BEFORE THE INDEPENDENT COMMISSIONERS

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of the Proposed Canterbury Land and Water Plan

REBUTTAL EVIDENCE OF RUSSELL GEORGE DEATH ON BEHALF OF NORTH CANTERBURY, NELSON/MARLBOROUGH AND CENTRAL SOUTH ISLAND FISH AND GAME COUNCILS

13 FEBRUARY 2013

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QUALIFICATIONS AND EXPERIENCE

1. My name is Russell George Death. My qualifications and evidence were set out in my Evidence in Chief ("EiC"), dated 4 February 2013.

2. In preparing this rebuttal evidence I have reviewed:

   a. The reports and statements of evidence of other experts giving evidence relevant to my area of expertise, including:

      i. Gerard Willis for Fonterra and Dairy NZ; and

      ii. Shirley Hayward for Fonterra and Dairy NZ.

3. I have again prepared this evidence in compliance with the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2011.

4. The particular points that I consider it useful for me to rebut are set our below.

EVIDENCE OF GERARD WILLIS

5. Mr Willis in his evidence in chief provides an analysis of the National Policy Statement on Freshwater (3.9 onwards). In this section he draws a number of conclusions about the overall state of water quality in the region and the influence of human activities on that water. Mr Willis focuses on net changes across the region; as such he fails to take into account essentially the purpose of establishing freshwater quality limits in the first place; to protect values in individual rivers.

6. The establishment of limits should be determined by the instream values one is trying to manage for so that they are appropriate for that waterbody and not too high, or too low. Ideally this analysis would occur at the river or reach scale not the region or management unit. Once these values have been determined then it is possible to set numerical water quality limits to provide for these values. Then an

analysis of current instream water quality against the water quality limits, required to provide for the instream values, determines whether or not the waterbody is degraded. I understand from Fish and Game's planner, Mr Percy, that this also determines the allocation status of the waterbody (degraded, at allocation, or under allocated) under the NPSFW. While the scale (management unit is designated by waterbody type) used by Hayward et al. (2009) is coarser than river or reach analysis, it still follows the basic principal outlined above. The water quality limits represent the bottom lines required to provide for the instream values identified, and take into account the current state of the waterbody while considering resource use. The approach is pragmatic, but robust and ensures that the life supporting capacity and ecosystem health is provided for. The Horizons One Plan (schedule AB and D) provides an example of how this process occurs at the river and reach level

7. Mr Willis in his evidence at paragraph 3.13 states:

> *".. the overall quality of freshwater may be improved if the quality in the mainstem of a river is improved even though the quality of a particular tributary deteriorates. That is simply a function of there being a great deal more freshwater flowing in the mainstem than in the particular tributary. "*.

I do not agree with this as freshwater ecosystems are complex interconnected systems where the volume/flow is not a currency of their value. The biodiversity value of small streams is much greater than those of larger rivers and even more so per unit volume/flow if size is taken in to account.

8. The variety and variability of habitats within this interconnected system are important for influencing the biological diversity of the system and its health. This diversity is also important for providing resilience to the system at large. Tributaries and mainstem reaches provide for different lifestages of fish for example. Tributaries often provide spawning and nursery habitat and may act as refugia during periods of low or high flow. Many freshwater inhabitants such as salmonids move between small and large water bodies throughout the year for spawning, feeding etc. Furthermore, as water runs downhill, so

contaminates such as sediment and nutrients that enter a small headwater stream will make their way into the lower reaches even if those lower reaches are protected. In fact, to preserve ecosystem integrity it is far more effective to protect headwater streams than lower reaches of a river. The location of a stream or river in the river network is a far more important indicator of its ecosystem value than its volume/flow Degradation of water quality within a tributary such that it no longer supported its instream values would constitute degradation in the life supporting capacity of this system.

9. This is why I believe a two-step approach to management of waterbodies is effective; firstly to identify the instream freshwater values at a site and then secondly to set limits to provide for those values. As part of this it is important to consider the requirements of the entire system and ensure that this is provided for (i.e. setting appropriate limits). It is not possible to set defensible, meaningful limits in the absence of determining freshwater instream values. Identification of values enable limits to be set which provides for these values and safeguards Life Supporting Capacity/ ecosystem health.

10. Mr Willis' assertion in paragraph 3.14 is contrary to basic ecology:

> *"In that sense I consider it possible, in the overall judgement to be made, for a plan to give effect to this objective by allowing one contaminant to increase (say Dissolved Inorganic Nitrogen - DIN) while achieving an overall improvement in water quality by securing a decrease in (for example) microbial pollution (e.g. E.coli) and sediment."*

Ecosystems are not controlled by the overall average of the waterbody but by the single most limiting factor. This basic principle of ecology dates from 1840 encapsulated in A.E. Shelford's Law of the Minimum (Begon, Harper & Townsend, 1990). To illustrate, if the oxygen level in a waterbody drops too low all the animals die, even though sediment, nutrients, *E. coli* etc. may be that of a pristine environment. Thus one single factor can affect ecological integrity even though all other factors in that habitat may be fine.

11. In this context it also important to appreciate that potential contaminants such as nutrients have multiple dimensions. As outlined in my EiC nutrients include both nitrogen (N) and Phosphorous (P) either one of which may be limiting at a particular time or location. Management of only one of these can result in the other becoming the limiting resource for periphyton growth (facilitating further periphyton growth). To ensure that freshwater objectives are met it is therefore important to manage for both nutrients, even in scenarios where one appears to currently be the dominant issue (Francoeur *et al.*, 1999; Death, Death & Ausseil, 2007; McArthur, Roygard & Clark, 2010; Harpole *et al.*, 2011; Keck & Lepori, 2012).

12. Determination of water quality limits, which includes the range of parameters selected, is dependent on the values one is trying to provide for. While establishing *E. coli* limits, as a measure of microbial contamination of a waterbody are important for contact recreation and stock drinking purposes, the parameter has no value in regards to organisms that actually live in the water. Soluble inorganic nitrogen (SIN) on the other hand affects ecosystem health in a number of ways. Nitrogen can be toxic to instream life directly (fish and macroinvertebrates) or, as discussed above, at lower levels in combination with phosphorus lead to excessive periphyton growth, during periods of stable flow.

13. Periphyton proliferation impacts on aquatic ecosystem health in a number of ways. Nuisance periphyton growths cause changes in water chemistry, including increasing diurnal variations in dissolved oxygen ("DO") and pH. Changes in DO can significantly impact on aquatic life as thresholds in the early morning can drop below the requirements to sustain life; effects can also be sub lethal and for trout may adversely affect general fish health. Changes in DO and pH can also increase the potential for ammonia toxicity. Nuisance periphyton growths alter the composition and biomass of invertebrate communities, and fish communities, and can adversely impact on amenity and contact recreational values of the waterbody.

14. Deposited sediment also adversely affects aquatic health, however managing only sediment or SIN or vice versa will not ameliorate the impact of the other. Deposited sediment can clog interstices of streambed substrates leading to a reduction in water exchange with surface waters, and causing the interstitial layer to become oxygen depleted. Silt accumulation can generally bring about a change in invertebrate communities, with a loss of stonefly and mayfly species, and an increase in densities of animals such as chironomids (flies and midges) and oligochaetes (worms) (Ryan, 1991), which provide lower quality food for fish (Hayes, Stark & Shearer, 2000). High deposited sediment levels also adversely impact on trout spawning success by smothering the gravels, or interstitial spaces, and reducing the flow of water, and consequently dissolved oxygen to the eggs or alevins, and the removal of metabolic wastes.

15. I do not agree with much of the evidence presented by Mr Willis as it fails to take into account that aquatic ecosystems are complex, the species within them responding to temporal and spatial changes in their environment and the other species. Establishment of appropriate limits should take into account life cycles and life history requirements and thresholds. A single event where a limit is breached even for a short period can have dramatic effects on the viability and sustainability of a population. For example a single low flow, low oxygen event during spawning can destroy recruitment for an entire year. In just the same way that turning the oxygen off in a sealed room for 10 minutes results in everyone in the room dying even if the oxygen is high for the remaining time.

16. I believe the limits proposed by Fish and Game in Table 1a are a pragmatic balance between the out of river resource use that Mr Willis discusses and the maintenance of life supporting capacity and ecosystem health within those waterbodies at all stages in the life history of the organisms that live in Canterbury waterbodies.

EVIDENCE OF SHIRLEY HAYWARD

17. Ms Hayward in her evidence suggests that the management units in Table 1a are too coarse. Fish and Game has provided similar evidence for Urban springfed streams that managing for values and setting limits in a wide range of stream types in each management unit can be problematic. In urban streams the limits set will not be sufficient to provide for trout spawning or a sustainable fishery, even when they (as happens in some instances) occur in the urban stream management unit. However, a general framework for managing waterbodies within each management unit as proposed in Table 1a is a way forward. With the addition of the amendment to proposed policy 4.1 (d) set out in Philip Percy's planning evidence rebuttal, to *"Where fresh water limits are set in section s 6 – 15 as well as in Table 1 for a water body, the water body shall be managed to meet the more stringent of the two limits, <u>unless naturally occurring conditions justify the application of the less stringent limit</u>."* the concerns raised by Ms Hayward, as well as those raised by Fish and Game, will be able to be addressed at the sub catchment level in sections 6 – 15 of the plan. Where values are found to exist that require more stringent limits than Table 1a, (such as in some urban streams potentially) they can be imposed. And where natural conditions dictate that the Table 1a limits are inappropriate, less stringent limits can be set. I expect these situations to be the exception rather than the rule, which is why I support the use of Table 1a as an interim measure.

18. Ms Hayward in 3.2 outlines the basis of this approach well *"this provides a spatial framework based on grouping waterbodies with common key physical characteristics that are overarching controllers on the biological functioning and condition of rivers and lakes"*. I agree, from my experience geomorphological form and geographic locations (e.g., catchment) are the overarching controllers on biological communities. The limits set in Table 1a are also appropriate to provide for the values. Ms Hayward is using the exception to set the rules rather than the more sensible approach of using Table 1a to set the limits for most waterbodies in a management zone and allowing for alternative values as outlined in 17 above with the policy amendment. I don't think that the Table 1a limits should be downgraded because of

a few instances where site assessment would determine different limits because of differences in geology.

19. Ms Hayward also advocates *the 'average' condition* approach presented by Mr Willis. But as explained above ecosystems do not respond in this way, even short term breaches in a parameter can have significant adverse effects on aquatic life.

20. I support part of Ms Hayward's assertion at paragraph 3.14 that *"The numeric criteria set for each indicator and river/lake type was developed with the aim of setting 'aspirational but achievable objectives"*. They are technically achievable, but as they provide for the protection of values, in that respect they are not aspirational. Where the waterbody does not currently meet the limits then it is degraded and should be managed to address that degradation.

CONCLUSION

21. Identifying the values of each waterbody and setting appropriate bottom line limits to maintain those values is an effective form of management in my experience. I support Table 1a as proposed by Fish and Game on this basis.

22. Table 1a limits should be the ultimate bottom line and should not be set lower by Catchment groups, unless natural conditions such as differences in geology dictate minor amendment for specific waterbodies.

Associate Professor Russell George Death

13 February 2013

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