BEFORE THE ENVIRONMENT COURT

In the matter of	appeals under clause 14 of the First Schedule to the Resource Management Act 1991 concerning the Proposed One Plan for the Manawatu-Wanganui Region.
between	**FEDERATED FARMERS OF NEW ZEALAND ENV-2010-WLG-000148**
and	**MINISTER OF CONSERVATION ENV-2010-WLG-000150**
and	**HORTICULTURE NEW ZEALAND ENV-2010-WLG-000155**
and	**DAY, MR ANDREW ENV-2010-WLG-000158**
and	**WELLINGTON FISH & GAME COUNCIL ENV-2010-WLG-000157**
	Appellants
and	**MANAWATU WANGANUI REGIONAL COUNCIL**
	Respondent

STATEMENT OF REBUTTAL EVIDENCE OF DR OLIVIER AUSSEIL ON THE TOPIC OF SURFACE WATER QUALITY ON BEHALF OF THE MINISTER OF CONSERVATION AND WELLINGTON FISH & GAME COUNCIL

Dated: 18 April 2012

1. INTRODUCTION

1.1 My full name is Olivier Michel Nicolas Ausseil. A full description of my qualifications and experience was provided in my evidence in chief dated 14 March 2012, which was filed with the Court.

1.2 I attended two expert conferencing sessions on 21 and 29 March 2012. A record of that conferencing has been provided to the Court in the form of a conferencing statement. I have included further discussion around areas of agreement and disagreement for clarification where I think it is required in this evidence.

Purpose and Scope of Evidence

1.3 I have read the statement of evidence of Dr Michael Robert Scarsbrook.

1.4 The purpose of this evidence is to respond to specific points in his evidence.

Expert Witness Code of Conduct

1.5 I have been provided with the Code of Conduct for Expert Witnesses contained in the Environment Court's Consolidated Practice Note 2011. I have read and agree to comply with that Code. This evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

2. ISSUES IN CONTENTION

2.1 It was agreed at the first expert conferencing session on water quality (21 March 2012) that the term "limits" would be used when referring to Schedule D numbers. For consistency, I use the same definition of "limits" in this evidence.

Schedule D nutrient limits

2.2 In paragraph 189 of his evidence in chief, Dr Scarsbrook states that "the nutrient numeric in the POP that apply to rivers throughout the region are overly conservative and may be largely unachievable in many rivers". Dr Scarsbrook supports this point by stating that some reference sites do not meet the target loads, and cites in particular the case of the Tamaki River (paragraph 178).

2.3 There seems to be a degree of confusion in Dr Scarsbrook's evidence between Schedule D limits ("numerics") and target loads. Schedule D limits refer to annual average in-river nutrient concentrations at flows below the 20th exceedance percentile. In my opinion, any analysis of state destined to identify or assess water quality issues should in the first instance use in-river nutrient concentrations, which are measured, instead of target loads, which are estimated. Target loads are not part of Schedule D or other parts of the POP, they are a tool used in technical assessments to make the link between in-river concentration limits and nutrient sources (point and non-point sources).

2.4 Nutrient concentration limits as contained in Schedule D were defined at different levels to reflect different in-river values. In particular, nutrient concentration limits at reference sites were purposely set at stringent levels to reflect conditions close to natural conditions and protect expected high biodiversity values at these sites. Nutrient concentrations limits at sites located further downstream in the catchments were set at significantly higher levels to allow for a degree of nutrient enrichment in developed catchments.

2.5 Thus, if nutrient reference concentration limits were to be slightly exceeded at reference sites at the top of the catchment, this would certainly not mean that the nutrient concentration limits at the bottom of the catchment would also be exceeded, or unachievable, because significantly different concentration limits apply to different parts of the catchment.

2.6 For example, in the Mangatainoka catchment, the Schedule D nutrient concentration limits increase from 0.006 g/m^3 for DRP and 0.070 g/m^3 for SIN in the Upper Mangatainoka Water Management sub-Zone (WMsZ) to 0.010 g/m^3 for DRP and 0.444 g/m^3 in the middle and lower Mangatainoka WMsZ.

2.7 Importantly, both the SIN and DRP Schedule D concentration limits are met at the main monitoring site for the Upper Mangatainoka WMsZ, i.e. Mangatainoka River at Putara (Ausseil and Clark, 2007[1]).

2.8 Similarly in the Rangitikei River catchment, Schedule D nutrient concentration limits increase from 0.006 g/m^3 for DRP and 0.070 g/m^3 for SIN in the Upper and Middle Rangitikei Water Management Zones (WMZ) to 0.010 g/m^3 for DRP and 0.110 g/m^3 in the Lower Rangitikei and Coastal Rangitikei WMZ.

[1]Ausseil O and Clark M. (2007c).Recommended water quality standards for the Manawatu-Wanganui Region: technical report to support policy development.*Horizons Regional Council Report N. 2006/EXT/806. ISBN: 1-877413-89-5*

2.9 As shown in Table 7 of my evidence in chief, Schedule D in-stream nutrient concentration limits are met at the Rangitikei at Pukeokahu monitoring site, which, of all monitoring sites on the Rangitikei River mainstem, is the closest to reference conditions (although 40% of the catchment above Pukeokahu monitoring site is in sheep and beef farming).

2.10 In paragraph 178 of his evidence in chief, Dr Scarsbrook refers to the Tamaki at Reserve monitoring site, mentioning that this site exceeds the SIN target load by 30%, in spite of being a reference site.

2.11 This site has been monitored on a monthly basis since 2005 (and on a less regular basis since 1999). Based on water quality data collected between 2005 and 2011, the annual average SIN concentration at this site is 0.100 g/m^3 i.e. it is probably[2] correct that SIN concentration at this site exceed the Schedule D limit of 0.070 g/m^3. However, the Schedule D SIN concentration limit at this site is the most stringent "reference" limit (0.070 g/m^3), and it increases more than 6-fold (to 0.444 g/m^3) in the Lower Tamaki WMZ, i.e. immediately downstream of the Tamaki at Reserve site. Thus, even if the 0.070 g/m^3 limit is not met, it does not mean that the 0.444 g/m^3 limit applicable immediately downstream of this site is unachievable.

2.12 It is also interesting to note that a significant water quality trend, showing a decrease in SIN concentration over the last 6 years is evident at this site. I further address this point in paragraphs 2.20 to 2.36 of this rebuttal evidence.

2.13 In Paragraph 179 of his evidence in chief, Dr Scarsbrook states that "*all three sites in the Rangitikei River could not meet target loads even if the entire catchment reverted to native bush*". This statement is at odds with the fact that the Schedule D in-river nutrient concentration limits are actually met at the Pukeokahu monitoring site, in spite of only 52% of the catchment above this point being in native vegetation (refer to paragraph 0 above). This simply suggests that the assumptions Dr Scarsbrook used in his calculations may not be applicable to the Rangitikei River.

Nutrient Load Variability

2.14 In paragraphs 23 and 177 of his evidence in chief, Dr Scarsbrook states that "it appears that many of the changes predicted by Dr Roygard may not be measurable in reality due to high levels of natural variability". Although Dr Scarsbrook refers to evidence presented by another

[2] Schedule DO nutrient concentration limits only apply at flows below the 20th exceedance percentile. Flow data are not available at this site to undertake a proper assessment of state against Schedule D limits.

party (Horizons), I am responding to this point because it is directly relevant to the modelling I undertook and presented in my evidence in chief.

2.15 The modelling presented in both my evidence and in Roygard and Clark's evidence[3] is based on long-term average annual SIN loads estimated based on in-river water quality data, which minimises the natural variability observed in annual in-river nutrient loads. This point was discussed and agreed on at the 29 March water quality expert conferencing.

Scenario modelling

2.16 In point 22 of his evidence in chief, Dr Scarsbrook states that for the sake of balance it would be informative to have some scenarios included that estimate reductions in average N loss per hectare as a result of improvement in farm practices. Dr Scarsbrook then refers to the approach being put forward by Gerard Willis on behalf of Fonterra.

2.17 I am also aware of the approach put forward by Federated Farmers, as summarised in Dr Dewes's rebuttal evidence (i.e. with X and Y average N leaching rates as thresholds for different activity status).

2.18 To my knowledge, the above land-use scenarios have not been numerically characterised; for example, the average nitrogen losses from dairy farms within different water management zones as a result of each approach were not provided. This is the sole reason why I did not undertake modelling of these approaches. This point was agreed by all parties present at the 29 March expert conferencing session (as per point 1 of the record of technical expert conferencing, 29 March 2012).

2.19 If such numbers are provided, I could to model the outcomes of any approach put forward, using the same methodology I used for the other approaches to provide the Court with a complete view.

Water quality trends

2.20 Temporal trends in water quality at different water quality monitoring sites in the Rangitikei and Manawatu catchments have been discussed in Dr Scarsbrook's evidence in chief. Temporal trends at three water quality sites in the Upper Manawatu catchment were further discussed in a memo provided by Ms Maree Clark at the second expert conferencing session, and appended to the record of that session.

[3] Roygard J. and Clark M. (2012).Supplementary statement by Jon Roygard and Maree Clark on nutrient load scenarios and methodology.*Dated 24 February 2012.*

2.21 The results contained in this memo were accepted as a "robust and accurate summary of nutrient trends at three sites in targets zones" of the upper Manawatu catchment by the group of water quality experts conferencing on 29 March 2012 (refer to point 4 of the conferencing record), although the causes of nutrient trends were not discussed. The three sites in question were the Manawatu at Weber Road, Manawatu at Hopelands and Mangatainoka at SH2.

2.22 These results essentially show no significant long-term trends[4] in oxidised nitrogen (essentially nitrate-N) or SIN concentrations over the 1989-2011 period at these three sites. However, statistically significant trends appear when considering shorter periods of time:

(a) During the 1993-2003 period: increasing trends in oxidised-N at all three sites and SIN concentrations at one site (Mangatainoka at SH2); and

(b) During the 2001-2011 period: decreasing trends in oxidised nitrogen at all three sites and SIN concentrations at one site (Mangatainoka at SH2).

2.23 The magnitude of the trends (i.e. the percentage of average annual increase or decrease) was comparable for the two sub-periods considered above. In simple terms, the water quality degradation over the 1993 to 2003 period was offset by the water quality gains during the 2001 to 2011 period.

2.24 The issue in contention here is not whether water quality trends are, or not, identified; rather it is what may be causing these trends, and how much weight should these results be given. As with all scientific information, the uncertainties and limitation of water quality trend analyses need to be understood prior to their use or interpretation.

2.25 The existence of water quality trends in itself does not imply causality, and a number of factors may be causing an observed trend in water quality, including changes in point-source discharges, changes in non-point source discharges, climatic variability or a combination of these.

2.26 The uncertainties associated with the causes of water quality trends also mean that the trends should not be extrapolated in the future. In other words, if we are uncertain about the cause(s) of water quality trends, then it is not possible to say whether or not they will continue in the future.

[4] When considering flow adjusted trends.

2.27 Point source discharges of nutrients, from agricultural, industrial and domestic sources have been considerably reduced in the Manawatu catchment over the last 10-15 years primarily as a result of the implementation of regulatory processes within the Manawatu Catchment Water Quality Regional Plan. This is covered in some detail in Roygard and McArthur (2008). Based on this information, my interpretation is that these decreases in point-source discharges may have been a significant contributor to observed improvements in DRP concentrations, but would be insufficient in themselves to explain the observed trends in SIN concentrations.

2.28 Climate, or more precisely, the influence of known climatic patterns has been shown to be associated with water quality trends (Scarsbrook *et al*., 2003)[5]. In this article, Dr Scarsbrook and colleagues examine associations between El Nino Southern Oscillation climate patterns and water quality temporal trends in New Zealand. They conclude that "*trends in river water quality are somewhat dependent on climatic variability, making trends associated with human river management more difficult to detect. This is further supported by the finding that trends in water quality for sites with both minimal human modification and those impacted by human activity are generally consistent with trends in SOI. That is, many of the trends observed are equally apparent in Baseline and Impact sites and are, therefore, more likely to be associated with natural climate variability. These results suggest that the interpretation of long term datasets requires that climate variability be fully acknowledged and dealt with explicitly, particularly in trend analyses*".

2.29 In paragraph 95 of his evidence in chief, Dr Scarsbrook comments that "*the absence of trends in flow or temperature over the 2001-2010 period would suggest climatic variability is not a strong driver of the observed pattern*." I note that this comment seems at odds with Dr Scarsbrook's own conclusions in the 2003 article, which states that "*SOI*[6] *effects on water quality are not necessarily a direct consequence of changes in flow associated with rainfall variation*." In other words, the absence of trends in river flow should not be used to discount climatic variability as being, or not being, a driver of water quality trends.

2.30 The memo presented by Ms Clark only covered three sites in the Manawatu catchment. For completeness I analysed Horizons Regional SoE data for water quality trends at 5 sites in

[5]Scarsbrook M.R., McBride C. G., McBride G.B. and Bryers G. (2003). Effects of climate variability on rivers: consequences for long-term water quality analysis. *Journal of the American Water Resources Association, December 2003, p1435-1447.*
[6] Southern Oscillation Index

the Rangitikei catchment and one site in the Upper Manawatu catchment (Tamaki at Reserve) using very similar methodology.[7]

2.31 The Tamaki at Reserve water quality monitoring site is the only reference site in the upper Manawatu catchment where over five years of consistent monthly water quality data are available (the other key reference site in the Manawatu catchment above the Manawatu Gorge, the Mangatainoka at Putara, has only been monitored monthly every year since 2008).

2.32 Although only relatively short data record periods are available, results indicate that all five Rangitikei catchment sites present decreasing trends in DRP concentrations, and two sites present decreasing SIN concentration trends (i.e. improving water quality) (Table 1).

Table 1: Water quality trends a five sites in the Rangitikei catchment (Horizons state of the environment water quality data). Mann-Kendall test, LOWESS flow adjustment fitted to 30% of points. ➘ Indicates a statistically significant trend (p<0.05).– indicates no statistically significant trends. All trends are flow adjusted, except for the Tamaki at Reserve, where flow data were not available.

Site	Period of record	SIN trend	DRP trend
Rangitikei at Pukeokahu	July 2006 to June 2011	➘	➘
Hautapu at Alabasters	July 2006 to June 2011	➘	➘
Rangitikei at Mangaweka	July 2005 to June 2011	-	➘
Rangitikei at Onepuhi	July 2005 to June 2011	-	➘
Rangitikei at McKelvies	July 2006 to June 2011	-	➘
Tamaki at Reserve	July 2005 to May 2011	➘	➘

2.33 Although there are no true reference sites monitored in the Rangitikei catchment, two sites are located high up in the catchment and are the closest representation of reference or low-impact conditions for the Hautapu and Rangitikei rivers in Horizons' SoE monitoring programme: Hautapu River at Alabasters and Rangitikei River at Pukeokahu. Interestingly, both sites present the same decreasing trends in DRP concentrations as the sites further down the catchment, and are also the only sites presenting decreasing SIN trends. As quoted above, Scarsbrook *et al*. (2003) have identified that where trends were equally

[7] Trends were analysed using the Mann-Kendall test in Time Trends V2.0. Flow adjustment was made using LOWESS fit to 30% of points. No flow adjustment was made to Tamaki at Reserve data, due to the unavailability of flow data at this site.

apparent in sites with both minimal human modification and those impacted by human activity, these were more likely to be associated with natural climate variability.

2.34 Thus it appears that, although improving trends in water quality are apparent in the Rangitikei catchment over the last 5 to 6 years, these are observed consistently across the catchment regardless of land use, and are thus more likely to be associated with climatic patterns.

2.35 Similarly, statistically significant trends exist at the Tamaki at Reserve, showing a decrease in both SIN and DRP concentrations between 2005 and 2011. The fact that similar decreasing trends are observed at both reference (Tamaki at Reserve) and non-reference sites (the three sites assessed by Ms Clark) indicates that these trends are more likely to be associated with climatic patterns (Scarsbrook *et al*., 2003).

2.36 The analysis above is based only on short-term data records (5-6 years), and much longer records would be needed to robustly assess the association between water quality and climatic patterns, but it does illustrate the difficulty and uncertainty surrounding the interpretation of water quality trends. In particular the potential for climatic variability to be a driver of short-term water quality trends should not be underestimated or discounted.

2.37 Due to the difficulties in interpreting water quality trends analysis and identifying the actual causes of any significant trends, it is my opinion that the analysis of state in water quality and river ecology should be given more weight than trends when defining issues and guiding resource management decisions, as it is more certain and also provides a direct means of comparison between the current and the “target” state.

2.38 In my opinion, to be informative in the context of the POP, analyses of water quality state should be based on comparison with Schedule D limits. This approach was agreed upon and used during expert conferencing (refer to item 4 in the record of technical conferencing dated 21 March 2012).

2.39 My evidence in chief provides a comprehensive analysis of water quality state in the Rangitikei catchment, completed by Associate Professor Death’s analysis of ecological variables. Dr Kelly’s evidence also provides an analysis of state of water quality in lake catchments. Different pieces of evidence presented by Horizons Regional Council also provide a comprehensive analysis of water quality and aquatic ecology state (e.g. Ms McArthur’s S42A report). The state of water quality in the “priority” WMZ (i.e. specified in the council decision or contended by an applicant for inclusion as a specified WMZ) was examined by the group of water quality experts present at the 21 March 2012 expert conferencing. It was agreed that the state of water quality within these WMZ required management action within all or parts of each of these WMZ.

Dr Olivier Michel Nicolas Ausseil
18 April 2012