

## Freshwater Science and Technical Advisory Group:

### 26 March – priority paper compilation

Paper Author	Various	Classification	<b>Confidential</b>
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Meeting date	26 March 2019	Agenda item (number)	
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#### Background reading not in compilation - please see portal:

Agenda Item	Title
3	Deriving potential fine sediment attribute thresholds for the National Objectives Framework
3	<p>Four documents to address the “action register” questions raised during the November and January meetings on turbidity monitoring and the analytical framework linking catchment suspended sediment loads to attribute states:</p> <ol style="list-style-type: none"> <li>1. A brief write-up entitled “further information to STAG March 2019” that outlines how we approached answering the “action register” questions;</li> <li>2. An HTML document providing turbidity analyses comparing median timeframes, continuous versus discrete sampling, and monitoring at all flows versus low flows;</li> <li>3. A word document including the code for the analyses;</li> <li>4. The summary document of Hicks et al. 2016 (Stage 1a report) that discusses the analytical framework in depth.</li> </ol>
6	Example of use of water quality monitoring data as information for setting objectives and assessing whether water quality has been maintained or improved

## Science and Technical Advisory Group Meeting

### Agenda

**Dates and Location: Tuesday 26 February 2019** 9.30am-4.00pm, Meeting room 1C (Ahumairangi), Environment House, 23 Kate Sheppard Place, Wellington

**STAG Members present: (TBC)** Adam Canning, Bev Clarkson, Bryce Cooper, Chris Daughney, Clive Howard-Williams, Graham Sevicke-Jones, Ian Hawes, Jenny Webster-Brown, Joanne Clapcott, Jon Roygard, Mahina-a-Rangi Baker, Mike Joy, Ra Smith, Tanira Kingi.

**Apologies: (TBC)** Dan Hikuroa, Marc Schallenberg, Russell Death

#### Items:

- 9.00 am Coffee and tea (30 mins)
1. 9.30 am Previous meeting minutes and actions arising, apologies, feedback from other advisory groups (Ken Taylor) (15 mins)
  2. 9.45 am Nutrients – brief report back on progress (15 mins)
  3. 10.00 am Sediment (1 hour 30)
  4. 11.30 am Wetlands (30 mins)
  - 12.00 pm Lunch (30 mins)
  5. 12.30 pm Flows – brief report back on progress (15 mins)
  6. 12.45 pm Maintain or Improve (1 hour)
  7. 1.45 pm Ecosystem Health (1 hour 15)
  - 3 pm Afternoon tea (10 mins)
  - 3.10 pm Ecosystem Health (50 mins)
  - 4.00 pm Meeting close

#### Papers distributed:

Agenda Item	Paper	Confidential?
3	Deriving potential fine sediment attribute thresholds for the National Objectives Framework	Yes

Meeting date	Action	Who	Due date	Comment
26-Jan-19	Officials to provide worked examples to inform sediment discussion - (1) worked example to help the group consider whether to support the decision to base attributes on rolling medium-term (~2 years) measures of central tendency; (2) comparison of how continuous suspended sediment data compare to monthly sampling, across several rivers; (3) worked example of the analytical framework relating annual sediment load to environmental state variables in attribute tables; (4) more information or analysis on the 2-year period for medians. Horizons to provide data	Stephen Fragaszy	26-Mar-19	
26-Jan-19	Circulate papers on ecosystem respiration and gross primary productivity – to be discussed at future meeting	Jen Price	20-Mar-19	Can be discussed as part of ecosystem health metric sub-group
26-Jan-19	Officials to provide further information on ecological responses to sediment when NIWA work is complete	Stephen Fragaszy	26-Mar-19	
29-Nov-18	Officials to provide a worked example of "maintain or improve" to sub-group	Nik Andic	26-Feb-19	Sub-group will report back to main group again following consideration of worked example. This will likely be at 26 March meeting
18-Oct-18	Officials to keep group up to date with climate policy developments	?	Ongoing	
27-Feb-19	Finalise Maintain or Improve sub-group proceedings, send to STAG	Nik Andic	18-Mar-19	Sub group members have approved proceedings. They will be included in the docs for the 26 March meeting
27-Feb-19	Commission research on extent and effects of superoxygenation in all ecosystems, and deoxygenation of lake hypolimnia.	Jen Price	? Long term	

27-Feb-19	Report back from ecosystem health metric sub-group	Carl Howarth, sub-group members	26-Mar-19	
27-Feb-19	Flow to be incorporated into ecosystem health discussions	Carl Howarth, sub-group members	20-Mar-19	Will be considered at sub-group workshop on 20 March
27-Feb-19	Arrange work group to address questions relating to Russell Death's proposed nutrient attribute tables	Jen Price, Jo Burton	ASAP	

Released under the provisions of the OIA

## Science and Technical Advisory Group Meeting

### Minutes - draft

**Dates and Location:** Tuesday 26 February 2019 9.00am-5.00pm, Room 1A (Matairangi), Ministry for the Environment, 23 Kate Sheppard Place, Thorndon.

**STAG Members present:** Adam Canning, Bryce Cooper, Chris Daughney, Clive Howard-Williams, Dan Hikuroa (Skype), Graham Sevicke-Jones, Ian Hawes, Jenny Webster-Brown, Joanne Clapcott, Jon Roygard, Mahina-a-Rangi Baker, Marc Schallenberg, Mike Joy, Russell Death, Ra Smith, Mahina-a-rangi Baker. **Additional participants:** Cathy Kilroy, Chris Nokes (10.30am-1pm), Sarah Burgess (10.30am-1pm). **MfE officials:** Carl Howarth, Joanna Mason, Lucy Bolton, Jen Price, Nik Andic, Vicki Addison, Jo Burton, Kirsten Forsyth, Isaac Bain, Ton Snelder

**Apologies:** Ken Taylor, Bev Clarkson, Tanira Kingi

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#### Items:

##### **1. Previous meeting minutes and actions arising, apologies**

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Ken will be back next month and Bryce will update him on the proceedings of the meeting.

Bryce asked for comments on the previous minutes – these were approved by the group.

Bryce asked for comments on the abbreviated minutes that have been prepared for the MfE website for the meetings on 18 & 19 October and 29 November 2018. These have been prepared in accordance with the instruction from the group in the first meeting that the publicly available minutes will be high level and not attribute names to the discussion. These are in addition to the fuller meeting records which are prepared for the group members' reference.

Comments: it should be "maintain or improve" not "maintain and improve"

It was asked whether the longer version of the minutes can be requested under the Official Information Act (OIA)? Response from MfE: Yes. We will notify the group if any OIA request is made.

The short minutes were approved with minor modifications as above.

##### **2. Report back on Maintain or Improve small group session**

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On 15 February 2019, officials met with a sub-group of STAG members to discuss these risks and co-develop technically workable options to address them.

A summary of the proceedings of the sub-group workshop will be circulated separately to the group.

Key points are:

- There are risks associated with the existing requirement to maintain or improve water quality, which mean planning could allow material declines in ecosystem health while maintaining water quality within attribute bands. The current objective/policies leave a number of questions unanswered making implementation difficult (e.g. does the requirement apply at every monitoring site, can sites be aggregated, how current state is determined, etc).
- The group understood regional councils are faced with two tasks when implementing requirements to maintain or improve: producing a plan that is sufficient to give effect to the

relevant objective and policies of the NPSFM; and assessing performance over time to determine the efficacy of plans (i.e. has water quality actually been maintained – if not, that would indicate changes are needed).

- With this in mind, the group developed the following option/approach to mitigate risks with the existing requirements:
  - (a) Requiring freshwater objectives to maintain the current state of water quality (as opposed to within a band); and
  - (b) Require councils to report on performance in terms of water quality state/achievement of these objectives alongside a wider range of information, including: pressures (e.g. human inputs and climate); higher level measures of state (e.g. overall state of ecosystem health); and responses like plan rules, methods and implementation progress.

**Outcome and Actions:** MfE and the sub-group members will finalise the paper and send it around to the sub-group by email. Maintain or Improve will be discussed at the next meeting.

### **3. Dissolved oxygen**

MfE staff asked the group to consider whether the current minimum measures in the attribute table were sufficient and appropriate, and whether the attribute should be amended to delete the text “below point sources”.

Discussion points included:

- This attribute refers to the continuous monitoring of dissolved oxygen.
- The minimum measures are appropriate for dissolved oxygen.
- The time period for monitoring was questioned, as in some areas low dissolved oxygen concentrations can occur after 30 April. There is a marginal labour cost involved in monitoring through winter, but there is a high risk of gear loss in high flows.
- It is possible to remove “below point sources”. Some group members thought that monitoring below point sources is a consent monitoring issue, and others pointed out the importance of monitoring where dissolved oxygen is likely to be low.
- It was suggested that there could be guidance on where to monitor dissolved oxygen.
- The intent of removing “below point sources” would be to highlight that it applies everywhere.
- Group members pointed out the challenges involved in determining the right management levers for dissolved oxygen.
- Superoxygenation (concentrations of dissolved oxygen above 100% saturation) is also an issue. Maybe someone could put some thought into the prevalence of this issue. It often occurs in lakes, and may also be associated with low dissolved oxygen minima. Fish can also suffer from embolisms in rivers due to superoxygenation. This is a longer term project. Superoxygenation of lake surface waters may place less of a limit on habitat compared with deoxygenation of bottom waters.
- The extent of natural deoxygenation of the hypolimnion (bottom waters) of lakes is another area that requires further research to separate this from deoxygenation caused by anthropogenic eutrophication. It would be worth examining this issue.

**Outcome:** STAG recommends using the minimum as the dissolved oxygen measure, and it applies everywhere. Including but not limited to below point sources.

**Actions:** Areas for further work are the extent and effects of superoxygenation in all ecosystems, and deoxygenation of lake hypolimnia.

#### 4. Ecosystem Health

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Carl gave a brief overview of the wider Ecosystem Health work programme as outlined in the briefing note that has been sent to Minister Parker, and outlined the range of potential management tools that MfE could use. It was pointed out that work is being progressed on further populating and refining Appendix 2 attributes for dissolved oxygen, sediment and nutrients. Other components of ecosystem health are being incorporated into other policy instruments.

Discussion points included:

- Group members questioned when metrics for aquatic life would be incorporated. MfE staff clarified that if there is a metric that this group feels is ready to go without further work required, we can progress that. Any metric we proceed with will require analysis of spatial and economic impacts. This does limit what we can do in this round of changes. However if there is a high level of consensus among the group to proceed with an attribute, there is an option to progress it. Group members indicated that they could easily help to determine the spatial impacts.
- A group member asked, if we put forward biological metrics, would MfE then explore the best way to incorporate those metrics? MfE staff responded that that's right. Attributes may not be the best mechanism and we would address that. It may be that we can't progress something as an attribute, but we could progress something as a metric in another way.
- The higher-level indicators have been prioritised in the last meeting. The next step would be to come up with the specific metrics.
- Work not progressed in this tranche of work can be addressed in the next round of changes.
- This work links to the "Maintain or Improve", reporting and offsetting work.
- There is an opportunity for community and iwi values to have input about what they want to see in their own communities.
- A sub-group is the best way to progress this work.

There was discussion on freshwater biosecurity:

- Freshwater biosecurity is not mentioned in this work. The Biodiversity Collaborative Group specifically excluded freshwater biodiversity and invasive species. Where does the issue sit? It seems to be a gap at the moment.
- We know that water quality in many places is affected by invasive species – for example, koi carp in the lower Waikato region.
- Regional councils develop pest management plans but these are not required to take into account the effects of pest species on water quality.
- Biosecurity should be part of the conversation and is an important component of "Maintain or Improve". Councils could set rules and objectives relating to the influence of biosecurity on water quality and ecosystem health.

There was a discussion on "no net loss" in the context of offsetting adverse effects in a resource consenting context:

- Offsetting sits in a continuum (from most to least preferred): avoid, remedy, mitigate, offset or compensate. Offsetting is a tool for addressing residual effects once avoidance, remediation or mitigation has been ruled out.

- Important considerations are the scale at which the policy applies, how to quantify losses and gains, and what effects can be offset. Offsetting may not be appropriate for some types of ecosystems. How this policy would relate to the requirement to “maintain or improve” is also important.
- Cumulative effects are an issue. When you add up each minor effect – it can add up to be significant. Is this being dealt with? As part of the “no net loss” policy there could be an accounting system to weigh up losses and gains.
- Permitted activity rules are also an issue being considered. A group member pointed out that “improving” rather than “maintaining” should be the goal of permitted activities.
- When the Land and Water Forum (LAWF) considered cumulative effects, such as from increasing agricultural intensity, it was agreed that the only way to deal with cumulative effects is for Councils to set limits on resource use (ie water takes or nutrient discharges) We have never considered limit setting for in-stream or in-lake processes.
- If permitted activities permit cumulative effects, this would conflict with limits.
- This package of work also contains proposals on integrated strategic planning, which includes an option to limit certain activities in certain places.

**Outcome:** Carl will arrange the sub-group discussion workshop with volunteers (Adam, Mike, Marc, Joanne, Ra, Clive, and Dan). Results from the sub group will come back to the next STAG meeting on 26 March.

*Helli Ward, Sarah Burgess and Chris Nokes arrived.*

## 5. Flows

MfE staff outlined the matters to be discussed with STAG, building on the discussion on a narrative attribute table in the previous meeting.

Discussion points included:

- It's not so much the amount of water in the river but the pattern of the flow. If we want to make a difference in the effects of water abstraction on ecosystem health, we need to use metrics that will characterise flow regimes in a more nuanced way. The instream flow incremental methodology (IFIM) method is insufficient and internationally, more sophisticated measures are now being used.
- Indicators are too narrowly focussed on individual elements.
- When talking about how councils set flow limits it's important to distinguish where they have discretion and where they are directed by legislation and court processes.
- The aim of the narrative table for flow would be to align flow setting methodology with the rest of the Freshwater NPS, and to help define the environmental outcome you want to achieve. These may take into account existing hydro dams for example which create highly regulated flows in some rivers.
- The existing research from overseas was based on salmonids and the RHYHABSIM approach, so this was the information that was used.
- We don't yet have a full understanding of flushing flow requirements in rivers.

Group members discussed the complexities of translating the narratives into numbers:

- The narrative table describes diversity of flows as well as the amount of habitat. The A and B bands mention a variety of flows to provide for substrate movement and ecosystem processes. It's important to highlight the role of flow variability in influencing habitat.



- It is currently difficult for regional council scientists to measure at what point is the ecosystem health of the catchment not being provided by the flows.
- The role of the Proposed National Environmental Standard on Ecological Flows and Water Levels (2008) was discussed. Any new policy would need to make clear that the National Environmental Standard process can be used to set flows, but do not direct how to set the higher level objectives that guide selection of appropriate flows.
- Flows are one component of the Ecosystem Health framework.
- It was clarified that in the suggested narrative table, the bottom line is at the bottom of the C band, consistent with other attributes.
- Some members felt habitat would be a more achievable attribute to measure, while others thought that work on both habitat and flow should continue.

The group addressed the questions:

Question 1: Do the draft narrative descriptions above make sense from a biophysical aquatic ecosystem perspective? How could they be improved?

*Discussion:*

- These are useful narrative descriptions, but group members wanted to be able to measure a river to find out what band it's in. In hearings, narratives can be criticised but numbers are more defensible.
- Guidance could potentially help with determining where a river sits in the bands, deriving the numbers for a particular river system, and interpreting the table.
- Flow variability, flows and habitat need to be mentioned in all bands.
- The habitat measures in the ecosystem health work need to align with this table.

Question 4: Is it sufficient and defensible to use the habitat requirements for trout as a surrogate for safeguarding ecosystem health (remembering that if communities want to safeguard rivers for trout, there is a separate value for that)? If so, can we be more specific here with some numeric specifications?

*Response:* The NPS-FM definition of Ecosystem Health doesn't provide for trout. STAG members agreed that the answer is no, it's not sufficient to provide for trout habitat.

The importance of Te Mana o te Wai was discussed:

- The concept of Te Hauora o te Wai (the health and mauri of the water) ensures the river can be a river. We don't need to provide water for habitat – we just need to provide flow for its own sake. Flow links directly with Te Hauora o te Wai.
- The group discussed how to define letting a river be a river - what would the natural variability of flow and minimum amount of flow be for this river to still be a river? You need to set this based on knowledge of the natural flow variability in the river. The other two key components are Te Hauora o te Taiao (the health and mauri of the environment) – and Te Hauora o te Tangata (the health and mauri of the people) – abstraction can only occur once the other two hauoras can be assured.
- We need to acknowledge that Ecosystem Health is a definition within a particular cultural context. In a Māori context, we would be talking about different things – we would be thinking of ourselves as part of that ecosystem. How do the measures that we set within this western science space fit with the measures in the Māori world? Do they fit together, how do they work together? There are issues with the concept of ecosystem health being used to assess the concept of Te Mana o te Wai.

There was a discussion on level setting in lakes:

- There has been quite a lot of work on lake levels and water residence time. Lake levels can be modified by manipulating inflows and out flows. This will also affect lake residence times.
- The Proposed National Environmental Standard on Ecological Flows and Water Levels (2008) has a section on lakes.

**Outcome** – the group agreed that a way forward would be to ensure that flow is incorporated into the ecosystem health metrics sub-group discussions.

## **6. Nutrients**

Introduction by MfE staff - This is an important issue and there has been a lot of debate around this. The key point is to ask if the current ways of managing nutrients in the NPS-FM are adequate or if they need to be re-worked. The outcome of the discussion will be reported to the Freshwater Leaders Group meeting tomorrow.

There were four short presentations from Chris Nokes on nitrate toxicity relating to human health, Cathy Kilroy and Ton Snelder on nutrient periphyton relationships, and Russell Death on a weight of evidence approach to setting nutrient targets. Presentation slides have been provided to group members separately.

### **Questions for Chris Nokes**

-What proportion of drinking water comes from people's own bores? Response: We don't know because we don't know enough about the people not on municipal systems, and we don't know how many people on their own systems have problems with nitrates. Most of the supplies that record nitrate concentrations above the Maximum Allowable Value (MAV) are small suppliers.

-Why are the numbers describing exceedances of the MAV for nitrate supplied as proportions and not as raw numbers that could be assessed against the Danish study? Response: Water suppliers provide a summary of data in relation to the MAV, they are not legally required to report raw values but they will have this data.

-Reporting against a MAV which is too high is not useful. Response: The MAV is protective for blue baby syndrome. Whether the values will be revised in light of the new research on cancer is still an open question depending on the results of meta-analyses.

-Studies of drinking water supplies in Canterbury suggest this is a huge issue. We can't look at the data that is available at the moment as the water suppliers are not required to report it. They only report exceedances. Response: Regulators need to be reasonably certain that they have enough information to justify the expense that would be required to change the drinking water standards.

Comments from STAG members: We have the highest rates of colorectal cancer in the developed world. The levels we are talking about for ecosystem health are similar to the levels required for human health.

-We have a large proportion of groundwater sources in Canterbury that are increasing in nitrate.

-What about the long term WHO value for nitrite (as opposed to nitrate)? Response: The long-term value for nitrite is not relevant for the risk of blue baby syndrome as this is only relevant for the first 3 months of life.

-How is compliance assessed? Response: the water supplier has to demonstrate compliance with the MAV, any exceedance indicates non-compliance with the standard. This is not a comparison of mean values.

-Nitrites are also carcinogenic. It seems that this could be an issue, as nitrate is converted to nitrite in the gut. Response: Conversion depends on gastric acidity, babies and other individuals with low stomach acidity are most at risk. The nitrite concentration is back-calculated from the nitrate concentration to allow for conversion.

-Wouldn't conversion of nitrate to nitrite in the anoxic areas of the gut be important? Response: The WHO guidelines possibly have a discussion on this topic.

### Questions for Cathy Kilroy

-There is not much data compared with the number of variables being examined, and some variable are highly correlated with each other, are you over-learning the data set? Response: Yes, we are over-learning the data, but we had to work with the data we had. Conductivity, which was one of the most important predictors, was not strongly related to dissolved inorganic nitrogen (DIN) over the entire data set.

-What is the causal relationships between conductivity and periphyton biomass? Response: This is likely to be related to calcium and other ions. It may be an effect of species composition.

-Why did the national model perform poorly? Response: Due to the variation in river types across the country.

-The presentation focussed on chlorophyll a, what about percentage cover? Response: Percentage cover doesn't lend itself well to modelling. There are differences in the relationships between percentage cover and chlorophyll a between regions.

-Biggs used cover of different periphyton types the NZ Periphyton Guidelines (2000), is this a possibility for this work? Response: Councils measure mats and filaments separately but chlorophyll a shows the strongest relationships.

-Are you suggesting dissolved reactive phosphorus should be left out of predictive models? Response: No.

-Periphyton can also take up nutrients, particularly phosphorus, from the sediment. Response: Yes, dissolved nutrient concentrations are a blunt tool.

-Freshwater Ecosystems of NZ (FENZ) has a variable relating to phosphate in rock, was this used? Response: This was included in the random forest model but it wasn't one of the best predictors.

-Phosphorus in the water column doesn't fully represent what is available for the mat. This helps explain why DRP is a predictor of periphyton in some cases, but not all.

-How important is ammonium? Response: The proportion of ammonium, relative to nitrate, in the water is low, though it is important below point sources.

-What is the strongest predictor, total nitrogen (TN), DIN, or nitrate? Response: TN sometimes works better but we don't have national data for TN. In Horizons, TN is a better predictor.

-Does the same situation apply to TP and DRP? Response: No, there is not the same relationship.

-Is TN measuring the same thing in lakes and rivers? Response: No, in lakes it will include the nitrogen stored in phytoplankton cells, whereas in rivers, TN will not include the periphyton cells as these are on the bottom of the river.

#### **Questions for Ton Snelder**

-This approach uses 21 river classes to divide up 77 river sites, that means there isn't much data in each class. Response: That's right, this was a data mining exercise.

-Were some streams removed from the analysis because of substrate? Response: Yes, the record was split because some sites have changed over time. The criteria developed in the report apply to gravel bed river sites.

-Would you have expected the same result from DIN? Response: TN is a better predictor. But DIN would give similar answers. On a site-by-site basis you can convert between DIN and TN.

-Is DRP a limiting nutrient at these sites and has it been removed from the water column by periphyton? Response: The DRP model worked well for this dataset. Different data was used in this analysis and Cathy Kilroy's which is why the results for DRP were different.

-It would be good to test this method for predicting chlorophyll a. Response: The test data were biomass as chlorophyll a. Weighted composite cover (WCC) was converted to chlorophyll a in this work.

-Is N or P most often the limiting variable? Response: it varies among sites and over time.

-Periphyton can get P from the sediment. Could you use nutrient loads, rather than concentrations, to predict periphyton? Response: We've tried this and it hasn't worked. The models use median TN and DRP as long-term indicators.

-In rivers in alpine areas there is very little sediment.

-Would it be possible to combine the REC categories to improve certainty in the predictions? Response: Yes, the uncertainties could inform which classes were different to each other.

-You've used linear relationships? Response: We use a log transformation for nutrients, but other variables seem to be linear at this scale. We tried a neural network but that didn't help. These models predict the 92<sup>nd</sup> percentile. We don't use interaction terms in the model because the models tend to become overfitted and it doesn't help when making predictions.

#### **Questions for Russell Death**

-Fish IBI is less effective as a predictor because in some locations it is affected by downstream conditions, e.g. dams or discharges that might affect fish passage. Response: the quantile regression of Fish IBI against nitrate did show a relationship though.

-How did you decide the thresholds? Response: some use the EPA approach, some use MCI, some use ANZECC.

-There is a decision to be made about where to put the thresholds in relation to MCI. Response: We have log-transformed the nutrient values because the relationship between MCI and nutrients flattens out once you reach an MCI below about 90.

-The C/D threshold was 1.32 in the previous paper, how does this relate to the new values? Response: Adam Canning has provided new numbers with 6 bands. This allows you to have a bottom

line corresponding to an MCI of 90. This is for the group to think about – where should the bottom line be? Once the MCI gets below 80, there is little relationship with stressors.

Comment: The MCI is in the NPS-FM with a requirement to respond to scores below 80.

#### **Discussion on incorporating Russell Death's attribute tables into the NPS-FM.**

*Note: The points below were made by members of the group during the discussion and do not necessarily reflect general agreement within the group. They are records of the richness of the discussion. Where the level of agreement was gauged among group members, this is clearly indicated.*

There has been a relationship put forward using different methods and data sources connecting higher trophic levels to nutrients. We would need to evaluate the quality of all the data sources. Can we accept the assumption that nutrients affect those higher trophic levels in the same way around the country?

You're not necessarily looking at the direct effects of the nutrients on the biota. Macroinvertebrates are affected through the effect of periphyton. But there are also relationships with other factors. You're not necessarily seeing a causation between the two. The nutrients are affecting periphyton and microbial communities.

This treats nitrate not as a driver but as an index of a degraded system. It's something that is correlated with the degradation.

If we achieve these concentrations, if we're not confident of the causal link, will achieving those standards help us achieve what we want? No, because other factors need to be managed. This is not a silver bullet but managing nutrients in waterways needs to occur for improvement.

Nitrate is correlated with the proportion of pasture in the catchment. One member expressed concern that the proposed attribute is a proxy for general water quality and habitat degradation. Recent work in Environment Bay of Plenty suggests there's no relationship between nitrate and MCI within that region. It's not known if that is specific to a region. It is not certain whether these relationships break down at smaller scales. One member suggested there may be an influence of soft-bottomed habitats in this data set.

One member pointed out that sampling can cause variability. For example, Canterbury samples are collected in runs not riffles.

It was suggested that habitat was the main predictor of macroinvertebrates, and another member suggested that an attribute for habitat was needed.

The way things have been framed until now in the NPS-FM process is that you're trying to achieve an ecosystem health outcome. Managing one attribute on its own, such as nitrogen, will not be sufficient to meet the outcome.

Some members expressed concern that Russell Death's bottom line will be too permissive in some locations and too restrictive in others.

One member asked, what do we do when the chlorophyll a target is met, but the nutrient targets are not?

Ecosystem health is a complex variable and changing one attribute is not expected to improve things on its own. This work needs to proceed as a package, including the Ecosystem Health metrics. With a

package of variables, one option would be to use the most restrictive attribute for freshwater management purposes.

One member asked if you could achieve the ecosystem health outcomes by doing other things rather than improving nutrient levels? It was agreed that this was true, but it was pointed out that this was not a reason for not managing nutrients. It was pointed out that the decision not to act is also a decision.

The group agreed that having ecosystem health attributes for nutrients is a good thing to do.

One group member expressed a desire for the ecosystem health metric discussion to happen among the whole STAG group, rather than a STAG sub-group.

In formulating the attributes for sediment, researchers looked at multiple ecosystem components. They looked at a range of responses to sediment and used the most conservative one. This approach could be used with nutrients.

One member noted that there has to be a degree of certainty that achieving the outcomes will achieve the effect. Concern was expressed about the role of estuaries and lakes in this – a concentration may be suitable for the rivers, but the concentrations needed for estuaries may well be more restrictive. Controls on nutrients are just one instrument, we need many different instruments to effect change. A weight of evidence approach can be useful.

It was pointed out that you can still keep the requirement to manage for sensitive receiving environments. The attribute doesn't prescribe the goal for every single river – but it specifies that the bottom line needs to be achieved. There is still local flexibility for communities to decide what they want to achieve in their rivers.

The point we've agreed to is that there is a general gradient of ecosystem health and nitrate is not the main driver, but is an indicator. The one thing that farmers can control very finely is nitrogen. If you give them a nitrogen target, they will change their nitrogen. But if nitrogen is not the cause, changing the nitrogen will not make a difference. Managing nitrogen is necessary but not sufficient. The intent of having a nitrogen number is that farmers will tweak their operation to manage nitrogen.

It was noted that there are other policy changes coming, so farmers will not just be focussing on limiting nitrogen.

The problems are complex. Nationally applicable nutrient attributes are one instrument that can effect a change and help conversations. Farmers can come up with many different ways to affect N – altering land-use intensity is not the only mechanism. If the nitrate attribute was pursued on its own there may be perverse outcomes but this needs to be progressed as part of the wider package of changes related to ecosystem health.

We need to emphasise the importance of values. We see farmers as partners in caring for water. The view needs to shift towards enhancement rather than tweaking N.

Considering the status quo and the other approaches: the status quo relies on quite a technical process. The larger question is the degree to which we want to have a nationally applicable number, as opposed to locally derived numbers. It was suggested that we can have both approaches.

**Presentation: Processes leading to current NOF attributes**

*At this point one of the group members gave a summary of the past process that has led to the current state in the NPS-FM regarding the setting of nutrient criteria to manage periphyton.*

Notes on discussions from the NOF Reference Group and the Land and Water Forum between 2016 and 2017 had been previously circulated to the STAG.

A summary was presented of discussion points on this matter that arose at the **July 26 2016 NOF Science Review Panel** meeting and recorded in the minutes of that meeting.

[It was noted that in 2016 there was a lot less information on periphyton and nutrients than today (having heard Dr Kilroy's and Dr Snelder's presentations today)].

The question addressed at the 2016 Science Review Panel meeting was : **"Is it feasible and scientifically defensible to expect councils to set maximum in-stream nutrient concentrations for periphyton that take account of downstream receiving environments?"**

The meeting's discussion points can be summarised as follows:

- Uncertainty as to the strength of the correlation of periphyton abundance to water quality concentrations of dissolved N and P. In many cases nutrients in sediments are just as important, as well as flow and temperature in defining periphyton biomass.
- Uncertainty in the relationships means that here is only ability to explain 50% variation in temperature, flow, N, and P at this stage.
- There are too many confounding influences on periphyton to only specify water quality concentrations as controlling factors. To consider all the influences would require a large multivariate look-up table.
- Analysis of the Horizons RC dataset on periphyton indicates that nutrient relationships with periphyton could not clearly be established at spatial scales larger than sub-catchments
  - If default numbers were to be used in the way presented (ie a matrix table of NOF Bands for DIN and DRP across several classes of water body) then they should only be used under limited circumstances and for a limited timeframe, and should only be used as guidance.
  - It would be critical to articulate how to deal with downstream receiving environments in the process and be clear that any default table should never apply in those cases.
  - It was recognised that where nutrient effects on periphyton can be clearly demonstrated these may not apply in the same way to periphyton communities that are comprised of didymo and cyanobacteria.
  - Given the uncertainties, the Panel suggested that it may therefore be preferable for Councils to set their own concentrations that would account for scale, local complexity and downstream receiving environments.

In summary, the Panel was not convinced that it would be scientifically defensible to put numbers for DIN and DRP concentrations for controlling periphyton into a table for use as attributes. Such a table cannot account for local impact complexities, or downstream receiving environments. The SRP was wary of a default table due to the risks and cautioned that such a table should only be used in guidance.

The Panel agreed that it may, however, be possible to specify a process for councils to work out waterbody specific concentrations. Currently the NPS does this through requiring councils to manage periphyton to NOF bands so improved policy direction (possibly as guidance) may make the process easier for councils.

**[End of Presentation]**

**General discussion resumed:**

A group member noted that there is more justification now for managing nutrients for ecosystem health, rather than just for trophic state. It may be possible to have two approaches:

1. One set of nutrient attributes for trophic state
2. One set of nutrient attributes for ecosystem health

It was noted that communities can set appropriate numbers – they don't have to default to the bottom line.

One group member emphasised the need to shift the focus away from just managing N. We need to figure out what the priorities are for improving ecosystem health.

**The Chair asked group members to consider the questions in the meeting notes:**

1. Are the current provisions in the NPS-FM sufficient to maintain or improve ecosystem health in rivers?
  - a. If not, why not?
2. How far does current understanding take us? What further work is required?
3. Would it be (1) feasible and (2) necessary to provide default concentrations for DIN and DRP?
  - a. If so, how would the DIN/DRP concentrations need to be derived to provide for maintaining or improving ecosystem health in different river types?
  - b. What should be the process for defining them?
  - c. Are classification systems needed to appropriately vary the default DIN and DRP concentrations?

**Responses:**

1. No (the group is in agreement)
  - a. It doesn't cover components of ecosystem health. Relationships between periphyton and nutrients are weak
2. The Chair summarised: from what I've heard, there is data that people have mined to try to draw conclusions. There is always the scientific desire for more data and more analysis. There are gaps in our understanding and uncertainty around the numbers – e.g. the periphyton/nutrient relationship. RD is confident in his numbers and is certain that those numbers, using the precautionary approach, would lead to a better ecosystem health. It was noted that the uncertainty needs to be communicated carefully, and that the different lines of evidence align with each other.

It was suggested that the group look at this in more detail. If we have national ballpark figures, it may be necessary, from an implementation standpoint, to make sure they are spatially representative, and to examine spatial variation in relationships, e.g. whether the figures vary across different river types. In the meantime, we have generic numbers to inform the discussion. This has parallels to what has been proposed for sediment. There are similarities to the numbers used overseas. We should frame it as "they may need to be refined".

The Chair asked the group to clearly describe possible options, communicate the degree of agreement and their pros and cons.

**Option 1: Incorporate Russell Death's nitrate and DRP attributes into NPS-FM now (supported by 2 members)**

Key aspects of this option:



- The attribute tables were developed using a weight of evidence approach, taking into account multiple ecosystem health outcomes/components and trophic levels.
- One nationally applicable attribute table for each metric.
- Aligns with approaches and numbers derived internationally.
- The bottom line is aligned with a MCI score of 90. But the numbers are not only based on MCI, there are multiple lines of evidence.

It was pointed out that these numbers would not be suitable for managing periphyton.

The group agreed that the periphyton attribute, its note and supporting guidance should remain.

There are some rivers that would naturally have nitrate concentrations above the bottom line suggested by Russell. You could retain the periphyton attribute note but require councils to use the more restrictive set of numbers.

We do need to point out that just managing nutrients on their own is not sufficient.

**Option 2: Incorporate Russell Death's nitrate and DRP attributes into NPS-FM, with further work to answer outstanding questions (supported by 12 members)**

This option would involve investigating further the attributes put forward in Option 1.

Key questions are:

1. How to weight evidence
2. How and where to set bands in relation to ecological responses
3. Whether attribute tables should vary spatially
4. Whether TN and TP attributes for ecosystem health are more appropriate than nitrate and DRP (as per Marc's suggestion by email after the meeting)

**Option 3: Strengthen the requirement in Periphyton Attribute Note to account for ecosystem health effects (not supported by the group)**

This option was put forward as a possibility in the case that options 1 and 2 were not possible.

**Option 4: Status quo (not supported by the group)**

**Discussion points relating to these options:**

Is there an appetite to put an attribute table in the Periphyton Attribute Note? One member responded that this is better to be done regionally.

Is there the capacity to separate out upland and lowland streams, would this be a middle road (instead of having one attribute table or many, as in Ton's analysis)

Are permissible nitrogen concentrations lower in lowland rivers? Response: Upland rivers have a higher permissible nutrient concentration as they are more flashy etc. But there is the requirement to manage for downstream receiving environments.

Having 21 classes for rivers is manageable, but these might be able to be collapsed based on an analysis of ecological responses.

**The group then discussed the following four options for the periphyton attribute:**

1. Provide default nutrient table – in guidance – which councils can choose to use
2. Provide default nutrient table – in NPS-FM – that councils must use
3. Provide default nutrient table – in NPS-FM – to be used unless councils derive their own
4. Do not use the default nutrient table (i.e. keep the status quo of the periphyton attribute and accompanying note)

Discussion points included:

- There is a possibility that councils may still need to defend values in court if they derive their own values. There is also a risk that councils will use the values provided and not bother deriving their own.
- They may also ignore large changes in flows or shading which may affect the periphyton relationships. There may therefore be perverse outcomes of providing a default table.
- Providing a table in guidance provides a way for councils to check the objectives they have derived for their local rivers.
- The recent periphyton research showed us that regional analysis provides a way forward. Not all regions have the suitable data yet, but the science is advancing very quickly.
- It was noted that we can always improve data, but what can we do now to achieve the Minister's objective of improvement in the next 5 years?
- The data suggests that regional approach is suitable, but it could be useful to provide guidance for councils in the form of a default table (Option 2). The wider group supported this approach.

**Outcome:** The group supports the Periphyton Attribute Note being retained with additional guidance in the form of attribute tables (Option 1)

Two group members noted that they didn't believe that a regional model can be better than a national model.

**There was then further discussion on the nutrient attribute approach:**

- One member suggested that the evidence required to support Option 2 could be provided in 6 months.
- The group agrees on the approach using a weight of evidence approach taking into account multiple ecosystem responses and trophic levels.
- It looks like the bottom line would be over protective in some areas and under protected in others.
- One of the members suggested a peer review of the data going into this approach and the weighting.
- Another member suggested quantifying the uncertainty of the data being used.
- The timeframe for this process is as follows: Cabinet would be taking final decisions on this in November 2019. Public consultation is in July – this is our first deadline. If we can get finalised numbers before we consult, that would be ideal. Otherwise we can go out to consultation with a straw man.

The group then voted on the four approaches; 2 members voted for Option 1, 12 voted for Option 2, and no members voted for options 3 or 4.

The group then discussed matters that could be examined as part of Option 2:

- One member suggested giving consideration to expanding this table in future to have other parameters. Can this structure potentially be expanded? If it is, is it an “and” or an “or”? Are the effects considered separately or together? Can this be applied to lakes and wetlands? (This would be something to consider for the future). It’s important to note that there are other freshwater bodies that will not be protected by these tables.
- One member suggested examining the percentile approach of putting in different thresholds and whether it is related to intrinsic ecological effects.
- Another area to look into would be how we define bands. This is related to the proposed sediment attributes and will be discussed at the next meeting.
- It was noted that in many cases there is a continuum in ecological effects and often, there isn’t a tidy drop off upon which to base bottom lines or bands.

5.00 pm

*Meeting close*

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**Papers distributed in compilation:**

<b>Agenda Item</b>	<b>Paper</b>	<b>Confidential?</b>
1	Agenda and meeting minutes from 24 January	Yes
2	Maintain or Improve update - No paper	-
3	Dissolved oxygen update - No paper	-
4	Ecosystem Health	Yes
5	Flows	Yes
6	Nutrients (longer summary)	Yes

**Papers distributed separately:**

<b>Agenda Item</b>	<b>Paper</b>	<b>Confidential?</b>
4	Briefing note: Managing all aspects of Ecosystem Health (on portal under joint freshwater advisory group page)	Yes
6	Nutrients (short summary with suggested reading – sent by email 28 January 2019)	Yes

Released under the provisions of the OIA

## Sediment attributes – 26 March 2019

This paper will structure our 26 March discussion about the proposed sediment attributes and our initial thinking on policy recommendations. It covers the following issues:

1. Context – STAG's consideration of sediment proposals to date and next steps for issues on which we seek STAG's considered opinion;
2. Research overview and core NIWA/Cawthron proposals: classification systems, attribute tables, and maps of their application;
3. Current state of our thinking on policy recommendations and rationale.

### 1. Context

To date we have discussed the sediment attribute work on three occasions:

**October 2018:** We introduced the body of work to date and discussed planned and contracted research. We also laid out the areas of advice we would seek from you, especially the appropriateness of methods and strength of evidence that underpin our policy proposals.

- STAG's discussion focused primarily on the sediment attributes' definition via long-term measures of central tendency (2-year medians) versus exceedance events.

**November 2018:** We asked for your consideration of the proposed attributes' measuring and monitoring criteria (2-year medians based on monthly samples).

- There was broad agreement on the deposited sediment indicator's appropriateness (SAM2 method, monthly monitoring regime for 2-year medians).
- STAG requested further information on monthly versus continuous turbidity monitoring to support their consideration of the suspended sediment indicator's appropriateness (monthly monitoring regime for 2-year medians of turbidity).
  - Alongside this paper, we have provided several documents with further information to support your consideration of this issue.

**January 2019:** We asked for your consideration of the new sediment state classification system proposed in the Stage 3 research.

- STAG had no major reservations about the classification approach but wanted to see how the framework incorporated ecological response information.

### What we seek going forward

In late February, we received the draft report with sediment attribute proposals and made it available in full on the portal. We now seek your consideration of several key technical points that shape our policy advice. These are listed roughly in our perceived order of priority.

1. Is the primary method on which bottom lines and bands are based – the community deviation method described in full in Appendix J – robust?
2. Can we provide for ecosystem health by including NPS-FM amendments with a deposited sediment attribute and a suspended sediment attribute using turbidity only?
3. Are the bottom lines set appropriately to provide for ecosystem health (keeping in mind the definition of the bottom line threshold)?
4. Is the proposed classification system fit for purpose considering how ecological response information was incorporated?
5. Should we incorporate bands even though fewer lines of evidence support setting band

thresholds according to the classification system?

6. Are the indicator definitions and monitoring requirements appropriate?
7. Is the suspended sediment exceptions regime appropriate?

We would like to cover as many of these issues as possible prior to our advice going to Ministers. Of course, we recognise there is limited time and a lot of detail underlying each question. While we must make policy recommendations in the very near future that include draft NPS-FM text, the recommendations we make now are not set in stone. We can revisit issues that arise through the consultation process.

On the 26<sup>th</sup>, then, we would like to discuss how best to approach our discussion on the day and how we should plan for future meetings before we launch into any of the topics in detail.

### Accompanying documents

We have four documents accompanying this paper to address the “action register” questions raised during the November and January meetings on turbidity monitoring and the analytical framework linking catchment suspended sediment loads to attribute states:

5. A brief write-up entitled “further information to STAG March 2019” that outlines how we approached answering the “action register” questions;
6. An HTML document providing turbidity analyses comparing median timeframes, continuous versus discrete sampling, and monitoring at all flows versus low flows;
7. A word document including the code for the analyses;
8. The summary document of Hicks et al. 2016 (Stage 1a report) that discusses the analytical framework in depth.

Also, Ton Snelder will present on the analytical framework during the meeting and we can provide the slides afterwards.

## **2. Research overview and core proposals**

### Research overview

The NIWA/Cawthron research team have proposed suspended and deposited sediment attribute bottom lines and bands according to “sediment state classification” systems that we discussed in January. A brief overview of the entire research approach helps to contextualise the proposals and hopefully makes them easier to understand.

As discussed in January, the research team developed classification systems for suspended and deposited sediment that reflect natural variation in riverine suspended and deposited sediment attribute states (i.e., clarity, turbidity and deposited fine sediment). The final systems they propose consist of 24 distinct groups of river types – 12 for suspended sediment and 12 for deposited sediment. These are defined according to their River Environment Classification (REC) climate, topography, and geology (CTG) characteristics. These characteristics are the primary determinants of a river’s supply, transport, and detention of sediment.

The researchers created nested classification systems that can include fewer (minimum of 2) or more (maximum of 12) groupings (i.e., classes) depending on their level of aggregation. They recommended using the least aggregated combinations – 12 groupings for each sediment state classification – in order to reduce the bias inherent in clumping groups of river types with different predicted reference states and ecological responses to changes in sediment levels.

The research team conducted numerous analyses of ecological responses to in-stream sediment. They assessed how fish and macroinvertebrate communities respond to variation in levels of turbidity, visual clarity, and deposited fine sediment (as determined by areal

coverage.. The ecological analyses varied in several ways:

1. The spatial scale used to assess sediment effects on ecology: some methods examined “global responses” using all available ecology and sediment data across the country whereas other methods focused on ecological responses to sediment within classes defined by the classification systems.
2. The type of ecological response: some methods indicate how much in-stream sediment will result in local extirpation of key species whereas others assess changes in fish and macroinvertebrate community composition.
3. How change points are assessed in ecological response: some methods highlight where ecological responses to increases in in-stream sediment become very rapid whereas others are based on a fixed deviation from the expected natural conditions.

For each method, the researchers identified the classification groupings and bottom line and/or band threshold values that could be set using that method’s outputs alone, as well as the relative strengths and weaknesses of that method. The research team synthesised ecological response information through a weight-of-evidence process whereby they gave different methods’ results different weighting and roles in the final determination of attribute thresholds. They prioritised results according to the reliability of the methods and underlying data, relevance of the outputs, and suitability for different purposes such as setting bottom lines or bands.

Following implementation of this process, the research team proposed bottom lines and bands for each attribute according to the least aggregated classification systems and based on the community deviation method. Overall, macroinvertebrate responses were more “constraining” for deposited sediment and fish were more “constraining” for suspended sediment.

### Core proposals

The researchers proposed thresholds for turbidity, visual clarity, and deposited fine sediment. We are considering recommending incorporation of only turbidity and deposited fine sediment and excluding visual clarity. Therefore, we have not included the classification system and thresholds for visual clarity in this document.<sup>1</sup>

Table 1 below shows the predicted reference state of deposited fine sediment and turbidity for each class of the two sediment state classifications, , the proportion of national river network in each class, and the REC CTG groups that make up each class. Maps showing the spatial distributions of classes in each classification are shown in Figures 1 and 2. Tables 2 and 3 show the proposed suspended and deposited fine sediment attribute tables. There is no “exceptions” regime (where bottom lines do not apply) for the deposited sediment attribute, and the suspended sediment exceptions regime includes the following exceptions:

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).

We are considering recommendation of the attributes largely as shown in Tables 2 and 3 with likely changes limited to suspended sediment monitoring definitions to permit use of continuous turbidity monitoring where available. Also, we will delete footnotes 1 and 3 in each table and define the classification system in an appendix rather than in the table itself.

<sup>1</sup> For the visual clarity classification system, see Stage 3 Report table 3-3 on p.36, and for the visual clarity attribute thresholds, see Table 1-3 on p. 19.

Table 1 - Deposited fine sediment classification system (left); suspended sediment classification (right)

Class (grouping)	Ref (deposited fine sediment)	% River Net.	CTG Classes	Class (grouping)	Ref (turbidity - NTU)	% River Net.	CTG Classes
1	0.79	1.88	WD_Low_VA; WD_Low_AI	1	1.6	7.05	WW_Low_VA; CW_Low_VA
5	0.74	3.05	WD_Low_SS	12	2.2	22.37	CW_Mount_HS; CW_Hill_SS
9	0.43	0.36	WD_Low_HS	2	4.9	1.42	WD_Low_AI
8	0.13	0.14	WW_Lake_Any	5	5.9	10.81	WW_Low_SS; WD_Low_SS
11	0.69	0.45	WW_Low_AI	8	3.6	3.61	CD_Low_SS
6	0.22	13.32	WW_Low_VA; WW_Low_HS; CD_Low_VA; CD_Hill_AI; CD_Low_HS	6	3.8	2.84	WW_Low_HS
12	0.20	19.73	CW_Hill_VA; CW_Low_VA; CW_Low_SS; CD_Hill_HS	3	1.1	2.72	CD_Low_HS
3	0.33	4.68	CW_Lake_Any; CW_Low_AI; CD_Hill_SS	4	2.7	6.01	CW_Low_SS
7	0.34	15.51	WW_Low_SS; CD_Low_SS; CD_Low_AI	7	2	10.92	CD_Low_AI; CW_Hill_VA
10	0.09	36.41	WW_Hill_VA; CW_Hill_HS; CW_Low_HS; CW_Mount_HS; CW_Hill_SS; CW_Hill_AI; CD_Mount_HS; CW_Mount_AI	10	0.9	1.63	CW_Lake_Any
2	0.04	1.46	WW_Hill_HS; CW_Mount_VA	11	0.9	2.03	CW_Low_HS
4	0.07	1.95	CW_Mount_SS	9	1.0	17.12	CW_Hill_HS; CD_Hill_HS; CW_Low_AI



Table 2 - Proposed deposited fine sediment attribute

Value	Ecosystem Health												
Freshwater Body Type	Rivers												
Attribute	Deposited fine sediment												
Attribute Unit	% fine sediment cover (percentage cover of the streambed in a run habitat determined by the instream visual method, SAM2)												
Attribute State	SSC class <sup>1</sup>												Narrative Attribute State
	1	2	3	4	5	6	7	8	9	10	11	12	
	Site median <sup>2</sup>												
A	<84	<9	<42	<12	<80	<30	<41	<22	<48	<15	<76	<27	Minimal likelihood of instream biota being impaired by deposited sediment cover. Ecological communities equivalent to minimally disturbed sites in the absence of other confounding stressors.
B	<90	<15	<50	<17	<86	<38	<48	<33	<54	<22	<82	<36	Low to moderate likelihood of instream biota being impaired by deposited sediment cover. Abundance of sensitive macroinvertebrate species reduced.
C	<97	<21	<60	<23	<92	<46	<56	<45	<61	<29	<89	<45	Moderate to high likelihood of instream biota being impaired by deposited sediment cover. Risk of sensitive macroinvertebrate and fish species being lost and change in community composition.
National Bottom Line <sup>3</sup>	≥97	≥21	≥60	≥23	≥92	≥46	≥56	≥45	≥61	≥29	≥89	≥45	
D													High likelihood of instream biota being impaired due to deposited sediment cover. High probability of loss of sensitive macroinvertebrate and fish species and change in community composition.

<sup>1</sup> Classes are streams and rivers defined according to the fourth level of aggregation (L4) of the deposited sediment Sediment State Classification (SSC).

<sup>2</sup> The minimum record length for grading a site based on an instream visual assessment of % fine sediment cover (SAM2) is 2 years based on a monthly monitoring regime.

<sup>3</sup> Bottom-line thresholds are anticipated to provide a sufficient level of protection at an overall macroinvertebrate community level (i.e., will cause <20% decrease in the *macroinvertebrate community deviation metric*), however, they may not always be sufficient for the protection of specific life-stages or habitat requirements in specific locations (for example, salmonid spawning habitats may require sediment cover of <10%). Fine sediments with high organic enrichment may also result in higher levels of impacts on macroinvertebrate communities or sensitive fish life-stages.

Table 3 - Proposed suspended fine sediment attribute

Value	Ecosystem Health												
Freshwater Body Type	Rivers												
Attribute	Suspended fine sediment												
Attribute Unit	Turbidity (NTU/FNU)												
Attribute State	SSC class <sup>1</sup>												Narrative Attribute State
	1	2	3	4	5	6	7	8	9	10	11	12	
	Site median <sup>2</sup>												
A	<2.0	<6.2	<1.3	<3.3	<7.5	<4.8	<2.3	<4.3	<1.2	<1.1	<1.1	<2.4	Minimal likelihood of instream biota being impaired by median turbidity. Ecological communities equivalent to minimally disturbed sites in the absence of other confounding stressors.
B	<2.5	<7.9	<1.6	<3.9	<9.8	<6.3	<2.8	<5.2	<1.4	<1.3	<1.3	<2.7	Low to moderate likelihood of instream biota being impaired by median turbidity. Abundance of sensitive fish species reduced.
C	<3.2	<10.5	<2.0	<4.8	<13.1	<8.3	<3.3	<6.4	<1.6	<1.5	<1.6	<3.1	Moderate to high likelihood of instream biota being impaired by median turbidity. Risk of sensitive fish and macroinvertebrate species being lost and change in community composition.
National Bottom Line <sup>3</sup>	≥3.2	≥10.5	≥2.0	≥4.8	≥13.1	≥8.3	≥3.3	≥6.4	≥1.6	≥1.5	≥1.6	≥3.1	
D													High likelihood of instream biota being impaired due to median turbidity. High probability of loss of sensitive fish and macroinvertebrate species and change in community composition.

<sup>1</sup> Classes are streams and rivers defined according to the fourth level of aggregation (L4) of the suspended sediment Sediment State Classification (SSC).

<sup>2</sup> The minimum record length for grading a site is 24 samples (i.e., 2 years of monthly sampling).

<sup>3</sup> Bottom-line thresholds are anticipated to provide a sufficient level of protection at an overall fish community level (i.e., will cause <20% decrease in the *fish community deviation metric*), however, they may not always be sufficient for the protection of specific life-stages or habitat requirements in specific locations.

## Aggregation Level 4

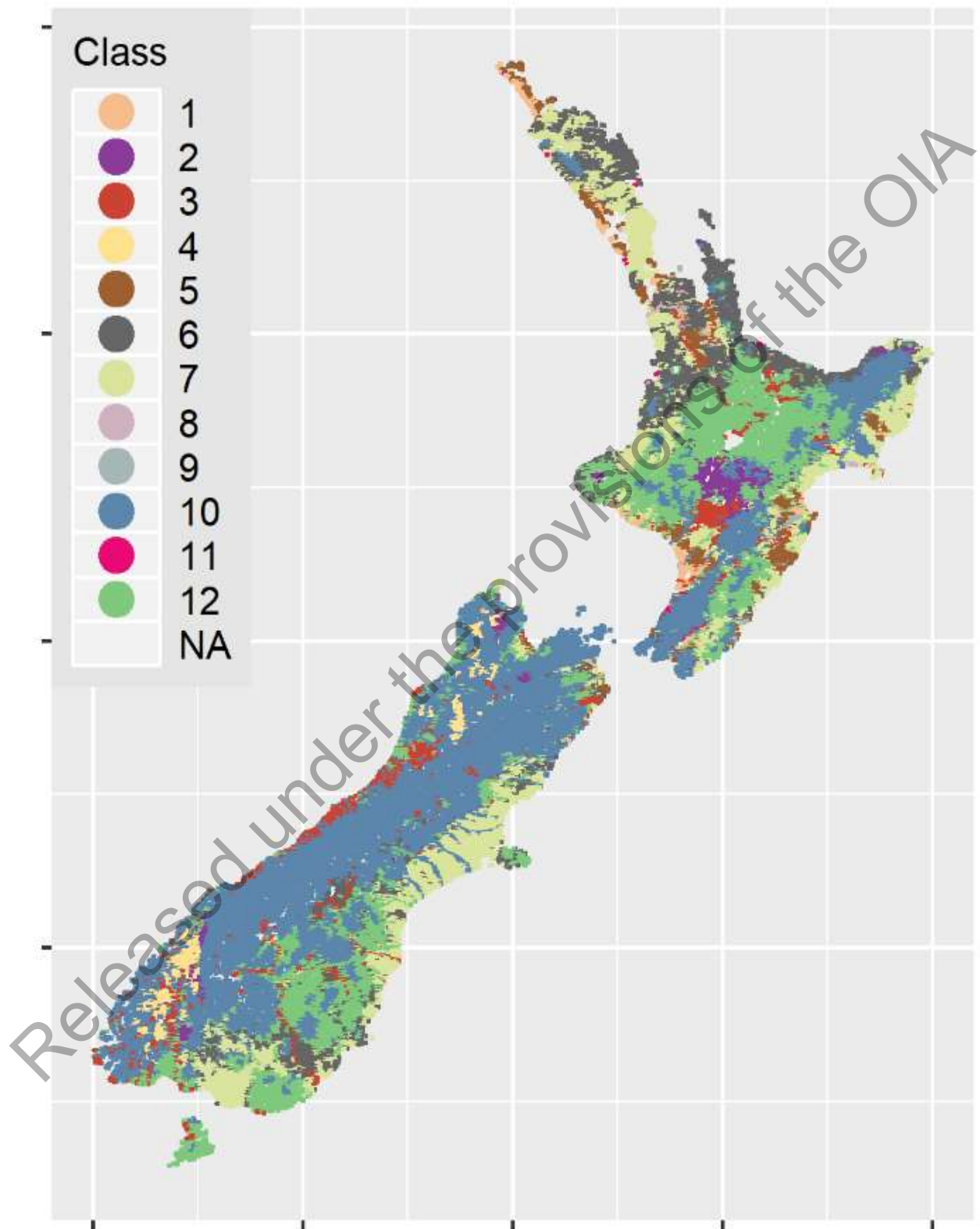


Figure 1 - Deposited sediment attribute classification system

## Aggregation Level 4

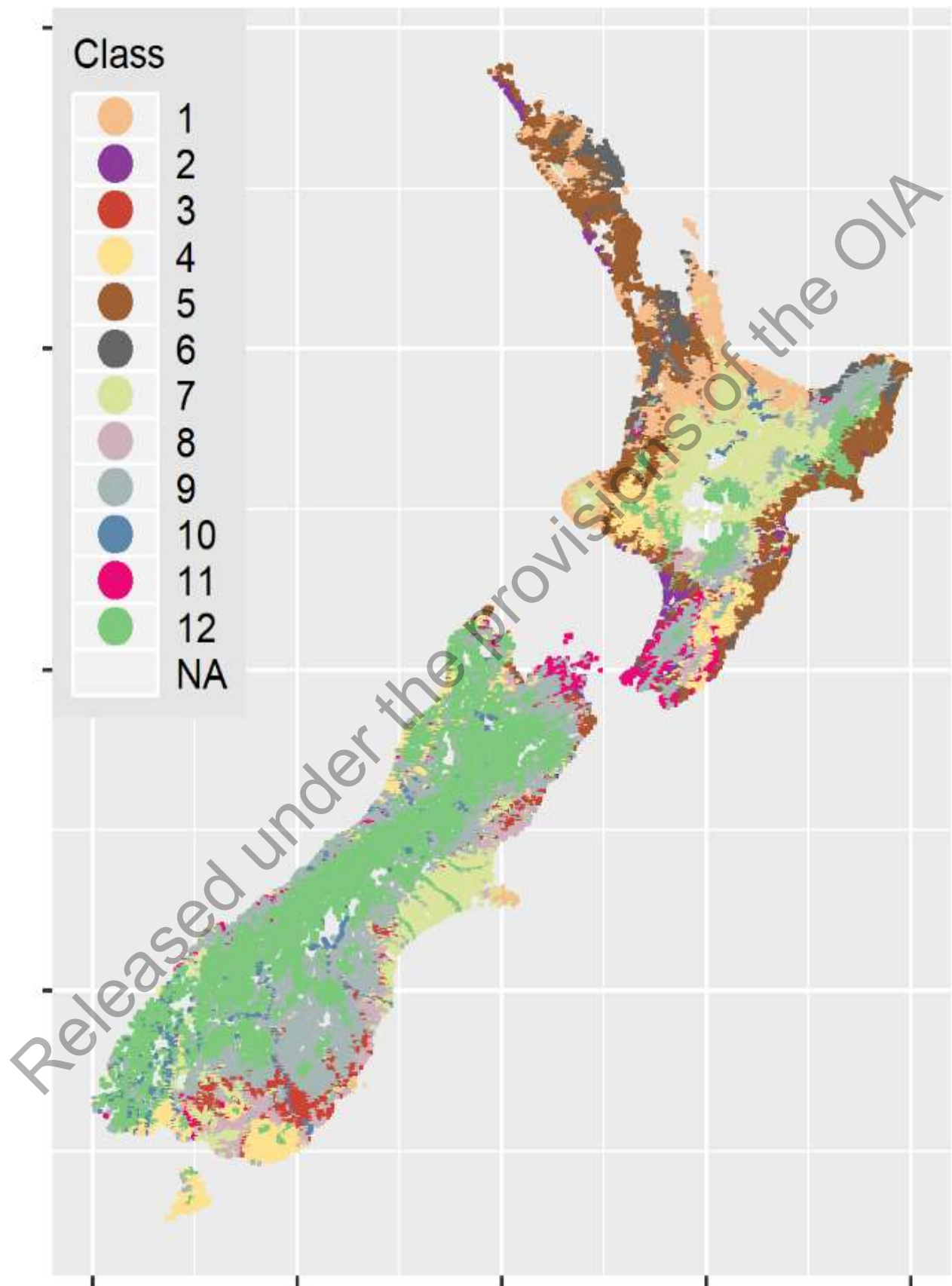


Figure 2 - Suspended sediment attribute classification system

### **3. Current state of thinking on recommendations and our rationale**

Below we provide more detail about each of the key technical considerations for policy development shown in the introduction. We indicate our initial thinking and welcome your feedback and suggestions on the positions, which are certainly not fixed.

In addition to these technical considerations, we must provide advice on the implications of incorporating the policies into the NPS-FM. This paper does not address these issues, although the “further information” document indicates one type of assessment we are conducting to inform this portion of the policy advice. We can cover the issue of policy implications in more depth in subsequent meetings if you wish.

#### Is the community deviation method robust?

At the time of writing this paper, we are still reviewing the method and results in detail, but to date we have not identified any “red flag” issues that would lead us to recommend use of another method’s outputs to set bottom lines and/or bands.

#### All attributes?

We are leaning towards recommending inclusion of deposited fine sediment and turbidity attributes but not visual clarity. We recognise that visual clarity is a direct measurement of ecological impact and turbidity is just a proxy. However, we consider the following strong arguments for including just turbidity:

1. Turbidity is often used – in conjunction with suspended sediment concentration and flow information – to estimate total suspended sediment loads. Therefore, it is more useful than visual clarity for deriving information critical for managing the attribute indicator itself. It is also more useful for connecting in-stream ecosystem health considerations to those of receiving environments like estuaries.
2. Turbidity is monitored continuously in several regions and is monitored more widely than visual clarity; several regions do not monitor visual clarity at present.
3. The turbidity datasets used to derive bottom lines had more sites than those for visual clarity, which had inadequate data to populate two classes (numbers 2 and 3) in the least aggregated classification system leading to the use of a more aggregated class in those cases.
4. The interventions for managing water quality to states defined by turbidity and visual clarity are the same, and we prefer to reduce complexity given the already major implications of sediment attribute inclusion for councils.
5. The data indicate that turbidity and clarity are highly correlated, both in terms of state and in terms of the proposed thresholds (except for the classes noted above, for which the least aggregated classification system could not be developed for visual clarity using the same method). This means that one of these attributes may be considered redundant and so can be discarded.

#### Bottom line metric threshold definitions appropriate?

At present, we are not considering a different “delta c” value from the community deviation method on which to base bottom line thresholds. Likewise, we have not identified strong reasons to consider different bottom line metric thresholds for other methods.

Detailed attribute classification systems?

We are considering progressing the attributes with the proposed classification system shown above. While there are pros and cons to having simpler classifications (more aggregation of river groupings) compared to more spatially detailed classifications, on the balance, we consider that the issue of “systematic under- and over-protection” of freshwater environments inherent in simpler classifications to be the main deciding factor.

Should we incorporate bands?

The researchers used fewer lines of evidence when proposing bands because of the nature of the analyses undertaken. However, we are also likely to recommend changes to the “maintain or improve” stipulation in the NPS-FM that removes the band component to that stipulation. As a result, bands would be less impactful from a regulatory implementation standpoint. Still, bands are useful from a communications and objective-setting perspective. Overall, we think that inclusion of bands is helpful to effect change even though it may have less importance from a purely regulatory standpoint.

Are the indicator definitions and monitoring requirements appropriate?

STAG has already indicated that the suspended sediment attribute indicator and required monitoring regime is appropriate. We have provided information to support your consideration of the appropriate turbidity indicator definition and monitoring requirements.

In your consideration of this issue, we point to the fact that ecological response analyses in most cases used space for time substitutions of the sediment/response metrics since paired observation of sediment and ecological response variables are not made in many cases. Also, several methods develop response gradients that are effectively timeless indicators.

Therefore, from a policy standpoint, we consider that the monitoring definition should be predicated on what is the most appropriate measure of central tendency of a time-span with ecological relevance.

Is the exceptions regime appropriate?

We will seek further clarification from the research team on the locations of these exceptions and potential ways to define them in a standard fashion. However, we are considering recommending them as they currently stand in the draft report.

# Maintain or improve: Options development with STAG sub-group

## Context

The Government has identified halting declines in water quality as a priority, and asked officials to develop a package of options to do this – the *Essential Freshwater* work programme. As part of this work programme, we are considering a range of issues with the existing National Policy Statement for Freshwater Management (the NPSFM), and how we can improve on it to achieve the Government’s objective.

There are risks associated with the existing requirement to maintain or improve water quality, which mean planning could allow material declines in ecosystem health while maintaining water quality within attribute bands. The current objective/policies leave a number of questions unanswered making implementation difficult (e.g. does the requirement apply at every monitoring site? Can sites be aggregated? And how is current state determined?).

On 15 February 2019, officials met with a sub-group of STAG members to discuss these risks and co-develop technically workable options to address them. The invitation email, including an annotated agenda, is included as Appendix 1.

**This paper summarises the outcome of that meeting – a technically workable approach that addresses issues with the existing requirement to maintain or improve water quality, as well as a record of outstanding issues and considerations that drove discussions.**

**Attached is a ‘worked example’ of how we might apply the sub-group’s approach when setting freshwater objectives, and assessing whether water quality has been maintained, using available data.**

## Summary of outcome

The group understood that regional councils are faced with two tasks when implementing requirements to maintain or improve: producing a plan that is sufficient to give effect to the relevant objective and policies of the NPSFM; and assessing performance over time to determine the efficacy of plans (i.e. if water quality has actually been maintained – if not, that would indicate changes are needed).

With this in mind, the group developed the following option/approach to mitigate risks with the existing requirements:

- (a) Requiring freshwater objectives to maintain the current state of water quality (as opposed to within a band); and
- (b) Require councils to report on performance in terms of water quality state/achievement of these objectives alongside a wider range of information, including: pressures (e.g. human inputs and climate); higher level measures of state (e.g. overall state of ecosystem health); and responses like plan rules, methods and implementation progress.

Page 2 of this document describes key elements of the approach in more detail, and flags outstanding issues for further discussion/consideration. This should be read alongside the range of considerations that drove options development, and the notes contained in the initial email invite included on pages 3 and Appendix 1.



## Key elements to be included in requirements to maintain current water quality

How do councils produce a regional plan that will maintain water quality?

### 1) Freshwater objectives to be set at or above *current state* and *at a site scale*, being *specific, measurable, and time-bound*

This will enable assessment of freshwater objectives against current state, as well as tracking progress towards an objective over time.

Any debate about site selection and how current state is determined to happen at the start of a planning process and not after the fact.

### Current state is determined according to A) any direction provided through Appendix 2 attributes, and B) expert input devolved to regional councils.

This is essentially the status quo. While attributes are a tool we can and do use to direct councils in determining current state, the group has mixed views on whether additional direction is needed, and how it should be provided (e.g. more specific sampling/monitoring requirements, NEMS, etc).

This is a key part of new attribute development. But we should consider how much time and resource we have to revise existing attributes, and whether there are other ways to help councils establish current state in an appropriate way. Equally, it may need to be longer term work (past 2019).

Discussions with the group also confirmed that it is technically possible to describe current state as a single point, although this is not sufficient for describing why/whether water quality has been maintained over time (hence the reporting requirement – see right).

### The ‘load to come’ must be addressed via explicit timeframes for achieving objectives, and reporting on current and predicted state (see reporting requirements)

#### Outstanding issue – appropriate site selection and adequate coverage is critical

There is an opportunity for future work look at how we can support this, or establish whether intervention is necessary (e.g. regulation or funding). However, this is not something we propose to ‘solve’ here – we are focussing on getting the framework within the NPSFM right first.

But there may be a role for the STAG to size up this issue and give the Government a clear signal about what is needed. Or this can be assessed as part of the 2020 implementation review (required under the NPSFM).

This is the same issue as concerns that an ‘FMU will be too large’ – the underlying question is, do freshwater objectives (i.e. set at a site scale) apply to, and are measured against, an inappropriately large area.

#### Outstanding issue – whether current water quality is a fixed concept (i.e. as it was in 2014, 2019, or the date of initial planning), or something that is reassessed over time (i.e. during future plan changes)

Currently the existing water quality is defined as the latter, something that is reassessed over time. But in parallel to this work we are considering how to address the risk this will lock in degradation over time (i.e. allow councils to aim lower following poor performance). Conversely, there are risks with a fixed concept – encouraging debate and litigation about past state, feasibility where the load to come represents a permanent decline that is already locked in under current land-use, and added complexity attributes are developed in the future.

We are continuing to work through this issue.

How do councils assess plan effectiveness/whether they have maintained water quality over time?

### 2) Performance is assessed and reported at regular intervals

Reporting intervals could be aligned with SOE reporting, or local government elections enabling councils to combine the task of reporting with preparing advice for incoming councillors.

This question is better suited for consultation than internal analysis, we don’t necessarily have the right information or expertise to know what is best/preferred (as central government).

### Reporting is *comprehensive* and tells the full story about what is happening to water quality

Discussions with the group really focussed on what information is needed to understand whether water quality has been maintained, and that simple pass/fail assessments of water quality outcomes are not sufficient to inform planning.

Reporting should include:

- Pressures – Climate influence and inputs like land-use are useful for understanding water quality outcomes (and clearly communicating uncertainty about their causes).
- State – This should include the current and predicted state of individual attributes (e.g. current state) AND integrate what these mean for the overall state of the values like ecosystem health AND additional measures that assist with this (e.g. biotic measures). It is important to communicate what water quality is, what it is likely to be, and what those outcomes mean for values. There is a significant overlap with ecosystem health work, which is looking at how councils can report on the overall state of ecosystem health, including potential templates for reporting, and valued metrics which could lead to additional attributes and include more integrated measures (e.g. biotic measures, etc).
- Response – Reporting should clearly communicate what action the council is taking (both regulatory and non-regulatory) to achieve freshwater objective, and their progress in implementing these – these can be useful indicators of progress towards success or failure.

Reporting should be comprehensive – include all information relevant to assessing whether water quality has been/will be maintained. We can specify what this must at least include (and are looking at doing just that via ecosystem health work), and at minimum, are looking to integrate existing requirements for monitoring (incl. MCI), accounting, and reporting on implementation.

### There is single reporting requirement, pulling together existing and new requirements, and giving councils scope to include all relevant information

For example, plan policies may mean specific information is relevant. Policy 11.4.7 of the Canterbury Land and Water Regional Plan is to—

*Reduce the total nitrogen load entering Te Waihora/Lake Ellesmere by restricting the losses of nitrogen from farming activities, industrial and trade processes and community sewerage systems in accordance with the target (the limit to be met over time) and limits in Tables 11(i) and 11(j).*

This implies changes in nitrogen loads, progress implementing restrictions on specific activities, and comparisons to targets and limits are all relevant. We can make sure councils refer to this in any assessment of maintaining water quality.

The NPSFM also requires regional councils to collect and make publicly available a range of information that is relevant, and should be used in any assessment of maintaining water quality, i.e. regional councils are already required to account for all takes and sources of contaminants, monitor progress towards achieving freshwater objectives, and publish progressive implementation plans.

Where reporting is not already required (e.g. predicted future state, and the influence of climate) we can direct councils/give them scope to include this as well, and tell a fuller story.



## Considerations that drove options development, or came up in discussions:

- **Limited ability to link changes in water quality to causes:** We have a limited ability to explain changes in water quality. Simply assessing performance in terms of water quality at points A and B will not provide enough information to attribute that to a cause and determine whether the plan was effective (or whether something else like climate was at play). There is a large amount of uncertainty here that needs to be communicated, and more information is needed to tell the full story.
- **Inputs are important too:** A narrow focus on water quality outcomes is unnecessarily limiting – inputs (e.g. changes in land use) can also provide useful information and tell a fuller story.
- **Taking a bottom-up approach is preferable:** It's more practical to think about maintaining water quality by starting at the individual site level, and building up a picture for the catchment from there (as opposed to starting at the catchment level and somehow deriving what needs to happen at the site level).
- **Adequate monitoring sites and coverage is critical.**
- **Load to come:** Need to consider how unavoidable or predicted declines are accounted for.
- **Implications for allocation and trading:** How requirements to maintain water quality are expressed (e.g. as maintaining current concentrations of a contaminant at every site) has implications for allocation systems and trade-ability of discharge rights.
- **The NOF is incomplete:** We are considering what 'maintaining' water quality means without a 'complete' set of attributes that need to be managed.
  - Other measures may be complex or have peculiarities that mean whatever approach we take is not appropriate (e.g. requiring specific monitoring periods/approaches, have complex relationships with other attributes, etc.).
  - Having adequate measures of water quality is critical to knowing whether you are maintaining in a meaningful way (i.e. how ecosystems are actually doing).
  - Measures that are yet to be included could provide a better way to assess maintenance (e.g. measures that integrate multiple aspects of ecosystem health, such as fish, which are less noisy).
- **'Overall' is confusing:** Still unclear what, if anything, the word 'overall' means within Objective A2. (Nb: it is very likely any option will involve removing this, in line with previous advice to Ministers).

## Appendix 1: Initial email invite and notes contained within

-----Original Appointment-----

**From:** Nik Andic

**Sent:** Thursday, 7 February 2019 2:29 PM

**To:** Nik Andic; Ton Snelder; bryce.cooper (bryce.cooper@niwa.co.nz); acanning (acanning@fishandgame.org.nz); Clive Howard-Williams (niwa.co.nz); Jon Roygard (jon.roygard@horizons.govt.nz); mike.joy (mike.joy@vuw.ac.nz); Jennifer Price; Vicki Addison; Carl Howarth; Stephen Fragaszy; Jo Burton

**Subject:** Essential Freshwater: Invitation to a STAG sub-group on the requirement to 'maintain or improve'

**When:** Friday, 15 February 2019 10:00 AM-4:00 PM (UTC+12:00) Auckland, Wellington.

**Where:** Ministry for the Environment, Room 3A

Hi all,

Thank you again for agreeing to participate in this sub-group looking at the requirement to maintain or improve.

**Based on people's availability it looks like Friday 15 Feb 2019 is the best option, but there is still time to change if it going to be a problem for you – please respond ASAP if that's the case.**

As discussed, we will use a worked example to develop approaches for maintaining. We will have a large screen in the room, and will be able to look at water quality data, graph it, map it, etc. I suggest we use an area with a reasonably developed plan such as Canterbury ([see plan here](#)). When reporting back to the STAG on a preferred approach, we will try and explain it in a real world scenario (e.g. in the Hinds catchment it would look like this).

I have booked us a room for the day, and suggest the following agenda. Also, rather than send out a separate paper, we have included some suggested objectives, criteria, and questions for the day further below.

### Agenda

**10:00 to 11:00 – Triaging the issues.** What concerns you about current settings? Is it a lack of clarity, an implementation issue, or a fundamental issue with the policy (or something else)? We propose to record these and try to address them by the end of the day. We will focus the day on fundamental issues with the policy, although we can pick up implementation issue and others at another meeting if there is interest.

**11:00 to 12:00 – Agree to criteria.** We have suggested some criteria that are important from our point of view. But there may be others that are important from yours. Equally we may have suggested something that is problematic – we are keen to form a joint view with the group on what criteria should be applied and why.

**12:00 to 13:00 – Lunch.** We will provide food.

**13:00 to 14:30 – Mock-up approaches.** We want to develop options for 'maintaining' water quality that would address our concerns (i.e. potential for water quality to decline, ability for councils to implement this in planning).

**14:30 to 15:30 – Decision/recommendation time.** We want to assess options against our criteria, and if possible, decide on a preferred approach or narrow down the list of option. The next step would be to report back to the wider STAG on this, and our reasons.

## Objectives

The purpose of this workshop is to develop an approach to ‘maintaining’ water quality that:

- a) Addresses the risk of material declines in ecosystem health if maintaining within attribute bands (e.g. by adding/modifying band thresholds, or maintaining at current state); and
- b) Provides regional councils with sufficient detail to implement the requirement through planning (e.g. how to determine current state, what level of change constitutes improvement or decline, etc).

## Suggested criteria

The following criteria are a starting point for assessing possible approaches. Please feel free to suggest additional criteria, or why any of these shouldn’t apply!

- **Unambiguous** – Uncertainty and low levels of confidence will be a significant issue for regional councils implementing the policy. As far as possible, how we characterise maintaining current state should minimise uncertainty and scope for debate.
- **Suitability for regional planning** – The ultimate goal of this exercise is to inform possible amendments to the NPSFM, which in turn must be implemented by regional councils, through planning. Planners are really faced with two tasks when giving effect to Objective A2 and related policies:
  - a. *producing a plan that is sufficient* to give effect to it (i.e. freshwater objectives aim high enough), and
  - b. *assessing performance over time* to determine the efficacy of plans (i.e. has water quality actually been maintained – if not, that would indicate changes are needed upon plan review or earlier).

It is not about individual compliance or pollution incidents.

- **Coherence with the wider monitoring and reporting** – As far as possible we should characterise ‘maintaining current state’ in a way that works with other monitoring and reporting practices/requirements (e.g. Environmental Reporting, state of the environment reporting, the specifics of current attributes, etc).
- **Feasibility within work programme timeframes/resources.**

## Questions for discussion

1. **How should we determine the ‘current state’ of water quality?** Is this a 5 or 10 year average? Something else?
2. **Do the current attributes, or technical constraints tell us anything about how ‘current state’ should be determined?** For example, given the actual frequency of monitoring, do ‘annual medians’ and ‘80<sup>th</sup> percentiles’ etc actually require X years of data get these with sufficient confidence?
3. **How should multiple monitoring sites be treated?** Should sites be treated separately when setting objectives and monitoring progress? Is it defensible to aggregate these, and if so, how? Does it matter as long as plans are explicit and can be tested on a case by case basis?
4. **How can we account for noise,** and distinguish this from improvement/maintenance/decline? What level of change can actually be detected (e.g. given actual monitoring frequency and how we determine current state)?
5. **What is an appropriate sensitivity?** What level of change is meaningful?
6. **What level of specificity does the NPSFM need to contain,** and what is more appropriate in technical guidance?