IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of applications for resource consent by various applicants to take and use water from the upper Waitaki River Catchment.

SUPPLEMENTARY STATEMENT OF EVIDENCE OF JONATHAN PETER BRAY ON BEHALF OF THE DIRECTOR GENERAL OF CONSERVATION

Dated: Friday 27 November 2009

Canterbury Conservancy
Department of Conservation
Level 4 Torrens House
195 Hereford Street
CHRISTCHURCH 8011
Tel 03 371 3700
Fax 03 365 1388

511202

Introduction

1 My full name is Jonathan Peter Bray.

2 I hold the position of Technical Support Officer for the Department of Conservation, and have been employed by the Department since October 2008. I am a PhD candidate at the University of Canterbury, and hold the qualifications of Masters of Science with Honors in Freshwater Ecology, Bachelor of Science (Ecology/Evolutionary Biology) from the University of Canterbury, and have a National Diploma in Science (Biology, Microbiology and Chemistry) from Christchurch Polytechnic Institute of Technology.

3 I have published in a peer reviewed scientific journal, and have assisted in producing a number of scientific documents, both as a primary author and co-author. I have presented scientific findings at the New Zealand Freshwater Sciences Society conference, of which I am a member. I have also worked as a Freshwater Ecologist for Aquatic Ecology Limited, a Christchurch based consultancy. I am a member of the Environment Canterbury led, Fish Barriers Working Group, and a member of both the Department of Conservation's Mudfish and Non-migratory Galaxiid Recovery Groups.

4 I have a degree of familiarity with the Upper Waitaki catchment and its freshwater ecosystems and I am familiar with the threatened fish species within this area, having carried out monitoring on these species and otherwise assisting with their recovery.

5 I confirm that I have read the Environment Court's Code of Conduct for Expert Witnesses and I agree to comply with it. In preparing this evidence I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

6 Since preparing my evidence in chief, a substantive amount of further information has been provided by the applicants. That further information has allayed some of the concerns I expressed in my evidence in chief, however I do still have some major remaining concerns regarding potential effects on water quality, and how these might be addressed in conditions if the Committee is minded to grant the consents sought. I have also read Dr Allibone's statement of evidence, Mr Ravencroft's supplementary statement of evidence, and Mr. Murray's statement of evidence on behalf of the Director-General of Conservation, and I agree with their conclusions.

7 In this supplementary statement, I discuss the following particular issues:

a) The current state of the environment and the monitoring undertaken to date;

b) The periphyton guidelines and threshold set which has been adopted by the applicants' water quality experts;

c) Mitigation and suggestions on how these issues could be addressed through conditions, if the Committee is minded to grant the consents sought, including comments on proposed conditions; and

d) My overall conclusions.

The state of the environment and the monitoring undertaken to date

8 I agree with Dr. Ryder (Rebuttal evidence paragraph 2.4 and 4.1) that taking into account recent data, 'stream health' appears quite variable. This variability will be associated with changing agricultural practices within the stream catchments of concern, indicated by data available.

9 However, the way in which Dr. Ryder has represented the figures in his rebuttal evidence, while valid, may be represented another way, where the 'quality classes' of the QMCI scores are considered (Stark and Maxted 2007, Appendix Table 1). This demonstrates that although stream health is variable, many stream systems may still be considered to have very *high* stream health, and further some may be seen to have rapidly *declining* in health in recent years. The Ahuriri River is one such example.

10 I have attached to my evidence a series of graphs, many of which are the same but differ in how stream health is represented, as in Dr Ryder's rebuttal evidence. Ratings of "Excellent" (above 5.99), "Good" (5 – 5.99), "Fair" (4 to 4.99), and "Poor" (below 4) have been used to more clearly outline stream health (Stark & Maxted, 2004, 2007) (Table 1). Where the quality is above "Clean" as referred to in Dr Ryder's figures, I have labelled this "Excellent". In terms of the Ahuriri River, I note that in December 1999 it scored nearly 7 (well above what may be considered excellent stream health), but as at December 2008, it scored only 4.98 (placing it within the "Fair" category).

11 I agree with Dr. Coffey that variable stream health may also be noted where the periphyton community is considered. Taxa indicative of higher concentrations of nutrient inputs and high biomass do indeed indicate already nutrient impacted streams (Coffey et al. 2008; 2009), which is in contrast to earlier findings (for example Wilks and Norton 2007).

12 Given that existing farming practices appear to have already had an impact on existing water quality, and a ~350% or ~4.5 fold increase in irrigated land area is proposed (Appendices; Coffey 2008; 2009), there is potential for significant impacts on stream health to occur.

Setting periphyton thresholds to minimise impacts

13 I would like to comment briefly on the method for adopting a 25% increase in maximum periphyton biomass in the GHD report as an acceptable threshold, and the resulting uncertainties with adopting such an approach.

(1) Methodology

14 Dr. Coffey has stated "*The 25% increase threshold has been adopted as this level of increase would not be perceptible or constitute a significant adverse effect above current conditions* (GHD 2009a, page 58).

15 I question the validity of using the periphyton guidelines (MfE 2000) within the upper Waitaki, and further query the validity of the particular threshold set. Using periphyton in this manner *without* setting this threshold with ecological integrity in mind, and quantitatively linking a threshold such as the proposed 25% increase (blanket threshold, although I understand there is an exception proposed for the Ahuriri) to actual nutrient enrichment may potentially lead to degradation of the freshwater environments in the upper Waitaki.

16 The MfE guidelines state "*it is important that the background soluble nutrient concentrations coming into the reach of interest are thoroughly evaluated. This will usually involve monthly sampling for a year to characterise temporal dynamics and get an estimate of the mean concentrations. This will provide the basis for nutrient supply*

calculations associated with any discharges in relation to the instream management objective and associated guideline biomass." (MfE 2000, page 104).

17 I would also suggest that this monitoring data is needed to properly assess the suitability of using these guidelines within the upper Waitaki generally, where a number of factors exist that could make them less applicable, for example a) very low background nutrient conditions (GHD 2009a), b) the broad scale of Didymo spread and its continued spread, c) the specifics of the hydrologic regime within the upper Waitaki, d) the difficulties in linking nutrients to periphyton biomass in streams because (from MfE 2000):

a) biomass accrual and loss process are dynamic

b) Concentrations measured are usually those measured after periphyton has 'taken up' what they require and thus don't represent supply concentrations

c) The difficulty of identifying upwelling zones to quantify local supply.

These matters need to be carefully considered.

18 It appears that the blanket (Ahuriri exception) 25% increase in periphyton biomass has not been set as the guidelines have proposed. It has been proposed without annual biomass data (no mean average), or without tying this into existing nutrient concentrations, among other physicochemical parameters (MfE 2000). The data was furthermore collected where biomass may have been at a seasonal high. Basing a threshold on a seasonal high, where biomass is know to already be nutrient impacted and setting the threshold based on aesthetic 'nuisance levels' may allow significant ecological degradation.

19 As per the guidelines the threshold must be effects based, i.e. where a given level of periphyton biomass is exceeded, this is due to a known level of nutrients. This threshold should be set in order to maintain suitable levels of biological integrity, benthic biodiversity, aesthetic/recreation, and/or trout habitat and angling (MfE 2000).

20 In addition, given the importance of this environment for rare and endangered fish species as Mr Ravenscroft and Dr Allibone explain in their evidence, I believe that the threshold should be set to minimise impacts on ecological integrity of receiving

freshwater environments as an instream management objective, but critically so that no material impact occurs to the habitats of *Galaxias cobitinis* and *G. macronasus* occurs.

(2) Uncertainties regarding effects

21 I disagree with the statement in the GHD report (2009a) that a "*25% increase threshold ~ would not be perceptible or constitute a significant adverse effect above current conditions*" given so little information is available on the likely impacts to alluvial spring fed streams which is a primary habitat of two threatened fish species.

22 Long term studies at specific sites need to be carried out to assess likely impacts of diffuse nutrients within these spring heads (on periphyton and macrophytes) and then how this impacts the habitats of these taxa.

23 The sampling to date has been undertaken at 26 sampling sites 11 of which were also sampled in 2008 (refer GHD Summary Report, Figure 9). However, given the limited temporal spread of sampling effort I believe repeated sampling needs to occur at these sites to properly assess mean annual maximum biomass (Dr. Coffey rebuttal evidence paragraph 5.02), and then reassess how this fits with guidance given within the guidelines.

24 Within the Ahuriri, as with a number of other catchments, nutrient deficits are required to maintain the status quo (lake trophic level). For example within the Ahuriri deficits of 10.7 kg nitrogen and 1.1 kg of phosphorus are required for every hectare of proposed or renewed irrigation (GHD 2009a).

Mitigation, thresholds and suggestions:

25 In my opinion, the Mitigations Toolkit has been thoroughly prepared, and proposed Farm Environmental Management Plans (FEMPs) have been comprehensively developed, identifying a range of risks (e.g. Section 4.3 Killermont FEMP), and generally proposing a high level of mitigation.

26 I do however note a number of areas of concern. My concerns, and some suggestions for addressing these concerns include the following:

(a) The periphyton guidelines are one means of assessing ecological integrity/stream health and nutrient enrichment, others could, and should be employed (See section 2.2 of Hayward et al. 2009). These may include the use of ANZECC guidelines (GHD 2009a), MCI type indicators (Stark and Maxted 2004), dissolved oxygen and temperature could also be considered (Hayward et al. 2009).

(b) In my view, further survey and delimitation work needs to be carried out within the upper Waitaki to ascertain better the areas where threatened fish species occur, in particular in relation to areas of intensification.

(c) In agreement with Mr. Potts evidence (paragraph 34), within the upper Waitaki temperatures may be cool for much of the year, soils may be porous and thus infiltration fast, and soils may have low carbon concentrations. This may mean the moist anoxic conditions necessary for denitrification do not exist. This will impact on rates of denitrification and may mean, within this environment, mitigation measures with denitrification as a mechanism, may be insufficient to attenuate the large flux of nitrogen to ground and surface waters.

(d) Subsurface flow and drainage is frequently the major pathway of nitrogen transport from intensive agriculture. Subsurface drains can develop and provide routes for the rapid transport of pollutants from soils during high water table conditions, rendering riparian margins ineffective (Muscutt et al. 1993; Parkyn 2004). Therefore, I consider that allowances for this type of nutrient transport need to be factored into the mitigation proposals.

(e) A range of factors also need to be considered when setting riparian zone widths (reviewed in Parkyn et al. 2000). Width and vegetation (as discussed below), topography, slope, soils and drainage, buffer age (time since establishment and longevity).

(f) Riparian buffers can also take many years before they become effective. Where this is the case, and more stock is placed on farms before buffers are effective at nitrogen and phosphorus removal, significant impacts may be expected in the short term (Parkyn et al 2000). I would therefore recommend that riparian buffers are created a minimum of two years in advance to any increases in stocking, allowing growth and root mats to develop.

(g) The vegetation generally suggested for riparian buffers is a mixture of native grasses, woody canopy species and understory species (Parkyn et al. 2000).

However canopy species may not be typical of the upper Waitaki terrestrial environment (pers. comm. N. Head). Using species that do not naturally occur within this landscape would alter the instream communities. Furthermore, planting unsuitable species that may not grow well, given the generally harsh environment, will also impact on buffer efficiency. Where this is the case natural tussock grassland and shrubland buffer strips should be employed wherever possible as they are more likely to protect the natural ecological integrity of the ecosystem per se. Furthermore species adapted and common (Matagouri, a nitrogen fixer, and tussock grasses) may be less efficient at removal of nutrients such as nitrate and phosphorus than other native woody species.

(h) Given the above, a 5 metre minimum distance for riparian zones may be completely insufficient to intercept the majority of dissolved Nitrogen and less than 10 metre widths may still not significantly protect some streams (Parkyn et al. 2000; Parkyn 2004). Some studies have shown that buffers 20-30m wide achieved close to 100% nitrate removal (Fennesy and Cronk 1997) and where they are larger are far more likely to be self maintaining (Parkyn et al 2000). Therefore, I would recommend significantly greater riparian widths than proposed.

(i) The restrictions and mitigation measures in the proposed FEMPs only apply to the areas within the FEMP, however it appears that stock may be grazed outside these areas. These same measures should apply across all areas where stock are to have access.

(j) The use of created wetlands, swales draining to wetlands, denitrification treatment walls or denitrification beds (Schipper and Vojvodic-Vukovic 2000), could be also be considered as an alternative where there is uncertainty about the performance of mitigation methods or where mitigation is found to be ineffective through the monitoring/auditing later. In short, specific engineering solutions may also be considered over and above those already considered to minimise nutrient losses.

(k) It is important that FEMPs and proposed consent conditions are clear, binding and enforceable.

(l) I also support the suggestion that Dr Allibone makes in his evidence that where levels set in conditions are exceeded, the conditions need to require abstractions/discharges to cease until a specified period after the required levels are regained.

Conclusions

27 With degraded and variable stream health already noted in a number of waterways within the upper Waitaki, and given the known impacts of intensive agriculture of this nature, the proposed increase in irrigated land will have impacts both on individual ecosystems and the upper Waitaki as a whole. The extent of these impacts is however currently uncertain.

28 It may be noted that there have been relatively rapid declines in stream health from the information and reports supplied (ECan data, and differences between the conclusions of Coffey et al. 2008; 2009 and Wilks and Norton 2007). The cause of decline requires further investigation.

29 Given the fact that nutrient deficits are required in a number of catchments, and that there are foreseeable impacts on the habitats of highly threatened species, and potential impacts have not been fully investigated, it is my view that caution should be applied in considering these consent applications.

30 If the Committee it is minded to grant the consents sought, I would recommend that it takes care in ensuring that that the measures in conditions will in fact work on the ground. As I have noted, while some things may appear fine "on paper", the reality may well be quite different, and the effects may well be much more difficult to manage than the applicants' experts anticipate.

Jonathan Bray
27 November 2009

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Appendices:

Table 1: Interpretation of MCI-type biotic indices (from Stark and Maxted 2007).

Stark & Maxted (2004, 2007) quality class	Stark (1998) descriptions	MCI MCI-sb	SQMCI & QMCI SQMCI-sb & QMCI-sb
Excellent	Clean water	> 119	> 5.99
Good	Doubtful quality or possible mild pollution	100–119	5.00–5.90
Fair	Probable moderate pollution	80–99	4.00–4.99
Poor	Probable severe pollution	< 80	< 4.00

All water quality data was supplied by ECan, from set monitoring sites monitored regularly, and from sites surveyed or monitored less frequently.

Figure 1.QMCI scores from Ahuriri Stream (ECan monitored site). Note apparent declines in QMCI scores 2007-08.

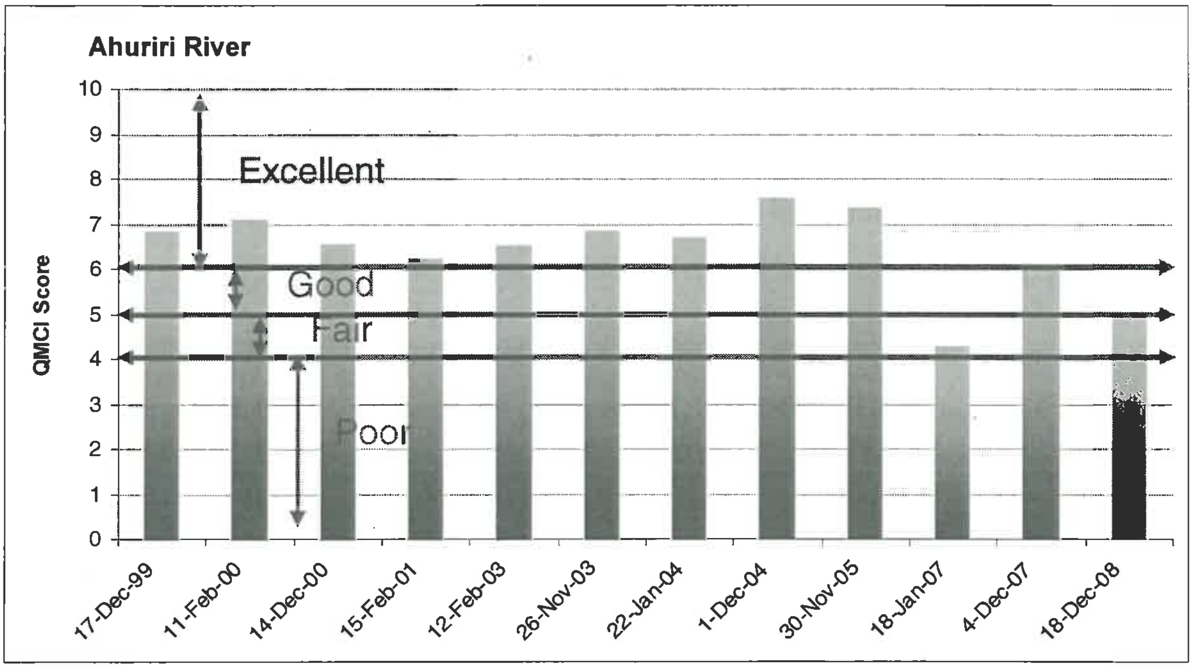

Figure 2. QMCI score from Irishman Creek (monitored site). Note the apparent decline in stream health apparent in 2008.

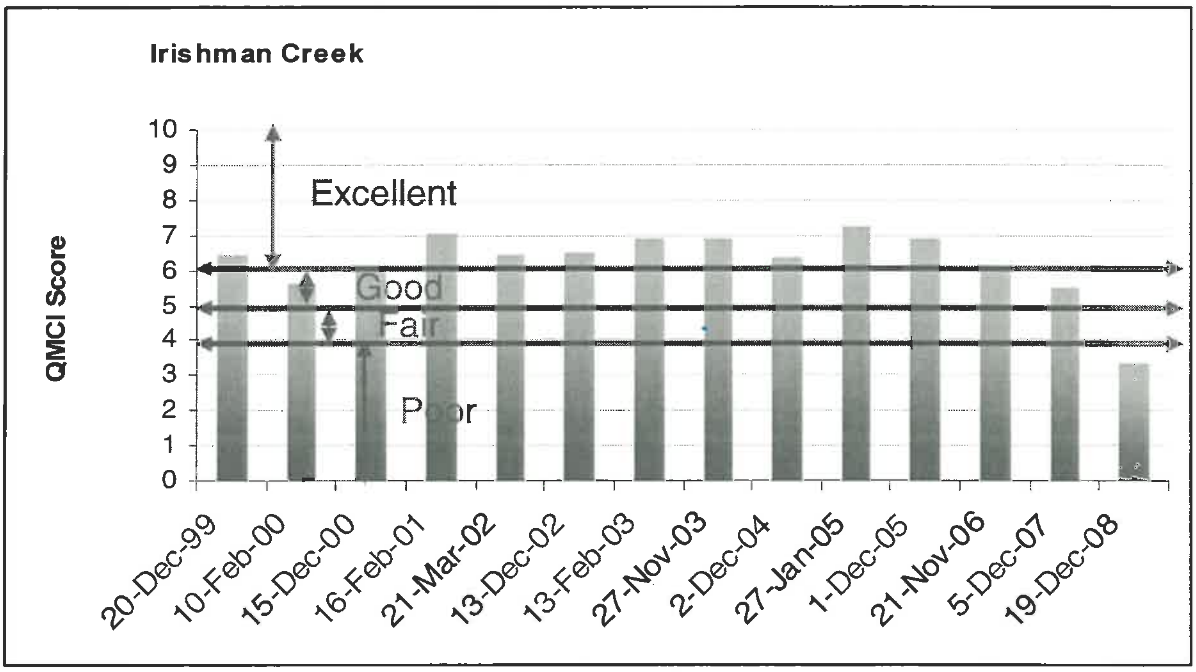

Figure 3. QMCI score from Quail Burn Stream (monitored site). Note the variability in scores. Quail Burn drains from Glen Eyrie Downs Station.

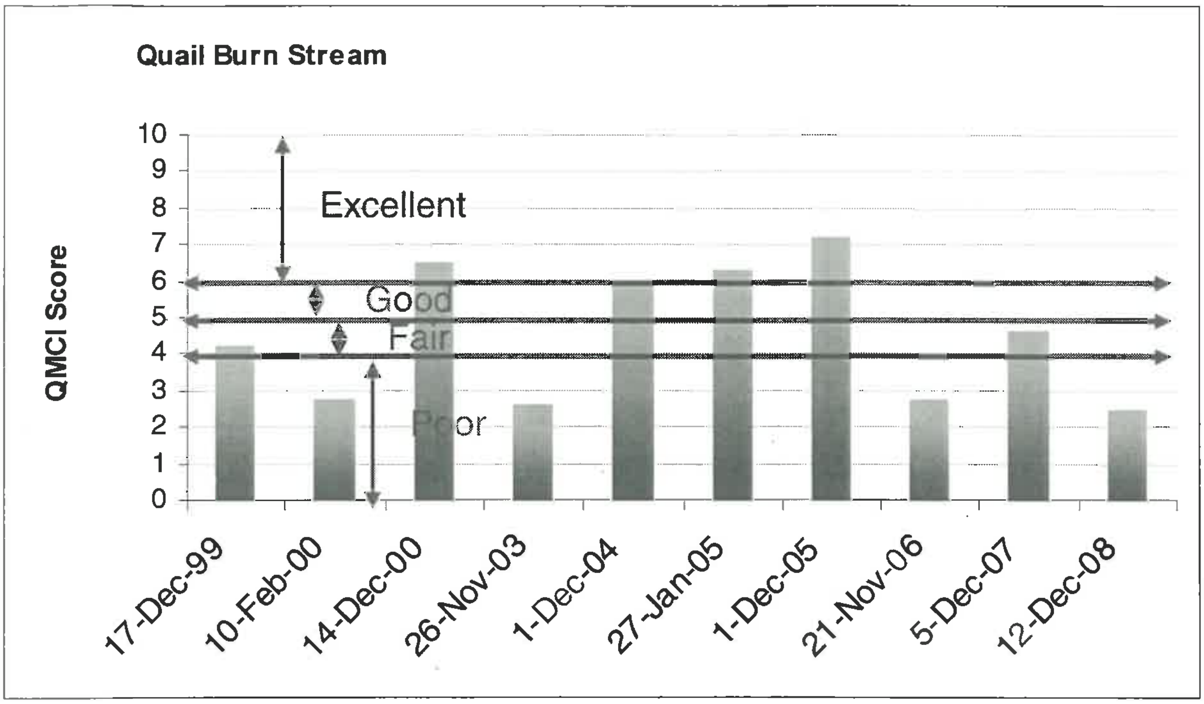

Figure 4 (a-d) QMCI Scores from select waterways (monitored sites), a) Waitaki, b) Fork Stream, c) Twizel River, d) Ahuriri River.

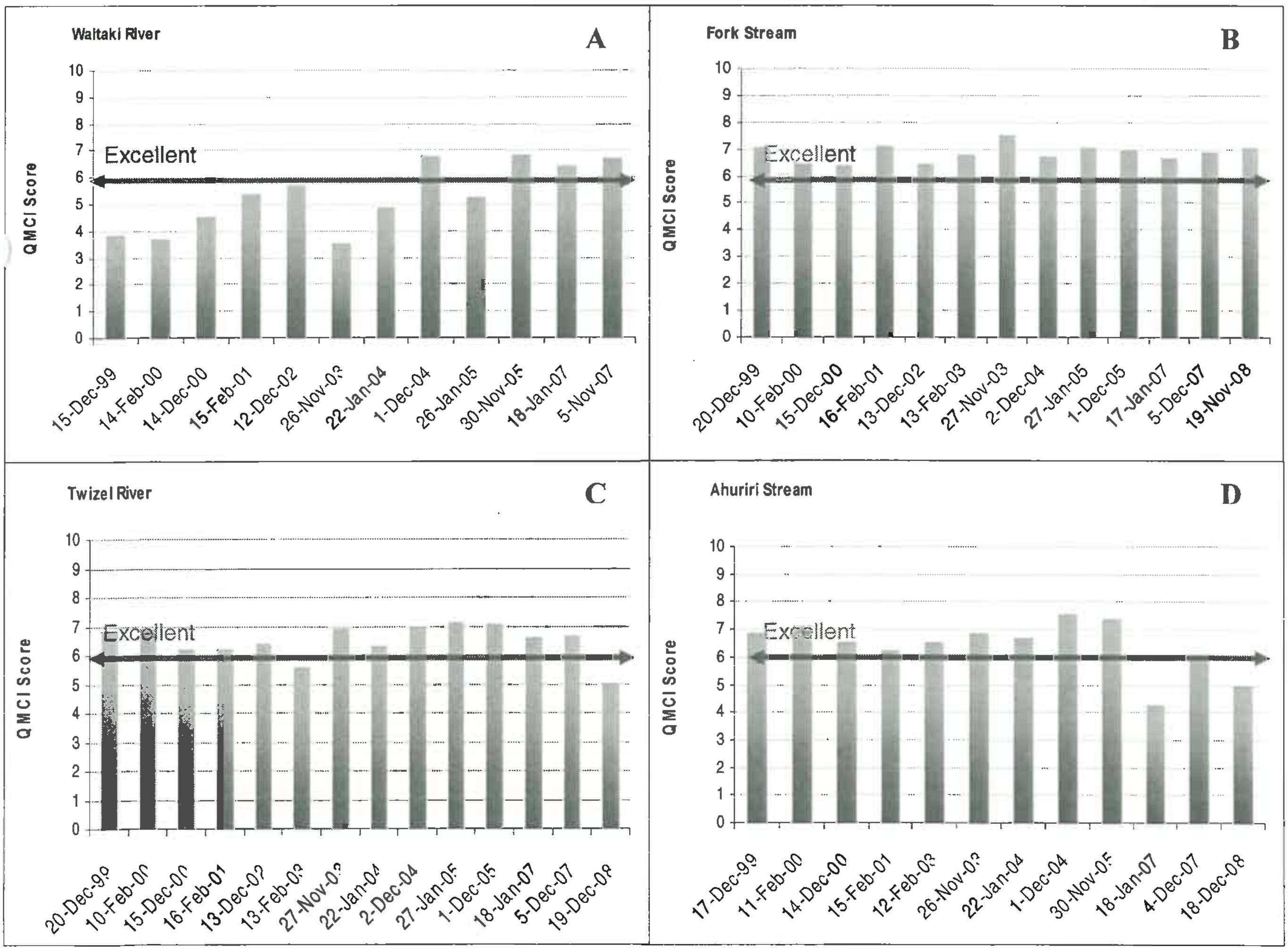

Figure 3. Mean QMCI scores from selected Upper Waitaki waterways. Error bars are standard error of the mean.

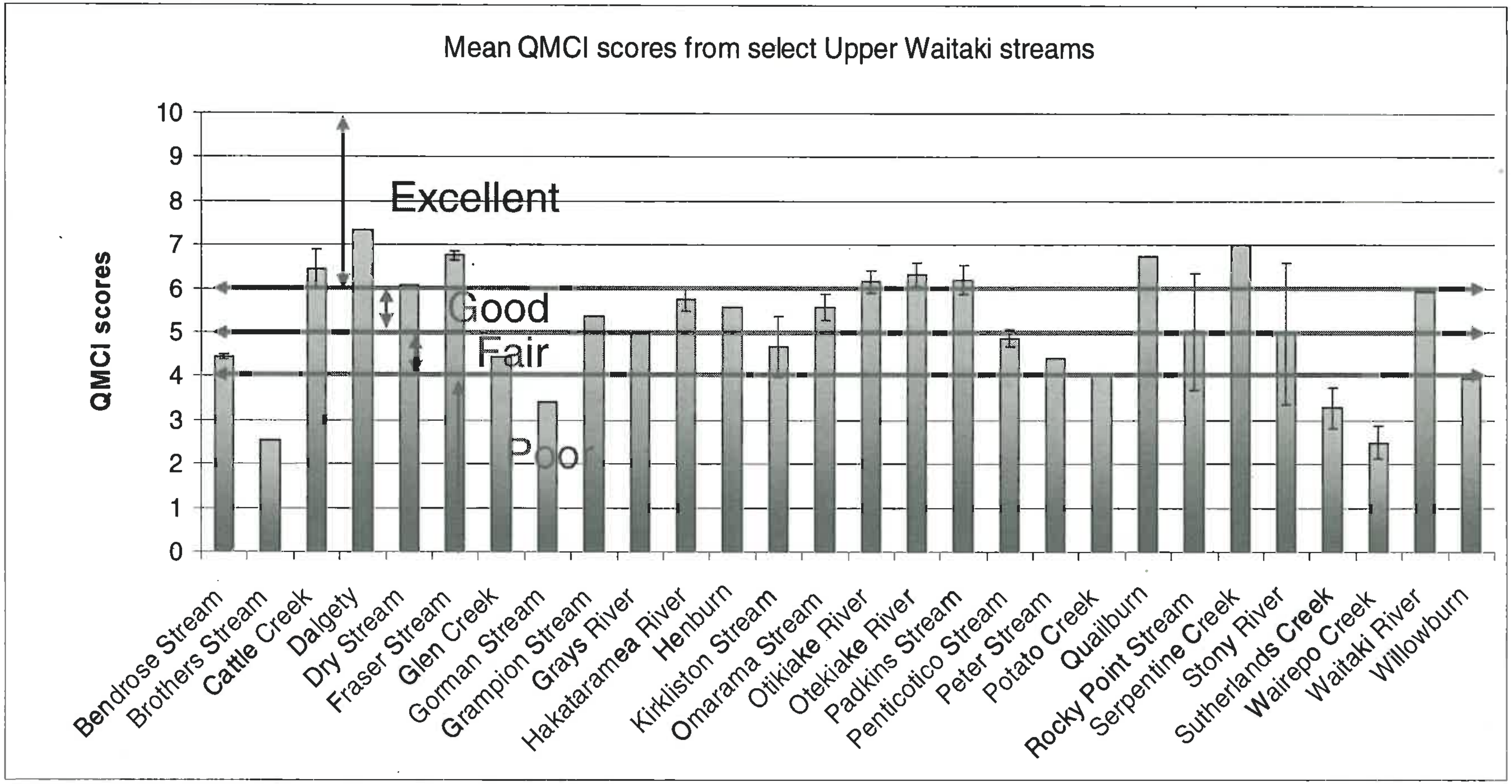

Figure 4. *Escherichia coli* concentrations Quail Burn at Henburn Road. Concentrations in most probably number (MPN) per 100mL (From the rebuttal evidence of Dr. Ryder).