

**MOKIHINUI HYDRO PROPOSAL
CONSENT APPLICATIONS
REVIEW OF ASSESSMENT OF EFFECTS ON HYDROLOGY**

JUNE 2008

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1.0 Introduction

1.1 Background

This report provides a review of the assessment of environmental effects (AEE) provided by Meridian Energy Ltd (the applicant) in support of resource consent applications as outlined in Appendix A of the Statutory Assessment Report. These consent applications are to take, use and discharge water for hydroelectricity generation, along with associated construction and maintenance related consents which are part of the Mokihinui Hydro Proposal (MHP).

The Mokihinui Hydro Proposal includes a dam located on the Mokihinui River approximately 3 km upstream from the township of Seddonville and 11 km upstream from the river mouth, a new lake upstream of the dam extending to just below the Mokihinui Forks Ecological Area, a new transmission line to carry electricity from the power station to the existing Inangahua-Waimangaroa transmission line at Cedar Creek, and a new substation at Cedar Creek.

This report will provide the decision-maker with information and advice related to the effects of the proposed activities on the hydrology and water resources in and around the Mokihinui River.

1.2 Qualifications

My name is Michael David Harkness. I have been employed by MWH as a hydrologist since 2007. My qualifications are a Bachelor of Science (Honours), majoring in Physical Geography from Victoria University of Wellington. I have fifteen years professional experience as an hydrologist in New Zealand.

1.4 Scope of Report

To carry out this review of the consent application I have considered the relevant sections of the AEE submitted by the applicant, and the following technical appendices:

- Henderson, R, McKerchar, A, 2007: Mokihinui River Proposed Hydropower Scheme: Hydrology Report. NIWA Client Report CHC2007-134

I have also taken into account issues raised by submitters in relation to the effects on surface water and groundwater hydrology.

In addition I have carried out a site visit on the Wednesday 5th March 2008. Further information on hydrology and ground water issues was provided by the applicant in response to a Section 92 request for further information.

2.0 Submissions

The following issues were raised by submitters in relation to the effects on river hydrology and groundwater in particular:

- The proposed scheme will change the flow regime of the river downstream of the dam resulting in prolonged, unnatural periods of low flow that will impact on the quality of instream habitat and ecosystems
- There will be a reduction in the magnitude/frequency of freshes or small floods that flush the river
- The proposed flow ramping downstream of the dam will effect access to the river, recreational use and farm operations
- The changes in water level due to the increased periods of low flow will impact on water availability from nearby bores
- A lack of information, description or discussion of the consequences of a dam breach/failure
- The proposal indicates a spillway capacity to pass the Probable Maximum Flood (PMF) of 7,200 m³/s. Hydrology report provides estimates of PMF up to 12,900 m³/s

3.0 Assessment of Effects

3.1 Introduction

I have reviewed the assessment of effects on hydrology, and have taken into account the mitigation proposed by the applicant. The issues and effects are discussed below, with a focus on the key issues.

3.2 Review of Assessment of Effects

3.2.1 Flow Regime

The operation of the proposed dam and power station to match market demand for electricity will alter the flow regime of the river downstream of the dam. Aspects of the flow regimes potentially affected include:

- Low flows and minimum flow
- Mean and median flows
- Flow variability
- Flow duration
- Flood flows

Flow data has been recorded on the Mokihinui River over a 22 year period between 1972 and 1994. The data is of good quality and has been audited to NIWA's quality standards. Flow record is also available for the nearby Karamea River and is used as a check on the Mokihinui River flow data.

Standard hydrological analyses have been carried out to determine the various flow statistics presented in the NIWA Hydrology report (Appendix 4 to the application documentation). The effect of the proposed dam and power station on the hydrology of the river and reservoir are modelled using a combination of an electricity optimisation modelling system and a reservoir simulation model. The outputs were used to describe the effects on the hydrology of the Mokihinui River.

The existing mean annual low flow (the average of the lowest 7-day period low flow reached each year) for the Mokihinui River is 16 m³/s. Flows in the river fall below this 3 percent of the time on average (11 days per year). The effect of the proposed scheme would be to maintain a minimum river flow below the dam at 16 m³/s (i.e. maintain the current mean annual low flow) for approximately 35% of the time (128 days per year on average).

The operation of the proposed scheme would leave the mean and median river flows the same as they are currently (90.4 m³/s and 45.6 m³/s respectively). However, the flow variability and flow duration around these values would change (as shown in Figure 12 of the NIWA Hydrology report). When compared to the existing smooth flow duration curve the proposed flow duration becomes stepped with river flow below the dam at 16 m³/s (minimum generation) and 120 m³/s (maximum generation) for 35% and 23% of the time respectively.

The proposed dam would have only a very small effect on the magnitude and frequency of flood flows in the river. The available reservoir volume is small compared to flood volumes and would reduce the magnitude of small floods by up to 150 m³/s (approximately 10%) and have negligible impact on large floods. The maintenance of natural floods and freshes occurring at frequent intervals would continue to provide flushing flows, helping prevent algal biomass developing and keep the river gravels clean.

Daily flow patterns would be the most affected aspects of the hydrology if consents are granted. The median daily flow change in the river would increase from 11 m³/s to 104 m³/s. Flow changes from minimum flow (16 m³/s) to maximum generation (120 m³/s) would occur once or twice per day between floods (storage allowing).

The proposed maximum ramping rates for increasing discharge from the power station are from 16 m³/s to 120 m³/s in 45 minutes in Winter (1 May to 31 August) and from 16 m³/s to 120 m³/s in 1 hour and 15 minutes in Summer (15 November to 30 April). Currently only 10% of natural flood events have such rapid rates of rise.

The changes in the daily flow patterns and rapid increases and decreases in flow will affect river water level, which would rise and fall in response. The projected difference in water level from a flow of 16 m³/s to 120 m³/s is 0.64 m.

The proposed scheme will result in considerable change to the typical daily flow pattern of the Mokihinui River, with large changes to the flow in response to generation patterns.

3.2.2 Mitigation of Flow Changes

The effects of the proposed changes to the hydrology of the Mokihinui River are not necessarily an effect in themselves. However, they could potentially impact on such things, for example, as aquatic ecology, sediment transport, recreation and river access. These are covered by the relevant technical experts in the relevant review reports.

3.2.3 Probable Maximum Flood

The Probable Maximum Flood (PMF) is a concept used in dam design to ensure there is a very small probability of dam failure as a result of a flood. PMF can be defined as the most severe combination of hydrological and hydrometeorological factors reasonably possible.

The NIWA Hydrology report has indicated a likely range of PMF from 6,560 m³/s to 12,900 m³/s based on previous PMF and Probable Maximum Precipitation (PMP) investigations in New Zealand. A recommended preliminary estimate of PMF is provided as 7,200 m³/s.

The method of calculating the range of PMF values is sound as it is based on previous PMF investigations throughout New Zealand, but there is considerable difference in the range of PMF estimates. The recommended estimate of PMF (7,200 m³/s) is adequate for this preliminary stage. However, in agreement with the (NIWA) Hydrology report, it is recommended that a more detailed re-consideration of the PMF be carried out if it is a critical parameter for detailed design.

3.2.4 Mitigation of Flood Aspects

As part of the detailed design phase, the applicant should undertake a full PMF assessment to provide a more detailed estimate of the size of the PMF at the proposed dam. This aspect is considered in Mr Tate's review of engineering matters.

3.2.3 Domestic Groundwater

Fluctuating water levels in the Mokihinui River downstream of the proposed dam could potentially have an effect on adjacent groundwater levels and any nearby bores.

The applicant concludes that any effects are likely to be insignificant and have found only two groundwater bores in the area that are registered with the West Coast Regional Council, inferring the water supplies in the area are sourced from rainwater or river takes.

A submission to the consent applications indicates there may be more groundwater bores used than the two known by the Regional Council. These would likely be for domestic or stock water supply.

3.2.4 Mitigation of Effects on Bores

The applicant should undertake monitoring of groundwater levels near the Mokihinui River downstream of the proposed dam to assess if there are any adverse effects on groundwater levels due to the extended periods of low river flow. A condition is required to ensure that if the scheme is found to affect supply from the bores that a replacement water supply should be provided by the applicant.

4.0 Conclusion

The proposed Mokihinui River hydro power scheme will introduce a number of significant changes to the hydrology of the Mokihinui River such as extended periods of low flow, large daily flow fluctuations, and change to the flow duration.

Although significant in terms of changes to the river hydrology it is the effect of the changes to the hydrology on other aspects such as instream ecology, recreation or sediment transport that will determine if they are adverse or not, and the extent of the subsequent effects.