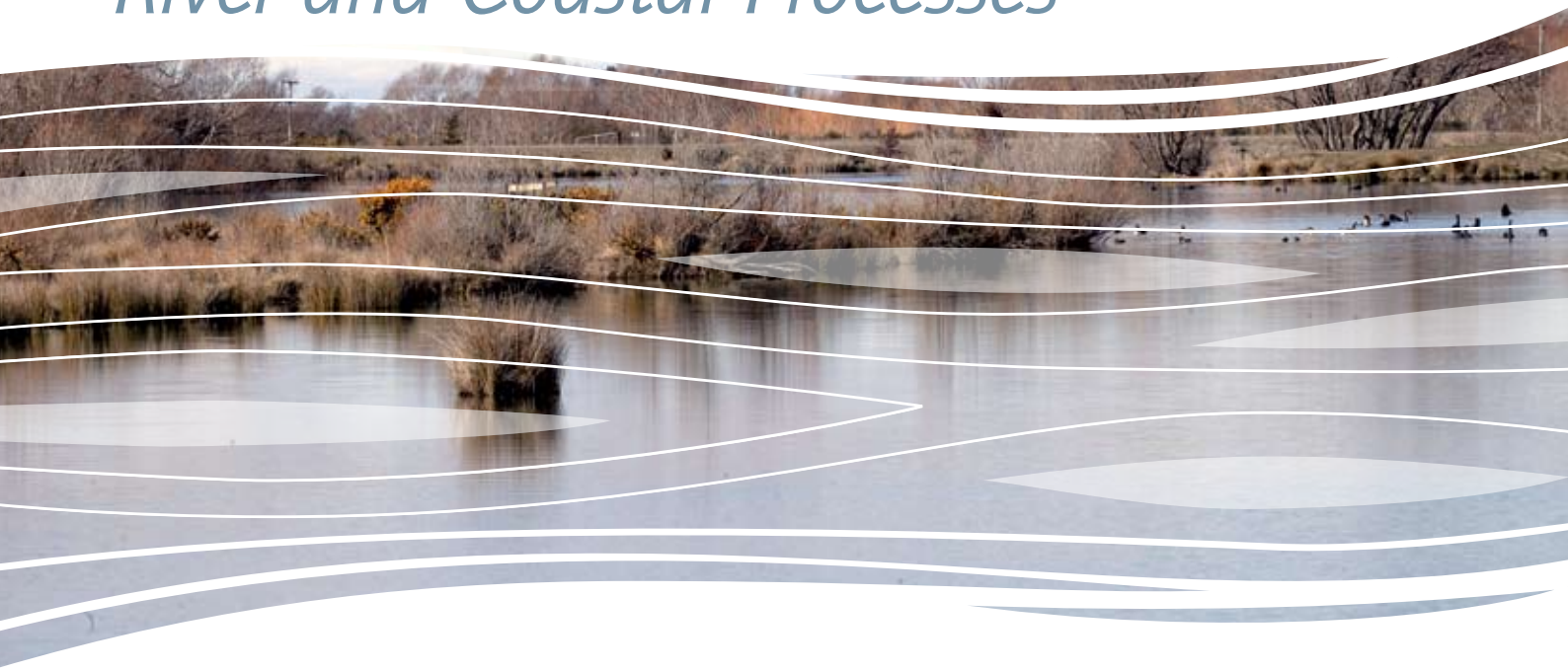
Meridian Energy

North Bank Tunnel Concept
River and Coastal Processes



The Waitaki River

The Waitaki River is one of New Zealand's largest braided river systems.

It is different from most other braided rivers in that it contains large, natural, glacier-formed lakes in its upper catchment. These lakes trap sediment and limit the supply of gravel to the lower reaches of the Waitaki system.

As a result, over the past few thousand years, the lower river has had a limited sediment supply and the river has incised (cut down) and armoured the river bed in this section. Armouring is where the finer sediment becomes protected by larger stones on the surface of the bed.

The Waitaki River downstream of the Waitaki Dam has three distinct sections.

In the first section, between the Waitaki Dam and around 1km upstream from Kurow, the river flows in a single, relatively low-gradient channel confined by a bedrock gorge.

The second section is from just upstream of Kurow to the mouth. In this section the river widens into a braided floodplain and is fed by a number of tributaries.

The third section is at the coast, where the river enters a tidal lagoon before flowing into the sea.

The Waitaki River has been highly modified by human activity, which includes hydroelectric development, weed encroachment, flood control measures, as well as agricultural development.

Hydroelectric operations, which began in the mid-1930s, have influenced the flow regime by damping flood flows and seasonal variability and have reduced the supply of sediment from the upper catchment to the lower Waitaki.

Crack willows were planted in an early attempt to control the river, but resulted in the river becoming choked with willows. Gorse and broom compounded the problem before vegetation control began in the 1960s. Farmers have also reclaimed land from the river margins.

The trend in the lower Waitaki River, as a result of the lower sediment supply from natural and imposed changes, is for the river to become more stable and less densely braided. This trend continues today.

At the coast, the river mouth and landforms reflect the underlying geology, glacial activity in the river's upper catchments, the rise in sea level over the past 10,000 years, as well as present-day coastal and river processes.

Large quantities of gravel moved down the Waitaki River system during glacial times (more than 11,000 years ago), prior to lake development in the upper catchment, and built a broad fan which advanced eastwards as sea levels fell as a result of growing glaciers.

When the glaciers began to melt again, the supply of gravel was reduced, the sea level rose again and storm waves began eroding the fan, causing the shoreline to retreat several kilometres over thousands of years. The cliffs that exist along the coast today are still eroding as this process continues.

At the river mouth, there is a zone of interaction between the river, tides, and ocean currents. The river flows through the Waitaki Lagoon, an elongated body of usually fresh water that can be up to 3km long, parallel to the coastline. It is separated from the ocean by a porous barrier of sandy gravel, with an outlet channel that moves depending on river and coastal processes.

Glossary of terms

Braided rivers – occur in the South Island where rivers carrying high sediment loads drain from steep mountain areas. They are dynamic with many channels and transport large amounts of sediment to the coast.

Cumec – one cubic metre of water per second flowing past a given point

Geomorphology – the study of the evolution and configuration of landforms

Managed reach – the 34km section of river from the Waitaki Dam to Stonewall.

NBTC flow regime – the way and rate that water is released at Waitaki Dam which has a minimum flow (monthly variable from 110-150 cumecs), flushing flows, and channel flows.

Riverbed armour – generally immobile course bed material resulting from finer sediments having been removed naturally by river flows.

The Waitaki River mouth.

The migration and size of the river mouth is related to:

- The river flow rate
- The position of the river's main channel
- Bar configuration
- Wave conditions

River and coastal morphology trends

The Waitaki River system is changing in response to human activity, but is also subject to long-term natural processes. For the past 10,000 years the river has been entrenching as a result of reduced sediment supply and coastal retreat (which shortens and steepens the river's run to the coast).

The effects from the hydro reservoirs built over the past 70 years have been superimposed on natural processes that have been happening for a much longer period of time, and which – by conditioning the river to a regime of relatively low bedloads and damped flood flows – have moderated the effects of human activity.

In the 1930s the river was only just above the theoretical threshold between a braided and non-braided system, and has possibly since fallen below that threshold. This trend has been slowed (but not stopped) by regular vegetation control.

At the coastline, the natural trend is also for continued coastal erosion. There is, however, no clear evidence that coastal erosion rates to the river mouth have increased on average since the construction of the Waitaki Dam in the 1930s, despite an anecdotal belief that this has occurred.

This could mean either that the effect of gravel entrapment in the hydro reservoirs has yet to reach the coast, (with the gravel load trapped in the reservoirs having been recovered from the braided floodplain through scour of bed and bank), or that it has reached the coast but is not detectable against the natural variability in coastal erosion rates.

North Bank Tunnel Concept effects

Reduced flow

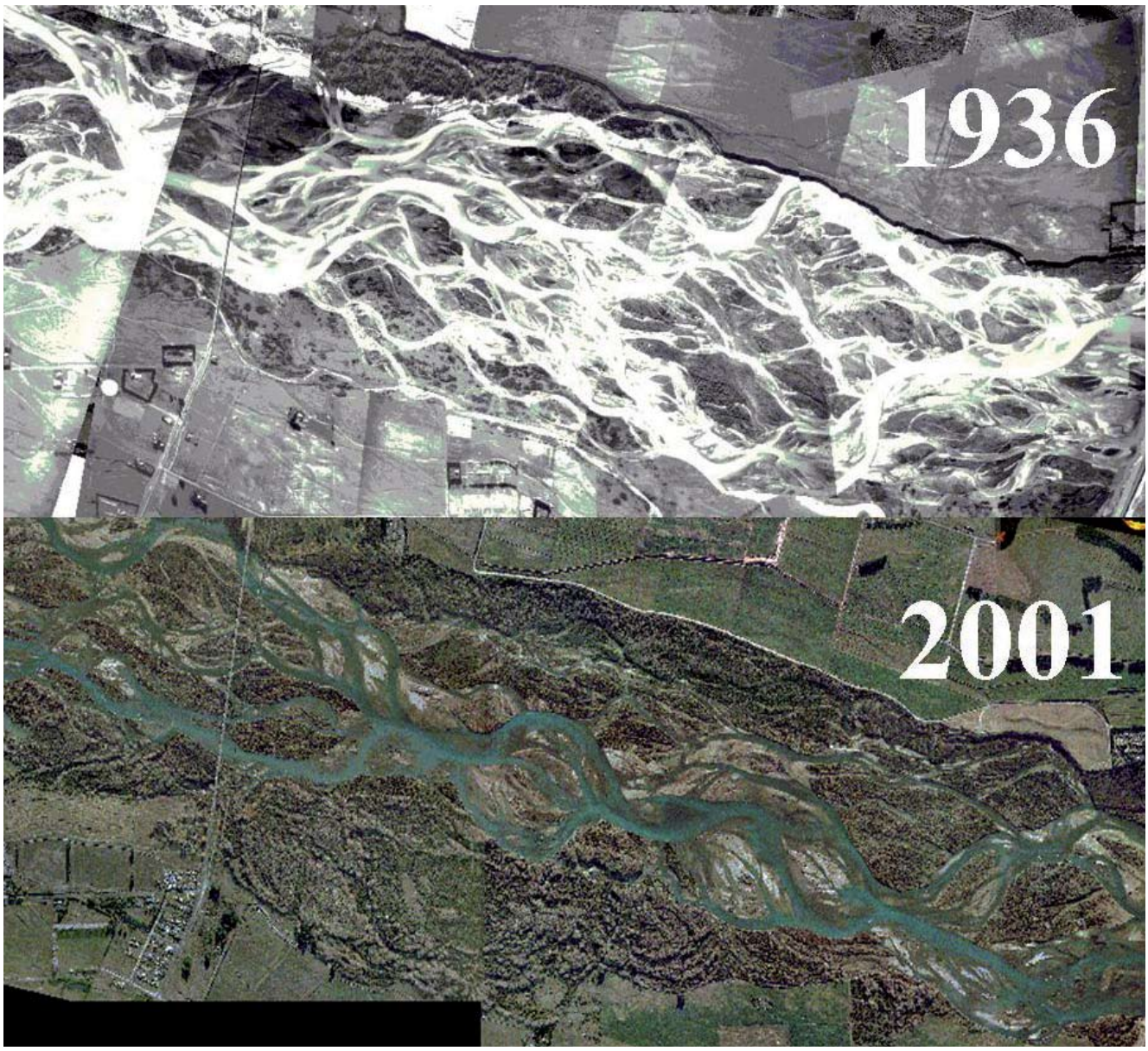
The minimum flow in the stretch of river between the Waitaki Dam and Stonewall would be between 110 cumecs (winter) and 150 cumecs (summer) under the flow regime proposed as part of the North Bank Tunnel Concept. The mean annual flow would be approximately 165 cumecs before abstractions.

Braiding

As a result of reduced flows, there would be an immediate reduction in the number of braids in the Kurow to Stonewall reach, from an average of about 8-9 braids to about 6-7 braids at normal flows. In the long-term the tendency for braiding in the Kurow to Stonewall reach should not be further reduced, due to the continued occurrence of large floods of 900 cumecs or more, and provided that vegetation is adequately controlled. Without flood flows and vegetation control the tendency for braiding would be expected to reduce.

Vegetation encroachment

The four flushing flows (450 cumecs) proposed should remove some vegetation seedlings and the 900-plus cumecs flood flows should preserve the river's current ability to scour vegetation. Together with other management techniques vegetation encroachment onto gravel islands would be controlled and would be an important factor in retaining braiding density and the dynamic nature of the river.



The same reach of river at SHW1 Bridge photographed in 1936 (top) and 2001 (bottom). A reduction in braiding density between 1936 and 2001 in the vicinity of SH1 is clear from the photo above.

Flood management

The magnitude and frequency of large floods (900-plus cumecs) originating in the upper Waitaki catchment would not change as the tunnel would be shut down for 48 hours at flows in excess of 900 cumecs. However, smaller floods and freshes (less than 900 cumecs) would have their peak flows reduced by up to 260 cumecs due to the tunnel diversion.

Bedload Transport

Upstream from Stonewall, reduced flow would have an effect on the capacity of the river to transport gravel bedload. Sediment from tributaries would, however, still be able to be moved. The beds of the channels would become less armoured and the average size of gravel would probably become finer. This process would take a decade or two to develop and would be most pronounced between Otekaieke and Stonewall.

There would be a long-term reduction in the amount of gravel being moved downstream from Stonewall, which would hasten an effect that is already occurring.

There could be more apparent, but temporary, periods of sediment build up at the confluences of the larger tributaries (e.g. Otekaieke and Maerewhenua). Physical works would be undertaken to remedy any loss of fish passage to the tributaries as a result of this process.

The fine sediment deposited in low-flow areas of the river would be moved by the 450 cumec flushing flows.

Didymo

The 900-plus cumecs by-passed flood flows are intended in part to help flush didymo by mobilising the riverbed material such as sand, gravel, and cobbles.

River mouth

The proposed NBTC flow regime should not alter the already low risk of river mouth closure.

The possibility exists that coastal erosion rates may be increased as a result of the NBTC flow regime. However, any impact on coastal sediment supply as a result of the NBTC flow regime would be delayed for several decades. The actual time-lag would depend on the net supply of gravel from the riverbed and on sediment storage at the river mouth.

Even in the worst-case scenario, the erosion rates would be a similar order of magnitude to those currently occurring and could be difficult to isolate from the natural variability and changes already caused by human activity. Careful monitoring will be required to determine the extent to which any accelerated coastal erosion occurs.

A possible best-case scenario is that there would be no long-term effects on coastal erosion.

Comparison of average number of braids

Braided river at 115 cumecs

Braided river at 350 cumecs

North Bank Tunnel Concept overview

The NBTC covers the 34km stretch of the lower Waitaki River from the Waitaki Dam, 6km upstream from Kurow, to Stonewall on the north bank of the river across from Black Point.

The North Bank Tunnel Concept would divert water from Lake Waitaki into a tunnel, through a power station, and return it to the river upstream of Stonewall.

If a scheme based on the NBTC went ahead, it would generate approximately 1100 to 1400 GWh of additional power each year (enough to power every household in Christchurch).

North Bank Tunnel Concept consenting process

Meridian Energy has proposed a two-stage process:

- Stage One, which is underway now, is to obtain the necessary water-only resource consents to divert and take water from Lake Waitaki and to use that water for hydro-electric generation, as well as to discharge the water back into the Waitaki River at Stonewall.
- Stage Two, which would only proceed if suitable water consents were granted, would be to obtain land-use consents and the other approvals needed to construct and operate a scheme based on the North Bank Tunnel Concept.

How to get more information

Information days: watch your local newspapers for notices of NBTC information days, which are held from time to time as part of the consultation process.

Send us a letter: Project Manager, NBTC, Meridian Energy, PO Box 2454, Christchurch.

Email us at: hydro.info@meridianenergy.co.nz

Phone us on: 0800 496 501

Web: www.meridianenergy.co.nz

Technical reports

This information sheet is one of a series summarising key areas from the Application for Water Consents for a *North Bank Tunnel Concept – Assessment of Environmental Effects.*

The topics covered by this series of information sheets are: NBTC Project Booklet; Consultation Process; Flow Regime; Recreation and Angling; Groundwater and Wetlands; The River Food-chain; Braided River Birds; River and Coastal Processes; Flow Regime in Waitaki River; and Mitigation.

We use recyclable chlorine-free paper and vegetable oil-based printing inks.

26139/8

Meridian Energy