In the Matter	of the Proposed Central Plains Water Enhancement Scheme
To	Environment Canterbury and Selwyn District Council
Submitter	Te Runanga o Ngai Tahu

BRIEF OF EVIDENCE OF PAUL ALBERT WHITE

13th October 2009

---

1. QUALIFICATIONS AND EXPERIENCE

1.1 My full name is Paul Albert White.

1.2 My qualifications and experience were presented to the Central Plains Water Commissioners in my primary brief of evidence and are not repeated here.

1.3 I have read the Code of Conduct for Expert Witnesses (Rule 330A, High Court Rules and Environment Court Practice Note) and agree to comply with it. I confirm that I have complied with it in the preparation of this statement of evidence.

2. SCOPE OF EVIDENCE

2.1 I have been asked by Te Runanga O Ngai Tahu to review 'Section 41C Report: review of nutrient and other contamination issues' by Vince Bidwell and Ned Norton (referred to here as Bidwell and Norton 2009) in relation to the revised Central Plains Water Enhancement Scheme.

2.2 My evidence will include:

- area of the revised Central Plains Water Enhancement Scheme and outline of irrigation;
- water discharge from the revised Central Plains Water Enhancement Scheme;
- nitrogen discharge from the revised Central Plains Water Enhancement Scheme;
- water discharge and nutrient discharge from the revised Central Plains Water Enhancement Scheme and effects on groundwater;
- water discharge and nitrogen discharge from the revised Central Plains Water Enhancement Scheme to spring-fed streams;

- water discharge and nutrient discharge from the revised Central Plains Water Enhancement Scheme and nutrient loadings on Te Waihora/Lake Ellesmere;
- CPWES, Christchurch City groundwater and the Waimakariri River.

3. THE CENTRAL PLAINS WATER ENHANCEMENT SCHEME AREA AND OUTLINE OF IRRIGATION

3.1 The revised Central Plains Water Enhancement Scheme (CPWES) boundaries (Tipler 2009) appear the same as first proposed (Tipler 2008).

3.2 The area of the revised CPWES is 105,349 ha (Tipler 2009). This is the same area as the original CPWES scheme area of 105,349 ha (Unauthored 2007).

3.3 The CPWES area currently includes irrigation on 30,000 ha of land (Tipler 2009, his Table 10), presumably all from groundwater (White 2008a, Section 6).

3.4 The revised CPWES (Tipler 2009, his paragraph 6) aims to irrigate approximately 60,000 ha using:

- run-of-river water plus groundwater for irrigation on one half of the CPWES area (Tipler 2009, his paragraph 7) with:
    - a 'very good' reliability of supply;
    - an area of 30,000 ha, presumably identified by Tipler (2009, his Table 11), as 'fully irrigated';
    - a distribution network as identified in the original CPWES (Tipler 2009, his paragraph 6);
- run-of-river water for irrigation on one half of the CPWES area (Tipler 2009, his paragraph 7) with:
    - 'no access to stored water at the present time';

- a 'reasonable reliability' of supply in spring and a 'poor reliability' of supply in summer and autumn;
- an area of 30,000 ha, presumably identified by Tipler (2009, his Table 11), as 'partially irrigated';
- a distribution network (White 2008a) as identified in the original CPWES (Tipler 2009, his paragraph 6).

3.5 The revised CPWES area will take an average of approximately 7.57 m^3/s (Tipler 2009, his paragraph 19), or approximately 240 Million cubic metres per year (Tipler 2009, his paragraph 80) from the Rakaia River and Waimakariri River and an unknown quantity of groundwater.

3.6 CPWES assumes groundwater is available to the scheme area (Tipler 2009). However, the 'mechanisms' (Tipler 2009, his paragraph 12) by which groundwater will become available to CPWES 'have not been resolved' (Tipler 2009, his paragraph 12). Therefore access to groundwater by CPWES is unknown at this time.

3.7 In my opinion irrigators in the 'partially irrigated' area may seek to increase their groundwater allocation (White 2008a, Section 9.2.6) as their supply has a 'poor reliability' of supply in summer and autumn (Tipler 2009, his paragraph 7).

3.8 Therefore an increase in groundwater allocation in the CPWES area (White 2008a, Section 9.3.4) may occur and groundwater may remain significantly over allocated with CPWES (White 2008a, Section 9.3.4).

4. WATER DISCHARGE FROM CPWES

4.1 Bidwell and Norton (2009) are in agreement with Tipler (2009) and others (e.g. White 2008a) that water discharge to groundwater from the CPWES area will increase with irrigation.

4.2 Water drainage to groundwater through the soil from the CPWES area of 105,349 ha is estimated by Bidwell and Norton (2009, their Table 1) as:

- 211 Million cubic metres per year without irrigation and a drainage to groundwater of 200 mm/yr;
- 301 Million cubic metres per year with irrigation on 30,000 ha and a drainage to groundwater of 500 mm/yr below irrigated land to represent existing conditions with irrigation from groundwater;
- 391 Million cubic metres per year with irrigation on 60,000 ha and a drainage to groundwater of 500 mm/yr below irrigated land to represent CPWES.

4.3 Therefore the increase of water drainage from irrigated land to groundwater from the CPWES area to groundwater estimated by Bidwell and Norton (2009, their paragraph 90) is 90 Million cubic metres per year (i.e. 391 Million cubic metres per year minus 301 Million cubic metres per year).

4.4 In addition, seepage from CPWES of 'low nitrate water' (i.e. seepage from canals and irrigation races) is estimated by Bidwell and Norton (2009, their paragraph 90) as 70 Million cubic metres per year.

4.5 The increase of water discharge to groundwater with CPWES estimated by Bidwell and Norton (2009, their paragraph 87) is 160 Million cubic metres per year, i.e. 90 Million cubic metres per year (water drainage from irrigated land) plus 70 Million cubic metres per year ('low nitrate water').

4.6 In my opinion Bidwell and Norton (2009) may underestimate the increase of water discharge to groundwater from the CPWES area because they:

- appear to neglect the effects of irrigation with run-of-river water on the area currently irrigated from groundwater, i.e. the 30,000 ha 'fully irrigated' area (Tipler 2009, his Table 11);
- do not consider security of supply in the 'partially irrigated' area and possible requirements for extra groundwater allocation.

4.7 In my opinion irrigation application by CPWES on 30,000 ha of land currently irrigated from groundwater irrigation will result in additional drainage to groundwater, However I do not calculate this additional drainage to groundwater here.

4.8 The increase (160 Million cubic metres per year) of water discharge from the CPWES area to groundwater estimated by Bidwell and Norton (2009, their paragraph 87) is much greater than that estimated by Tipler (2009, his paragraph 80) of 90 Million cubic metres per year.

4.9 The increase (160 Million cubic metres per year) of water discharge from the CPWES area to groundwater estimated by Bidwell and Norton (2009, their paragraph 87) is broadly consistent with the 5.8 m^3/s (or approximately 183 Million cubic metres per year) estimated by Weir (2009, his paragraph 63).

4.10 I have not assessed the causes of the large difference in water discharge to groundwater with CPWES calculated by the Bidwell and Norton (2009, their paragraph 87) and Tipler (2009, his paragraph 80).

5. NITROGEN DISCHARGE FROM CPWES

5.1 Bidwell and Norton (2009) are in agreement with Tipler (2009) and others (e.g. White 2008a) that nitrogen discharge to groundwater from the CPWES area will increase with irrigation.

5.2 The increase of nitrogen discharge to groundwater from the revised CPWES is calculated by the Bidwell and Norton (2009, their paragraph 7) as 750 tonnes N/yr.

5.3 The increase (750 tonnes N/yr) of nitrogen discharge from the CPWES area to groundwater estimated by Bidwell and Norton (2009, their paragraph 7) is similar to Tipler (2009, his paragraph 79, including 'clean water sources') of 760 tonnes N/yr.

5.4 I agree with some of the uncertainties in calculation of nitrogen discharge from the CPWES area identified Bidwell and Norton (2009, e.g. their paragraph 47).

5.5 However in my opinion nitrogen discharge from the CPWES area may be greater than calculated by Bidwell and Norton (2009, e.g. their paragraph 48) and Tipler (2009, his paragraph 79) because of the following factors:

- CPWES plan for intensification of land use on the area that is currently irrigated from groundwater (paragraph 3.4). Therefore nitrogen discharge can be expected to increase from this area with CPWES;
- Bidwell and Norton (2009) may underestimate the additional drainage to groundwater with CPWES (paragraph 4.6).

6. WATER DISCHARGE AND NUTRIENT DISCHARGE FROM THE REVISED CPWES AND EFFECTS ON GROUNDWATER

6.1 Water discharge to groundwater will increase with CPWES and nutrient (nitrogen) discharge to groundwater will increase with CPWES.

6.2 I agree with Bidwell and Norton (2009, their paragraph 12) that potential health effects are caused by 'increased groundwater levels on the performance of existing groundwater infrastructure' and that 'this risk could be addressed by technological solutions' (Bidwell and Norton 2009, their paragraph 12).

6.3 I agree that an increase in the 'volume and thickness of the nitrate-contaminated groundwater plume' (Bidwell and Norton 2009, their paragraph 10) would lead to 'additional well drilling and pumping costs' to reach high quality groundwater (Bidwell and Norton 2009, their paragraph 13).

6.4 I also agree with Weir (2009) that groundwater levels will increase in some lower-lying parts of the hydrogeological system with CPWES (Weir 2009, Appendix C).

7. WATER DISCHARGE AND NUTRIENT DISCHARGE FROM THE REVISED CPWES AND EFFECTS ON SPRING-FED STREAMS

7.1 In my opinion most water discharge to groundwater in the CPWES area (White 2008a, Section 5) and most nitrogen leached from land in the CPWES area (White 2008a, Section 9.8.1) will travel to spring-fed streams in the Te Waihora catchment and some will travel towards Christchurch City.

7.2 In my opinion the inflow to the groundwater system with CPWES (Bidwell and Norton 2009, their paragraph 87, White 2008a) will result in increased flow in spring-fed streams (White 2008a, Section 9.6).

7.3 However in my opinion the water discharge and nutrient discharge from CPWES to spring-fed streams may be greater than calculated by Bidwell and Norton (2009, their paragraph 87 and their paragraph 17) because of the factors outlined in paragraph 5.5.

7.4 In my opinion nutrient discharge (i.e. mass per time of nitrogen and phosphorus) in spring-fed streams will increase with CPWES (White 2008a, Section 9.8).

7.5 I agree with Bidwell and Norton (2009, their paragraph 16) that a 'higher proportion of contaminated groundwater' will 'inflow to surface waters' with CPWES.

7.6 In my opinion the elevation of groundwater levels in the lower-lying parts of the hydrogeological system with CPWES will also act to increase nitrogen concentrations in streams (White 2008a, Section 5.7.1.1 and Section 5.7.2.1). This increase is additional to the increase in nitrogen concentrations in streams with CPWES noted by Bidwell and Norton (2009, their paragraph 16).

7.7 I agree with Bidwell and Norton (2009, their paragraph 15) that 'the quantity and transport processes of phosphorus were insufficiently investigated' by CPWES.

7.8 Phosphorus is transported in streams by baseflow and quick flow (e.g. White 2008a, Section 5.7.2). CPWES operation will result in an increase in the mass of phosphorus transported in streams because baseflow in spring-fed streams will increase with CPWES. CPWES operation may result in an increase of quick flow in streams, due to raised groundwater levels in the some lower-lying parts of the hydrogeological system.

7.9 However, most of the mass of phosphorus in spring-fed streams (e.g. White 2008a, Section 5.7.2) is probably associated with local land use. Therefore in my opinion phosphorus concentrations in spring-fed streams streams rising to the east of the CPWES area will probably remain similar with CPWES (White 2008a, Section 9.7.2.3).

8. WATER DISCHARGE AND NUTRIENT DISCHARGE FROM THE REVISED CPWES AND TE WAIHORA

8.1 In my opinion (White 2008a, Section 9.8.1) most water discharge to groundwater in the CPWES area and most nitrogen leached from land in the CPWES area will travel to Te Waihora and some will travel towards Christchurch City.

8.2 In my opinion the water discharge and nutrient discharge from CPWES to spring-fed streams may be greater than calculated by Bidwell and Norton (2009, their paragraph 87 and their paragraph 7) because of the factors outlined in paragraph 5.5.

8.3 I disagree with Bidwell and Norton (2009, their paragraph 17) that all water discharge and all nitrogen discharge to groundwater in the CPWES area will travel to Te Waihora. Some of the water discharge and some of the nitrogen discharge from the CPWES area travels towards Christchurch City in my opinion (White 2008a, Section 5).

8.4 I agree (White 2008a, Section 9.8) with Bidwell and Norton (2009, their paragraph 17) that the full nitrate mass loading from existing irrigation has yet to reach Te Waihora.

8.5 I agree (White 2008a, Section 9.8) with Bidwell and Norton (2009, their paragraph 18 and their paragraph 24) that contaminant loads to Te Waihora will increase as a result of CPWES. I refer the Commissioners to Trolle et al. (2009) for some preliminary assessment of the effects of increased nutrient loads on Te Waihora.

9. CPWES, CHRISTCHURCH CITY GROUNDWATER AND THE WAIMAKARIRI RIVER.

9.1 The Christchurch City groundwater supply is 'highly valued by residents and is a water resource of national significance.' (White 2008b) and intensification of land use has the potential on water quality.

9.2 Some current research (White et al. 2009 in prep.) indicates that nitrate-nitrogen concentrations in a relatively deep Christchurch well are increasing. An interpretation of this increase is that land use is impacting on groundwater quality.

9.3 A 200.2 m deep National Groundwater Monitoring Programme well located near Avonhead has recorded a statistically significant trend (with a rate of increase of 0.006 mg/L/yr) in nitrate-nitrogen concentrations since the NGMP began sampling the well in 1995. This rate of increase is low, but the increase indicates the potential of intensifying land use to impact on Christchurch groundwater quality. Groundwater quality in the 200.2 m deep well is good; median nitrate-nitrogen concentration is 0.24 mg/L, and median oxygen concentration is 6.3 mg/L, of samples taken since 1995.

9.4 CPWES has the potential to impact on Christchurch City groundwater (White 2008a, Section 5 and Section 10) because:

- part of the CPWES area is in the groundwater catchment of Christchurch City aquifers with potential effects on groundwater quality and spring-fed streams;
- CPWES takes flow from the Waimakariri River which potentially impacts on groundwater recharge to Christchurch City aquifers from the Waimakariri River.

9.5 Therefore, in my opinion, Bidwell and Norton (2009) could have assessed the impacts of the revised CPWES on Christchurch City groundwater including groundwater quality, spring-fed streams and groundwater recharge to Christchurch City aquifers from the Waimakariri River.

DATED this 13th day of October 2009

____

P A WHITE

References.

Bidwell, V. and Norton, N. 2009. Section 41C Report: review of nutrient and other contamination issues.

Tipler, C. 2008. Brief of evidence of Clifford John Maxwell Tipler 1st February 2008.

Tipler, C. 2009. Brief of evidence of Clifford John Maxwell Tipler 7th September 2009.

Trolle, D. et al. 2009. Modelling the nutrient dynamics of Te Waihora. Talk to the Selwyn Science Symposium, 9 - 1 0 March 2009.

Unauthored, 2007. Central Plains Water Limited – nitrate contamination assessment. GHD, 22 June 2007. 16p + appendicies.

Weir, J. J. 2009. Supplementary evidence to the Central Plains commissioners.

White, P. A. 2008a. Central Plains Water – Technical Assessment for Te Runanga o Ngai Tahu. Report to Te Runanga o Ngai Tahu. 238p +app.

White, P. A. 2008b. Draft brief of evidence to Central Plains Water Commission.

White, P. A., Zemansky, G., Hong, T. 2009 in prep. Geology, groundwater chemistry and groundwater flow in the area between the Waimakariri River and Christchurch City. GNS Science Report 2009/42. 92p.