Science and Technical Advisory Group Meeting

Minutes - DRAFT

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: Adam Canning, Bev Clarkson, Bryce Cooper, Chris Daughney, Clive Howard-Williams, Graham Sevicke-Jones, Ian Hawes, Jenny Webster-Brown, Joanne Clapcott, Jon Roygard, Ken Taylor, Mike Joy, Ra Smith, Russell Death (by Skype before 11am). **MfE staff**: Jen Price, Jo Burton, Stephen Fragaszy (morning), Isaac Bain, Nik Andic, Carl Howarth (Ecosystem Health session), Kirsten Forsyth (Flows session)

Apologies: Dan Hikuroa, Marc Schallenberg, Tanira Kingi, (Russell Death), Mahinga-a-Rangi Baker

1. Previous meeting minutes and actions arising, apologies, feedback from other advisory groups

Ken thanked Bryce for filling in as chair.

MfE staff gave a brief update feeding back the comments from the Regional Sector Water sub-group, and outlining the proceedings of the Freshwater Leaders Group (FLG).

Comments on the minutes from 26 February:

- STAG recommends further guidance is provided on the management and monitoring of dissolved oxygen (MfE staff are progressing this).
- MfE needs to provide a case study of how the proposed dissolved oxygen attribute would be implemented.
- Flows – It should be made clear that STAG suggested that changes should be made to the policies and objectives rather than incorporating a narrative attribute table.
- There was discussion about the management responses to different policy mechanisms. When talking about attributes, we need to consider the attribute development criteria which include linkages between attributes and the management actions. However, there are other policy options for incorporating things in the NPS that would not have this requirement. It can be useful to identify nationally mandated measurement requirements.

Outcome: The minutes from 26 February were approved.

MfE staff outlined that the final decisions need to go to Ministers at the end of April. Everything we want to confirm needs to be sorted at the next meeting on 16 April. Sub-groups need to have their work done for the wider group to consider by the next meeting. The group should focus on the critical thresholds that we want to see in policy and not whether it should be an attribute or something else.

Actions:	**For:**
Conduct a case study of how proposed dissolved oxygen attribute would be implemented	MfE
Recommend guidance is developed on management and monitoring of dissolved oxygen	MfE
Update minutes from 26 February	MfE
Sub-group recommendations to be finalised	Sub-groups, MfE coordinators

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2. Nutrients – brief report back on progress

MfE staff provided an update on the scoping of further investigation into Russell Death's proposed attribute tables for nitrogen and phosphorus. There was discussion around the technical details of the investigation.

Discussion points:

- It was clarified that the intent is for the most stringent nutrient attribute to apply.
- We need to be clear that managing nutrient objectives on their own is not enough to provide for ecosystem health.
- Managing nutrient values is something we want to strive for to manage ecosystem health. The effect on periphyton is not the only mechanism we need to consider. The nutrients will have an effect somewhere, in downstream receiving environments such as estuaries or the ocean.
- It was recommended that MfE analyses where the new attribute tables would take effect
- It was pointed out that there may be differences between data sets arising from different sampling methodologies. Another member has collated Macroinvertebrate Community Index (MCI) data as part of the sediment work, which examined the spatial variation in MCI. Land use or nutrients always account for over 2/3 of the variation in MCI. The remaining 1/3 of variation is influenced by temperature, substrate, and flow variability.
- It was noted that the proposed nutrient attributes only use MCI as one of many lines of evidence. All of the components give roughly the same numbers for nutrient attributes.
- We need to understand to what extent we over-or-underestimate the impacts.
- One member asked, what is the mechanism for a given nitrate concentration having a different effect in different classes, for example in Northland and Southland? It was noted that MCI reference state will vary between river classes. But we don't know the mechanisms causing these differences in MCI – it could be that one class is more impacted than the others.
- It was asked whether you could include a note accompanying an attribute table saying that councils should manage for the most sensitive ecosystem component?
- It was noted that the requirement to "maintain or improve" will also have an effect.
- Loss of riparian vegetation is a key factor influencing ecosystem health, this is something councils can manage.
- Summary from the chair: The group has some questions remaining around spatial variability, but we've received information that spatial variation in MCI is a smaller determinant for the variation. But we are looking at multiple lines of evidence. Suggested as a way forward – to proceed with a one-table approach, with an investigation of spatial variation to investigate whether it will be effective in achieving outcomes.
- One member pointed out that he has repeated the analysis in Russell Death's paper using quantile regression, this is a useful method for examining relationships when there is variability in responses. The quantile regression results broadly line up with Russell's numbers.
- It was recommended that a MfE provides a worked example of a catchment using all approaches. It would be good to provide three or so examples. It would be useful to look at soft-bottomed rivers where there is no periphyton.
- A further question was raised: What is the general approach for dealing with uncertainty? You can build precaution into the values in the table, or into the measurements. You don't need to do both. It seems that there isn't a generally agreed stance in the National Objectives Framework (NOF) about where uncertainty is built in. It would be good to have

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an agreed approach. Action for MfE officials to provide advice on this and to advance work on principles to guide attribute development.

- It was recommended that the working group come up with an estimate of confidence in the numbers, e.g. for a given threshold, what is the mis-classification risk (ie, you think the ecosystem health objective will be met, but it won't). This can be expressed in qualitative terms if needed.

Outcome:

- It was agreed that STAG supports proceeding with nationally applicable attribute tables, with an investigation of spatial variation in the relationships between nutrients and ecosystem components. Another aim of the analysis will be to investigate where the attribute will be more constraining than the current periphyton attribute and accompanying note.
- The sub-group was asked to quantify uncertainty in the attribute table.
- STAG asked the sub-group to also provide a worked example of a catchment to show how the different attributes relating to nutrients would fit together.

Actions:	**For:**
Investigation of spatial variation in relation to where "unders and overs" might occur in relation to other existing nutrient attributes and MCI scores	Nutrient sub-group
Provide a worked example of a catchment to show how the different attributes relating to nutrients would fit together.	Nutrient sub-group
Provide advice on how uncertainty is taken into account in NOF attributes: 1. In the face of uncertainty how much of a margin are we giving to the environment, and 2. How confident are we that the number will provide the intended level of protection (may be qualitative).	MfE, STAG
Develop principles on uncertainty for attributes	STAG
Communicate uncertainty in attribute tables (may be qualitative).	Nutrient sub-group

3. Sediment

MfE staff asked STAG members for their feedback on the sediment attribute development work. This will be discussed again at the next meeting.

Questions discussed were:

a. Is the primary method on which bottom lines and bands are based – the community deviation method described in full in Appendix J – robust?

-STAG was broadly in agreement with the methods used.

Discussion points:

- 5 NTU represents good clarity, thresholds below this number may be within the margin of error of our measuring techniques.
- Foraging distance for fish will be impacted at the lower end of the turbidity measurements.

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- Native fish forage at night and so are less impacted by turbidity than daytime foragers such as trout.
- A key point is that the proposed attribute states refer to medians and they do not represent the turbidity distribution at the site.
- Fish were the most sensitive species and so have been used to derive these values. • Measurements have been based on the NEMS methods.
- Members made recommendations for amendments to the attribute tables which are outlined in the Actions section below.
- When you look at water you can't tell the difference between 1, 5, or 7 NTUs. There is a perception issue, there is a risk this will be seen as false precision. But there are many measurements sitting behind these measurements.
- This highlights the need for and importance of continuous monitoring.

Discussion about the method:

- This is a bespoke method developed for this project.
- It's important that the method used to derive the reference state is clearly set out
- To weight the evidence, the team held a workshop with an expert from the USEPA and weighted the methods using set criteria. The research group has expressed uncertainty around where to set the thresholds, they chose to do that based on what has been done internationally.
- Why has the median been used? Because this can be linked back to the load from the catchment.
- When communicating this work it will be important to express why a new method is required for NZ.
- If you plotted the data distribution of turbidity observations, what would this look like for classes with very different medians? It is very variable between sites. The median averages this out. Any dose-response relationship will have this kind of variability.
- We should also communicate that a literature review has been done of impacts on sediment, to indicate a potential range of thresholds. International thresholds tend to be based on infrastructure management such as providing flushing flows.
- It was noted that there is international literature on acute effects but it's difficult to summarise because different measurement methods are used, and concentrations are quite high because they are based on 24-hour exposures. Therefore the group decided to focus on environmental ambient conditions.
- The bottom lines do not protect salmonids at particular sensitive life-stages. However, brown trout were incorporated into the analysis as an indicator. One of the principles for this work was to use native fish responses, but to use salmonids when insufficient data is available on native fish.

b. Can we provide for ecosystem health by including NPS-FM amendments with a deposited sediment attribute and a suspended sediment attribute using turbidity only?

-STAG was comfortable with progressing turbidity as the only attribute for suspended sediment. An attribute for water clarity is not required at this stage.

Discussion points:

- Clarity is more complex to measure than turbidity as it is influenced more by colour etc.
- It was suggested that examples could be given to show people what different turbidity levels look like.

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c. Are the bottom lines set appropriately to provide for ecosystem health (keeping in mind the definition of the bottom line threshold)?

-STAG has recommended that it would be helpful to provide more description about whether the attributes do and don't protect, particularly in relation to salmonid spawning.

Discussion points:

- There was a discussion on the adequacy of the attribute for deposited sediment to provide for salmonid spawning. There is a proviso in the deposited sediment attribute table noting that all life stages of trout may not be provided for by this attribute tables.
- Fish & Game has developed a model of salmonid spawning reaches, we could examine the deposited sediment levels at salmonid spawning sites. Salmonid spawning will naturally not occur in all places.
- It was suggested that it would be helpful to include in the advice an analysis of where salmonid spawning occurs, and whether the attributes would provide for this.
- It was noted that native fish live in interstitial spaces, so providing for that may provide for trout spawning.
- It was pointed out that salmonids don't spawn everywhere, so an attribute for protecting trout spawning would not be relevant everywhere. The method predicts reference state based on the local environment.
- This method is based on community composition and has not been designed to protect individual species.
- This work uses presence-absence of fish because this is consistently quantified across the country. We now have the fish sampling protocols which will improve our data on fish abundance going forward.
- It was noted that the definition of C band includes "high likelihood of some impairment". It was recommended that these words require some consideration to make sure they are consistent with other attributes.
- In some classes, the attribute states are nearly exactly the same. Is there scope to reduce the number of classes and to have a narrative description of what each SSC class means? It was clarified that this will be included in an Appendix. MfE staff have discussed the implications of having many SSCs with regional council staff, and how these might be incorporated into FMUS which are defined differently in different regions.
- It was suggested that before we simplify things, we should ensure that our evidence is robust as possible. Is it worth holding off making a decision until we have better evidence?
- Another question raised was, how do we manage a catchment when there are different classes present? It would be helpful to have a case study on this. Guidance is required. STAG needs to understand how this will work to be able to provide advice.
- The existing periphyton attribute requirements are a good analogy of how councils deal with multiple objectives in one catchment. Councils are doing a good job of managing this. The bottom of the catchment e.g. the estuary, will be the constraining point.
- The policy needs to specify how management decisions will be made at the site level. E.g. will you apply the most conservative attribute?

d. Is the proposed classification system fit for purpose considering how ecological response information was incorporated?

- Some classes are nearly the same in terms of attribute states, it was asked whether it was possible to reduce the number of classes and to have a narrative description of what each SSC class means. Guidance is required on how to apply the different classifications in a Freshwater Management Unit.

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Discussion points:

e. Should we incorporate bands even though fewer lines of evidence support setting band thresholds according to the classification system?

-STAG recommends keeping the bands.

-Some of the classifications don't have much of a difference between the bottom line and the A band, we may not be able to practically measure the difference between attribute states given that most sampling is monthly. You wouldn't be able to eyeball the difference in clarity between the A band and bottom line in these cases and it will be difficult to communicate this to the public. However, these differences will have relevance for aquatic life.

f. Are the indicator definitions and monitoring requirements appropriate?

-STAG agreed that the indicator definitions and monitoring requirements were appropriate, and flagged that it's important to make clear that continuous monitoring can be used to measure the turbidity.

Discussion points:

- The attributes were developed based on single measurements at many sites, and do not include repeated measures of sediment over time.
- It was asked whether these attributes be applied to continuous monitoring? The response was: The monitoring requirement does not preclude continuous monitoring. There would be large implications of requiring continuous monitoring, so this is not being progressed as a requirement, just a recommendation.

g. Is the suspended sediment exceptions regime appropriate?

-This was not discussed due to time constraints and the chair asked the group to email any comments to MfE after the meeting.

Ton Snelder gave a presentation on "Suspended sediment loads to ESVs – analytical framework" which had been requested by STAG, and there was some discussion on the details of this.

Actions:	**For:**
Incorporate suggestions: The wording describing the bands needs refining, it is not necessarily the median turbidity that is impacting the biota. The notation of the A, B, C, D, bands needs to be consistent with other attributes, using < etc. Provide more description of what the attributes do and don't protect, particularly in relation to salmonid spawning	MfE
Make clear that continuous monitoring of turbidity can be used to assess the suspended sediment attribute and is encouraged	MfE
Email comments on exceptions to MfE	STAG
Sediment discussion at next meeting	All
Case study: how do we manage a catchment when there are different classes present? For next meeting	MfE
Add Ton's presentation to portal	MfE

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4. 11.30 am Wetlands (30 mins)

A discussion on wetlands was in the agenda, but this was deferred to an email discussion due to time constraints.

5. Flows – brief report back on progress

MfE staff updated the group on the policy work on flows.

MfE staff have previously presented a narrative attribute table to help councils set water quantity objectives. It was decided this was not the best way to proceed, but we still want to provide more guidance on how to set flows taking into account ecosystem health and human health for recreation.

MfE is progressing policy to direct councils to set objectives for surface water quantity taking into account habitat, flow variability, the habitat needs of aquatic life, and needs of connected surface water bodies. There will be guidance produced on various matters this policy raises.

Discussion points:

- The intent of this work is to replace the Proposed National Environmental Standard on Ecological Flows and Water Levels (2008). But the guidance going along with the NES will remain. The draft NES has a hydrological rule of thumb which defines the numeric part of flow setting. However, there is no guarantee that this approach will be protective in all cases. This is why we need more work on determining the ecological effect of existing flow regimes.
- One member recommended that more advice needs to be sought from NGOs and others.
- Flood protection works have an influence on flows and this should be considered.
- Flow is a critical component of many aspects of ecosystem health that we are considering. STAG members were disappointed that numerical values for flows are not being progressed.
- It was noted that the approach in the draft NES, if followed, would result in more water being allocated than is currently the case, and the environmental outcome would be worse.
- An approach is required that will be protective, but flexible enough to apply to different areas.
- One group member was of the opinion that the draft NES numbers could be provided as a minimum standard.
- It was recommended that the wording “recognise and provide for” is a stricter requirement and more appropriate in this case than “consider”
- It was suggested that numbers would be more reliable than a narrative.
- Another group member recognised that this is about strengthening the objective setting requirements, and wasn’t necessarily advocating for numerical values.

Outcome: STAG has indicated that more work on flow is critical. There will be more technical work that can be put into the NPS or an NES at a later date. This round of changes is setting the scene for this.

Key discussion points were:

- The group recognises that these changes are a first step and considers that more work on flow is critical. Numerical objectives are more reliable than policies and narrative objectives, and the group would like to see more work progressed on numerical objectives, providing adequate protection while accounting for differences in conditions around the country.
- The group recommended that stronger wording such as “recognise and provide for” is used

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- Revised wording will be provided to the group for comment.

Actions:	**For:**
MfE to provide updated policy wording for STAG to comment on by email	MfE/all

6. Maintain or Improve

MfE staff summarised the issues and the recommendations of the sub-group and presented a draft flow-chart setting out the process of determining whether water quality has been maintained or improved.

Key outcomes from the discussion were:

- Members suggested that there should be a requirement to have no material reduction within a band. This option should be investigated further.
- STAG members will consider the option of process 2a in MfE's flow chart ("Have all freshwater objectives been achieved?"), to advance a statistical measure.
- MfE's flow chart step 2b ("Evaluate whether water quality has been maintained more broadly") is about integrating a more holistic view and evaluating a broader range of information. STAG will consider this option further.
- MfE will email the sub-group making specific proposals, listing alternative options, and asking the sub-group to comment.

Detailed discussion points:

- STAG has previously that defining current state within a band is not adequate.
- One member pointed out that the way current state is defined varies between attributes. For example, human health bands for risk of infection are very narrowly defined. They might not be meaningful for people. In that instance it might be acceptable to stay within Band B. But other attributes, such as the toxicity attributes, are broader, and maintaining current state based on bands is less helpful. It was noted that the definition of what is an acceptable infection risk is a decision made by politicians.
- One member suggested that the requirement should be that a decline within a band should not be allowed for some attributes.
- There are uncertainties associated with different measurement techniques that need to be taken into account when assessing data against objectives. It was suggested that this could be done using standard error, and it was pointed out that trend analysis can be used
- If the band is suitably narrow, if the confidence interval intersects the boundary between bands, this could be interpreted as failing the test for that band. However, some of the bands are not sufficiently narrow for this.
- It was noted that it is not the group's role to decide if bands confer an adequate level of protection, but to describe the level of protection that a particular objective will provide.
- One member was unsure if it's helpful to require that water quality at an individual site should be maintained or improved. Sites can change over time for good reasons. There needs to be flexibility allowed for regional councils to change monitoring sites. Maintain or improve should be defined at the FMU level; which would comprise several monitoring sites. You could define "overall" by calculating the proportion of sites that are meeting the objective.
- MfE staff clarified that defining "maintain or improve" at a site level would be a way of simplifying the process and removing ambiguity.

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- The chair summarised that the key points from this discussion are (1) how you define whether water quality has been maintained and how the width of bands can help define this, and (2) an approach to defining maintain within an FMU with multiple sites.
- It was suggested that one option would be to require setting objectives at a site scale, and timeframes for achieving that. It then is simple to see if water quality has been maintained. The risk might be that if you were measuring within measurement error, the objective might be too restrictive.
- Members of the community have an idea about what maintaining water quality means. We need to explain our approach in a way that is meaningful for the community.
- One member noted that STAG has previously agreed that more bands would not be recommended, and that it is not acceptable to allow some sites within an FMU to decline while maintaining water quality "overall"
- It was pointed out that in some places, the community upstream has different values from downstream communities. FMUs were not based on communities, they are based on hydrological catchments in most cases. Communities will not always agree on the objectives to be met.
- The chair asked the group, can you define "maintain" in a statistical way?
- One option could be to provide a definition based on trends. However, one issue with this is that with monthly samples, you need a lot of data points to reliably demonstrate a trend.
- Biophysical measurements may not always be the best measures of change. Social metrics can be more responsive to changes being made in management.
- Attributes specify summary statistics and minimum requirements for data points.
- The discussion was summed up as: We can have a statistical measure of maintain based on a single water quality measure at a single site, but this doesn't help with defining what is happening across different variables. Aggregating sites and variables is not addressed by this. Defining maintain or improve across an FMU is more complex. Water quality state and trends can help, but you also need to measure inputs and social change.
- This discussion relates to the accounting requirements in the NPS-FM. Including communities in the monitoring would lead to greater engagement. The definition of freshwater accounting can be widened to better include communities in the process.
- Bryce – Aggregation can mask important detail. Having the raw information available for communities is important for guiding decisions. It's not our role to set out how the information is combined or aggregated, this is for communities and local government.
- The sub-group concluded that more information is required to assess whether water quality has been maintained or improved. Accounting should provide you with the information about any changes in sources and inputs that could lead you to expect a change in water quality.
- It was noted that we don't want a black box approach. Community members just want a simple answer about whether the water quality is going up or down, and what is happening to the bug numbers.
- If we chose to apply maintain or improve to attributes that vary less over time, such as MCI, would that be a solution? Others felt that MCI and QMCI are quite variable over time.
- It was noted that an objective is a desired outcome to guide plans and is not a compliance limit.
- MfE staff presented a draft flow chart setting out a process of determining whether water quality has been maintained or improved.
- It was noted that to achieve objectives, it is necessary to understand the actions that are required in the catchment. Different management levers have differing response rates. Achieving improvements in water quality requires a range of actions, and some are not included in the NPS-FM. In the past we have focussed on symptoms of ecosystem health

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decline, rather than the drivers. We need to consider how the NPS-FM fits in with the broader picture and other policy.
- The sub-group came up with two recommendations. One deals with statistical measures and the other deals with reporting against plans, e.g. The Selwyn-Waihora plan includes a requirement that nitrogen limits are not exceeded.
- There are two levels for defining maintain or improve – reporting against statistics, and reporting against the plans.

Actions:	**For:**
MfE will email the sub-group making specific proposals, listing alternative options, and asking the sub-group to comment. Proposals to be considered are: a statistical method for determining whether water quality is maintained; a "no material reduction" standard rather than current state, and a broader evaluation of information – not just water quality.	MfE, Maintain or Improve sub-group

7. Ecosystem Health

MfE staff gave the group an overview of different policy instruments being considered and it was agreed that the STAG would not be recommending particular instruments, but could make recommendations relating to the types of evidence available and management responses.

Copper and zinc

MfE staff provided an update about copper and zinc work as requested by one of the STAG members.

- Advice has been provided to Ministers.
- An attribute is not being progressed because regional councils do not have the means to control sources of copper and zinc.
- These sources require central government regulation and this will be progressed in the next 18-24 months.
- Copper and zinc attributes will be progressed in the next tranche of changes.
- MfE has scoped further work on acute and chronic attribute tables.

Macroinvertebrates

Discussion points:

- One group member recommended QMCI is used as it is a more sensitive indicator of effect. Well-known examples are acid mine drainage and wastewater treatment plant impacts. MCI may not indicate change to the same degree. The bottom line could be the QMCI equivalent of an MCI of 90.
- In the last round of submissions NIWA and NZFSS recommended that QMCI would be a better metric than MCI.
- It was suggested that if further macroinvertebrate metrics were progressed, guidance on sampling techniques would be required.
- It was noted that QMCI varies a lot more among seasons, this is why many regional councils use MCI in their plans. MCI is more useful for SOE monitoring, whereas QMCI is useful for addressing the effects of specific things.
- Including QMCI would require more monitoring and would require extra resources.

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- It was pointed out that different methods are required for measuring biodiversity and effects of flows. MCI is not the right tool for these, and just sampling in riffles and runs is not sufficient for these applications. We may need to revisit how to monitor macroinvertebrates for ecosystem health. It was suggested that we need a wider shift in the way we use macroinvertebrates for monitoring. This would need to be done at a national level.
- One of the members recommended that both MCI and % EPT abundance (the percentage of individuals from Ephemeroptera, Plecoptera, Tricoptera) could be used, as this would avoid confusion between the two metrics. MCI is a measure of organic enrichment, whereas % EPT abundance is less specific. Bands would need to be defined.
- It was asked whether there was another way to bring the ecosystem health components into the NPS-FM, rather than introducing a large number of piecemeal indicators? We could introduce a more informative index that includes many indicators. The Ecosystem Health Framework is being progressed as a way to improve freshwater management.
- The "Average score per metric[1]" is another way of defining ecosystem health based on macroinvertebrates. A similar index has been developed using % EPT taxa rather than % EPT abundance[2].
- Further work would be required to do a case study incorporating % EPT abundance into this approach.
- There was discussion on the importance of lining up the bottom lines of different ecosystem health attributes. Group members recommended harmonising the different attributes. Approaches for this might involve matching up bottom lines, or using deviation from reference state.

Outcomes:

- STAG recommends retaining the Macroinvertebrate Community Index (MCI) in the NPS-FM, and that an attribute table with bands and a bottom line is developed.
- STAG recommends progressing more work on a more sensitive macroinvertebrate indicator. Different indicators were suggested, such as the published "Average score per metric" which incorporates three different macroinvertebrate indices. More work is required before an attribute table with bottom lines and bands can be developed, however it would be straightforward to ensure that the thresholds line up with MCI. These metrics are not directly connected to specific management levers but are useful and sensitive indicators of change. Councils could develop management plans to improve scores. There may be a requirement to conduct more monitoring to effectively measure such an indicator. More information and a case study needs to be provided to the group.
- There was discussion on how to set bottom lines and there was agreement that the bottom lines for different ecosystem health metrics should match up/be harmonised.
- MfE staff will provide further information to the group and further the discussion by email.

Actions:	**For:**
Develop attribute table with bands for MCI	Adam/STAG

[1] Collier KJ. 2008. Average score per metric: an alternative metric aggregation method for assessing wadeable stream health. New Zealand Journal of Marine and Freshwater Research 42: 367-378.

[2] Clapcott J, Wagenhoff A, Neale M, Storey R, Smith B, Death R, Harding J, Matthaei C, Quinn J, Collier K, Atalah J, Goodwin E, Rabel H, Mackman J, Young R 2017. Macroinvertebrate metrics for the National Policy Statement for Freshwater Management. Prepared for the Ministry for the Environment. Cawthron Report No. 3073. 139 p. plus appendices

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Provide more information to the group on a more sensitive macroinvertebrate indicator such as average score per metric	MfE
Investigate developing an attribute table with bottom line and bands for average score per metric, including what is the national state of this metric, how many waterways do not meet the bottom lines, implications for monitoring	?
Continue discussion by email and at next meeting	All

Fish Index of Biotic Integrity (IBI)

Discussion points:

- The matters discussed by the sub-group were summarised.
- One issue is whether to use a regional or national model. There are regional differences, but it's not certain whether they are natural differences or caused by land use. What is an achievable A band in one region may not be achievable in another.
- Fish IBI is more holistic than other measures such as MCI because it takes into account downstream conditions, such as dams. The method is established and published.
- It was noted that trout are in the IBI – some regions have included trout as an "honorary native" species in the IBI based on the fact that trout are an indicator of good ecosystem health condition. Other exotic species such as carp are indicators of poor conditions. Trout and salmon habitat is protected under the RMA.
- Fish IBI is based on presence/absence and takes existing conditions into account.
- It would need to be standardised in a national model and could be an online tool.
- The model will be updated, with two versions, including and not including trout
- It was suggested that Fish IBI could be incorporated in the same way as MCI is currently in the NPS-FM.
- It is also possible to incorporate different scores for different threat classification levels.
- The Fish IBI incorporates six components and during model development, there was an analysis done to make sure none of the components are redundant.

Outcome:

STAG recommends progressing work on developing an attribute table with bottom lines and bands. STAG members will develop this with Mike Joy (who originally developed the Fish IBI), investigating the implications of including trout in the index or not, as an "honorary native species". This is because trout, though not native, are sensitive indicators of land use and can provide useful information for guiding management.

Actions:	**For:**
Create proposed attribute tables with bottom lines and bands based on including and not including trout and report these back to the group	Adam
Discuss further at next meeting	All

Dissolved Oxygen in Lakes

A discussion paper was provided by Ian Hawes, Clive Howard-Williams and Marc Schallenberg proposing two attribute tables relating to biogeochemistry and habitat for aquatic species. The

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attributes take into account the need to harmonise with other attributes and account for natural variation. These attributes would provide a good fore-warning about declining lake conditions before they become severely degraded. There would be additional monitoring requirements for many councils to implement this attribute.

Discussion points:

- The long-term solution to address deoxygenation is to reduce the productivity in the surface waters of the lake.
- There may need to be exceptions for allow for naturally deoxygenating lakes. For example, in Lake Tikitapu, the hypolimnion deoxygenates naturally.
- Is this an average measure or something that cannot be exceeded? This is a one-off measurement at the end of the stratified period (i.e. in the last month before stratification breaks down)
- In polymictic lakes you would likely need to have continuous recording of dissolved oxygen.
- It was noted that the minima in the proposed lake dissolved oxygen attribute are lower than the river dissolved oxygen attribute. Most lake organisms are more tolerant of depleted dissolved oxygen than river organisms, and have more opportunity to seek better conditions elsewhere.
- It is the intent that both lake dissolved oxygen attributes would need to be met.
- It was noted that many regional council lake monitoring programmes are relatively new, and that there are many lakes in the "D" category of existing lake attributes.
- Some councils do helicopter sampling of surface waters, this would not be adequate for the proposed dissolved oxygen attribute.
- Management levers for lake oxygen are the same as those for TN, TP, and chlorophyll a.
- DO in lakes is a good metric for providing forewarning before conditions get too bad.
- This attribute doesn't require too much more work to develop. Work needs to be done on Question 4 – collating all the data available to see what the current state is.
- A group member estimated that there are measurements for 60 lakes out of 3800.
- It would be informative to examine trends approaching thresholds.
- This is also a climate change issue.
- Is there a way to direct councils to focus their efforts on lakes that are likely to be an issue? This also came up in relation to the dissolved oxygen attribute in rivers. You could incorporate a surveillance philosophy.
- Exceptions might be needed for peat lakes in Westland, geothermal lakes, and undisturbed lakes that are anoxic.

Outcome:

STAG was supportive of this approach.

Actions:	**For:**
Collate all the data available to assess current state and how many lakes would be below the bottom line, consider monitoring implications of new attributes	MfE to commission / Lake DO sub-group working on
Examine what guidance would be needed	

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Ecosystem Metabolism

The proceedings of the sub-group were summarised.

Discussion points included:

- Ecosystem processes (as a component of ecosystem health) are not represented in the NOF at present.
- There has been previous work on this topic including Young et al. (2008)[3] and Cawthron has reviewed the applicability of these indicators in wadeable vs. non-wadeable rivers. The bands were suitable for non-wadeable rivers.
- Ecosystem metabolism approaches are not used in legislation overseas yet, this is likely to be related to the relatively new development of continuous monitoring of dissolved oxygen. There is a new free database where people are loading their dissolved oxygen data, and there are free online servers to calculate gross primary productivity (GPP) and ecosystem respiration (ER).
- STAG were supportive of this work and recommended that it should be progressed.
- Cotton strips would be a method that would be ready to be used immediately. This measures cellulose decomposition potential, and gives a measure of productivity. This is a relatively cheap test. There are internationally accepted methods and protocols.
- Are high or low decomposition rates good? The tricky part is that it is not a linear response variable. Usually slow is good and fast is bad because it is driven by nutrient status. But zero decomposition would also be bad.
- There have been national studies and this method is used by three regional councils. Cotton strips can be used for wadeable and non-wadeable streams, there are no bands for this yet but these can be estimated. This has not yet been tested.
- In general we lack metrics for large rivers. Ecosystem metabolism metrics can be used in large rivers and address this gap. These metrics need to be viewed in relation to the river continuum.
- GPP and/or ER would be appropriate for non-wadeable rivers.
- Further work would be needed to develop attributes for these metrics. This would be suitable for the second tranche of work which would be developed over a 18-24 month time frame.

Outcome:

STAG recommends that further work is carried out to develop attributes for ecosystem metabolism.

Actions:	**For:**
Collate existing data and development of attribute tables for ecosystem metabolism metrics	MfE to commission

Summary from chair

The sub-groups need to provide clear recommendations at the next meeting on 16 April. STAG will need a clear list of what is a priority for this round of changes and what will be progressed in the next round.

[3] Young RG, Matthaei CD, Townsend CR 2008. Organic matter breakdown and ecosystem metabolism: functional indicators for assessing river ecosystem health. Journal of the North American Benthological Society 27 (3): 605-625.

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