

## Background

In April 2012, the Land and Water Forum (the Forum) made recommendations to Ministers on further measures to support implementation of the objective and limit setting requirements of the National Policy Statement for Freshwater 2011 (NPS-FM). Amongst other things, the Forum’s recommendations included the establishment of a national objectives framework (including national bottom-lines) to support and guide objective setting by regional councils.

Ministers requested that further work be undertaken by officials to test some of the Forum’s recommendations (see Appendix 1) and populate a potential national framework, including consideration of the impacts of various bottom-lines. To inform officials’ work, a reference group including representatives from iwi, regional councils and key stakeholder groups was formed. This report summarises the work of this group, including identifying some potential bottom lines, and recommendations for further work.

## Summary of view on Forum recommendations

<p>Recommendation 1a: Acknowledge tāngata whenua relationships with fresh water and their connections with formal objectives</p>	<p>Support this recommendation.</p> <p>A series of objectives are proposed (see below) which would collectively address the key elements of <i>mana atua and mana tangata</i> set out in Appendix 2.</p>
<p>Recommendation 1b: Add an objective of managing risks to human health to apply to all waterbodies.</p>	<p>Support this recommendation.</p> <p>It should be a national objective that all surface waters are safe for secondary contact recreation values (eg wading, boating).</p> <p>In addition provision for protection of human health will also be relevant to a number of other objectives that regions may adopt for specific management units and sub- units. Numeric objectives should be provided at the national level (to apply only where adopted) for primary contact recreation (swimming), mahinga kai (food gathering), fisheries, or untreated irrigation water used on fresh food crops.</p>
<p>Recommendations 4 and 5: Establish a national framework, within which regional objective setting is undertaken, which includes some numeric bottom-lines with bands (eg fair, good, excellent) above this.</p>	<p>Support this recommendation.</p> <p>Testing has found the creation of a national framework using the broad approach provided by the Forum to be feasible and useful. Some potential population of this framework is included in this report, but further scientific input is needed<sup>1</sup>.</p> <p>The group considers that using such a framework would enable national consistency and increase the efficiency and transparency</p>

<sup>1</sup> Some matters can be progressed quickly with further work by the science panels. Other matters (eg sediment) require more significant scientific consideration and will require work over a longer period.

	<p>of regional conversations on freshwater management.</p> <p>The framework would include:</p> <ul style="list-style-type: none"> <li>• Some national objectives that would apply to all water bodies (national bottom-lines). A ‘poor’ numeric objective could not be adopted except via exception<sup>2</sup> (see below).</li> <li>• Objectives for a range of other important values and uses. Regions would be required to consider which, if any, of these should apply to a water body. For adopted values or uses, the region would be required to apply any relevant narrative and numeric objectives, and could not adopt a ‘poor’ objective<sup>3</sup>.</li> </ul> <p>The minimum monitoring and reporting requirements to demonstrate that objectives are being met at a management unit scale should be specified to assist with national consistency and to assist resource managers to prioritise monitoring investment (including reflecting resource use intensity). National protocols would also be provided to ensure consistent methods of monitoring are used.</p>
<p>Recommendation 6: Maintain or improve could mean that an objective for a waterbody cannot be set in a band lower than the current state except by way of an exception.</p>	<p>This reference group recommends an alternative to this recommendation.</p> <p>Firstly, whether or not water quality is maintained or improved should be determined at the scale of the management unit. A management unit may be multiple or single catchment(s), a sub-catchment, zone or aquifer. The selected management unit should reflect community and iwi interests as well as biophysical realities. The group notes that water quantity is also relevant to how well a water body provides for particular values or uses and so common management units should be used for both water quality and quantity. Each management unit would be further defined by management sub-units eg a <i>tributary</i> may be a sub-unit of the <i>catchment</i> management unit.</p> <p>‘Maintain’ with regard to a management unit or sub-unit is defined as staying within an objective band for a value/use, but allows for movement within the band. Break points between bands are set so that movement within the band does not result in a major change in objective outcomes for the value/use being managed for. ‘Improve’ means to move up a band.</p> <p>Decisions to set objectives in regional plans that would result in the state of the water body moving within and between bands (relative to existing condition) may be acceptable at the management <b>sub-</b></p>

<sup>2</sup> The reference group recognizes that the existing water body condition may be below a bottom line value in some instances but that the NPS-FM allows for long adjustment time frames to enable the water body be brought above the bottom line.

<sup>3</sup> If a region cannot adopt at least a ‘fair’ objective for a given value or use then they cannot claim that the water body is being managed for that value or use.

	<p><b>unit</b> scale provided that:</p> <ul style="list-style-type: none"> <li>• Objectives are above any bottom-lines for values and uses that have been nationally determined to apply to all water bodies (unless by way of exception).</li> <li>• Objectives are above any bottom-lines for regionally adopted uses and values a water body is to be managed for.</li> <li>• The overall water quality of the management unit of which that water body is a part is maintained or improved (ie the movement of a water body within the management unit to a higher band offsets the movement of another water body within the management unit to a lower band<sup>4</sup>).</li> <li>• Community and iwi are involved at all stages of the decision making so that: <ul style="list-style-type: none"> <li>○ Relevant iwi and communities are well-informed</li> <li>○ And are satisfied that, for the management unit, the objectives adopted will result in overall water quality being maintained or improved.</li> </ul> </li> </ul> <p>Principles to support the regional processes to achieve the requirements above should be developed nationally. Some possible principles are provided in this report.</p> <p>Regions should have regard to state and trends, including forecasted state and trends, informed by state of the environment reporting, when considering whether or not the NPS-FM requirement to maintain or improve overall water quality has been given effect to. Monitoring and evaluation of water quality should be undertaken in a robust and nationally consistent way.</p>
<p>Recommendation 7: Criteria for exceptions to bottom-lines that have been nationally determined to apply to all waterbodies are:</p> <ol style="list-style-type: none"> <li>a. the inability to meet a minimum state objective due to natural conditions of a waterbody; OR</li> <li>b. a regional decision to set a numeric state objective in a water quality band lower than the current state because: <ol style="list-style-type: none"> <li>i. an exceptional economic benefit will result from the relevant activity AND</li> <li>ii. a net environmental gain will result, taking into</li> </ol> </li> </ol>	<p>The reference group supports (a), but notes that where possible, the need for exceptions should be avoided through the use of appropriate objectives for different water body classes that reflect natural conditions.<sup>5</sup></p> <p>The group supports (b), but it should apply only where this occurred within a management unit (see the modified framework provided under recommendation 6 above).</p> <p>The group also recommends that a third circumstance in which exceptions could apply would be where the lower quality results from historic events where it is not practicable to address the effects of those events.</p> <p>Further consideration of exceptions may be needed as population of the national objectives framework is completed and impacted</p>

<sup>4</sup> Movements may relate to the same or different values and uses.

<sup>5</sup> An example would be if a river reaches below a native bird nesting colony of high value exceeds the bottom line *E. coli* values for secondary contact recreation because of the birds. The exception in this case would be that secondary contact recreation would not be an objective applied to this reach.

<p>account compensatory actions.</p>	<p>areas are identified.</p> <p>The group notes that, if a water body is below a bottom-line, regions can choose to set a timeframe for adjustment as an alternative to using the exceptions process. Timeframes for achieving objectives should also be used to allow for known deterioration to come due to time lags.</p>
<p>Recommendation 8 and 9: Aquifers should be classified to recognise their connections (or lack of) with surface and sea water and for locally identified uses.</p>	<p>The national objectives framework has been developed without a detailed aquifer classification system. However, in implementing the framework regional councils will need to understand the relationship between ground and surface waters.</p>
<p>Recommendation 10: Constraints associated with hydrologically altered catchments need to be accommodated within the national objectives framework.</p>	<p>Support this recommendation.</p> <p>The reference group considers that the framework needs to include a clear definition of 'hydrologically altered catchment', which should include sub-catchments or catchments where there have been substantial and long-term changes to the hydrological regime resulting in a fundamental change to a water body type (eg from river to lake, or to a diverted river and canal).</p> <p>In this case the objective setting process would recognise that the change has occurred and, where relevant, there would be an appropriate class that the water body would fit into based on its current type. Objectives for future management would be selected from those that are appropriate for that class.</p> <p>There are other circumstances where the reference group considers that water bodies have been altered but have retained characteristics that allow it to function ordinarily within the classification of its water body type.</p> <p>If the use to which the water body was put has ceased and the alteration of the water body is no longer of value to the community, objectives relating to the original class of the water body may be adopted where it is practical and desirable for it to be restored.</p>

## Design and population of national objectives framework – progress to date

The reference group considers that a national objectives framework should include objectives that relate to all iwi, and common values and uses. Only a few objectives would apply to all water bodies. In the case of the other objectives, iwi and the community would determine whether or not they applied to each water body. The reference group anticipates that objectives would generally be set through a collaborative community based process as recommended by the Forum.

The national bottom-line objectives that should be set for all water bodies relate to the following values and uses:

- The protection of human health during secondary contact recreation<sup>6</sup> (refined Forum recommendation)
- Ecosystem health (including ecosystem processes – NPS-FM objective A1/B1<sup>7</sup>)
- Indigenous species including their associated ecosystems of fresh water (NPS-FM objective A1/B1)

The group discussed including ‘life-supporting capacity’ which is part of NPS-FM objective A1/B1 (and section 5 of the RMA) but considered that there was so much variability and complexity within the concept that it could not be satisfactorily defined to a level of specificity that allows for the setting of bottom-lines and bands. However, the group considers the national bottom-line objectives listed above to represent important components of life-supporting capacity. In particular, the reference group considers that the management of risks to human health is an important part of life supporting capacity, as the definition of life-supporting capacity of a water body could not exclude the interaction of humans with that water body.

The national objectives also cover significant parts of ‘mana atua’ within the *Tangata Whenua Values and Relationships with Fresh Water* framework included in the Forum’s report (see Appendix 2).

The reference group considers that objectives relevant to all of the national values listed in the preamble to the NPS-FM could be included in the framework (at least as a narrative objective if numeric data are not available). In some cases it may be desirable to breakdown the values further, for example ‘recreational activities’ encompasses swimming, fishing, kayaking and waka ama (amongst other things) and these would need to have different objectives (and/or levels of bands) set to ensure they were provided for. Communities would have to decide whether they were relevant for each water body (making those decisions very transparent), and if they did adopt the objectives, then the bottom lines for that objective would have to be met. Communities could, if they wished, adopt a higher band for the objective for a particular water body to meet their desired outcomes, or they could adopt objectives relevant to other values/uses not included in the framework. See Appendix 3 for values/uses proposed for inclusion in the framework.

For each value/ use, the framework should identify:

- broad narrative objective (ie statement of values and uses that are to be delivered)
- critical factors that need to be managed if broad objective is to be achieved (water quality, quantity and physical parameters should be considered)

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<sup>6</sup> Based on *E. coli* only. Toxicants are covered by more stringent ecological thresholds.

<sup>7</sup> To safeguard the life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems of fresh water...

- for those factors, tight narrative objectives to guide nationally consistent regional objective setting
- where possible, numeric objectives expressed as bottom-lines (below which the value or use cannot be considered to be provided for) and bands of 'fair', 'good' and 'excellent' above these representing how well the value or use is provided for
- where numeric objectives are included, which numeric objectives are appropriate for what types and classes of water body (including hydrologically altered catchments)
- the measure(s) and minimum level of monitoring required (considering cost, practicality and meaningfulness) to be confident a water body is meeting a given numeric or narrative objective.<sup>8</sup>

Water should be managed to ensure it remains within the objective bands set through development of the regional plan. While there may be some variability in the measurements within a band, that variability should not mean that the value/use is compromised.

In the time available, it has not been possible to develop a fully populated framework for all values and uses across all water body types. But sufficient work has been done to show that the approach is workable and likely to provide a valuable contribution to nationally consistent water management. In testing the framework concept the group has focussed on rivers, lakes and groundwater, but scientific advice is that the same framework is achievable for wetlands and estuaries.

Those parts of the framework which have been indicatively populated are provided in Appendix 3.

In testing the framework concept the group has identified a number of principles to inform further scientific and technical work needed to more fully populate the framework. These include:

- Set bottom-lines at a sufficient buffer above any tipping point, to provide resilience. For this purpose, the term "tipping point" is used to mean the point below which recovery to a higher banding would become difficult or impossible.<sup>9</sup>
- Set numeric objectives in a way that accounts for natural variability (for example, using a 95<sup>th</sup> percentile, annual median or a rolling average).
- Breakpoints between bands represent (where possible) thresholds where there is a meaningful difference in what is provided for by the different bands, eg a shift in the biological community or the suitability of its stated use.
- A movement within the band should (ideally) not result in any meaningful difference for the community. If that is not possible, that fact should be clearly conveyed to the community (for example, the level of risk may be a continuum rather than having clear breakpoints).
- Thresholds should be set using the best available information.
- Narratively describe what the bottom-lines and bands represent in terms of how the value or use is provided for.

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<sup>8</sup> Any national protocols on monitoring included should build on existing work programmes (such as NEMAR) already underway through collaborations between MfE, the Regional Councils and the research agencies/Universities.

<sup>9</sup> For example, the tipping of a shallow lake from a macrophyte dominated state to a phytoplankton state can be difficult, if not impossible to reverse.

- Where possible indicators that integrate a range of values and uses should be used (as long as the ability to monitor the suitability of a water body for each value/ use is not compromised).
- Use classifications to deal with geospatial variation and the new types of water bodies created by major human-induced changes (eg hydro lakes and artificial canals) where possible (in order to minimise the number of exceptions). Because management units and sub-units may not always align with biophysical classifications, existing management units and sub-units need to be considered in the development of the framework.

The group believes that there is sufficient existing science to populate the framework more fully over the coming months. Where full population of the framework is not possible, key elements should still be included at the narrative objective level, and the missing numeric objectives should be prioritised for research investment, with the results added into the national objectives framework over time.

### **Hydrologically altered catchments**

The framework described above will incorporate separate water body classes for significantly hydrologically altered catchments. It will, however, be important to clearly define what level of alteration meets the criteria for a separate class. Defining aspects could be:

- There is a substantial hydrological change in the water body from the natural reference state to a new state at a sub-catchment or catchment level that is relevant to water management. For example, such changes may be evident as level fluctuations and residence-time variability in natural lakes (due to range or seasonal differences), reservoirs in place of rivers with different limnology and residence time, rivers diverted via canals or tunnels, modified flows or morphology in downstream river reaches (quantity or seasonal variability and timing).
- The hydrological alteration is or is likely to be intergenerational .
- There are likely to be multiple values present in the water body that are different from those provided by the natural reference state.
- There is likely to be different habitat diversity associated with the water body.
- There are changes to morphology and connectivity that require an alternate approach to the management of the values.

### **Artificial water bodies**

Artificial water bodies were outside of the scope of the reference group except where they effectively replace a natural water body. For artificial water bodies that are in scope, they may be included in the separate classes for hydrologically altered catchments (see criteria above) or they may fall into the class of the natural water body they are replacing.

As the different types of artificial water bodies form a continuum from what is clearly outside of scope to what is clearly inside scope, it will be important that regions are able to readily identify 'out of scope' artificial water bodies. Principles to inform this identification could include consideration of:

- the primary purpose for which the water body has been created
- scale (both of the water body and of national vs local interest)
- connectivity to the other water bodies in the management unit and whether or not this is governed by consents (eg waters from which it is taken, modified from or discharged into)

- cumulative effects of this and similar modified water bodies in the management unit
- use of, or value for, the water body for reasons other than the primary management purpose
- use of, or value for, the water body for publicly managed resources such as wildlife and fisheries
- public and private interests in the water body.

Examples of artificial water bodies that may be 'out of scope' are:

- Ponds created for fire fighting or emergency or utility contingency purpose
- Ponds created for private irrigation storage
- Wastewater treatment ponds
- Sediment retention structures
- Drainage channels
- An artificial lake surrounded by land, that is not on a river or stream alignment and has no natural inflows or headwaters (eg an ornamental pond).

Where an artificial water body is being managed for a purpose within the national framework, the relevant objectives would apply.

### **NPS-FM requirement to maintain and improve overall water quality within a region**

The first stage of plan development would be to define appropriate management units. These might be at a scale ranging from catchment(s), sub-catchment, zone or aquifer. The management unit should be hydrologically and ecologically coherent, and also be relevant to the way that communities of interest are geographically located (eg iwi and hapū boundaries). Common management units should be used for both water quality and quantity. Although a management unit could be at the regional scale, the expectation is that there will be a number of management units within each region. Note also that management units may sometimes cross council boundaries.

Objectives would then be set for a management unit and may also be set for management sub-units.

A freshwater objective that will allow a reduction of the water quality for a defined value or use in a management sub-unit is acceptable as long as

1. the overall water quality (ie quality of water for all defined use) of the management unit is maintained or improved.
2. the water quality in that management sub-unit remains appropriate to the objectives set (ie would not go below the bottom lines for each objective)<sup>10</sup>
3. there is a corresponding increase in water quality in another part of the management unit in order to ensure that overall water quality is at least maintained.
4. Community and iwi are involved at all stages of the decision making so that:
  - a. Relevant iwi and communities are well-informed

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<sup>10</sup> Exceptions from bottom-lines for values and uses that have been nationally determined to apply to all water bodies may be allowable. For a regionally adopted value or use, if objectives cannot be set above the related bottom-lines then the water body cannot be considered to provide for that value or use.

- b. And are satisfied that, for the management unit, the objectives adopted will result in overall water quality being maintained or improved.

It is critical that relevant iwi and communities are involved in all stages of the objective setting decision making process so that they are satisfied that the overall water quality will be maintained or improved and that the distribution of costs and benefits is appropriate. Parties involved in the decisions must be well informed about the effects of any “trading off” between water bodies or objectives within the management unit, including the economic and social implications of adjustment where there is over-allocation. Any decision must reflect tāngata whenua values and interests in accordance with Objective D1 of the NPS-FM.

In setting an objective, regard should be had to how the proposed objectives compare to the current and previously existing states. State of the environment reporting and modelling should be used to determine likely future trends in the absence of changes in management, and likely effects of proposed objectives. There will need to be an efficient and workable mechanism for assessing whether there will be (and is in practice) maintenance or improvement. This should not be a highly detailed accounting system but instead build on the principles explained below. The expectation is that iwi and the community will receive ongoing information on both progress against objectives set in the plan and overall state of the environment trends. This transparency must be sufficient for ensuring that NPS-FM requirement is met over time.

“Maintain and improve quality” is to be assessed in terms of delivery of the objective rather than exact numeric figures. For example nitrogen may fluctuate significantly, while the quality in terms of periphyton and habitat does not change materially. Band boundaries are intended to reflect the points at which numeric change will generate significant quality change. The group notes that water quantity is likely to also be an important consideration in terms of delivery of the objective.

### **Principles for balancing objectives to support both environmental and economic outcomes**

A number of principles are proposed to guide decisions within a collaborative process on how to balance between objectives and bands so that both environmental and economic outcomes are supported. This may include the setting of an objective mix that includes improvements in some management sub-units and degradation in others. The proposed principles are:

- Measurable ‘like for like’ exchanges are preferable. However, ‘like for unlike’ exchanges are acceptable so long as iwi and community agree that there will be an overall environmental gain, in terms of maintaining or improving overall water quality for defined values and uses within the management unit.
- No unique, irreplaceable, or non-transferable (in geographic location) value should be lost. This is not just ecological uniqueness. Other types of uniqueness can include the accessibility of the value/use for iwi and the community.
- Decline in water quality for particular values and uses should only be the result of best practice activities that generate significant economic benefit, not the result of poor practice. New activities should operate according to best practice immediately, but existing activities may need to adjust to best practice over time.
- All values and components of the system should be taken into account, even if there is poor knowledge of particular components and the values are held by parts of the community that are poorly represented in processes (eg disadvantaged communities).
- Uncertainties in predictions of change and effects must be taken into account. While outcomes can never be guaranteed, uncertainties should not be so high that there is a significant risk of unacceptable

outcomes (eg irreversible environmental losses that were not intended, or economic losses that have provided no environmental gain).

- There needs to be a clear statement of what is intended, and what that would look like on the ground, so that the degree of compliance with the intent can be measured. Information used in decisions must be available to all parties and be easily understood.
- Systems are needed to ensure that those responsible for improvements are accountable for their delivery, and that they are incentivised appropriately.
- Adaptive management is essential where there is uncertainty regarding outcomes and trade offs are required.
- The relative timeframes for losses and improvements need to be factored in. If there is a long delay before improvements will be achieved, losses may also need to be delayed, or additional improvements required. Objectives for any component of freshwater (whether a stream, river, lake, groundwater aquifer or estuary) shall not compromise the objective of any other component to which it is connected.

## **Exceptions from national bottom-lines**

The reference group agreed that an exceptions regime was necessary for:

- Objectives being set that are below a national bottom line (ie would result in the water body remaining “poor”).
- Objectives being set that would result in a decline in water quality at the management unit level (ie where offsetting improvements within the management unit are not achievable).

This narrows the need for exceptions from the Forum’s proposal. Note that, in line with the NPS-FM, exceptions for objectives that would result in a decline at the management unit level are only acceptable if overall water quality is maintained or improved at the regional level (ie there would need to be offsetting improvements in another management unit within the region).

In general, the effects of natural processes on water quality should be covered in the water body classification systems (eg for glacial rivers and geothermal lakes) and through the measures used for objectives (eg use of a median will allow for some natural variation). However, an exception from national bottom-lines for natural circumstances will still be needed.

The Forum’s proposed additional criteria exemptions were supported, ie

- i. an exceptional economic benefit will result from the relevant activity AND
- ii. an overall environmental gain<sup>11</sup> will result, taking into account compensatory actions.

The ‘principles for balancing objectives to support both environmental and economic outcomes’ (above) would apply to exceptions under (ii).

There also needs to be exemptions for the effects of historical circumstances, where:

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<sup>11</sup> The reference group does, however, prefer the term ‘overall environmental gain’ rather than ‘net environmental gain’ as it does not imply that a complex accounting system is required.

- i. it is not reasonably practicable to address them; OR
- ii. the activity is still generating an exceptional economic benefit, operating according to current best practice and an overall environmental gain can be provided.

Further consideration of exceptions will be needed as further population of the national framework is completed, and areas where there may be unforeseen impacts are identified. However the group notes that the exceptions criteria are not intended to prioritise any particular land uses over any others.

The group notes that, if a water body is below a bottom-line, regions can choose to set a timeframe which is fast enough to make some improvement but not so fast as to cause social and economic dislocation through adjustment as an alternative to using the exceptions process. Timeframes for objectives to be achieved should also be used to allow for anticipated deterioration to come due to time lags.

### **How the national objectives framework would impact on regional decision-making**

When setting regional objectives regional councils would, through a collaborative process with iwi and the community:

- Determine appropriate management units, and management sub-units, for objective setting that take into account relevant connectivity (cultural, economic, environmental or social). These may be at a catchment(s), sub-catchment, zone or aquifer scale.
- Consider which of the objectives in the national framework are relevant to each water body, management unit or sub-unit. Other objectives may also be set. The objectives for each water body would have to include those that have been nationally determined to apply to all water bodies, unless an exception was agreed at a national level.
- For each objective, decide which band is appropriate. Where the chosen band is below the current state, a process to consider “maintain and improve across the management unit” would need to be initiated (or it could equally be initiated if a chosen band is above the current state). The band chosen could not be “poor” (unless by way of exception from a national bottom-line objective) as this would mean that the relevant value /use cannot be delivered.
- Consider the full range of costs and benefits (environmental, economic, social and cultural) of achieving and managing to objectives (limits and other management methods), including where those costs and benefits will fall. Consider options for different timeframes for adjustment in catchments that would be over-allocated. Assessment of these costs and benefits may lead to the desired objectives being changed.
- Acknowledge any information uncertainties regarding environmental, economic, social and cultural outcomes and identify where there are priorities to improve information in order to better inform the setting or meeting of limits.
- Ensure the objectives are measurable (in accordance with any national requirements) and able to be reported to the community in clear terms (scale and time important).

## **Appendix 1: Relevant Forum recommendations**

### ***Recommendation 1***

The government should support and enhance the objectives currently in the National Policy Statement on Freshwater Management (NPS-FM) by:

- a. the incorporation of the substantive content of the material developed by iwi on (tangata whenua) relationships with fresh water (attached as Appendix 2), into the preamble to the NPS-FM, to provide acknowledgement of those relationships and their connections with the formal objectives
- b. expanding the existing objectives in the NPS-FM to include managing the risks to human health from micro-organisms and toxic contaminants, to apply to all waterbodies.

### ***Recommendation 5***

Further work is required to fully populate and finalise the sets of numeric and narrative objectives. This should be done through a collaborative process involving stakeholders, iwi, and scientists, which the Forum would be pleased to undertake, with government support. The Forum will then, as part of its September 2012 report, provide the technical basis for a national instrument. This further work should review and refine the following:

- a. the list of parameters and indicators
- b. the assignment of parameter levels for minimum numeric state objectives and breakpoints between the bands for 'Fair', 'Good' and 'Excellent' categories
- c. the classification of waterbody types, in particular for lakes, wetlands, estuaries and hydrologically modified catchments
- d. an analysis of the measurable state objective options against current water quality and quantity state data
- e. the options for either dealing with wetlands and estuaries through a similar framework, or to continue to deal with these classes through use of tight narrative objectives in regional plans.

### ***Recommendation 6***

In respect of NPS-FM Objective A2, the meaning of "maintained or improved" should be further defined. "Maintained" could be defined to mean that, within the national banded framework, a freshwater state objective for any parameter cannot be set in a band lower than that of its current state unless by way of an exception. "Improved" means setting a state objective higher than the existing state, and setting a limit based on that objective.

The development of the limits framework and its population with numerical state parameters (as outlined in Recommendation 5), together with catchment case studies, will provide the opportunity to analyse the effectiveness of this regime in practice. This may necessitate a revision of this recommendation on completion of that process.

### ***Recommendation 7***

Freshwater state objectives and related limits set at a regional level must comply with relevant national objectives except in exceptional circumstances. A system for applying for exceptions should be defined nationally, and criteria for exceptions to national objectives should be:

- c. the inability to meet a minimum state objective due to natural conditions of a waterbody;  
OR
- d. a regional decision to set a numeric state objective in a water quality band lower than the current state because:
  - i. an exceptional economic benefit will result from the relevant activity AND
  - ii. a net environmental gain will result, taking into account compensatory actions.

The Forum would welcome the opportunity to work with the government in developing a system for applying for exceptions, including on the detail of relevant criteria and processes.

***Recommendation 8***

The government should direct regional councils to identify aquifers and classify them into classes that recognise the following characteristics:

- a. aquifers that are connected to surface water
  - b. aquifers that are connected to the sea
  - c. confined aquifers
- (Note: aquifers will often be in more than one class)

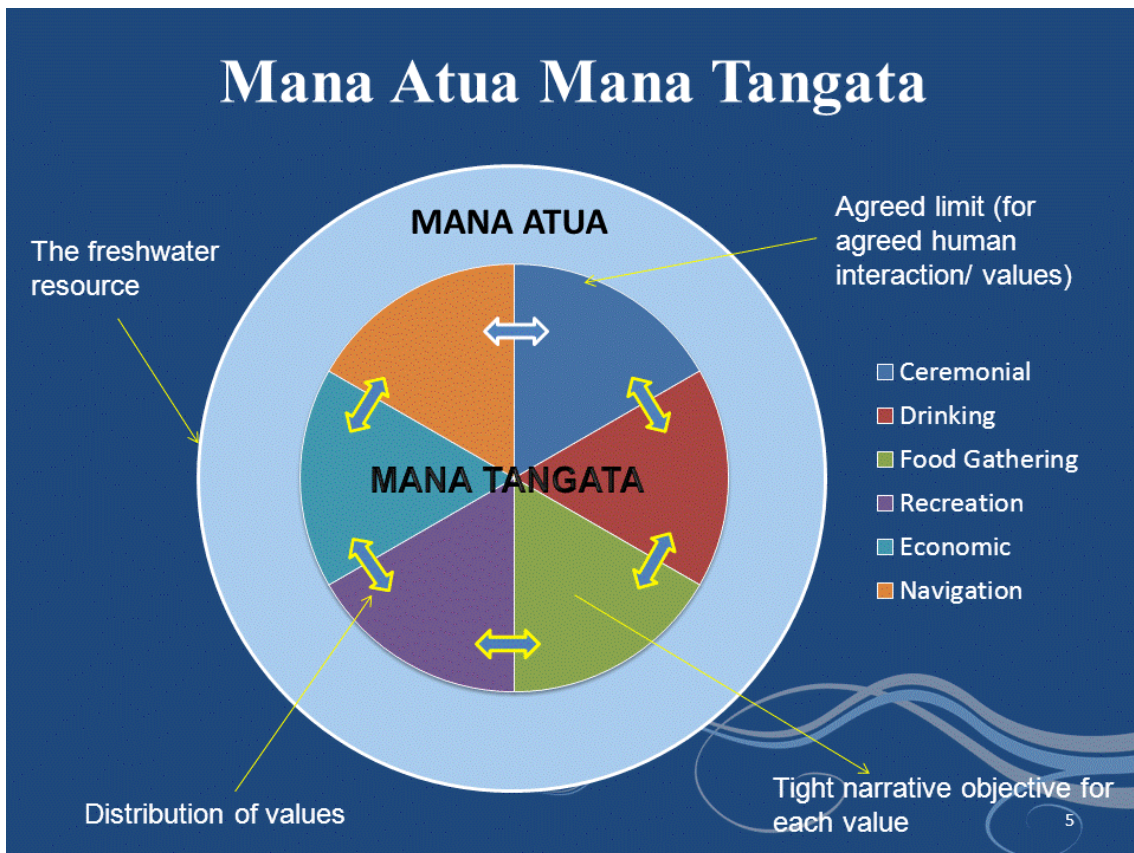
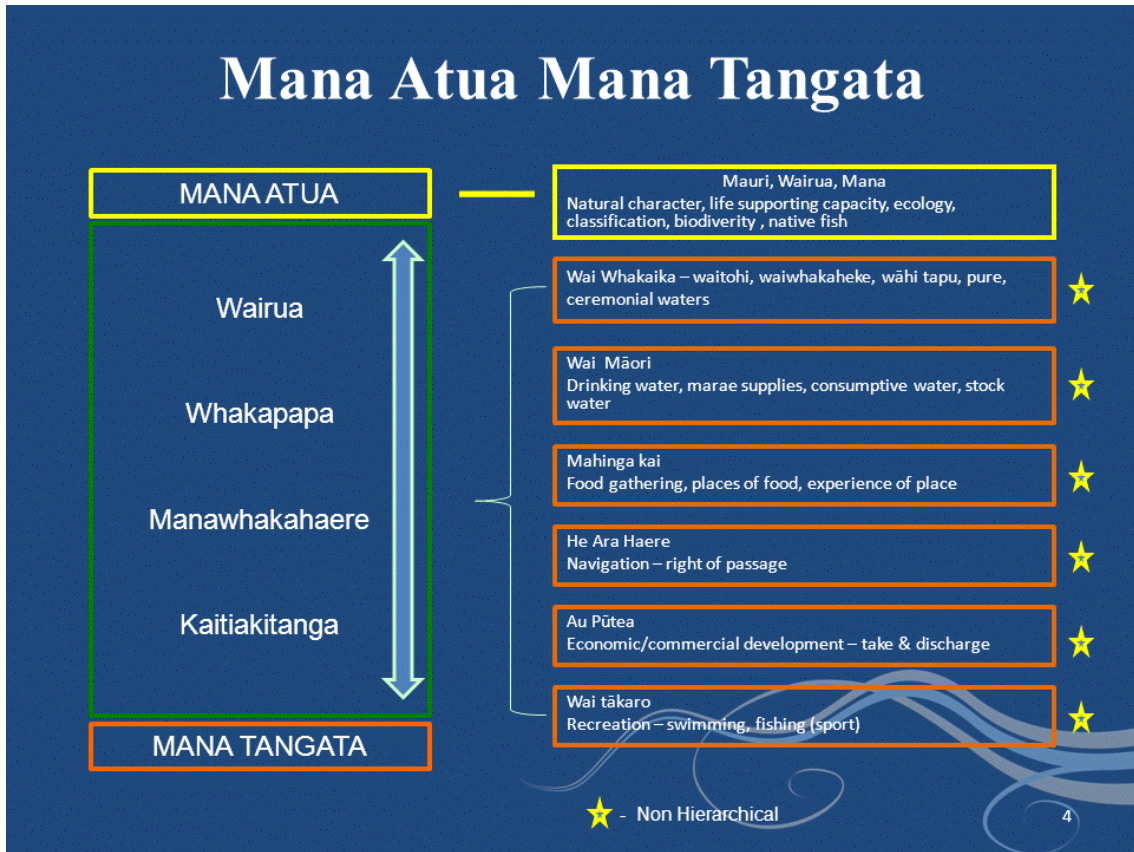
***Recommendation 9***

The state objectives and limits for aquifers connected to surface water should be consistent with those of the connected surface waterbody and be developed through a whole of catchment approach. Aquifers that are connected to the sea should be managed to prevent salt water intrusion. Confined aquifers that are not connected to surface water or the sea should be managed on a case-by-case basis. Local values and uses of aquifers, such as for drinking water, should be identified and taken into account.

***Recommendation 10***

Central and regional government should, when setting state objectives, consider the constraints in significantly hydrologically altered catchments. These catchments are those that have been modified by long-term major structures for hydro-generation, municipal water supply dams, and irrigation dams. This use category should be accommodated in a waterbody classification system.

Appendix 2: Tāngata whenua values and relationships with fresh water



Note: Some terms used in the *Mana Atua Mana Tangata* model are also defined terms in certain legislation. However, those terms are used in the model in accordance with their ordinary meaning, and are not to be interpreted with reference to their statutory meanings.

### Appendix 3: Partially populated national objectives framework

This appendix summarises the current status of a populated National Objectives Framework (NOF) following deliberations of a series of science panels for different freshwater body types (rivers, lakes, groundwater, estuaries and wetlands) and specialist topics (periphyton, iwi science). A separate group of scientists has reviewed the work of all of the science panels. The science panels have initially focussed on rivers, lakes and groundwater. Within those environments, the focus has been on human health (following the recommendation of the Forum) and on the requirements of objective A1/B1<sup>12</sup> of the NPS-FM. However, over time the framework will be able to be more fully populated. In some cases this can be done quite readily using existing science, in other cases more extensive scientific work is needed and some indicative priorities for research have been included.

#### Overview of framework

National value (from NPS-FM preamble or objectives)	Component values/uses	Relationship to <i>Mana atua mana tangata</i>	Proposed application	Progress to date	Comments
Life-supporting capacity	<b>Ecosystem health</b>	<b>Mana atua</b>	<b>National bottom-line to apply to all freshwater bodies</b>	See following tables	Measures for sediment and habitat space (including flows) not yet included. Significant gaps for sediment in relation to both national and regional objective setting. There are also gaps in toxicity information specific to indigenous species and further work is needed on other measures related to general indigenous species protection.
	<b>Indigenous species – general protection</b>	<b>Mana atua</b>	<b>National bottom-line to apply to all freshwater bodies</b>		
	Indigenous species – rare and threatened	Mana atua	Regional decision about where applies and for what species	Not yet progressed	Science is variable for different species
Animal drinking water		Wai māori	Regional decision about where applies	Not yet progressed	
Community water supply	Untreated drinking water	Wai māori	Regional decision about where applies	Addressed by Ministry of Health Drinking Water Standards	
	Drinking water sources for treatment	Wai māori	Regional decision about where applies	Addressed by Sources of Human Drinking Water NES	
Fire fighting		Wai māori	Regional decision about where applies	Not yet progressed	
Electricity generation		Au pūtea	Regional decision about where applies	Not yet progressed	
Commercial and industrial processes		Au pūtea	Regional decision about where applies	Not yet progressed	
Irrigation	Irrigation water used on fresh food crops	Au pūtea	Regional decision about where applies	Not yet progressed	
	Irrigation water for other purposes	Au pūtea	Regional decision about where applies	Not yet progressed	ANZECC guidelines being revised by 2014
Recreational activities	Primary contact – swimming	Wai tākaro/ Wai māori	Regional decision about where applies	See following tables	Based on existing MfE 2003 guidelines used by regions
	<b>Secondary contact – human health aspects</b>	<b>Mana atua</b>	<b>National bottom-line to apply to all freshwater bodies</b>	See following tables	Cyanobacteria not yet included – further short-term work needed.
	Secondary contact – kayaking, boating	Wai tākaro/ Wai māori	Regional decision about where applies	Not yet progressed	
Food production and harvesting	Aquaculture	Au pūtea	Regional decision about where applies and for what species	Not yet progressed	
	Food gathering, customary fisheries	Mahinga kai	Regional decision about where applies and for what species	Initial work started	Initial work has been completed, but not yet incorporated.
	Recreational fisheries, spawning	Wai tākaro	Regional decision about where applies and for what species	Not yet progressed	Significant work required to populate.
Transport and access	Navigation	He ara haere	Regional decision about where applies	Not yet progressed	
	Tauranga waka	He ara haere	Regional decision about where applies	Not yet progressed	
Cleaning, dilution and disposal of waste		Wai Māori/ Au Pūtea	Regional decision about where applies	Not yet progressed	
Natural form and character		Mana atua	Regional decision about where applies	Not yet progressed	Could be based on ‘excellent’ band for national bottom-lines, or use the ecological integrity indicator developed through NEMAR <sup>13</sup> .
Cultural and traditional relationships	Ceremonial waters	Wai whakaika	Regional decision about where applies	Initial work started	Initial work has been completed, but not yet incorporated.
	Aesthetic values	Mana atua	Regional decision about where applies	Not yet progressed	

<sup>12</sup> To safeguard the life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems of fresh water...

<sup>13</sup> National Environmental Monitoring and Reporting project.

## Detail of framework

The parts of the framework which have been partially populated are described in more detail in the following pages. This information is a summary of the work and recommendations of the science panels, and there are a number of existing and new technical papers that underpin this work.

### ***Ecosystem health and indigenous species (general protection) – proposed national bottom-line***

These values relate to objectives A1 and B1 of the NPS-FM – to safeguard the life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems of fresh water.

The critical parameters to manage will vary by water body type. Those relevant to rivers and lakes are summarised below, but similar work is also underway for estuaries and wetlands. There is a lack of information on the ecosystem requirement of groundwater, so it is proposed that objectives for groundwater relate to those for connected surface water bodies.

### **Rivers and lakes**

Critical parameters identified as needing management if this value/use is to be provided for in both rivers and lakes are:

- Nitrate (a toxicant to aquatic life at high enough concentrations) – see below.
- Ammonia (a toxicant to aquatic life at high enough concentrations) – see below.
- Heavy metals (toxicants to aquatic life at high enough concentrations) – not proposed for inclusion as they are generally a location-specific issue. Regional councils advised to use thresholds in the ANZECC water quality guidelines (currently under revision).
- Habitat space and ecological flows and levels – not yet considered but can build on proposed NES for Ecological Flows and Levels.

There are also additional parameters that are relevant to either rivers or lakes. These are discussed separately.

#### *Nitrate (aquatic toxicity) [Rivers and Lakes]*

The following bottom-lines and bands are proposed for nitrate:

<b>Objective band</b>	<b>Band descriptor</b>	<b>Annual median mg Nitrate-N/litre</b>	<b>Annual 95<sup>th</sup>ile mg Nitrate-N/litre</b>
Excellent	99% species protection level: No observed effect on any species tested	<1.1	<2.0
Good	95% species protection level: Starts impacting occasionally on the 5% most sensitive species	1.1 – 2.3	<3.6
Fair (national bottom line)	80% species protection level: Starts impacting regularly on the 20% most sensitive species (6% reduction in growth)	2.3 – 6.3	<8.7
Unacceptable - Poor <sup>14</sup>	Starts approaching acute impact level (ie risk of death) for sensitive species	6.3 – 20	8.7–30
Unacceptable – very poor	Acute impact level (ie risk of death) for sensitive species	20<	30<

The acceptable level of risk is a value-based judgment so, alternatively, the bottom-line could be set at a 90% species protection level for example (ie starts impacting regularly on the 10% most sensitive level). This would

<sup>14</sup> This additional band is proposed for nitrate toxicity, as there is significant change in impact below this threshold, where nitrate impacts on aquatic life become acute (ie deaths begin to occur).

be a bottom-line of 3.6 mg Nitrate-N/litre. Thresholds between bands could also be adjusted for different level of species protection.

Thresholds above the bottom line are set to protect against impacts on growth and reproduction. The bottom line has been set at a safe distance above lethal thresholds (ie where fish start to die). This is largely based on international data, as data on native NZ species is lacking. Trout and salmon (while non native) show considerably higher sensitivity to all other species tested internationally to date. The proposed thresholds are highly protective of most species, which is considered to be a reasonable surrogate for native species protection until further research testing is done on the latter.

There is no need for classification based on water body type – the same standard should apply to all rivers and lakes.

#### *Ammonia (aquatic toxicity) [Rivers and Lakes]*

The following bottom-lines and bands are proposed for ammonia:

<b>Objective band</b>	<b>Band descriptor</b>	<b>Annual median mg Ammoniacal-N/litre</b>	<b>Annual 95<sup>th</sup>ile mg Ammoniacal-N/litre</b>
Excellent	99% species protection level: no observable effect on any species tested	<0.02	<0.03
Good	95% species protection level: Starts impacting occasionally on the 5% most sensitive species	0.02 – 0.18	<0.25
Fair (national bottom line)	80% species protection level: Starts impacting regularly on the 20% most sensitive species (6% reduction in growth)	0.18 – 1.2	0.25 – 1.6
Unacceptable	Starts approaching acute impact level (ie risk of death) for sensitive species	1.2 <	4.4<

Thresholds have been developed in a similar way to those for Nitrate, focusing on the degree of species protection from growth impacts. Freshwater mussels are the most sensitive species, but only international species have been tested; there is no data on sub-lethal impacts on NZ species. Like for Nitrate, the bottom line for Ammonia is set at a safe distance above where lethal impacts kick in, but is also a value-based judgment in terms of the acceptable level of sub-lethal effects.

There is no need for classification based on water body type – the same standard should apply to all rivers and lakes.

#### **Additional parameters for rivers**

On top of the parameters for both rivers and lakes above, critical parameters identified as needing management if this value/use is to be provided for in rivers are:

- Slime (periphyton) – see below. This drives the condition of other biological components in freshwater ecosystems.
- Sediment – further work needed. Although there is some existing science to draw on, more work is needed to inform both objectives that may be included in a national framework and local objective setting by regional councils. Progressing this work should be a priority.
- Fish and macroinvertebrate indicators – there has been some initial work, but more is needed before objectives for inclusion in a national framework can be proposed.

## Slime (periphyton)

The following bottom-lines and bands are proposed for periphyton:

Objective band	Band descriptor	Mean Annual Max % WCC <sup>15</sup>
Excellent	Rare blooms reflecting negligible nutrient enrichment and/or alteration of the natural flow regime or habitat	<20
Good	Occasional blooms reflecting low nutrient enrichment and/or alteration of the natural flow regime or habitat	20 – 40
Fair (national bottom line)	Periodic short-duration nuisance blooms reflecting moderate nutrient enrichment and/or alteration of the natural flow regime or habitat	40 – 55
Unacceptable	Frequent blooms reflecting significant nutrient enrichment and/or alteration of the natural flow regime or habitat	55<

Thresholds have been developed arising out of science currently in progress to revise the previous (MfE, 2000) periphyton guideline, which were highly conservative for many NZ streams. A bottom line of 55% cover has been developed to maintain 'fair' ecological condition in streams, mainly based on correlations with invertebrate measures of enrichment such as MCI. The 40% threshold uses similar parameters to derive a 'good' condition, although the 40% value is also close to desirable periphyton cover thresholds for contact recreational use (ie swimming)<sup>16</sup>.

As indicated by the band descriptors, nutrients flow and habitat are drivers of periphyton growth. However it is not recommended that these be included in the national objectives framework as bottom-lines derived from the bottom-lines for periphyton growth. This is because periphyton response to nutrients and other drivers is highly variable by river type throughout the country and robust in-stream thresholds can only be generated through detailed site-specific science studies for each local river or river reach. National methodologies and tools could be developed to support regions to develop their own in-stream thresholds at an appropriate scale to achieve the periphyton cover thresholds outlined above.

It is not proposed to use a classification to vary the bottom-lines and thresholds by river type.

### Additional parameters for lakes

On top of the parameters for both rivers and lakes above, critical parameters identified as needing management if this value/use is to be provided for in lakes are:

- Algae (see below). This drives the condition of other biological components in freshwater ecosystems.
- Nutrients (see below). Nutrient concentrations are drivers of algal growth and are more strongly correlated in a lake environment than in a river environment.
- Oxygen (see below). Supports life.

The following bottom-lines and bands are proposed nutrients, algae and oxygen levels:

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<sup>15</sup> %WCC = "Percentage Weighted Composite Cover" (mats and filaments) – a robust measure of periphyton cover suitable for monthly monitoring in rivers, developed as part of a recent report on review of the NZ Periphyton Guidelines (John Quinn & co-authors). The "Mean Annual Maximum" measure requires an inter-annual period to be specified, eg. 5-year rolling average.

<sup>16</sup> Periphyton thresholds are typically 30-40% in existing regional plans

Objective band	Band descriptor	TP mg/m <sup>3</sup>	TN (mg/m <sup>3</sup> )		Median Chl-a mg/m <sup>3</sup>	Max Chl-a mg/m <sup>3</sup>	DO (%) SS lakes only
			SS & brackish	Mixed lakes			
Excellent	Lakes ecological communities are not under stress from nutrients and rarely experience algal blooms.	<10	<160	<300	<2	<10	60>
Good	Lakes ecological communities are under low stress from nutrients and occasionally experience algal blooms.	10–20*	160–350*	300–500*	2–5	10–25	50–60
Fair	Lakes ecological communities are stressed from nutrients or exotic species and occasionally experience algal blooms.	20–50	350–750	500–800	5–12	25–60	40–50
Unacceptable	Lakes ecological communities are under high stress from nutrients or exotic species and frequently experience algal blooms. Lakes are at risk of flipping.	50<	750<	800<	12<	60<	<40

\*Becomes the bottom line (lower bound of Fair) when *Egeria* macrophytes or coarse fish species are present

TP = Total Phosphorus

TN = Total Nitrogen

SS = Seasonally stratified lakes

Chl-a = Chlorophyll-a (a measure of green pigment in algae)

DO = Dissolved Oxygen

Some variables like Total Nitrogen and Dissolved Oxygen have different thresholds applying to different lake types or classes. Note that, in contrast to rivers, national bottom lines for nutrients have been included as drivers of algal blooms. This is because the variation in lake dynamics throughout the country is considerably less than for rivers, though a decision could also be made that this should be determined locally with a methodology provided nationally as for rivers. An alternative approach could be to provide them as defaults rather than bottom-lines.

### ***Secondary contact (human health aspects) – proposed national bottom-line***

A secondary contact bottom line and thresholds are proposed to provide a minimum of protection for human health across all surface waters.

Critical parameters identified as needing management if this value/use is to be provided for are:

- *E. coli* (an indicator of microbiological contamination and infection risk) – see below.
- Cyanobacteria (a toxicant) – being developed.

Heavy metals are also a risk to human health, but have not been included because the level of protection needed for ecological health will be more stringent than that needed for human health.

### **E. coli**

The following bottom-lines and bands are proposed for *E. coli*:

Objective band	Band descriptor	Median <i>E.coli</i> /100mL
Excellent	<0.1% infection risk	< 260
Good	0.1% – 1% infection risk	260 – 540
Fair	1% – 5% infection risk	540 – 1000
Unacceptable	>5% infection risk	>1000

Alternatively, bottom-lines and bands could be set relative to a bottom-line of 1% infection risk as follows:

<b>Objective band</b>	<b>Band descriptor</b>	<b>Median E.coli/100mL</b>
Excellent	<0.1% infection risk	< 260
Good	0.1% < 0.5% infection risk	260 < 460
Fair	0.5% < 1% infection risk	460 < 540
Unacceptable	>1% infection risk	> 540

These proposals are based on preliminary analysis by making an assumption about the level of ingestion compared to swimming, and re-running the analysis used to produce the primary contact standards in existing NZ guidelines. Additional work will be required to confirm the appropriateness of the thresholds and to check that all assumptions underpinning the thresholds are transparent and robust.

There is no need for classification based on water body type for entirely fresh waters– the same standard should apply to all freshwater surface water bodies. However, an alternative or additional parameter may be needed for estuaries given the saline influence from marine waters. Existing guidelines for coastal beaches and estuaries utilise the indicator *Enterococci*.

There is the potential for a national bottom-line to be exceeded in a small number of locations for ‘natural state’ reasons, but these cannot be managed through a classification. An example would be if a river reach below a native bird nesting colony of high value exceeded the bottom line values because of the birds.