greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

MEMO

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Recommended changes to Schedule H attributes and outcomes for the draft Natural Resources Plan: Rivers and streams

1. Introduction

Schedule H of the Regional Plan: Working Document for Discussion (WDFD) (GWRC 2013) included narrative and numeric outcomes for a range of river and stream values (Appendix 1). This memorandum sets out recommended changes to outcomes for rivers and streams in Tables H1.1–H1.5 of the WDFD for inclusion in the draft Natural Resources Plan (dNRP). These recommendations take into account stakeholder feedback, the recently released National Objectives Framework (NOF) under the National Policy Statement for Freshwater Management 2014 (NPS-FM, MfE 2014), and further technical work undertaken by GWRC.

Recommended river and stream attributes and outcomes for the dNRP are provided in Appendix 2.

1.1 National objectives framework

The NOF under the NPS-FM (MfE 2014) identifies 'numeric attribute states' for a number of attributes relating to river and stream ecosystem health and contact recreation values. For each attribute, numeric and narrative states are identified that form the basis of four 'bands' ranging from A to D. The boundary between the C and D bands represents the 'national bottom line' or the minimum level at which the compulsory values are provided for.

1.2 Stakeholder feedback

Feedback from major stakeholders was summarised for the Environmental Science Department in a memo (Vujcich & Fairbrother 2014). Feedback was also provided from the Department of Conservation and Friends of Taputeranga Marine Reserve. This feedback along with responses is summarised in Appendix 3.

2. Aquatic ecosystem health and mahinga kai

Outcomes in Schedule H of the WDFD (GWRC 2013) to protect aquatic ecosystem health and mahinga kai values in rivers and streams consist of narrative and numeric outcomes for a range of biological, water quality and habitat attributes. Outcomes are provided for each of six river classes which represent natural biogeographical differences in rivers and streams across the

region (see Greenfield et al. 2013 for more information). Outcomes are intended to represent a 'good' level of ecosystem health as a default while outcomes representative of 'excellent' ecosystem health have been identified for rivers and streams with significant macroinvertebrate values listed in Schedule C1 of the WDFD (GWRC 2013).

Recommended changes to attributes relating specifically to mahinga kai aspects are documented in a separate memo (Royal & Barriball 2014). These recommendations are incorporated into the tables in Appendix 2.

2.1 Biological attributes

2.1.1 Modification of narrative outcomes

It is recommended that narrative outcomes for macrophyte, invertebrate and fish attributes be modified from:

"*……community structure, composition, diversity and abundance is within an acceptable range of that found under natural conditions.*"

To:

"*……communities are resilient and their structure, composition and diversity are balanced.*"

The mention of abundance has been removed as it is considered that this aspect is incorporated within the terms "resilient" and "structure". The mention of natural conditions has been removed based on a reviewer recommendation (J. Quinn, NIWA) which suggested that use of this term may create the impression that the outcomes do not allow any deviation from natural or pristine conditions. It will be made clear in the Technical Guidance Document (Greenfield et al. in prep.) accompanying the outcomes for the dNRP that natural variation in biological attributes needs to be taken into account when assessing whether the outcomes are met.

2.1.2 Aquatic plants

A narrative outcome for phytoplankton communities has been added in recognition that these can be important in the lower reaches of some of our largest rivers (eg, the Ruamahanga River).

The remainder of the key changes to outcomes for aquatic plants relate to changes in numeric outcomes for periphyton biomass. Outcomes for periphyton communities in the WDFD are a set of periphyton biomass outcomes based around chlorophyll *a* concentrations identified in the New Zealand Periphyton Guidelines (Biggs 2000) (ie, 50, 120, 200 mg/m^2), the rationale for which is documented in Greenfield (2014a). The outcomes vary by river class with some classes (classes 3, 5 and 6) which are thought to be naturally productive having an outcome of ≤ 200 mg/m^2.

The numeric states outlined in the NOF (MfE 2014) for periphyton biomass use the same thresholds and identify 200 mg/m^2 as a compulsory national bottom line (Table 1). However, in addition to thresholds for periphyton biomass the NOF bands include an exceedance frequency. The intention of this is to allow for occasional periods of elevated periphyton biomass that can occur even in relatively non-enriched systems.

Table 1: NOF (MfE 2014) numeric attribute states (as an annual maximum) for periphyton in rivers and streams based on the recommendations of Snelder et al. (2013)

Attribute state	Numeric attribute state (mg chlorophyll a/m^2)*	Narrative attribute state
A	<50	Rare blooms reflecting negligible nutrient enrichment and/or alteration of the natural flow regime or habitat
B	50–120	Occasional blooms reflecting low nutrient enrichment and/or alteration of the natural flow regime or habitat
C	120–200	Periodic short duration nuisance blooms reflecting moderate nutrient enrichment and/or alteration of the natural flow regime or habitat
National Bottom Line	**200**	
D	>200	Regular and/or extended duration nuisance blooms reflecting high nutrient enrichment and/or significant alteration of the natural flow regime or habitat

*Exceeded on no more than 8% of samples for river and stream segments in the 'default' class and on no more than 17% of samples for segments in the 'productive' class (based on a minimum monitoring record length of three years).

The band thresholds have an allowable exceedance frequency of 8% of samples based on monthly sampling over a minimum of three years – this equates to an average of one exceedance per year. However, for sites that are productive due to natural enrichment and/or long biomass accrual periods an exceedance frequency of 17% of samples or an average of two occasions per year or is recommended.

The approach of varying both the periphyton biomass threshold and the exceedance frequency represents an advance in thinking since the Biggs (2000) guidelines. As such it is recommended that periphyton biomass outcomes for the dNRP be modified to align with the NOF numeric attribute states for periphyton.

It is recommended that numeric outcomes for rivers and streams fall at the boundary of either the A/B or B/C NOF bands depending on river class (Table 2). For class 1 it is recommended that the outcome be set at the boundary of the A/B band due to the unproductive nature of these rivers and streams (see Greenfield et al. (2013) for more information). For all other classes it is recommended that the outcome be set at the boundary of the B/C band (ie, 120 mg/m^2). For classes 1, 2 and 4 an average exceedance frequency of one occasion per year is recommended. For classes 3, 5 and 6, which are considered to be naturally productive, it is recommended that the exceedance frequency identified for the NOF 'productive' category be adopted (ie, an average of two exceedances per year). River and stream segments in classes 3, 5 and 6 vary from those identified in Snelder et al. (2013) as belonging to the 'productive' class. This variation on the NOF recommendations is discussed next.

Table 2: Recommended numeric outcomes for periphyton biomass as indicated by the concentration of chlorophyll *a* per square meter of the stream bed (mg/m^2)

River class	All rivers and streams	Rivers and streams with significant macroinvertebrate values (SM)	Allowable exceedance frequency (average no. occasions/year)	Allowable exceedance frequency (% of samples)
1	50	50	1	8
2	120	50	1	8
3	120	50	2	17
4	120	50	1	8
5	120	50	2	17
6	120	50	2	17

2.1.3 Modification of the 'productive' class for the Wellington region

In Snelder et al. (2013) the 'productive' class is defined as rivers and stream segments that fall into the River Environment Classification (REC) 'Dry' climate categories **and** 'nutrient enriched' geology categories. In the Wellington region 'Dry' climate categories are Warm-dry (WD) and Cool-dry (CD) while nutrient enriched geology categories are Soft sedimentary (SS). River and stream segments that fall into both 'dry' and 'nutrient enriched' categories in the Wellington region are mainly limited to areas of the eastern Wairarapa hill country (Figure 1).

It is recommended that for the dNRP the 'productive' class is extended to include all rivers and streams in river classes 3, 5 and 6 (Figure 2). These classes include rivers and streams in the soft sedimentary geology areas of eastern Wairarapa as well as streams in lowland areas of the Wairarapa Valley and Kapiti Coast. Rivers and streams in these classes have longer periphyton accrual periods than those in other classes. The extent of these classes roughly equates to that of the 'dry' **or** 'nutrient enriched geology' REC categories.

The five existing Rivers State of the Environment (RSoE) monitoring sites that fall into river classes 3, 5 and 6 have an estimated annual average accrual period of 38 days (from data presented in Thompson & Gordon (2010)). In contrast, rivers and streams in classes 1, 2 and 4 tend to have considerably shorter accrual periods (annual average accrual periods of 18, 26 and 20 days respectively).

Due to the predominant occurrence of river classes 3, 5 and 6 in lowland areas there are few un-impacted examples that can be used as reference sites. However, annual periphyton biomass monitoring at a small stream site in class 3 with a high proportion of indigenous forest in the upstream catchment (93%), good riparian shade and only limited impact from human activities (Coles Creek at Lagoon Hills) indicates that periphyton biomass can reach up to 90 mg/m^2. In contrast rivers and streams in classes 1, 2 and 4 with similar levels of impact (eg, Hutt River at Te Marua, Orongorongo River at Orongorongo Station) have a maximum biomass of no more than 35 mg/m^2.

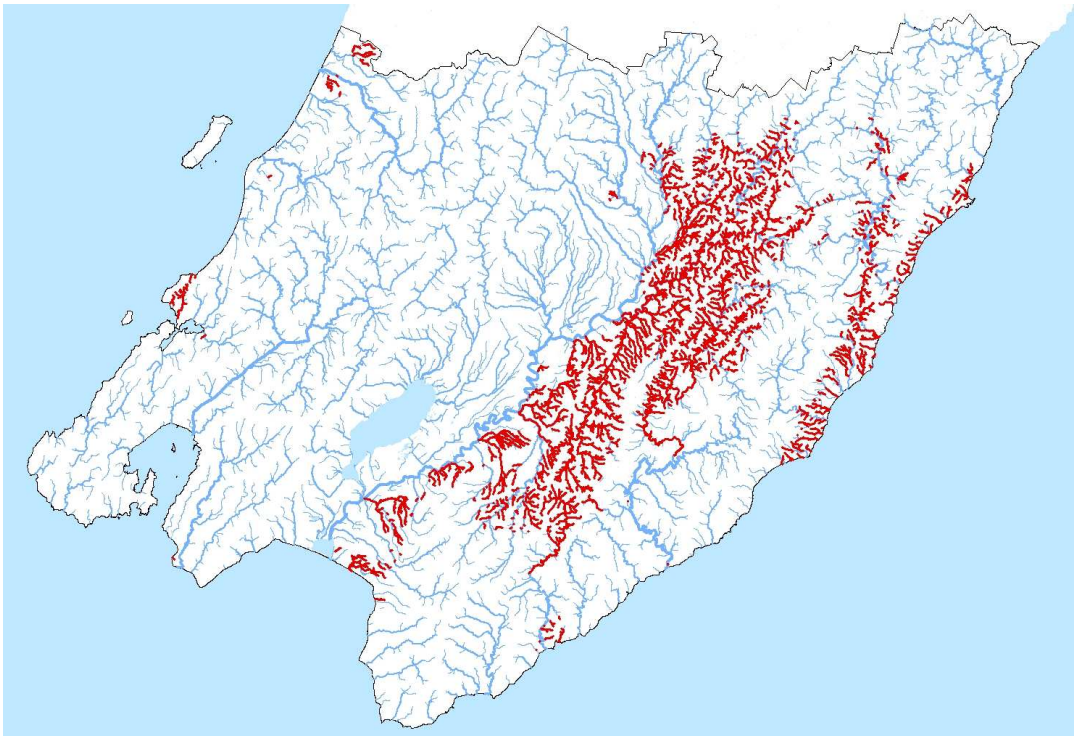

Figure 1: Extent of rivers and streams in the NOF productive periphyton class (shown in red) for the Wellington region

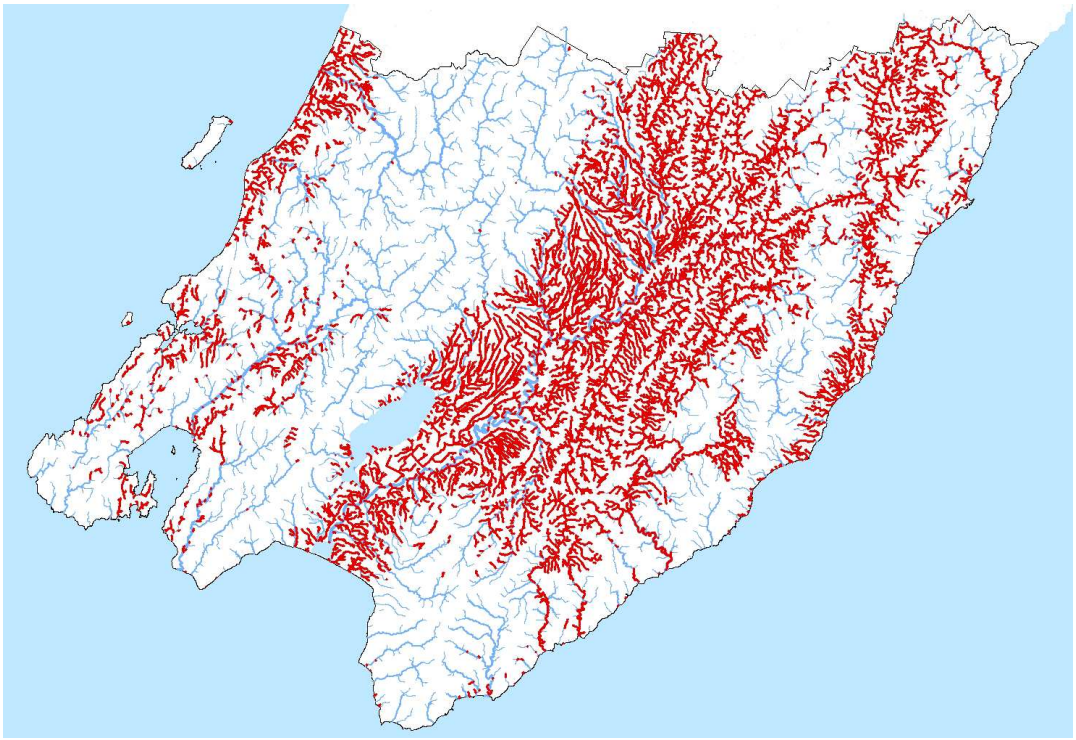

Figure 2: Extent of rivers and streams in the recommended GWRC productive periphyton class (shown in red)

Based on accrual period estimates for rivers and streams in classes 3, 5 and 6, as well as limited periphyton biomass data, it is considered that rivers and streams in these classes are likely to have naturally elevated periphyton production. As such it is considered appropriate that outcomes for these streams allow a greater frequency of exceedances of the periphyton biomass threshold than other river classes in the region.

2.1.4 Macroinvertebrates

The outcome relating to macroinvertebrate community health in the WDFD (GWRC 2013) is narrative only. Numeric outcomes were not included due to a lack of robust information on variation in reference condition (natural state) macroinvertebrate metrics for the Wellington region. Initial work undertaken by Greenfield (2014b) used a national scale model (Clapcott et al. 2011) as the basis for Macroinvertebrate Community Index (MCI) thresholds. However, lack of information as to the accuracy of model predictions for the Wellington region meant that these thresholds were not used in Schedule H of the WDFD. In early 2014 the Cawthron Institute was commissioned to develop predictive models of contemporary MCI metric scores specific to the Wellington region on which numeric outcomes for macroinvertebrate community health could be based (Clapcott & Goodwin 2014). The region-specific model provides greater accuracy than a similar national model developed for MfE by Clapcott et al. (2013) and is considered sufficiently robust to form the basis of regional scale numeric outcomes.

Based on the work of Clapcott and Goodwin (2014) the numeric outcomes in Table 3 are recommended for the macroinvertebrate attribute in Table H1.1.

Table 3: Recommended numeric outcomes for macroinvertebrate health as determined by Clapcott and Goodwin (2014). Outcomes are Macroinvertebrate Community Index (MCI) scores

River class	All rivers and streams	Rivers and streams with significant macroinvertebrate values (SM)
1	125	140
2	105	130
3	105	130
4	110	130
5	100	120
6	100	120

2.1.5 River-dependant birds

A narrative outcome for bird communities is recommended for inclusion in the suite of biological attributes in Table H1.1.

The larger rivers of the Wellington region support nationally significant breeding populations of several rare and threatened shorebird species, including the black-billed gull (nationally endangered), banded dotterel (nationally vulnerable), black-fronted dotterel (coloniser) and pied stilt (at-risk declining) (McArthur et al. 2013; Robertson et al. 2013). Each of these species requires large, open gravel beaches and islands free of woody weeds within the bed of the river in order to breed successfully. The maintenance of this habitat within a river channel requires a natural seasonal variation in river flows and careful management or mitigation of

flood protection and gravel extraction activities (Hughey 1985; Rebergen 2011). Up to 30 other bird species share this riverbed habitat, including waterfowl species such as mallard and paradise shelduck which are of value to recreational hunters, in addition to shags, herons, gulls and a number of terrestrial songbirds. Vertical banks on river margins provide important nesting habitat for both welcome swallows and New Zealand kingfishers and riparian vegetation provides foraging and nesting habitat for a number of native species including NZ kingfisher, NZ pigeon, shining cuckoo, grey warbler and fantail (McArthur et al. 2013, McArthur[1], pers obs).

2.2 Water quality attributes

The NOF (MfE (2014) includes numeric states for dissolved oxygen as well as ammonia and nitrate toxicity attributes in relation to ecosystem health.

Outcomes for nitrate toxicity in the WDFD (GWRC 2013) are consistent with those in the NOF as they are both based on recommendations from Hickey (2013). However, it is recommended that nitrate toxicity numeric outcomes be changed from the concentration values to a protection level to be consistent with numeric outcomes for other toxicants in Schedule H and the nitrate toxicity numeric outcome for groundwater (Table H4.1, Tidswell 2014). Outcomes for nitrate toxicity are the 99% (for rivers and streams with significant macroinvertebrate values) and 95% (for all others) protection levels from Hickey (2013) and are equivalent to the A and B bands, respectively, of the NOF (MfE 2014).

Numeric states proposed for dissolved oxygen and ammonia toxicity attributes differ from those in the WDFD. However, it is not currently recommended that the NOF attribute states be incorporated into the dNRP. No technical background report regarding the ammonia thresholds has yet been made available and the dissolved oxygen attribute only applies to areas downstream of point source discharges. It is considered that if the outcomes in Schedule H of the WDFD are met for these attributes the equivalent NOF national bottom lines will not be breached.

The Department of Conservation (DoC) listed a number of concerns about the WDFD numeric outcomes for dissolved oxygen, temperature and water clarity. In addition, a number of stakeholders requested that numeric outcomes for nutrients be added. Responses to this feedback are listed in Appendix 3.

In response to DoC's feedback it is recommended that the reference to the 'minimum of monthly spot measurements' for dissolved oxygen, temperature and pH be removed from the interpretation notes for Table H1.1. This change addresses concerns that monthly spot measurements of dissolved oxygen would likely give significantly different results to those based on a 5^{th} percentile of continuous data. While it has always been the intention that those attributes with significant diurnal variation would have their outcomes assessed using continuous monitoring data it is recognised that mention of spot measurements is ambiguous. The interpretation notes for these attributes should refer to continuous monitoring data only.

Some minor changes have also been made to the narrative outcome for nutrients in order to align with similar outcomes for other surface water bodies (eg, lakes and coastal waters).

[1] Nikki McArthur, GWRC Environmental Scientist – Terrestrial Ecology.

2.3 Substrate quality attributes

It is recommended that a number of attributes relating to substrate quality are added to the outcomes for aquatic ecosystem health and mahinga kai in recognition of the importance of these for aquatic ecosystem health in rivers and streams and to align with the equivalent tables for lake and coastal water bodies. A brief description of each attribute to be included is outlined in Table 4.

Table 4: Summary of substrate quality attributes recommended for inclusion in Table H1.1 for rivers and streams (adapted from Oliver et al. 2014)

Attribute	Rationale
Substrate composition	Originally covered in the narrative habitat outcome, substrate composition has now been identified as an attribute in its own right. The size, distribution and condition of the stream substrate influences the habitat quality for algae, invertebrates and fish, and determines the quantity and quality of refugia from floods and predators. The suitability of substrate for different species depends on the dominant particle size, the range of substrate sizes, the degree of packing and compactness and the availability of interstitial spaces for refuge (Gordon et al. 2004).
Sediment anoxia	Surface sediments need to be well oxygenated to support healthy invertebrate communities; anoxic sediments contain toxic sulphides and very little aquatic life.
Organic carbon	Total organic carbon (TOC) content is an important source of food and energy but too much organic content depletes sediment oxygen as it degrades and can result in anoxic sediments, adversely impacting biota.
Nutrients	Nutrients associated with river and stream bed sediment can be released into the water column thus potentially contributing to increased aquatic plant growth. As discussed in Greenfield et al. (2013), excessive aquatic plant growth can have detrimental effects on river and stream ecosystem health.
Toxicants	Many chemicals (eg, heavy metals, hydrocarbons, pesticides) discharged to rivers and streams via urban and rural runoff are toxic, even at very low concentrations. These chemicals can accumulate in sediments and bio-accumulate in fish and shellfish, affecting river and stream life.

2.4 Physical habitat attributes

It is recommended that narrative outcomes for channel geomorphology, connectivity and riparian vegetation attributes are added to Table H1.1. These outcomes, along with the substrate composition outcome, replace the more general 'habitat' narrative outcome in the WDFD. A brief description of each recommended new attribute is included in Table 5.

Table 5: Summary of physical habitat attributes recommended for inclusion in Table H1.1 for rivers and streams

Attribute	Rationale
Channel geomorphology	Channel geomorphology refers to a range of aspects including channel width and depth, velocity, substrate size, degree of sinuosity and braiding which strongly influence the plant and animal communities that live within rivers and streams (Allan & Castillo 2007). Rivers and stream ecosystems function best when channel geomorphology results in a range of habitat types.
Riparian vegetation	Riparian vegetation strongly influences life in streams and rivers by providing shade, food and habitat as well as services such as bank erosion protection and buffering of contaminant inputs (Collier et al. 1995). Rivers and streams function best when bordered by a riparian margin with healthy vegetation.
Connectivity	Connectivity refers to the free movement of water, nutrients, sediment and biota between mutually dependant ecosystems. Common obstacles to river and stream ecosystem connectivity include man-made structures and stream diversion. Discharge of contaminants to rivers and streams can also affect the movement of biota.

3. Contact recreation and tangata whenua use

Outcomes in Schedule H of the WDFD (GWRC 2013) to protect contact recreation and tangata whenua use values consist of numeric and narrative outcomes for a range of human health and aesthetic indicators. Feedback from stakeholders on these outcomes is listed in Appendix 3 along with a response. Stakeholder feedback has not resulted in any recommended changes to outcomes in Schedule H for the dNRP.

The NOF (MfE 2014) includes a set of numeric attribute states for both primary and secondary contact recreation. The secondary contact recreation value is identified as compulsory while the primary contact recreational value is optional. Schedule H of the WDFD (GWRC 2013) did not include an outcome for secondary contact recreation. However, given that the NPS-FM now requires secondary contact recreation to be provided for as a national compulsory value, Table H1.2 has been updated to include an outcome for this value.

Recommended changes to attributes relating specifically to tangata whenua use aspects are documented in a separate memorandum (Royal & Barriball 2014). These recommendations are incorporated into the tables in Appendix 2.

3.1 Primary contact recreation

The numeric outcomes that relate to human health in Schedule H of the WDFD are *E. coli* counts based on the surveillance thresholds of the MfE/MoH (2003) microbiological water quality guidelines for marine and freshwater recreational areas. Either the 'alert' or 'action' triggers are applied depending on flow and time of year. In comparison, numeric attribute states for primary contact recreation in the NOF are 95th percentile values based on the Microbiological Assessment Category (MAC) values identified in the MfE/MoH (2003) guidelines. Band A of the NOF for primary contact recreation equates to the B MAC category and band B equates to the C MAC category (Table 6). The NOF band B is identified as the minimum acceptable state for primary contact recreation in rivers.

Table 6: NOF (MfE 2014) numeric attribute states for primary contact recreation in rivers and streams. The numeric attribute state is a 95th percentile. Narrative attribute states give the risk of *Campylobacter* infection

Attribute state	Numeric attribute state (*E. coli*/100 mL)	Narrative attribute state
A	<260	People are exposed to a low risk of infection (up to 1% risk) when undertaking activities likely to involve full immersion.
B	260–540	People are exposed to a moderate risk of infection (less than 5% risk) when undertaking activities likely to involve full immersion.
Minimum acceptable state	**540**	

In order to be consistent with the NOF, it is proposed that *E. coli* outcomes be based on the MfE/MoH (2003) MAC thresholds rather than the MfE/MoH (2003) surveillance thresholds proposed in the WDFD. Due to the known association between rainfall and river flow and *E. coli* counts in the region's rivers it is recommended that numeric outcomes include a modified 'dry weather' *E. coli* 95th percentile.

It is important to note that *E. coli* 95th percentile outcomes should not be applied to rivers and streams that are impacted by a nearby point source discharge of treated wastewater (eg, parts of the Ruamahanga River) without the relationship between indicator bacteria and pathogens in the discharge first being established. As stated in the MfE/MoH (2003) guidelines, the wastewater treatment process can alter the relationship between faecal indicator bacteria and pathogens (ie, treatment may remove indicator bacteria but not pathogens) meaning that the guidelines may not accurately represent the health risk to river users.

3.1.1 Use of 'dry weather' *E. coli* 95th percentiles

As it is based on a 95th percentile and therefore the highest results recorded at a site, the MAC grade is highly influenced by results collected during and immediately after rainfall – the time when runoff from land washes pathogens and indicator bacteria into rivers and streams. This results in the MAC category being primarily determined by rainfall-related conditions. Milne and Wyatt (2006) identified that Suitability for Recreation Grades (SFRGs) and associated MAC grades for many river sites in the Wellington region were heavily influenced by a small number of elevated *E. coli* counts recorded following heavy rainfall. Where this was the case the MAC and associated SFRGs were more representative of wet weather/high flow conditions when contact recreation is less likely to occur.

The MfE/MoH (2003) guidelines allow for modification of a SFRG grade (and therefore a MAC category) if occasional and predictable contamination events, such as those that occur after heavy rainfall, are identified. Analysis of *E. coli* counts from 22 river sites between 2005/06 and 2010/11 shows that around 80% of exceedances of the 'action' trigger occurred at median river flow or higher (Figure 3). These moderate to high river flows are generally associated with heavy or prolonged rainfall in the days preceding sampling.

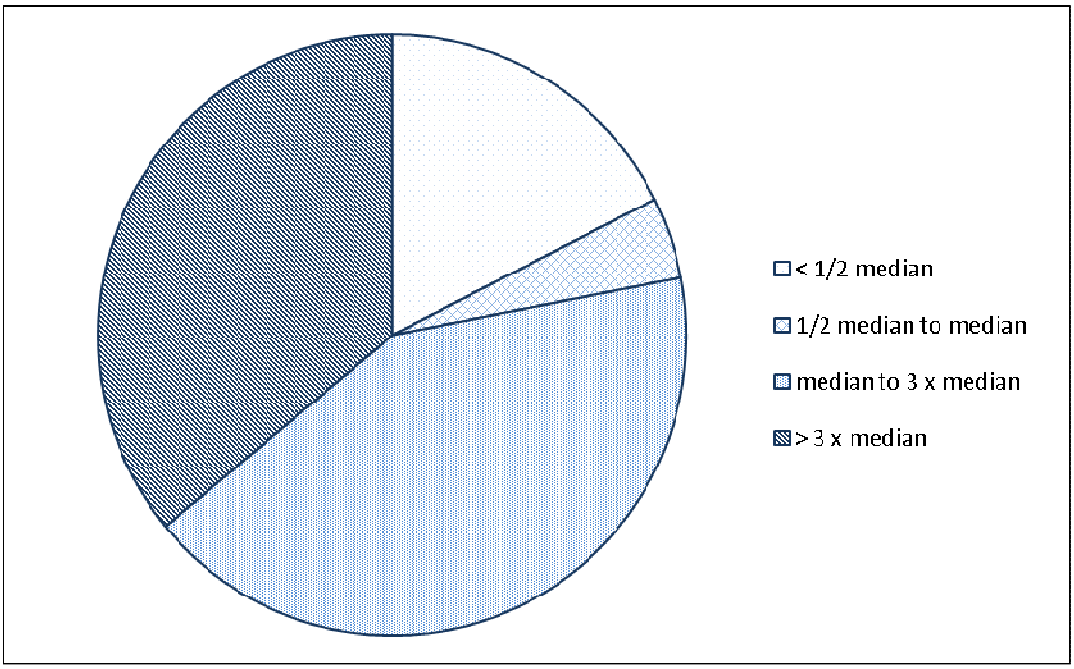

Figure 3: Proportion of exceedances of the MfE/MoH (2003) 'action' guideline at different flows for 22 river sites monitored over summer bathing seasons between 2005/06 and 2010/11

In collaboration with Regional Public Health, Greenfield et al. (2012) developed a method to identify 'dry weather' SFRGs (and associated MAC categories) for rivers and streams in the Wellington region. The 'dry weather' MAC category is calculated using only *E. coli* data coinciding with less than median river flow. The 'dry weather' SFRG and associated MAC category is considered to better reflect the water quality conditions the public are usually exposed to.

It is recognised that rivers and streams are still used, albeit to a lesser extent, at moderate flows that could be affected by rainfall and during winter (eg, by white water kayakers). For this reason it is recommended that an additional *E. coli* outcome be identified in the dNRP for moderate flows and for times outside the bathing season. This outcome should also be an *E. coli* 95th percentile based on the appropriate NOF band rather than the surveillance-based threshold outcome recommended in Schedule H of the WDFD. No outcomes are recommended for microbiological water quality at flows greater than three times median which is when many rivers are considered to be in 'flood' and unsafe for recreational use.

3.1.2 Selection of outcomes for Schedule H

Determining which NOF band/MAC category is most suitable as an outcome for primary contact recreation in rivers is a policy decision to be made by GWRC's Te Upoko Taiao – Natural Resource Management Committee (Te Upoko Taiao). An important part of this decision is the acceptable level of infection risk to river users. The risk of *Campylobacter* infection associated with each MAC value is included in Table 6.

3.2 Secondary contact recreation

Numeric attribute states for secondary contact recreation identified by the NOF (MfE 2014) are based on analysis by McBride (2012) and consist of annual median *E. coli* counts (Table 7). Determining which NOF band is most suitable as an outcome for secondary contact recreation in rivers is a policy decision to be made by Te Upoko Taiao. An important part of this decision is the acceptable level of infection risk to river users. The level of risk of *Campylobacter* infection associated with each NOF band is listed in Table 7. Another consideration is that the use of an annual median statistic as recommended by the NOF is less precautionary for safeguarding public health than the 95th percentile approach used in the MfE/MoH (2003) guidelines and recommended by World Health Organisation (2003). For this reason the New Zealand Freshwater Sciences Society (NZFSS) recommended in its submission on the proposed NOF that the secondary contact recreation numeric attribute state be based on a 95th percentile rather than a median.

For the reasons outlined for primary contact recreation outcomes above, secondary contact recreation outcomes should not be applied to rivers and streams that are impacted by a nearby point source discharge of treated wastewater without the relationship between indicator bacteria and pathogens in the discharge first being established.

Table 7: NOF (MfE 2014) numeric attribute states for secondary contact recreation in rivers and streams. The numeric attribute state is an annual median. Narrative attribute states give the risk of *Campylobacter* infection

Attribute state	Numeric attribute state (*E. coli*/100 mL)	Narrative attribute state
A	<260	People are exposed to a very low risk of infection (less than 0.1% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating).
B	260–540	People are exposed to a low risk of infection (less than 1% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating).
C	540–1,000	People are exposed to a moderate risk of infection (less than 5% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating).
National Bottom Line	**1,000**	
D	>1,000	People are exposed to a high risk of infection (greater than 5% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating).

4. Health needs of people

No changes are recommended to Table H1.3.

5. Stock watering

Apart from the addition of narrative outcomes for all attributes no changes are recommended to Table H1.4 for outcomes relating to stock watering.

6. Trout fisheries and spawning

Outcomes in Schedule H of the WDFD (GWRC 2013) to protect trout fishery and spawning values consist of numeric and narrative outcomes for a range of biological, water quality and habitat attributes. No feedback was received from stakeholders on these outcomes and the NOF (MfE 2014) does not include numeric attributes states that relate to trout fishery and spawning values. However, some minor changes are recommended for trout fishery and spawning outcomes as discussed below (and presented in Appendix 2).

6.1 Biological attributes

Biological attributes of significance to trout fishery and spawning values are invertebrates and aquatic plants. Apart from the addition of narrative outcomes no significant changes are recommended to the outcomes for these biological attributes. However, a note should be added to the interpretation notes for the MCI score outcome stating that rivers and streams are excluded where there is evidence that the outcomes would not be achieved even under near natural conditions. This note is needed to take into account natural variation in macroinvertebrate communities across the region (as reflected in the MCI outcomes for the aquatic ecosystem health and mahinga kai value) which may mean that some rivers and streams identified as important for trout fisheries or spawning may not be able to meet the outcome even under near natural conditions.

6.2 Water quality attributes

No changes are recommended other than the addition of narrative outcomes for all attributes.

6.3 Physical habitat attributes

It is recommended that narrative outcomes are added for substrate composition, flow, channel geomorphology, connectivity and riparian vegetation in recognition that these factors can significantly affect trout fisheries and spawning.

The numeric outcome for sediment cover of 20% of the river bed should be removed and a narrative outcome added in its place. This is because the 20% fine sediment cover threshold recommended in Clapcott et al. (2011) represents more of a 'bottom line' for aquatic ecosystem health than a threshold representing slightly to moderately impaired conditions. This is likely to apply equally to the effects of fine sediment cover on trout fishery and spawning values. This means that the 20% cover outcome is unlikely to be representative of 'good' conditions as outcomes for the dNRP are intended to be. Until such time as a suitable numeric outcome can be identified it is recommended that the sediment cover outcome be narrative only.

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Appendix 1: WDFD (GWRC 2013) Schedule H outcome tables for rivers and streams

Table H1.1: Aquatic ecosystem health and mahinga kai

Water type	Rivers																	
Value	Aquatic ecosystem health and mahinga kai																	
Broad outcome	River water quality, quantity and habitat safeguards healthy aquatic ecosystems and supports mahinga kai																	
		Biological					**Water quality**										**Flows**	**Habitat**	
		Fish	**Macroinvertebrates**	**Periphyton biomass**	**Macrophyte cover**	**Mahinga kai**	**Temp**	**pH**	**Nutrients**	**DO**	**Water clarity**	**Toxicants**						**Sediment cover**	**Habitat**
												NO_3-N		**NH_3-N**		**Other**			
	River Class											**Chronic**	**Acute**	**Chronic**	**Acute**				
Outcome	**1**	Native fish community structure, composition, diversity, and abundance is within an acceptable range of that found under natural conditions	Macroinvertebrate community structure, composition, diversity, and abundance is within an acceptable range of that found under natural conditions	50 **SM:** 50	Macrophyte community structure, composition, diversity and abundance is within an acceptable range of that found under natural conditions	Taonga species are present in quantities, sizes and of a quality that is appropriate for the area	19 **SM:** 19	5.8-8.5 **SM:** 6.1-8.2	The concentration of plant-available nitrogen and phosphorus avoids nuisance in-stream plant growth	80 **SM:** 80	1.8 **SM:** 2.2	2.4/3.5 **SM:** 1.0/1.5	20	99	USEPA 2009	95 **SM:** 99	Minimum flows are met in accordance with policy LW.P57	Cover of fine sediment on the river bed is within an acceptable range of that found under natural conditions	The quality, diversity and connectivity of habitat including riparian margins is within an acceptable range of that found under natural conditions
	2			120 **SM:** 50			20 **SM:** 20	6.4-8.9 **SM:** 6.7-8.6		70 **SM:** 70	1.3 **SM:** 1.9								
	3			200 **SM:** 120			21 **SM:** 21	6.8-8.7 **SM:** 7.1-8.4		60 **SM:** 70	0.5 **SM:** 0.8								
	4			120 **SM:** 50			21 **SM:** 20	5.8-8.5 **SM:** 6.1-8.2		70 **SM:** 80	1.6 **SM:** 2.2								
	5			200 **SM:** 120			23 **SM:** 21	5.8-8.7 **SM:** 6.1-8.4		60 **SM:** 70	0.5 **SM:** 0.8								
	6			200 **SM:** 120			21 **SM:** 21	5.8-7.8* **SM:** 6.1-7.5*		60 **SM:** 70	1.3 **SM:** 1.6								
Limits	Relevant resource use limits to be defined																See interim limits set in Schedule I	Relevant resource use limits to be defined	

Interpretation of Table H1.1

River class	Description
1	Steep gradient, hard sedimentary
2	Moderate gradient and coastal, hard sedimentary
3	Moderate gradient, soft sedimentary
4	Low gradient, large, draining ranges
5	Low gradient, large, draining plains and eastern Wairarapa
6	Low gradient, small

River classes are mapped by stretches in Maps 20A to 20E

SM Stretches of rivers with significant macroinvertebrate values, as identified in the first column of the table in Schedule C1

Interpretation of rivers aquatic ecosystem health and mahinga kai Table H1.1					
Attribute		**Unit**	**Direction**	**Narrative**	**Compliance notes**
	Periphyton biomass	mg/m^2 Chl *a*	≤	Periphyton biomass does not exceed … mg/m^2 Chl *a*.	Maximum of monthly periphyton biomass measurements.
Temp	Temperature	°C	≤	The temperature of the water does not exceed …°C.	95th percentile of continuous temperature measurements, or if not available the maximum of monthly spot temperature measurement. Applies to all flows.
	pH	pH units	Range	The pH of the water is between … and ….	5th and 95th percentile of continuous measurements or the minimum and maximum of monthly spot measurements. Applies at all flows. * indicates that these outcomes do not apply to streams with high peat cover in the upstream catchment.
DO	Dissolved oxygen	% saturation	≥	The concentration of dissolved oxygen exceeds …% of saturation.	5th percentile of continuous daily or the minimum of monthly spot measurements. Applies at all flows.
	Water clarity	m	≥	The 20th percentile of visual clarity measured as the horizontal sighting range of a black disc is no less than …m, at flows at or below median flow.	20th percentile of monthly black disc measurements collected at flows at or below median flow.
NO_3-N	Nitrate-N	mg/L	Chronic: ≤ median/ ≤ 95th percentile Acute: <	Chronic: annual median nitrate-N concentration does not exceed … mg/L, and annual 95th percentile concentration does not exceed … mg/L. Acute: In-stream nitrate-N concentration does not exceed 20mg/L.	This outcome relates to nitrate toxicity only. Nutrient outcomes for management of in-stream plant growth will be developed as part of the whaitua process. The chronic outcomes are firstly a 'grading' outcome based on an annual median and secondly a 'surveillance' outcome based on an annual 95th percentile as stipulated in Hickey (2013). These outcomes correspond to a level of protection of 95 % of species and 99% of species for SM rivers. Both chronic and acute outcomes apply at all flows.
NH_3-N	Ammonia (chronic)	%	Chronic: ≤	Annual median ammonia concentrations must not exceed the trigger value for freshwaters defined in the ANZECC (2000) guidelines table 3.4.1 for the level of protection of …% of species. The trigger value must be adjusted for temperature and pH as directed in section 8.3.7.2 of the guidelines.	Annual median of monthly sample results. Applies at all flows.
	Ammonia (acute)	mg/L	≤	The concentration of ammonia does not exceed ….mg/L as defined in the US EPA 2009 table referring to acute criterion for freshwaters with mussels present.	Maximum concentration. Applies at all flows.
	Other toxicants	%	≤	Toxicants other than nitrate and ammonia do not exceed the trigger values identified in the ANZECC (2000) guidelines for the level of protection of …% of species.	Applies to the dissolved fraction of heavy metals and other contaminants. Based on annual median. Applies at all flows. http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol1.pdf

Table H1.2: Contact recreation and tangata whenua use

Water type	Rivers											
Value	Contact recreation and tangata whenua use											
Broad outcome	The quantity and quality of water in rivers are suitable for contact recreation, and support tangata whenua use and their relationship with water											
Outcome	**Health**					**Aesthetic**						
	E. coli	**Benthic cyanobacteria cover**	**pH**	**Toxicants/ irritants**	**Tangata whenua use**	**Macrophyte cover**		**Mat algae cover**	**Filamentous algae cover**	**Water clarity**	**Sediment cover**	**Sewage fungus**
						Total	**Emergent**					
	Bathing season: 260 at low flow* 550 at moderate flow** **Outside bathing season:** 550***	20	6.5-8.5	Refer to tables 5.2.3 and 5.2.4 ANZECC 2000	Rivers are safe for primary contact and ceremonial use	60	30	60	30	1.6	25	No bacterial or fungal slime growths visible to the naked eye as plumose growths or mats
Limit	Relevant resource use limits to be defined											

Interpretation of Table H1.2

Interpretation of rivers contact recreation and tangata whenua use Table H1.2					
Attribute		**Unit**	**Direction**	**Narrative**	**Notes**
E. coli	*Escherichia coli*	cfu/100mL	≤	The concentration of *E. coli* must not exceed 260cfu/100mL between 1 Nov - 31 Mar (inclusive) when flows are at or below the median flow, or 550cfu/100mL when flows are between the median and 3x median flow. The concentration of *E. coli* must not exceed 550cfu/100mL between 1 Apr – 31 Oct (inclusive) when flows below 3x median flow.	Bathing season is November to March inclusive. Non-bathing season is April to October inclusive. 95th percentile of at least 100 data points * at < median flows ** between median and 3x median flow *** at <3x median flow
	Filamentous algae	% cover	≤	Filamentous algae cover does not exceed …%	Applicable at all flows
	Mat algae	% cover	≤	Mat algae cover does not exceed …%	
	Benthic cyanobacteria	% cover	≤	Benthic cyanobacteria cover does not exceed …%	
	Macrophyte	% cover	≤	Macrophyte cover does not exceed …%	
	pH	pH units	Range	The pH of the water is between … and ….	5th and 95th percentile of continuous measurements or the minimum and maximum of spot measurements. Applies at all flows.
	Water clarity	m		The 20th percentile of visual clarity measured as the horizontal sighting range of a black disc is no less than …m, at flows at or below median flow.	20th percentile of black disc measurements collected at flows at or below median flow.
	Sediment cover	%	≤	Sediment cover of stream and river beds is less than …%.	
	Toxicants/irritants		≤	Concentrations of toxicants/irritants do not exceed those specified in tables 5.2.3 and 5.2.4 of ANZECC 2000.	Applies at all flows. ANZECC 2000 table available at http://www.daff.gov.au/__data/assets/pdf_file/0003/316128/wqg-ch5.pdf. Note that New Zealand's Ministry for the Environment/Ministry of Health guidance for contact recreation water quality standards does not cover toxicants/irritants

Table H1.3: Health needs of people

Water type	Rivers	
Value	Health needs of people	
Broad outcome	River water is suitable for the health needs of people	
Outcome	**Water quantity**	**Water quality**
	Sufficient water from rivers is available for the health needs of people	The quality of water within group and community water supply areas is maintained or enhanced

Table H1.4: Stock watering

Water type	Rivers			
Value	Stock watering			
Broad outcome	River water is available in quantities and is of a quality that is suitable for stock watering			
	E. coli	**Benthic cyanobacteria cover**	**pH**	**Toxicants/irritants**
Outcome	≤550	20	6.0-9.0	Refer to table 5.2.3 in ANZECC 2000
Limit	Relevant resource use limits to be defined			

Interpretation of rivers stock watering Table H1.4					
Attribute		**Unit**	**Direction**	**Narrative**	**Notes**
E. coli	*Escherichia coli*	cfu/100mL	≤	The concentration of *E. coli* does not exceed …cfu/100mL.	Applies at flows less than 3x the median flow Applies year round 95th percentile of at least 100 data points
	Benthic cyanobacteria cover	%	≤	Benthic cyanobacteria cover does not exceed …%	
	pH	pH units	Range	The pH of the water is between … and ….	
	Toxicants/irritants		≤	Concentrations of toxicants/irritants do not exceed those specified in tables 5.2.3 and 5.2.4 of ANZECC 2000.	See http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol1.pdf

Table H1.5: Trout spawning and trout fisheries

Water type	Rivers														
Value	Trout spawning and trout fishery														
Broad outcome	Where appropriate, rivers support trout fisheries and trout spawning														
Outcome		**Biological**			**Water quality**										**Habitat**
		MCI	**In-stream plants**		**Temp**	**pH**	**DO**	**Water clarity**	**Nutrients**	**Toxicants**					**Sediment cover**
			AFDW	**Filamentous algae cover**						**NO_3-N**		**NH_3-N**		**Other**	
										Chronic	**Acute**	**Chronic**	**Acute**		
	Regionally important	120	35	30	19	6.3-8.4	80	Waikanae: 2.0 Wainuiomata: 2.0 Ruamāhanga: 3.0 Waiohine: 2.5 Hutt: 2.1	The concentration of plant-available nutrients supports healthy trout fisheries	1.0/1.5	20	95%	USEPA 2009	99%	20
	Locally important	100			24	6.0-9.0	70	2.0		2.4/3.5		95%		95%	
	Trout spawning	120			11	6.3-8.4	80	NA		1.0/1.5		95%		99%	

Interpretation of Table H1.5

For the purposes of this table, regionally and locally important trout fishery rivers and trout spawning waters are set out in Schedule N.

Interpretation of rivers trout fisheries Table H1.5					
Attribute		**Unit**	**Direction**	**Narrative**	**Notes**
MCI	Macroinvertebrate community index		≥	The average MCI score shall be or exceed ….	Minimum score, applicable at all flows
AFDW	Ash free dry weight	mg/m^2	≤	Periphyton AFDW does not exceed …mg/m^2.	Annual maximum. Applies at all flows
	Filamentous algae	% cover		Filamentous algae cover does not exceed …% during the open fishing season.	See http://wellington.fishandgame.org.nz/local-fishing-regulations for details on the open fishing season.
Temp	Temperature	°C	≤	Water temperature does not exceed…ºC.	95th percentile of continuous temperature measurements, or if not available the maximum of monthly spot temperature measurement. Outcomes for regionally and locally significant sites apply year round. The outcome for trout spawning sites applies between 1 May and 31 October. Applies at all flows.
	pH		Range	The pH of the water is between … and ….	5th and 95th percentile of continuous measurements, or if not available the minimum and maximum of monthly spot measurements. Outcomes for regionally and locally significant sites apply year round. The outcome for trout spawning sites applies between 1 May and 31 October. Applies at all flows.
DO	Dissolved oxygen	% saturated	≥	The concentration of dissolved oxygen exceeds …% of saturation.	5th percentile of continuous measurements, or if not available the minimum of monthly spot measurements. Outcomes for regionally and locally significant sites apply year round. The outcome for trout spawning sites applies between 1 May and 31 October. Applies at all flows.
	Water clarity	m	≥	The 20th percentile of visual clarity measured as the horizontal sighting range of a black disc is no less than …m, at flows at or below median flow.	
NO_3-N	Nitrate-N	mg/L	Chronic: ≤ median/ ≤ 95th percentile Acute: <	Chronic: annual median nitrate-N concentrations do not exceed … mg/L, and annual 95th percentile values do not exceed … mg/L. Acute: In-stream nitrate-N concentrations do not exceed 20mg/L.	This outcome relates to nitrate toxicity only. Nutrient outcomes for management of in-stream plant growth will be developed as part of the whaitua process. The chronic outcomes are firstly a 'grading' outcome based on an annual median and secondly a 'surveillance' outcome based on an annual 95th percentile as stipulated in Hickey (2013). These outcomes correspond to a level of protection of 95% of species for locally significant sites and 99% of species for regionally significant and trout spawning sites. Both chronic and acute outcomes apply at all flows.

NH_3-N (chronic)	Ammonia	%	≤	Annual median ammonia concentrations must not exceed the trigger value for freshwaters defined in the ANZECC (2000) guidelines table 3.4.1 for the level of protection of …% of species. The trigger value must be adjusted for temperature and pH as directed in section 8.3.7.2 of the guidelines.	Annual median of monthly sample results. Applies at all flows.
	NH_3-N (acute)	mg/L	≤	The concentration of ammonia does not exceed ….mg/L as defined in the US EPA 2009 table referring to acute criterion for freshwaters with mussels not present.…	Maximum concentration. Applies at all flows.
	Other toxicants	%	≤	Toxicants other than nitrate and ammonia do not exceed the trigger values identified in the ANZECC (2000) guidelines for the level of protection of …% of species	Applies to the dissolved fraction of heavy metals and other contaminants. Based on annual median. Applies at all flows. http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol1.pdf
	Sediment cover	%	≤	Sediment cover of river beds is less than …%.	Based on a bank side or in stream visual estimate of sediment cover, an annual average of monthly assessments. Sediment is defined as inorganic particles that are less than 2mm in diameter. Exceptions may be made where it can be proven that sediment cover naturally exceeds this outcome.

Appendix 2: Recommended attributes and outcomes for rivers and streams in Schedule H of the dNRP

Table H1.1: Aquatic ecosystem health and mahinga kai – biology attributes

<table>
<tr><td>Value</td><td colspan="9">Aquatic ecosystem health and mahinga kai</td></tr>
<tr><td>Broad outcome</td><td colspan="9">River water quality, quantity and habitat safeguards healthy aquatic ecosystems and supports mahinga kai</td></tr>
<tr><td rowspan="9">Outcome</td><td rowspan="3">River class</td><td colspan="8">Biology</td></tr>
<tr><td colspan="4">Aquatic plants</td><td colspan="2" rowspan="2">Invertebrates</td><td rowspan="2">Fish</td><td rowspan="2">Birds</td><td rowspan="2">Mahinga kai</td></tr>
<tr><td>Macrophytes</td><td colspan="2">Periphyton</td><td>Phytoplankton</td></tr>
<tr><td>1</td><td rowspan="6">Native macrophyte communities are resilient and their structure, composition and diversity are balanced</td><td rowspan="6">Periphyton communities are balanced with a low frequency of nuisance blooms</td><td>50 SM: 50</td><td rowspan="6">Phytoplankton communities are balanced and there is a low frequency of blooms</td><td rowspan="6">Invertebrate communities are resilient and their structure, composition and diversity are balanced</td><td>125 SM: 140</td><td rowspan="6">Native fish communities are resilient and their structure, composition and diversity are balanced</td><td rowspan="6">River dependant bird communities are resilient and their structure, composition and diversity are balanced</td><td rowspan="6">Taonga species are present in quantities, size and of a quality that is appropriate for the area and are safe to eat</td></tr>
<tr><td>2</td><td>120 SM: 50</td><td>105 SM: 130</td></tr>
<tr><td>3</td><td>120* SM: 50*</td><td>105 SM: 130</td></tr>
<tr><td>4</td><td>120 SM: 50</td><td>110 SM: 130</td></tr>
<tr><td>5</td><td>120* SM: 50*</td><td>100 SM: 120</td></tr>
<tr><td>6</td><td>120* SM: 50*</td><td>100 SM: 120</td></tr>
<tr><td>Limit</td><td colspan="9">Relevant resource use limits to be defined</td></tr>
</table>

Table H1.1: Aquatic ecosystem health and mahinga kai – water quality attributes

Value	Aquatic ecosystem health and mahinga kai																
Broad outcome	**River water quality, quantity and habitat safeguards healthy aquatic ecosystems and supports mahinga kai**																
Outcome	**River class**	**Water quality**															
		Dissolved oxygen		**Temperature**		**pH**		**Clarity**		**Nutrients**	**Nitrate toxicity**			**Ammonia toxicity**			**Other toxicants**	
												Chonic	**Acute**		**Chronic**	**Acute**		
	1	Dissolved oxygen varies within a range that sustains aquatic plant, invertebrate and fish communities	80 **SM**: 80	Temperature varies within a range that sustains aquatic plant, invertebrate and fish communities	19 **SM**: 19	pH varies within a range that sustains aquatic plant, invertebrate and fish communities	5.8-8.5 **SM**: 6.1-8.2	Water clarity sustains aquatic plant, invertebrate and fish communities	1.8 **SM**: 2.2	Nutrient concentrations do not cause an imbalance in aquatic plant, invertebrate or fish communities	Nitrate concentrations do not cause unacceptable effects on aquatic plants, invertebrates or fish	95 **SM**:99	20	Ammonia concentrations do not cause unacceptable effects on aquatic plants, invertebrates or fish	99	USEPA 2009	Concentrations do not cause unacceptable effects on aquatic plants, invertebrates or fish	95 **SM:**99
	2		70 **SM**: 70		20 **SM**: 20		6.4-8.9 **SM**: 6.7-8.6		1.3 **SM**:1.9									
	3		60 **SM**: 70		21 **SM**: 21		6.8-8.7 **SM**: 7.1-8.4		0.5 **SM**: 0.8									
	4		70 **SM**: 80		21 **SM**: 20		5.8-8.5 **SM**: 6.1-8.2		1.6 **SM**: 2.2									
	5		60 **SM**: 70		23 **SM**: 21		5.8-8.7 **SM**: 6.1-8.4		0.5 **SM**: 0.8									
	6		60 **SM**: 70		21 **SM**: 21		5.8-7.8* **SM**: 6.1-7.5*		1.3 **SM**: 1.6									
Limit		Relevant resource use limits to be defined																

Table H1.1: Aquatic ecosystem health and mahinga kai – physical habitat attributes

Value		Aquatic ecosystem health and mahinga kai										
Broad outcome		River water quality, quantity and habitat safeguards healthy aquatic ecosystems and supports mahinga kai										
	River class	Substrate quality						Flow		Channel geomorphology	Riparian margin vegetation	Connectivity
		Substrate composition	Sediment cover	Sediment anoxia	Nutrients	Toxicants	Organic carbon					
Outcome	1	Substrate composition is within a range that sustains plant, invertebrate, fish and river dependant bird communities	Cover of fine sediment does not cause an imbalance in aquatic plant, invertebrate or fish communities	There is low incidence of sediment anoxia with no gross anoxic areas and/or nuisance conditions	Nutrient concentrations do not cause an imbalance in aquatic plant, invertebrate or fish communities	Concentrations do not cause unacceptable effects on aquatic plants, invertebrates and fish	Organic carbon concentrations do not cause an imbalance in aquatic plant, invertebrate or fish communities	Flow varies within a range that sustains plant, invertebrate, fish and river dependant bird communities	nt plants ows are met in accordance with policy LW.P57	Channel geomorphology is within a range that sustains plant, invertebrate, fish and river dependant bird communities	Riparian vegetation cover and composition sustain plant, invertebrate, fish and river dependant bird communities	The connectivity between rivers and streams, their riparian margins and other water bodies sustains plant, invertebrate, fish and river dependant bird communities
	2											
	3											
	4											
	5											
	6											
Limit	Relevant resource use limits to be defined								See interim limits set in Schedule I		Relevant resource use limits to be defined	

Table H1.1: Aquatic ecosystem health and mahinga kai, rivers and streams – interpretation notes

River class	Description
1	Steep gradient, hard sedimentary
2	Moderate gradient and coastal, hard sedimentary
3	Moderate gradient, soft sedimentary
4	Low gradient, large, draining ranges
5	Low gradient, large, draining plains and eastern Wairarapa
6	Low gradient, small

SM	Stretches of rivers with significant macroinvertebrate values, as identified in the first column of the table in Schedule C1

Table H1.1: Aquatic ecosystem health and mahinga kai, rivers and streams – interpretation notes for numeric outcomes

Attribute		Unit	Direction	Narrative	Notes
Periphyton		mg/m^2 Chlorophyll *a*	≤	Periphyton biomass does not exceed … mg/m^2 Chlorophyll *a* more than the allowable exceedance frequency	* For rivers and streams in classes 3, 5 and 6 the allowable exceedance frequency is two per year. For all other classes the allowable exceedance frequency is one per year. Compliance is to be based on monthly assessments.
Invertebrates		Macroinvertebrate Community Index (MCI) units	≥	MCI score exceeds … units	Based on a minimum of annual summer-time assessments
Dissolved oxygen		% saturation	≥	The concentration of dissolved oxygen exceeds …% of saturation.	5th percentile of continuous daily measurements. Applies at all flows.
Temperature		°C	≤	The temperature of the water does not exceed …°C.	95th percentile of continuous temperature measurements. Applies to all flows.
pH		pH units	Range	The pH of the water is between … and ….	5th and 95th percentile of continuous measurements. Applies at all flows. * indicates that these outcomes do not apply to streams with high peat cover in the upstream catchment.
Water clarity		m	≥	The 20th percentile of visual clarity measured as the horizontal sighting range of a black disc is no less than …m, at flows at or below median flow.	20th percentile of monthly black disc measurements collected at flows at or below median flow.
Nitrate toxicity	Chronic	%	≤	Annual median and 95th percentile nitrate-N concentration does not exceed the trigger values identified in Hickey (2013) for the level of protection of …% of species.	These outcomes relate to nitrate toxicity only. Nutrient outcomes for management of in-stream plant growth will be developed as part of the whaitua process. The chronic outcomes are firstly a 'grading' outcome based on an annual median and secondly a 'surveillance' outcome based on an annual 95th percentile as stipulated in Hickey (2013). These outcomes correspond to a level of protection of 95 % of species and 99% of species for SM rivers. Both chronic and acute outcomes apply at all flows.
	Acute	mg/L	≤	Nitrate-N concentration does not exceed 20mg/L.	
Ammonia toxicity	Chronic	%	≤	Ammonia concentrations must not exceed the trigger value for freshwaters defined in the ANZECC (2000) guidelines table 3.4.1 for the level of protection of …% of species. The trigger value must be adjusted for temperature and pH as directed in section 8.3.7.2 of the guidelines.	Applies at all flows. Based on median compliance.
	Acute	mg/L	≤	The concentration of ammonia does not exceed ….mg/L as defined in the USEPA 2009 table referring to acute criterion for freshwaters with mussels present.	Maximum concentration. Applies at all flows.
Other toxicants		%	≤	Toxicants other than nitrate and ammonia do not exceed the trigger values identified in the ANZECC (2000) guidelines for the level of protection of …% of species.	Applies to the dissolved fraction of heavy metals and other contaminants. Applies at all flows. http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol1.pdf

Table H1.2: Contact recreation and tangata whenua use – human health attributes

Water type	Rivers										
Value	Contact recreation and tangata whenua use										
Broad outcome	The quantity and quality of water in rivers are suitable for contact recreation, and support tangata whenua use and their relationship with water										
Outcome	Human health										
	Primary contact									**Secondary contact**	
	Pathogens		**Benthic cyanobacteria**		**pH**		**Toxicants/ irritants**		**Tangata whenua use**		***E. coli***
		E. coli		**% cover**							
	Concentrations of pathogens are safe for primary contact recreation	Dry weather'* **TBC** Moderate flow**/outside bathing season*** **TBC**	Toxins from benthic cyanobacteria do not pose a threat to river users	20	pH levels do not pose a threat to river users	6.5-8.5	Concentrations of toxicants or irritants do not pose a threat to river users	Refer to Tables 5.2.3 and 5.2.4 ANZECC 2000	Rivers are safe for primary contact and support tangata whenua use [1]	Concentrations of pathogens are safe for secondary contact recreation	**TBC**
Limit											

* based on sample results at median flow or less and collected during the bathing season (November-March inclusive) only

** between median and 3x median flow

***Non-bathing season is April to October inclusive, applies only at flows <3x median

[1] "Tangata whenua use" refers to supporting the social, cultural, economic and environmental wellbeing of tangata whenua as defined by the iwi or hapū

TBC To be confirmed (policy decision to be made by Te Upoko Taiao)

Table H1.2: Contact recreation and tangata whenua use – aesthetic attributes

Water type	Rivers								
Value	Contact recreation and tangata whenua use								
Broad outcome	The quantity and quality of water in rivers are suitable for contact recreation, and support tangata whenua use and their relationship with water								
Outcome	**Aesthetic**								
	Aquatic plant growth					**Water clarity**		**Sediment cover**		**Sewage fungus**
		Macrophyte cover		**Mat algae cover**	**Filamentous algae cover**					
		Total	**Emergent**							
	Growth of aquatic plants does not cause a nuisance or pose a threat to safety of river users	60	30	60	30	Water is of a clarity that provides for safe recreational use	1.6	Fine sediment cover of the river bed does not cause a nuisance or pose a threat to safety of river users	25	No bacterial or fungal slime growths visible to the naked eye as plumose growths or mats
Limit	Relevant resource use limits to be defined									

Table H1.2: Contact recreation and tangata whenua use, rivers and streams – interpretation notes for numeric outcomes

Attribute		Unit	Direction	Narrative	Notes
	Escherichia coli (E. coli)	cfu/100mL	≤	The 'dry weather'* concentration of *E. coli* must not exceed …. cfu/100mL	* 'Dry weather' *E. coli* concentration is based on sample results collected at median flow or less and applies during the bathing season (November-March inclusive) only.
				The concentration of *E. coli* must not exceed …. cfu/100mL at moderate flows** during the bathing season. The concentration of *E. coli* must not exceed …. cfu/100mL outside of the bathing season***.	Applies as a 95th percentile. Bathing season is November to March inclusive. Non-bathing season is April to October inclusive. ** between median and 3x median flow *** applies only at flows <3x median
	Benthic cyanobacteria	% cover	≤	Benthic cyanobacteria cover does not exceed …. %	Applies at all flows
	pH	pH units	Range	The pH of the water is between … and ….	5th and 95th percentile of continuous measurements or the minimum and maximum of spot measurements. Applies at all flows.
	Toxicants/irritants		≤	Concentrations of toxicants/irritants do not exceed those specified in tables 5.2.3 and 5.2.4 of ANZECC 2000.	ANZECC 2000 table available at http://www.daff.gov.au/__data/assets/pdf_file/0003/316128/wqg-ch5.pdf. Note that New Zealand's Ministry for the Environment/Ministry of Health guidance for contact recreation water quality standards does not cover toxicants/irritants
Secondary contact	*E. coli*	cfu/100mL	≤	The concentration of *E. coli* must not exceed ….. cfu/100mL.	Applies as a median. Applies at all flows and all times of year
Aesthetic	Filamentous algae	% cover	≤	Filamentous algae cover does not exceed …%	Applies at all flows
	Mat algae	% cover	≤	Mat algae cover does not exceed …%	Applies at all flows
	Macrophyte	% cover	≤	Macrophyte cover does not exceed …%	Applies at all flows
	Water clarity	m	≥	The 20th percentile of visual clarity measured as the horizontal sighting range of a black disc is no less than …m, at flows at or below median flow.	20th percentile of black disc measurements collected at flows at or below median flow.
	Sediment cover	%	≤	Sediment cover of stream and river beds is less than …%.	Applies at all flows.

Table H1.4: Stock watering

Water type	Rivers						
Value	Stock watering						
Broad outcome	River water is available in quantities and is of a quality that is suitable for stock watering						
Outcome	**Pathogens**		**Benthic cyanobacteria**		**pH**		**Toxicants/irritants**
		E. coli		**Cover**			
	Concentrations of pathogens are safe for stock watering	550	Toxins from benthic cyanobacteria do not harm stock	20	pH levels do not harm stock	6.0-9.0	Concentrations of toxicants or irritants do not harm stock	Refer to Table 5.2.3 in ANZECC 2000
Limit	Relevant resource use limits to be defined						

Interpretation of rivers stock watering Table H1.4				
Attribute	**Unit**	**Direction**	**Narrative**	**Notes**
E. coli *Escherichia coli*	cfu/100mL	≤	The concentration of *E. coli* does not exceed …cfu/100mL.	Applies at flows less than 3x the median flow Applies year round 95th percentile of at least 100 data points
Benthic cyanobacteria cover	%	≤	Benthic cyanobacteria cover does not exceed …%	
pH	pH units	Range	The pH of the water is between … and ….	
Toxicants/irritants		≤	Concentrations of toxicants/irritants do not exceed those specified in tables 5.2.3 and 5.2.4 of ANZECC 2000.	See http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol1.pdf

Table H1.5: Trout spawning and fishery, rivers and streams – biological attributes

<table>
<tr><td>Water type</td><td colspan="5">Rivers</td></tr>
<tr><td>Value</td><td colspan="5">Trout spawning and trout fishery</td></tr>
<tr><td>Broad outcome</td><td colspan="5">Where appropriate, rivers support trout fisheries and trout spawning</td></tr>
<tr><td rowspan="5">Outcome</td><td rowspan="2">Class</td><td colspan="4">Biology</td></tr>
<tr><td colspan="2">Periphyton</td><td colspan="2">Invertebrates</td></tr>
<tr><td rowspan="3">Regionally important</td><td rowspan="4">Periphyton growth does not cause an imbalance in the trout fishery or a nuisance for anglers</td><td>AFDW</td><td>Filamentous algae cover</td><td rowspan="4">Invertebrate community structure, composition and diversity sustains a healthy trout fishery</td><td>MCI</td></tr>
<tr><td rowspan="3">35</td><td rowspan="3">30</td><td rowspan="2">120*</td></tr>
<tr><td>Locally important</td><td>100*</td></tr>
<tr><td>Trout spawning</td><td>120*</td></tr>
<tr><td>Limit</td><td colspan="5">Relevant resource use limits to be defined</td></tr>
</table>

Table H1.5: Trout spawning and fishery, rivers and streams – water quality attributes

Water type	Rivers																		
Value	Trout spawning and trout fishery																		
Broad outcome	Where appropriate, rivers support trout fisheries and trout spawning																		
Outcome	**Class**	**Water quality**																	
		Dissolved oxygen		**Temperature**		**pH**		**Water clarity**		**Nutrients**	**Nitrate toxicity**			**Ammonia toxicity**			**Other toxicants**		
												Chronic	**Acute**		**Chronic**	**Acute**		
	Regionally important	Dissolved oxygen varies within a range that sustains trout fisheries and spawning	80	Temperature varies within a range that sustains trout fisheries and spawning	19	pH varies within a range that sustains trout fisheries and spawning	6.3-8.4	Water clarity sustains trout fisheries	Waikanae: 2.0	Nutrient concentrations do not cause an imbalance in the trout fishery	Nitrate concentrations do not cause unacceptable effects on trout fisheries or spawning	99	20	Ammonia concentrations do not cause unacceptable effects on trout fisheries or spawning	99	USEPA 2009	Concentrations do not cause unacceptable effects on trout fisheries or spawning	99
									Wainuiomata: 2.0										
									Ruamāhanga: 3.0										
									Waiohine: 2.5										
									Hutt: 2.1										
	Locally important		70		24		6.0-9.0		2			95			95			95	
	Trout spawning		80		11		6.3-8.4		NA			99			99			99	
Limit	Relevant resource use limits to be defined																		

Table H1.5: Trout spawning and fishery, rivers and streams – physical habitat attributes

Water type	Rivers						
Value	Trout spawning and trout fishery						
Broad outcome	Where appropriate, rivers support trout fisheries and trout spawning						
Outcome	**Class**	**Substrate**		**Flow**	**Geomorphology**	**Connectivity**	**Riparian margin vegetation**
		Substrate composition	**Sediment cover**				
	Regionally important	Substrate composition is within a range that sustains trout fisheries and spawning	Cover of fine sediment does not cause an imbalance in the trout fishery	Flow varies within a range that sustains trout fisheries and spawning	Channel geomorphology is within a range that sustains trout fisheries and spawning	The connectivity between rivers and streams, their riparian margins and other water bodies sustains trout fisheries and spawning where appropriate	Riparian vegetation cover and composition is within a range that sustains trout fisheries and spawning
	Locally important						
	Trout spawning						
Limit	Relevant resource use limits to be defined						

Table H1.5: Trout spawning and fishery,, rivers and streams – interpretation notes for numeric outcomes

Attribute		Unit	Direction	Narrative	Notes
MCI	Macroinvertebrate community index		≥	The average MCI score shall be or exceed ….	Minimum score, applicable at all flows. *Rivers and streams where there is evidence that this score would not be achieved under near natural conditions are excluded.
AFDW	Ash free dry weight	mg/m^2	≤	Periphyton AFDW does not exceed …mg/m^2.	Annual maximum. Applies at all flows
Filamentous algae		% cover		Filamentous algae cover does not exceed …% during the open fishing season.	See http://wellington.fishandgame.org.nz/local-fishing-regulations for details on the open fishing season.
Dissolved oxygen		% saturated	≥	The concentration of dissolved oxygen exceeds …% of saturation.	5th percentile of continuous measurements. Outcomes for regionally and locally significant sites apply year round. The outcome for trout spawning sites applies between 1 May and 31 October. Applies at all flows.
Temperature		°C	≤	Water temperature does not exceed…°C.	95th percentile of continuous measurements. Outcomes for regionally and locally significant sites apply year round. The outcome for trout spawning sites applies between 1 May and 31 October. Applies at all flows.
pH			Range	The pH of the water is between … and ….	5th and 95th percentile of continuous measurements. Outcomes for regionally and locally significant sites apply year round. The outcome for trout spawning sites applies between 1 May and 31 October. Applies at all flows.
Water clarity		m	≥	The 20th percentile of visual clarity measured as the horizontal sighting range of a black disc is no less than …m, at flows at or below median flow.	
Nitrate toxicity	Chronic	%	≤	Annual median and 95th percentile nitrate-N concentration does not exceed the trigger values identified in Hickey (2013) for the level of protection of …% of species.	These outcomes relate to nitrate toxicity only. Nutrient outcomes for management of in-stream plant growth will be developed as part of the whaitua process.The chronic outcomes are firstly a 'grading' outcome based on an annual median and secondly a 'surveillance' outcome based on an annual 95th percentile as stipulated in Hickey (2013). Both chronic and acute outcomes apply at all flows.
	Acute	mg/L	≤	nitrate-N concentrations do not exceed 20mg/L.	
Ammonia toxicity	Chronic	%	≤	Annual median ammonia concentrations must not exceed the trigger value for freshwaters defined in the ANZECC (2000) guidelines table 3.4.1 for the level of protection of …% of species. The trigger value must be adjusted for temperature and pH as directed in section 8.3.7.2 of the guidelines.	Applies at all flows. Based on median compliance.
	Acute	mg/L	≤	The concentration of ammonia does not exceed ….mg/L as defined in the US EPA 2009 table referring to acute criterion for freshwaters with mussels not present.…	Maximum concentration. Applies at all flows.
Other toxicants		%	≤	Toxicants other than nitrate and ammonia do not exceed the trigger values identified in the ANZECC (2000) guidelines for the level of protection of …% of species	Applies to the dissolved fraction of heavy metals and other contaminants. Based on annual median. Applies at all flows. http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol1.pdf

Appendix 3: Summary of stakeholder feedback and GWRC (Environmental Science) response

Stakeholder	Relevant value	Feedback	GWRC response	Changes recommended
Carterton workshop attendee	Aquatic ecosystem health and mahinga kai	*Do the temperature outcomes take account of groundwater flow effects?*	Only indirectly through river classes. River class 6 includes many small streams in the central Wairarapa Valley and the Kapiti Coast which have significant interaction with groundwater. Temperature outcomes for this class will be partly influenced by the lower natural temperatures brought about by groundwater inputs to these streams.	None
Carterton workshop attendee	Aquatic ecosystem health and mahinga kai	*If clarity improves, you may see resulting higher periphyton biomass – have these types of interactions been considered in the development of the Schedule H outcomes?*	No. These sorts of interactions will be taken into account during scenario testing for different management options during the whaitua stage.	None
Carterton workshop attendee	Aquatic ecosystem health and mahinga kai	*Has Brenda Bailey's research on MCI and forestry been used in analysis?*	No, not at this stage. The focus of technical work for biological outcomes such as macroinvertebrates has been the understanding of natural variation in biological indicators across the region's rivers and streams. Effects of different types of land use will be taken into account during the whaitua stage.	None
Porirua workshop attendee	Aquatic ecosystem health and mahinga kai	*The [periphyton] monitoring data is not credible if only measured once per year. Do MFE guidelines say how you should measure?*	Agree. As stated in the interpretation notes for Table H1.1 in the WDFD (GWRC 2013) periphyton biomass outcomes are to be assessed based on monthly measurements. This is consistent with guidance in the National Objectives Framework (MfE 2014).	None
Porirua workshop attendee	Aquatic ecosystem health and mahinga kai	*Sch H1.1 has a narrative outcome for plant growth, how does this relate to periphyton biomass?*	Assume this is referring to the narrative outcomes for nutrients and their effect on plant growth? If so it is intended that the narrative outcomes for nutrients will give effect to the periphyton biomass numeric outcomes.	None
Various	Aquatic ecosystem health and mahinga kai	*Request from a range of stakeholders to include nutrient numbers to control in-stream plant growth as well as for toxicity.*	As stated in Greenfield et al. (2013) there are currently insufficient data to identify robust numeric outcomes for nutrient concentrations to control in-stream plant growth at a regional scale. Identification of numeric outcomes requires detailed modelling of the relationship between in-stream plant growth, nutrients and other environmental factors such as flow variation. This is more appropriate to be undertaken at a catchment scale and will be addressed through the whaitua process.	None

Stakeholder	Relevant value	Feedback	GWRC response	Changes recommended
Department of Conservation	Aquatic ecosystem health and mahinga kai	*The final 'minimum' outcomes selected for Class 3 and 5 'Healthy' rivers appear to be too low to have confidence that aquatic ecosystem health will be protected. The database from which these outcomes were derived is not large, and because they are mainly based on spot measurements cannot reflect the true minimum. Further the compliance notes state that the minimum DO in each class should be based on the continuous daily or the minimum of monthly spot measures. These two measures are likely to be significantly different unless spot measurements are made outside of normal working hours.* *Whilst the 60% saturation minimum for Healthy Class 3 and 5 rivers may reflect the Regional SOE data the outcomes are not aspirational. If for example strategies were put in place that limited nutrient exports to these rivers, one might expect lower periphyton biomass, which in turn would result in less oxygen excursions (lower maxima, higher minima). We suggest that 70% saturation for both 'Healthy' and 'Significant' river reaches would better protect aquatic ecosystems and provide impetus to improve those rivers in which lower minimums are currently recorded. In other words we think the 60% saturation levels are too permissive and reflective of the status quo.*	The lack of continuous dissolved oxygen data on which to base outcomes does make it difficult to identify robust outcomes for this attribute. The lack of reference sites for all river classes apart from classes 1 and 2 adds an additional challenge. However, we feel that the outcomes are appropriate based on the data available. We agree that measuring compliance using a 5th percentile of continuous data *vs* a minimum from spot monthly measurements will yield very different results in many cases. While it was always the intention that compliance would be assessed using continuous data we accept that the mention of spot measurements adds ambiguity. The reference to spot measurements is to be removed from the interpretation notes for Table H1.1. Given that RSoE data used to identify the outcomes are spot measurements while compliance with the outcomes is to be measured as a 5th percentile of continuous data it is likely that the outcomes are more aspirational than they appear to be (ie, results from continuous monitoring will often be lower than those from spot measurements). Changes may be made to these outcomes in future in response to NOF recommendations and continuous monitoring data becoming available.	The reference to spot measurements has been removed from the interpretation table for Table H1.1.

Stakeholder	Relevant value	Feedback	GWRC response	Changes recommended
Department of Conservation	Aquatic ecosystem health and mahinga kai	*The temperature outcomes are well founded in terms of the background science. However we still have some reservations with respect to the application of these outcomes long term. The outcome temperatures recommended for most river classes would prevent the potential re-establishment of more temperature - sensitive species, even if otherwise suitable habitat could be re-instated through restoration. This would limit the potential for biodiversity enhancement, for example in lowland streams.*	The current temperature outcomes are considered to be appropriate for achieving 'good' ecosystem health for the various river classes. The differing temperature outcomes primarily reflect the likely natural differences in macroinvertebrate communities in these classes due to factors such as gradient and temperature. This is reflected in the varying MCI outcomes recommended for each class for the draft Natural Resources Plan. As stated in Ausseil (2013) the outcome of 21^{o}C for classes 3,4 and 6 is below the threshold for which ephemeroptera losses are likely, although stoneflies may be affected on some occasions. The outcome of 23^{o}C for class 5 reflects the location of rivers and streams in this class near the bottom of larger, relatively dry catchments (eg eastern Wairarapa). It is likely that naturally fewer sensitive macroinvertebrate taxa would be present in rivers and streams in this class. Changes may be made to these outcomes in future in response to NOF recommendations and continuous monitoring data becoming available.	None
Department of Conservation	Aquatic ecosystem health and mahinga kai	*There is no discussion within Greenfield et al (2013) on how the final outcomes were derived; they appear to be consistent with Aussiel (2013). However it is unclear why the recommended outcome for reference sites on major rivers (Table 12) was so much less than the 20%ile of the data collected at < median flows. The outcomes reflect the status quo and will protect existing aquatic ecosystems but as with DO they are not aspirational.*	Water clarity outcomes in the WDFD are those recommended in Table 11 of Ausseil (2013). These outcomes were based on either a 20% or 33% (depending on the natural characteristics of the catchment) reduction from reference condition for each river class. As stated in Ausseil (2013) these thresholds were identified in the RMA for the protection of aesthetic values but should also provide adequate protection of the habitat of sighted animals. Due to the large amount of natural variation in river catchments it is difficult to identify water clarity outcomes that are robust at a regional scale. More catchment-specific outcomes for water clarity may be identified during the whaitua process (eg, using the river-specific thresholds identified in Table 12 of Ausseil (2013)).	None

Stakeholder	Relevant value	Feedback	GWRC response	Changes recommended
Department of Conservation	Aquatic ecosystem health and mahinga kai	*The temperature and pH of the water needs to be defined for ammonia outcomes*	This is not necessary as it is stated in the interpretation notes of Table H1.1 that the trigger value must be adjusted for temperature and pH as directed in Section 8.3.7.2 of the ANZECC (2000) guidelines.	None
Department of Conservation	Aquatic ecosystem health and mahinga kai	*A clear and robust monitoring program needs to sit alongside the outcomes, which allows for feedback into the plan and realignment of outcomes to meet the objectives and policies.*	Agree. GWRC is currently reviewing its monitoring programmes. Part of this review will include identifying a plan effectiveness monitoring programme.	None
Friends of Taputeranga Marine Reserve	Contact recreation and tangata whenua use	*Do not have low flow and moderate flow but fixed volumes. A small river at high flow might be used for recreation yet a large river at low flow might not be used for recreation. The aim was contact but I think it's flawed.*	Disagree that there will be a significant difference in use of rivers and streams in the region under the same relative flow conditions. The less than median flow criteria should represent the most likely time for contact recreation for all rivers and streams. It is not considered that there will be any significant advantage to using absolute flows to define the outcomes for each river and stream. In addition, due to the large number of rivers and streams in the region and the change in flow along their lengths it would be impossible to identify absolute flow thresholds at a regional scale.	None
Friends of Taputeranga Marine Reserve	Contact recreation and tangata whenua use	*Should have pathogen markers for where there is likely wastewater treatment contamination, since they treat for e-coli but might not treat other pathogens which pose a human health risk*	Agree that this is an issue with sole use of faecal indicator bacteria where wastewater treatment plants are present. Outcomes for both primary and secondary contact recreation should not be applied to rivers and streams that are impacted by a nearby point source discharge of treated wastewater without the relationship between indicator bacteria and pathogens in the discharge first being established.	That it be made clear in the dNRP that FIB/pathogen relationships need to be established in order to apply outcomes to rivers and streams near to wastewater discharges.