

TABLED AT HEARINGDate 22/4/2010**Addendum evidence 22nd April –****Response to query raised by Dr Jim Cooke regarding flushing of the upper Haldon Arm**

1. Dr Cooke noted that my use of the annual mean inflow ($1.3 \text{ Mm}^3/\text{day} = 15 \text{ m}^3/\text{s}$) may over-estimate typical discharges from the Tekapo-Pukaki Rivers since it includes lake spills. He suggested a more appropriate value would be the discharge used by NIWA (Table E.1, Appendix E, NIWA 2009) of $3.69 \text{ m}^3/\text{s}$ ($0.3 \text{ Mm}^3/\text{day}$).
2. Dr Cooke suggested this would result in a flushing timescale of 6 days, substantially more than the value of 1.9 days presented in my evidence.
3. My initial estimate of the plunge point (for a discharge of $15 \text{ m}^3/\text{s}$) at a water depth $h_0 \approx 3.6 \text{ m}$ resulting in a plume area (area where the discharge remains unmixed) of approx. 1 km^2 , which corresponds with Donna Sutherlands observation during spilling.
4. When the Tekapo-Pukaki discharge does not include spills it has less momentum and will plunge/mix sooner than during periods of higher flows which include spills. The plume area of the Tekapo-Pukaki discharge (area where the discharge remains unmixed) will be reduced accordingly.
5. My revised estimate of the water depth at which the Tepako-Pukaki discharge plunges/mixes without spills is depth $h_0 \approx 2 \text{ m}$ resulting in a reduced plume area of approx. 0.78 km^2 . The depth of the plunge point ($h_0 \approx 2 \text{ m}$) is the maximum depth at the edge of the plume. The average water depth in the area where the discharge remains unmixed is less than this (approx. 1 m).
6. Using the reduced inflow ($0.3 \text{ Mm}^3/\text{day}$), the reduced plume area (0.78 km^2) and reduced average depth (1 m) results in a flushing timescale of approx. 3 days.
7. It is worth noting that Donna Sutherland's observation that the Tekapo-Pukaki discharge did not mix over an area of approx. 1 km^2 refers to a period of lake spilling (Plate 2, evidence 16th September).

Summary

8. Donna Sutherland's observation that the Tekapo-Pukaki discharge did not mix over an area of approx. 1 km^2 refers to a period of lake spilling.
9. My original estimate of the flushing time of the Tekapo-Pukaki plume area (area where the discharge remains unmixed) of 1.9 days included lake spills.
10. In periods excluding lake spilling, the flushing time of the Tekapo-Pukaki plume area (area where the discharge remains unmixed) is expected to increase to approximately 3 days.