Statement of Evidence

under: the Resource Management Act 1991

in the matter of: **Horizons Proposed One Plan**

between: Horizons Regional Council

and: **Wellington Fish and Game and Forest and Bird**
[A person having given notice under section 274 of the Resource Management Act 1991]

Statement of evidence of Associate Professor Russell George Death on Behalf of the Wellington Fish and Game and Forest and Bird

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Dated: 19th October 2009

Date of hearing: **[dates]** **March 2010**

STATEMENT OF EVIDENCE OF RUSSELL GEORGE DEATH

INTRODUCTION

1. My full name is Russell George Death. I am an Associate Professor in Freshwater Ecology in the Institute of Natural Resources – Ecology at Massey University where I have been employed since 1993. Prior to that I received a Doctor of Philosophy in Zoology from the University of Canterbury (1991) and was a Foundation for Research, Science and Technology postdoctoral fellow at Massey University (1991-93).

2. I have had nineteen years experience in professional ecology research, teaching and management. My area of expertise is the ecology of stream invertebrates and fish. I have 62 peer-reviewed publications in international scientific journals and books. I have written 40 plus consultancy reports and given around 60 conference presentations. I have been the principal supervisor for 38 post-graduate research students.

3. I have been a Quinney Visiting Fellow at Utah State University. I am a member of the Ecological Society of America, British Ecological Society, New Zealand Ecological Society, the New Zealand Freshwater Sciences Society and the North American Benthological Society. I have refereed scientific manuscripts for seventeen scientific journals and two books. I am on the editorial board of the journal *Marine and Freshwater Research*. I have been commissioned by a number of governmental and commercial organisations to provide scientific advice on matters related to the management of freshwater resources.

4. I have been researching the invertebrates, periphyton and fish of the Horizons area streams and rivers for the past sixteen years and have conducted research and advised Horizons between 1999 and 2007.

5. I have particular expertise in the area of high and low flow effects on riverine invertebrate and periphyton communities. In 2007 I was one of thirteen scientists funded to attend a special symposium of the Royal Entomological Society in Edinburgh to review the current state of research on aquatic invertebrates. I was asked to review the effects of floods on aquatic invertebrates.

6. I have conducted a range of research projects between 1999 and 2007 for Horizons Regional Council related to the invertebrate, fish and periphyton communities of rivers and streams of the Manawatu Wanganui Regional Council area.

7. I am familiar with the Proposed One Plan and associated reports to which these proceedings relate.

8. I have read the Environment Court's Code of Conduct for Expert Witnesses, and I agree to comply with it. My qualifications as an expert are set out above. I confirm that the issues addressed in this brief of evidence are within my area of expertise.

9. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

10. My evidence will deal with the following:

    a) My research and knowledge of the current state of the ecological condition and water quality of waterbodies in the Manawatu Wanganui Regional Council area.
    b) The philosophical approach of the Proposed One Plan POP.
    c) Specific details on water quality.
    d) Specific details on water quantity.
    e) Specific details on river and lake beds.
    f) Summary and recommendations.

EVIDENCE

ECOLOGICAL AND WATER QUALITY OF WATERWAYS IN THE HORIZONS REGION

11. I (along with numerous graduate students) have been studying the ecological integrity (e.g., invertebrate, fish and periphyton communities) of rivers and streams in the Horizons region since 1993. My conclusion from this extensive research is that the ecological integrity of many rivers and streams of the region is extremely poor (Fig. 1) (Issue 6-1).

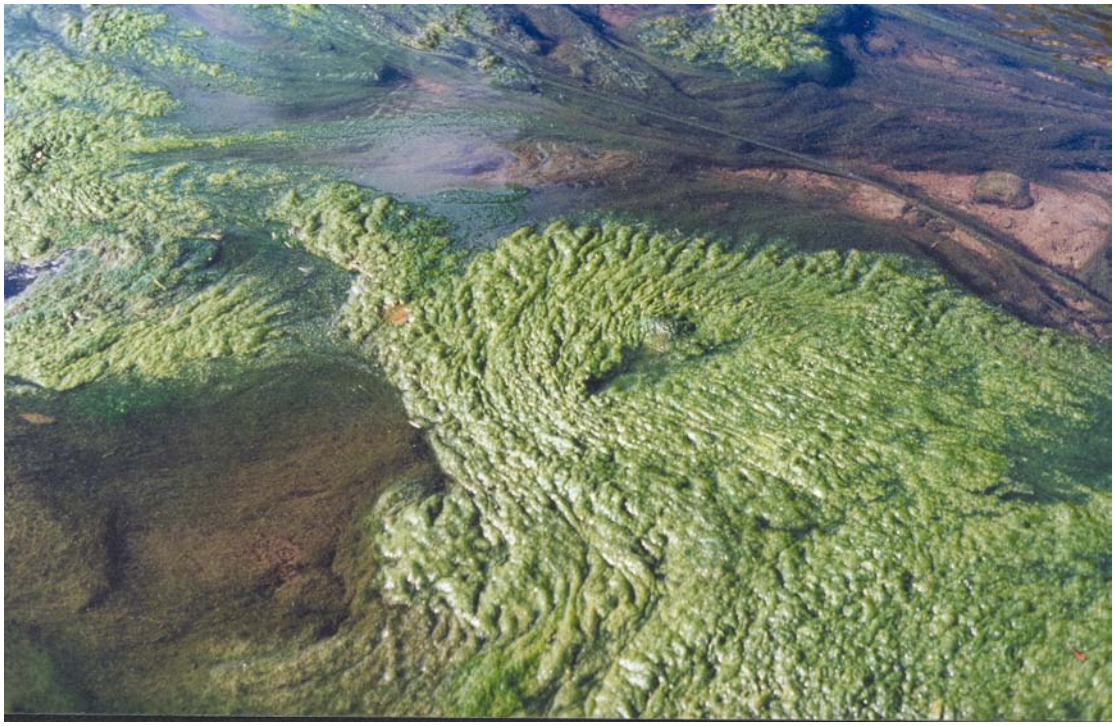

Figure 1A. Excessive periphyton growth as a result of eutrophication

Figure 1B Inflowing tributary of the Kahuterawa Stream delivering high sediment loads that can smoother aquatic life.

Figure 1C High levels of sediment and nutrients in a small Norsewood stream smothering invertebrate and fish habitat.

Figure 1D Mangatera Stream downstream of Daniverke Sewage Treatment Plant discharge showing excessive periphyton growth.

12. As a scientist interested in freshwater ecosystems this is of concern but also indicates something about the water quality of these rivers and streams.
13. I concur with the conclusions of many of the supporting technical documents to the POP that the regions waterways are not in general in a good state but would prefer to see this assessment based more on biological indicators than chemical and/or physical parameters as I believe they better assess ecological condition.
14. As part of my own research on the ecological condition of the regions waterbodies I compiled information on the biological communities from just under a 1000 streams and rivers my students and I have sampled in the lower North Island. I used that information and the linkages between that data and numerous environmental measures to create a picture of the water quality status (QMCI value) of rivers and streams in the Horizons region (Fig. 2). The QMCI is used to express a measure of water quality from what invertebrate species are present. Values greater than 6 indicate good water quality and values less than 4 indicate poor water quality.

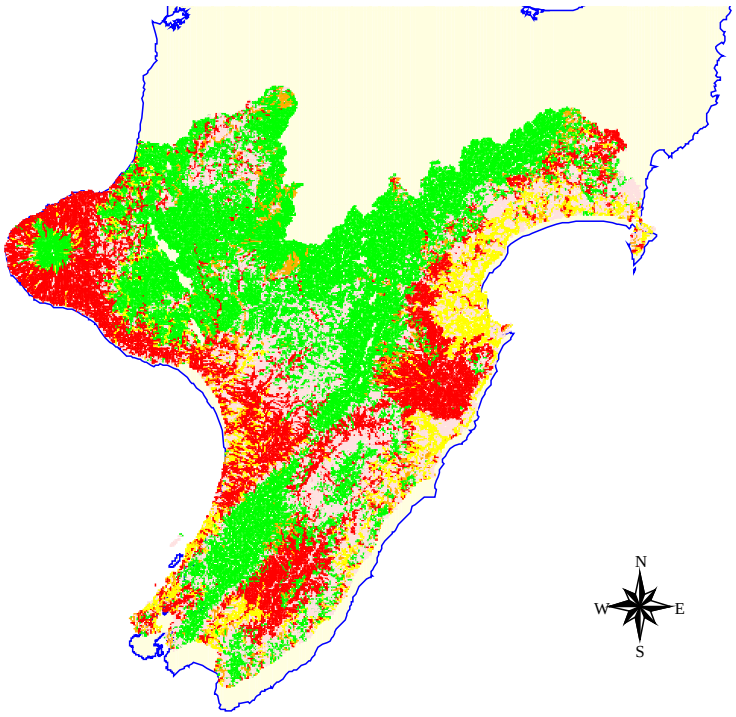

Figure 2. Water quality of streams and rivers as assessed by the QMCI (red – severe pollution, yellow moderate to mild pollution, green clean) modelled from 963 sites in the lower North Island.

15. The environmental variables, from a wide selection of potential candidates, that were linked most strongly with predicting water quality (QMCI) were the amount of native vegetation, impervious cover (urbanisation), temperature, elevation and Nitrogen concentration in the catchment. Note however I did not have DRP or deposited sediment variables to analyse in my study.
16. It is clear from this picture that many streams and rivers have low water quality and that these low water quality sites are more abundant in urban and intensively farmed agricultural areas.
17. In my opinion they do not need to be this degraded and could be significantly improved without serious detrimental economic consequences. On a recent trip to Spain I was able to observe high water quality streams in regions where cattle were

grazing right up to the stream (Fig., 3) The are also still pristine waterways left in the region that need to be protected (Fig.4) (Objective 6.2).

Figure 3. Tributary of Rio Caras, Spain in Picos de Europa draining steep land grazing cattle

Figure 4A. River draining Ruapehu plateau showing riparian vegetation and instream habitat diversity that promote biological diversity.

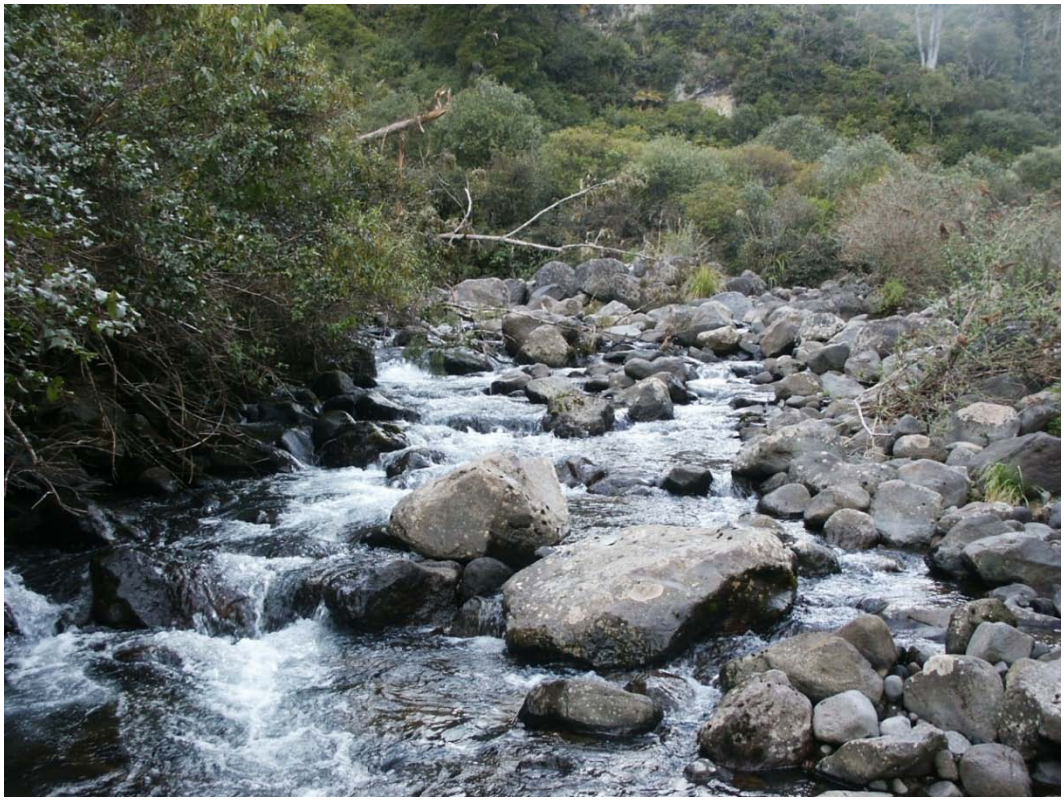

Figure 4B. Stream draining Ruahines showing flow and substrate variability necessary to maintain ecological integrity.

Figure 4C. Small forest stream showing close linkages between riparian and instream habitat.

PHILOSOPHICAL APPROACH OF THE PROPOSED ONE PLAN

18. I suspect that even submitters with strong objections to parts of the POP will be supportive of the general approach and sentiment of the approach Horizons is attempting to bring to resource management (Objective 6-1, 6-2, 6-3 and 6-4). As a scientist, and active member of a rural community, interested in helping to find the appropriate balance between the environment, economy and society I am also fully supportive of what Horizons are attempting to achieve.
19. I support Policy 6-1 the use of water management (catchment) zones to focus management objectives and values in the POP. Rivers by their very nature are strongly affected by activities in their upstream catchment (Allan, 2004; Hynes, 1975). Adopting a catchment management framework is consistent with much of modern thinking on the best mechanisms for managing waterbodies (Allan *et al.*, 1997; Stanford *et al.*, 1995; Roth *et al.*, 1996; Baron *et al.*, 2002; Richter *et al.*, 1997; Richter *et al.*, 2006; Richards *et al.*, 1996).
20. In conjunction with this I support the intent of the land chapter to minimise adverse effects of poor land management on waterbodies.

21. As a scientist I believe the development of specific numerical standards for evaluating POP objectives is a positive and effective way of improving water management, provided of course that the standards are appropriately developed and reviewed as our scientific understanding grows (Schedule D). Numerous resource management documents make reference to avoiding, remedying or mitigating adverse effects. However, while the sentiment of these statements may seem clear during the development of these documents putting these in practise often leads to ambiguous interpretation. Specific numerical standards should avoid such ambiguity (Policy 6-3, 6-4 and 6-5).
22. However, I understand that the standards will not be given effect as rules and as such allow for situations where the standards do not have to be met. I believe if the standards are included in the POP (and I believe they should) they should be adopted as rules to avoid the ambiguity discussed above. Guidelines can be ignored or enforced inconsistently depending on the perspectives of those judging them, whereas rules provide certainty for all involved. If the standards are actioned as rules any activities either meet of do not meet the standards.
23. Although chemical measures of water quality were traditionally the principal mechanism for assessing water quality they have been replaced by biological measures in most countries (Rosenberg & Resh, 1993; Collier & Winterbourn, 2000). There are a number of reasons for this but the ability of biological measures to integrate effects is one of the most important. A comparable human example might be oxygen in a room. If we turn off the oxygen in this room for 15 minutes we all die. If oxygen is then replaced anyone subsequently monitoring the environment would find no chemical problem. However, the lack of life is clearly indicative of some severe detrimental effect that occurred in the past but is no longer present.
24. In light of the need to assess the standards and objectives of the POP I believe that Horizons could interact more effectively with local water quality scientists and resource managers rather than the current strong reliance in the POP of experts from elsewhere in New Zealand. Given the international expertise and standing of some of these scientists and the unique nature of much of the region I would propose a formal meeting on an annual basis to bring together Horizons, NGO and University science to assess the effectiveness of the standards and objectives of the POP. In this case this should be focused on the ecological integrity of the waterways and include Fish and Game, Department of Conservation, Forest and Bird and Massey University

freshwater ecologists and provide a mechanism for open debate and sharing of information relevant to improving ecological integrity of the region's waterways, and the effectiveness of the POP standards and objectives. This would be a mechanism for facilitating an adaptive management strategy for the POP that appears inherent in the sentiment of the POP but appears to lack a specific mechanism. I have been involved in a similar approach dealing with the Tongariro Power Development scheme that I think is beneficial to all parties involved.

25. I do not support the apparent splitting of waterbody management in to water quality, water quantity, biodiversity and beds of lakes and rivers. These parameters cannot effectively be managed in isolation if the stated objectives of much of the POP are to be achieved. For example the effects of discharge of nutrients in to a waterbody will differ with the amount of water in that river or stream. If there are increases in the amount of water abstracted from a waterbody then the amount of nutrients that waterbody can assimilate without degradation of the waterbody will decline. Thus there will need to be a concomitant reduction in the nutrient standards for that waterbody. It is not clear to me how these sections are integrated in the wider umbrella of the POP.

SPECIFICS - WATER QUALITY

26. Horizons have convened a large amount of expert evidence on the mechanisms and effects of many anthropogenic stressors on water way ecology and quality. I do not intend to restate this information but highlight where I think the interpretation of current scientific knowledge is correct and where the conclusions drawn may not lead to the outcomes desired in the POP. Although we have been researching water resource management for over 100 years, and have a reasonable handle on what causes degradation, we are still a long way from knowing how to effectively and economically reverse those effects (Allan, 1995; Allan, 2004; Collier & Winterbourn, 2000).
27. Sites of Significance aquatic were selected based on having found one or more species that are rare or threatened. This relies on a site having been sampled which is not always the case. A scientifically rigorous alternative that would avoid this problem is the use of highly accurate biological distribution models developed for freshwater fish species in the region (Joy & Death, 2002; Joy & Death, 2004;

Leathwick *et al.*, 2005; Moilanen *et al.*, 2008). These would be a much more consistent and scientifically defensible technique for establishing SOS-Aquatic. Surprisingly, it seems the above approach I advocate is used for determining SOS-Riparian.

28. I support Policy 6-7 but only part a. From my studies and experience I would conclude that in general, nutrient enrichment and sedimentation are the two most pervasive and detrimental effects on water quality and ecological integrity on streams and rivers in the Horizons region.
29. Horizons appear to identify nutrients and *Escherichia coli* as the principal issues of water quality. While *E. coli* may be of concern for contact recreation it is unlikely to have adverse effects on the ecological integrity of the waterways. As mentioned above I concur with the view that nutrients are a primary issue of concern and support their steps to reduce their detrimental effect. However, I think they have overlooked an equally important detrimental influence in the form of sediment deposition. This appears to have been done because of a lack of scientific research on the link between sediment deposition and ecological integrity. However I believe an equally rigorous approach could have been applied to sediment deposition standards as has been done for nutrients given the current status of our knowledge on the link between sediment and ecological integrity.
30. Sedimentation is critically important for many of the values and objectives of the POP such as Trout Spawning and the protection of native fish communities. Avoiding the sediment issue runs a serious risk of not achieving some of the important goals of the POP. Policy 6-7c relies on farm plans reducing erosion I would prefer to see specific standards in schedule D for deposited sediment.
31. I therefore fully support the inclusion of nitrogen and phosphorous standards as mechanisms for improving water quality (Policy 6-7a). The importance of each nutrient will vary between catchments (Death *et al.*, 2007) and may also vary with time of year.
32. Given the large geographic area and variety in rivers and streams of the region I also support a catchment/water management zone approach to setting standards. For example streams of the Ruapehu region, draining volcanic geology, are going to respond differently to anthropogenic disturbance than streams in lowland Manawatu sand country (Policy 6-1).

33. My research has been focused on rivers and streams and therefore do not have the information to make comment on the current state of lakes in the region. However, as important and unique waterbodies in New Zealand they should be given equal consideration to the rivers and streams. Horizons do not seem to have a similar level of information on the regions lakes to those of its rivers. It would therefore seem imperative for them to establish mechanisms and protocols for collecting that information on lakes.
34. If a single index must be selected, I concur that QMCI should be used to assess potential discharge and/or other anthropogenic effects. Choosing a value of 20% seems rather arbitrary to assess a significant change and I would prefer the more scientific approach of using the appropriate statistical tests and power analysis. However, if a single percent change must be selected the 20% value is consistent with my observations of change in QMCI downstream from some of the worst sewage discharges in the region (e.g., Marton sewage discharge, Feilding sewage discharge).
35. One of the reasons for preferring the QMCI to the MCI is highlighted by an example told to me by Dr Harding of Canterbury University working on acid mine drainage on the West Coast of the South Island. In some of these streams the effect of the AMD is so severe it excludes all life. However, consultants sampling downstream collected invertebrate samples and found 3 individual high MCI scoring insects that had floated in from upstream (draining pristine West Coast forest). Because all 3 taxa were high scoring the MCI score was high even though there were only 3 individual animals when there would normally be thousands. A QMCI, because it takes in to account how common each of the animals sampled are, would go some way to avoiding this complication.
36. I do support the establishment of nutrient standards to attempt to minimise the deleterious effects of eutrophication. However, I have some concerns about the heavy reliance on Dr Biggs expert opinion rather than a critical assessment of the periphyton / nutrient information that Horizons has collected over the last 10 years. I do not believe concerns by Horizons over the chemical used for pigment extraction warrant this extensive data set being ignored.
37. However, having said that the standards set seems to be consistent with my own nutrient ecological integrity research in streams of the Manawatu catchment (Schedule D).

38. I have been studying nutrients, periphyton and invertebrate communities in 24 streams and rivers in the Manawatu (Fig. 5)

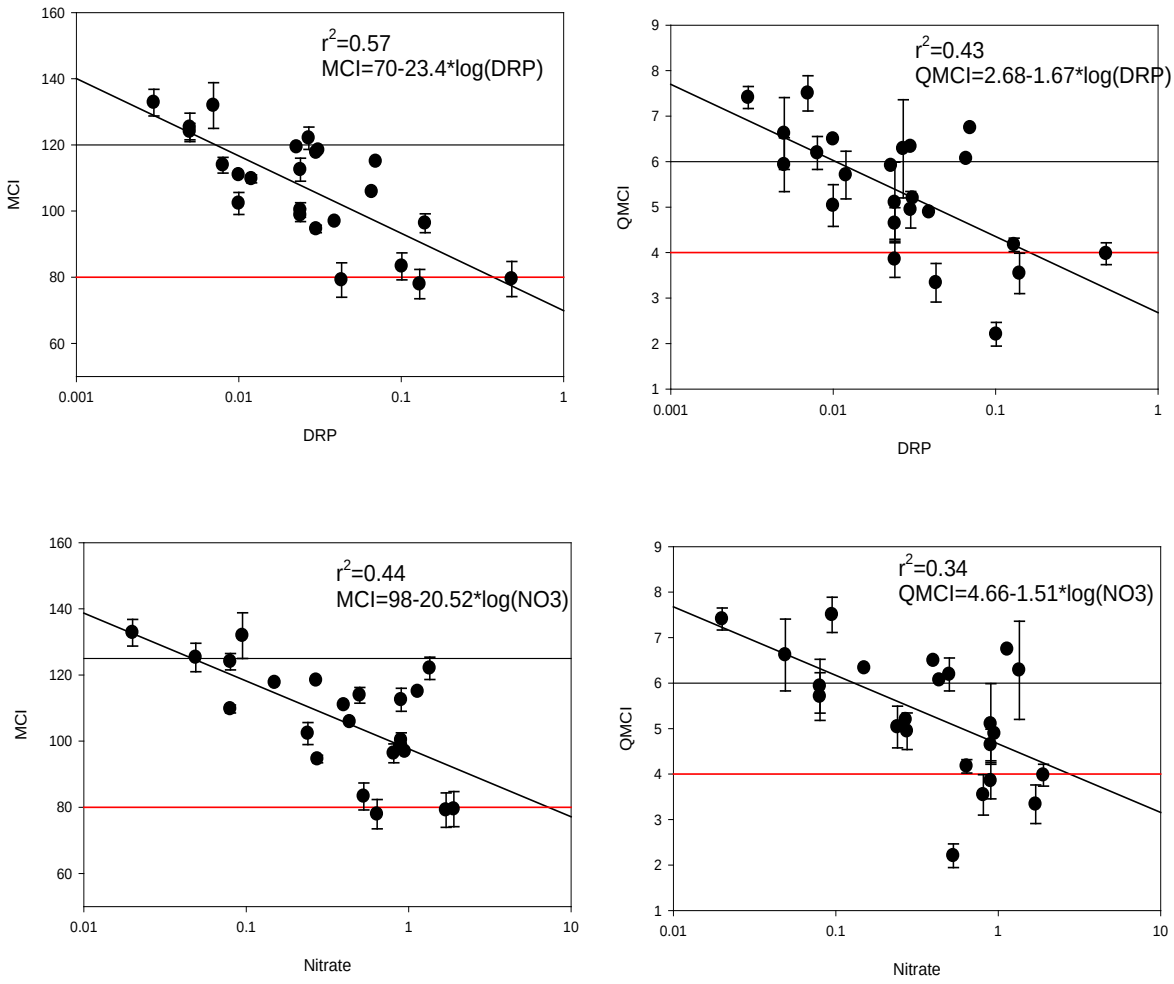

Figure 5. Water quality measured as MCI and QMCI from 24 streams plotted against mean nitrate and dissolved reactive phosphorous levels.

39. From the equations derived from these local streams (in contrast to most of the data used by Dr Biggs which was collected nationally) it yields DRP thresholds of 0.007-0.01 g/m^3 and for Nitrate thresholds of 0.08 – 0.13 g/m^{3}to maintain good water quality. These are broadly similar for the POP standards for the upper Manawatu (Policy 6-7a).
40. Thus while I have concerns about the application of nationally derived data to generate local water quality standards I think Horizons and their experts have ended

up with appropriate levels for their standards that have been validated with my research in this region.

41. I think Horizons have under emphasised the importance of the detrimental influence of sediment deposition (Fig. 6). If they truly wish to improve the ecological health of the regions waterways they will need to address this issue. They appear to have excluded it from numerical standards because of a lack of scientific research on the link between sediment deposition and ecological integrity. However, I believe an equally rigorous approach could have been applied to sediment deposition standards as has been done for nutrients given the current status of our knowledge on the link between sediment and ecological integrity. I do not believe that controlling nutrients alone will yield the desired outcome in improved ecological health if the effects of sediment deposition are not also mitigated. I support the intent of Policy 6-7c to manage sediment input into waterbodies but believe this should be best managed by way of rigorous standards.

Figure 6A. Koura struggling in deposited sediment

Figure 6. Banded kokopu struggling in deposited sediment

42. There has been considerable press about the effects of non-point source discharges on water quality locally and nationally. While there is no denying that some agricultural activities have significant adverse effects on our waterways (Quinn, 2000) there are also numerous significant point source discharges (often from sewage treatment plants in small rural communities) that are still contributing to the degradation of regional waterways many of which are outlined in McArthur's evidence.
43. An example of this is research I conducted between 2001 and 2004 on the Oroua River (Fig. 7).

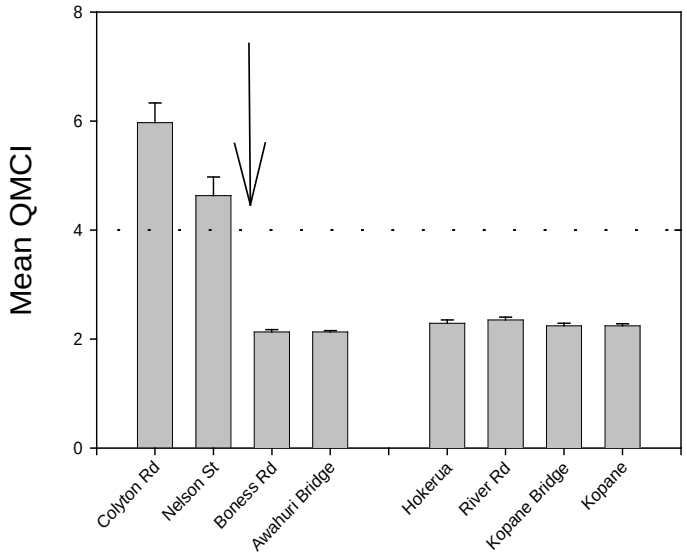

Figure 7. Mean QMCI at 8 sites along the Oroua River February 2001. Other biological metrics and other dates show similar effects.

There is an obvious large reduction in water quality (QMCI less than 4 indicating severe pollution) below the point source discharge from the Fielding sewage treatment plant at Boness road. This is just one of a number of examples I know of in the region where point source discharges have a detrimental effect on water quality and ecological integrity. Thus I support the intent of Policy 6-8 to reduce the impact of point source discharges although I do not think the specifics of the Policy will achieve this.

44. I have no evidence to suggest the standards set for the other parameters will not achieve the desired outcomes in the POP if used as strict limits. Horizons scientists appear to have adopted the most sensible standards for these other parameters based on the current knowledge of our science. Thus I support other standards and parameters included in Schedule D.

SPECIFICS WATER QUANTITY

45. As with the water quality section I am generally supportive of the recommended minimum flows of 90% of MALF (Mean Annual Low Flow). Although it needs to be made clear whether that is a flow of 90% of MALF or a flow for 90% of suitable

habitat at MALF. However I do have concerns over the methodology used and the focus on water quantity rather than the pattern of water supply. Given this caveat I support Policy 6-16.

46. As an ecologist I do not believe the IFIM or Rhyhabsim approach is appropriate for predicting the effects of water reduction on biological communities. The approach rests on habitat being the limiting resource for species distributions and that is often not the case.
47. I do not support minimum flows lower than the 90% MALF set with IFIM and Rhyhabsim as I do not believe the fundamental assumptions (e.g., habitat limitation) of the approach appropriately protect ecological integrity of waterbodies. A minimum flow limit of 90% of MALF does however seem to be a suitable precautionary level that will allow for water abstraction and maintenance of ecological integrity.
48. Dr Hayes in his evidence provided examples of published reviews of flow setting methodology that have advocated IFIM as the most appropriate technique. However, these conclusions are often made on pragmatic grounds, such that although there are acknowledged problems with IFIM and habitat suitability modelling they are really the only current available techniques for setting flow thresholds.
49. One of the principle characteristics of almost all New Zealand rivers and streams is that they experience flood events on a highly regular basis throughout the year. As a result the biological communities require that flow variability in order to retain their ecological condition (Death, 2006; Death, 2008; Death & Joy, 2004; Death & Zimmermann, 2005). Changing the flow regime can have a far more deleterious effect than changing the volume of that flow (Dewson *et al.*, 2003; Dewson *et al.*, 2007c; Dewson *et al.*, 2007a; Dewson *et al.*, 2007d; Dewson *et al.*, 2007b).
50. It has been acknowledged for quite some time that the critical component of managing water abstraction to maintain ecological integrity is the pattern of the flow regime and techniques have been available to manage these rather than flow quantity (Poff *et al.*, 1997; Richter *et al.*, 1996; Richter *et al.*, 2003). Only very recently has their use been gaining popularity as the inability of techniques such as IFIM to achieve the appropriate environmental outcomes is recognised (Poff & Zimmerman, 2009; Poff *et al.*, 2009; Poff *et al.*, 1997).
51. In summary then although I do not support the methodology for establishing flow limits adoption of a precautionary principle has probably set the limits at the appropriate level. I would however like to see preservation of hydrological variability

specifically addressed in the POP such as with HVA (Hydrological Variability Assessment) or ELOHA (Ecological Limits Of Hydrologic Alteration) (Richter *et al.*, 1996; Poff *et al.*, 2009; Poff & Zimmerman, 2009). Based on my extensive research in this area I think this is more important for maintaining ecological integrity than IFIM management of flow quantity.

52. Thus I only support Policy 6-18 in part. The policy should also include maintenance of high flows, specify what significant departure is, how natural flow regime is assessed and how a flushing flow is assessed.
53. As with the rest of the POP the key to the success of these flows is that the objectives and expected outcomes of the POP are monitored, critically evaluated and judged against quantifiable targets (e.g., a 20% increase in QMCI) and that these are reported back to the public and key stake holders.

SPECIFICS RIVER AND LAKE BEDS

54. Along with the environmental characteristics of a water body discussed in the water quality and quantity chapters, the physical and morphological structure of the river or stream and its surrounding riparian zone are critical to maintaining a diverse and healthy ecosystem.
55. Research over the last 10 years has revealed that the surrounding riparian zone of a river ecosystem is critical to the proper functioning of that ecosystem (Kato *et al.*, 2003; Laeser *et al.*, 2005; Kawaguchi *et al.*, 2003; Burdon & Harding, 2008; Zalewski *et al.*, 2001; Zalewski *et al.*, 1998). Many fish feed on terrestrial insects, the nature of the terrestrial vegetation affects the food resource base and hence type of invertebrates in a waterway, most aquatic insects have a terrestrial adult stage and many fish species in New Zealand even lay their eggs in the riparian zone.
56. To maintain a healthy ecosystem within the wetted confines of a waterway it is imperative to also manage the riparian zone to that effect as well.
57. Policy 6-27 gives a clear priority to managing waterbodies to avoid or mitigate the effects of flooding. While I support this approach I do not believe that flood protection necessarily needs to be at the expense of a healthy river bed, within river heterogeneity or maintenance of the natural character of that waterbody. In fact experiences in the Northern hemisphere would suggest that managing a waterbody for

natural character may in fact be a more effective mechanism of flood control (e.g., 2004 Mississippi River flooding).

58. Maintenance of habitat heterogeneity is one of the most critical components to a healthy riverine ecosystem. Greater heterogeneity leads to more diverse ecosystems and is why natural tropical forests have more biological diversity than pine plantations and mountain streams have more biological diversity than concrete drains.
59. Habitat variability is also part of the mechanism behind the ability of New Zealand riverine communities to recovery from severe disturbances such as floods so quickly (Death, 2008). During high flows the invertebrates and fish seek refuge in areas such as the hyporheic zone (underneath the river bed), large boulders or the floodplain and then recolonise when flows subside. In channelized rivers where these habitats are not available the animals and plants are washed downstream. Thus high habitat heterogeneity within the river and floodplain are critical for the resilience of these communities.
60. Policy 6.27 discusses avoiding significant reduction of habitat and morphological diversity. But there is no explanation of what significant is, who judges this, and how habitat and morphological diversity are measured. All three should be specifically defined.
61. Management of natural character is also mentioned but this is an ambiguous concept (Urlich & Ward, 1997) and should be defined in policy 6.27.
62. This chapter should also deal with the extremely deleterious effects of deposited sediment. Along with alteration of habitat diversity and morphology one of the potential major effects of flood control activities may be an increase in deposited fine sediments. This will dramatically affect the periphyton, invertebrate and fish communities.
63. There is mention in this chapter of turbidity but there appears to be no specific reference to deposited sediment. As much of the suspended sediment will of course deposit in the stream bed, and as this affect is far more detrimental than increased turbidity from suspended sediment guidelines need to be put in place to minimise the deposition of sediment.
64. Table 16.1c states that any discharge of sediment directly caused by the activity shall not be undertaken for more than 5 days or for more than 12 hours on any of those 5 days. This approach could still lead to the deposition of a large amount of sediment. I propose that this should be amended so that the maximum total accumulated time for

sediment discharge over the 5 day period is 12 hours. This should still allow activities but will minimise the amount of deposited sediment on the stream bed.

65. Table 16.1k Any permanent straightening or channelling of a river must not exceed a length equal to two times the bed width of the river in any 2-km length of river in any 12-month period. River straightening is one of the principal mechanisms for loss of habitat variability as flows are increased uniformly and channels created. I propose removal of “in any 12-month period” to “in any 10 year period” to avoid a progressive annual increment on the straightening of river channels.
66. Policy 6.32 does not make mention of where in a waterbody gravel extraction can occur. It needs to be specifically stated that gravel extraction should not be made from the wetted channel. This should prevent increases in deposited sediment downstream of the extraction that could have the adverse effects discussed above while still allowing for gravel removal.

SUMMARY AND RECOMMENDATIONS

66. I have been researching invertebrate, fish and periphyton communities in the Horizons region since 1993.
67. I support Issue 6-1 that many of the rivers, streams and lakes in the Manawatu Wanganui Regional Council area are degraded as a result of excessive input of nutrients and deposited sediment from agriculture and point source disharges.
68. I believe with suitable adaptive management and assessment these waterbodies do not need to be so degraded without any adverse economical or societal consequences for people in the region (Objective 6-2).
69. Setting numerical standards for environmental characteristics of those waterbodies is an effective mechanism for all resource users and managers to have surety about what can or can not be achieved. But these need to be rules against which activities are judged.
70. Specific goals for achievement in a specified time line should be included against which to judge the effectiveness of the POP. I recommend this be a 20% improvement in ecological condition of 20% of the regions streams and rivers in 20 years.
71. The best gauge of this is the biological communities of these waterbodies (e.g., fish communities (Index of Biotic Integrity) and QMCI).
72. Effective implementation of the objectives of the POP would best be achieved by adaptive management through an annual formal meeting to discuss the achievement (or lack of) of objectives in the POP. This should include Horizons science staff, Fish and Game, Department of Conservation, Forest and Bird and Massey University freshwater ecologists.
73. I support Policy 6-1 as a modern and effective mechanism for management of waterbodies but may require a more careful integration of water quality, water quantity, biodiversity, beds of rivers and lakes and land management.
74. I support Policy 6-3, 6-4, 6-5 and Schedule D that water quality should be maintained and enhanced.
75. I support Policy 6-7a (nutrient limits) but believe Policy 6-7c (deposited sediment) should also have associated Schedule D standards as it is an equally, if not more important, factor degrading the regions waterbodies.

76. I support Policy 6-8 that any adverse effects of point source discharges should be eliminated.
77. I support Policy 6-16 if minimum flows are set at flows of 90% of MALF.
78. I only support Policy 6-18 in part. The policy should also include maintenance of high flows, specify what significant departure is, how natural flow regime is assessed and how a flushing flow is assessed.
79. Maintenance and enhancement of habitat heterogeneity should be an equally important goal to an improvement in water quality.
80. Policy 6.27 needs to specify what natural character is, what significant is, who judges this, and how habitat and morphological diversity are measured.

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