

Date: 6 December 2007
To: Walter Lewthwaite
From: Tim McMorran
Subject: Effects on groundwater levels at Waianiwaniwa Dam

This memo responds to a Section 92 request from Environment Canterbury to Central Plains Water Trust dated 2 November 2007. Under the heading "*Effects on groundwater levels at Waianiwaniwa Dam*", the letter requests:

"Please provide an assessment of the change in groundwater conditions and slope stability in the vicinity of the dam and impoundment."

Groundwater depths below ground level in the floor of the Waianiwaniwa valley were measured at 2 to 4 m during preliminary site investigations in September 2002. The depth to groundwater was more than 30 m below the extensive terrace that underlies most of the proposed dam footprint. It is anticipated that a small rise in groundwater levels will occur downstream of the dam, but this rise will be limited by the foundation seepage cutoff features incorporated in the dam design.

With the exception of the dam site, the reservoir appears to be contained within Tertiary age sedimentary rocks or basement rocks which have low permeability. The contact between these rocks and the overlying Quaternary gravels is believed to be above reservoir level. As a result, leakage out of the reservoir is expected to be insignificant and the potential for the reservoir to affect slope stability outside the valley is negligible.

Within the valley, the reservoir will locally raise groundwater levels by up to 45 m around the perimeter of the impoundment and this will have a minor local destabilising effect on the slopes. The slopes that will be most affected will be those within the operating range of the reservoir. These slopes will experience increased erosion and local shallow slope instability. Wave action is expected to cause local erosion up to maximum reservoir level and the oversteepened slopes are expected to experience some minor instability extending above maximum reservoir level.

The Tertiary age sedimentary rocks that surround much of the reservoir may experience instability where unfavourably oriented bedding locally dips towards the reservoir. This will mainly affect southeast facing slopes where bedding is sufficiently steep to allow sliding to occur. Based on our preliminary evaluation of reservoir geology we believe this to be an unusual configuration around the reservoir. No areas have been identified where large existing landslides will be inundated and adversely affected by the increased groundwater levels. Initiation of new large scale landslides would require a combination of weak layers with adverse orientation and high uplift pressures. This combination of conditions has not been identified during investigations.

Waste rock stacks at the existing coal mine in Bush Gully have been designed by others to take account of the proposed full reservoir.

While preliminary level engineering geological assessment has not identified slope instability that could represent a significant engineering risk to the reservoir, further detailed engineering geological mapping of the complete reservoir area will be undertaken during future design stages. If any areas are identified where slope instability represents a significant engineering risk, these could be mitigated by engineering measures such as earthworks, drainage or buttressing.