“Significant observations” and questions from David Leong - 30 June 2007

Answers to questions that have been provided by Meridian are shown in *italics and highlighted*.

Warwick’s question 1 from email:

> The HD AEE doesn't outline how the scheme would be operated in conjunction with NBTC if they both get the nod, and that this could have a significant impact on some of the scenario modelling and reliability analyses.
>
> *The HDI AEE does not outline operating in conjunction with NBTC on the basis that the intake location for HDI is downstream of the NBTC outfall and the modelling undertaken for NBTC confirmed that the flows downstream of the proposed NBTC out fall would be very similar to the Status Quo flows at Waitaki Dam.*
>
> *The flows below the NBTC out fall are discussed in NIWA report in NBTC AEE Vol 2 appendix 6 “North Bank Tunnel Concept – Water Consents – Hydrology Report” at pg 12.*

David Leong’s questions:

1. The proposed computation method for computing permitted rate of abstraction (e.g. Section 1.2.3 AEE) clearly allows for the possibility of future hydro: “plus any flow taken upstream of the Kurow Gauge <u>and</u> returned …..<u>but</u> upstream of the Hunter Downs…”. In implementing this flow computation method, there will be issues with relative timing of the various inflow and outflows and the flow measured at Kurow. If flows are being ramped up or down at the dam (or Stonewall), and ignoring tributary inflows, the actual flow at any given location (e.g. HDIS intake) will not be a simple arithmetic sum of the instantaneous flows. The flow released at the dam will take some time to reach Black Point, and the shape of the hydrograph (or generation pulse) will progressively change (attenuate) as flow travels downstream. Averaging flows on a rolling hourly basis is expected to “absorb” some of the flow transients, but not eliminate this effect completely. **MEL / SCIT are invited to comment**, but this is also an issue for ECan to deal with as plan administrator.

   The words “plus any flow taken upstream of the Kurow Gauge <u>and</u> returned …<u>but</u> upstream of the Hunter Downs” were included as the WRP allows for flows to be taken in excess of the 90 cumecs provided they are returned above Black Point. As rightly pointed out the management of consent compliance in the lower Waitaki will need careful consideration and Meridian is keen to discuss methods to report flows at the NBTC outfall that would facilitate this. Initial thoughts are that flows recorded through the NBTC outfall would need to be added to the flows at Kurow with a sufficient real-time allowance to cover any difference

   Although we have made the comments above we also agree with you that it is not a matter with any immediate relevance to the HDI application.

2. The obvious departure from the WRP is the proposal to take the minimum flow in the main stem down to 100 m^3/s compared with 150 m^3/s in the WRP.

This ought to have significant implications for a wide range of environmental and socio-economic values.

The matters raised have been the subject of assessment undertaken by NIWA, Glasson Potts Fowler and The Agribusiness Group.   however it is noted that minimum flows below the last take currently approach 100 cumecs.

The lower of two graphs in Fig 5.1 of Annex E shows how much of a difference there is – i.e. a lot, in terms of low flow hydrology / statistical terms. Fig. 5.2 in Annex E can give a misleading interpretation i.e. the 100 m^3/s case looks better than the 150 m^3/s in terms of frequency of threshold flow occurrence **MEL/SCIT should be requested to provide**:

a. a comparison of the two minimum flow regimes on the same plot showing the number of years the minimum flow reaches or goes below, say 170, 150, 130, 110, 100 cumecs for each month of the year .

   Please see the attached graph of flows showing a continuous comparison

b. a comparison of the two minimum flow regimes with the historical flow record (adjusted for takes below Kurow of course).

   This information is included in the printout of flow graphs but it is noted that this is an estimate only as MEL/SCIT are not able to source historical abstraction data.

c. statistical analyses of the above i.e. low flow frequency analyses, if possible, although it is appreciated that both the historical low flows and the simulated flows are managed (not natural) to a large extent .

   This information will be presented in Roddy Henderson's evidence for the hearing.

Confirmation whether the Plexos model (see 9. and 10. also) or some other approach was used for modelling the various flow scenarios (Annex E, page 11 last paragraph).

The Plexos model simulated discharge for Waitaki Dam was applied to an EXCEL spreadsheet to simulate the flow which would remain at the point in the river downstream of the last irrigation abstraction point (nominally Bells Pond, 16 km upstream of the Waitaki Mouth).

3. Section 6.3.2.1 of the AEE (Reliability). The description of the modelled four scenarios is hard to follow, and I am not convinced is entirely accurate. Given the statement at the top of page 112 of AEE that "there is likely to be enough water within the allocation limit of 90 m^3/ to satisfy he entire HDIS demand"

This was based on an assessment of what was considered to be the irrigation demand and irrigable areas of the Irrigation North Otago (INO) and Hakataramea Valley Irrigation (HVI) consent applications. Since lodgement of the HDI applications in October 2006 INO has reduced its take from 25 to 10 cumecs and HVI have reduced their application from 4 cumecs to 3. In addition, the Waihao Downs application for 3.06 m^3/s is within the HDIS *command area and should not be double counted. The total peak rate of abstraction is now assessed to be approximately 88.35 cumecs.*

(in fact Annex L models a max. take of 85 m^3/s –

It is noted that a monthly average for irrigation demand has been used as explained in the text. the reliability ought to be close to 100% if MEL was indeed operating to WRP rules as claimed in the description in Scenarios 1 and 3, especially since a lower minimum of 100 m^3/s is conditionally allowed? The description of the flow modelling in paragraph 3 on page 80 of the AEE provides a potentially conflicting description viz. "This model is a representation of how Waitaki Power Scheme is operated now with …., current consented rules, …" (emphasis on "current" consents, not future WRP rules) **MEL/SCIT is requested to clarify.**

Current Waitaki Dam operation is based on a consented minimum flow of 120 cumecs with an operational buffer of 30 cumecs to ensure compliance with consent conditions. This is based on the fact that minimum flow compliance under the current consent conditions is simply based on instantaneous rates. Conversely, under the WRP the minimum flow is 150 cumecs with a 1 hour rolling average. This would allow the Waitaki Dam to operate without the need for the significant buffer it currently employs. For this reason it was considered that the modelling of the existing Waitaki Dam release undertaken for the WRP hearings adequately represented operation with the WRP 150 minimum.

The restrictions noted in Table 6.3 of the AEE (percent irrigation restriction in cumec range) all look overestimated

It is accepted that the 100% reliability conclusion could be reached if Rule 7 of the WRP is factored into the way the Waitaki Dam is operated in the future. However, as Rule 25 of the WRP does not allow for a review to implement Rule 7 it was considered valid for downstream irrigation reliability modelling to assume that the Waitaki Dam under the WRP would only have to comply with 150 cumec minimum flow.

4. Minor point: second last para on page 81 of the AEE refers to Policy 26 of the WRP for target reliability. This policy is not for the Lower Waitaki main stem but for the Ahuriri, Hakataramea and the tributaries of the Lower Waitaki.

Agreed

5. MEL's Plexos model. There is only a one-paragraph description of this model in the AEE for the HDIS (page 80, 3rd para), which is considered insufficient for review. **More detail on the modelling framework, assumptions and results is requested from MEL/SCIT**.

See 6 below

6. There is a longer (half page) description of the Plexos model in Appendix 2 of the NBTC. The last paragraph of this description creates some concern (and certainly accords with my own experience with this model during Project Aqua investigations). It is stated that "The nature of the model is such that it produces results that are considered to tend towards an optimistic level of

control and optimisation especially at the higher resolution (e.g. daily) end of the results spectrum." **Several questions arise for MEL/SCIT**:

a. what is the native (finest) time resolution of the Plexos model (daily, hourly)?

An hourly resolution was used. That is to say, the model made operational decisions for each hour. The model simulated a week at a time by taking the opening storage at the start of the week, and the list of inflows for the week, and calculating a schedule of hourly generation and releases for the whole week. This schedule was chosen to maximise generation revenue, while conforming to minimum flow and ramping rate constraints., NIWA analysis presented in evidence will show that the model results were similar to actual operations.

b. what resolution data has been used in the various analyses in the AEE (e.g. the reliability analysis, the in-stream habitat and low flow analysis*?*

Daily Waitaki Flow data from the Plexos model was used with monthly average irrigation demand. The irrigation demand profile was a combination of border dyke profile from Morven Glenavy and a spray demand profile prepared by Glasson Potts Fowler.

c. how would the results / conclusions differ (if at all) if level of flow control/regulation in the Waitaki scheme were more realistic ? (A qualitative overview may suffice here, as I imagine it will be difficult to re-do the analysis using another approach in the timeframe available.)

Comparison of last 20yrs historic with modelled status quo

	Flow Scenario			
	Modelled Flows	Historical flows	Modelled Flows	Historical flows
Peak demand cumecs	85	85	85	85
Minimum flow cumecs	150	150	100	100
Start Year	78\79	78\79	78\79	78\79
Stop Year	03\04	03\04	03\04	03\04
Total Years in Analysis	26	26	26	26
Irrigation season length days	242	242	242	242
Average % reliability	96%	93%	99%	97%

The modelled flows produce a higher level of reliability than that seen if historical flows are used. Therefore, the modelling undertaken using modelled flows is considered to be conservative. The results are different to those provided in the AEE due to the shorter time frame used for comparison. We used modelled flow rather than recorded flow to get a longer period of record with consistent operation of the hydro system for the analysis of reliability. As the modelled "status quo" flows have been used to compare different river low flow scenarios for comparative purposes. However, in using the dam management regime that is likely to be operated, it is considered that the modelling is realistic and appropriate.

d. the NBTC application mainly used an Excel spreadsheet model (clearly a sophisticated one at that) to simulate future operation of the scheme and downstream flows. What are the reasons this model was not used in the HDIS application? For consistency and to facilitate comparison of the flow regimes from the two applications (HDIS and NBTC), it would be strongly preferable to use one common model.

The NBTC model looks at intraday variations and considers that 26 years of data(when there has been consistent operation of the hydro system) is sufficient to show the effects of the operation of NBTC. HDI does not have the ability to significantly change the flows compared with a major hydro-electric abstraction and accordingly the longer record has been used to simulate the reliability that could be expected for the life of the project. A shorter record could be used for HDI but the last 20 odd years have been significantly wetter than the full record and would not give a full picture of actual and expected reliability. The NBTC model was intended to model the management of flows that approach and exceed the capacity of the NBTC to assess the number of events exceeding NBTC minimum flows. The model does not manipulate storage during periods of low inflows and these are effectively the same as the historic record.

7. Geomorphological effects – the more critical issue discussed via telephone is raised under theThe memo from Murray Hicks, NIWA dated 14 June 2007, compares NBTC queries. the alternative flow regimes and discusses geomorphological effects in a broad sense and on specific issues (e.g. mouth closure, barrier width, etc.) and specific areas (the coast, river mouth). No description of the near-field effects has been given. **MEL/SCIT should be requested to provide an assessment of the predicted changes on the local river reach and effects on existing infrastructure say, from the Stonewall, past the LWIS intake, to a point 2 km downstream of the LWIS intake lagoon**

It is considered that HDI's take of 20.5 cumecs will not cause any effect on the operation of existing infrastructure. It is no larger than two other takes in the Lower Waitaki River (Lower Waitaki Irrigation Scheme and Morven Glenavy Irrigation Scheme) and thus the effects of a take of this magnitude can already be seen. The near-field effects have been described in the AEE, Section 6.3.2.2.

8. Finally, and further to point 2. above, it would be instructive/useful, not only for HDIS but the NBTC proposal also, **if MEL/SCIT could undertake a hydraulic modelling study to show how a typical generation pulse attenuates as it travels downstream to the coast from the Waitaki dam under a range of baseflow conditions.**

NIWA advise that Field gaugings have shown that there is no detectable attenuation from typical generation pulses. The assumption used for the AEE is conservative in that any attenuation would decrease adverse environment effects by increasing minimum flows and decreasing the range of fluctuations.