NIWA
Taihoro Nukurangi

Memo

From	**Mike Hickford**
To	Meridian Energy Limited
Date	4 June 2024
Subject	Manapōuri Lake Control Improvement Project – RFI Native fish

Meridian Energy Ltd (Meridian) requested assistance with the Request for Further Information (RFI) from Environment Southland for the Manapōuri Lake Control Improvement Project (**MLCIP**) resource consents application as related to native fish. Specifically, this memo addresses the following RFI: RFI 2 dated 13 May 2024:

Please provide further information to support your assessment of effects on At Risk and Threatened native fish, given the lack of recent fish records in the area, the acknowledged significant values present, and the sensitivity of these species to sediment effects.

To support the following response, I have reviewed the documents listed in footnotes throughout this memo.

1 Summary

The assessment of environmental effects: freshwater ecology made by Hoyle et al. (2023)[1] (attached as Appendix D to the AEE for the MLCIP) concluded that *"if the suspended sediment and DFS [deposited fine sediment] thresholds are adhered to, the effects of the Project will be less than minor for lamprey and minor for other fish species*".

Potential effects of the MLCIP on fish species can be separated into:

- 'direct' effects on species in and immediately around the MLCIP Area (i.e., the lower Waiau Arm and the Mararoa confluence) from excavation works; and
- 'indirect' effects of increased suspended sediment and DFS in the Lower Waiau River (LWR) downstream of the Manapōuri Lake Control structure (MLC).

The species present, and the management response in relation to MLCIP effects, are different depending on whether effects are direct or indirect, as explained below.

There are sufficient data available in relation to larger fish species in the Waiau Arm to assess the effects of the MLCIP. Although there are no records of Threatened smaller fish species in the Waiau Arm, I consider it unlikely that they are present given the available habitat and food sources. If these species are present, an appropriate response would be to undertake a pre-construction fish survey and specify that they are included in the Freshwater Fauna Management Plan (FFMP).

[1] Hoyle, J., Kilroy, C., Haddadchi, A., Hogsden, K., Hickford, M., Egan, E. (2023) Manapōuri Lake Control Flow Improvement Project - Assessment of Environmental Effects: Freshwater Ecology. *NIWA Client Report*, 2023293CH: 92p.

Subject to my recommendations in relation to an additional fish survey and FFMP response that is tailored to smaller fish species (see Section 2.1), I consider that the risk to Threatened native fish species around the MLCIP area is low, and the direct effects on these species will be minor.

There are sufficient data in relation to fish communities in the Lower Waiau River to assess the effects of the MLCIP. Subject to adherence to suspended sediment and DFS thresholds that are designed to limit indirect effects to within the natural range fish communities in the LWR are already adapted to, and instream excavation occurring outside of key spawning and migration periods, I consider the risk to Threatened native fish species in the LWR is low, and the indirect effects on these species will be minor.

2 Direct effects

2.1 Analysis

In considering the direct effects of the MLCIP on fish species in the lower Waiau Arm, Hoyle et al. (2023)[1] relied on existing datasets, and a fish survey carried out in 2021 by Egan et al. (2023)[2]. The detail of this is set out below, and in Hoyle et al. (2023)[1].

Of note, the Egan et al. (2023) methodology was designed to target adult eels, rather than the entire fish community. The larger mesh size of the fyke nets used would not have caught any smaller fish species. If smaller fish are present in this area, species of concern would be Threatened – Nationally Vulnerable non-migratory galaxiids that are known from elsewhere in the catchment (i.e., southern flathead galaxias and Gollum galaxias). However, it is highly unlikely that either of these species is present in the Waiau Arm because of the habitats[2] and food sources[3] that are available.

For fish communities in and around the MLCIP area, it is likely that the greatest risk from increased suspended sediment loads and DFS will be during the final phase of the excavation when the two 'breakout' areas are completed, joining the new parallel channel to the current Waiau Arm. This risk will be minimised if the two breakout areas are completed concurrently, minimising the duration over which suspended sediment is released.

However, the excavation itself may directly impact resident fish near the two breakout areas. If Threatened smaller fish species are present in the Waiau Arm, then this risk could be addressed through:

- an additional fish survey near the MLCIP breakout areas using fine-mesh (4 mm) fyke nets;
- integrating a salvage programme for resident fish in these areas into the FFMP. I recommend that this is implemented immediately prior to the 'breakout' phase.

I recommend that these measures are included in the conditions of consent for the MLCIP, and with these measures in place I consider that direct effects on Threatened native fish species in and around the MLCIP areas will be minor.

2.2 Background information

Hoyle et al. (2023)[1] relied on three data sources to characterise the fish community near the MLCIP Area:

[2] Egan, E., Sinton, A., Crow, S., Jellyman, P., Rose, A., Williams, P., Charsley, A., Hickford, M. (2023) Native freshwater fish distribution and abundance in the Waiau catchment. *NIWA Client Report*, 2021329CH: 140p.

[3] de Winton, M., Hoyle, J., Smith B., Hogsden, K., Lambert, P. (2022) Benthic ecological survey of the lower Waiau Arm. *NIWA Client Report* 2022057CH.

1. 2021 survey data from Egan et al. (2023)[2];

2. Searches of the New Zealand Freshwater Fish Database (NZFFD), which contained data from Egan et al. (2023), but no other records for the Waiau Arm;

3. Searches for publicly available eDNA data on the Wilderlab website, which returned no records from the Waiau Arm.

The 2021 surveys targeted adult eels in Waiau Arm, and mainly used large-mesh (12 mm) fyke nets from the migrant eel trap-and-transfer programme. Any smaller-bodied fish species that might have been present (e.g., bullies) are much less likely to have been captured by these large-mesh nets.

The 2021 surveys only identified three fish species near the proposed MLCIP Area. Large-mesh fyke nets set adjacent to the proposed MLCIP Area captured longfin eels (size range 319–983 mm), shortfin eels (512–940mm) and perch (54–64mm). Closer to Lake Manapōuri in the Waiau Arm, large-mesh fyke nets also captured longfin eels (296–991 mm), shortfin eels (446–864 mm) and perch (60-250 mm), as well as brown trout (364–530 mm), rainbow trout (222 mm) and common bully (56–112 mm). Fine-mesh fyke nets (4 mm mesh size), which were only set in the middle reach of Waiau Arm, caught noticeably more common bully (33–83 mm), as well as longfin eels (371–647 mm), shortfin eels (523–792 mm), perch (29–57 mm) and brown trout (59–109 mm).

Of the species captured in large-mesh fyke nets adjacent to the MLCIP Area, only longfin eels have a 'Threatened' conservation status[4] (At Risk -Declining). Other species found at this site, or elsewhere in Waiau Arm, are either 'Not Threatened' (i.e., shortfin eels and common bully) or 'Introduced and naturalised' (i.e., perch, brown trout, and rainbow trout).

Longfin eels are thought to have low sensitivity to increases in suspended sediment loading in rivers because:

- Survey data showed there was no relationship between the duration of turbid conditions in rivers and their occurrence[5]
- their feeding is not greatly dependent on sight, and they can feed actively in turbid flood conditions[6]
- the survival of juveniles is not affected by long-term (21 days) exposure to very high turbidity[7].

Longfin eels are thought to be more sensitive to increases in DFS than suspended sediments because:

- longfin eels are more common in areas with stony substrates[8]

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[4] Dunn, N.R., Allibone, R.M., Closs, G.P., Crow, S.K., David, B.O., Goodman, J.M., Griffiths, M., Jack, D.C., Ling, N., Waters, J.M., Rolfe, J.R. (2018) Conservation status of New Zealand freshwater fishes, 2017. *New Zealand Threat Classification Series*, 24: 1-15.

[5] Rowe, D.K., D.M. Hicks, and J. Richardson (2000). Reduced abundance of banded kokopu (*Galaxias fasciatus*) and other native fish in turbid rivers of the North Island of New Zealand. *New Zealand Journal of Marine and Freshwater Research* 34(3): 547-558.

[6] Jellyman, D.J. (1989). Diet of two species of freshwater eel (*Anguilla* spp.) in Lake Pounui, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 23(1): 1-10.

[7] Cavanagh, J.E., K.L. Hogsden, and J.S. Harding (2014). Effects of suspended sediment on freshwater fish, in *Landcare Research Contract Report* No. LC1986, 2p.

[8] Glova, G.J., D.J. Jellyman, and M.L. Bonnett (1998). Factors associated with the distribution and habitat of eels (*Anguilla* spp.) in three New Zealand lowland streams. *New Zealand Journal of Marine and Freshwater Research* 32(2): 255-269.

- significant reductions in biomass of resident eels were found because of increased DFS in a New Zealand stream[9]
- when deposited sediments are decreased, longfin eel densities increase substantially[10].

However, although longfin eels have relatively small home ranges, they are capable of more extensive movements to occupy more beneficial habitat[11].

3 Indirect effects

3.1 Analysis

In considering the indirect effects of the MLCIP on fish species in the LWR, Hoyle et al. (2023)[1] relied on existing datasets, and a fish survey carried out in 2021. The detail of this is set out below, and in Hoyle et al. (2023)[1].

For fish communities in the LWR, it is likely that the greatest risk from increased suspended sediment loads and DFS will be during the final phase of the excavation when the two 'breakout' areas are completed. This risk will be minimised if the two breakout areas are completed concurrently minimising the duration over which suspended sediment is released.

Indirect risks to fish species in the LWR from the MLCIP are minimised through:

- Adherence to specified suspended sediment and DFS thresholds that are designed to limit the effects to be like those already experienced naturally by fish communities in the LWR, and
- Instream excavation, particularly the breakout phase, occurring outside of key spawning and migration periods for sensitive species.

With these measures in place I consider that the indirect effects of the MLCIP on Threatened native fish species in the LWR will be minor.

3.2 Background information

Hoyle et al. (2023)[1] relied on three data sources characterise the fish community in the LWR:

4. 2021 survey data from Egan et al. (2023)[2];
5. Searches of the NZFFD;
6. Searches of publicly available eDNA data on the Wilderlab website.

These data sources identified 13 native fish species (beyond those found in the Waiau Arm) in the LWR. Of these species, several have a 'Threatened' conservation status[3], but some (īnanga and giant kōkopu) are only known from the lower reaches of the LWR. Of the 'Threatened' species known, or expected, to occur

[9] Holmes, R.J.P., Hayes, J.W., Closs, G.P., Beech, M., Jary, M., Matthaei, C.D. (2019) Mechanically reshaping stream banks alters fish community composition. *River Research and Applications*, 35(3): 247-258.

[10] Ramezani, J., L. Rennebeck, G.P. Closs, and C.D. Matthaei (2014). Effects of fine sediment addition and removal on stream invertebrates and fish: a reach-scale experiment. *Freshwater Biology* 59(12): 2584-2604.

[11] Jellyman, D.J. and J.R.E. Sykes (2003). Diel and seasonal movements of radio-tagged freshwater eels, *Anguilla* spp., in two New Zealand streams. *Environmental Biology of Fishes* 66: 143-154.

within the upper reaches of the LWR (where elevated suspended sediment and DFS from the MLCIP are likely to be greatest - downstream of MLC to Excelsior Creek), only torrentfish and non-migratory galaxiids are considered to have high sensitivity to elevated DFS[12]; longfin eels are thought to have low sensitivity to elevated suspended sediments but are more sensitive to DFS (see above).

Torrentfish (At Risk – Declining) are widely distributed in the Lower Waiau catchment (below the MLC) including in the LWR mainstem. Torrentfish shelter between and beneath loose gravels and cobbles during the day in shallow, fast-flowing riffles, and rapids[13]. At night they move to slower-flowing areas to feed on aquatic insects[14]. Elevated levels of DFS will reduce their habitat quality and quantity (although least likely impacts in fast-flowing riffles and rapids) and impact their food supply by infilling the interstitial spaces (gaps) between rocks in the river bed[12]. However, the turbidity and DFS thresholds proposed by Hoyle et al. (2023)[1] are based on naturally occurring levels and durations in the Mararoa River. Adherence to the thresholds is designed to limit the effects to be like those already experienced naturally by fish communities in the LWR during large flood events. As such, in my opinion, the effects of the MLCIP on torrentfish in the LWR should be minor.

Two species of non-migratory galaxiids may be present within the upper reaches of the LWR: Southern flathead galaxias (Threatened – Nationally Vulnerable) and Gollum galaxias (Threatened – Nationally Vulnerable). Southern flathead galaxias occur in stony streams and rivers and show some preference for cobble and boulder habitats[15]. They are most abundant in smaller tributaries in the Lower Waiau catchment[2]. However, they have been found in the upper reaches of the LWR mainstem (near Whare Creek), but in low numbers because they struggle to co-exist with predatory trout. Southern flathead galaxias are generally site-attached with little movement[16]. They spawn in spring (October to November) laying their eggs in saucer-shaped depressions beneath large cobbles or boulders in fast-flowing riffles. Deposited fine sediment may clog that microhabitat or smother the eggs themselves (although DFS is least likely in fast-flowing riffles). Again, adherence to turbidity and DFS thresholds will limit DFS to naturally occurring levels that fish in the LWR could be exposed to. Furthermore, it is expected that instream excavation associated with the MLCIP will have been completed before the spring spawning period of southern flathead galaxias. As such, in my opinion, the effects of the MLCIP on southern flathead galaxias in the LWR should be minor.

Gollum galaxias (Threatened – Nationally Vulnerable) are not known from the mainstem of the LWR but have a disjointed distribution in low gradient tributaries and wetland habitats associated with the LWR. They are found in a wide range of habitats but are usually found in the slower margins of waterways. They are generally site-attached with little movement[16]. Spawning takes place in late winter and early spring (late August to October) with eggs being deposited under boulders in streams and on plants in wetlands[17].

[12] Franklin, P.A., Stoffels, R.J., Clapcott, J.E., Booker, D.J., Wagenhoff, A., Hickey, C.W. (2019) Deriving potential fine sediment attribute thresholds for the National Objectives Framework. *NIWA Client Report* 2019039HN: 290p.

[13] Glova, G.J., Bonnett, M.L., Docherty, C.R. (1985) Comparison of fish populations in riffles of three braided rivers of Canterbury, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 19(2): 157-165.

[14] Glova, G.J., Sagar, P.M., Docherty, C.R. (1987) Diel feeding periodicity of torrentfish (*Cheimarrichthys fosteri*) in two braided rivers of Canterbury, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 21(4): 555-561.

[15] Sinton, A.M.R., Crow, S.K, Dunn, N.R. (2016) Habitat preference of southern flathead galaxias (Galaxias "southern"). *NIWA Client Report* CHC2016-063 17p.

[16] Crow, S.K., Waters, J.M., Closs, G.P., Wallis, G.P. (2009) Morphological and genetic analysis of *Galaxias* 'southern' and *G. gollumoides*: interspecific differentiation and intraspecific structuring, *Journal of the Royal Society of New Zealand* 39:2-3, 43-62.

[17] Gollum galaxias: Non-migratory galaxiids (doc.govt.nz)

The location and extent of their spawning habitats in the Waiau catchment are unknown. Deposited fine sediments may clog spawning habitats under boulders or smother eggs. However, adherence to the turbidity and DFS thresholds, particularly during their spawning season, will likely limit the MLCIP effects on Gollum galaxias to minor.

Longfin eels (At Risk – Declining) are present in the LWR. Elvers (longfin and shortfin eel) are collected immediately downstream of the MLC structure between December and March (as part of the trap-and-transfer programme) and are transferred to the Mararoa River, Lakes Manapōuri and Te Anau and selected tributaries of Lake Te Anau. No elvers are transferred into the Waiau Arm.

Longfin elvers are thought to have low sensitivity to increases in suspended sediment loading in rivers because:

- Elvers do not avoid even extremely high turbidities in experiments[18]
- In some situations, migrating elvers appear to be attracted towards turbid tributaries[19].

Adult eels migrate via the MLC and down the LWR and out to sea for reproduction. The Waiau eel trap-and-transfer programme also transfers adult migrant eels from Lake Manapōuri to immediately below the MLC at Duncraigen Road. This programme will not be impacted by the works given the proposed management controls that are promoted to manage turbidity and DFS below the MLC if thresholds are exceeded.

[18] Boubée, J.A.T., T.L. Dean, D.W. West, and R.F.G. Barrier (1997). Avoidance of suspended sediment by the juvenile migratory stage of six New Zealand native fish species. *New Zealand Journal of Marine and Freshwater Research* 31(1): 61-69.

[19] Schicker, K.P., J.A. Boubée, A.G. Stancliff, and C.P. Mitchell (1990). Distribution of small migratory fish and shrimps in the Waikato River at Ngāruawāhia, *New Zealand Freshwater Fisheries Miscellaneous Report* No. 63: Hamilton 21p.

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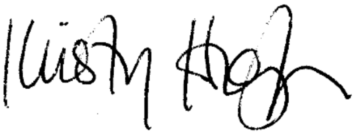	Reviewed by:	Kristy Hogsden
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