BEFORE THE COMMISSIONER APPOINTED BY THE OTAGO REGIONAL COUNCIL

IN THE MATTER	of the Resource Management Act 1991 ("the Act")
BETWEEN	BSTGT Ltd and A P McQuilkin, N J McQuilkin, K L Skeggs, S A McQuilkin and G M Todd being Trustees of the A P McQuilkin Family Trust Consent Application RM19.151

BRIEF OF EVIDENCE OF DEAN OLSEN EVIDENCE ON BEHALF OF BSTGT LTD AND A P MCQUILKIN, N J MCQUILKIN, K L SKEGGS, S A MCQUILKIN AND G M TODD BEING TRUSTEES OF THE A P MCQUILKIN FAMILY TRUST

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STATEMENT OF EVIDENCE OF MATT HICKEY

1. My name is Dean Antony Olsen.

2. I am the owner-operator of Freestone Freshwater, a freshwater science consultancy based in Dunedin.

3. I hold the degrees of B.Sc. (Honours I) in Zoology and Ph.D. in Zoology, both from the University of Otago. Riverine macroinvertebrate communities the primary focus of both my Honours[1] and Ph.D.[2] theses. I am a member of the New Zealand Freshwater Sciences Society.

4. I worked at the Otago Regional Council from 2013 to 2018. I was the Manager of the Resource Science team between 2015 and 2018. Prior to that, I was a Water Resource Scientist and spent approximately half of my time on water allocation and half on water quality. While at ORC, I led several studies that were intended to support policy development, specifically minimum flow setting, including reports on management flows and water quality. I also undertook numerous technical assessments of applications to replace deemed permits and other resource consents.

5. My first job in freshwater ecology was as a summer Research Assistant in the Zoology Department, assisting on a wide range of projects in the field and laboratory in the summers from 1995 until I began my Ph.D. in 1999. In this role, I undertook numerous macroinvertebrate surveys and processed hundreds of macroinvertebrate samples in the laboratory.

6. After completing my Ph.D. in 2003, I worked for two years as a Post-Doctoral Research Associate at the University of Vermont in Burlington, Vermont, USA on a USDA-funded project considering the effects of agricultural pollutants on macroinvertebrates.

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[1] Olsen DA (1998). Investigating the hyporheic fauna in a gravel-bed stream: Influence of channel geomorphology, sediment structure and sampling technique. Honours Dissertation. University of Otago, Dunedin.

[2] Olsen DA (2003). Patchiness in the Hyporheic Zone of a Gravel-Bed Stream: Roles of Disturbance, Vertical Hydrological Exchange and Physicochemistry. PhD Thesis. University of Otago, Dunedin.

7. I worked as a Freshwater Scientist at the Cawthron Institute in Nelson between 2005 and 2011, where I led the Macroinvertebrate and Biomonitoring team. I have as an Associate Director at Ryder Consulting (2011-2013) and Ryder Environmental (2018-2020).

8. I have given evidence at numerous hearings, including four before the Environment Court (Arnold, Wairau, Lindis & ORC's Plan Change 7) and one before a Special Tribunal (Nevis). At these hearings, I have been an expert witness for a range of clients, including farmers, large hydro-electricity companies, Fish & Game Councils (including Otago Fish and Game Council) and the Department of Conservation.

9. I have worked on a variety of projects assessing the effects of flow diversion or abstraction on stream ecology including reviews of assessments of hydroelectric schemes in the Wairau[3] and Arnold Rivers[4] and investigations of the effects of diversions from rivers in the upper Waitaki Catchment[5]. I led assessments for a major hydro-electric power scheme in the Central North Island (although this scheme has not been announced publicly) and was first author of the report presenting assessments of the effects of Meridian Energy's Amuri Hydro Project on aquatic communities in the Waiau River in North Canterbury[6].

10. I was also lead author of a review of information on the effects of water temperature on aquatic biota for Auckland Council, Hawkes Bay Regional Council and Waikato Regional Council[7].

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[3] Olsen (2006). Macroinvertebrates of the Wairau River and the likely consequences of proposed hydro-electric development. Prepared for the Department of Conservation, Nelson-Marlborough Conservancy. *Cawthron Report No. 1124.* 22 p.

[4] Olsen DA; Hay J, Strickland RR, Hayes JW 2006. A Review of the Arnold River Hydro-Electric Power Scheme Assessment of Environmental Effects. Prepared for the Department of Conservation, West Coast, Tai Poutini Conservancy. *Cawthron Report No. 1228*. 24 p.

[5] Olsen DA 2009. Ecological Effects of a Micro-Hydro-Electric Power Scheme on Station Stream. Prepared for Lilybank Station Ltd. *Cawthron Report No. 1556*. 4 p; Olsen DA 2008. Station Stream Ecological Survey. Prepared for Lilybank Station. *Cawthron Report No.* 1438. 16 p.; Olsen DA 2008. Mistake River Ecological Survey. Prepared for Lone Star Godley Peaks. *Cawthron Report No. 1437*. 19 p.

[6] Olsen D, Maxwell I, Holmes R, Hay J, Allen C, Doehring K, Hayes J, Young R 2011. Assessment of the Amuri Hydro Project on the Waiau River, North Canterbury. Prepared for Meridian Energy Ltd. Cawthron Report No. 2011. 129 pp. plus appendices

[7] Olsen, Tremblay, Clapcott & Holmes (2012). Water temperature criteria for native aquatic biota. Auckland Council Technical Report 2012/036.

11. I have published thirteen scientific papers in peer-reviewed international journals and one peer-reviewed report in the Department of Conservation *Research & Development Series*. I have peer-reviewed manuscripts for a wide range of international scientific journals.

12. I have been given a copy of the Environment Courts code of conduct for expert witnesses. I have reviewed that document and confirm that this evidence has been prepared in accordance with it and that all opinions that I offer in this evidence are within my expertise. I have not omitted to refer to any relevant document or evidence except as expressly stated. I agree to comply with the code and in particular to assist the Commissions in resolving matters that are within my expertise.

Scope of Evidence

13. This brief of evidence addresses the following:

    1. Macroinvertebrates of the Royal Burn.
    2. Water quality in the Arrow catchment.
    3. Assessment of the proposed environmental flow regime.

Hydrological setting

14. Mr Matt Hickey has provided detailed hydrological evidence to this hearing and I will not duplicate that here. However, the hydrology of the Royal Burn is an important part of the environmental settings for the proposed activities, so I will briefly summarise aspects of the hydrology of the Royal Burn that I believe are relevant to the assessment of the ecological impacts of the application.

15. The upper reaches of the North Branch are perennial, with a naturally intermittent reach between the point of take for permits 97029 and 3073B and the confluence of the North and South Branches of the

Royal Burn below which is a perennial reach that gains flows from groundwater.

Macroinvertebrates of the Royal Burn and New Chums Gully

16. During the electric fishing survey in the North Branch of the Royal Burn and New Chums Gully, Mr Hickey and I noted that large numbers of stoneflies and mayflies were washed into the stop net as we were electric fishing. Mayflies (Ephemeroptera) and stoneflies (Plecoptera) along with caddis flies (Trichoptera) are collectively known as EPT taxa.

17. Whilst electric fishing is not typically used as a quantitative macroinvertebrate method, it is an excellent way of semi-quantitatively sampling drift-prone species, such as EPT taxa. It would, however, underestimate the abundance of taxa such as cased caddis flies and snails. I would characterise the abundance of stoneflies and mayflies we observed as being very high.

18. The diversity and abundance of EPT taxa is used as an indicator of water quality as EPT taxa are typically associated with sites with good water quality. This is particularly the case for stoneflies, which are usually found in sites with cold, well-oxygenated water and good water quality. The exception to this are the micro-caddis flies (Hydroptilidae[8]), which can be extremely abundant in enriched streams when algae and macrophytes are abundant.

19. Given the macroinvertebrate taxa I observed in the North Branch and their abundance, I anticipate that the MCI/QMCI and ASPM scores for these sites will be high and would likely be within the A-band of the NOF. Similarly, I anticipate that the macroinvertebrate scores for New Chums Gully will be similarly high.

20. Many EPT taxa are large compared to many other types of macroinvertebrates and are commonly found in the invertebrate drift. As such, they are favoured prey for drift-feeding fish, such as trout.

[8] In New Zealand, this family of caddis flies includes the genera *Oxyethira* and *Paroxyethira*

21. The abundance of EPT taxa in the North Branch indicated an absence of fish (particularly trout) in this reach, as the presence of trout typically means that the macroinvertebrate taxa we observed are typically less abundant or absent in streams with trout. As Mr Hickey outlines in his evidence in chief, no fish were collected from the North Branch of the Royal Burn in our survey.

Water quality and periphyton

22. ORC does not monitor water quality in the Royal Burn catchment. However, it does monitor water quality in the Arrow River at Morven Ferry Road.

23. Water quality in the lower Arrow River indicates a low level of nutrient enrichment and periphyton monitoring in the lower Arrow River indicates that periphyton proliferations would be rare, reflecting negligible nutrient enrichment[9] [10].

24. My observations and consideration of video footage of the North Branch of the Royal Burn suggest that bed cover in the vicinity of the points of take typically consists of low cover by diatoms, bryophytes, sometimes with cover of green filamentous algae, particularly on vegetation. The type and cover of periphyton (and bryophytes) were typical of this sort of small stream.

25. Downstream of the lower take, the North Branch flows into thick cover of willows and other exotic trees. The habitat quality in this section was poor, the bed was heavily shaded with a large amount of organic matter (leaves, twigs, roots) and fine sediment accumulations. This section is also where flow losses occur (see Mr Hickey's evidence).

Assessment of proposed environmental flow regime

26. The proposed environmental flow regime was adopted from the residual flow recommendation by Mr Pete Ravenscroft of ORC's Resource Science Unit and supported by Mr Hickey with amendments

[9] Olsen DA (2019). Arrow River Periphyton Assessment. Prepared for Arrow Irrigation. Ryder Environmental Ltd., Dunedin.
[10] Ozanne R (2021). State and Trends of River and Lake Water Quality in the Otago Region: 2000-2020. Otago Regional Council, Dunedin

to provide for downstream water users. The following residual flow conditions have been proposed for these takes from the Royal Burn:

(a) Ensuring a surface flow for at least 50 m past the intakes.

(b) The 5 l/s cut-off flow at the downstream boundary of the BSTGT Limited property immediately above the LOFTS take on the North Branch of the Royal Burn.

27. Based on my observations of the North Branch of the Royal Burn and New Chums Gully and the ecological values the supports, it is my opinion that the proposed residual flow conditions will provide for the life supporting capacity of these systems.

28. In the Section 42A report, Ms Alexandra King notes that the 5 l/s residual flow was changed following Mrs Bryony Miller's recommending that the residual flow be changed to 10 l/s. The reason given for this is *"to reduce the likelihood of potential for stagnancy in the 'swamp' and reductions in water quality required to support ecological values such as dissolved oxygen and changes to water temperature, as well as increased stretches of creek intermittency."*[11]

29. There does not appear to be a technical basis for this change. As a general concept, a higher flow past the lower intake may result in an increase in the length of wetted habitat through the losing reach downstream. However, as noted earlier, downstream of the lower take, the North Branch flows through a thicket of willows and other exotic trees. As a result, the habitat for macroinvertebrates in this section is poor. Therefore, an increase in flow is unlikely to result in a tangible increase in the quantity or quality of macroinvertebrate habitat in this section.

30. Downstream of the Glencoe Road culvert, the Royal Burn gains water from groundwater. Mrs Miller's concerns regarding dissolved oxygen and water temperature are of less relevance given the groundwater inputs, as these would naturally be expected to have lower dissolved

[11] Page 31 of the Section 42A report of Ms Alexandra King.

oxygen and buffered[12] water temperatures. Given that Mr Hickey and I caught small trout in the vicinity of the gaining reach, dissolved oxygen and water temperatures appear to be of little concern, as trout are typically considered to be intolerant of low oxygen and high water temperatures.

31. Based on the above, I consider that an increase in the residual flows for the takes from the North Branch of the Royal Burn from 5 l/s to 10 l/s is unlikely to be of any material benefit to macroinvertebrate communities in the Royal Burn.

32. The s42A report also suggests a residual flow of 4.2 l/s on the take from New Chums Gully, as sought by the Aukaha submission. Given the steep gradient of New Chums Gully and the natural flow accrual (as outlined in Mr Hickey's evidence), I do not consider that the recommended residual would result in a materially different outcome to that sought by the applicant (ensuring a surface flow for at least 50 m past the intakes), as this would adequately provide for macroinvertebrate habitat and life-supporting capacity.

Summary

33. The North Branch of the Royal Burn naturally has both a perennial and a losing/drying reach, while the mainstem of the Royal Burn downstream of the North and South Branch confluence is perennial, gaining water from groundwater downstream of the Glencoe Road ford.

34. The abundance of mayflies and stoneflies observed in the North Branch of the Royal Burn indicated good water quality and habitat and is consistent with the lack of fish.

35. There is no water quality from the Royal Burn catchment. However, the results of water quality and periphyton monitoring in the lower Arrow River are consistent with low level of nutrient enrichment.

36. The proposed residual flow condition ensuring a surface flow for at least 50 m past each of the two North Branch intakes will provide for

[12] The temperature of groundwater is less affected by ambient conditions and typically show reduced annual and daily fluctuations.

macroinvertebrate habitat during low flows and ensure that effects on macroinvertebrates are less than minor.

37. I consider that an increase in the residual flows for the takes from the North Branch of the Royal Burn from 5 l/s to 10 l/s is unlikely to be of any material benefit to macroinvertebrate communities in the Royal Burn.

Dr Dean Olsen