IN THE MATTER OF	the Resource Management Act 1991
AND	
IN THE MATTER OF	applications by Central Plains Water Trust to: Canterbury Regional Council for resource consents to take and use water from the Waimakariri and Rakaia Rivers and for all associated consents required for the construction and operation of the Central Plains Water Enhancement Scheme Selwyn District Council for resource consents to construct and operate the Central Plains Water Enhancement Scheme
AND	
IN THE MATTER OF	a notice of requirement by Central Plains Water Limited to: Selwyn District Council for the designation of land for works associated with the construction and operation of the Central Plains Water Enhancement Scheme

---

SUPPLEMENTARY EVIDENCE OF DAVID PHILIP HAMILTON

INTRODUCTION

1. My full name is David Philip Hamilton.

2. My qualifications and experience have been presented to this Committee previously and are therefore not repeated here.

3. The purpose of this supplementary brief of evidence is to comment on the effects of the proposed revised Central Plains Water Enhancement Scheme (CPW) on the water quality of Lake Ellesmere/Te Waihora.

BACKGROUND ON NUTRIENT ADDITIONS TO LAKES

4. In this section I present general background information on lake water quality and ecology that I consider important to considerations of the effect of the CPW on water quality in Te Waihora, but without reference to the specific case in question.

5. Additional loads of potentially limiting nutrients to a lake, especially nutrients that are immediately available (dissolved inorganic forms), are likely to increase growth rates of phytoplankton and result in greater biomass. The effect that additions of nutrients have will vary amongst different lakes and at different times of year, depending on complex interactions amongst other factors that affect growth and loss of phytoplankton, such as flushing rates, water temperature, zooplankton grazing rates, water mixing depths and availability of light. These interactions make it difficult to predict with precision the magnitude of changes in phytoplankton biomass in response to a given change in nutrient load.

6. Increased hydraulic flushing of a lake can in some cases significantly reduce phytoplankton biomass by flushing cells from the water column when they are in a phase of rapid growth as a result of favourable environmental conditions (e.g., light, nutrients). A hydraulic residence time of less than c. 20 days is required to induce sufficient rates of loss of phytoplankton cells so that flushing can effectively control biomass. In most other circumstances pertaining to natural lakes, where hydraulic residence times are considerably greater than 20 days, inflows will generally stimulate phytoplankton growth by bringing in higher concentrations of nutrients in available forms (e.g. nitrate and

ammonium species of nitrogen and phosphate for the case of phosphorus) relative to concentrations of these nutrients in the lake water.

7. Low levels of light that occur, for example, in the water column of highly turbid waterbodies, can reduce phytoplankton growth rates and potentially constrain biomass to lower levels than what would be expected from nutrient concentrations alone. This situation should not, however, be interpreted as a ónutrient-saturatedô state because there are times when phytoplankton may still be exposed to high light intensities in surface waters of turbid waterbodies.

CONSIDERATION OF EFFECTS OF CPW ON WATER QUALITY OF TE WAIHORA

8. In light of the background information given above, it is apparent that the increased flushing brought about by the CPW will not decrease water residence time in Te Waihora to an extent that it will have any significant impact on phytoplankton biomass.

9. As concentrations of dissolved inorganic nutrients in the water from CPW are high relative to those in the lake, the CPW is likely to stimulate higher levels of phytoplankton biomass in the lake. This increase in phytoplankton biomass may be moderated to some extent by limited light availability in the water column of turbid Te Waihora. Without substantial field work and modelling, it is difficult to determine to what extent phytoplankton biomass might increase due to the CPW, but implicit with an increase in phytoplankton biomass is an increase in the occurrence of algal blooms.

10. Observations (e.g. Environment Canterbury) show that there is a strong gradient of nitrate concentration in Te Waihora, with concentrations generally decreasing with distance from the Selwyn River inflow. This gradient is indicative of a large demand for nitrogen imposed by the high phytoplankton biomass in the lake. Concentrations of inorganic nitrogen (nitrate and ammonium) in the main waterbody are for most of the time sufficiently low that they fit within a range where nitrogen can be limiting phytoplankton growth (Reynolds 1997; Schladow and Hamilton 1997). Consistent with point 9, it can therefore be assumed that additions of nitrate to the lake with the CPW will increase phytoplankton biomass.

IMPLICATIONS FOR RESTORATION OF TE WAIHORA

11. The addition CPW to Te Waihora from CPW is likely to increase phytoplankton biomass, making it more difficult to improve water quality of the lake and achieve lake ŕestorationô

12. Restoration of water quality in Te Waihora would be extremely challenging, with or without addition of CPW. It is unlikely that any conventional methods (e.g., riparian planting, best management agricultural practices within the catchment) will achieve a ŕegime shiftôfrom the current highly turbid degetated state to clear water in which bottom sediments are stabilised by submerged plants. Recent data (Schallenberg and Sorrell 2009) indicate that the turbid, phytoplankton-dominated state is more likely to occur in shallow New Zealand lakes as percentage of lake catchment in pasture increases above 30% and especially once it increases above 70%.

13. Significant improvements in wildlife habitat and appearance of lakes can be achieved with plantings around lake-edges and riparian areas, but evidence in the Waikato region (Hamilton et al., in press) indicates that these changes alone will not have a major effect on water quality (i.e., nutrients concentrations and phytoplankton biomass) of lakes that are already highly turbid and devegetated.

References

Hamilton, D.P., W.N. Vant and K. A. Neilson. Lowland Lakes. In: Waters of the Waikato, editors: K. Collier, W.N. Vant, C. Howard-Williams and D. P. Hamilton. In press.

Reynolds, C.S., 1997. Vegetation Processes in the Pelagic. A Model for Ecosystem Theory. ECI, Oldendorf.

Schallenberg, M. and B. Sorrell, 2009. Regime shifts between clear and turbid water in New Zealand lakes: environmental correlates and implications for management and restoration. New Zealand Journal of Marine and Freshwater Research 43: 701ï 712.