

## **BEFORE THE HEARINGS' COMMITTEE**

**IN THE MATTER** of hearings on submissions concerning the proposed One Plan notified by the Manawatu-Wanganui Regional Council

### **STATEMENT OF SUMMARY EVIDENCE OF**

***Dr JOHN (JACK) ALLEN McCONCHIE***

**ON BEHALF OF:**

***PALMERSTON NORTH CITY COUNCIL***

#### **1.0 INTRODUCTION**

- 1.1 I am a Principal Water Resources Scientist working for Opus International Consultants Ltd.
- 1.2 Prior to the start of 2008, I was an Associate Professor with the School of Earth Sciences at Victoria University of Wellington. I hold a Bachelor of Science degree with First Class Honours, and a PhD. I am a member of the New Zealand Hydrological Society, the American Geophysical Union, the New Zealand Geographical Society, the Australia-New Zealand Geomorphology Group, and the Environment Institute of Australia and New Zealand. I taught undergraduate courses in geomorphology and hydrology, and a post-graduate course in hydrology and water resources. For more than 20 years my research focused on various aspects of hydrology and geomorphology, including: slope and surface water hydrology; hydrometric analysis; slope and fluvial coupling; hydraulic modelling; soil-water interactions; landscape evolution; slope stability and erosion; and natural hazards.
- 1.3 Within these fields I have edited one book. I have written, or co-authored, 10 book chapters and over 40 internationally-refereed scientific publications.
- 1.4 I was the New Zealand Geographical Society representative on the Joint New Zealand Earth Science Societies' Working Group on Geopreservation. This group produced the first geopreservation inventory; published in 1990 as the *New Zealand Landform Inventory*.

- 1.5 For three years I coordinated an investigation, and undertook a range of field studies, into the effect of hydro-electric operations on the fluvial and geomorphic processes of the Waikato River. This was part of the *Assessment of Environmental Effects* required for Mighty River Power Ltd's resource consent application to operate the Waikato hydro-electric system.
- 1.6 Specific to this evidence I have undertaken a field visit to the Turitea catchment and the various flow monitoring and control sites. I have compiled a comprehensive hydrometric archive of the available climatic and hydrologic data relating to the Turitea and surrounding catchments. I have analysed these data in detail, and therefore have an excellent understanding of the climate and hydrology of this area.
- 1.7 In my evidence I have addressed specifically:
- The flow regime of the Turitea Stream;
  - The effects of the existing take for water supply purposes from the Turitea Stream;
  - The present minimum and residual flows in the Turitea Stream;
  - The development of a 'naturalised' flow regime for the Turitea Stream;
  - The appropriateness of a MALF of 41l/s at Ngahere Park; and
  - The appropriateness of a core allocation of 37,000m<sup>3</sup>.
- 1.8 I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note (31 July 2006). I agree to comply with the Code of Conduct. Except where I state that I am relying upon the specified evidence of another person, my evidence in this statement is within my areas of expertise. I have not omitted to consider any material facts known to me that might alter, or detract from, the opinions that I express.

## **2.0 PROCESS SO FAR**

- 2.1 In support of Palmerston North City Council's submission on the Proposed One Plan I undertook detailed analysis of the flow regime of Turitea Stream. This analysis, and its results and conclusions relating to the minimum flows and core allocation within Turitea Stream, was presented to the panel in my *Statement of Evidence dated 30 September 2009*.
- 2.2 In response to this evidence a 'caucusing meeting of experts' was arranged between myself (expert on behalf of Palmerston North City Council); Jon Roygard and Raelene Hurdell (experts on behalf of Horizons RC); and Richard Thompson, facilitator.
- 2.3 The purpose of the meeting was to discuss, and attempt to resolve, issues of difference between the experts who had prepared Statements of Evidence in regard to surface water quantity. In particular, the meeting discussed the minimum flow and cumulative core allocation limit set for Sub-zone Turitea in the Lower Manawatu Water Management Zone (WMZ) Mana 11 in Schedule B of the One Plan. The meeting was held without prejudice. The minutes of those discussions have been presented to the hearings' panel in the

*Report Of A Meeting Between Experts* dated about 1 December 2009.

- 2.4 Following that meeting I was tasked with undertaking further analysis of a synthetic natural flow record for Turitea Stream and to report back to the other experts. My report is submitted as a **Supplementary Statement of Evidence** dated 18 November 2009.
- 2.5 Jon Roygard and Raelene Hurdell from Horizons R.C. reviewed this new information and agreed with the overall conclusions that relate to the Provisional One Plan. These are that: the recommended minimum flow for Sub-zone Turitea be 41l/s, measured at the Turitea @ Ngahere Park flow recorder; and, that the core allocation be 37,000m<sup>3</sup>/day.
- 2.6 Consequently, it was agreed between both parties that for Sub-zone Turitea in the Lower Manawatu WMZ Mana 11 in Schedule B of the Proposed One Plan:
- The recommended minimum flow should be 41l/s, measured at the Turitea @ Ngahere Park flow recorder.
  - The core allocation from Turitea Stream should be 37,000m<sup>3</sup>/day.
- 2.7 This resolution is detailed in *Report Of A Meeting Between Experts* dated about 1 December 2009 tabled for the hearing panel.

### **3.0 EXECUTIVE SUMMARY OF EVIDENCE**

- 3.1 The flow regime of Turitea Stream has been modified to help meet Palmerston North City's potable water supply needs for over 100 years.
- 3.2 Flows in Turitea Stream have only been monitored quasi-continuously since August 2000 (at Ngahere Park). The catchment area above the monitoring site is approximately 32.13km<sup>2</sup>. Of this total area the flow from 66% is affected by abstraction and the water supply dams. Flow from the remaining 34% of the catchment is essentially natural.
- 3.3 The effect of the two dams in the upper catchment on the flow regime downstream depends on the status of the dams prior to any inflow. When the dams are full their effect is minimal. Any inflow is passed over the spillway to the lower catchment. When the dams are not full a portion of the inflow is 'captured', reducing the potential flow downstream. In general, however, the dams fill very quickly and so their effect on flows can be relatively short-lived. Overall, the dams and abstraction of water tend to moderate and attenuate flood events, and reduce total flow downstream. The maintenance of a residual flow past the lower dam tends to stabilise low flow conditions downstream.
- 3.4 The moderation and attenuation of flows by the dams, and the extraction of water for supply purposes, therefore modify the flow regime in the lower valley. Despite this, Turitea Stream above Ngahere Park maintains the natural flow characteristics typical of a

small hill country catchment. The catchment also continues to support a viable and healthy aquatic ecosystem that is comparable to reaches above the dams.

- 3.5 Analysis of the actual flow record indicates a mean annual low flow (MALF) of 41l/s, which reduces to 33l/s when only complete years of record are included. Annual low flows have ranged from about 10l/s to 85l/s. Because the flow record coincides with a period of higher than average rainfall and runoff, the present MALF is likely to be higher than the long term index.
- 3.6 Palmerston North City Council currently maintains a residual flow past the lower dam of 25l/s. This is equivalent, when scaled appropriately for contributing area, to a minimum flow of 38l/s in the Turitea Stream at Ngahere Park.
- 3.7 The amount and distribution of rainfall has a significant effect on the flow regime of the river as expected. A reduction in annual rainfall by 50% reduces median and lower flows by approximately 50%.
- 3.8 The period for which there are flow data from Ngahere Park has a mean annual rainfall of 1316mm. This period has been significantly wetter than the long term average (i.e., 1270mm) despite having the driest year recorded (i.e., 2003 had only 786mm).
- 3.9 As outlined above, the flow regime of the Turitea Stream has been modified by the dams and water abstraction for over 100 years. Although a range of measurements are made in relation to the reservoir levels and abstraction, it is not possible to derive an accurate naturalised flow record using currently available information.
- 3.10 A longer term synthetic naturalised flow regime for the Turitea was therefore generated by correlation, translation, and then adjustment of the flow records from the adjacent Kahuterawa Stream and Tokomaru River.
- 3.11 This synthetic flow series for the Turitea is, however, biased by the higher rainfall to the south. This is a result of the higher elevations of the headwaters of the Tokomaru and Kahuterawa catchments, and the orographic enhancement of rainfall i.e., these catchments get more rain and therefore experience higher flows. The flow series may also be biased by different rainfall-runoff processes in the various catchments.
- 3.12 While this synthetic record is considered to reasonably reflect the flow regime under natural conditions there is still a degree of inherent uncertainty. This uncertainty is likely to be greatest at low flows where catchment parameters that affect the rainfall-runoff relationship are likely to have more significance than rainfall distribution.
- 3.13 The MALF of the synthetic flow record for Turitea Stream is approximately 135l/s. However, minimum flows as low as 57l/s would have been experienced.

- 3.14 Assuming the conservative MALF derived from the actual flow record from Ngahere Park, and that this continues to be adequate to maintain the in-stream values etc., the minimum recommended flow at this site would be about 37l/s; using Roygard's methodology adopted for the One Plan (i.e.,  $41l/s \times 0.909$ ). Scaling this back, as a simple function of area, to provide a residual flow past the lower dam yields a value of 24.6l/s (i.e.,  $37 \times 0.66$ ). This is approximately the current minimum residual flow of 25l/s.
- 3.15 The maintenance of a residual flow of 25l/s therefore has had the effect of generating a MALF of about 41l/s. This is likely to be less than the MALF under a natural flow regime. The stream and its ecology, however, have adapted over the past 100 years to this reduced flow without any apparent adverse environmental effects.
- 3.16 The maintenance of a MALF at Ngahere Park of 41l/s would therefore appear reasonable and sustainable given the long history of modified flows, and the importance of the Turitea to meeting Palmerston North City's potable water supply.
- 3.17 Notwithstanding the reasonableness of the argument for a MALF of 41l/s, and therefore a minimum flow of 37l/s to be consistent with the Proposed One Plan methodology, it is accepted that for the Turitea Stream the minimum flow could equal the MALF. This recognises the modified nature of the flow regime, and the impact of this modification on the MALF derived from the instrumental record.
- 3.18 A maximum daily allocation of 37,000m<sup>3</sup> is equal to only 28% and 47% of the mean and median daily flows in Turitea Stream respectively. The stream can sustain this maximum level of take without adversely affecting the flow regime.
- 3.19 There are days when the full maximum daily allocation of 37,000m<sup>3</sup> cannot be met by natural inflow in the catchment. During 'wet' years (1980) with higher flows the maximum daily allocation can be satisfied every day. However, during a 'dry' year (2003) there were 153 days when this full maximum daily allocation could not have been met by daily inflows. Even during this extremely dry year, however, the maximum daily allocation represented only 36% and 65% of the mean and median daily flows respectively.
- 3.20 The dams therefore provide an effective buffer to manage any miss-match between daily inflows and maximum daily abstraction. They also mitigate any adverse effects downstream by providing water to maintain a residual flow. This is the reason for the existence of the dams; they buffer periods of higher and lower flow thereby allowing the average demand to be met.
- 3.21 A maximum daily allocation of 37,000m<sup>3</sup> represents a relatively small proportion of flows within the catchment. It should also be noted that this maximum daily allocation would not be taken every day; therefore its overall effect on the flow regime is likely to be relatively minor.

#### 4.0 RECOMMENDATION

4.1 It is the recommendation of the experts acting on behalf of both Horizon's RC and Palmerston North City Council that:

***For Sub-zone Turitea in the Lower Manawatu WMZ Mana 11 in Schedule B of the Proposed One Plan:***

- ***The recommended minimum flow should be 41l/s, measured at the Turitea @ Ngahere Park flow recorder.***
- ***The core allocation should be 37,000m<sup>3</sup>/day.***



**John (Jack) McConchie**  
**Principal Water Resources Scientist**  
**10 February 2010**