APPENDIX A
AMENDMENTS TO NATIONAL POLICY STATEMENT FOR FRESHWATER MANAGEMENT
Draft National Policy Statement for Freshwater Management

Proposals for consultation September 2019

Authority
This National Policy Statement is issued by the Minister for the Environment under section 54 of the Resource Management Act 1991.

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1.1 Title
This is the National Policy Statement for Freshwater Management 2019.

1.2 Commencement
This National Policy Statement comes into force on [to come].

1.3 Purpose of National Policy Statement
The purpose of this National Policy Statement is to set out objectives and policies in relation to freshwater management and to specify what local authorities, in their governance and management roles, must do to help achieve those objectives and policies.

1.4 Matter of national significance
The matter of national significance that this National Policy Statement is about is freshwater management.

1.5 Fundamental concept – Te Mana o te Wai
Te Mana o te Wai, “the mana of the water”, refers to the fundamental value of water and the importance of prioritising the health and wellbeing of water before providing for human needs and wants. It expresses New Zealanders' special connection with freshwater. When Te Mana o te Wai is recognised and provided for, the future wellbeing of people and our unique ecosystems is protected.

Upholding and providing for Te Mana o te Wai protects the mauri of the water and requires that Te Hauora o te Talao (the health of the environment), Te Hauora o te Wai (the health of the waterbodies), and Te Hauora o te Tangata (the health of the people) are all recognised and provided for.

As it applies to freshwater management, Te Mana o te Wai is a framework that has a number of features. These may be interpreted differently by different people in different contexts. It is relevant to the application of various regulatory and non-regulatory tools. The features of Te Mana o te Wai that are relevant to, and reflected in, this National Policy Statement, are the principles of mana whakahaere/governance, kaitiakitanga/stewardship and manaakitanga/respect and care:

• the principles of mana whakahaere/governance, kaitiakitanga/stewardship and manaakitanga/respect and care;
• the hierarchy of obligations – to waterbodies first, then to the essential needs of people, and finally for other uses.

In the context of this National Policy Statement, recognising and providing for giving effect to Te Mana o te Wai requires the following, and may include other things as determined locally:
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a) adopting the priorities set out in the hierarchy of obligations;
b) providing for the involvement of iwi and hapū in freshwater management and identifying and reflecting tangata whenua values and interests;
c) engaging with tangata whenua and communities to identify matters that are important to them in respect of waterbodies and their catchments;
d) enabling the application of broader systems of values and knowledge, such as mātauranga Māori, to the health and wellbeing of waterbodies and freshwater ecosystems;
e) adopting an integrated approach, ki uta ki tai, to the management of waterbodies and freshwater ecosystems.

1.6 Definitions

(1) In this National Policy Statement:

Act means the Resource Management Act 1991

attribute means a measurable characteristic that can be used to assess a particular component of a value applied to water under the national objectives framework (see clauses 3.5 – 3.14)

commencement date means the date on which this National Policy Statement comes into force

compulsory value means any of the 3 [4] values of: Ecosystem Health, Human Contact, [Mahinga Kai or Tangata Whenua Value,] and Threatened Species, as described in Appendix 1A

ecosystem health has the meaning given in Appendix 1A

ecosystem services are the benefits obtained from ecosystems, which include:

a) supporting services (e.g. nutrient cycling, soil formation, habitat creation);
b) provisioning services (e.g. food, freshwater, wood, fibre, fuel);
c) regulating services (e.g. water purification, climate regulation, flood regulation, disease regulation); and

d) cultural services (e.g. aesthetic, spiritual, educational, recreational)

efficient allocation, in relation to water, includes economic, technical, and dynamic efficiency

environmental outcome means an environmental outcome for an FMU, or for individual waterbody or freshwater ecosystem that is described as required by clause 3.7

FMU, or freshwater management unit, means all or any part of a waterbody or waterbodies, and their related catchments, that a regional council determines under clause 3.6 is an appropriate unit for freshwater management and accounting purposes

inland wetland has the meaning in clause 3.15

ki uta ki tai (“from the mountains to the sea”), as used in the context of this National Policy Statement, refers to a holistic and integrated approach to freshwater management

limit refers to either a limit on resource use or a take limit

limit on resource use means a limit as defined in clause 3.10

national bottom line means an attribute state identified as such in Appendix 2A or 2B

natural wetland has the meaning in clause 3.15
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outstanding waterbody means a waterbody identified in a water conservation order, regional policy statement or plan as having outstanding values (such as ecological, landscape, recreational, or spiritual values)

over-allocation in relation to both the quantity and quality of water, is the situation where the water:
   a) has been allocated to users beyond a limit on resource use or a take limit, or
   b) is being used to a point where one or more target attribute states is not being met.

over-allocation in relation to water quality, is the situation where one or more target attribute states is not being met and / or water has been allocated to users beyond a limit on resource use

over-allocation in relation to water quantity, is where water has been allocated to users beyond a take limit and / or environmental flows are exceeded

primary contact site means a site identified by a regional council that it considers is regularly used, or would be regularly used, but for existing freshwater quality, for recreational activities such as swimming, paddling, boating, fishing, or watersports, and particularly for activities where there is a high likelihood of water or water vapour being ingested or inhaled

publish, in relation to an obligation on a local authority to publish material, means to make the material freely available to the public on the local authority’s Internet site

stream has the same meaning as river in the Act, and is used interchangeably with that term, as consistent with common usage

take limit means a limit on the amount of water that can be taken from an FMU, as set under clause 3.12

Te Mana o te Wai has the meaning set out in clause 1.5

terrestrial environment means land above mean high water springs


waterbody has the meaning in the Act, except that it does not include geothermal water.

(2) Terms defined in the Act and used in this National Policy Statement have the meanings in the Act, except as otherwise specified.

1.7 Application

Geographic application

(1) This National Policy Statement applies to freshwater in the terrestrial environment throughout New Zealand, except that any consideration of receiving environments includes consideration of environments in the coastal marine area.

Commented [CM8]: Amendments for clarity.

Commented [CM9]: See comment below re Clause 1.7(1).
Temporal application

(2) This National Policy Statement applies as from the date [to come], which means references to “current” or “existing” means existing as at that date, for instance, that:

a) references to “current” or “existing” means existing as at that date, and
b) a requirement to “maintain” something is a requirement to maintain the thing as it was at that date.

(3) See Part 4 for provisions about the timing of the implementation of this National Policy Statement.

Information note

The coastal marine area is covered by the New Zealand Coastal Marine Policy.

1.8 Application of section 55(2) of Act

(1) A requirement in this National Policy Statement to include a specific objective or policy (as, for instance, in clauses 3.2(1) and 3.15(2)) is a requirement referred to in section 55(2)(a) of the Act.

(2) This means the specified objective or policy must be included in policy statements or plans (as required) without using the process in Schedule 1 of the Act.

Part 2: Objectives and policies

2.1 Objectives

The objective of this National Policy Statement is to ensure that resources are managed in a way that prioritises:

a) first, the health and wellbeing of waterbodies and freshwater ecosystems; and
b) second, the essential health needs of people; and
c) third, the ability of people and communities to provide for their social, economic, and cultural wellbeing, now and in the future.

The objectives of this National Policy Statement are to:

(a) recognise and provide for Te Mana o te Wai;
(b) maintain and enhance the ecosystem health of freshwater bodies;
(c) increase the proportion of rivers and lakes that are suitable for primary contact;
(d) ensure freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole-of-catchments basis, including the effects on sensitive receiving environments;
(e) ensure freshwater is allocated and used efficiently, all existing over-allocation is phased out, and future over-allocation is avoided;
(f) ensure there is no further loss or degradation of natural inland wetlands;
(g) ensure there is no further net loss of streams.

Commented [CM10]: Copied from below.
Commented [CM11]: No because we want to improve water quality where it is currently not good enough.
Commented [CM12]: This creates uncertainty and is disconnected from the provisions it applies to. A simpler and more effective approach is to include the requirement in the relevant provision. For example, see the amendment below to Clause 3.2(1) below.
Commented [CM13]: Most of the policies are actually objectives or not necessary – see below.
Commented [CM14]: This can be read as turning section 5 of the RMA on its head. A better way to express what the draft is trying to achieve is via the proposed alternative objectives below.
Commented [CM15]: Copy from below as this is an objective, not a policy.
Commented [CM16]: Copy from below as this is an objective, not a policy.
Commented [CM17]: Copy from below as this is an objective, not a policy. What does no net loss of streams mean?
(h) ensure that outstanding waterbodies identified and the values that make them outstanding are protected;

(i) ensure the habitats of indigenous freshwater species and trout and salmon are safeguarded; and

(j) ensure people and communities are enabled to provide for their social, cultural, and economic wellbeing and their health and safety while achieving the above objectives.

2.2 Policies

The policies that this National Policy Statement is intended to achieve are as follows:

Policy 1: Freshwater is managed in a way that gives effect to Te Mana o te Wai.

Policy 2: Freshwater is managed through a national objectives framework, in order to ensure that the health and wellbeing of waterbodies and freshwater ecosystems is maintained or improved.

Policy 3: The condition of waterbodies and freshwater ecosystems is systematically monitored over time, and action is taken to reverse deteriorating trends.

Policy 4: Freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole-of-catchments basis, including the effects on sensitive receiving environments.

Policy 5: Iwi and hapū are involved in freshwater management, and tangata whenua values and interests are identified and reflected in the management of, and decisions relating to waterbodies and freshwater ecosystems.

Policy 6: The national target for water quality improvement (as set out in Appendix 3) is achieved.

Policy 7: Freshwater is allocated and used efficiently, all existing over-allocation is phased out, and future over-allocation is avoided.

Policy 8: There is no further loss or degradation of natural inland wetlands;

Policy 9: There is no further net loss of streams;

Policy 10: The significant values of outstanding waterbodies are protected;

Policy 11: The habitats of indigenous freshwater species are safeguarded;

Policy 12: Information about the state of waterbodies and freshwater ecosystems, and the challenges to their health and wellbeing, is regularly reported on and published;

Policy 13: Communities are enabled to provide for their economic wellbeing while managing freshwater in a manner consistent with Te Mana o te Wai and as required by the national objectives framework and other requirements of this National Policy Statement.
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Part 3: Implementing Giving effect to the objectives and policies

3.1 Overview of Part
This Part sets out the policies, matters, requirements, constraints, methods, limits, and directions what local authorities must do to implement or give effect to the objectives and policies of this National Policy Statement and covers the following matters, as follows:

a) subpart 1 sets out provisions relevant to Te Mana o te Wai; is about the manner in which local authorities must go about implementing this National Policy Statement;

b) subpart 2 sets out the national objectives framework for managing freshwater;

c) subpart 3 set out additional specific obligations on regional councils;

d) subpart 4 sets out exceptions applying to requirements on regional councils.

Subpart 1 Approaches to implementing objective and policies Te Mana o te Wai

3.2 Te Mana o te Wai

Section 55 direction
(1) In accordance with section 55 of the Act, every regional council must include the following objective (or words to the same effect) in its regional policy statement as soon as reasonably practicable without using the process in Schedule 1 of the Act:

“The management of freshwater in our region must be carried out in a manner that gives effect to recognises and provides for Te Mana o te Wai, as it is described in the National Policy Statement for Freshwater Management 2019 and understood locally.”

Policies
(2) Every regional council must make or change its policy statement and plans to recognise and provide for give effect to Te Mana o te Wai in implementing in order to give effect to Objective 2.1(a) of this National Policy Statement.

(3) In order to recognise and provide for Te Mana o te Wai in regional policy statements and plans, regional councils must:

a) engage in discussion with communities and tangata whenua to determine local understandings of Te Mana o te Wai as applied to freshwater bodies in the region;

b) identify tangata whenua values and interests in relation to waterbodies and freshwater ecosystems;

c) reflect those values and interests in the regional policy statement and plans.

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(d) articulate in regional policy statements, a long-term vision that recognises and provides for give effect to Te Mana o te Wai.

(4) The long-term vision must:
(a) be developed through discussion with communities and tangata whenua about their long-term wishes for waterbodies in the region and express what communities and tangata whenua want their waterbodies to be like in the future.
(b) be informed by an understanding of the history of, and current pressures on, waterbodies in the region; and
(c) express what communities and tangata whenua want their waterbodies to be like in the future.

(5) Every regional council must assess whether waterbodies in the region can both sustain current pressures on them and provide for the long-term vision articulated in its regional policy statement.

(6) The long-term vision and the discussions that led to it must inform and provide the context for all subsequent freshwater management and freshwater planning decisions in the region.

(3) Te Mana o te Wai must inform the interpretation of:
(a) the objective and policies of this National Policy Statement; and
(b) the objectives and policies required by this National Policy Statement to be included in local authority policy statements and plans.

(4) As part of the requirement to give effect to Te Mana o te Wai, when implementing this National Policy Statement, regional councils must specifically engage in discussion with communities and tangata whenua to determine local understandings of Te Mana o te Wai as applied to freshwater bodies in the region.

(5) In particular, every regional council must develop, and articulate in its regional policy statement, a long-term vision that gives effect to Te Mana o te Wai.

(6) The long-term vision must:
(a) be developed through discussion with communities and tangata whenua about their long-term wishes for waterbodies in the region; and
(b) be informed by an understanding of the history of, and current pressures on, waterbodies in the region; and
(c) express what communities and tangata whenua want their waterbodies to be like in the future.

(7) Every regional council must assess whether waterbodies in the region can both sustain current pressures on them and provide for the long-term vision articulated in its regional policy statement.

(8) The long-term vision and the discussions that led to it must inform and provide the context for all subsequent freshwater management and freshwater planning decisions in the region.
3.3 Tangata whenua roles and interests
(1) As part of the requirement to give effect to Te Mana o te Wai, regional councils must engage with tangata whenua in the management of waterbodies and freshwater ecosystems.
(2) Engagement with tangata whenua requires taking reasonable steps to:
   a) involve tangata whenua in freshwater management and decision-making regarding freshwater planning; and
   b) identify tangata whenua values and interests in relation to waterbodies and freshwater ecosystems; and
   c) reflect those values and interests in the management of, and decision-making regarding, the waterbodies and freshwater ecosystems in the region.

3.4 Integrated management

Section 55 directions
(5) In accordance with section 55 of the Act, every regional council must insert the following method policy (or words to the same effect) into its regional policy statement as soon as reasonably practicable without using the process in Schedule 1 of the Act:

“District plans must include objectives, policies, and methods to avoid, remedy, or mitigate the cumulative adverse effects of land use on freshwater bodies, freshwater ecosystems, and sensitive receiving environments resulting from urban development.”

(6) Every territorial authority must include objectives, policies, and methods in its district plan at the next review of the plan to avoid, remedy, or mitigate the cumulative adverse effects of land use resulting from urban development on waterbodies and sensitive receiving environments.

Information note:
The following are examples of the kinds of methods territorial authorities could use to comply with clause 3.4(6):
   • Regulating impervious surface cover and/or requiring on-site infiltration;
   • Requiring treatment of contaminants at source;
   • Using zoning/designations to avoid all, or certain types of development in areas where the effects on freshwater could not be adequately managed;
   • Provision of green infrastructure (especially for stormwater management);
   • Use of best practice Water Sensitive Urban Design or Low Impact Design techniques.

Policies
(1) Regional councils must, consistent with Te Mana o te Wai:
   a) recognise the interactions ki uta ki tai between freshwater, land, waterbodies, freshwater ecosystems, other ecosystems, and sensitive receiving environments, including the coastal environment; and
   b) manage freshwater, and land use and development, in catchments in an integrated and sustainable way to avoid, remedy, or mitigate adverse effects, including cumulative effects.

(2) Regional councils must make or change their regional policy statements to the extent needed to provide for the integrated management of the effects of:
(a) the use and development of land on freshwater; and
(b) the use and development of land and freshwater on sensitive receiving environments, including the coastal environment.

(4)(5) Giving effect to subclause (2) includes encouraging the co-ordination and sequencing of regional or urban growth, land use and development, and the provision of infrastructure.

(4)(6) In order to give effect to this National Policy Statement, local authorities that share jurisdiction over a catchment should co-operate in the integrated management of the effects on freshwater of land use and development.

(5) Every regional council must insert the following method (or words to the same effect) into its regional policy statement:

“District plans must include objectives, policies, and methods to avoid, remedy, or mitigate the cumulative adverse effects of land use on freshwater bodies, freshwater ecosystems, and sensitive receiving environments resulting from urban development.”

(6) Every territorial authority must include objectives, policies, and methods in its district plan at the next review of the plan to avoid, remedy, or mitigate the cumulative adverse effects of land use resulting from urban development on waterbodies and sensitive receiving environments.

Information note:
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• Regulating impervious surface cover and/or requiring on-site infiltration;
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• Using zoning/designations to avoid all, or certain types of development in areas where the effects on freshwater could not be adequately managed;
• Provision of green infrastructure (especially for stormwater management);
• Use of best practice Water Sensitive Urban Design or Low Impact Design techniques.

Subpart 2 National objectives framework

3.5 Overview of national objectives framework

(1) The national objectives framework requires that every regional council:

(a) identifies values for each FMU in its region;
(b) sets environmental outcomes that achieve the objectives and policies of this National Policy Statement;
(c) sets target attribute states, and flows and levels, for waterbodies;
(d) develops interventions (limits specified in rules, or action plans) to achieve the target attribute states, flows, and levels;
(e) monitors waterbodies and freshwater ecosystems; and

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(f) takes steps if deterioration is detected.

(2) At every stage of the process, regional councils must engage with communities and tangata whenua in order to give effect recognise and provide for to Te Mana o te Wai, as required by clause 3.2.

3.6 Identifying FMUs and monitoring sites

Policies

(1) Every regional council must identify FMUs for its region in the regional plan or regional policy statement.

(2) Every fresh waterbody in the region must be located within an FMU.

(3) Every regional council must also identify in the regional plan or regional policy statement the following (if present) within each FMU:
   a) sites to be used for monitoring attributes;
   b) primary contact sites if present;
   c) the location of habitats of threatened species and at risk species if present;
   d) outstanding waterbodies if present;
   e) inland wetlands (see clause 3.15) if present.

(4) Monitoring sites in an FMU must be located at sites that are either or both of the following:
   a) representative of the FMU;
   b) representative of one or more primary contact sites in the FMU if present.

3.7 Identifying values and environmental outcomes

Policies

(1) Every regional council must identify the values that apply to each FMU, as follows:
   a) the compulsory values as set out in Appendix 1A;
   b) any of the other values set out in Appendix 1B that the council considers applies;
   c) any other value as the council considers, after consultation with its community and tangata whenua, applies.
   d) The values and their locations within an FMU must be identified in the regional plan or regional policy statement.

(2) For each FMU, or for individual waterbodies or freshwater ecosystems within an FMU, the regional council must describe the environmental outcomes that achieve the objectives and policies of this National Policy Statement and that it wants to achieve for:
   a) the value Ecosystem Health, and each of its components; and
   b) the value Human Contact, and each of its components; and
   c) the value(s) [Mahinga Kai or Tangata Whenua Value and] Threatened Species; and
   d) any other values and components the council identifies.

(3) A regional council may identify additional components and attributes for any of the compulsory values, and components and attributes for any additional values identified.

(4) Any additional attributes developed by councils must be specific and, where possible, be able to be assessed in numeric terms.

Commented [CM56]: Amended for clarity.
Commented [CM55]: Amended for clarity.
Commented [CM57]: Amendment for clarity.
Commented [CM58]: These words should apply to b) to e), but not a).
Commented [CM59]: At risk species should be included as well.
Commented [CM60]: Needs to be both.
Commented [CM61]: Might not be any primary contact sites.
Commented [CM62]: Amendment for consistency with amendments above referring to the regional policy statement or regional plan.
Commented [CM63]: Addition to clarify what this actually means.
Regional councils must include the environmental outcomes identified or described under this clause as an objective in their regional plans.

### 3.8 Identifying current attribute states

**Policies**

1. Every regional council must identify the current state of each attribute (noting that water quantity does not have attributes – see clause 3.11).
2. The current state need not be a single measure but may take into account natural variability and sampling error.
3. If a regional council does not have complete and scientifically robust data on which to establish the current state of an attribute, it must use its best efforts to identify a current state using the information that is available, including partial data, local knowledge, and information obtained from other sources.

### 3.9 Setting target attribute states

**Policies**

1. In order to achieve the environmental outcomes described under clause 3.7, every regional council must set a target attribute state for every attribute, at each relevant monitoring site.
2. Every target attribute state must:
   a) for attributes relating to the value Human Contact, be above the current state of that attribute as determined under clause 3.8 unless the current state is already in Attribute Band A or Excellent, in which case the attribute state must be set in Attribute Band A or Excellent; and
   b) for all other attributes, be at or above the current state of that attribute as determined under clause 3.8 unless the current state is already in Attribute Band A, in which case the attribute state must be set in Attribute Band A.
3. However, if the current attribute state is worse than the national bottom line for that attribute (as identified in Appendix 2A or 2B), the target attribute state must be set at, or better than, the national bottom line (see subpart 4 for exceptions to this).
4. Every target attribute state must:
   a) specify a timeframe for achieving the target attribute state; and
   b) for attributes for compulsory values, be set in terms of the requirements of Appendix 2A or 2B, as appropriate; and
   c) for any other attribute, be set in any way appropriate to the attribute.
5. Timeframes for achieving target attribute states:
   a) may be of any length or period **but no longer than 35 years**; but
   b) if timeframes are long-term, they must include interim targets (set for intervals of not more than 10 years) to be used to assess progress towards achieving the target attribute state in the long-term.
6. When setting target attribute states, regional councils must:
   a) have regard to the following:
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i. the foreseeable impacts of climate change;
ii. the long-term vision set under clause 3.2;
iii. the environmental outcomes set under clause 3.7(2);
iv. the connections between waterbodies;
v. the connection of waterbodies and coastal water; and
b) use the best information available at the time; and
c) not delay making decisions because of uncertainty about the quality or quantity of the information; and
d) take into account results or information from freshwater accounting systems; and
e) consider the requirements of all other national directions.

(7) If an attribute applies to more than one value, the most stringent target state that is required to achieve the environmental outcomes described under clause 3.7 must be applied wherever that attribute applies.

3.10 Identifying limits on resource use and preparing action plans

Policies

(1) In order to achieve the target attribute states for the attributes in Appendix 2A and Appendix 2B, every regional council:
   a) must identify limits on resource use that will achieve the target attribute state; and
   b) must include the limits on resource use as rules in its regional plan; and
   c) may prepare and publish action plans that set out how the target attribute states are to be achieved; and
   d) may impose conditions on resource consents.

(2) In order to achieve the target attribute states for the attributes in Appendix 2B, every regional council:
   a) must prepare an action plan for achieving the target attribute state within the specified timeframe; and
   b) must publish the action plan; and
   c) may identify limits on resource use and include them as rules in its regional plan; and
   d) may impose conditions on resource consents.

(3) In order to achieve any other target attribute states, a regional council may do any or all of the following:
   a) identify limits on resource use and include them as rules in its regional plan;
   b) prepare and publish action plans that set out how any other target attribute states are to be achieved;
   c) impose conditions on resource consents.

(4) Limits on resource use may:
   a) apply to any activity or land use practice; and
   b) apply at any scale (such as to all or any part of an FMU, or to a specific waterbody or individual property); and
   c) be expressed as an input control (such as an amount of fertiliser that may be applied) or an output control (such as a volume or rate of discharge); and
   d) describe the circumstances in which the limit applies.

(5) In setting limits on resource use, regional councils must:
3.11 Setting environmental flows and levels

Policies

(1) Every regional council must set environmental flows and levels for each FMU, and may set them for individual waterbodies or parts of waterbodies in an FMU.

(2) The environmental flows and levels must be developed on the basis of the environmental outcomes identified under clause 3.7.

(3) The environmental flows and levels must be expressed in terms of the water level, flow rate, and variability of flow (as appropriate to the waterbody) at which:
   a) for flows and levels in rivers, the taking, damming, or diverting of water meets the environmental outcomes for the river and any connected waterbody; and
   b) for levels of lakes, the taking, damming, or diverting of water meets the environmental outcomes for the lake and any connected waterbody; and
   c) for levels of groundwater, the taking, damming, or diverting of water meets the environmental outcomes for the groundwater and any connected surface water.

(4) Clause 3.9(6) applies when regional councils are setting environmental flows and levels.

3.12 Identifying take limits

Policies

(1) In order to meet environmental flows and levels, every regional council:
   a) must identify take limits for each FMU; and
   b) must include the take limits as rules in its regional plan; and
   c) must state in its regional plan whether existing water permits will be reviewed to comply with environmental flows and levels; and
   d) may prepare and publish action plans that set out how the environmental flows and levels are to be met; and
   e) may impose conditions on resource consents.

(2) Take limits must be expressed as a total volume or total rate at which water may be taken from each FMU, or from parts of an FMU, and must state the circumstances in which the take may occur and any circumstances in which it must be reduced or cease.

(3) Take limits must be identified at levels that:
   a) provide for flow or level variability that meets the needs of the relevant waterbody and connected waterbodies, and their associated ecosystems; and
   b) safeguard ecosystem health from the effects of the take limit on the frequency and duration of lowered flows or levels; and
   c) provide for the lifecycle needs of aquatic life; and
   d) provide for the essential health needs of people; and

Commented [CM72]: Missing word – see a) and b).
Commented [CM73]: This should be required, not optional.
Commented [CM74]: Needs to be clear what the purpose of action plans is.
Commented [CM75]: Amendment for clarity.
NOT GOVERNMENT POLICY– CONSULTATION DRAFT – AMENDMENTS PROPOSED BY EDS SHOWN IN UNDERLINING AND STRIKE-THROUGH

e) take into account provide for the environmental outcomes applying to the relevant waterbodies and any connected waterbodies (such as aquifers and downstream surface waterbodies), whether in the same or another region.

(4) Clause 3.10(5) and (6) apply when regional councils are identifying take limits.

3.13 Monitoring Policies

(1) Every regional council must establish methods for monitoring progress towards achieving target attribute states and identified environmental outcomes for values and components.

(2) The methods must include:
   a) measures of the health of indigenous flora and fauna; and
   b) mātauranga Māori.

(3) Monitoring methods must recognise the importance of long-term trends in monitoring results, and the relationship between results and their contribution to evaluating the environmental outcomes set under clause 3.7(2).

3.14 What to do if deterioration detected Policies

(1) If a regional council detects a trend indicating a deterioration in any attribute state, or a failure to achieve environmental flows or levels or identified environmental outcomes for values or components, it must prepare an action plan for halting, and if possible reversing, the deterioration and amend the relevant action plan(s) in order to halt, and if possible reverse, the deterioration as soon as reasonably practicable.

(2) The action plan(s) must be amended to include actions to identify the causes of the deterioration, methods to address those causes, an evaluation of the effectiveness of the methods, and processes for regular review and adjustment.

(3) Where a target attribute state, environmental flow or level, or environmental outcome is not being met, the regional council may take any other steps, which may be regulatory (such as making rules or implementing methods), non-regulatory, or both, to assist the improvement of water quality, and avoid over-allocation, within defined timeframes.

Information notes

Action plans may include, for example:

a) describing the circumstances (ie, minimum flows) at which water takes will be restricted by way of a water shortage direction under section 329 of the Act;

b) points at which monitoring will be increased.

The following table identifies the values, components, and attributes of the compulsory values, and the minimum interventions that regional councils must use to achieve the target attribute states.

Commented [CM76]: Stronger and consistent with wording of a) i) and d).

Commented [CM77]: Needs to be clear that environmental flows and levels are included.

Commented [CM78]: Amendments made above to make action plans compulsory, so the obligation here should be to review and amend the action plan.

Commented [CM79]: Most of this table does not identify minimum interventions: it refers to limits. Limits / targets are set under the NOF. If they are not being met, then an action plan is required.
<table>
<thead>
<tr>
<th>Table Number</th>
<th>Value</th>
<th>Component</th>
<th>Attribute</th>
<th>Minimum Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Ecosystem health</td>
<td>Water quality</td>
<td>Total nitrogen (lakes) (to be included in Appendix 2A)</td>
<td>Limit</td>
</tr>
<tr>
<td>4</td>
<td>Ecosystem health</td>
<td>Water quality</td>
<td>Total phosphorus (lakes) (to be included in Appendix 2A)</td>
<td>Limit</td>
</tr>
<tr>
<td>5</td>
<td>Ecosystem health</td>
<td>Water quality</td>
<td>Dissolved inorganic nitrogen (rivers)</td>
<td>Limit</td>
</tr>
<tr>
<td>6</td>
<td>Ecosystem health</td>
<td>Water quality</td>
<td>Dissolved reactive phosphorus (rivers)</td>
<td>Limit</td>
</tr>
<tr>
<td>7</td>
<td>Ecosystem health</td>
<td>Water quality</td>
<td>Ammonia toxicity (rivers)</td>
<td>Limit</td>
</tr>
<tr>
<td>8</td>
<td>Ecosystem health</td>
<td>Water quality</td>
<td>Nitrate toxicity (rivers)</td>
<td>Limit</td>
</tr>
<tr>
<td>9</td>
<td>Ecosystem health</td>
<td>Water quality</td>
<td>Dissolved oxygen (rivers)</td>
<td>Limit or Action plan</td>
</tr>
<tr>
<td>10</td>
<td>Ecosystem health</td>
<td>Water quality</td>
<td>Suspended fine sediment (rivers)</td>
<td>Limit</td>
</tr>
<tr>
<td>11</td>
<td>Ecosystem health</td>
<td>Water quality</td>
<td>Dissolved oxygen (general)</td>
<td>Action plan</td>
</tr>
<tr>
<td>12</td>
<td>Ecosystem health</td>
<td>Water quality</td>
<td>Dissolved oxygen (lakes - bottom)</td>
<td>Action plan</td>
</tr>
<tr>
<td>13</td>
<td>Ecosystem health</td>
<td>Water quality</td>
<td>Dissolved oxygen (lakes - seasonally stratifying) (mid-hypolimnion)</td>
<td>Action plan</td>
</tr>
<tr>
<td>14</td>
<td>Ecosystem health</td>
<td>Water quality</td>
<td>Deposited sediment (rivers - wadeable)</td>
<td>Action plan</td>
</tr>
<tr>
<td>15</td>
<td>Ecosystem health</td>
<td>Aquatic life</td>
<td>Phytoplankton (lakes) (to be included in Appendix 2A)</td>
<td>Limit</td>
</tr>
<tr>
<td>16</td>
<td>Ecosystem health</td>
<td>Aquatic life</td>
<td>Periphyton (rivers) (to be included in Appendix 2A)</td>
<td>Limit</td>
</tr>
<tr>
<td>17</td>
<td>Ecosystem health</td>
<td>Aquatic life</td>
<td>Macroinvertebrates (MCI, QMCI) (rivers - wadeable)</td>
<td>Action plan</td>
</tr>
<tr>
<td>18</td>
<td>Ecosystem health</td>
<td>Aquatic life</td>
<td>Macroinvertebrates (ASPM) (rivers - wadeable)</td>
<td>Action plan</td>
</tr>
</tbody>
</table>
Subpart 3  Specific requirements

3.15  Inland wetlands

In this subpart:

coastal wetland means a natural wetland that is influenced by marine or coastal geomorphological processes to the seaward extent of freshwater influence, and includes:

a) saltmarshes (of which mangroves can be a structural component); and
b) seagrass meadows in intertidal and subtidal zones less than 2 m below mean low water spring tide

constructed wetland means a wetland constructed by artificial means that:

a) supports an ecosystem of plants that are suited to wet conditions; and
b) is constructed for a specific purpose in a place where a natural wetland does not already exist

effects management hierarchy means an approach to managing the adverse effects of subdivision, use, and development that requires that:

a) adverse effects are avoided where possible; and
b) adverse effects that cannot be demonstrably avoided are remedied where possible; and

c) adverse effects that cannot be demonstrably remedied are mitigated; and

d) in relation to adverse effects that cannot be avoided, remedied, or mitigated, offsetting is considered; and

e) if offsetting is not demonstrably achievable, compensation is considered

<table>
<thead>
<tr>
<th>Table Number</th>
<th>Value</th>
<th>Component</th>
<th>Attribute</th>
<th>Minimum Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Ecosystem health</td>
<td>Aquatic life</td>
<td>Fish (IBI) (rivers)</td>
<td>Action-plan</td>
</tr>
<tr>
<td>16</td>
<td>Ecosystem health</td>
<td>Aquatic life</td>
<td>Lake submerged plants (native)</td>
<td>Action-plan</td>
</tr>
<tr>
<td>17</td>
<td>Ecosystem health</td>
<td>Aquatic life</td>
<td>Lake submerged plants (invasive species)</td>
<td>Action-plan</td>
</tr>
<tr>
<td>22</td>
<td>Ecosystem health</td>
<td>Ecosystem processes</td>
<td>Ecosystem metabolism (rivers)</td>
<td>Action-plan</td>
</tr>
<tr>
<td>11</td>
<td>Human contact</td>
<td>Human Health</td>
<td>E. coli (lakes and rivers)</td>
<td>Limit or Action plan</td>
</tr>
<tr>
<td>12</td>
<td>Human contact</td>
<td>Human Health</td>
<td>Cyanobacteria (lakes and lake-fed rivers)</td>
<td>Limit or Action plan</td>
</tr>
<tr>
<td>23</td>
<td>Human contact</td>
<td>Primary contact</td>
<td>E. coli</td>
<td>Action-plan</td>
</tr>
</tbody>
</table>
inland wetland means any wetland that is not a coastal wetland, but does not include geothermal wetlands.

loss or degradation, in relation to a wetland, means the loss of extent, or a condition of deteriorated or depleted ecosystem health, ecosystem services, processes, or functioning.

natural wetland means a wetland as defined in the Act (regardless of whether it is dominated by indigenous or exotic vegetation), except that it does not include:

a) wet pasture or paddocks where water temporarily ponds after rain in places dominated by pasture, or that contain patches of exotic sedge or rush species; or
b) constructed wetlands; or

c) geothermal wetlands.

net gain, in relation to a wetland or stream, means the point at which the measurable positive effects on the ecosystem health of the wetland or stream exceed the point of no net loss.

net loss means the point at which measurable positive effects from targeted environmental management activities match the environmental losses due to the impacts of a specific development project, so that compared to a baseline there is no net reduction in environmental values over space and time.

Section 55 direction

(2) In accordance with section 55 of the Act, every regional council must include in its regional policy statement the following policy (or words to the same effect) as soon as reasonably practicable without using the process in Schedule 1 of the Act:

“The loss or degradation of all or any part of a natural inland wetland is avoided.”

(3) However, the policy required by subclause (2):

a) must be read subject to any rules that give effect to the requirements of the National Environmental Standards for Freshwater, or to any more stringent rules that the council, as permitted by those Standards, includes in its regional plan; and

b) does not apply to adverse effects from an activity that is for the purpose of restoring a wetland and those effects are temporary and reversible, or are consistent with achieving the long-term restoration aims for the wetland.

Policies

(4) Every regional council must make or change its policy statement and plan to ensure that, when considering an application for a consent, adverse effects on any natural inland wetland are managed by applying the effects management hierarchy.

(5) Every regional council must, in respect of natural inland wetlands, and may in respect of constructed wetlands:

a) identify and map wetlands in its region that are:
   i. 0.05 hectares or greater in size; or
   ii. known to contain threatened species; or
   iii. of a type that is naturally less than 0.05 ha in size (such as ephemeral wetlands or springs); and

b) establish and maintain an inventory of wetlands that includes, at a minimum, the following information about each mapped wetland:
   i. identifier and location;
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ii. area and Geographic Information System (GIS) polygon;
iii. classification of wetland type;
iv. values (such as ecosystem services, habitat for indigenous biodiversity, amenity values);
v. results of monitoring.

(6) In case of uncertainty or dispute about the existence or extent of a natural inland wetland, a regional authority must use the wetland delineation protocol available at: https://www.landcareresearch.co.nz/__data/assets/pdf_file/0003/181353/1903-TSDC148-Wetland-delineation-protocols.pdf, and the outcome of applying that protocol must be taken as definitive.

(7) Every regional council must include objectives, policies, or methods in its regional policy statement and plans that provide for and encourage the restoration of natural inland wetlands in its region.

(8) Regional councils must permit provide for the management of a constructed wetlands to prioritise activities and management practices that are necessary for, or consistent with, the purpose for which the wetland was constructed.

(9) Every regional council must:
   a) develop and undertake a monitoring plan to monitor the condition of its region’s natural inland wetlands by reference to, at a minimum, their extent, vegetation, hydrology, and nutrients (in water, soil, or both); and
   b) have methods to respond when degradation of wetland conditions is detected.

Information note:
Examples of constructed wetlands include areas of wetland habitat in or around bodies of water created for, or in connection with, any of the following purposes:

- nutrient attenuation;
- effluent treatment and disposal systems;
- stormwater management;
- reservoir for firefighting;
- hydroelectric power generation;
- irrigation;
- stock watering;
- domestic and community water supply;
- water storage ponds;
- landscaping;
- other artificial water storage facilities, including open drainage channels and engineered soil conservation structures;
- conservation or biodiversity offsetting;
- hunting.

The National Policy Statement on Indigenous Biodiversity 2020 contains additional relevant policies concerning the restoration and enhancement of wetlands.

The National Environmental Standard for Freshwater sets out regulations for the management of wetlands, river bed infilling, and fish passage.
3.16 Streams

Section 55 direction
(1) In accordance with section 55 of the Act, every regional council must include the following policy (or words to the same effect) in its regional policy statement as soon as reasonably practicable without using the process in Schedule 1 of the Act:

“The extent and ecosystem health of rivers and streams in the region, and their associated freshwater ecosystems, are at least maintained”.

(2) However, the policy must be read subject to any rules that give effect to the requirements of the National Environmental Standards for Freshwater, or to any more stringent rules that the council, as permitted by those Standards, includes in its regional plan.

Policies
(3) Every regional council must make or change its policy statement and plans to ensure that, when considering an application for a consent, adverse effects on any stream are managed by applying the effects management hierarchy.

(4) Every regional council must make or change its regional policy statement and plans to ensure that the following do not result in a net loss in the extent or ecosystem health of a stream:
   a) permanently diverting a stream;
   b) culverting a stream, where that is allowed and as far as practicable;
   c) reclamation of a stream.

(5) Every regional council must make or change its regional policies policy statement and plans to ensure that the infilling and / or reclamation of river or stream beds is avoided, unless there are no other practicable alternative methods of providing for the activity, and it is part of an activity:
   a) designed to restore or enhance the natural values of the stream or of any adjacent or associated ecosystem; or
   b) necessary to enable the development, operation, maintenance and upgrade of nationally significant infrastructure; or
   c) required for the purposes of flood prevention or erosion control.

(6) However, subclause (5) is subject to any rules that give effect to the requirements of the National Environmental Standards for Freshwater, or to any more stringent rules that the council, as permitted by those Standards, includes in its regional plan.

3.17 Fish passage

Policies
(1) Every regional council must make or change its regional plan to include aquatic life objectives to achieve diversity and abundance of fish in all or specified streams.

(2) When preparing the objectives, regional councils must:
   a) identify the valued species, and their relevant life stages, for which instream structures must provide passage; and
   b) identify undesirable species whose passage can or should be prevented; and
c) identify streams where fish passage for undesirable fish species is to be impeded in order to manage their adverse effects on fish populations upstream of any barrier; and
d) take into account any Freshwater Fisheries Management Plans and Sports Fish and Game Management Plans approved by the Minister of Conservation under the Conservation Act 1987; and
e) consult with the Department of Conservation to identify any threatened or at risk fish species that may benefit from natural or built barriers to exclude undesirable species.

(3) Regional councils must make or change their plans to require that regard is had to at least the following when considering an application for a consent relating to an instream structure:
   a) the extent to which the structure provides, and will continue to provide for the foreseeable life of the structure, the council’s aquatic life objectives for fish;
   b) the extent to which the structure does not cause a greater impediment to fish movements than in adjacent stream reaches;
   c) the extent to which it provides efficient and safe passage for all fish (other than undesirable species) at all their life stages;
   d) the extent to which it provides a diversity of physical and hydraulic conditions leading to a high diversity of passage opportunities for fish;
   e) any proposed monitoring and maintenance plan for ensuring that the structure meets the council’s aquatic life objectives for fish now and in the future.

(4) Regional councils must establish and implement a work programme to improve the extent to which existing structures achieve the council’s aquatic life objectives for fish.

(5) The work programme must include the following:
   a) identifying existing instream structures within the region, and evaluating the risk they present as an undesirable barrier to fish migrations;
   b) prioritising structures for remediation, applying the ecological criteria described in Table 5.1, of the New Zealand Fish Passage Guidelines;
   c) documenting the structures or locations that have been prioritised, the remediation that is required to achieve the desired outcome, and how and when this will be achieved;
   d) identification of structures that have been remediated since the commencement date;
   e) how the ongoing performance of the remediated structure will be monitored and evaluated.

(6) Regional councils must collect, maintain, and publish records of new and (known) existing instream structures and assess their likely impact on fish passage and river connectivity.

Information note:
The following is a useful tool to help with managing fish passage:

3.18 Primary contact sites

Policies

(1) Regional councils must manage primary contact sites for:
   a) their risk to human health; and
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b) their suitability for the activities that take place in them, in terms of, for example, the absence of slippery or unpleasant weed growth, and the visual clarity of the water.

(2) For every primary contact site in an FMU, regional councils must identify a sampling site or sites representative of the primary contact site or a number of primary contact sites.

(3) Between 1 November and 31 March each year, every regional council must undertake weekly sampling for \( E. \text{coli} \), unless:
   a) a single sample from the sampling site is greater than 260 \( E. \text{coli} \) per 100 mL, in which case:
      i. sampling frequency must be increased to daily, where practicable; and
      ii. the regional council must take all reasonable steps to identify potential causes of microbial contamination; or
   b) a single sample from the sampling site is greater than 540 \( E. \text{coli} \) per 100 mL, in which case the regional council must take all reasonable steps to notify the public, and keep them informed, that the site is unsuitable for primary contact until further sampling shows a result of 540 \( E. \text{coli} \) per 100 mL or less.

3.19 Water allocation

Policies

(1) Every regional council must make or change its regional plan to include criteria for:
   a) deciding applications to approve transfers of water take permits; and
   b) deciding how to improve and maximise the efficient allocation of water.

(2) Every regional council must identify in regional plans methods to encourage the efficient use of water.

(3) Regional councils must define a timeframe within which over-allocated is phased out, and methods to achieve that, so that the limits on resource use and take limits are reduced to levels that meet the objective and policies of this National Policy Statement.

3.20 Accounting systems

Policies

(1) Every regional council must operate and maintain, for every FMU for which target attribute states and limits have been or are being set:
   a) a freshwater quality accounting system; and
   b) a freshwater quantity accounting system.

(2) The purpose of the accounting systems is to provide the baseline information required:
   a) for setting target attribute states, environmental flows and levels, and limits; and
   b) to assess whether an FMU is over-allocated or not; and
   c) to track over time the cumulative effects of activities (such as the granting of resource consents).

(3) The accounting systems must be maintained at a level of detail commensurate with the significance of the water quality or quantity issues applicable to each particular FMU.
(4) Every regional council must make information from those systems available to the public, regularly and in a suitable form, for every FMU for which target attribute states have been, or are being, set.

(5) The freshwater quality accounting system must (where possible), for each FMU, record, aggregate, and regularly update information on the measured, modelled, or estimated:
   a) loads, concentrations, or both, of relevant contaminants; and
   b) where a load or concentration has been set on the amount of a contaminant that is acceptable in a waterbody, the proportion of that amount recorded at monitoring sites for that contaminant; and
   c) sources of relevant contaminants; and
   d) the amount of each contaminant attributable to each source.

(6) The freshwater quantity accounting system must, for each FMU, record, aggregate, and regularly update information on the measured, modelled, or estimated:
   a) amount of freshwater take; and
   b) the proportion of freshwater taken by each major category of use; and
   c) where a take limit has been set, the proportion of the allocation taken.

(7) In this section, freshwater take refers to all takes, whether metered or not, whether subject to a consent or not, and whether authorised or not.

Information note:
The Resource Management (Measurement and Reporting of Water Takes) Regulations 2010 require water takes of more than 5 l per second to be measured and reported on.

3.21 Assessing and reporting Policies

(1) Every regional council must produce a report annually on freshwater management in its region that sets out:
   a) actual data, or a link to those data, about each component of the values Ecosystem Health and Human Contact, as obtained from monitoring sites for the attributes of the components; and if no data has been collected in relation to any attribute, this must be identified; and
   b) actual data, or a link to those data, from any other monitoring done for the purpose of freshwater management; and
   c) a description of any uncertainties associated with the data.

(2) As part of the report required by section 35 of the Act (which is required at least every 5 years), every regional council must assess the freshwater management in its region and produce a synthesis report on it.

(3) The assessment required for the synthesis report must cover at least the following:
   a) a comparison of the present state of attributes (and other things that are monitored) as at the time of the assessment as compared with any target attribute states for those things, including the extent to which the present state aligns with the environmental outcomes sought, in relation to each value, for each FMU; and
   b) an assessment of the cumulative effect of changes across multiple sites within an FMU and multiple attributes during the period covered by the assessment;
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c) if monitoring shows a deterioration from the current state or a downward trend, information on the known or likely causes;
d) an assessment of the actions taken since the last assessment, whether regulatory or non-regulatory and whether by local authorities or others, that contribute to the implementation of this National Policy Statement [not mentioned];
e) an assessment of whether the target attribute states and environmental outcomes for each FMU in the region are being achieved and, if not, whether and when they are likely to be;
f) the environmental pressures on each FMU (such as water takes, sources of contaminants, or waterbody modification) as indicated by information from the freshwater accounting systems referred to in clause 3.20;
g) any uncertainties in the data, evidence, or other information referred to or relied on in the assessment;
h) predictions of changes that are likely to affect waterbodies and freshwater ecosystems in the region;
i) an account of the extent to which, in the region:  
   i. the long-term visions for waterbodies, as identified under clause 3.2, are being achieved; and
   ii. the objective and policies of this National Policy Statement are being met.

(4) The synthesis report must set out the results of the assessments and also:
a) report on the state of each component of the value Ecosystem Health, and identify where any data or information is missing; and
b) provide a single ecosystem health score (by reference to the 5 components of Ecosystem Health) for each FMU in the region.

(5) The synthesis report must:
a) be written and presented in a way that members of the public are likely to understand easily; and
b) include specific data, or a link to where that data may be viewed; and
c) be freely available on the regional council's website.

Information note

Subpart 4 Exceptions

3.22 Exception for large hydro schemes

(1) This section applies to the following 6 hydro-electricity generation schemes (referred to as Schemes):
   a) Waikato Hydro Scheme;
   b) Tongariro Power Scheme;
   c) Waikaremoana Power Scheme;
   d) Waitaki Hydro Scheme;
   e) Manapouri Power Scheme;
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6. Clutha Hydro Scheme.

(2) When setting limits or developing action plans, and when making plan changes required by this National Policy Statement, regional councils must have regard to the importance of not adversely impacting the generation capacity, storage and operational flexibility of a Scheme.

(3) Regional councils may accordingly set target attribute states that are below national bottom lines in respect of waterbodies or freshwater ecosystems that are adversely impacted by structures that form part of any Schemes, to the extent of such an impact.

(4) Despite subclause (3), regional councils must still set target attributes states that, to the extent possible, improve any waterbody or freshwater ecosystem affected by any Scheme.

(5) Subclause (1) only applies to structures that were first operational as part of any Scheme on or before 1 August 2019, including any subsequent maintenance, repair or like replacement works.

Policies

3.23 Exception for naturally occurring processes

(1) If all or part of a waterbody is affected by naturally occurring processes that mean that the current state is worse than the national bottom line, and a target attribute state at or better than the national bottom line cannot be achieved, the regional council may set a target attribute state that is worse than the national bottom line, but must still set it to achieve an improved attribute state to the extent feasible given the natural processes.

(2) In any dispute about whether this exception should apply, the onus is on the relevant regional council to demonstrate that it is naturally occurring processes that prevent the national bottom line being achieved.

(3) For the purposes of this section, naturally occurring processes means processes that could have occurred in New Zealand before the arrival of humans.

3.24 Transitional exception

Regional councils may set target attribute states that are worse than national bottom lines in respect of freshwater ecosystems identified in Appendix 4, until the times, or for the periods, specified in that appendix.

Part 4 Timing

4.1 Timing

Policies

(1) Every regional council must implement the objectives and policies of this National Policy Statement as soon as reasonably practicable.

(2) The final decisions on changes to policy statements and plans that are necessary to give effect to this National Policy Statement must be publicly notified no later than 31 December 2025.
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(3) To the extent that regional policy statements and plans already implement the objectives and policies of this National Policy Statement, regional councils are not obliged to make changes to wording or terminology merely for consistency with it.

(4) However, in case of dispute, the onus is on the regional council to show that, despite the different wording or terminology used, their regional policy statement or plan does implement the objectives and policies of this National Policy Statement.
Appendices

Appendix 1A: Compulsory values

1 Ecosystem health
In relation to a waterbody in an FMU, ecosystem health refers to the extent to which the FMU supports an ecosystem appropriate to the type of waterbody (eg, river, lake, wetland, or aquifer).

There are 5 biophysical components that contribute to freshwater ecosystem health, and it is necessary that all of them are managed. They are:

- **Water quality** – the physical and chemical measures of the water, such as temperature, dissolved oxygen, pH, suspended sediment, nutrients and toxicants.
- **Water quantity** – the extent and variability in the level or flow of water.
- **Habitat** - the physical form, structure and extent of the waterbody, its bed, banks and margins, riparian vegetation and connections to the floodplain.
- **Aquatic life** – the abundance and diversity of biota including microbes, invertebrates, plants, fish and birds.
- **Ecological processes** – the interactions among biota and their physical and chemical environment such as primary production, decomposition, nutrient cycling and trophic connectivity.

In a healthy freshwater ecosystem, water quality, quantity, habitat and processes are suitable to sustain appropriate indigenous aquatic life, as would be found in a minimally disturbed condition (before providing for other values).

2 Human contact
This refers to the extent to which waterbodies in an FMU support people being able to connect with the water through a range of activities such as swimming, waka, boating, fishing, mahinga kai, and water skiing, in a range of different flows.

Matters to take into account for a healthy waterbody for human contact include pathogens, clarity, deposited sediment, plant growth (from macrophytes to periphyton to phytoplankton), cyanobacteria, and other toxicants.

3 Threatened species
This refers to the extent to which an FMU that supports a population of threatened species has the conditions necessary to support the continued presence and survival of the threatened species. The basic conditions relate to aquatic habitat, water quality, and flows or water levels, but may also include specialised habitat or conditions needed for only part of the life-cycle of the threatened species.
Mahinga kai – Kai are safe to harvest and eat.

Mahinga kai generally refers to indigenous freshwater species that have traditionally been used as food, tools, or other resources. It also refers to the places those species are found and to the act of catching them. Mahinga kai provide food for the people of the rohe and these sites give an indication of the overall health of the water. For this value, kai would be safe to harvest and eat. Transfer of knowledge would occur about the preparation, storage and cooking of kai. In freshwater management units that are used for providing mahinga kai, the desired species are plentiful enough for long-term harvest and the range of desired species is present across all life stages.

Mahinga kai – Kei te ora te mauri (the mauri of the place is intact).

For this value, freshwater resources would be available and able to be used for customary use. In freshwater management units that are valued for providing mahinga kai, resources would be available for use, customary practices able to be exercised to the extent desired, and tikanga and preferred methods are able to be practised.
Appendix 1B: Other values that must be considered

Contents
1 Natural form and character
2 [Mahinga kai]
3 [Mahinga kai]
4 Fishing
5 Irrigation, cultivation, and food productions
6 Animal drinking water
7 Wai tapu
8 Potable water supply
9 Commercial and industrial use
10 Hydro-electric power generation
11 Transport and Tauranga waka

Descriptions of other values

Natural form and character – Where people value particular natural qualities of the freshwater management unit.

Matters contributing to the natural form and character of a freshwater management unit are its biological, visual and physical characteristics that are valued by the community, including:

i. its biophysical, ecological, geological, geomorphological and morphological aspects;
ii. the natural movement of water and sediment including hydrological and fluvial processes;
iii. the location of the waterbody relative to its natural course;
iv. the relative dominance of indigenous flora and fauna;
v. the presence of culturally significant species;
vi. the colour of the water; and
vii. the clarity of the water.

They may be freshwater management units with exceptional, natural, and iconic aesthetic features.
Mahinga kai – Kai are safe to harvest and eat.

Mahinga kai generally refers to indigenous freshwater species that have traditionally been used as food, tools, or other resources. It also refers to the places those species are found and to the act of catching them. Mahinga kai provide food for the people of the rohe and these sites give an indication of the overall health of the water.

For this value, kai would be safe to harvest and eat. Transfer of knowledge would occur about the preparation, storage and cooking of kai. In freshwater management units that are used for providing mahinga kai, the desired species are plentiful enough for long-term harvest and the range of desired species is present across all life stages.

Mahinga kai – Kei te ora te mauri (the mauri of the place is intact).

For this value, freshwater resources would be available and able to be used for customary use. In freshwater management units that are valued for providing mahinga kai, resources would be available for use, customary practices able to be exercised to the extent desired, and tikanga and preferred methods are able to be practised.

Fishing – The freshwater management unit supports fisheries of species allowed to be caught and eaten.

For freshwater management units valued for fishing, the numbers of fish would be sufficient and suitable for human consumption. In some areas, fish abundance and diversity would provide a range in species and size of fish, and algal growth, water clarity and safety would be satisfactory for fishers. Attributes will need to be specific to fish species such as salmon, trout, eels, lamprey, or whitebait.

Irrigation, cultivation and food production – The freshwater management unit meets irrigation needs for any purpose.

Water quality and quantity would be suitable for irrigation needs, including supporting the cultivation of food crops, the production of food from domesticated animals, non-food crops such as fibre and timber, pasture, sports fields and recreational areas. Attributes will need to be specific to irrigation and food production requirements.

Animal drinking water – The freshwater management unit meets the needs of stock.

Water quality and quantity would meet the needs of stock, including whether it is palatable and safe.
Wai tapu – Wai tapu represent the places where rituals and ceremonies are performed, or where there is special significance to iwi/hapū.

Rituals and ceremonies include, but are not limited to, tohi (baptism), karakia (prayer), waerea (protective incantation), whakatapu (placing of raahui), whakanoa (removal of raahui), and tuku iho (gifting of knowledge and resources for future generations).

In providing for this value, the wai tapu would be free from human and animal waste, contaminants and excess sediment, with valued features and unique properties of the wai protected. Other matters that may be important are that there is no artificial mixing of the wai tapu and identified taonga in the wai are protected.

Water supply – The freshwater management unit can meet people’s potable water needs.

Water quality and quantity would enable domestic water supply to be safe for drinking with, or in some areas without, treatment.

Commercial and industrial use – The freshwater management unit provides economic opportunities to people, businesses and industries.

Water quality and quantity can provide for commercial and industrial activities. Attributes will need to be specific to commercial or industrial requirements.

Hydro-electric power generation – The freshwater management unit is suitable for hydro electric power generation.

Water quality and quantity and the physical qualities of the freshwater management unit, including hydraulic gradient and flow rate, can provide for hydro-electric power generation.

Transport and tauranga waka – The freshwater management unit is navigable for identified means of transport.

Transport and tauranga waka generally refers to places to launch waka and water craft, and appropriate places for waka to land (tauranga waka).
Appendix 2A: Attributes requiring limits

Table 1 - Phytoplankton (Trophic state)

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem Health (Aquatic Life)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Freshwater Body Type</strong></td>
<td>Lakes</td>
</tr>
<tr>
<td>Freshwater Body Type</td>
<td></td>
</tr>
<tr>
<td>Attribute Unit</td>
<td>mg chl-a/ m³ (milligrams chlorophyll-a per cubic metre)</td>
</tr>
<tr>
<td>Attribute band and description</td>
<td>Numeric attribute state</td>
</tr>
<tr>
<td></td>
<td>Annual median</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td></td>
</tr>
<tr>
<td>Lake ecological communities are healthy and resilient, similar to natural reference conditions.</td>
<td>≤2</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td></td>
</tr>
<tr>
<td>Lake ecological communities are slightly impacted by additional algal and/or plant growth arising from nutrient levels that are elevated above natural reference conditions.</td>
<td>&gt;2 and ≤5</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td></td>
</tr>
<tr>
<td>Lake ecological communities are moderately impacted by additional algal and plant growth arising from nutrient levels that are elevated well above natural reference conditions. Reduced water clarity is likely to affect habitat available for native macrophytes.</td>
<td>&gt;5 and ≤12</td>
</tr>
<tr>
<td><strong>National Bottom Line</strong></td>
<td>12</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td></td>
</tr>
<tr>
<td>Lake ecological communities have undergone or are at high risk of a regime shift to a persistent, degraded state (without native macrophyte/ seagrass cover), due to impacts of elevated nutrients leading to excessive algal and/or plant growth, as well as from losing oxygen in bottom waters of deep lakes.</td>
<td>&gt;12</td>
</tr>
</tbody>
</table>

For lakes and lagoons that are intermittently open to the sea, monitoring data should be analysed separately for closed periods and open periods.
### Table 2 - Periphyton (Trophic state)

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem health (Aquatic Life)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Body Type</td>
<td>Rivers</td>
</tr>
<tr>
<td>Attribute Unit</td>
<td>mg chl-a/m² (milligrams chlorophyll-a per square metre)</td>
</tr>
<tr>
<td>Attribute band and description</td>
<td>Numeric Attribute State (default class)</td>
</tr>
<tr>
<td>A</td>
<td>Exceeded no more than 8% of samples</td>
</tr>
<tr>
<td>Rare blooms reflecting negligible nutrient enrichment and/or alteration of the natural flow regime or habitat.</td>
<td>≤50</td>
</tr>
<tr>
<td>B</td>
<td>Occasional blooms reflecting low nutrient enrichment and/or alteration of the natural flow regime or habitat.</td>
</tr>
<tr>
<td>C</td>
<td>Periodic blooms reflecting moderate nutrient enrichment and/or moderate alteration of the natural flow regime or habitat.</td>
</tr>
<tr>
<td>National Bottom Line</td>
<td>200</td>
</tr>
<tr>
<td>D</td>
<td>Regular and/or extended-duration nuisance blooms reflecting very high nutrient enrichment and/or very significant alteration of the natural flow regime or habitat.</td>
</tr>
</tbody>
</table>

Classes are streams and rivers defined according to types in the River Environment Classification system (REC). Numeric attribute states must be derived from the rolling median of monthly monitoring over five years.

**Note:** To achieve a freshwater objective for periphyton within a freshwater management unit, regional councils must at least set appropriate instream concentrations and exceedance criteria for dissolved inorganic nitrogen (DIN) and dissolved reactive phosphorus (DRP). Where there are nutrient sensitive downstream receiving environments, criteria for nitrogen and phosphorus will also need to be set to achieve the outcomes sought for those environments. Regional councils must use the following process, in the following order, to determine instream nitrogen and phosphorus criteria in a freshwater management unit:

a) either:
   i. if the freshwater management unit supports, or could support, conspicuous periphyton, derive instream concentrations and exceedance criteria for DIN and DRP to achieve a periphyton objective for the freshwater management unit; or
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ii. if the freshwater management unit does not support, and could not support, conspicuous periphyton, consider the nitrogen and phosphorus criteria (instream concentrations or instream loads) needed to achieve any other freshwater objectives.

b) if there are nutrient sensitive downstream environments, for example, a lake and/or estuary, derive relevant nitrogen and phosphorus criteria (instream concentrations or instream loads) needed to achieve the outcomes sought for those sensitive downstream environments:

c) compare all nitrogen and phosphorus criteria derived in steps (a) – (b) and adopt those necessary to achieve the freshwater objectives for the freshwater management unit and outcomes sought for the nutrient sensitive downstream environments.
### Table 3 – Total Nitrogen (Trophic state)

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Freshwater Body Type</th>
<th>Attribute Unit</th>
<th>Attribute band and description</th>
<th>Numeric attribute state</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lakes</td>
<td>mg/m³ (milligrams per cubic metre)</td>
<td>Seasonally Stratified and Brackish</td>
<td>Polymictic</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td></td>
<td></td>
<td></td>
<td>≤160 ≤300</td>
</tr>
<tr>
<td>Lake ecological communities are healthy and resilient, similar to natural reference conditions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B</strong></td>
<td></td>
<td></td>
<td></td>
<td>&gt;160 and ≤350 &gt;300 and ≤500</td>
</tr>
<tr>
<td>Lake ecological communities are slightly impacted by additional algal and/or plant growth arising from nutrient levels that are elevated above natural reference conditions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C</strong></td>
<td></td>
<td></td>
<td></td>
<td>&gt;350 and ≤750 &gt;500 and ≤800</td>
</tr>
<tr>
<td>Lake ecological communities are moderately impacted by additional algal and plant growth arising from nutrient levels that are elevated well above natural reference conditions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>National Bottom Line</strong></td>
<td></td>
<td></td>
<td></td>
<td>750 800</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td></td>
<td></td>
<td></td>
<td>&gt;750 &gt;800</td>
</tr>
<tr>
<td>Lake ecological communities have undergone or are at high risk of a regime shift to a persistent, degraded state (without native macrophyte/seagrass cover) due to impacts of elevated nutrients leading to excessive algal and/or plant growth, as well as from losing oxygen in bottom waters of deep lakes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For lakes and lagoons that are intermittently open to the sea, monitoring data should be analysed separately for closed periods and open periods.
<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem Health (water quality)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Body Type</td>
<td>Lakes</td>
</tr>
<tr>
<td>Attribute Unit</td>
<td>mg/m³ (milligrams per cubic metre)</td>
</tr>
<tr>
<td>Attribute band and description</td>
<td>Numeric attribute state</td>
</tr>
<tr>
<td></td>
<td>Annual Median</td>
</tr>
</tbody>
</table>

| A                      | Lake ecological communities are healthy and resilient, similar to natural reference conditions. | ≤10 |
|                       | B Lake ecological communities are slightly impacted by additional algal and plant growth arising from nutrient levels that are elevated above natural reference conditions. | >10 and ≤20 |
|                       | C Lake ecological communities are moderately impacted by additional algal and plant growth arising from nutrient levels that are elevated well above natural reference conditions. | >20 and ≤50 |
|                       | National Bottom Line | 50 |
|                       | D Lake ecological communities have undergone or are at high risk of a regime shift to a persistent, degraded state (without native macrophyte/seagrass cover), due to impacts of elevated nutrients leading to excessive algal and/or plant growth, as well as from losing oxygen in bottom waters of deep lakes. | >50 |

For lakes and lagoons that are intermittently open to the sea, monitoring data should be analysed separately for closed periods and open periods.
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Table 5 – Dissolved inorganic nitrogen

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem health (water quality)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Body Type</td>
<td>Rivers</td>
</tr>
<tr>
<td>Attribute Unit</td>
<td>DIN mg/L (milligrams per litre)</td>
</tr>
<tr>
<td>Attribute band and description</td>
<td>Numeric Attribute State</td>
</tr>
<tr>
<td></td>
<td>Median</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td></td>
</tr>
<tr>
<td>Ecological communities and ecosystem processes are similar to those of natural reference conditions. No adverse effects attributable to DIN enrichment are expected.</td>
<td>≤ 0.24</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td>&gt; 0.24 and ≤ 0.50</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td></td>
</tr>
<tr>
<td>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 &amp; fish taxa, and high rates of respiration and decay.</td>
<td>&gt; 0.5 and ≤ 1.0</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td>&gt; 1.0</td>
</tr>
</tbody>
</table>

Groundwater concentrations also need to be managed to ensure resurgence via springs and seepage does not degrade rivers through DIN enrichment. Numeric attribute state must be derived from the rolling median of monthly monitoring over five years.
### Table 6 – Dissolved reactive phosphorus

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem health (water quality)</th>
<th>Freshwater Body Type</th>
<th>DRP mg/L (milligrams per litre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute Unit</td>
<td></td>
<td>Rivers</td>
<td></td>
</tr>
<tr>
<td>Attribute band and description</td>
<td>Numeric Attribute State</td>
<td>Median</td>
<td>95th percentile</td>
</tr>
<tr>
<td>A</td>
<td>Ecological communities and ecosystem processes are similar to those of natural reference conditions. No adverse effects attributable to DRP enrichment are expected.</td>
<td>≤ 0.005</td>
<td>≤ 0.021</td>
</tr>
<tr>
<td>B</td>
<td>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.</td>
<td>&gt; 0.006 and ≤ 0.010</td>
<td>&gt; 0.021 and ≤ 0.030</td>
</tr>
<tr>
<td>C</td>
<td>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 &amp; fish taxa, and high rates of respiration and decay.</td>
<td>&gt; 0.010 and ≤ 0.018</td>
<td>&gt; 0.030 and ≤ 0.054</td>
</tr>
<tr>
<td>National Bottom Line</td>
<td>0.018</td>
<td>0.054</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>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.</td>
<td>&gt;0.018</td>
<td>&gt;0.054</td>
</tr>
</tbody>
</table>

Numeric attribute state must be derived from the rolling median of monthly monitoring over five years.
### Table 7 – Ammonia (Toxicity)

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem Health (Water Quality)</th>
<th>Freshwater Body Type</th>
<th>Attribute Unit</th>
<th>mg NH4-N/L (milligrams ammoniacal-nitrogen per litre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute band and description</td>
<td>Numeric Attribute State</td>
<td>Annual Median</td>
<td>Annual Maximum</td>
<td></td>
</tr>
<tr>
<td><strong>A</strong> 99% species protection level: No observed effect on any species tested</td>
<td>≤0.03</td>
<td>≤0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B</strong> 95% species protection level: Starts impacting occasionally on the 5% most sensitive species</td>
<td>&gt;0.03 and ≤0.24</td>
<td>&gt;0.05 and ≤0.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C</strong> 80% species protection level: Starts impacting regularly on the 20% most sensitive species (reduced survival of most sensitive species)</td>
<td>&gt;0.24 and ≤1.30</td>
<td>&gt;0.40 and ≤2.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>National Bottom Line</strong></td>
<td>1.30</td>
<td>2.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>D</strong> Starts approaching acute impact level (i.e. risk of death) for sensitive species</td>
<td>&gt;1.30</td>
<td>&gt;2.20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Numeric attribute state is based on pH 8 and temperature of 20°C. Compliance with the numeric attribute states should be undertaken after pH adjustment.
### Table 8 – Nitrate (Toxicity)

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem Health (water quality)</th>
<th>Freshwater Body Type</th>
<th>Attribute Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Rivers</td>
<td>mg NO₃⁻ N/L (milligrams nitrate-nitrogen per litre)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute band and description</th>
<th>Numeric Attribute State</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Annual Median</td>
</tr>
<tr>
<td><strong>A</strong> High conservation value system. Unlikely to be effects even on sensitive species.</td>
<td>≤1.0</td>
</tr>
<tr>
<td><strong>B</strong> Some growth effect on up to 5% of species.</td>
<td>&gt;1.0 and ≤2.4</td>
</tr>
<tr>
<td><strong>C</strong> Growth effects on up to 20% of species (mainly sensitive species such as fish). No acute effects.</td>
<td>&gt;2.4 and ≤6.9</td>
</tr>
<tr>
<td><strong>National Bottom Line</strong></td>
<td>6.9</td>
</tr>
<tr>
<td><strong>D</strong> Impacts on growth of multiple species, and starts approaching acute impact level (ie risk of death) for sensitive species at higher concentrations (&gt;20 mg/L).</td>
<td>&gt;6.9</td>
</tr>
</tbody>
</table>

**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.
Table 9 – Dissolved oxygen

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem health (Water Quality)</th>
<th>Freshwater Body Type</th>
<th>mg/L (milligrams per litre)</th>
<th>Attribute band and description</th>
<th>Numeric Attribute State</th>
<th>7-day mean minimum (Summer Period: 1 November to 30th April)</th>
<th>1-day mean minimum (Summer Period: 1 November to 30th April)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Rivers (below point sources only)</td>
<td></td>
<td></td>
<td>No stress caused by low dissolved oxygen on any aquatic organisms that are present at matched reference (near-pristine) sites.</td>
<td>≥8.0</td>
<td>≥7.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Occasional minor stress on sensitive organisms caused by short periods (a few hours each day) of lower dissolved oxygen. Risk of reduced abundance of sensitive fish and macroinvertebrate species.</td>
<td>≥7.0 and &lt;8.0</td>
<td>≥5.0 and &lt;7.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Moderate stress on a number of aquatic organisms caused by dissolved oxygen levels exceeding preference levels for periods of several hours each day. Risk of sensitive fish and macroinvertebrate species being lost.</td>
<td>≥5.0 and &lt;7.0</td>
<td>≥4.0 and &lt;5.0</td>
</tr>
<tr>
<td>National Bottom Line</td>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
<td>Significant, persistent stress on a range of aquatic organisms caused by dissolved oxygen exceeding tolerance levels. Likelihood of local extinctions of keystone species and loss of ecological integrity.</td>
<td>&lt;5.0</td>
<td>&lt;4.0</td>
</tr>
</tbody>
</table>

The seven day mean minimum is the mean value of 7 consecutive daily minimum values. The one day mean minimum is the lowest daily minimum across the whole summer period.
Table 10 – Suspended fine sediment

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem Health (water quality)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Freshwater Body Type</strong></td>
<td>Rivers and streams</td>
</tr>
<tr>
<td><strong>Attribute Unit</strong></td>
<td>Turbidity (FNU)</td>
</tr>
<tr>
<td>Attribute band and description</td>
<td>Numeric attribute state by Suspended Sediment Class</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>Minimal impact of suspended sediment on instream biota. Ecological communities are similar to those observed in natural reference conditions.</td>
</tr>
<tr>
<td>B</td>
<td>Low to moderate impact of suspended sediment on instream biota. Abundance of sensitive fish species may be reduced.</td>
</tr>
<tr>
<td>C</td>
<td>Moderate to high impact of suspended sediment on instream biota. Sensitive fish species may be lost.</td>
</tr>
<tr>
<td>National Bottom Line</td>
<td>3.2</td>
</tr>
<tr>
<td>D</td>
<td>High impact of suspended sediment on instream biota. Ecological communities are significantly altered and sensitive fish and macroinvertebrate species are lost or at high risk of being lost.</td>
</tr>
</tbody>
</table>

The minimum record length for grading a site is two years of at least monthly samples (at least 24 samples).
See Appendix 2C Tables 1 and 3 for the definition of each suspended sediment class and its River Environment Classification composition.
Appendix A: Amendments to NPS-FM

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 11 – *Escherichia coli* (*E. coli*)

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Human contact (human health)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Body Type</td>
<td>Lakes and rivers</td>
</tr>
<tr>
<td>Attribute</td>
<td><em>Escherichia coli</em> (<em>E. coli</em>)</td>
</tr>
<tr>
<td>Attribute Unit</td>
<td><em>E. coli</em>/100 mL (number of <em>E. coli</em> per hundred millilitres)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute band and description</th>
<th>Numeric Attribute State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of risk of Campylobacter infection (based on <em>E. coli</em> indicator)</td>
<td>% exceedances over 540 <em>E. coli</em>/100 mL</td>
</tr>
<tr>
<td><strong>A (Blue)</strong></td>
<td>&lt;5%</td>
</tr>
<tr>
<td>For at least half the time, the estimated risk is &lt;1 in 1000 (0.1% risk)</td>
<td>The predicted average infection risk is 1%</td>
</tr>
<tr>
<td><strong>B (Green)</strong></td>
<td>5-10%</td>
</tr>
<tr>
<td>For at least half the time, the estimated risk is &lt;1 in 1000 (0.1% risk)</td>
<td>The predicted average infection risk is 2%</td>
</tr>
<tr>
<td><strong>C (Yellow)</strong></td>
<td>10-20%</td>
</tr>
<tr>
<td>For at least half the time, the estimated risk is &lt;1 in 1000 (0.1% risk)</td>
<td>The predicted average infection risk is 3%</td>
</tr>
<tr>
<td><strong>D (Orange)</strong></td>
<td>20-30%</td>
</tr>
<tr>
<td>20-30% of the time the estimated risk is ≤50 in 1000 (&gt;5% risk)</td>
<td>The predicted average infection risk is &gt;3%</td>
</tr>
<tr>
<td><strong>E (Red)</strong></td>
<td>&gt;30%</td>
</tr>
<tr>
<td>For more than 30% of the time the estimated risk is ≤50 in 1000 (&gt;5% risk)</td>
<td>The predicted average infection risk is &gt;7%</td>
</tr>
</tbody>
</table>

Attribute state should be determined by using a minimum of 60 samples over a maximum of 5 years, collected on a regular basis regardless of weather and flow conditions. However, where a sample has been missed due to adverse weather or error, attribute state may be determined using samples over a longer timeframe.

Attribute state must be determined by satisfying all numeric attribute states.

The predicted average infection risk is the overall average infection to swimmers based on a random exposure on a random day, ignoring any possibility of not swimming during high flows or when a surveillance advisory is in place (assuming that the *E. coli* concentration follows a lognormal distribution). Actual risk will generally be less if a person does not swim during high flows.
Table 12 – Cyanobacteria (Planktonic)

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Human contact (human health)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Body Type</td>
<td>Lakes and lake fed rivers</td>
</tr>
<tr>
<td>Attribute Unit</td>
<td>Biovolume - mm$^3$/L (cubic millimetres per litre)</td>
</tr>
<tr>
<td>Attribute band and description</td>
<td>Numeric Attribute State</td>
</tr>
<tr>
<td>A (Blue)</td>
<td>80th percentile</td>
</tr>
<tr>
<td>Risk exposure from cyanobacteria is no different to that in natural conditions (from any contact with freshwater).</td>
<td>$\leq 0.5$ mm$^3$/L biovolume equivalent for the combined total of all cyanobacteria</td>
</tr>
<tr>
<td>B (Green)</td>
<td>$&gt;0.5$ and $\leq 1.0$ mm$^3$/L biovolume equivalent for the combined total of all cyanobacteria</td>
</tr>
<tr>
<td>Low risk of health effects from exposure to cyanobacteria (from any contact with freshwater).</td>
<td>$&gt;1.0$ and $\leq 1.8$ mm$^3$/L biovolume equivalent of potentially toxic cyanobacteria OR $&gt;1.0$ and $\leq 10$ mm$^3$/L total biovolume of all cyanobacteria</td>
</tr>
<tr>
<td>C (Yellow)</td>
<td>$&gt;1.8$ mm$^3$/L biovolume equivalent of potentially toxic cyanobacteria OR $&gt;10$ mm$^3$/L total biovolume of all cyanobacteria</td>
</tr>
<tr>
<td>National Bottom Line</td>
<td>$1.8$ mm$^3$/L biovolume equivalent of potentially toxic cyanobacteria OR $10$ mm$^3$/L total biovolume of all cyanobacteria</td>
</tr>
<tr>
<td>D (Orange/Red)</td>
<td>$&gt;1.8$ mm$^3$/L biovolume equivalent of potentially toxic cyanobacteria OR $&gt;10$ mm$^3$/L total biovolume of all cyanobacteria</td>
</tr>
</tbody>
</table>

The 80th percentile must be calculated using a minimum of 12 samples collected over 3 years. 30 samples collected over 3 years is recommended.
### Appendix 2B: Attributes requiring action plans

**Table 13 – Macroinvertebrates (1 of 2)**

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Freshwater Body Type</th>
<th>Attribute Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecosystem health (aquatic life)</td>
<td>Wadeable streams and rivers</td>
<td>Macroinvertebrate Community Index (MCI) score; Quantitative Macroinvertebrate Community Index (QMCI) score</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute band and description</th>
<th>Numeric Attribute States</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>QMCI ≥6.5 MCI ≥130</td>
</tr>
<tr>
<td>Macroinvertebrate community, indicative of pristine conditions with almost no organic pollution or nutrient enrichment.</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>QMCI 5.5 &amp; &lt;6.5 MCI ≥110 &amp; &lt;130</td>
</tr>
<tr>
<td>Macroinvertebrate community indicative of mild organic pollution or nutrient enrichment. Largely composed of taxa sensitive to organic pollution/nutrient enrichment.</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>QMCI ≥4.5 &amp; &lt;5.5 MCI ≥90 &amp; &lt;110</td>
</tr>
<tr>
<td>Macroinvertebrate community indicative of moderate organic pollution or nutrient enrichment. There is a mix of taxa sensitive and insensitive to organic pollution/nutrient enrichment.</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>QMCI &lt;4.5 MCI &lt;90</td>
</tr>
<tr>
<td>Macroinvertebrate community indicative of severe organic pollution or nutrient enrichment. Communities are largely composed of taxa insensitive to inorganic pollution/nutrient enrichment.</td>
<td></td>
</tr>
</tbody>
</table>

**National Bottom Line**

|                  | MCI 4.5 | QMCI 90 |

MCI and QMCI scores to be determined using annual samples taken between December and March (inclusive) with either fixed counts with at least 200 individuals, or full counts, and with current state calculated as the five-year rolling average score. All sites in Deposited Sediment Classes 1, 5, and 11 per Table 18 are to use soft-sediment sensitivity scores and taxonomic resolution as defined in Table A1.1 in Clapcott et al. 2017 Macroinvertebrate metrics for the National Policy Statement for Freshwater Management. Cawthron: Nelson, New Zealand.

MCI and QMCI to be assessed using the method defined in Stark JD, Maxted, JR 2007 A user guide for the Macroinvertebrate Community Index. Prepared for the Ministry for the Environment. Cawthron Report No. 1166. 58, except for sites in deposited sediment classes 1, 5 and 11 per Table 18, which require use of the soft-sediment sensitivity scores and taxonomic resolution defined in Table A1.1 in Clapcott et al. 2017.
Table 14 – Macroinvertebrates (2 of 2)

<table>
<thead>
<tr>
<th>Attribute band and description</th>
<th>Numeric Attribute States ASPM score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>≥0.6</td>
</tr>
<tr>
<td>B</td>
<td>&lt;0.6 &amp; ≥0.4</td>
</tr>
<tr>
<td>C</td>
<td>&lt;0.4 &amp; ≥0.3</td>
</tr>
<tr>
<td>D</td>
<td>&lt;0.3</td>
</tr>
</tbody>
</table>

Macroinvertebrate communities have high ecological integrity, similar to that expected in reference conditions.

Macroinvertebrate communities have mild-to-moderate loss of ecological integrity.

Macroinvertebrate communities have moderate-to-severe loss of ecological integrity.

Macroinvertebrate communities have severe loss of ecological integrity.

ASPM scores to be determined using annual samples taken between December and March (inclusive) with either fixed counts with at least 200 individuals, or full counts, and with current state calculated as the five-year rolling average score. All sites in Deposited Sediment Classes 1, 5, and 11 per Table 18 are to use soft-sediment sensitivity scores and taxonomic resolution as defined in Table A1.1 in Clapcott et al. 2017 Macroinvertebrate metrics for the National Policy Statement for Freshwater Management. Cawthron: Nelson, New Zealand.

Table 15 – Fish (rivers)

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem health (aquatic life)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Body Type</td>
<td>Wadeable</td>
</tr>
<tr>
<td>Attribute Unit</td>
<td>Fish Index of Biotic Integrity (F-IBI)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute band and description</th>
<th>Numeric Attribute State (Average)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong> High integrity of fish community. Habitat and migratory access have minimal degradation.</td>
<td>≥34</td>
</tr>
<tr>
<td><strong>B</strong> Moderate integrity of fish community. Habitat and/or migratory access are reduced and show some signs of stress.</td>
<td>&lt;34 and ≥28</td>
</tr>
<tr>
<td><strong>C</strong> Low integrity of fish community. Habitat and/or migratory access is considerably impairing and stressing the community.</td>
<td>&lt;28 and ≥18</td>
</tr>
<tr>
<td><strong>National Bottom Line</strong></td>
<td>18</td>
</tr>
<tr>
<td><strong>D</strong> Severe loss of fish community integrity. There is substantial loss of habitat and/or migratory access, causing a high level of stress on the community.</td>
<td>&lt;18</td>
</tr>
</tbody>
</table>

Sampling is to occur at least annually between December and March (inclusive) following the protocols for at least one of the backpack electrofishing method, spotlighting method, or trapping method in Joy M, David B, and Lake M. 2013. New Zealand Freshwater Fish Sampling Protocols (Part 1): Wadeable rivers and streams. Palmerston North, New Zealand: Massey University.

Table 16 – Submerged plants (natives)

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem health (Aquatic life)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Body Type</td>
<td>Lakes</td>
</tr>
<tr>
<td>Attribute Unit</td>
<td>Lake Submerged Plant Indicators: Native Condition Index</td>
</tr>
<tr>
<td>Attribute band and description</td>
<td>Numeric Attribute State (% of maximum potential score)</td>
</tr>
</tbody>
</table>

- **A**
  - Excellent ecological condition. Native submerged plant communities are almost completely intact
  - \( \geq 75\% \)

- **B**
  - High ecological condition. Native submerged plant communities are largely intact
  - \( 50 \% \leq \% \leq 75\% \)

- **C**
  - Moderate ecological condition. Native submerged plant communities are moderately impacted
  - \( 20 \% \leq \% \leq 50\% \)

- **D**
  - Poor ecological condition. Native submerged plant communities are largely degraded or absent
  - \( \% < 20\% \)

National Bottom Line: 20%


Scores are reported as a percentage of maximum potential score (\%) of the Native Condition Index, and lakes in a dev egetated state receive scores of 0.
Table 17 – Submerged plants (invasive species)

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem health (aquatic life)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Body Type</td>
<td>Lakes</td>
</tr>
<tr>
<td>Attribute Unit</td>
<td>Lake Submerged Plant (Invasive Impact Index)</td>
</tr>
<tr>
<td>Attribute band and description</td>
<td>Numeric Attribute State (% of maximum potential score)</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td>No invasive plants present in the lake. Native plant communities remain intact.</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>Invasive plants having only a minor impact on native vegetation. Invasive plants will be patchy in nature co-existing with native vegetation. Often major weed species not present or in early stages of invasion.</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>Invasive plants having a moderate to high impact on native vegetation. Native plant communities likely displaced by invasive weed beds particularly in the 2 – 8 m depth range.</td>
</tr>
<tr>
<td><strong>National Bottom Line</strong></td>
<td>90%</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>Tall dense weed beds exclude native vegetation and dominate entire depth range of plant growth. Species concerned likely hornwort and Egeria.</td>
</tr>
</tbody>
</table>

NOT GOVERNMENT POLICY – CONSULTATION DRAFT – AMENDMENTS PROPOSED BY EDS SHOWN IN UNDERLINING AND STRIKE THROUGH

Table 18 – Deposited fine sediment

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem Health (Physical Habitat)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Body Type</td>
<td>Wadeable Rivers and Streams</td>
</tr>
<tr>
<td>Attribute Unit</td>
<td>% fine sediment cover</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute band and description</th>
<th>Numeric attribute state by Deposited Sediment Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>A Minimal impact of deposited fine sediment on instream biota. Ecological communities are similar to those observed in natural reference conditions.</td>
<td>&lt;84</td>
</tr>
<tr>
<td>B Low to moderate impact of deposited fine sediment on instream biota. Abundance of sensitive macroinvertebrate species may be reduced.</td>
<td>&lt;90</td>
</tr>
<tr>
<td>C Moderate to high impact of deposited fine sediment on instream biota. Sensitive macroinvertebrate species may be lost.</td>
<td>≤97</td>
</tr>
</tbody>
</table>

National Bottom Line

| 97 | 21 | 60 | 23 | 92 | 46 | 56 | 45 | 61 | 29 | 89 | 45 |

D High impact of deposited fine sediment on instream 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 |

The indicator score is percentage cover of the streambed in a run habitat determined by the instream visual method, SAM2, and the monitoring method is defined in p. 17-20 of Clapcott, J.E., Young, R.G., Harding, J.S., Matthaei, C.D., Quinn, J.M. and Death, R.G. (2011) Sediment Assessment Methods: Protocols and guidelines for assessing the effects of deposited fine sediment on in-stream values. Cawthron Institute, Nelson, New Zealand.

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.

See Appendix 2C Tables 2 and 3 for the definition of each class River Environment Classification composition.
Table 19 – Dissolved oxygen

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem health (Water Quality)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Body Type</td>
<td>Rivers</td>
</tr>
<tr>
<td>Attribute Unit</td>
<td>mg/l (milligrams per litre)</td>
</tr>
<tr>
<td>Attribute band and description</td>
<td>Numeric Attribute State</td>
</tr>
<tr>
<td></td>
<td>7-day mean minimum</td>
</tr>
</tbody>
</table>

**A**
No stress caused by low dissolved oxygen on any aquatic organisms that are present at matched reference (near-pristine) sites.

<table>
<thead>
<tr>
<th></th>
<th>7-day mean minimum</th>
<th>1-day mean minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>≥8.0</td>
<td>≥7.5</td>
</tr>
</tbody>
</table>

**B**
Occasional minor stress on sensitive organisms caused by short periods (a few hours each day) of lower dissolved oxygen. Risk of reduced abundance of sensitive fish and macroinvertebrate species.

<table>
<thead>
<tr>
<th></th>
<th>7-day mean minimum</th>
<th>1-day mean minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>≥7.0 and &lt;8.0</td>
<td>≥5.0 and &lt;7.5</td>
</tr>
</tbody>
</table>

**C**
Moderate stress on a number of aquatic organisms caused by dissolved oxygen levels exceeding preference levels for periods of several hours each day. Risk of sensitive fish and macroinvertebrate species being lost.

<table>
<thead>
<tr>
<th></th>
<th>7-day mean minimum</th>
<th>1-day mean minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>≥5.0 and &lt;7.0</td>
<td>≥4.0 and &lt;5.0</td>
</tr>
</tbody>
</table>

**D**
Significant, persistent stress on a range of aquatic organisms caused by dissolved oxygen exceeding tolerance levels. Likelihood of local extinctions of keystone species and loss of ecological integrity.

<table>
<thead>
<tr>
<th></th>
<th>7-day mean minimum</th>
<th>1-day mean minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>&lt;5.0</td>
<td>&lt;4.0</td>
</tr>
</tbody>
</table>

National Bottom Line: 5.0 4.0

Seven-day continuous dissolved oxygen monitoring to be collected at least once during summer (December to March inclusive). Objectives apply year-round.
<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem Health (water quality)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Body type</td>
<td>Lakes</td>
</tr>
<tr>
<td>Attribute Unit</td>
<td>mg/L (milligrams/litre)</td>
</tr>
<tr>
<td>Attribute band and description</td>
<td>Numeric attribute state</td>
</tr>
<tr>
<td></td>
<td>Measured or estimated annual minimum</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td>No risk from bottom DO of biogeochemical conditions causing nutrient release from sediments.</td>
</tr>
<tr>
<td></td>
<td>≥7.5</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>Minimal risk from bottom DO of biogeochemical conditions causing nutrient release from sediments.</td>
</tr>
<tr>
<td></td>
<td>≥2.0 and &lt; 7.5</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>Risk from bottom DO of biogeochemical conditions causing nutrient release from sediments.</td>
</tr>
<tr>
<td></td>
<td>≥0.5 and &lt; 2.0</td>
</tr>
<tr>
<td>National Bottom line</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>Likelihood from bottom DO of biogeochemical conditions resulting in nutrient release from sediments.</td>
</tr>
<tr>
<td></td>
<td>&lt;0.5</td>
</tr>
</tbody>
</table>

To be measured less than 1m above sediment surface at the deepest part of the lake using either continuous monitoring sensors or discrete DO profiles.
Table 21 – Mid-hypolimnetic dissolved oxygen

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Ecosystem Health (water quality)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Body type</td>
<td>Seasonally stratifying lakes</td>
</tr>
<tr>
<td>Attribute Unit</td>
<td>mg/L (milligrams/litre)</td>
</tr>
<tr>
<td>Attribute band and description</td>
<td>Numeric attribute state</td>
</tr>
<tr>
<td></td>
<td>Measured or estimated annual minimum</td>
</tr>
</tbody>
</table>

**A**
- No stress caused to any fish species by low dissolved oxygen.
  - ≥7.5

**B**
- Minor stress on sensitive fish seeking thermal refuge in the hypolimnion. Minor risk of reduced abundance of sensitive fish and macro-invertebrate species.
  - ≥5.0 & <7.5

**C**
- Moderate stress on sensitive fish seeking thermal refuge in the hypolimnion. Risk of sensitive fish species being lost.
  - ≥4.0 & <5.0

**D**
- Significant stress on a range of fish species seeking thermal refuge in the hypolimnion. Likelihood of local extinctions of fish species and loss of ecological integrity.
  - <4.0

Numeric attribute state to be measured using either continuous monitoring sensors or discrete DO profiles.
Table 22 – Ecosystem metabolism

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Freshwater Body Type</th>
<th>Attribute</th>
<th>Attribute Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecosystem health (ecosystem processes)</td>
<td>Rivers</td>
<td>Ecosystem metabolism (Both Gross Primary Production and Ecosystem Respiration)</td>
<td>g O₂ m⁻² d⁻¹ (grams of dissolved oxygen per square metre per day)</td>
</tr>
</tbody>
</table>

Derived from at least seven days of continuous dissolved oxygen monitoring to be collected at least once during summer (December to March inclusive), using the method of 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.

Councils are to monitor, and develop an action plan to respond to deteriorating trends.
Table 23 – *Escherichia coli* (*E. coli*) (primary contact sites)

<table>
<thead>
<tr>
<th>Value (and component)</th>
<th>Human contact (recreation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Body Type</td>
<td>Primary contact sites in lakes and rivers (during the bathing season)</td>
</tr>
<tr>
<td>Attribute Unit</td>
<td>95th percentile of <em>E. coli</em>/100 ml (number of <em>E. coli</em> per hundred millilitres)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute Band and description</th>
<th>Numeric Attribute State</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Excellent</strong></td>
<td>≤ 130</td>
</tr>
<tr>
<td>Estimated risk of Campylobacter infection has a &lt; 0.1% occurrence, 95% of the time</td>
<td></td>
</tr>
<tr>
<td><strong>Good</strong></td>
<td>131 – 260</td>
</tr>
<tr>
<td>Estimated risk of Campylobacter infection has a 0.1 – 1.0% occurrence, 95% of the time</td>
<td></td>
</tr>
<tr>
<td><strong>Fair</strong></td>
<td>261 – 540</td>
</tr>
<tr>
<td>Estimated risk of Campylobacter infection has a 1 – 5% occurrence, 95% of the time</td>
<td></td>
</tr>
<tr>
<td><strong>National bottom line</strong></td>
<td>540</td>
</tr>
<tr>
<td><strong>Poor</strong></td>
<td>&gt; 540</td>
</tr>
<tr>
<td>Estimated risk of Campylobacter infection has a &gt; 5% occurrence, at least 5% of the time</td>
<td></td>
</tr>
</tbody>
</table>

The narrative attribute state description assumes “% of time” equals “% of samples”
### Appendix 2C: Sediment Classification Tables

#### Table 1 – Suspended sediment attribute class REC composition

<table>
<thead>
<tr>
<th>Suspended Sediment Class</th>
<th>Suspended Sediment REC Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WW_Low_VA; CW_Low_VA</td>
</tr>
<tr>
<td>2</td>
<td>WD_Low_Al</td>
</tr>
<tr>
<td>3</td>
<td>CD_Low_HS</td>
</tr>
<tr>
<td>4</td>
<td>CW_Low_SS</td>
</tr>
<tr>
<td>5</td>
<td>WW_Low_SS; WD_Low_SS</td>
</tr>
<tr>
<td>6</td>
<td>WW_Low_HS</td>
</tr>
<tr>
<td>7</td>
<td>CD_Low_Al; CW_Hill_VA</td>
</tr>
<tr>
<td>8</td>
<td>CD_Low_SS</td>
</tr>
<tr>
<td>9</td>
<td>CW_Hill_HS; CD_Hill_HS; CW_Low_Al</td>
</tr>
<tr>
<td>10</td>
<td>CW_Lake_Any</td>
</tr>
<tr>
<td>11</td>
<td>CW_Low_HS</td>
</tr>
<tr>
<td>12</td>
<td>CW_Mount_HS; CW_Hill_SS</td>
</tr>
</tbody>
</table>

#### Table 2 – Deposited sediment attribute class REC composition

<table>
<thead>
<tr>
<th>Deposited Sediment Class</th>
<th>Deposited Sediment REC Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WD_Low_VA; WD_Low_Al</td>
</tr>
<tr>
<td>2</td>
<td>WW_Hill_HS; CW_Mount_VA</td>
</tr>
<tr>
<td>3</td>
<td>CW_Lake_Any; CW_Low_Al; CD_Hill_SS</td>
</tr>
<tr>
<td>4</td>
<td>CW_Mount_SS</td>
</tr>
<tr>
<td>5</td>
<td>WD_Low_SS</td>
</tr>
<tr>
<td>6</td>
<td>WW_Low_VA; WW_Low_HS; CD_Low_VA; CD_Hill_Al; CD_Low_HS</td>
</tr>
<tr>
<td>7</td>
<td>WW_Low_SS; CD_Low_SS; CD_Low_Al</td>
</tr>
<tr>
<td>8</td>
<td>WW_Lake_Any</td>
</tr>
<tr>
<td>9</td>
<td>WD_Low_HS</td>
</tr>
<tr>
<td>10</td>
<td>WW_Hill_VA; CW_Hill_HS; CW_Low_HS; CW_Mount_HS; CW_Hill_SS; CW_Hill_Al; CD_Mount_HS; CW_Mount_Al</td>
</tr>
<tr>
<td>11</td>
<td>WW_Low_Al</td>
</tr>
<tr>
<td>12</td>
<td>CW_Hill_VA; CW_Low_VA; CW_Low_SS; CD_Hill_HS</td>
</tr>
</tbody>
</table>
Table 3 – REC groups for both classification

<table>
<thead>
<tr>
<th>REC Variable</th>
<th>REC Values</th>
<th>SSC abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Warm-Wet</td>
<td>Warm-Wet (WW)</td>
</tr>
<tr>
<td></td>
<td>Warm-Extremely Wet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Warm-Dry</td>
<td>Warm-Dry (WD)</td>
</tr>
<tr>
<td></td>
<td>Cold-Wet</td>
<td>Cold-Wet (CW)</td>
</tr>
<tr>
<td></td>
<td>Cold-Extremely Wet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cold-Dry</td>
<td>Cold-Dry (CD)</td>
</tr>
<tr>
<td>Topography (Source of flow)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lowland</td>
<td>Lowland (Low)</td>
<td></td>
</tr>
<tr>
<td>Lakefed</td>
<td>Lakefed (Lake)</td>
<td></td>
</tr>
<tr>
<td>Hill</td>
<td>Hill (Hill)</td>
<td></td>
</tr>
<tr>
<td>Mountain</td>
<td>Mountain (Mount)</td>
<td></td>
</tr>
<tr>
<td>Glacial Mountain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soft Sedimentary</td>
<td>Soft Sedimentary (SS)</td>
<td></td>
</tr>
<tr>
<td>Plutonic Volcanic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hard Sedimentary</td>
<td>Hard Sedimentary (HS)</td>
<td></td>
</tr>
<tr>
<td>Alluvium</td>
<td>Alluvium (AI)</td>
<td></td>
</tr>
<tr>
<td>Volcanic Basic</td>
<td>Volcanic (VA)</td>
<td></td>
</tr>
<tr>
<td>Volcanic Acidic</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 3: National target

The national target is to increase proportions of specified rivers and lakes that are suitable for primary contact (those that are in the blue, green and yellow categories) to at least 80% by 2030, and 90% no later than 2040, but also to improve water quality across all categories.

The categories above represent combined improvements in all regions. For each region, this means reducing the length of specified rivers and lakes in the red and orange categories, and increasing the length of specified rivers and lakes in the yellow, green and blue categories.

The categories are based on water quality in terms of the two human health attributes, E. coli and cyanobacteria – planktonic in Appendix 2 of this National Policy Statement.

For rivers and lakes, the target categories are same as the E. coli table attribute states. However, the categories do not include the 95th percentile of E. coli/100 mL numeric attribute state if there is insufficient monitoring data to establish the 95th percentile.

For lakes, the categories are also based on the cyanobacteria – planktonic attribute states, however, to provide additional granularity for tracking improvements over time, the D band has been split into two categories (orange and red) as follows:

a) orange means the lake has between 1.8 and 3.0 mm3/L biovolume of cyanobacteria – planktonic, using an 80th percentile; and
b) **red** means the lake has more than 3.0 mm$^3$/L biovolume of cyanobacteria – planktonic, using an 80th percentile.

For lakes, the lowest category for either *E. coli* or cyanobacteria – planktonic applies.
Appendix 4: Temporary exception for specified freshwater management units

<table>
<thead>
<tr>
<th>Freshwater management unit</th>
<th>Time until, or period, when exception in clause 3.23 applies</th>
</tr>
</thead>
</table>

NOT GOVERNMENT POLICY– CONSULTATION DRAFT – AMENDMENTS PROPOSED BY EDS SHOWN IN UNDERLINING AND STRIKE-THROUGH
APPENDIX B
SUBMISSION ON “ACTION FOR HEALTHY WATERWAYS: A DISCUSSION DOCUMENT ON NATIONAL DIRECTION FOR OUR ESSENTIAL FRESHWATER”

By Tim Hazledine
SUBMISSION ON “ACTION FOR HEALTHY WATERWAYS: A DISCUSSION DOCUMENT ON NATIONAL DIRECTION FOR OUR ESSENTIAL FRESHWATER”

By Tim Hazledine
Professor of Economics at the University of Auckland
*Independent expert report commissioned by the Environmental Defence Society Incorporated*
*October 29, 2019*

1 Introduction

At the request of the EDS, I have carried out an assessment of economic issues raised by the proposal to effect improvements in the quality of New Zealand Aotearoa’s fresh waterways – specifically, to improve the ecological health of freshwater in acknowledgement of Te Mana o te Wai.

My submission is in five sections following this introductory section.

In section 2, I provide some historical perspective on the long-run difficulties experienced by the farm sector worldwide; point out how New Zealand farmers have to an extent mitigated these difficulties by their exporting to world markets, and note the unusual (by first world standards) willingness of our farmers to eschew subsidies and other governmental supports, in the interests of achieving an internationally competitive primary farming sector.

In section 3, I examine particular issues raised in the current situation by the application of absolute standards of water quality, rather than a cost-benefit trade-off approach.

In section 4, I discuss likely macroeconomic consequences – good and bad – of adjustment to significant changes in the supply of, in particular, dairy products as a result of retrenchments in the primary dairy sector.

Section 5 covers important technical modelling issues raised by previous recent work.

Section 6 concludes with a brief discussion of issues concerning predicting the costs of changes required to reach the new fresh water quality standards.

2 Scenes from rural life

Farmers have had a tough time of it, these past one hundred and twenty years or so. Supplementing the power of hand and horse with electric or fuel powered machines – tractors, diggers, harvesters, milkers and so on – and the serious application of science to breeding, genetics, pesticides, fertilisers have generated spectacular increases in the productivity of the people who work the land.

Why then is productivity growth bad news for farmers, as it has not been for, say, the workers on assembly lines making automobiles, for whom spectacular machine-driven productivity improvements led the breakthrough for the industrial working class into middle class incomes and standards of living in the middle of the twentieth century?

The difference is this: one hundred and twenty years ago no-one owned a car – they had barely been invented. Now, everyone owns one or wants to own one. Farming, in contrast, produces food, and everyone always has had to eat. That’s good news for the industry in the sense that farmers’ products will never go out of fashion (as cars just might, and blacksmiths and candlemakers certainly have), but it also means that the growth in general prosperity largely bypasses the agricultural sector. We do eat more than we used to – perhaps too much more – but there are natural
limits there. In economists’ terms, the demand for food is ‘inelastic’: it tends to grow at a slower rate than the growth in peoples’ incomes and it is not very responsive to cuts in price.

The inexorable consequence of this is that growth in productivity – output per worker – at a rate greater than the growth in the numerator of productivity – total output – simply must mean fewer workers – people must leave the land. So, in this sense, farming is an industry continually in decline. Whereas in most of what are now called first world nations the share of the workforce working the land was around thirty percent in the nineteenth century, now in most of those countries it is little more than two percent, even in countries that we might typify as being ‘agricultural’, such as Canada and Denmark.

And there is more bad news for farmers. In most manufacturing and many service industries the technology of production lends itself to economies of scale – firms get bigger, and some very big indeed, such as the manufacturers of automobiles. And with bigness comes what economists call ‘market power’ – the ability of sellers to maintain a margin of profits between costs and prices: the ability of the owners of those big firms to become extremely rich. Now, most farmers are owners of their business – capitalists, if you like – but few of them make a lot of money out of it, because they are (nearly all) ‘small’ businesses. Farming remains a very old-fashioned business of owner-operators: family farms. There are a few fairly large ‘corporate’ farms, but they don’t predominate. The basic business of looking after animals and crops seems to require a level of personal attention that doesn’t automate well, and doesn’t lead to the assembly-line organisation of modern industry. Technology in farming has certainly allowed – indeed, forced – farms to become bigger, but no bigger than the span of control manageable by the family and perhaps a hired hand or two.

Thus, agriculture is an example – and in fact it is the only real-world example – of what in our economics textbooks we call ‘perfect competition’: thousands of little firms producing similar products, the market price of which must always stay very close to the costs of production: no one farmer can charge more than the market price, because buyers would just go to their numerous ‘competitors’; no one farmer can charge less than the market price, because this would mean pricing below costs and they would go out of business. Farmers perennially have to run hard just to stay in the same place.

And that’s not all. Manufacturers go about their business in big sheds, sheltered from sun and rain. Farmers suffer the vagaries of climate, both directly in terms of the production of their own crops and livestock and indirectly because the vagaries of other farmers feed through to market supply and thus fluctuations in prices.

So, overall, perfect competition isn’t a lot of fun for the competitors. Though your product never goes out of fashion, the way you produce it is always changing, and each farmer has to change just to stay in business, never mind get to pocket any profits from technological change. Farm communities are in continual decline as technology forces people off the land, with serious social and often psychological consequences. And when the sun shines but not too much, and you have a good year, you can’t go out and spend the windfall (though actually many do), because the next year the weather gods may deliver something quite different.

It is really hardly surprising that farmers, the world over, are famous grumblers, in particular because their grumbling can actually bring some results. The agricultural sector may not have any economic power, but it does have political power. Rural electorates are naturally single-issue electorates – it’s all about farming, which enables them to elect representatives closely attuned to their interests and – while there are still enough rural electorates – to form power blocks to get governments to do something for farmers. And they have been spectacularly good at getting stuff done: subsidies, price supports, ‘stabilisation’ programs, protection from trade competition – on a scale unimaginable in just about any other industry.

Except in New Zealand. New Zealand is different. We are basically a monoculture – we produce just one crop well: grass. Our temperate, wet climate allows us to produce grass fairly dependably year in and year out, and so our farmers can turn the grass into fat sheep and cattle in a fairly predictable way. We have our local weather problems of drought and floods but, overall, the supply side of NZ agriculture is fairly benign, compared, say, with the vicious fluctuations in yields suffered by growers of crops such as wheat or rice or coffee or corn. While the farm share in total employment has declined as everywhere, at more than six percent it is still sizeable, matched in the first world only by two other small countries, Ireland and Portugal.
And on the demand side, our farmers have come up with a brilliant solution to the problem of inelastic food demand, which basically is a problem of local demand for local produce not growing fast enough. With our favourable land/population ratio, farming in New Zealand, at least after colonisation, was always going to produce more food than the domestic market could eat, so the farm sector very early on turned its attention to feeding the much larger world market (actually, for the first hundred years, mainly Britain). After the invention, in the 1880s, of one of the greatest of all applications of power to machinery: refrigeration, we were able to attenuate our locational disadvantage and exploit our comparative economic advantage in pastoral farming to sell our meat, cheese and butter at a good price on the UK market. In 1890, the share of trade (exports+imports) in New Zealand’s national income (what we now call GDP) was 26 percent, far higher than any other rich country, with most of the exports – being of course what pays for the imports – agricultural products.

One hundred years later, in 1990, the global expansion in trade of manufactured goods and then services had brought up the overall Trade/GDP ratios of other first world countries, but it is probably true that, relative, to size, no rich country is as dependent on world agricultural markets as we are.

Well, the farm lobby may be able to pull strings in Wellington, but not in Washington, or London or Brussels. I do think it is fair to give credit to successive NZ governments over the last forty years for good work negotiating trade and other agreements to protect or enhance market access for New Zealand farm products, but there are limits to what they can achieve. Basically, our farmers have had to fight their own battles in the marketplaces of the world, battles which can be won only by getting the fundamentals right: producing what people in other countries want to buy at a sharp price. And with this reality developed an ethos of genuine self-reliance. Our farmers, of course, are hugely supportive of each other at the local and personal level, but – unlike farmers just about everywhere else – they have never expected to be supported by the taxpayers of our or any other governments, and as a quid pro quo, they have never wanted government to meddle much in their affairs either.

A truly spectacular demonstration of the depth of this ethos came in 1984. The late 1970s had been a difficult time economically for New Zealand, and the Prime Minister of the time, Robert Muldoon, had decided to help out the farmers with subsidies – Supplementary Minimum Payments’ (SMPs), paid out on a per-animal basis. Miraculously – and as satirised in a famous Fred Dagg skit – the reported number of sheep in New Zealand doubled overnight, and the expenditure on the SMPs ballooned. Then, in 1983, Muldoon was ousted by David Lange and this administration’s liberalising, market-oriented program (which would become known as ‘Rogernomics,’ after Finance Minister Roger Douglas). In 1984, the farmers did an extraordinary thing. Under the leadership of their President, Peter (later Sir Peter) Elworthy, the main farm lobby group, Federated Farmers, asked the government to abolish SMPs: basically, ‘Stop giving us money, please – it’s not good for us. We can’t survive and thrive in our competitive international markets if we are propped up at home by subsidies.’

I know of no comparable episode in any other country, and it is impressive. In the same spirit, when we introduced a goods and service tax, in 1985, we may have been the only country (I don’t know for sure) that applied it to everything, with no exemptions, in particular, for ‘food.’ All this shouldn’t be over-idealised: Federated Farmers did not, for example, demand that the subsidy on fuel for their tractors be abolished, nor other (moderate) assistance schemes. But the ethos is a real force to be reckoned with when we are considering now how best to deal with our major current environmental problems: the use and pollution of fresh water, and the emissions of Greenhouse Gases (GHGs) of the farm sector – in particular, dairying.

It is disappointing that the face-the-full-cost-of-farming ethos is not yet universally accepted when it comes to dealing with the environmental impact of farming in NZ. Perhaps the implicit cost of using and abusing fresh water seems less ‘real’ than subsidies based on fertiliser use or numbers of sheep. Perhaps – actually, probably – government and the town sector have failed to present these matters in ways that are sympathetic to, and knowledgeable of, the interests and expertise of our farmers. If so, then this needs to be dealt with. Although facing up to the environmental impacts of all our economic activities is going to happen sooner or later, it will be more pleasant, efficient and even ethical if this is done in partnership with farmers, not in conflict with them.
3 Objectives and trade-offs

The fresh water policy is defined in terms of a set, universal, target: all New Zealand’s internal waterways are to be healthy in ecological terms, with swimming spots swimmable. When? This is not set, but ‘material improvement’ is to be achieved within five years, and restoration to ‘health’ within a generation.

Universal target policies raise special issues. Is the target feasible? Is it desirable (compared with alternative possible targets or a flexible case-by-case goal setting process)? Should, indeed, exceptions be allowed? What about clashes with other targets or policy goals? How is the target to be achieved, on the ground? What will be the costs of achieving it, and who will bear these costs? All these issues must be dealt with.

3.1 Feasibility of the freshwater target

Obviously, there is not much point in setting a target if it is simply technically infeasible. For example, government can set a maximum speed limit for the open road of, say, 80 km/hour. This is technically feasible: under almost all conceivable scenarios it would be possible for all drivers to not drive faster than 80 km/hour. The issue then becomes whether this is the best of all feasible targets (and how to enforce it). But suppose government ruled instead that “all vehicles once they have achieved a cruising speed of at least 80 km/hour must not in the course of their journey let their speed fall below this number, or else a bomb built in to the chassis of their vehicle will explode” (as in the movie Speed). In the real world, there would be explosions—it is not in general feasible to keep road speed always above the set rate.

It seems that the proposed fresh water target is generally feasible. How do we know? Because all the waterways used to be swimmable and drinkable, and their deterioration due to the pollutants pumped in over recent years has not irreversibly damaged their ecosystems. Nor, in this case, is it the case that exogenous (uncontrollable) events, such as global climate change, are the causes. We have done harm to the waterways, and by us ceasing to do harm they can heal themselves.

3.2 Desirability of set, universal targets

In many –perhaps most– public policy situations, the policy is established on the merits of the case, using the now-standard tool of Cost-Benefit Analysis (CBA). For example, just about all transport infrastructure decisions are made– or are supposed to be made– on this basis, using as the template the processes and parameters set out in the NZTA’s Economic Evaluation Manual.

Environmental issues can be, and perhaps usually are, assessed using CBA. So, the analyst could survey a large sample of people to get an idea of the general willingness to pay for swimmable water. It could use soil type and other relevant markers to estimate costs, in each segment of each waterway, of achieving swimmability. The result would most likely be that rivers and streams near large population centres would get cleaned up, and those in relatively inaccessible locations would not.

The proposed freshwater standards are radically different. There is no CBA-mounted trade-off of costs and benefits in different situations. Deep ethical considerations trump economic trade-offs. The moral basis for this is Te Mana o te Wai: the well-being of the water. In everyday terms, it is proposed that the answer to the question: “Who owns the water?” should be: “No-one owns the water. The water owns itself, and it wants, and has the right, to be clean and free-flowing, whether people choose to swim in it or not.”

An implication of this approach must be that all rivers have an equal right to be clean and free-flowing – even if costs of achieving this differ, say, across regions, the swimmability or ecological standards should not differ.

The remarkable renaissance of Māori ethical systems is perhaps the most significant and exciting development in natural resource management in Aotearoa/New Zealand, and will no doubt play a foundational role in reform of the Resource Management Act. However, it cannot guide all practical decision-making, and in particular the interface between situations appropriate to blanket targets and traditional trade-off jurisdictions creates problems which need to be dealt with, and have not yet been dealt with in the Healthy Waterways discussion document.
3.3 Exemptions?

The Discussion Document proposes exceptions for the (six largest) Hydroelectric power schemes, whose output (Greenhouse Gas-free electricity) is intended to contribute to NZ meeting GHG targets:

‘Climate change action and freshwater health are both priorities for the government and a careful balance needs to be achieved...need for pragmatism’ (page 35)

Well, actually, no. You can't balance two absolute priorities, and you can't even balance one absolute (freshwater standards) with one non-absolute (costs and benefits of using Hydro as part of GHG climate policy). Climate change action is (I believe) hugely important, but we have a menu of choices when it comes to effecting it. Swimmable waterways can only be achieved by making waterways swimmable.

There is another factor here, which is fairness to farmers. If Hydro is to be exempted on ‘pragmatic’ grounds, why not also farmers who are particularly inconvenienced and/or financially penalised by the need to adjust to meet the water quality targets?

Such is the position of James Allen, an independent expert submitting on behalf of Fonterra. Mr Allen is supportive of the goals that the Waikato and Waipa rivers be safe both for swimming and the harvesting of food. He recognises that this will sometimes require changes in land use on farms. But he supports a 75th percentile cut-off or baseline for reducing N-leaching, at the FMU level. That is, only farms in the top 25% of nitrogen leaching should be required to cut back to at least the leaching level of the 75th percentile farm in the FMU.

In fact, Mr Allen would prefer that this standard be implemented at a sub-catchment level. I would recommend going in the other direction if cut-offs are to be used: using pollution from the 75th percentile farm in the whole country as the maximum leaching level for all farms in the country. To do otherwise is definitely to generate inequity between farmers, as Mr Allen's own data show. Of the four Waikato region FMUs, one –Upper Waikato– is drastically different in soil type from the other three, with more than 60% 'leaky' pumice soils. Dairy farms in this FMU are going to be, on average, relatively high water polluters. So, applying the 75th percentile cut-off at the FMU level will mean that many relatively low polluting farms in the other three FMUs will be required to incur costly mitigation efforts, when some farms in the Upper Waikato, polluting a lot, but below the 75th percentile, will be allowed to continue without mitigation. This is surely unfair as well as inefficient.

There are important practical considerations in implementation of standards, too. The water quality target in general is predominantly to be achieved by changes in farm and farming practices, not all of which are at this stage easily predictable (with respect to cost and efficacy). Farmers are the on-the-ground experts here, and their morale and skills will be essential to making progress towards the target.

3.4 Climate change side-effects

As I understand it, there are five important contributors to the low quality of many of our rivers and streams: (i) nitrogen pollution; (ii) phosphorus pollution; (iii) E.coli; (iv) suspended sediment (muddy water); (v) deposited sediment (muddy bottoms).

The last three of these do not (so far as I am aware) have climate change implications, but of course nitrogen and phosphorus both contribute to global warming through the greenhouse gases they emit. So, should this 'positive externality' from reducing nitrogen and phosphorus emissions be factored in to the decision about the freshwater target?

The answer is no: not into the target itself, because this is solely determined by the rivers’ right to be clean. But if and when there are trade-offs in how to achieve the target, the wider environmental benefits of lower GHG emissions could be brought in to the calculations.
4 Macroeconomic considerations

Because of our country’s relatively large ratio of arable land to population, most of our agricultural industries (unlike those of larger countries) sell most of their output in overseas markets—that is, they export. And New Zealand being a small country means that we can’t be self-sufficient in the production of many manufactured products (even if we wanted to be), so we need exports to pay for imports. However, this does not mean that exporting should be subsidised; nor that any other government policy or program would necessarily be called for as a result of, in particular, a cutback in milk production resulting from action to meet freshwater quality targets. We have a floating exchange rate now in New Zealand, and part of the job of a floating exchange rate is to automatically adjust to bring exports and imports into balance. Three aspects of the international macroeconomics of primary product exporting are worth discussing briefly: the status of exporters; the wider consequences of exchange rate adjustment, and the possibility of ‘terms of trade’ effects.

4.1 Exports not to be privileged

Most firms have to compete with other firms in their downstream markets. In agriculture, some of the other firms will be foreign firms. If our firms compete with foreign firms in their markets, they are exporting. If our firms compete with foreign firms in our local market, they are import-replacing. Even if we value earning foreign exchange in itself (and we shouldn’t), there is no real difference between taking the foreigner’s dollar in the export market, or taking it in the domestic market, by replacing imports with local production.

The idea that there is something particularly worthy (ie from society’s point of view) about a NZ firm making its profits from exporting probably goes back to the 1960s and 70s, when we had controls restricting imports into New Zealand, implying a shortage of foreign exchange at the current (fixed) exchange rate. Such has not been the case since 1985.

4.2 How macroeconomic adjustments play out

Given the likelihood of some pull-back in dairy farming, and thus in exports of dairy products, what would be the effects throughout the NZ economy? I will tell the story in a series of steps, using the appropriate economic jargon along the way.

First, how big a pull-back in dairy exports? Suppose it was quite large—say, 10%, which represents about 2% of the country’s total current export receipts. Assuming international payments in balance initially, this would at once open up a two percent shortfall in foreign exchange earnings needed to pay for the current level of imports. The price of the Kiwi dollar would need to fall to compensate. This will mean, given world prices, that exports of all NZ-made products will be worth more (in $NZ), which would encourage all our exporters—including the dairy farmers not pushed out by the clean-water requirements to supply more (they would make more money). Also, a lower NZ dollar means more NZ dollars needed to purchase a US dollar or Euro or whatever, and thus more expensive imports, the demand for which in NZ would fall in response. These adjustments would continue until the demand and supply of NZ dollars was back in balance.

How would it all play out in detail? This depends on what economists call ‘elasticities,’ being our measure of the responsive or supply or demand to changes in price. Often, empirical studies find elasticities to be around plus or minus one. If so, then a 1% depreciation of the price of the NZ currency would evince a 1% increase in exports, and a 1% decrease in imports, summing to the overall 2 percent adjustment needed to restore balance in our foreign accounts.

If all the resources freed up in the dairy sector (in particular land and labour) were quickly absorbed into other industries and activities, then the overall effect on NZ’s real GDP would be tiny in proportion to the cutback. However, in this particular case, we can expect that a substantial proportion of the cutback in dairy production would be the direct result of increased fenced setbacks from waterways—that is, land taken out of market production, in which case there would be a predictable effect on GDP: basically, the cost of achieving better water quality, this being something whose benefits are not measured in standard GDP calculations.
4.3 Terms of trade effects

The above calculations implicitly assumed no effect on world prices of New Zealand's exporting and importing activity: ie, that NZ is a ‘price-taker’ in world markets. This is indeed a very commonly made assumption, but it seems almost always to be wrong in the real world. The idea that even a small country like New Zealand can without effort sell as much as it wants of anything we produce without affecting the revenue per unit brought in, seems in fact to be simply incorrect. If we want to move more product, we have to make the deal more attractive to our customers; if we pull product off the market, we can move up the demand curve.

This is true not just of obviously 'branded' products like wine, but even for the most basic, apparently undifferentiated ‘commodity’ product, such as dried milk powder. I have carried out an econometric analysis of unit values ($NZ per kilogram, on average) received for NZ exports of whole milk powder to the 27 largest customer countries for NZ dairy product sales, using annual data covering the 1990-2009 period, during which this commodity made up around 30% of total dairy exports, by value.

I found significant evidence of what is called ‘pricing to market’. Changes in unit values received in New Zealand varied with changes in world market prices, but only by around 50 cents in the dollar, and there was a similarly sized effect of changes in the NZ-destination market exchange rate. Note that numerous factors can be varied in export sales contracts, and each will have their impact on the realised revenue per kilogram— including payment terms, delivery dates, risk, contract size, transport costs – along with the nominal ‘price’ per kg. Put it another way: any New Zealand exporting firm or organisation (such as Fonterra) which has a marketing department and a sales department (and a commercial legal department and a logistics department) is evidently not a simple price-taker.

How does this relate to meeting freshwater standards? Because of Fonterra’s current legislated requirement (under the Dairy Industry Restructuring Act) to accept and process all milk supplied by its farmer members, it seems to me likely that we are currently pushing too much product onto world markets, with the result being what the industry itself calls ‘weak selling’. If so, then a cutback in total milk production as a by-product of meeting environmental standards could result in higher prices achieved on export sales, to the benefit of farmers and New Zealand as a whole. This would fit in with an emerging trend in all our exporting activities (including tourism) to aim for higher value at the expense of volume: to adopt a ‘Clean, Green and Expensive’ national marketing strategy for the country, replacing the old supply-driven ‘pump out the product’ mentality of the 1960s and 70s.

5 Modelling land-use changes

Perhaps most public attention – even, alarm – has focused on predictions from some mathematical modelling that meeting given targets for dissolved inorganic Nitrogen (DIN) and dissolved reactive Phosphorus (DRP) for waterways in the Waikato-Waipa catchment would:

(i) not be possible by means of mitigation practices applied given current land use (ie given current shares of dairy, drystock and forestry land use)

(ii) be possible if land use were altered

(iii) involve as the least-cost reallocation of land use substantial reductions in drystock farming in favour of forestry (from 43% to 14% coverage of land, or a 68% reduction) and a much smaller (13%) decrease in dairy farming, with the net result requiring a 160% increase in land planted in forest, to more than one half of the total catchment

(iv) result in quite tiny losses in primary industry profitability overall, because seven percent and forty percent, decreases in dairy and drystock profits, respectively, are almost offset by a nearly three-fold (190%) increase in forestry profits’

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It is easy to see why lobbyists for sheep and beef (drystock) farmers expressed some dismay at these predictions (dairy lobbyists were more muted), for at least three reasons:

- Huge lifestyle shifts from animal husbandry to watching trees grow
- Profits from newly planted forests won’t be realised for more than twenty years, even if planted in *pinus radiata*
- Dairying is, on average, much more polluting per hectare than drystock farming, yet is required to cut back much less

In essence, most (perhaps all) of the abatement action dictated by the model is generated by retiring land from farming, in favour of planting – minimally polluting (perhaps even environmentally efficient) – trees.

It is my view, as an economist, that absolutely no reliance should be placed on these projections.

The model was developed in 2015 by a team led by Dr Graeme Doole, then a professor of environmental economics at Waikato University, now chief economist at Dairy NZ.

The model is what I call a ‘Central Planning Model’. It basically treats the whole of the Waikato catchment as though it is an old-style Soviet or Chinese collective farm, with all management decisions made by the central planners in the cause of ‘optimising’ resource use according to some mandated goal, which in this case is the achievement of overall water quality targets at the lowest possible costs, subject to various ‘constraints’, such as biological equations linking nitrogen and phosphorus use to effects on water quality in different soil types and slopes.

There are problems with the central planning optimisation approach both in principle and in execution in this particular case.

Conceptually, there are two huge drawbacks. The first is that the Waikato region is in fact not a huge state-run collective farm, but rather a patchwork of about five thousand independent farmers, each making their own decisions about what to produce and where. That is, there is no mechanism in NZ to actually achieve the modelled re-allocation of resources, even if it were indeed the best of possible worlds.

Second, it is almost absolutely unlikely that the solution churned out by this model does indeed delineate the best of possible worlds. We can say this with no knowledge at all of the specifics of the situation, or indeed any knowledge about farming in general. Put it this way: let us grant that Dr Doole and his team were indeed smart, competent, diligent modellers, as I have no doubt at all they were – the work put into this modelling exercise is on its own hugely impressive. But how likely is it that they are smarter and more competent and more diligent than the five thousand Waikato farmers whose independent decisions and actions have created the situation actually observed today (or in 2015)?

There is actually a huge amount of information embodied in the situation created by these farmers in their market economy setting – information which Doole et al totally ignore in their optimisation exercise. In what I will call the ‘market economics’ approach, the information implied by the actual state of affairs is treated – perhaps to a fault – as sacrosanct: specifically, as revealing to anyone who cares to look what is the outcome of rational, profit-seeking behaviour by competent individuals in the setting – as we have nearly everywhere in New Zealand agriculture– of established, well-understood, competitive markets.

I will apply the market economics approach below, but need first to point out what I consider to be a fatal flaw in the execution of the optimisation model, even aside from the conceptual problems. The model is fitted out with 12,747 equations, each carrying information about particulars of particular sites and sub-catchments in the Waikato-Waipa catchment. For example, equations 4093 through 4165 give the proportions of cows on stand-off pads; equations 8543 to 8616 tell the ‘diffuse median load of microbes in each sub-catchment from dairy’; and so on and so on.
I cannot take issue with 12,743 of these equations, but the four equations 11,619 to 11623 – or, at least, their use in the model, may be seriously problematic. These are described as ‘total opportunity cost of land for each mitigation,’ which I take to record the average profitability of land over the whole Waikato region in each pastoral use – drystock or dairy (but why four not two such values?), compared with the profitability of the alternative forestry use of land. If this is not what is meant by these variables, then I cannot find any others that could measure what is referred to in IEAR as explaining the savage switches in land use generated by the model:

‘The switch away from drystock farming [to forestry] is an artefact of the optimisation approach of the model: because drystock has a lower profit per hectare than dairy farming, the opportunity cost of planting [in trees] a drystock farm is lower than planting a dairy farm.’ (page 17)

Consistent with this, the profit per hectare of Paul and Emma’s ‘average’ mainly lowland dairy farm is about $2,240, compared with Ian and Jo on their ‘average’ rolling hill country sheep and beef farm, bringing in profits of just $240/ hectare. But these are averages, which should not be taken as true for all farms in each category.

Put it this way, if the numbers did apply to all farms, then Ian and Jo – and just about all other drystock farmers– must be really stupid, carrying on with their ranching activities when they should be milking cows for much larger profits. Indeed, we’d have to ask why the central planning model doesn’t dictate that just about all pastoral land be used for dairying: the reason it doesn’t is probably the self-imposed constraint that changes in land use should not go further than actual land use patterns observed on the land over the 1972-2012 period.

Of course, Ian and Jo are not stupid– they have their reasons. What could they be? First, we would need to know more about how profitability is defined here. Does it allow for differences in the price of land for different soil etc types? How does it impute income– including ‘psychic income’– to the owner/operator? These factors may explain much of what is otherwise a puzzle.

Second, even if average values are correctly calculated, economic life is not lived on average; it is lived at the margin. One of the truly striking facts of farm life is the extraordinary differences in productivity and hence profitability between farmers in the same line of business and even the same locality.

Below I show a graphic revealing substantial difference in grass production per hectare between best practice and average farmers on the same soil type in the Waikato. And I also show what looks like a supply curve of Waikato dairy farmers ranked from lowest to highest cost (using Dairy NZ data on difference in profitability). In this diagram, I have taken ‘Paul and Emma’s’ achieved revenues of $7,800/ha. We can probably ignore the turn-ups and turn-downs at the end and beginning of the curve (special cases; bad data…), and we can then see that any average for costs or profitability conceals substantial differences within the sector.

A similar curve would no doubt apply to the Waikato region’s drystock farmers, albeit somewhat flatter throughout, reflecting the smaller average profit per typical farm.

5.1 The market economics explanation

So, how does the person I call a ‘market economist’ interpret the data shown on the distribution of average costs of Waikato dairy farmers?

First, the market economist has no problem with some farms being more profitable than others, due to ‘rents’ from ‘fixed factors,’ such as soil type and farmer skill.

Second, the market economist however expects that no farm that is systematically unprofitable can survive (and nor do they, according to the diagram).

Third, and perhaps a little implausibly, the market economists assumes that, even though some farmers are better than others, all farmers are reasonably proficient at responding to price signals; to exploiting such opportunities for profit making that present themselves (balanced however against other personal objectives, such as enjoying family life).
The resulting prediction is that each farmer, given market prices, will produce output of, say, milk, up to the point where the 'marginal' (the last) litre of milk just costs as much to produce as it will return from Fonterra, based on the fatty and non-fatty solids extractable from the milk.

We predict also that astute farmers will implicitly carry out these calculations for other possible land uses, such that their chosen land use delivers more total profit than the best alternative.

To summarise the story so far: within every farming sector there is a range of average profitability per farm. In all cases the low end of the range is where profits – correctly measured – are around zero (this is the extensive margin of the sector). Differences in sector averages then are generated by differences in the profitability of the most profitable farms in each sector, with these caused by differences in soil quality and farmer skills.

We can now predict, at least in general terms, what will happen if additional water quality mitigation costs (fencing, etc) are imposed on, say, dairy farmers. It is tempting to assume a tendency for the best farmers to have already voluntarily undertaken fencing etc themselves– ie, that good farmers are not dirty farmers. But we don’t seem to have data on this.

So assume, say, that there is no association between current farm profitability and mitigation costs (per hectare). Then imposing mitigation costs is equivalent to shifting up the cost curve drawn below. This will impact all farmers, including low-cost farmers (because the latter are at the margin of price = cost of last unit). Some high-cost farmers will now be making a loss, and will have to either sell up or shift to forestry or perhaps drystock farming. All the other farmers will cut back a little on their milk output; for example by withdrawing cows from the most porous soils and/or from the bits of the farm most tricky to fence away from waterways.

We could put some numbers on how these two adjustment mechanisms might pan out. My expectation is that doing so would lead to predictions of market responses resulting in much less draconian land use changes than those mandated by the Central Planning Model, but possibly at a higher total cost to the sector, because we cannot assume the availability of free money handed out by shifting pastoral farming in relative terms away from drystock towards dairy. I would expect that most adjustment would involve some rolling back of recent ‘intensification’ of use of land for dairying.

There is an unresolved (I believe) issue complicating prediction of the likely costs of successful mitigation of fresh water pollution. To the extent that farms or parts of farms are induced to shift from dairying to drystock agriculture, and/or from both of these to forestry, the adjustments to farming practices of the remaining dairy and livestock operations required to achieve defined water quality limits will be reduced, and the more so because, in general, it will be the worst polluters who are most likely to switch activities (because their abatement costs are likely to be the highest).

Also, other things equal, the farms most likely to switch to a less polluting activity rather than face mitigation costs, are going to be those farms for which the best alternative land use is closest in net profitability to the current activity, which again will work to reduce the loss in profits incurred by improving fresh water quality.

6 Efficacy of nitrogen and phosphorus mitigation

I have some worries about the science informing our knowledge of the links, in particular, between Nitrogen and Phosphorus and water quality, for which low values may have been a factor in preventing the Central Planning Model from achieving water quality targets by on-farm mitigation alone (ie, without massive shifts of land use to forestry). The belief in low efficacy of N and P abatement appears to be justified by two scatter diagrams shown on p18 of IEAR, each of which correlates in turn, Nitrogen with water quality and Phosphorus with water quality, with weak correlations in both cases.

This may be poor statistical methodology. If both attributes affect MCI, then both should be included in the same multivariate model to explain differences in MCI (along with any other measured factors, such as shading, etc).
Suppose the true model is \( M = Z - aN - bP \), where \( a \) and \( b \) are parameters which can be taken as constant, at least over a range, and \( Z \) is the level of \( M \) if there is no pollution. Without loss of generality, set \( a = b = 1 \).

So the true model is simply \( M = Z - N - P \). If you just show bivariate scatters (\( M/N \) and \( M/P \)) then each factor’s effect on \( M \) will be at least partially obscured by the noise created by ignoring the presence of the other factor. To illustrate the point, I have made up some data for 20 localities, in which the incidence of \( N \) and \( P \) happens to be strongly negatively correlated– localities with high \( N \) happen to have low \( P \), and vice versa. Setting \( Z = 25 \), if I run a least-squares model of \( M \) on \( N \) and \( P \), we get (of course) a perfect fit: \( R^2 = 1 \). If we then do each bivariate regression, we get total rubbish – no correlation at all. This is extreme because (as far as I know, anyway), \( N \) and \( P \) are not likely to be so extremely negatively correlated, and indeed may be positively correlated, but the general point remains.

Beyond this, my reading of the submissions and the discussion document is that there has been some exaggeration of the likely costs of achieving acceptable fresh water standards due to:

- Adding the full cost of Farm Environment Plans to the costs of mitigation
- Not allowing for possible creative uses of the 5 metre set-asides on the banks of waterways
- Not allowing full scope for application of the expertise and ingenuity of farmers.
Endnotes

1 Trade shares
2 Share in 1990
3 The EDS Submission does note some cases of nitrogen being so deeply embedded in the water table that it will take many years for it to dissipate.
4 Actually, there may be some rivers whose 'natural' state is muddy.
5 Are some slow-draining lakes exceptions here?
6 Twenty years ago when the monopolisation of the dairy industry (ie, creation of Fonterra with statutory near-monopoly powers) was being discussed, ‘weak selling’ was claimed as a likely consequence of having more than one NZ dairy exporter competing with each other in world markets. In the event, and as usual, it is the argument for monopoly that has turned out to be weak. Dairy farmers would be better off with active competition on a large scale for the purchase of their milk. Fonterra has been a disappointment.
7 It is not clear to me why the changes in dairy and drystock profits are smaller than, and the change in forestry profits larger than the percentage changes in land use for each activity, given the assumptions of constant average profitability per hectare for each activity that apparently are made in the modelling.
8 The budgets for abatement on two ‘average’ dairy and drystock farms shown in Action for healthy waterways, pp91-5, are about $650/ha and $400/ha, respectively.
9 The model is ‘solved’ (arrives at an internally consistent answer) by a computational technique called ‘programming’. The basis of this technique, and the use of the word, predates, I believe, the use of the word programming as instructions for a computer, though of course the latter is required in this context.