



MEMO

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

1. Introduction

Schedule H of the Regional Plan: Working Document for Discussion (WDFD, GWRC 2013) included narrative and numeric outcomes for a range of values associated with groundwater. This memorandum sets out recommended changes to groundwater outcomes in Tables H4.1 and H4.4 of the WDFD for inclusion in the draft Natural Resources Plan (dNRP). These recommendations take into account stakeholder feedback on the WDFD and further external specialist advice.

1.1 Stakeholder feedback

Feedback from stakeholders was received during stakeholder and expert workshops held late in 2013 and early 2014 respectively. Specific written comments relating to technical aspects of the Schedule H outcomes for groundwater were received from Federated Farmers on a range of matters. These comments are addressed in Sections 2 and 3.

1.2 Expert workshop

In late March 2014 an expert workshop was held at GWRC to discuss groundwater quality ecosystem health outcomes in relation to both groundwater ecosystems and groundwater-dependent ecosystem (eg, wetlands, rivers and streams). Dr Chris Daughney (GNS Science), Dr Graham Fenwick (NIWA) and Dr Scott Larned (NIWA) were the external specialists that attended the workshop. The workshop discussion is summarised in Tidswell and Crisp (2014) and the key findings have been used in Section 2 to address stakeholder feedback.

2. Aquatic ecosystem health and mahinga kai

Responses to stakeholder feedback are outlined in Table 1 and have not resulted in any recommended changes to Table H4.1 other than amending the interpretation table for nitrate toxicity (see Appendix 1). In addition, after further internal discussion with Environmental Science and Environmental Policy about the important contribution groundwater plays in delivering nutrients to surface water, with potential for eutrophication-related effects, it is recommended that consideration is given to including nutrients as an attribute in their own right, as is the case in existing Table H4.2 of the WDFD. The narrative for the “connection to

other water bodies” in part captures nutrients but is not specific. Suggested amended wording is included in Appendix 1.

Table 1: Summary of stakeholder feedback on Table H4.1 of the WDFD and GWRC’s responses

Stakeholder feedback	GWRC response
Consistency between Table H1.1 and Table H4.1 for the nitrate-nitrogen toxicity numerical outcome.	Table H1.1 (see Greenfield 2014) has been adjusted to be consistent with the protection level based outcome in Table H4.1. An error in the interpretation table for Table H4.1 with regard to nitrate-nitrogen has also been corrected.
Is the aim of Table H4.1 to protect certain key surface water species? Should you be protecting a range of surface water species? Or is the aim to protect groundwater ecology in its own right?	The aim of Table H4.1 is to protect both groundwater and surface water quality and ecological values. Targeted surface water species for protection are defined in Table H1.1. However, there is a need to recognise the importance groundwater ecosystems in their own right. Currently, understanding of the function and importance of groundwater stygofauna and groundwater microbes is limited, as is stygofauna and microbial limits in regards to contaminants (ie, lethal doses and sub lethal effects).
Clarification about the suitability of using surface water outcomes and guidelines (eg, Hickey 2013) for groundwater.	Hickey (2013) and surface water thresholds in Table H1.1 are considered to have the most relevance in protecting groundwater ecological values.
Hickey (2013) did not study the response of groundwater stygofauna (groundwater invertebrates) to nitrate-nitrogen and there is limited information about the response of stygofauna to other contaminants in general (stygofauna not mentioned in Australian New Zealand Environment and Conservation Council (ANZECC) 2000 guidelines). Therefore, can surface water ecological limits be used to protect groundwater ecology?	Using the Drinking-water Standards for New Zealand (2008) Maximum Acceptable Values as groundwater ecological outcomes is an unsuitable alternative as these guidelines are related to human health. Using a measurement against the current state of groundwater quality has no relevance for the protection of groundwater ecology.
Can groundwater quality and ecological outcomes be based on alternative guidelines such as DWSNZ (2008) maximum acceptable values (MAVs) or against a measurement related to the current state of water quality?	
What are the effects of nitrate-nitrogen toxicity concentrations, based on surface water outcomes (Hickey 2013), on more sensitive groundwater organisms?	Unknown at this stage. There are limited studies on groundwater ecology.
In the absence of scientific understanding about groundwater attenuation in aquifers, recharge mechanisms, transmissivity and dilution of groundwater; is it appropriate to set a numerical outcome for nitrate-nitrogen for Category A & B groundwaters (directly and moderately hydraulically connected to surface water)?	Denitrification occurs mostly in anoxic conditions. Therefore, it could be assumed no attenuation occurs where oxygen is present in groundwater (ie, Categories A and B plus shallow groundwater zones). Application of numerical values with regards to understanding recharge mechanisms, transmissivity and dilution of groundwater and the application of outcomes and monitoring/management on a finite scale is considered difficult. However, it was agreed at the Expert Panel workshop that a precautionary approach for the management of groundwater quality and ecology is appropriate.
What is the age of water in the different groundwater categories?	The age of groundwater can vary between aquifers. There is relatively limited information on groundwater age in the Wellington region.

Stakeholder feedback	GWRC response
Where aquifers are classed as Category C (limited groundwater connectivity to surface water) numerical outcomes imposed would exist purely for the protection of groundwater ecology. It is now considered inappropriate to use surface water ecological guidelines where groundwater and surface water are not hydraulically connected. Therefore, groundwater quality and ecology in Category C areas under Table H4.1 (Aquatic ecosystem health and mahinga kai) are not currently protected by either numerical or narrative objectives. This leaves Category C groundwater vulnerable to contamination without limit.	<p>Groundwater stores the majority of freshwater on earth. The process of water migration through aquifers serves a function where biofilm and invertebrates improve water quality within a certain capacity limit.</p> <p>Groundwater is a large resource that needs protecting. Therefore, quality and ecology values need to be afforded a higher protection level using numerical values. This includes groundwater quality and ecology in Category C zones.</p>

3. Contact recreation and tangata whenua use

No changes are proposed to Table H4.2.

4. Health needs of people

Responses to stakeholder feedback are outlined in Table 2. No changes are proposed to Table H4.3 for the dNRP.

Table 2: Summary of stakeholder feedback on Table H4.3 of the WDFD (GWRC 2013) and GWRC's responses

Stakeholder feedback	GWRC response
Is human health more at risk depending on the source of <i>E. coli</i> exposure (ie, human verses animal)?	<p><i>E. coli</i> (<i>Escherichia coli</i>) and faecal coliforms are types of bacteria that exist in the intestines of both humans and animals. These types of bacteria are merely an <u>indicator</u> of contamination due to faecal matter, and therefore the presence of potentially harmful pathogens.</p> <p>While most strains of bacteria are harmless, some strains can cause illness in humans. The source of illness-causing bacteria can be from both sewage or animal effluent (CDC 2012).</p>

5. Stock watering

Numerical outcomes in Table H4.4 are consistent with those recommended in Table H1.4 for rivers and streams (Greenfield 2014). Optional narrative outcomes have also been included in Appendix 1 alongside the existing numerical outcomes.

References

ANZECC. 2000. *Australia and New Zealand guidelines for fresh and marine water quality, Volume 1, The guidelines*. Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand, Canberra.

Centres for Disease Control and Prevention (CDC). 2012.
<http://www.cdc.gov/ecoli/general/index.html>

Greenfield S. 2014. *Recommended changes to Schedule H attributes and outcomes for the draft Natural Resources Plan: Rivers and streams*. Unpublished internal memo (Document No. #1346977), Greater Wellington Regional Council, Wellington.

Greenfield S, Milne J, Vujcich H, Conwell C, Tidswell S, Crisp P and Perrie A. 2013. *Technical report for Schedule H of the Regional Plan working document for discussion*. Unpublished internal report prepared for the Environmental Policy Department (Document No. #1234058_V8), Greater Wellington Regional Council, Wellington.

GWRC. 2013. *Regional Plan: Working document for discussion*. Greater Wellington Regional Council, August 2013.

Hickey CW. 2013. *Updating nitrate toxicity effects on freshwater aquatic species*. Prepared by NIWA for the Ministry of Building, Innovation and Employment. Funded by Envirolink.

Ministry of Health. 2008. *Drinking-water Standard for New Zealand 2008*. Ministry of Health, Wellington.

Tidswell S, Conwell C and Milne JR. 2012. *Groundwater quality in the Wellington region: State and trends*. Greater Wellington Regional Council, Publication No. GW/EMI-T-12/140, Wellington.

Tidswell S and Crisp P (compilers). 2014. *Groundwater quality outcomes for the Wellington region: Summary from a technical expert panel workshop*. Unpublished memorandum (Document No. #1346927), Greater Wellington Regional Council, Wellington.

Appendix 1: Recommended changes to Tables H4.1 and H4.4 of Schedule H for the dNRP

Recommended changes/additional optional narratives are indicated in blue font

Table H4.1: Aquatic ecosystem health and mahinga kai – groundwater

Value	Aquatic ecosystem health and mahinga kai				
Broad outcome	The water quality and quantity of groundwater safeguards aquatic and groundwater-dependent ecosystem health and supports mahinga kai				
Outcome		Quality			Quantity and flow
		NO₃-N Nitrate toxicity chronic	Other toxicants	Connection to other water bodies Nutrients	
	Groundwater directly connected to surface water	95% Nitrate concentrations do not cause unacceptable effects on aquatic plant, invertebrate or fish communities.	The quality of water is maintained to safeguard healthy groundwater-dependent ecosystems ¹	Water quality does not cause any outcome specified for the directly connected surface water bodies to be exceeded Plant-available nitrogen and phosphorus do not cause nuisance algal or macrophyte growth in the directly connected surface water body	The quantity of water is maintained to safeguard healthy groundwater-dependent ecosystems
Groundwater not directly connected to surface water	95% Nitrate concentrations do not cause unacceptable effects on stygofauna communities or other groundwater ecology	NA			
Limit	Relevant resource use limits to be defined				Relevant resource use limits are defined in Schedule I

¹ See Table H1.1 Rivers and Streams – Aquatic ecosystem health and mahinga kai. 1354533-V3

Interpretation of groundwater aquatic ecosystem health and mahinga kai Table H4.1				
Attribute	Unit	Direction	Narrative	Notes
Nitrate toxicity	mg/L %	≤	The annual 95th percentile nitrate-N concentrations do not exceed ... mg/L. Annual median and 95th percentile nitrate-N concentrations do not exceed their respective trigger values identified in Hickey (2013) for the level of protection of ...% of species.	This outcome relates to nitrate toxicity only. See Hickey (2013). Link

Table H4.4: Stock watering – groundwater

Value	Stock watering					
Broad outcome	Groundwater is suitable and available for livestock drinking.					
	<i>E. coli</i> Pathogens		pH		Toxicants/irritants	
Outcome	Concentrations of pathogens are safe for stock watering	<i>E. coli</i> (cfu/100mL) ≤550	pH levels do not harm stock	6.0-9.0	The quality of groundwater meets relevant guidelines for livestock drinking	Table 5.2.3 in ANZECC 2000
Limit	Relevant resource use limits to be defined					

Interpretation of groundwater stock watering Table H4.4				
Attribute	Unit	Direction	Narrative	Notes
<i>E. coli</i> <i>Escherichia coli</i>	cfu/100mL	≤	The concentration of <i>E. coli</i> does not exceed ...cfu/100mL	
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.	http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol1.pdf