IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of submissions (288) and further submissions (480) by **WINSTONE PULP INTERNATIONAL LIMITED** to the **HORIZONS REGIONAL COUNCIL** on Chapter 6 (water), Chapter 13 (discharges to land and water), Chapter 15 (takes, uses and diversions of water and bores) and Schedule D of the Proposed One Plan

---

EVIDENCE OF PAUL CAMERON KENNEDY

TOMPKINS WAKE
LAWYERS

WESTPAC HOUSE
430 VICTORIA STREET
PO BOX 258, DX GP20031
HAMILTON
NEW ZEALAND
PH: 07 839 4771

Solicitor: L F Muldowney
Counsel: Marianne Mackintosh
Email: mmackintosh@tomwake.co.nz
Fax: (07) 839-4855

INTRODUCTION

1. My name is Paul Cameron Kennedy and I have prepared this statement of evidence on behalf of Winstone Pulp International Limited (WPI).

2. I hold the degrees of BSc and BSc. (Hons) in Botany and Zoology from Victoria University of Wellington and have been involved in environmental research and assessment since 1975. I am a Principal Environmental Consultant with Golder Associates (NZ) Limited a global engineering and environmental consulting company. Prior to December 2006 I had been employed by Kingett Mitchell Ltd since 1985 and was a Director of that Company. I am a member of the New Zealand Water & Wastes Association (Chair Stormwater Special Interest Group) and the Society for Environmental Toxicology.

3. I have undertaken a wide range of environmental assessments that have a bearing on many of the issues that require consideration in relation to my review of matters relating to WPIs submission on the One Plan.

4. I am familiar with the Whangaehu River and waterways in the area as I undertook the preparation of a series of 'pre-assessments of effects' reports (reports that were prepared prior to the preparation of the full Assessment of Effects on the Environment) on the key sections of the Tongariro Power Scheme for Electricity Corporation of New Zealand Limited that led up to the re-consenting of the power scheme. Of these, the Moawhango Pond Assessment (Wahianoa Aqueduct and Lake Moawhango) is directly relevant.

5. I have also been responsible for studies undertaken on the Wahianoa Aqueduct and for an assessment of effects prepared for repair and maintenance work required on the intakes and aqueduct for Genesis Power Ltd. I have also undertaken reviews of the ecology water quality in the tributaries draining into the upper Whangaehu River and have assessed the long term water quality data records held by Horizons for the Whangaehu River. In that work I focussed on the unusual water quality characteristics of the Whangaehu and the longitudinal water quality changes that occur as it flows to the sea.

6. I have undertaken a range of work relating to wastewater disposal for natural resource industries and councils including assessments of discharge impacts of contaminants and nutrients. In the North Island I have undertaken assessments relating to the Huapai, Helensville, Drury, Mangere, Rosedale, Kingseat, Owhanake (Matiatia), Paeroa, Ngatea, Waihi Beach, Clive, Waikanae, Paraparaumu wastewater treatment plants. I have also been involved in assessments and peer reviews for a range of wastewater treatment plants and outfalls elsewhere in New Zealand.

7. I have undertaken work for other natural resource industries including dairy factories, meat works, wool scours and forestry. The latter including studies for the Kinleith Pulp and Paper Mill and the Norske Skog/Tasman mill at Kawerau. In the Horizons Region I have and am assisting or have assisted clients in industries such as carpet manufacture (Feltex Kakariki), dairy (Fonterra Pahiatua) and brewing (DB Mangatainoka).

8. I have published a number of scientific papers and publications (including Chapter 9 - Sewerage network and treatment plant monitoring and Chapter 10 - Discharge monitoring in the "New Zealand municipal and community wastewater monitoring guidelines") in the area of New Zealand ecology and environmental chemistry and have been involved in and prepared more than 400 reports on environmental assessments, impacts and resource investigations.

9. I have read the code of conduct for expert witnesses described on the Environment Court website (Section 5 Environment Court Note 2006; consolidated-practice-note.pdf; last modified 22/11/2007). I have complied with it whilst preparing my written statement of evidence and I agree to comply with it as I give my oral evidence.

10. The evidence I am about to give is within my area of expertise and represents my best knowledge about the land. To my knowledge, I have

not omitted any material facts that might alter or detract from the opinion expressed here.

SCOPE OF EVIDENCE

11. I have read through the extensive body of technical information that has been produced during the last few years supporting the water quality aspects of the One Plan. This information is extremely valuable and has advanced Horizons knowledge of the State of the Environment in the region immensely. This is particularly the case in relation to nutrients which were identified by Horizons as one of the key issues for the region.

12. This evidence has been prepared in respect of the Winstone Pulp Internationals' ("WPIs") submission on the following provisions of the Proposed One Plan (Proposed Plan). In particular I will:

    - Discuss Objectives and Policies 6-1 and 6-2;
    - Policy 6-4 which deals with enhancement where water quality standards are not met;
    - Discuss Schedule D in relation to the submissions made by a number of submitters who recommended that the numeric value should be a guide rather than standards.

13. The purpose of this evidence is to discuss the assignment of management values on an 'across the board' basis to all water bodies and the purpose and effect of applying water quality standards (as set out in Schedule D) to these bodies.

SUMMARY OF EVIDENCE

14. In the following evidence I will comment on a number of matters in the Proposed Plan relating to surface water quality that have a direct bearing on the District and City Councils. The key matters I will highlight are:

    - The standards identified for a range of key non-toxicant parameters are technically robust and will afford a significant amount of

protection. However in some cases they are considered conservative.

- The ANZECC trigger values for toxicants used in Schedule D are not standards and were not intended for that use.
- The ANZECC trigger values identified as standards in the Proposed Plan are the start of an assessment process that is not embodied in the One Plan.
- The ANZECC values used in Schedule D are no-effects based water quality trigger values and as such there is conservatism built into their use.
- There appears to be no process in place for incorporating amendments and changes to the Schedule D water quality 'standards'.
- The macroinvertebrate community indices standards included in Schedule D for the Whangaehu water quality management zone are not appropriate for all of the catchment.

WATER QUALITY OBJECTIVES AND POLICIES

15. I have read the recommended amendments to the water quality Policies and Objectives 6-1 and 6-2. The most significant change made in the August 2009 staff report (Barton & James 2009) is the inclusion of a long term target in relation to Schedule D (now split into Schedule D and Ba). That is:

> *Surface water bodies are managed in a manner which sustains safeguards their life-supporting capacity and recognises and provides for the values set out in Schedule Ba by 2030.*

16. The inclusion of the long term target in Objective 6-1 is important and it reflects commentary made by a number of submitters and commentators. My interpretation of the revision is that the objective relates to the identified values for the Water Quality Management Zones (WQMZs) and not to the water quality standards that have been identified to meet those values. The disconnection of the WQMZ values that were in

Schedule D with the water quality standards means however that the standards which are the benchmarks for the values apply today rather than in 2030.

17. The recommended revision to Objective -2 now states:

Surface water quality is managed to ensure that:
(i) Water quality is maintained or enhanced in water bodies at a level which supports the values of the river water bodies.

18. Objective -2 must be read in conjunction with Policy 6-1 which sets out the management framework. The Policy is now recommended to read:

For the purpose of safeguarding the life-supporting capacity of water bodies and to avoid, remedy or mitigate adverse effects of activities on water quality, water quantity and the beds of rivers and lakes, water bodies in the Manawatu-Wanganui Region shall be managed in accordance with the following framework:

(i) The Water Management Zones and Water Management Sub-zones and Groundwater Management Zones defined in Schedule Ba, Part Ba1 shall be used as the units for integrated management of water bodies;

(ii) Water bodies shall be managed in a manner that recognises and provides for the surface water management values defined in Schedule Ba, Part Ba2;

(iii) Surface water quality shall be managed according to the standards set in Schedule D, which provide for the values defined for each Water Management Sub-zone;

19. Policy 6-3 establishes the expectation that if all the water quality standards in Schedule D are met in a WMZ then they will continue to be met through appropriate management.

20. Policy 6-4 then establishes that:

In each case where the existing water quality does not meet the relevant water quality standard within a Water Management Sub-zone, as shown in Schedule D, activities shall be managed in a manner which maintains or enhances existing water quality in order to meet the water quality standard for the Water Management Sub-zones shown in Schedule D.

21. Although this re-wording has been recommended, Barton & James (2009) have indicated in their Officers Report that information about how this is implemented will be provided in a Supplementary Report. This supplementary information was not available at the time of preparing this

evidence. In the absence of this additional interpretive information my understanding of the Policy is that in circumstances where current or to be consented discharges do not meet Objective 2 then Policy 6-4 provides for a mechanism for a discharger to improve discharge quality/contaminant loads with the aim of meeting the WQMZ value standards as set out in Schedule D by 2030. This is even though the Schedule D standards are not to be exceeded standards as written

22. For most water quality parameters provided in Schedule D, the approach provides benchmarks that can be readily identified and measured that allow a existing consent holder to identify whether they comply or not with the Schedule D standards. For many parameters, meeting the Schedule D standards will not be a load related issue as the effects are typically related to concentration rather than mass load. However, for nutrients the process is considerably more complex and this requires catchment specific assessment. In this evidence, I will focus principally on the appropriateness of the Schedule D toxicity standards.

23. As outlined in Carmen Taylor's evidence, Schedule D of the Proposed Plan contains proposed water quality standards that apply, either on a region wide basis, or which are specific to Water Management Sub-zones and to different types of water bodies (i.e., streams, rivers, lakes etc.,). These standards then underpin, via the policy framework (i.e., objectives and policies) contained in Chapter 6 (Water), the Proposed Plan's approach to the future management of the region's water quality (i.e., namely the requirement to enhance or maintain water quality in order to meet the water quality standards).

24. In their submission, WPI opposed the use of the water quality standards in Schedule D. The request to delete Schedule D was rejected by the Officer's review but as noted by Carmen Taylor, the Officer identified that further discussion would be undertaken to look at whether WPI concerns were met. To date, as I understand it, this discussion has not occurred.

SETTING AND WATER MANAGEMENT ZONES

25. As has been previously described in Carmen Taylor's evidence, the Tangiwai Mill located alongside SH-49 and operated by WPI discharges to the upper Whangaehu River from a pipe structure approximately 700 m upstream of the Tangiwai Rail bridge. WPI is one of the most significant users of the upper Whangaehu River. The townships of Ohakune and Ratehi are located to the west within the drainage catchment of the Mangawhero River which discharges to the lower Whangaehu River.

26. The Whangaehu WQMZ is unique within the Horizons Region. Its uniqueness arises because of its catchment location in relation to Mt Ruapehu. The WQMZ has been broken up into a sequence of sub-zones that are designed to reflect the unique features on the overall WQMZ. Although not directly affecting WPI, I will comment on the nature of the sub zones in the WQMZ.

27. To the west, the sub-zones draining to the Mangewhero River (which enters the Lower Whangaehu River WQM sub zone) drain a catchment not directly affected by catchment runoff coming directly from Mt Ruapehu.

28. The key catchment directly affected by drainage from Mt Ruapehu is the upper Whangaehu (Whau-1a) located between the upper Whangaehu River and the Mangawhero River catchment (Mangawhero 3d). The Whangaehu River is directly affected by volcanic activity on Mt Ruapehu and is well known because of the Tangiwai rail disaster resulting from a lahar that flowed down the river and hit the Tangiwai rail bridge in 1954. The quality of the river is affected by lahars but is also affected by direct discharge from the crater lake and from snow melt affected by volcanic activity. I will discuss the water quality of the river further later in my evidence. Schedule D identifies that the characteristics of the main stem need to be recognised when considering the numeric values in the Schedule. It should be noted however that the Wahianoa River is also within subzone 1a. The river arises from the

Wahianoa Glacier on Mt Ruapehu and as such, the flow in the Wahianoa River is therefore influenced by activity on the mountain and snow melt from the mountain. Although it appears to be influenced by activity on Mt Ruapehu to a lesser degree than the Whangaehu River, the Wahianoa River can become very acidic at times. There are also a number of smaller tributaries in sub-zone Whau 1a that are not influenced by Mt Ruapehu and have water quality similar to adjacent waterways such as the Tokiahuru River.

SCHEDULE D AND THE WATER QUALITY STANDARDS

29. In the following sections of my evidence I will focus on two matters related to Schedule D as it relates to the Whangaehu Management Zones (upper, middle and lower) and their respective sub-zones. I will focus mainly on the upper Whangaehu in the vicinity of the WPI mill and its discharge.

30. I have read the various supporting technical information supporting the standards set out in Schedule D. This material includes Aussiel & Clark (2007) (Recommended Water Quality Standards for the Manawatu-Wanganui Region : Technical Report to Support Policy), McArthur (2009) and Roygard (2009) and the current Officers Report setting out track change recommendations (Barton & James 2009).

31. Aussiel & Clark (2007) note (Section 1.3.1) that sections 70(1) and 107(1) of the Resource Management Act (1991) (RMA) set five narrative standards in relation to permitted and consented discharges. They identified that these standards relate to different potential impacts of a discharge, ranging from visual impact to adverse effects on aquatic life. There are numerous definitions of standards but the section 70 'Rules' about discharge relate in my opinion to non standard matters that cannot be readily controlled by standards (e.g., conspicuous change, production of conspicuous scums, foams, oil and grease films, floatable or suspended material etc) and the prevention of significant adverse effects on aquatic life.

32. In Section 1.4.2, the authors identified:

> *It is recommended the One Plan includes: "Standards, that will define the environmental bottom line beyond which values will be lost or compromised. In other words, the standards will define the bounds within which an activity can occur without compromising the values. They will represent one aspect of the regulatory translation of the values into policies. The definition of water quality standards is the subject of this report.*

33. Furthermore, in Section 3.2.3.9 they noted:

> *The 2000 ANZECC guidelines incorporated the best scientific information available at the time of development. To the best of our knowledge, there are no further comprehensive studies justifying a significant departure from the ANZECC recommendations on acceptable levels of waterborne toxicants. The ANZECC guidelines recommend several levels of protection, depending on the level of disturbance acceptable at the site. These levels of protection correspond to the percentage of species likely to be adequately protected by the corresponding guideline level: 99% is the recommended level for systems of high biodiversity value, 95% for slightly to moderately disturbed ecosystems, and 90% for highly disturbed ecosystems."*

34. Having provided these quotations I will discuss the following matters that I consider are critical to the incorporation of numeric values into Schedule D of the Proposed Plan:

- The purpose of the ANZECC (2000) guidance.
- The status and correctness of the ANZECC (2000) guidance.
- The incorrect use of a range of numeric water quality values in Schedule D.
- The appropriateness of the numeric values for individual parameters as they relate to the management of water quality and values in the Whangaehu management zones.

35. Objective 6-2 of the Proposed Plan sets the direction for the management of surface water quality in the Region. It recognises that the life sustaining capacity of surface water bodies depends to a large extent on the quality of those waters and that the maintenance or enhancement of water quality may be required to support the values of the water body. Policy 6-2 states that the water quality standards in Schedule D are to be used for the management of surface water quality in the manner set out in Policies 6-3, 6-4 and 6-5.

WATER QUALITY STANDARDS AND THE ANZECC FRAMEWORK

36. ANZECC (2000) outlines the management framework recommended for applying the recommended water quality guidelines to marine and fresh waters in Australia and New Zealand. On the very first page of ANZECC (2000) ANZECC note:

> *These Guidelines should not be used as mandatory standards because there is significant uncertainty associated with the derivation and application of water quality guidelines. For example, data on biological effects are not available for all local species; there is uncertainty over the behaviour of contaminants in the field; there is uncertainty in water quality measurements. The user should be aware of this uncertainty when determining if an environmental value has been supported or not. However, the Guidelines should provide a framework for recognising and protecting water quality for the full range of existing environmental values. The Guidelines also provide risk-based decision frameworks wherever possible*".

This is a fundamental point particularly in relation to toxicants which has not been followed to date in their use by regional councils in New Zealand.

37. Section 3.4.3.2 of ANZECC (2000) sets out a decision tree process for applying the guideline values (called trigger values) for toxicants. The trigger system commences at the top of the tree (Figure 3.4.2 in volume 1 of ANZECC 2000) by referring to the initial assessment of acid soluble metal concentrations. ANZECC (2000) also intended that using acid soluble measurements was only the first step in the assessment tree. Following that assessment and comparison with the trigger values, the data would be evaluated further in the hierarchical assessment process in subsequent steps that involve ecological assessment to refine actual impacts if and where they occur. That is, the "trigger values" are intended to trigger more detailed site specific ecological assessment, rather than act as standards. There is no such comparative assessment process embodied in the Proposed Plan.

38. If any reference to ANZECC (2000) is to be made in Schedule D, it would be assumed that analysis of metals and metalloids to compare to the toxicant standards in Schedule D (ANZECC 2000 by default) would be made using an acid soluble extraction. However, whether acid soluble fraction is determined depends on whether toxicity or contaminant load

information is required. For toxicity, the dissolved fraction is more relevant and this is recognised by ANZECC. I am uncertain if the Proposed Plan identifies the methodology to be used.

39. I need to point out that over the last two years there has been discussion about revisions to the ANZECC guidelines in particular those for toxicants and there has also been discussion and work carried out in relation to some of the actual values for toxicants reported in ANZECC (2000). Following discussion about the need for ANZECC (2000) to be revised, a revision process was announced in May 2009 (refer http://www.mfe.govt.nz/publications/water/anzecc-water-quality-guide-02/ for more information). This process is likely to occur through 2010 and into 2011. I am unsure how the Proposed Plan proposes to accommodate changes to Schedule D when revisions to the ANZECC (2000) guidelines occur.

TOXICANTS AND THE USE OF NUMERIC VALUES FROM ANZECC

40. In the last two years, there has also been some technical discussion about the 'accuracy' or 'correctness' of some of the toxicant trigger values in ANZECC (2000) (refer Fitzpatrick 2008, Fitzpatrick and Kennedy 2008). Revisions have been undertaken for a range of toxicants. For example, MfE provide on their website, a copy of the recalculation of the ANZECC (2000) trigger value for nitrate-nitrogen undertaken by Hickey (2002). Recently Hickey & Martin (2009) have prepared another revision dramatically lowering the trigger values for nitrate toxicity. The boron trigger values have also been recalculated (Golder Associates for Solid Energy) and these have been accepted by Environment Waikato and incorporated into consent conditions (refer also Fitzpatrick & Kennedy 2008).

41. As a part of evidence presented to Environment Canterbury (for the Proposed Natural Resources Regional Plan (PNRRP) hearings), Christchurch City Council had a recalculation of the ANZECC (2000) zinc trigger values (95% trigger value of 8.0 mg/m^3) undertaken (by

Golder Associates). The recalculated 95% trigger value for zinc was identified as being of high reliability and the concentration was 23.0 mg/m^3. Similar re-calculation exercises have now been undertaken for elements such as aluminium, cadmium, lead and nickel and ammoniacal-nitrogen. It is important to note that the overall ANZECC approach is not in question only the correctness of the calculation of the trigger values (actually the appropriateness of the data used in the calculations).

42. Overall, the inclusion of any standards for toxicants derived directly from ANZECC (2000) poses several problems for the Proposed Plan. These are:

- The ANZECC (2000) values for toxicants as used in Schedule D are in some cases incorrect and should be revised. Revisions have been prepared and the revisions 'published' for a number of key toxicants in New Zealand.
- The ANZECC (2000) trigger values are in the process of being revised.

THE RMA AND EFFECTS

43. The RMA aims to prevent any significant adverse effects on aquatic life. In selecting the ANZECC trigger values as benchmarks for maintaining water quality and ecosystem well-being in the Proposed Plan, it needs to be recognised that the ANZECC trigger values for toxicants are based on NOEC data (No observable effects data). This level of protection is more conservative that the well known USEPA chronic criteria which provide protection for most aquatic organisms. It was the basis of this approach that ANZECC clearly identified that the numeric trigger values were not standards but were the start of an assessment process (as noted earlier).

44. In addition to the technical reports produced by Horizons staff I have read the evidence prepared for the Proposed Plan hearing by Kathryn McArthur, Dr Gibbs and Dr Quinn who all comment on the use of standards in the Proposed Plan. My comments relate principally to toxicants in Schedule D.

45. In para 219 of evidence, Kathryn McArthur identified the three methods that were used to define the water quality standards for each of the Life-Supporting Capacity classes in the One Plan. It was noted in Ms McArthur's evidence that

> *In the absence of enough data for the first two methods, the application of national or international guidelines or trigger values that provide for a wide range of aquatic species were employed. The use of these three methods is consistent with the recommendations within the ANZECC guidelines (ANZECC, 2000) for deriving localised trigger values (see Figure 3.1.2 in Appendix 1 of this evidence, reproduced from ANZECC (2000)).*

I agree that was generally the approach, but ANZECC identified that that was the process for developing "trigger values" not standards. That point appears to have been missed.

46. Dr Biggs (Biggs 2009) made a useful commentary of the standards in Schedule D in his evidence at para 38. He identified (in relation to nutrients) the difference between effects based guidelines (such as the New Zealand periphyton guidelines) and reference based guidelines (the ANZECC guidelines). However this just confirms that the proposed Plan Schedule D standards are a mixture of the different types. Generally, the effects based guidelines proposed in the Plan (e.g., oxygen demand, temperature, periphyton) are more robust that the guidance values taken directly from ANZECC (2000). The presence of the different types of 'standards' in the Schedule is what makes using the Schedule as presented in the Proposed Plan difficult. If the different approaches used for the standards were taken into account then water quality management would be carried out through the use of standards (like the New Zealand Drinking water standards) and through guidelines (e.g., such as the approach used by ANZECC 2000).

47. In summary, I have significant issues with the adoption of ANZECC (2000) water quality trigger values for toxicants in Schedule D of the Proposed Plan. These are:

- The ANZECC (2000) trigger values are not standards and were not intended for that use.

- The ANZECC trigger values are the start of an assessment process that is not embodied in the Proposed Pan.
- The ANZECC values are no-effects based water quality trigger values and as such there is conservatism built into their use.
- There appears to be no process in place for incorporating amendments and changes to the Schedule D water quality 'standards'.

SPECIFIC COMMENTS ON WATER QUALITY STANDARDS

48. Schedule D provides numeric not to be exceeded values for a number of key water quality parameters. These are:

- pH.
- temperature.
- Dissolved oxygen.
- Biological oxygen demand.
- Particulate organic matter.
- Dissolved reactive phosphorous (DRP) and soluble inorganic nitrogen (SIN).
- Ammonia.
- Toxicants (specified as set out in ANZECC (2000).

49. In evidence Dr Quinn made supportive comments about the approach the Proposed Plan has taken as well as the work undertaken. I would generally support those comments. Dr Quinn made particular reference to expressing standards as "shall not be exceeded limits". Dr Quinn identified that he supported the Proposed Plan approach of using maximum values (without percentiles specified) for attributes that have potential lethal effects on biota, such as maximum temperature, minimum dissolved oxygen and ammonia. However, I would note that

the numeric values identified in Schedule D for ammonia-nitrogen are no-effects values and values at that concentration do not have potential to cause lethal effects on aquatic biota. I will discuss ammonia in more detail below.

50. Dr Quinn discussed the allowance of breaches (refer Ausseil & Clark 2007) of the maximum numeric values in Schedule D and indicated on page 23 of evidence that he would see advice on interpretation of such exceedence being presented in "the supporting document". I have not to-date seen any further information supporting such an approach. In my reading of various expert evidence provided in support or review of Horizons technical work in this area I identified several places where an acceptable exceedance or breach system may be appropriate. The current tracked change version of Schedule D still notes for toxicants that "the concentration of toxicants in the water shall not exceed the trigger values defined in the ANZECC guidelines table etc.". The current wording of Policy 6-4 appears to reflect the allowance of Schedule D standard exceedences but does not provide information about what the expectations would be when interpreting these.

pH

51. Schedule D identifies that the main stem of the Whangaehu River is exempt from the pH standard of 7-8.5 due to the influence of acidic waters from Mt Ruapehu. I would note that this exception should not just apply to the main stem of the river as there are a number of tributaries that drain to the Whangaehu River that are also affected by acidic effects associated with activity on Mt Ruapehu.

52. There have been a wide range of studies on the water quality and pH of the Whangaehu River and its tributaries. Deely & Sheppard (1996) summarised Regional Council data and undertook longitudinal sampling noted that in 1992, the pH was seen going from a low of just above pH 2 in January and February to a high of pH 7 over the period April through June and then back to acidic conditions in August. Smith & Fowles (1980) reported the results of the Rangitikei-Wanganui Catchment Board

and Regional Water Board carried out during 1976, 1977 and 1978. This work included surveys along the length of the river, of the inflows and during storms. The work showed that the pH in the river is variable and at times the pH can be at and near neutral. In the period 1975 through 1982, the pH of the river at Tangiwai was at or above pH 6 for at least half of the year. That is it had a relatively normal pH. Since 1982, the percentage of the time that the pH has been below pH 6 has increased. This appears to have resulted from activity on Mt Ruapehu at that time.

53. Surveys in November 1976 showed that the river was acidic above the aqueduct (about pH 4) and as tributaries inflow, the water became less acidic and the water returned to a pH around 7.5 at and below the inflow from the Tokiahuru Stream. In a further survey in March of the following year (1977), the pH in the river above the aqueduct was 2.7. Downstream, the pH improved slightly (2.7 to 3.5) until the inflow from the Tokiahuru which increased the pH to about 4.5 and then the inflow from the Mangawhero River (160 km downstream) where the pH increased to 7.0.

54. Water quality surveys of all of the upper river tributaries have shown that the Wahianoa River, like the main stem of the Whangaehu River, is also subject to pH changes but less so that the main river. Carr (1978) indicated that it was likely that the Wahianoa River was somewhat more protected from the effects of volcanic activity on the mountain than the Whangaehu River. The Wahianoa should be identified as an exception as well.

Temperature

55. Although I appreciate the importance of maintaining good ambient water temperatures in freshwaters, water temperature variation is complex and affected by a variety of factors. Horizons technical reviewers (e.g., Dr Quinn) noted that the temperature standards required more definition; in particular what the temperature differential was compared against. Dr Quinn identifies the use of reference sites which is an approach often used (e.g., by ANZECC). However, in catchments with poor riparian

vegetation this can pose significant constraints on a discharger if water temperatures were generally low and not near critical temperatures. Overall, there is a need to control upper maximum temperatures and temperature change. If the 'standards' for particular WQMZs are able to be modified in certain circumstances through the consent and impact assessment process then the limitations may provide useful environmental benchmarks.

56. After reviewing the application of the <2°C and <3°C change I have some difficulty in the justification of applying a stricter limit of <2°C in some WQMZs. In my opinion, the allowable change should be left as a single <3°C change. The Schedule D temperature maximum values should be defined in relation to whether they are instantaneous, daily maximum or averages.

57. Overall, there is a need to control upper maximum temperatures and temperature change. If the 'standards' for particular WQMZs are able to be modified in certain circumstances through the consent and impact assessment process then the maximum limitations may provide useful environmental benchmarks. However, I would recommend that the temperature change identified for temperature be simplified to a single value, 3°C.

Dissolved oxygen, BOD and POM

58. Dissolved oxygen is a fundamental water quality parameter but many fish and invertebrates are moderately insensitive to lowered dissolved oxygen. Having said that, the WQMZ minimum limits are relatively pragmatic and account for lowered saturations in waters in some parts of the region.

59. Biochemical oxygen demand (corrected from the notified version of Schedule D as recommended in the Officer's Report) is probably a more important water quality constituent as it has a direct bearing on dissolved oxygen concentrations in waterways. The revised Schedule D now proposes that BOD be assessed as soluble $cBOD_5$ rather than total. This

measure is generally more appropriate than total $cBOD_5$ but my preference would be to ensure that total $cBOD_5$ is also measured in discharges to assess total BOD_5 entering waterways (this could be included as an advisory note in Schedule D) especially if modelling is required to predict dissolved oxygen consumption in waterways impacted by particulate discharges. The proposed particulate organic matter (POM) limits proposed in Schedule D have been put forward to overcome total $cBOD_5$ measurement needs and protect river beds from effects of POM. I concur with the removal of the lower of the two POM limits as noted in the recommended revisions to Schedule D (Officers Report). I note that the POM value is a maximum and does not allow for any natural POM which may have different oxygen demand characteristics.

Ammonia

60. Ammoniacal-nitrogen is a relatively complex parameter for which a considerable amount of technical work has been undertaken by Horizons staff. There has also been a range of comments made by technical reviewers. The numeric values used in Schedule D are derived from ANZECC (2000) and were developed by ANZECC as guidelines not as standards as set out in Schedule D. This is not discussed in the technical support for the ammoniacal-nitrogen standard in Schedule D.

61. I have read the technical support assessment in Ausseil & Clarke (2007) (section 3.2.3.8) and the comments made by the technical reviewers who appear to support the numeric values identified. It is my opinion that the approach taken and the results obtained and promoted as standards to protect aquatic biota from the adverse effects of ammoniacal nitrogen toxicity are extremely conservative and should be changed. The conservatism arises from the manner by which the calculations were carried out and the use of the ANZECC (2000) numeric values which were NOEC values and identified only as trigger values for further assessment.

62. The conservatism in the numeric values arises as both Horizons staff and technical reviewers consider that pH should not or does not need to be taken into account in the Horizons standards. Simplifying the standard because pH may be difficult to assess (as noted by Dr Wilcock para 51) is not a technically sound reason for not including this as a variable in assessing ammoniacal nitrogen effects. The difference in acceptable NOEC derived trigger values in ANZECC (2000) changes significantly from 0.400 g/m^3 at pH 8.5, 0.90 g/m^3 at pH 8.0 to 2.18 g/m^3 at pH 7.0. Essentially the Horizons approach has been to utilise the trigger value at pH 8.0 and assume that as this covers the 95thpercentile of all receiving pH data and also covers the 95th percentile of all temperature data that is a robust standard. In a situation where a water body has lower pH (e.g., 6.5-7.5) naturally then a standard of 0.4 g/m^3 would be roughly 50% of what ANZECC (2000) indicates would be a suitable trigger value. As such the Horizons approach is in my view very conservative.

63. Overall, the method of defining the Horizons ammoniacal-nitrogen trigger value is very conservative and will provide significantly more protection from potential toxicity than required. The ANZECC (2000) trigger values are in themselves conservative. This coupled with the use of the ANZECC trigger values as not to be exceeded standards is not appropriate. I would recommend that in the interim the ANZECC (2000) trigger values for ammoniacal-nitrogen be used in Schedule D. Alternatively the ammoniacal-nitrogen trigger values can be re-calculated to ensure that they are robust and up-to date.

Nutrients - DRP and SIN

64. The Schedule D standards contain effects based guidelines based on the information contained in Biggs (2000) (refer Biggs 2009 for a more detailed discussion as to how the Schedule D values were determined).

65. Concentrations of DRP in the upper Whangaehu River appear to be vey low and SIN concentrations have been measured up to values similar to the proposed limit for the upper Whangaehu River Sub-zone (0.062 g/m^3

in the river compared to 0.07 g/m^3 recommended standards). As such, based on existing data, the upper Whangaehu River already carries sufficient SIN concentrations at times (in the absence of anthropogenic inputs) that the river could be considered at capacity. This obviously has implications for dischargers in other parts of the whole Whangaehu River WMZ. This is similar to issues that arise in catchments/rivers with natural elevated DRP concentrations.

Toxicants

66. I have made a number of comments earlier in my evidence about the ANZECC (2000) guidelines which applied mainly to toxicants. The insertion of the ANZECC (2000) trigger values directly into Schedule D does not account for the reliability status of the trigger values developed by ANZECC which range from low to high depending upon the quality of the data used to calculate them

67. In relation to sulphide in waters, USEPA (1986) considered that the aquatic hazard from hydrogen sulfide was often transient and localised and that 'concentrations in excess of 2.0 mg/m^3 would constitute a long-term hazard', but this was based on earlier data. Some waters in the region may contain naturally elevated concentrations of hydrogen sulphide derived from geothermal waters or volcanic activity. The Whangaehu River may contain elevated sulphide at times with concentrations of >20 mg/m^3 being recorded.

68. The differences between toxicant trigger values in ANZECC (2000) and those derived from recent re-calculations are in some cases minor but in some they are large and have significant implications in relation to water management. The example of zinc described earlier is a good example.

69. Overall, I would recommend that the status of the numeric values for toxicants in the Proposed Plan be changed to guidelines.

FRESHWATER ECOLOGY

70. The aquatic ecology of the Whangaehu River is highly modified as a result of natural chemical contamination from the crater lake on Mount Ruapehu. The contamination from the crater lake, and the highly disturbed nature of the river (including lahars) results in very low benthic invertebrate diversity and abundance in the river.

71. Macroinvertebrate surveys have been carried out on several occasions in the Upper Whangaehu River. The early work of Wells & Fowles (1980) showed that the upper river contained low abundances of chironomids, craneflies, *Oxyethira* caddisflies, and *Zelandobius* stoneflies and concluded that species recorded in the upper reaches of the Whangaehu River probably originate as drifting organisms from tributary streams with cleaner water quality.

72. Bioresearches (1985) reported a total of 3 taxa in samples collected in the river (at the Tangawai Rail Bridge above WPI) and a total abundance of 4 individuals in five samples. Kingett Mitchell recorded similar results to those reported by Bioresearches in a 2006 survey with low invertebrate diversity and abundance. Mean MCI values recorded at the upstream sites (U1 and U2) were indicative of poor water quality (MCI <80). There was large variability in the mean %EPT values recorded with 10 and 40% at the two sites. High %EPT variability was due to low total abundances recorded and the influence of a few EPT individuals representing a high proportion of the community. No more than five EPT individuals were recorded at any one site.

73. At times when the Whangaehu River and other waterways such as the Wahianoa are subject to acidic events (e.g., pH 2-4), the river may contain no macro-invertebrates. Following these events the rivers re-adjust with colonists entering the rivers from drifting invertebrates sourced from refugea and tributaries with unaffected water quality.

74. This low macroinvertebrate density and abundance makes the ecological indices (e.g., MCIs) that are regularly used for the assessment of the

condition of biological community quality in effects assessments less reliable. The revised Schedule D uses the MCI as a measure of the state of the macroinvertebrate community and sets a standard of 120 in the upper Whangaehu WNZ and a range of 100-120 in other WMZs within the overall catchment. It is evident that the MCI set as the ecological standard for this catchment has not been set appropriately in Schedule D as the MCI in Whau-1a and further downstream can range from 0-80 naturally. Sub-zones likely to be affected by activity on Mt Ruapehu resulting in lowered MCIs are Whau 1a, Whau-2, Whau-3a and Whau-4.

75. Overall, I recommend that the MCI value for the Whangaehu WQMZ be amended or tagged (as for pH) to allow for natural variation.

Periphyton

76. I note that in the revised Schedule D recommended by the Officers Report, the periphyton measures have been simplified to remove % cover keeping the measurement of chlorophyll-a. Although the periphyton standards have been developed using the extensive background of Biggs (2000), the % cover standards provided a useful semi-quantitative means of assessing periphyton abundance without resorting to laboratory analysis.

77. I would observe that the Whangaehu River WQMZ has periphyton chlorophyll-*a* biomass standards identified of 50 mg/m^2 increasing to 200 mg/m^3 in the middle and lower sections of the river. Although, chlorophyll-*a* concentrations in periphyton biomass appear to be low in the upper Whangaehu River (<2 mg/m^2 Chlorophyll-*a*) there is very little actual data.

78. However, in identifying very low periphyton chlorophyll-*a* standards for the upper Whangaehu River, the standard does not take into account the fact that the periphyton guidelines are typically set to protect aquatic habitat values and macroinvertebrate community values. In the upper section of the river, the benthic ecological community is unique in its low abundance and diversity. This WQMZ is however relatively complex

containing rivers such as the Wahianoa and the Whangaehu which can be naturally depauperate at times and other tributaries that are not depauperate. As such, the standard is a strict effects based guideline that does not make allowance for situations where elevated periphyton biomass may have little adverse effect on in river biological communities.

SCHEDULE D OVERVIEW

79. In the previous sections of my evidence I have discussed a number of aspects relating to the numeric values incorporated in Schedule D of the Proposed Plan. Schedule D has been incorporated into the Proposed Plan as not to be exceeded numeric values. Changes to Objectives and Policies of the Proposed Plan now identify these standards as an integral part of the attainment of identified water quality values by the year 2030. However the standards in Schedule D still appear as not to exceed values.

80. The numeric values incorporated into Schedule D have been derived from a number of sources. These include New Zealand specific effects based numeric water quality guidelines and the ANZECC (2000) trigger values. The latter being used in Schedule D to provide numeric values for toxicants. The inclusion of the ANZECC (2000) numeric values as standards in Schedule D is not considered appropriate in my opinion. Even with the identification of agreed trigger value levels for the protection of aquatic biota (e.g., 95, 99%) for a given water management sub-zone, it is my view that there are sufficient concerns about how robust many of the toxicant trigger values that they should not be used as standards. As discussed the trigger values were not developed by ANZECC as standards and this was specifically identified by ANZECC.

81. The ANZECC (2000) numeric values are currently under complete revision. Re-calculations of toxicant trigger values in New Zealand has shown that for some, the changes in values are significant. Inclusion of some numeric values into Schedule D will result in conservative constraints being placed on some discharges. Although toxicants are not

a significant issue in the region compared to nutrients, these issues reflect poorly on the effort that Horizons have put into the water quality management aspects of the Proposed Plan. I recognise that Schedule 1 of RMA precludes the simple amendment of values in the Schedule unless a Plan Change Process is followed. However, If the numeric values remain in Schedule D I would recommend that the some process is found that allows Proposed Plan to accommodate revisions to the numeric values where changes have been promulgated by ANZECC. The simplest option may be to not include any specific values from ANZECC (2000) but to require that the guidelines utilise values from ANZECC (2000). This is currently complicated by many of the current the ANZECC (2000) values being technically incorrect.

82. Overall, given the numeric values in Schedule D, it is my view that the standards in the Schedule should not all be used as standards in the strictest sense. Given that the Objectives of the Plan appear to allow for exceedance of the values and Schedule D wording has also been adjusted to remove the "shall not exceed" references, the numeric values are in my opinion water quality goals. This is particularly the case for some constituents such as dissolved nutrients where water quality currently exceeds the numeric values.

CONCLUSION

83. In my evidence I have focussed on the use of Schedule D in the management of water quality in the region through the Proposed Plan. The key matters that I have identified that are likely to have a significant bearing on users of the Proposed Plan and in particular dischargers such as WPI are as follows:

84. The standards identified for a range of key non-toxicant parameters are technically robust and will afford a significant amount of protection. However in some cases they are considered conservative.

85. The ANZECC trigger values used in Schedule D are not standards and were not intended for that use.

86. The ANZECC trigger values identified as standards in Schedule D of the Proposed Plan are the start of an assessment process that is not embodied in the One Pan.

87. The ANZECC values used in Schedule D are no-effects based water quality trigger values and as such there is conservatism built into their use.

88. The standard for ammoniacal nitrogen identified in Schedule D is in my opinion very conservative and does not reflect was intended when the original trigger value was identified.

89. There appears to be no process in place for incorporating amendments and changes to the Schedule D water quality 'standards'. I would recommend that this be explored further to confirm whether there are any alternatives other than making direct reference in the Proposed Plan to ANZECC (2000) or current version to allow changes to be accommodated (given that there may well be significant changes within 24 months).

90. The MCI standards incorporated into Schedule D for the Whangaehu WQMZ are not appropriate for the zone due to the naturally variable and low MCI values that occur there.

Paul Kennedy

19 October 2009

REFERENCES

ANZECC, 2000: Australian and New Zealand guidelines for fresh and marine water quality 2000. Australian and New Zealand Environment and Conservation Council.

Barton, C.; James, N. 2009: Planning Evidence and Recommendations Report. Planners Report on Submissions to the Proposed One Plan – (a) Chapter 6 – Water (b) Chapter 13 - Discharges to Land and Water; (c) Chapter 15 - Takes, Uses and Diversions of Water and Bores; (d) Chapter 16 - Structures and Activities involving Beds of Rivers and Lakes, and Artificial Water Courses and Damming; and (e) Schedules B, C and D. August 2009.

Bioresearches, 1985: Ecological assessment of the impact of a pulp mill effluent on the Whangaehu River. Preliminary draft report prepared for Winstone Samsung Ltd. October 1985.

Biggs, B. J. F. 2000: New Zealand periphyton guideline: Detecting, monitoring and managing enrichment of streams. New Zealand Ministry for the Environment, Wellington, June 2000.

Biggs, B. J. F. 2009: Section 42A Report of Dr Barry John Franklyn Biggs on behalf of Horizons Regional Council.

Carr, R. G. 1978: An investigation of contamination of the Wahianoa River, Tongariro Power Development. Report prepared by Engineering geology Section, New Zealand Geological Survey, Department of Scientific and Industrial Research. February 1978.

Deely, J. M.; Sheppard, D. S. 1996: Whangaehu River, New Zealand: Geochemistry of a river discharging from an active earlier lake. Applied geochemistry 11:447-460.

Fitzpatrick, M. 2008: A Review of the ANZECC 2000 Trigger Values for Zinc. NZWWA Stormwater Conference, Rotorua.

Fitzpatrick, M.; Kennedy, P. 2008: Re-evaluation of ANZECC 2000 trigger values in the New Zealand setting. 5th SETAC World Congress, Sydney 3-7 August 2008

Fowles, C. R. 1982: Water quality baseline data for the Rangitikei catchment board region. Rangitikei Wanganui Catchment Board and Regional Water Board report.

Hickey C. W. 2002: Nitrate guideline values in ANZECC 2000. Memo to James Court, MFE Date: 30 September 2002.

Hickey C. W.; Martin M. L. 2009: A review of nitrate toxicity to freshwater aquatic species. Environment Canterbury Report R09/57, June 2009.

Kennedy, P. 2003: The effects of road transport on freshwater and marine ecosystems. Report prepared by Kingett Mitchell Ltd for Ministry of Transport. October 2003.

Kingett Mitchell, 1999: The Wahianoa aqueduct assessment of effects. Report prepared by Kingett Mitchell & Associates limited for Electricity Corporation of new Zealand July 1999.

McArthur, K. 2009: Section 42A Report of Mrs Kathryn Jane McArthur on behalf of Horizons Regional Council.

Roygard, J. 2009: Section 42A report of Dr Jonathan Kelvin Fletcher Roygard on behalf of Horizons Regional Council. August 2009.

Wells, P. C.; Fowles, C. R. 1980: Water resources of the Whangaehu River. Rangitikei-Wanganui Catchment Board. November 1980.