Before the Commissioners appointed by Canterbury Regional Council

IN THE MATTER OF The Resource Management Act 1991

AND

IN THE MATTER OF 78 Applications to Take Water in the Ashburton River and Valetta Groundwater Allocation Zones.

Section 42A Officer's Report

Date of Hearing: 21 July 2008

Report of Dr Adrian Selwyn Meredith

Qualifications and Experience

1. My full name is **Adrian Selwyn Meredith** and I hold the degrees of Bachelor of Science (First Class Honours) in animal physiology (1981) and Doctor of Philosophy in Zoology from the University of Canterbury (1985). I have been employed by the Canterbury Regional Council for over eleven years, firstly as the southern area water quality scientist in Timaru for two years, and then as a Christchurch based water quality scientist. My areas of responsibility include monitoring, investigations, and technical advice on water quality and ecology of rivers, streams and lakes.

2. Prior to this I was employed for ten years, as an environmental scientist in the areas of ecology, fisheries, coastal ecology and water quality, by the Waikato Regional Council and its preceding authorities, and for two years as a freshwater fisheries scientist with the Fisheries Research Division of the Ministry of Agriculture and Fisheries. I am a member of the New Zealand Freshwater Sciences Society (formerly the NZ Limnological Society), and the American Fisheries Society.

3. I acknowledge that I have read the code of conduct for expert witnesses contained in the Environment Court's Practice Note dated 31 March 2005. I have complied with it when preparing my written statement of evidence and I agree to comply with it when I give oral evidence.

Ambit of my evidence

4. My evidence will describe the structure and values of the surface waters of both the Valetta (VA) and Ashburton River (AR) Groundwater Allocation Zones, and the importance of adequate surface water flows to maintain these values.

5. In the Valetta Zone, the surface water resources include:

   (i) the Hinds River;

   (ii) tributary streams/drains of the Hinds River, and

   (iii) a series of streams that feed directly into the sea along the mid Canterbury coast between the Hinds and Ashburton Rivers.

6. In the Ashburton River zone the surface water resources include:

   (i) the Ashburton River, including the north and south branches and other foothill tributaries (Taylors, Bowyers, Pudding Hill Streams)

   (ii) spring-fed tributaries of the Ashburton River in the upper half of the plains upstream of the confluence of the north and south branches of the Ashburton River (e.g. O'Sheas, Greenstreet, Mt Harding, Annadale streams).

(iii) spring-fed streams and tributaries of the Ashburton River or zone in the low half of the plains east of State Highway 1 (i.e. Wheatstone, Carters, Laghmor, Riverside, Wakanui Creek).

7. From my analysis of these resources, I conclude that:

- These surface water resources posses a wide range of intrinsic values including supporting aquatic biodiversity of common, rare, and endangered fauna, native and introduced fisheries, and wildlife values.

- They also provide for functions such as drainage, stockwater, amenity values such as fishing, picnicking, and swimming, and aesthetic values associated with flowing waters within an otherwise flat and poorly featured landscape.

- The integrity of these surface water resources need to be protected so that they are not degraded with respect to flows, water quality, or habitat quality as a result of additional water abstraction and use in their groundwater allocation zones.

8. Such evidence is within the ambit of my professional experience and technical expertise.

BODY OF EVIDENCE

Valetta Zone:

9. I have conducted investigations into the state and values of the surface water resources in the Valetta groundwater allocation zone and this has been recently published as ECan Technical Report No. R06/19 (appended). This report forms the technical basis of a large proportion of my evidence relating to the Valetta Zone.

10. The network of surface water resources of the Valetta zone of mid-Canterbury is a general structure of rivers and streams that is repeated in many parts of the Canterbury plains. That is:

- a foothill-fed river (the Hinds River) that has intermittently flowing reaches over its length down the plains,

- a series of spring-fed tributaries (Swamp Road Drain, Taylors Drain, O'Shaugnesseys Drain) and,

- a series of at least 12 unconnected spring-fed streams that drain directly to the coast.

11. This structure therefore resembles many other catchment systems such as:

- the Selwyn River and lower tributaries in the Ellesmere area (in Selwyn District),

- the Ashley River and lower tributaries in the Waimakariri District,

- the Orari River and tributaries (in the Timaru District), and
- the Waihao River and lower tributaries in the Waimate District

(to name a few).

These are all based around an extensive area of plains, with an extensive aquifer system, a hill-fed river with intermittent reaches, and lowland tributaries and/or independent streams that arise from springs in areas where the aquifers discharge (often perennially) to the surface as springs and seeps, and form a network of spring-fed streams.

12. This illustrates that the Hinds River and associated stream systems are not entirely unique, man-made, or an artificial systems, but similar to many other very important and highly valued, although modified freshwater systems in Canterbury. Most are similarly under high allocation and abstraction pressure. Furthermore, all of these systems are essentially natural water resource systems, but have often been modified to improve drainage, straighten or channelise the stream reaches. Many streams are named as 'drains' and have a history of extensive development or maintenance, but contain, and have supported extensive natural values throughout their history. They are therefore modified natural waterbodies rather than artificial waterbodies.

13. The Hinds River and associated stream systems are notable in that recent monitoring has confirmed that they contain some of the highest quality lowland stream habitats, biological communities and systems in Canterbury with respect to water quality, quality of aquatic habitats, macroinvertebrate communities, and fish populations.

14. The history of the development of the Hinds to Ashburton drainage areas are well documented (Mitchell 1980) and are agreed in our joint statement of facts. The surface water resources (streams and drains) have undergone a series of stages of development since first being 'drained' in the 1860's (Figure 1). The first, and biggest development was to 'cut' a channel to extend the Hinds River directly to the sea. Previously it flowed into the extensive Hinds swamp, whereby water found its way to the coast through a number of diffuse exit channels. Subsequently, many other spring fed streams were also drained or channelled into existing or modified paths, to form the current network of streams and drains (Map 2 in joint statement of evidence). Some of these streams follow paths identical to those identified in the 1860 maps, and most exit to the sea through eroded 'dongas' (extensive eroded coastal gullies) that are similarly identified in the 1860's (Map. 2 in our joint statement).

15. These streams generally flow year round, as perennial streams with little seasonal variation in 'average' years. They are therefore not seasonally flowing drainage systems as their 'drain' names may suggest. Over July 2001 to June 2002 flows in 12 of these streams were gauged monthly in association with water quality monitoring, and flow rates exhibited very little seasonality. Flows were also appreciable, with the streams draining to the sea, averaging a combined flow of approximately 2000 litres per second. Additional to this are the flows in other spring-fed streams that drain directly into the Hinds River, and the flows in the Hinds River itself (approximately

600-700 l/sec). Therefore the surface flows (as over the 2001/02 year) average between 2500 and 3000 litres per second of continuous flow.

16. Many of these streams have historically set minimum flow controls on them that were set in the 1980's or 1990's as conditions of resource consents. These minimum flows acknowledged them as perennial water bodies, with a significant array of values. They were set to protect the stream flows and values. These minimum flow setting processes were largely set on the basis of 'expert opinion' and included input from local runanga, from Fish and Game/Acclimatisation societies, and local advice (Anthony *et al.* 2003). These minimum flow controls are scheduled to be reviewed as part of Environment Canterbury's region wide NRRP planning processes, although the Valetta streams are not scheduled for formal review until 2009/2010.

17. The water quality of these streams (again intensively monitored in 2001/2002) is high in regard to some values (high clarity, low temperature, high dissolved oxygen concentration), and low in regard to other values. Very high concentrations of nitrate nitrogen (median 3-8 mg/l) and indicator faecal bacteria (*E. coli*: medians of over 1000 cfu/100ml) mean that stream waters are not generally suitable for human uses (potable, stockwater or bathing (contact recreation)).

18. This degradation of a potentially high quality water resource results from both intensive landuse (extensive nitrate leaching), land surface run-off, and livestock access to water bodies. These can be addressed (improved) by a wide range of 'best practice' farming controls implemented prior to irrigation development or intensification. These 'best practice' controls are increasingly being required as a condition of resource consents to 'take and use water' and consist of requirements to apply water efficiently, protect waterways from run-off and livestock access, nutrient budgeting, and fertiliser application controls (to name a few).

19. The Valetta surface waters are most importantly considered to be of high quality, for supporting aquatic ecosystems and aesthetic purposes. They do not suffer significantly from reduced water clarity, depressed oxygen concentrations, high temperatures, or other attributes of significance to aquatic ecosystem values and their flora and fauna. Not surprisingly, these waters therefore currently support a significant array of ecosystem values. However, some water quality attributes such as nitrate concentrations are at or approaching the (ANZECC 2000 and amendments) thresholds of chronic adverse effects.

20. High aquatic health of the VA streams is also indicated by high scores for health of aquatic insect (macroinvertebrate) communities. These indicate not only the generally good water quality for aquatic life, but also a current lack of significant toxicant thresholds being breached, and reasonable habitat (generally clean gravel beds, vegetated and uneroded banks) for such modified water courses.

21. Overall, these streams stand out as a subset of particularly high quality lowland spring-fed streams for Canterbury. They are generally sustaining higher qualities (water, habitat and ecology) than the equivalent systems mentioned previously (Selwyn, Ashley, Orari, Waihao). These other systems have variously become increasingly stressed through landuse effects and increasing water allocation also.

22. The fisheries resources of these streams have not been so comprehensively studied, but many are known to contain a number of valued fish communities, including introduced trout fisheries, diverse native fish communities, eel fisheries, and populations of the endangered Canterbury Mudfish.

23. The Hinds River and a number of the larger streams contain (often abundant) populations of brown trout. At least thirteen drains and streams are identified by Fish and Game Council as currently or previously holding trout populations:

- Deals Drain
- Windermere Drain
- Home Paddock Drain
- Parakanoi Drain
- McLennons Drain
- Waterton Drain
- Flemington Drains (upper and lower)
- Wheatstone Cut-off
- O'Shaugnesseys Drain
- Blees Drain
- Kennaughs Drain
- Griffiths Drain
- Maginness Drain

While not being highly fished as an angling resource by fishermen, many of these streams have had large numbers of small trout harvested (up until recently (pre-Didymo risk)) to stock high country lakes fisheries.

24. The Hinds River and Parakanoi Stream have also been recorded as containing diverse communities of native fish species, many being species requiring seasonal migration to or from the sea. Their presence indicates that at least these two stream/rivers are routinely open to the sea long enough to allow regular migratory fish recruitment. The other streams probably have variable recruitment as the frequency and timing of their opening to the sea are lower or occur rarely Never-the-less, many contain numbers of eels, indicative of occasional coastal access, such that they often contain abundant eels of cultural, recreational or commercial fisheries value.

25. A number of the smaller streams maintain remnant populations of the endangered Canterbury mudfish. While being able to tolerate periods of stream drying provided moist habitats are available, mudfish do not obligatorily require drying periods, and periods of stream drying are stressful and damaging to mudfish populations. Sustained flow periods are therefore also beneficial to the persistence of these valued mudfish populations.

26. Particularly low flows in summer 2005/06, (and more recently in 2007/08)saw many streams dry up for what many describe as the first time in recent living memory. They are considered to be an extreme event resulting from both a combination of both increasing abstraction pressure and climate (low rainfall) patterns, and so should not be considered routine ‘minimum flow’ conditions.

27. Furthermore, groundwater levels in 2005/06 reached all-time lows, and many streams including the larger (Home paddock, Parakanoi, Blees Deals Drains) ceased to flow for parts of the summer.

28. As a result of these low flow or drying periods, ecological stream and river communities either perished, or became heavily degraded. Consequently, stream insect and fish communities in subsequent (recent) years are still degraded and recovering slowly in many streams.

29. This effect has been seen in other groundwater zones that have similarly seen shallow groundwater-fed surface water resources dewatered by extreme or excessively lowered groundwater levels. This is one of the effects that necessitates active management of groundwater allocation zones to protect surface water values in particular.

30. Overall, the stream systems in the Valetta groundwater zone, alongside or associated with the Hinds River are important and valued stream systems, in a particularly good ecological state, and with a range of natural values. It is therefore important that groundwater zone allocations and additional abstractions from the groundwater zone, do not impact significantly on the 2000-3000 litres per second of surface flow routinely flowing in the streams/rivers in the Valetta zone and supporting considerable ecological freshwater resources.

Water quality mass-load considerations:

31. In the ECan Technical Report No. R06/19, I further considered the water quality implications of intensive land use in the Mayfield-Hinds, Valetta, and Ashburton zones. Particularly the mass transport of contaminants via the streams and rivers. The current degree of land intensification results in significant transport of contaminants such that I estimated that in excess of 600 tonnes of sediment, 450 tonnes of nitrogen (mostly as nitrate), 2 tonnes of phosphorus, and the 'equivalent' bacterial content of 300,000 cowpats of faecal material are discharged to the sea annually during base flows from these (Hinds-Ashburton) coastal streams alone. The discharges of nutrients directly to the sea via groundwater could be of a similar magnitude again, and discharges during storm flows could also at least further double these mass load estimates.

32. These surface flow mass loads on a district or an area specific basis (kgN/km^2) are greater than those causing significant coastal water quality problems of suffocated marine 'dead zones' in Chesapeake Bay in the USA (the most studied world example of this phenomena), and similar issues are increasing in open ocean areas of the Gulf of Mexico, and (closer to New Zealand) in Morton Bay in Brisbane, Australia.

33. The south and mid-Canterbury coastline is shallow, and can be functionally constrained by pressure waves and the Southland current, such that exchange of water with the open ocean is reduced or prevented (Darby *et al.* 2003). It is therefore possible that high loads and concentrations of diffuse nutrient discharge could generate widespread adverse effects in the marine environment. We have frequently described extensive foaming, red-tides, and other unusual discolourations associated with algal blooms along the mid and south Canterbury coast during water quality monitoring and resource investigations in recent years. These often also correspond with public observations and complaints.

34. This effect on coastal receiving environments, is also an issue that was raised before the Environment Court in its decision on the Rangitata Conservation Order (2004). Judge Jackson considered (C109/2004, Pg. 80) "*These are*

potentially important issues that should not be lost sight of. As we have stated, while it can be efficient to dump waste and clean it up later, it is worth at least raising the issue so that it can be in the public arena".

35. It is therefore an issue worthy of closer scrutiny, as to whether further unregulated intensification of water and land use, and effects on broader receiving environments, is warranted in extensive areas of the Canterbury Plains, without explicit requirement for mitigations such as:

- efficient irrigation management
- soil management
- nutrient management (budgeting)
- animal effluent management
- pesticide and agrichemical management
- waterway and riparian management
- biodiversity and ecosystem management
- energy management

ASHBURTON ZONE

Ashburton River

36. The Ashburton River has been the subject of extensive studies of water balances and flow requirements for maintaining or enhancing different values. These have culminated in the Ashburton Schedule WQN1.1 (plan and flow regime) to the proposed Canterbury NRRP.

37. These flow requirements have also been the subject of considerable consultation and discussion. Therefore, I do not offer any additional observations on the Ashburton River over and above those presented by Mr Miller, and those covered in our joint statement of facts.

Upper Ashburton spring-fed tributaries.

38. There are a number of spring-fed streams that arise in the mid levels of the Canterbury plains and flow into the north or south branches of the Ashburton River. Most of these streams have minimum flow restrictions set to protect both in-stream values and flows for the Ashburton River. These minimum flows and flow regimes are also embodied in the Ashburton schedule (plan and flow regime) to the ECan Proposed Natural Resources Regional Plan.

39. I undertook additional resource investigations of several of these streams in 2005/06. They are significant streams with appreciable flows and offer high quality habitat to fish communities, including populations of trout, eels and diverse native fish communities. Their water is derived from shallow groundwater associated with the Ashburton River, or the Rangitata Diversion Race (RDR) irrigation scheme races, and as such is generally of high quality, except at the lower end of irrigation scheme areas subject to bywash (i.e. Greenstreet irrigation area).

40. These spring-fed streams therefore afford high quality water and habitats associated with the Ashburton River, and are important parts of the Ashburton River system. It is important that groundwater zone allocations and additional abstractions from the groundwater zone does not impact significantly on the surface flows in these mid-plains streams, and that the minimum flow provisions are not compromised.

Lower Ashburton spring-fed streams

41. There are a number of spring-fed streams that arise on the lower plains adjacent to the Ashburton River. Investigations of the main tributary on the south bank of the Ashburton River (Wheatstone Creek), has been recently published in ECan Technical Report No. R06/19. Other south bank tributaries (Laghmor and Carters Creeks) are now largely captured by Lake Hood (Ashburton Aquatic Park). Information on north bank streams (Riverside Stream and Wakanui Stream) is contained in my ECan Technical Report No. U04/68 (appended).

42. **Wheatstone Creek** is largely considered as a further spring-fed stream in the Hinds-Ashburton coastal series of streams, and as such requires consideration and management in concert with the other 12 to 15 coastal streams, and tributaries of the Hinds River. However, it differs from most of the streams in that it possesses a direct connection to the sea via the Ashburton River, and in its lower reaches traverses gullied areas of land such that it maintains natural meander patterns rather than straight channelisation. It therefore contains a diverse fish fauna including trout, inanga (whitebait), eels, and several other migratory native fish species.

43. The habitat of Wheatstone Creek was previously of good quality, although in recent years the flows have suffered through high levels of abstraction, and recently, the streambeds were disturbed whilst the Ashburton District Council installed the land disposal areas for the district sewage disposal upgrade project. It is assumed that the affected reaches of the creek will be improved and rehabilitated on completion of this project, such that its values will continue to require protection. It will continue to be important to ensure that groundwater zone allocations do not impact significantly on the surface flows in this stream.

44. **Wakanui Creek and Riverside Stream**: These streams, on the north bank of the Ashburton River (east of Ashburton Township) do not possess the flow and values that they were historically known for. Riverside Stream, has negligible flows, and the lower end of the stream has been captured by the Five Star Beef (5SB) feedlot complex. As such Riverside Stream retains little value except as a potential aesthetic asset on the entrance/approach to the 5SB feedlot complex.

45. In contrast, Wakanui Creek is a much larger and longer creek that stretches from above (west of) Ashburton Township to the coast, and posesses a large area of wetland/lagoon system adjacent to the coast, with some significant stands of native vegetation. Wakanui Creek can flow strongly in the winter and early spring, but dries up rapidly in the spring/early summer. The extent of drying is variously attributed to diversions into stockwater races near Ashburton township, and shallow groundwater abstractions. It is noted by both DoC and Fish and Game in published communications, that Wakanui Creek has previously held considerable instream values associated with both the stream and its lagoon. Any further reduction in flow as a result of AR

groundwater zone allocations would further compromise the persistence of the lagoon system and the remaining values of Wakanui Creek.

CONCLUSION

46. From my analysis of these resources, I conclude that:

- These Valetta and Ashburton River surface water resources posses a wide range of intrinsic values including supporting aquatic biodiversity of common, rare, and endangered fauna, native and introduced fisheries, and wildlife values.

- They also provide for functions such as drainage and stockwater; amenity values such as fishing, picnicking, and swimming; and aesthetic values associated with flowing waters within an otherwise flat and poorly featured landscape.

- The integrity of these surface water resources needs to be protected so that they are not degraded with respect to flows, water quality, or habitat quality as a result of additional water abstraction and use in their groundwater allocation zones.

- Any further intensification of extensive areas of the Canterbury Plains may require explicit requirements to implement and monitor best practice management to avoid effects on surface and groundwater freshwater values and to avoid potential effects on the coastal environment.

REFERENCES CITED

Anthony, M.K., Harvey, M., Main, M.R., Meredith, A.S. 2003: A review of minimum flows in the Canterbury Region. Environment Canterbury Report U03/85, December 2003.

Meredith A.; Smith Z. 2004: Water quality and ecology of races, streams and drains along the Ashburton to Rakaia Coast. Environment Canterbury Report U04/68, June 2004.

Meredith A.; Croucher R.; Lavender R.; Smith Z. 2006: Mid-Canterbury coastal streams: assessment of water quality and ecosystem monitoring, 2000 to 2005. Environment Canterbury Report R06/19, May 2006

Mitchell, D.T. 1980: History of the Ashburton – Hinds drainage district. South Canterbury Catchment Board, Ashburton.

Figure 1. Extent of original Hinds swamps in 1860 (Mitchell 1980)