Fish passage issues at Lake Tuakitoto

Charles Mitchell & Associates
Te Manu Road
RD 2
Rotorua

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1. Executive Summary

The outlet canal from Lake Tuakitoto has two barriers to fish migration. One is the newly resited sill for the control of lake levels. Downstream is the second and more significant obstacle, the Kaitangata floodgates, which have been in place for over 40 years.

The floodgates are only needed to protect the surrounding reclaimed swampland when the Clutha floods. However they block fish passage at all times. It is suggested that the operation strategy shift from continuous closure to closing only when a flood is anticipated. Modern telemetering and communications equipment means that this operation strategy could be easily attained.

This portion of the lower Clutha River is still tidal. In addition to allowing native fish easy access into the outlet canal a further and major benefit would be the restoration of a minor tidal effect in Lake Tuakitoto. Apart from expanding the potential spawning area for fish which are known to spawn on water level fluctuations, such as inanga and banded kokopu, the tide would flow over the sill for a considerable number of days each month.

Even weak swimming fish such as smelt and inanga and black flounder would then have easy access into the lake. The productivity of the lake margin can be expected to increase with regular tidal flooding, expanding feeding opportunities for native fish and waterfowl. Allowing a tidal movement in the outlet canal has much greater potential environmental benefits than constructing a fish pass, which may or may not function as desired.

Construction and annual maintenance costs implicit in a fish pass would not be incurred.

2. Introduction

The native freshwater fish community of New Zealand is dominated by species which must migrate to and from the sea to complete their life-cycles. As a result it is not sufficient to merely protect aquatic habitats in order to conserve or enhance the populations of these fish. Any development or modification of freshwater habitats must also be considered from the viewpoint of impacts upon the migration pathways of native freshwater fish.

The history of the decline of native fish stocks following development in most of the larger waterways of New Zealand show that the potential for impacts was seldom given serious consideration. In a step by step process, large areas of habitat have either been drained or rendered inaccessible to native fish. Losses to the whitebait fishery and the eel stocks were inevitable. The former phenomenal abundance of the fish stocks in many areas has faded into local legend.

The Department of Conservation is now charged with the conservation of native freshwater fishes. Among other avenues, one responsibility has been to advocate for the retention and restoration of fish passage wherever possible. The legal teeth for their argument is provided by Part VI (FISH PASSAGE) of the freshwater fisheries regulations 1983.

Section 43 states ...

"The Director-General may require that any dam or diversion structure proposed to be built include a fish facility".

3. The Site

Lake Tuakitoto is a shallow ponding area within surrounding wetlands on the true left bank of the Clutha River. It can be considered as an extension of the Clutha estuary. The design water level (100.760m summer minimum) remains below spring tide level (approx 100.960). Lake Tuakitoto is a remnant of a very much larger wetland system which included Lake Kaitangata. This area has since all been drained and converted to farmland. Water levels are now controlled by a complex of pumps and floodgates.

It was planned to continue drainage and development so that Lake Tuakitoto could also be reclaimed. Fortunately these plans were averted and the natural values of this now rare, lowland, wetland habitat are nationally recognised.

In consultation with affected parties, decisions have been made on the summer and winter lake levels for Lake Tuakitoto. It is a central theme of this water management process that summer levels should be kept as high as possible whereas some lowering of winter levels may occur, to protect adjacent farmland from the risk of flooding.

A primary concern is that floodwater from the Clutha River should not be allowed to flow back up the canal flowing from the lake. The first water control structure is the Kaitangata Floodgates. These act to prevent flow from the Clutha River back up the canal. Under normal conditions water flows from the canal through the floodgates and into the Clutha. A head is required to force the floodgates open; water can flow between the floodgates and the seals at considerable velocity. At full tide and during floods, the river level rises above the canal level and the flood gates close. It is only the fact that holes have developed in this 40 year old structure and that the local Regional Council staff have made a commendable effort to open one or two gates when fish are attempting to migrate, that many small weak swimming fish such as whitebait move past the flood gates.

Further upstream a new sill structure has recently been built, replacing an older, less effective sill at the lake outlet into the canal. Replacement of the sill has raised the issue of fish passage into Lake Tuakitoto and has allowed for the concerns of DoC, the Otago Regional Fish and Game Council and the Eel Fisherman's association, to be considered.

4. Fish Passage Issues

A study made by MAFFisheries (1988) showed that some estuarine species such as inanga and smelt were present in Lake Tuakitoto in only low numbers (although the time of sampling, in May, may have been a contributing factor). Other fishes such as black flounder and yelloweyed mullet, which could have been expected, were absent. A lack of suitable habitat is probably responsible for the absence of a further group of fishes such as blue-gilled bullies and torrent fish.

However the lake has supported a productive eel fishery, contains brown trout and is the centre for a population of giant kokopu, a whitebait species now rare or absent from many areas throughout New Zealand.

Allowing for easy fish passage between Lake Tuakitoto and the estuary should have a range of benefits. The density of smelt and inanga should increase and the output of larvae should also increase. This production may be reflected in an enhanced whitebait catch. Sea run trout may be able to establish a population in the Tuakitoto system. Recruitment of elvers to support the local eel fishery would be better assured and the downstream migration of spawning eels could be safer for these fish. Flounder may reappear in the fish catch from the lake and a range of other native fish (including the giant kokopu) are expected to benefit.

Based on discussions and an examination of some correspondence from the parties involved, it is obvious that there is general agreement on the desirability of allowing fish passage into Lake Tuakitoto. When the sill was replaced with a new structure, the opportunity was taken to request that the issue of fish passage be considered. Accordingly the Otago Regional Council made provision for both trout and native fish access by casting a V notch and a rectangular notch into both the summer sill and the winter sill. A report describing a design for a fishpass over the Braemar Lagoon Weir (Mitchell 1994) was then consulted to develop a design for a native fish pass up the downstream face of the sill, leading to the notch. After concern was expressed by DoC staff that the proposed design might not function as expected, the site was visited by the author.

5. Optional Designs

When the Tuakitoto control sill was visited, it was immediately obvious that the obstacle presented by this structure was not great, in the range of centimetres rather than metres. But a very dry summer and autumn had greatly reduced water yields from the Tuakitoto catchment. At the time of the visit there was no water flowing over the top of the weir. The openings cast in the concrete sills by the Regional Council had been blocked up in order to maintain water levels for duck shooting. Various fish pass designs were discussed.

The problems of vandalisation and maintaining any fish pass structures when the sills were removed or replaced for level control were considered.

While we stood around at the floodgate the tide came and went. Owing to a tree jammed in one of the doors of the Kai floodgates, and to holes in another door, there was a tidal rise at the sill on May 8, 1995. This was a neap tide, only 1.6m above chart datum. The tide rose to within 50 mm of the top of the sill. According to Mr C.Wyndham, a 250 mm tidal range could be expected at the sill if the floodgates were left open. Obviously this implies that at the peak of the tide, water would over-top the sill by up to 200 mm, allowing fish to swim freely into the lake. Fig. 1 shows the tidal range expected at the sill over a month, modelling the tidal cycle at Dunedin and allowing for the greatly reduced tidal amplitude to be expected at Tuakitoto.

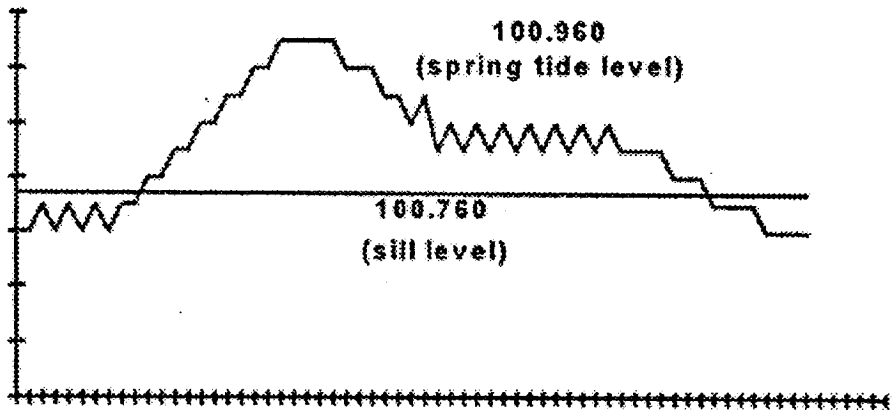

Figure 1. Estimated high tide height at the Tuakitoto sill over a monthly tidal cycle showing that 43 tides out of 58 (74%) would cover the sill if the floodgates were left open.

It was considered that water would flow over the sill on a spring tide for up to one and a half hours (C.Wyndham pers comm.). As the tidal amplitude fell toward neap tides the interval over which water would flow into the lake would obviously reduce.

Smelt and inanga migrate upstream on the rising tide. It can be anticipated that they would freely move over the sill as the tide flowed over it. Their migration upstream can largely be considered as a feeding movement and so delays in the canal over neap tides are very unlikely to be fatal. In contrast elvers make a purposeful migration upstream. The numbers of elvers moving upstream from the estuary peaks over spring tides (Jellyman 1979). Studies at Huntly Power station showed that this migration timing was retained 80 km upstream from the sea (Mitchell & Saxton 1983).

Concentrations of fish can be expected to attract predators. Smelt and inanga will have to take their chances as they swim over the sill. Shags and herons will spend much time in the area. Observations on the Braemar Lagoon fish pass showed that a flume design can quickly become exploited by predatory eels with dire consequences for fish confined within such a limited space. At Tuakitoto this problem would not occur. In addition to swimming freely over the sill at high tide, elvers will attempt to climb the sides of the sill at night

when water is spilling. At these times they may be vulnerable to rats in addition to adult eels lurking in ambush around the structure. But the coarse rock rubble at the base of the sill should provide ample cover for elvers during the daytime. Owing to the small height of this sill and the tidally modulated migratory activity of elvers, it is likely that delays and mortalities will be relatively minor.

6. Kai Floodgates -The Real Issue

It is obvious from Fig. 1 that there would be very little problem with fish passage over the Lake Tuakitoto sill if some or all of the Kaitangata floodgates were left open during normal river levels. As these floodgates appear to have the potential to offer a significant obstruction to fish passage, leaving them open would also remove a major barrier which has been in place across the system for the past 40 years.

Obviously the floodgates are in place for a very good reason. But is it justifiable to leave a barrier for fish in place all the time, in anticipation of the relatively few times over a year when the Clutha is in flood? There have already been large and permanent losses to fisheries values from the reclamation of Lake Kaitangata.

The impact of allowing normal tidal fluctuations in Lake Tuakitoto was discussed and it was considered that the estimated maximum tidal increase of 200 mm would be unlikely to affect farming operations around the lake edge. In fact the old sill was often inaccessible when flood events occurred (C. Wyndham pers comm.). The farmers have apparently survived when the lake was unable to be lowered. In fact the lake has often been maintained at summer levels for considerable periods (Table 1). It can be seen from this table that the lake has been left at summer levels for over 5 years at a time. Farmers have shown the ability to adjust to these high levels.

Eel fishermen discussed a justifiable concern about routinely lowering the lake for winter. There is no minimum winter lake level. Eels often hibernate under marginal vegetation when water temperatures drop. If the lake is then lowered after these fish have become inactive they are very vulnerable to the risk of being frozen and killed during hard frosts. Heavy mortalities of this very valuable fish can occur this way. If it was essential that the lake be lowered then it should be done before temperatures fall (although this would be most unpopular with the duck shooters). Stable high levels have a good deal to recommend them.

One scenario that would lend caution to a policy of restoring the natural tidal cycle to Lake Tuakitoto, is the risk of flooding if the flood gates were not closed in time. However it was obvious that the Otago Regional Council staff were very professional. They maintain a very close watch on river levels and

Table 1. Times of insertion and removal of the summer sill in Lake Tuakitoto.

Sill inserted	Sill removed	Period summer sill in place (months)
18.4.74	16.5.74	1
3.10.74	5.5.75	8
14.10.75	21.5.76	8
22.10.76	17.8.77	10
5.12.77	23.5.78	6
21.12.78	22.6.79	7
17.12.79	18.5.81	18
14.4.82	24.6.82	2
14.3.83	16.8.83	5
18.1.84	3.5.84	4
13.12.84	9.6.86	7
9.9.86	8.7.87	10
14.10.87	3.8.93	70
5.10.93	25.5.94	8
13.10.94	-	-

climatic events in this flood prone area. There is a sophisticated telemetering system with level recorders on the Pomahaka and the main river. There can be up to 12 hours warning of a flood from Roxburgh Hydro. Therefore, with modern technology, there does not appear to be a great risk that the flood gates would be simply opened and forgotten, with dire consequences on a later flood.

A steel rope or some form of log-barrier should be considered for protecting the downstream face of the floodgates from logs. When the time comes, the gates must be able to be easily closed.

Owing to the great flow of the Clutha, there is never saltwater penetration into the Tuakitoto Canal. There would be no risks of salt damage to clay banks or pastures from opening the floodgates.

7. Recommendations

1. It is not considered necessary to construct a fish passage facility at the Lake Tuakitoto Sill.

2. The Kaitangata Floodgate operation rationale should be reversed. The floodgates should be left open at normal river levels and closed when there is a flood warning.

3. Otago Regional Council staff are on-site almost every day inspecting pumps and pump screens. If there is any flood risk or emergency, the flood gates could easily be closed down at that time.

4. It is recommended that closure of the floodgates should be one of the tasks on Warning Sheet no 1 of the Flood Procedures Manual. This would mean that the floodgate would always be closed and checked as closed at river levels of 106.00 metres and above

8. Acknowledgements

I would like to thank the people who came to discuss the issues at Lake Tuakitoto with myself and M.J. Neilson (DoC), R. Dungey from the Otago Regional Fish and Game Council, Vic Thompson and Brian Smith from the Eel Fisherman's Association. C.Wyndham (Otago Regional Council) was extremely helpful and made a very significant contribution to the development of the argument presented here.

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