegetation on the bank, and compact the soil surface. Compaction can lead to reduced infiltration, followed by erosion of the bank surface by overland flow, rilling and/or gullying. Vehicle and animal stream-access tracks can create breaks or gaps in otherwise continuous stream bank systems and thereby create points of weakness in their structure.

Planting the setback area

Maximising the benefits of riparian planting depends on local circumstances. Larger planted buffers can be highly desirable to achieve freshwater ecosystem and biodiversity outcomes. Studies have shown a clear correlation between riparian planting and ecosystem health (as measured by MCI).[450] However, the most appropriate planting will depend on the particular risk sought to be addressed/objective sought to be achieved (for example, shading smaller streams to reduce water temperature, or intercepting sediment).

The initial costs of riparian planting can be very high. Typical native planting costs around $3.70 per metre for a single row of plants. For a one km length of stream, where just two rows of native planting are required on each side, the cost is estimated to be around $14,700. In addition, the riparian buffer will require ongoing maintenance (weed control and replacement of lost plants) at least until the plants are established. Buffers up to approximately 10 to 15 metres wide are less likely to need long-term on-going weed control than narrower buffers because once they are established they become self-sustaining. Farmers will need to consider these factors at the farm scale and decide where to invest in wider buffers because they will be very expensive to establish over long distances.

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[448] Eg Hughes, A. 2016. Riparian management and stream bank erosion in New Zealand, New Zealand Journal of Marine and Freshwater Research, 50:2, 277-290, DOI: 10.1080/00288330.2015.1116449.

[449] Paradigm and Morphum (2019) Effect of Annual Variability and Land Disturbance during Construction on Predicted Sediment Yields. Continuous Simulation of Land Development Scenarios. Prepared by Paradigm Environmental and Morphum for the Ministry for the Environment.

[450] E Graham, C M Jones-Todd, S Wadhwa, R Storey, Analysis of stream responses to riparian management on the Taranaki ring plain. NIWA 2018.

Modelling suggests riparian planting effectively doubles the cost of stock exclusion fencing of even a modest five metre setback for a typical Waikato dairy farm (adding $90,727) and more than doubles the cost on a sheep and beef farm ($138,970). [451]

Designs of regulatory approaches

Stock access to water bodies is a land use activity that can affect aquatic ecosystems and water quality and so can be regulated under section 9 of the RMA. There are two regulatory instruments available under the RMA: national environmental standards can require specified activities to be undertaken in accordance with specified standards or in accordance with resource consents, and section 360 regulations can prescribe measures to exclude stock from water bodies.

A section 360 regulation can apply to any stock access immediately, regardless of any existing use rights, or compliance with regional rules. No consent is required, meaning there is no administrative cost for applying for and assessing a land use consent (as there wold be for a national environmental standard). But section 360 applies only to water bodies which, by definition, excludes drains.

Many different permutations of all the variables described above are possible, however, three clearly distinguishable feasible options within either regulatory framework were identified. These are described below and have been assessed against the general *Essential Freshwater* criteria to evaluate the best option to achieve the objective and address the problems with the status quo.

Summary assessment of three options considered

Criterion	Option 1 (targeted)	Option2 (comprehensive)	Option 3 (even treatment/risk based)
Effectiveness	**0**	**++**	**+**
Timeliness	**+**	**-**	**0**
Fairness	**-**	**--**	**++**
Efficiency	**-**	**--**	**+**
Principles of the Treaty of Waitangi	**0**	**-**	**0**
Te Mana o te Wai	**-**	**0**	**+**
Overall assessment	**0**	**-**	**+**

Option 1 – Highly targeted stock exclusion regulation

Option 1 would regulate the access of some stock to lakes, wetlands, and rivers over one metre wide. Cattle, pigs and deer would be targeted because they can cause the greatest effects on waterbodies because of their affinity for water. Specifically, a regulation would apply to:

a. Cattle, pigs & deer only. It would not affect horses, sheep, goats or any other livestock

[451] Modelling of Mitigation Strategies on Farm Profitability: Testing Ag Package Regulations on-Farm, Journeaux, May 2019.

b. Lakes and wetlands and streams wider than one metre (as per the 2016 proposal). It would not apply to streams that flow only intermittently or drains

c. Intensive systems/practices only. It would not regulate sheep and/or beef farming unless intensive practices (such as break feeding, irrigation or high stock rates) are employed

d. The lowland areas of the country only (being the plains and gently rolling country, generally in the lower parts of major river catchments and in river valleys). It would not apply at all in the steeper hill or high country

e. Excluding targeted livestock (by any effective means) without a setbacks requirement, potentially allowing fencing along the water's edge (as per the 2016 proposal).

Criterion	Option 1 – Highly targeted stock exclusion regulation
Effectiveness	+ Would address key livestock types that cause main water quality issues and would introduce stock exclusion rules in places where they are not currently present. However, would not address small and intermittent stream that contribute the majority of contaminants into river networks.[452] The option is no more (and in some cases less) protective of water bodies that many existing regional plans. Limiting intervention to lowlands reduces many potential benefits from stock exclusion. (The 2016 National Stock Exclusion Study (2016 Study) found that the additional benefits of excluding stock from hill country up to 28 degrees was $3.37 billion whereas the benefits of excluding stock from flat and rolling land only was just $983 million).[453]
Timeliness	+ Could be implemented quickly because less time would be required to transition to the new obligations (given they are less onerous).
Fairness	- Not fair because farms with similar effects on water bodies would be treated differently simply because the size of stream on the property or location of the property. Fair only to the extent that those with facing the most expensive stock exclusion would not be caught by the regulation. The entire burden would fall on low country farmers (many of whom already take voluntary action) regardless of the impact.
Efficiency	- Considered in isolation from existing regional regulation the option does achieve a lot for modest cost (likely in the order of $367 million based on the 2016 Study). However, the marginal benefit achieved by this option would be small being limited to a few regions only. Considerable effort would be expended on this option for little benefit.

[452] The study referenced below found that 77% of the nutrients in water ways was contributed by stream less than 1m wide. *Assessing the Yield and Load of Contaminants with Stream Order: Would Policy Requiring Livestock to be Fenced Out of High-Order Streams Decrease Catchment Contaminant Loads*, McDowell, R.W, Cox, N and Snelder T.H. Journal of Environmental Quality, September 2017.

[453] Ministry for the Environment and Ministry for Primary Industries (2016). National Stock Exclusion Study; analysis of the costs and benefits of excluding stock from New Zealand waterways. https://www.mpi.govt.nz/dmsdocument/16513-national-stock-exclusion-study-analysis-of-the-costs-and-benefits-of-excluding-stock-from-new-zealand-waterways-july-2016

Principles of the Treaty of Waitangi	**0** This option would not provide any increased recognition to the principles of the treaty. The cost of policy may fall less heavily on Māori given Māori land owner interests are overrepresented in less intensive farming (often in hill country areas).
Te Mana o te wai	- Would not put the wellbeing of water above other considerations. Issues of burden and cost would prevail over concerns for water stewardship.
Overall assessment	0 The option provides marginal benefit. It has a corresponding modest cost but would not achieve any step change in stock access to water, and would not make a significant impact on the contaminants associated with stock (pathogens, sediment and nutrients).

This could be supplemented by use of Freshwater Modules in Farm Plans (FW-FPs) for streams less than one metre wide.

Option 2 – Comprehensive livestock exclusion

Option 2 would regulate the access of all stock to all lakes, wetlands, and rivers. Sheep would be included as well as cattle, deer and pigs to maximise opportunities to reduce stock dung in the water body, and reduce their impacts on the stream banks. All waterbodies would be included to reduce the effects of smaller streams and drains on the downstream receiving environments.

Specifically, a regulation would apply to:

a. All farmed livestock (including sheep)
b. All streams regardless of size (including intermittent streams) and all drains
c. Farms of all intensities (including low intensity/low stocking rate farming systems)
d. All terrains/landscapes (including hill and high country farms)
e. The provision of setbacks from every waterway from which stock are excluded.

Criterion	Option 2 – Comprehensive stock exclusion regulation
Effectiveness	+ + If implemented comprehensively it would be effective in eliminating contamination of waterway from stock access. It would also assist in the reduction in contamination from overland flows (due to the widespread presence to buffers). However the task of implementing this option would be so great and so expensive that it is doubtful it could be implemented. This is confirmed by impact testing[454] that shows that in single modelled hill country farm the cost of fencing all streams is $1.37 million with a reduction in EBIT of 44 percent and a debt increase of 220 percent on a per stock unit basis. That level of cost means it is not economically viable for the farm owner to make the required investment. The modelling assumptions in this report are still being assessed as appropriate and relevant.

[454] MRB (2019). Impact of Possible Environmental Policy Interventions on Case Study Farms. (The predicted cost estimates in this report are being peer reviewed and may change as a result.)

Timeliness	- While some elements could be implemented quickly this option would need a very long implementation tail, probably over several decades with progressive requirements for individual streams to be fenced over time.
Fairness	- - The option is unfair on some farmers who would be captured by the regulation (and face the highest costs) notwithstanding posing very little risk. Extensive hill country farms, in particular, pose a low risk of stock accessing/damaging water bodies. Excluding sheep poses a disproportionately large cost both because of the higher cost of sheep-proof fencing and because of the size of sheep farming properties and the generally much more challenging terrain (further increasing fencing cost). Because sheep generally pose a relatively low risk to water bodies given their reluctance to enter water, mitigating the effects of overland flow carrying sheep dung to the water body directly via the sheep track may be more effective than comprehensive fencing. In short, the option would impose the majority of cost on that part of the rural sector that (a) poses the least risk and (b) is least able to meet those costs.
Efficiency	- - For the reasons set out above, the option is highly inefficient. Very significant costs are imposed to achieve very small gains in water quality and freshwater habitat protection over large areas of the country where the current impact and future risk is low. As a general rule, as stock exclusion obligations extend out from intensively farmed lowland areas the marginal benefit decreases and the margin cost increases making intervention less efficient. That is demonstrated by impact testing and previous research. The 2016 National stock exclusion study showed, for example, that applying stock exclusion comprehensively to hill country as well as plains and lowland hills would require an additional $1,069 million to be spent by farmers (with additional benefits of $2286 million). The benefit-cost ratio for stock exclusion on plains and lowland hills was 2.7, dropping to 2.3 if the requirements also applied in the hill country (note also that these costs did not account for excluding sheep).
Principles of the Treaty of Waitangi	- This option would not provide any increased recognition to the principles of the treaty. However, the cost of the policy would likely fall disproportionately heavily of Māori given Māori land owner interests are overrepresented in extensive farming (often in hill country areas)
Te Mana o te wai	**0** The option would put the wellbeing of water above other considerations but does not take a holistic view, paying no attention to the needs of people.
Overall assessment	- The option may represent a theoretic optimum result from a water body protection perspective but the costs, unfairness of where those costs fall and the inefficiency in terms of marginal gains mean it is not a feasible option.

Option 3 – Even treatment/risk-based stock exclusion

Option 3 would regulate the access of some stock to all lakes, wetlands, and rivers. Cattle, pigs and deer would be targeted as they can cause the greatest effects on waterbodies because of their affinity for water.

To provide greater protection to the freshwater ecosystems than the status quo, this option would target all waterbodies, including drains, because of the contribution these smaller streams and drains have on downstream environments.

To maintain some equity between farmers who have already fenced stock out, particularly the dairy farmers, this middle ground option would target stock that are farmed at similar intensity to dairy cattle.

Specifically, a regulation would:

a. require stock exclusion generally comprehensively (to farms of all intensities but only in respect to high risk stock being cattle, pigs and deer, and to all natural waterbodies and drains within a defined low-slope land area); and

b. Outside the defined low-slope land area, require stock exclusion from all natural water bodies and drains in respect of activities that pose a known risk being:

   i. Dairy farming
   ii. Beef and deer farming at stocking rates equivalent to average dairy stocking rates (14SU/ha)
   iii. Break feeding on fodder crops
   iv. Grazing irrigated pasture (being an indicator of high stocking rate farming)
   v. Stocking individual paddocks at high stocking rates

c. Require an average five metre setback from lakes and rivers (assessed as an average width for each stream on a property, and provided the setback is no less than one metre)

d. Allow landowners to apply for exemptions to the regulations (exemptions would be reviewed every five years).

Criterion	Option 3 – Even treatment/risk-based stock exclusion regulation
Effectiveness	**+** goes beyond existing industry initiatives and most regional plans. Importantly captures all intensive beef farming. The 2016 Study showed a large marginal increase in benefits from moving beyond dairy cattle ($125 million in benefits from regulation focusing on dairy cows only versus $716 million for a regulation that addressed beef cattle as well as dairy).
Timeliness	**0** Elements of the approach can be implemented rapidly although requiring set backs will mean shifting existing fences in many cases. This will require a reasonable transition period.

Fairness	++ Very fair approach because all those with like land (and hence similarly feasible fencing burden) will be treated similarly. Also, those with similarly intensive (and hence stock access) risk will be treated similarly. The efforts of some to exclude stock should not be undermined by the inaction of others. The 'free-rider' problem is minimised.
Efficiency	+ Would be economically efficient because it would avoid imposing cost where fencing is impractical and costly and where the marginal benefit of exclusion is minimal. Administratively efficient in terms of all lowland farmers having a consistent obligation (few, if any, issues of interpretation or implementation discretion). However, may lead to large numbers of applications for exceptions for councils to process.
Principles of the Treaty of Waitangi	**0** Offers high level of protection for Māori interests. Would not fall disproportionately heavily on Māori land owners.
Te Mana o te wai	+ Provides good balance between putting the needs of the water first and taking into account the needs of people.
Overall assessment	+ Likely to significantly improve status quo by putting regulation in place across the country in a manner that reflects risk but without the delay of waiting for regional rules to be developed and made operative.

Recommendation

Option 3 - national regulation that treats all low-slope land cattle, pig and deer farms equally, and outside of that area requires stock exclusion on the basis of risk presented by the farming system/practice meets more criteria than Option 1 or 2.

This option is the most effective, fair and efficient means of improving freshwater ecosystem health as affected by stock access water bodies and their margins in a way that is timely and comprehensive. Further evaluation of option 3 is provided below.

This option is the most effective at addressing risk associated with stock access (except for those options likely to be unaffordable). It is fair in the sense that it does not differentiate on the basis of type of farming except to the extent that different farm types/activities present different levels of risk. Although the costs are high, that needs to be offset against:

a) the high expected benefits for ecosystem health and people's use of the water

b) the existing high level of stock exclusion in lowland areas by the dairy industry

c) the fact that much of the modelled cost will occur with or without the regulation since many regional plans already provide for stock exclusion obligations to phase in over the next few years.

Further options to mitigate impacts on farmers

The five metre setback averaged across the farm presents opportunity costs to farmers in terms of lost pasture. This could be mitigated by

a. allowing an alternative setback to be developed as part of a farm environment plan (but the time needed to develop these plans may not be fast enough to meet the stock exclusion requirements)
b. allowing setback distances for streams less than one metre wide to be less than five metres.

Implementation timeframes

There is need for some flexibility in timeframes for different stock types to comply with the stock exclusion requirements reflecting what is feasible for each sector, given the amount of work left to do and the costs and practical constraints for different farm types.

The industry reports 97 percent compliance with industry targets for the exclusion of dairy cows (excluding third party grazing). The pork industry is similarly well progressed with regards to stock exclusion, so a deadline of 12 months after gazettal of the Regulation has been assessed as achievable for rivers and streams greater than one metre wide. However, there is a lot of work left to do for beef cattle and deer, and the costs for individual farmers are likely to be higher due to the (generally) larger size of these farm types. Similarly, extending exclusion to streams less than one metre wide will significantly increase the task.

Timeframes with lead time enable farmers to budget and plan for stock exclusion work, and provides the ability to spread the costs over time. Modelling has demonstrated extending the implementation time frames significantly reduces cost. Giving achievable timeframes has the benefit of being more feasible and being likely to achieve a higher rate of compliance.

Recommended content of the stock exclusion regulation

According to the analysis above, a national stock exclusion regulation should:

a) apply to all farming of dairy cattle, pigs, beef cattle and deer in a mapped area of "low-slope land" across New Zealand[455]

b) outside the low-slope land area, apply only to higher risk/high stock density farming including outdoor farming of pigs, dairying, grazing on irrigated pastures, break feeding animals on fodder crops and beef and/or deer farming at carrying capacities greater the 14SU/ha (or higher rate when assessed on a paddock scale).

c) relate to all wetlands, lakes, rivers (including intermittent but excluding ephemeral streams) and drains (but excluding shallow drains designed only to channel surface flows)

d) apply in association with a setback requirement of five metres on average across each wetland, river or lake on a property (with a minimum width of one metre), excluding drains.

e) Require that stock (excluding deer) should not be permitted to cross water bodies subject to this regulation except by a dedicated culverted or bridged cross point (unless that crossing is infrequent - no more than twice per month).

To mitigate costs (estimated costs of this option are described below):

[455] The final map will be web-based allowing property owners to check whether their property is "low-slope" land.

i. The requirement should be phased in over time with the most onerous requirements having the longest phase-in period (see Table 3)
ii. An opportunity should be provided for landowners to seek an exemption from requirements (or an extension of the phase-in timeframes) in defined circumstances
iii. Those with existing fences that do not comply with setback requirements should be allowed to retain fences in their current positions until 2035 provided they meet a minimum standard of a two metre average width across the property and at least a one metre setback).

Table 3 Proposed deadlines for compliance with a national stock exclusion regulation (assuming a 1 July 2020 gazettal date)

Farm/stock type	Lakes and all streams >1m	Streams <1m and drains	Wetlands
Dairy cattle (on milking platform), dairy support and pigs	1 July 2021 (across all terrain)	1 July 2023	1 July 2021 for wetlands identified in regional or district plans. 1 July 2023 for all other wetlands
Beef cattle and deer	1 July 2023	1 July 2025	
Any new pastoral system establishing after gazettal	Immediately	Immediately	Immediately

Stakeholder views

Prior to consultation the Ministry engaged with a range of stakeholder groups, as well as the Minister-appointed advisory groups (Kahui Wai Māori, Freshwater Leaders Group, and the regional sector water sub group).

The feedback has generally reflected widespread support in principle for national intervention on stock exclusion. However, the strength and enduring nature of that support will be dependent on many matters of design detail, and in particular how flexibility can be incorporated into the proposal so that the requirements remain practical, feasible and reasonable in all instances.

Kahui Wai Māori supports the proposal but has concerns that the flexibility provided by freshwater modules in farm plans (or other means) may undermine the policy. The group noted the importance of compliance monitoring.

The Freshwater Leaders Group supports national intervention on stock exclusion to go further than existing industry initiatives. It has questioned aspects of the proposal (including both the proposed stocking rate threshold and the five metre wide setback, suggesting the latter may not be appropriate for all situations). The Freshwater Leaders Group also suggested that setbacks should be required to be planted. Any grand-parenting of existing non-compliant fencing (fencing that does not provide for a setback) is opposed.

A combined group of some members of the Freshwater Leaders, Kahui Wai Māori and the Science and Technical Advisory group met to discuss all proposals in June 2019. The group suggested that the threshold for requiring stock exclusion from non-lowland land should be a carrying capacity of 18

stock units at the paddock scale, and 14 stock units at the farm scale. This was consistent with the approach proposed.

The regional sector water sub group strongly supports national regulation of stock exclusion. However, it considers that where stock are already excluded but the required setback has not been provided, landowners should not be required to shift fences (unless required by a regional plan or FW-FP). The sub group has also questioned whether five metres is justifiable in all situations. The group has raised questions about the difficulty of compliance monitoring and the absence of information held by regional councils on stocking rates.

Consultation undertaken as part of the previous stock exclusion proposals raised similar issues. Typically, regional council and primary industry concerns relate to the lack of flexibility of a national regulation, the costs of fencing and practical issues such as weed control. Respondents from the West Coast have previously been concerned that the topography there would make it difficult for farmers to comply, especially by the proposed deadlines.

The proposal is broadly consistent with some of the views expressed by some stakeholders but not entirely consistent with some of the views of others. That is inevitable given that, in some respects, the views of those consulted are not aligned. Particular issues are:

a. the width of the required set back (which most agree may not be appropriate in all instances)

b. how existing non-compliant fences are managed (whether these should be able to remain)

c. the feasibility of compliance outside the low-slope land area where councils will need detailed information on farm activity.

The first two concerns may be able to be dealt with by allowing an alternative setback distances to be developed as part of a farm environment plan (but the time needed to develop these plans may not be fast enough to meet the stock exclusion timeframes). A requirement for a farm environment plan and regulation of high risk farming activities will assist with the third issue.

Summary of costs and benefits of the preferred approach

Context

New Zealand has over 400,000km of river/stream. Of this, 143,000km is potentially accessible by stock (being located within grassland landscapes). The mapped low-slope land includes 46,552km of river/stream (33 percent of the country's grassland). This includes annual cropland, which may be grazed sometimes, and almost all dairy land. Because at least 36,000km of fencing has already been completed on dairy land there may only be about 10,500km remaining to be fenced in the low-slope land. The majority of existing fencing may, however, need to be relocated over time to provide the required five metre setback.[456]

In addition to work already done, regional rules already require (or will require) fencing of streams and rivers on intensively farmed land in Auckland, Canterbury, Marlborough, Northland, and Southland, which comprise 50 percent of the low-slope land (23,543 km). Bay of Plenty and Manawatu-Whanganui have regional rules that apply to priority areas, some of which will be in low-

[456] The estimated length of streams already fenced comprises 24,744 km "Accord streams", and 10,900 km "non-Accord" streams.

slope land. Thus the amount of stock exclusion required on low-slope land by national regulation would be significantly less than 10,500 km.

Assuming fencing costs of $5 per linear metre (and fencing both sides), 8,400 hectare lost grazing land (because the first metre has no opportunity cost) for a five metre setback, at $2,747 EBITD per hectare, the **total costs for low-slope land would be $128 million (or 116.5 million for a three metre setback)**.[457] In addition, there is a cost of **$170 million** over the next ten years for lost grazing. These estimated costs will be reviewed after consultation.

Outside the low-slope land there remains about 96,000km of rivers and streams. The total length that is already excluded from stock is not known.[458] Within the non-low-slope land area we estimate from GIS analysis that just 354km of river is adjacent to fodder cropping. The area adjacent to irrigated pasture is also likely to be small. Further, the proportion of this land carrying more than 14 stock units per hectare is likely to be less than 10 percent of the total (around 9,600 km).

The possible costs for the non-low-slope land could therefore be $268.8 million for fencing, and $4 million in lost grazing, the **total costs for non-low-slope land could be $272.8 million (or 270.8 million for a three metre setback)**.[459] In addition, there is a cost of **$29 million** spread over the following ten years from lost grazing. These estimated costs will be reviewed after consultation. The marginal cost difference in decreasing the setback distances on non-low slope land is because of the lower EBITD for class five sheep and beef land ($520 per hectare compared with $2,747 for dairy land).

Thus, the total costs for stock exclusion could be **$599.8 million**, for fencing and lost grazing over ten years.

Against these costs, the Survey of Rural Decision-makers (with 4,500 respondents) reported that 75 percent of farmers found no change in profit after excluding stock from waterways, 8 percent with increased profits and 17 percent with lower profits. This is against farmer expectations before stock exclusion where 51 percent believed they would have lower profits.[460] Also, farm performance and environmental performance were both higher than expected (52 percent and 65 percent compared with their expectations of 20 percent and 41 percent).

A section 360 regulation can apply to any stock access immediately, regardless of any existing use rights, or compliance with regional rules. No consent is required, meaning there is no administrative cost for applying for and assessing a land use consent (as there would be for a national environmental standard). But section 360 applies only to water bodies which, by definition, excludes

[457] These assumptions are as per those in Journeaux (2019). Modelling of mitigation strategies on farm profitability: testing Ag package regulations on farm.

[458] As noted earlier, one survey of drystock farms indicated that 50% of streams on these farms may be fenced but that survey was not necessarily representative and care should be taken in relying on those results.

[459] Assumes assuming fencing costs of $14 per linear metre (and fencing both sides), 7,680 hectare lost grazing land (because the first metre has no opportunity cost) for a 5 metre setback, at $520 EBITD per hectare.

[460] www.landcareresearch.co.nz/science/portfolios/enhancing-policy-effectiveness/srdm/srdm2017/farm-plans-and-land-management/management-stock-exclusion-from-waterways

drains. Excluding stock from drains would need to be achieved via a regulation in a national environmental standard.

The table below records modelling of impacts on individual representation farms that would captured by the regulation. [461] The ongoing opportunity cost was calculated as the present value of the annual opportunity cost (calculated from the EBITD/ha) over 20 years at 6 percent. The area of land lost was based on an average length of streams on the specified farm-type, with no opportunity costs for the first metre, 50 percent for the next two metres, and 100 percent for the remaining setback (giving 0.6 ha/km of stream length for a 5 metre setback, and 0.2 ha/km for a 3 metre setback).

Affected parties	**Comment***:*	**Impact**	**Evidence certainty**
Additional costs of proposed approach, compared to taking no action			
Regulated parties	**Excluding stock**: a. new fencing and/or relocation or existing fencing b. Provision of alternative stock drinking water supplies (where required). c. Fence maintenance costs **Setback** • Opportunity cost of land (setback) lost to production	Modelling of a farms based on an assumption of no compliant fencing existing, new 2-wire electric fence, a five year implementation timeframe indicates that: • A 125 ha Waikato/Bay of Plenty dairy farm would incur costs of $19,229 if a new fence was erected • A North Island 281 ha intensive (lowland) beef farm and stocking rate of 9.6 SU/ha would incur costs of $75,131 if a new fence was used • A 571 ha central North Island hill country sheep and beef farm and stock rate of 8.7SU/ha would incur costs (based on 10 percent of the farm triggering exclusion) of $15,252 for new fencing. Modelling three farms assuming a five year implementation timeframe and five or three metre setback: • The Waikato/Bay of Plenty dairy farm would incur $67,414 opportunity cost in lost land from a five metre setback (or $16,853 for a three metre setback) • North Island intensive (lowland) beef farm would incur costs of $14,018 opportunity cost in lost land from a five metre setback (or $3,505 for a three metre setback) • A hill country farm would incur (based on 10 percent of the farm triggering exclusion) $1,899	High High

[461] Modelling of Mitigation Strategies on Farm Profitability: Testing Ag Package Regulations on-Farm, P Journeaux, May 2019

		opportunity cost in lost land from a five metre setback (or $475 for a three metre setback). (All costs are in addition to the fencing costs itemised above). Separate modelling of a dairy farm in Canterbury indicated a reduction in operating surplus of $22,000pa (although this did not take into account existing setbacks or existing regional rules and modelled wholly new, rather than relocated, fences).	High
	Applying for an exemption	Low cost (The 2017 Draft Regulation provided for a maximum application fee of $2000). There are no costs for resource consents (because of the type of regulation).	
	Farmers' mental wellbeing	Low. Negative effect derived from additional pressure and anxiety if financial costs associated with fencing and stock exclusion are perceived to significantly affect the available income of farming families. [462]	Low/ Medium
Regulators	Costs of compliance monitoring and taking follow up and enforcement action. Costs of processing applications for exceptions	Medium. Likely to be monitored as part of existing compliance monitoring programmes. Likely to be an increase in public complaints about stock in water ways that will require greater follow up action. Likely to be large numbers of application for exceptions to regulations although these should be largely able to be managed on a cost recovery basis.	Medium
Wider government	General oversight of effectiveness of regulation	Low	High
Other parties	Impact of rural production/revenue at community scale	Modelling in the Ruamahanga catchment in Wairarapa suggested a catchment wide net revenue reduction relative to the BAU (ie given the regional rules already in place) of 0.6 percent (a regional production output of 2.2 percent and a regional employment reduction of 2.1 percent). Of some note, the same modelling showed a reduction of catchment revenue of 4.6 percent when modelled relative to a "no exclusion" BAU scenario.	

[462] Farmers' mental health: A review of the literature (ACC Policy Team, 2014) https://www.mentalhealth.org.nz/assets/ResourceFinder/wpc134609.pdf Also see Botha N, Roth H and Brown M (2013) '*The Adaptation of Pastoral Farmers to Environmental Policy Changes: A New Zealand Case Study*.' South African Journal of Agricultural Extension, Vol. 41: 16-25.

		This illustrates that modelling results that do not take into account existing regional rules will overestimate the marginal cost of the national regulation.	
Total Monetised Cost		Not possible to provide aggregated cost due to uncertainty on whether modelled farms are representative across all regions. Total costs (high estimate) for low-slope land would be $128 million (or $116.5 million for a three metre setback). Total costs for non-low-slope land (high estimate) would be $272.8 million (or $270.8 million for a 3 metre setback).	Medium
Non-monetised costs		Moderate/High	High

	Expected benefits of proposed approach, compared to taking no action		
Regulated parties	Some benefit from improved water quality on farm (for stock drinking etc and reduction in stock losses).	Low/medium. Excluding stock from waterways enhances productivity by preventing stock losses from drowning (particularly new born and young stock) and improves stock health as water quality in water troughs is expected to be higher. Putting water troughs away from waterways and well dispersed across pasture can also help improve pasture quality and utilisation.[463] It would contribute to enhance access to consumer markets demanding greater sustainability, provide more opportunities to gain a greater market share. Where fencing waterways is accompanied by riparian planting, this will improving the aesthetic and financial value of rural properties.	High
	Positive effect on farmer wellbeing (anxiety/mental health)	Low/medium. This will be particularly so if: • financial benefits are realised in the near future (eg reduced stock losses, improved stock health) • excluding stock from waterways builds the farming industry's social licence to operate 464 • There is certainty about what is required and by when • Increased opportunity for recreation/leisure in the local area (eg fishing, swimming).	Low/ medium

[463] Beef and Lamb Fact sheet July 2018 Available at https://beeflambnz.com/knowledge-hub/PDF/stock-exclusion-managing-stock-around-waterways.

[464] Clark-hall, P. (2018). *How to Earn a Social Licence to Operate.*

	Greater safety at work	Low/medium. Keeping stock out reduces the need for people to go in waterways. Mud, crumbling or steep banks make waterways hazardous for farm employees.	Low/ medium
Regulators	Will avoid need to develop regional stock exclusion rules and remove one source of debate and litigation in regional plan-making processes	Medium	High
Wider government	Potential benefits to the Government's biodiversity enhancement objectives	Medium	Medium
Other parties	Improved water quality and hence improvement in ecological and recreational values. Social benefits Opportunities for economic diversification in rural communities Cultural benefits	Modelling of the Ruamahanga indicated that relative to the no-stock-exclusion scenario the option would deliver: • 2.2 percent reduction in nitrogen in water • 4.2 percent reduction in phosphorus in water • 7.3 percent reduction in sediment in water. (Reductions relative to the BAU assuming council's existing rules were significantly less). Reduction of the physical damage to water bodies or to the level of microbial contaminant were not modelled but could be expected to be high. This would reduce risk to public health from exposure to *E. coli* and other pathogens. See Appendix 7 "*E. coli* for swimming" for the estimated benefit of reducing illness associated with recreational water contact. With water quality improvements, freshwater ecosystem improvements, and co-benefits for biodiversity (it is assumed that part of setback areas will be planted or revert to riparian vegetation providing more habitat in land as well) this option improves opportunities to further develop eco-tourism. Medium. Contributes to New Zealanders' cultural identity and values. Recommended option would give greatest assurance that future generations will have access to at least the same natural capital while dealing with a more extreme climate.	High

		Benefit the mauri of waterbodies, increasing opportunities for food gathering / mahinga kai as a result improved ecosystem health, particularly where fenced areas are planted. Improved perception of the farming community as stewards (kaitiaki) of the land.	
Total Monetised Benefit		The 2016 Study assessed the benefits of excluding cattle, pigs and deer from all streams >1 metre wide in flat and rolling landscape at $983 million. The current proposal would deliver greater benefit than that given it includes smaller streams.	Medium
Non-monetised benefits		High	Medium

The benefits of protecting wetlands are described in Appendix 13.

What other impacts is this approach likely to have?

There is potential for setbacks to remain unmanaged and become weed/pest plant colonised which could lead to future land management/biodiversity issues. This issue can be managed by supporting regional councils to further develop riparian management programmes. Work is also underway within the Ministry to examine the potential for riparian planting to attract a form of GHG emissions credit in order to incentivise the planting of setbacks by landowners.