IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of an application by Meridian Energy Limited for the resource consents related to the construction of a new channel to enable a permanent diversion of part of the flow of the Waiau Arm and the associated removal of bed material and gravels, together with any maintenance and ancillary activities.

STATEMENT OF EVIDENCE IN CHIEF OF MICHAEL HICKFORD

TABLE OF CONTENTS

INTRODUCTION

1. My full name is Michael (Mike) Julian Hames Hickford.

2. I am an aquatic ecologist holding the following degrees: BSc (Zoology), MSc 1st Class (Zoology) and PhD (Ecology), all from the University of Canterbury, Christchurch.

3. I have a background in basic and applied research in freshwater and marine ecology and biology, with over 25 years' professional experience, including research and consulting. The principal focus of my research has been to gain a better understanding of ecological processes in rivers, coastal and open ocean systems. I have worked in New Zealand, USA, Australia, and Chile. My research has resulted in over 35 publications. These have included scientific papers in international journals and book chapters on the biology and ecology of freshwater and marine fishes, fisheries management, habitat restoration, as well as the effects of natural disasters and anthropogenic activities on aquatic ecosystems.

4. In 1998 I was employed by the University of Canterbury as a research fellow, then in 2000 moved to University of California, Santa Barbara as a post-doctoral research fellow. In 2004, I was appointed a senior research biologist at the University of Canterbury where I led large multi-disciplinary programmes funded by the Foundation for Research, Science and Technology (**FRST**) and the Ministry for Business, Innovation and Employment (**MBIE**) on topics such as 'Riparian-pelagic coupling' (FRST), 'Maintenance and rehabilitation of aquatic ecosystems' (MBIE) and 'Overcoming dispersal and recruitment constraints on native freshwater biodiversity' (MBIE). In 2021, I was employed as a freshwater ecologist by the National Institute of Water and Atmospheric Research Limited (**NIWA**). I also have a continuing appointment as an Adjunct Senior Fellow (Biological Sciences) at the University of Canterbury.

5. My specific experience with the Waiau Catchment began in 2022 when I was engaged to provide advice to Meridian Energy Limited (**Meridian**) on aquatic matters associated with the Manapōuri hydroelectric power scheme. I am familiar with the area near the proposed Project, including the Waiau Arm, Manapōuri Lake Control structure (**MLC**), and lower Waiau River and completed a fish survey in the proposed Project area in July 2024.

6. I confirm that while employed by NIWA, I have been involved in work relating to Meridian's proposed Manapōuri Lake Control Structure Improvement Project (**MLC:IP**). This work has included co-authoring of the Assessment of Environmental Effects: Freshwater Ecology (which I will refer to as the **Freshwater Ecology Report** or **my Report**) and providing input into proposed conditions of consent. This report is attached as Appendix D to the Assessment of Effects on the Environment (**AEE**) for the MLC:IP.

7. I confirm that I have read the following draft statements in preparing my evidence:

   (a) Mr Andrew Feierabend (Meridian);

   (b) Mr Daniel Murray (Tonkin + Taylor);

   (c) Dr Dougal Clunie (Damwatch);

   (d) Dr Jo Hoyle (NIWA); and

   (e) Dr Kristy Hogsden (NIWA).

8. The purpose of my evidence is to:

   (a) Summarise the existing environment for freshwater fish communities in the Waiau Arm and lower Waiau River;

   (b) Summarise the effects of the MLC:IP construction on freshwater fish communities;

   (c) Respond to issues raised in submissions, and by the Council technical expert reviewers, in relation to the effects on freshwater fish and the framework applied to assess these effects.

9. I note that the evidence of my colleague Dr Hogsden summarises the assessment of plant community and macroinvertebrate effects, and that the evidence of my colleague Dr Hoyle explains the proposed management response in relation to the sediment discharge to the lower Waiau River.

10. The existing configuration of the Waiau Arm, the MLC and the lower Waiau River, as well as the proposed MLC:IP are described in Sections 2, 4 and 5 of the AEE and in Mr Feierabend's evidence and are not repeated in detail here.

CODE OF CONDUCT

11. Although this is not an Environment Court hearing, I confirm that I have read the 'Code of Conduct for Expert Witnesses' contained in the Environment Court Consolidated Practice Note 2023. I agree to comply with this Code of Conduct. In particular, unless I state otherwise, this evidence is within my sphere of expertise, and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

SCOPE OF EVIDENCE

12. In my evidence I will:

    (a) Describe the existing environment for freshwater fish in the Waiau catchment, and the methods used to establish this;

    (b) Summarise the effects of the MLC:IP, including proposed mitigations, on freshwater fish;

    (c) Comment on issues raised by submitters in relation to freshwater fish;

    (d) Respond to issues in the Officers' Report in relation to freshwater fish; and

    (e) Provide my conclusions.

SUMMARY

13. Considering known freshwater fish species distributions in the Waiau catchment, as well as expected sensitivities to elevated fine sediment, the greatest effects of the MLC:IP with respect to fish are likely to be on salmonids (brown and rainbow trout) and longfin eel. Other species that might be at risk from elevated fine sediment in the lower Waiau River include southern flathead galaxias and Gollum galaxias.

14. The effects of additional deposited fine sediment on salmonid spawning grounds is considered **negligible** because most spawning will occur in tributary headwaters. In low flow conditions, elevated suspended sediment may impede migration of trout aggregating at the confluence of the Mararoa River and Waiau Arm. This effect is likely to be **minor** given the relatively short, expected duration (five to seven weeks) of instream excavation (for breakout areas).

15. Effects on longfin eels are possible due to increased suspended sediment and deposited fine sediment near the MLC. However, these effects will be **minor** if the proposed sediment management framework (see evidence of Dr Hoyle) is adhered to, instream works (including future maintenance work) fall outside of the elver and migrant eel trap-and-transfer periods, and a fish salvage programme is deployed in the Waiau Arm in the vicinity of the works area. These matters are addressed in the draft conditions attached to the evidence of Mr Daniel Murray.

16. Non-migratory galaxiid species, such as the southern flathead and Gollum galaxias, are regarded as highly sensitive to increased fine sediment levels. Both are found in the lower Waiau River below the MLC, although they are rare. Potential effects are more likely at low flows but will be minimised if the proposed sediment management framework (see evidence of Dr Hoyle) is adhered to.

17. The sensitivity of lamprey to elevated suspended sediment is unknown, but adult lamprey are transitory through the MLC:IP area while migrating into the Mararoa catchment and elevated turbidity may stimulate this migration. Juvenile lamprey (ammocoetes) use deposited fine sediment as a key habitat within streams.

18. Elevated levels of deposited fine sediment in the lower Waiau River may temporarily reduce torrentfish habitat quality and quantity and impact their food supply. However, the proposed sediment management framework is based on naturally occurring levels and durations in the Mararoa River, so any effects from deposited fine sediment should be less than those already experienced naturally by fish communities in the lower Waiau River.

19. Overall, I consider that, if the proposed sediment management framework (see evidence of Dr Hoyle) is adhered to, the effects of the MLC:IP construction will be **less than minor** for lamprey and **minor** for other fish species found in the area near the proposed Project.

MY INVOLVEMENT WITH THE MLC:IP

20. My role in the MLC:IP has been as a freshwater fish expert.

21. From April 2022, NIWA was involved in workshops with Meridian and other experts making high level assessments of the potential effects of alternative methodologies

for this Project and alternative sediment scenarios. During these early stages of the Project, advice on freshwater fish was provided by Dr Eimear Egan.

22. My involvement with the MLC:IP began in April 2023, after Dr Egan left NIWA, and when NIWA was engaged to prepare assessments of the effects of the MLC:IP on freshwater ecology.

23. In July 2024, I led a field survey within the Project Area to further clarify fish species present in the Project area.

CHANGES SINCE LODGEMENT

24. During the preparation of my evidence, it became apparent that knowledge of the existing environment in the Waiau Arm was limited by the methodology (i.e., large-mesh fyke nets) used there in the only previous survey near the Project area. As a result, a further fish survey was completed in July 2024. This survey used specific methodology (fine-mesh fyke nets, Gee minnow traps and electrofishing) to target small fish species that may have avoided capture in the 2021 survey (e.g., bullies, non-migratory galaxiids and lamprey ammocoetes). The findings of the 2024 survey have been incorporated into my evidence.

25. I have had input into the proposed conditions of consent which are relevant to freshwater fish and agree that these are appropriate to manage effects on these species. I note that conditions have been updated following consideration of issues raised in submissions on the application, and because of conversations with submitters through a pre-hearing process.

26. In particular, I note that a condition suite is proposed detailing the contents of the Freshwater Fauna Management Plan, and key timings and specifics of fish salvage operations.

27. These updated conditions are appended to the evidence of Mr Murray.

EXISTING ENVIRONMENT

28. A combination of desktop investigations and field-based methods were used to assess the ecological value and composition of freshwater fish communities in the Waiau Arm and lower Waiau River.

29. Initial desktop investigations used the New Zealand Freshwater Fish Database and publicly available eDNA data on the Wilderlab website to identify fish species recorded in the Waiau Arm and lower Waiau River.

30. Data from fish surveys in 2021 throughout the Waiau catchment[1], including the Waiau Arm, and a fish survey in July 2024 in the Project area complemented existing data. These data were also available in the New Zealand Freshwater Fish Database.

31. The 2021 surveys used a variety of methods to capture fish, including electrofishing and fyke nets with various mesh sizes. It is important to note that the 2021 surveys in the Waiau Arm specifically targeted adult eels and mainly used large-mesh (12 mm) fyke nets from the migrant eel trap-and-transfer programme at the locations shown in Figure 1. 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 (and if captured in low numbers could also have been eaten by eels in the fyke nets before being observed).

[1] Egan, E., Sinton, A., Crow, S., Jellyman, P., Rose, A., Williams, P., Hickford, M. (2023) Native freshwater fish distribution and abundance in the Waiau catchment. Client report prepared for Meridian Energy Limited. 2021329CH: 144 p.

Figure 1: Locations where coarse-meshed (12mm) and fine-meshed (4mm) fyke nets were used during 2021 surveys by Egan et al. (2023) to characterise fish communities in the Waiau Arm.

32. The 2024 fish survey used fine-mesh (4 mm) fyke nets, Gee minnow traps and electrofishing to characterise the fish community in the Project area.

33. At least 15 native and four introduced (non-native) freshwater fish species are known from the Waiau Arm and/or the lower Waiau River (from downstream of the MLC to the river mouth)[1]. The species are listed in Table 5-5 (Pg 44) of the Freshwater Ecology Report.

34. The four introduced fish species include salmonids that are part of a nationally important fishery.

35. Several of the native fish species present were identified as 'Threatened' in the Department of Conservation's (**DOC**) most recent classification[2] and are also thought to be especially sensitive to elevated sediment levels[3]. These taxa (i.e., longfin eel, southern flathead and Gollum galaxias, lamprey and torrentfish) and salmonids are the primary focus of my evidence.

36. Other fish species present in the Waiau Arm and/or the lower Waiau River are of less concern because they do not have a Threatened conservation status (usually because they have large, widespread populations) and they are not thought to be especially sensitive to elevated sediment levels[3].

Salmonids

37. There are too few records in the New Zealand Freshwater Fish Database of Chinook salmon (Conservation status: Introduced and Naturalised) from the Waiau catchment to characterise their spatial distribution. Anecdotal reports suggest Chinook salmon occur in sufficient numbers in the lower Waiau River to comprise a valued fishery. Chinook salmon are typically found in the lower Waiau River and

[2] 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.

[3] 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: 290 p.

Mararoa catchment, but a catch of sea-run salmon has also been recorded in Lake Te Anau[4].

38. Brown and rainbow trout (both Introduced and Naturalised) are broadly distributed throughout the Waiau catchment and support a highly-valued recreational fishery[5]. In the 2021–22 angling season, the lower Waiau River was the 7th most popular waterbody in the Southland region with over 7,300 angler days (5.8% of the total Southland fishing effort)[6].

39. Trout density in the lower Waiau River is approximately 10% of that observed in the upper Waiau River and declined significantly between 1996 and 2013[7]. Trout densities in the Mararoa River have also declined significantly during the last two decades. Brown trout density in the middle reaches of the Mararoa River during 2015–2017 was approximately 30% of that observed during 1999–2001. There is no evidence of a significant change in rainbow trout abundance in the Mararoa River. However, there is evidence of a shift in their distribution with declining abundance in the middle reaches but increasing abundance in the lower reaches over the last two decades[7].

40. Pre-spawning salmonids (brown and rainbow trout) migrate upstream from April through to September and use the vertical slot fish way at the MLC to access the Waiau Arm and Mararoa River.

41. Salmonids excavate redds (akin to a gravel nest) in instream gravel and cobble habitat to lay their eggs; the Upper Waiau River is recognised as one of the most important spawning areas in the Waiau catchment. Trout (mostly pre-spawning trout) aggregate just above the MLC at the confluence of the Mararoa River and the Waiau Arm[8]. There is limited substrate suitable for salmonid spawning from directly below the MLC downstream to the Borland Burn[9].

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[4] https://www.stuff.co.nz/southland-times/news/4987000/Big-catch-reeled-in-shoes-kept-dry

[5] Unwin, M. (2013) Values of New Zealand angling rivers: results of the 2013 National Angling Survey. NIWA Client Report CHC2013-120: 85 p.

[6] Stoffels, R., Unwin, M. (2023) Angler usage of New Zealand lake and river fisheries: results from the 2021/22 National Angler Survey. NIWA Client Report, 2023189CH: 142 p.

[7] Stoffels, R. Kilroy, C., McIvor, I., Daly, O. Jellyman, P. (2019) Waiau catchment salmonid populations. Status and possible effects of the Manapōuri Power Scheme. NIWA Client Report 2019275CH: 38 p.

[8] https://www.facebook.com/watch/?v=1936542599967531

[9] Jellyman, P., Jowett, I. (2019) Waiau River habitat modelling report Manapōuri Lake Control to Borland Burn. Client report prepared for Meridian Energy Limited. 2021005CH: 79 p.

Longfin eel

42. Longfin eels (Conservation status: Declining) are present in the Waiau Arm, in the lower Waiau River and throughout the upper Waiau catchment.

43. As part of the Migrant Eel Mitigation Programme in the Waiau catchment, elvers are trapped downstream of the MLC and are transferred to the Mararoa River (above Weir Road bridge), Lake Manapōuri, Lake Te Anau and selected tributaries of Lake Te Anau[10]. No elvers are transferred into the Waiau Arm. The Migrant Eel Mitigation Plan stipulates that the elver trap-and-transfer programme must run from 1 December to at least 10 March.

44. The extent of the juvenile eel population in the Waiau Arm is poorly understood because the habitat is too deep to electric fish, and juvenile eels are too small to be captured efficiently by fine mesh fyke nets or Gee minnow traps. However, it is likely that there is little suitable habitat (i.e., shallow fast-flowing water with coarse substratum) in the lower reach of the Waiau Arm to support significant numbers of juvenile eels[11].

45. Surveys in 2021 recorded the greatest catch-per-unit-effort of adult longfin eels across the Waiau catchment in the Waiau Arm**Error! Bookmark not defined.**, but these fish also had the lowest body condition in the catchment, indicating that densities are too high and/or the existing habitat is poor[12].

46. To successfully migrate, adult migrant eels leave Lake Manapōuri via the Waiau Arm towards the MLC and go down the lower Waiau River and out to sea for reproduction. As part of the Migrant Eel Mitigation Programme, adult migrant eels are trapped in Lake Manapōuri (Shallow Bay is targeted to capture migrating eels from the Te Anau catchment) and transferred to immediately below the MLC near the Duncraigen Bridge. The Migrant Eel Mitigation Plan stipulates that the adult

[10] See https://www.tewaiaumahikakaitrust.co.nz/tuna-trap-transfer-programme

[11] Glova, G.J., Jellyman, D.J., Bonnett, M.L. (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.

[12] Egan, E., Sinton, A., Rose, A., Crow, S., Jellyman, P., Charsley, A., McDermott, H., Willsman, A. (2022) Longfin eel population structure in the Waiau Catchment. Client report prepared for Meridian Energy Limited. 2022128CH: 171 p.

migrant trap-and-transfer programme must run from 1 December to at least 10 May[13].

47. Migrant eel activity is related to mean monthly water temperature. Almost two-thirds of successful migration occurs between March and May, and little activity is observed between June and August[14]. The last day of May is typically taken as the end of the migration season in the Waiau population, but longfin eels can migrate most months of the year except for July.

Non-migratory galaxiids

48. Two non-migratory galaxias species may be present in areas of the Waiau catchment that could be affected by the MLC:IP: southern flathead and Gollum galaxias.

49. Southern flathead galaxias (Conservation status: Nationally Vulnerable) 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[Error! Bookmark not defined.]. However, they have been found in the upper reaches of the lower Waiau River mainstem (near Whare Creek), but in low numbers probably because they struggle to co-exist with predatory trout.

50. Southern flathead galaxias have not been recorded in the Waiau Arm and it is unlikely that there is any suitable habitat there, or refuges from predation, to support them.

51. 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.

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[13] Currently, Meridian is trialling starting the migrant trap-and-transfer programme in November to test whether more migrant eels can be transferred with an earlier start to the season.

[14] Jellyman, D.J., Unwin, M.J. (2017) Diel and seasonal movements of silver eels, *Anguilla dieffenbachii*, emigrating from a lake subject to hydro-electric control. *Journal of Fish Biology* 91: 219-241.

[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: 17 p.

[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.

52. Gollum galaxias (Conservation status: Nationally Vulnerable) are not known from the mainstem of the lower Waiau River but have a disjointed distribution in low gradient tributaries and wetland habitats associated with the lower Waiau River. They are found in a wide range of habitats but are usually found in the slower margins of waterways.

53. Gollum galaxias are generally site-attached with little movement[16]. They spawn in late winter and early spring (late August to October) with eggs being deposited under boulders in streams and on plants in wetlands[17]. The location and extent of their spawning habitats in the Waiau catchment are unknown.

Lamprey

54. Lamprey/kanakana (Conservation status: Nationally Vulnerable) adults migrate upstream in the lower Waiau River between August and December[18]. Spring is considered the peak migration period, but adult lamprey have also been caught below the MLC in summer (late January)[19]. The upstream migrations of lamprey are stimulated by increases in stream discharge[20]. Migrations can occur during the day, but they occur most often at night. Migrations are linked to receding flood waters and occur on small and large flood flows.

55. The location of adult lamprey habitat is not well known in the Waiau catchment, particularly the extent of any habitat in the mainstem of the lower Waiau River. However, it is highly likely most adults reside in tributaries**Error! Bookmark not defined.**.

56. The only juvenile lamprey habitat near the Project area is at the confluence of the Waiau Arm and the Mararoa River. Two ammocoetes were found at this site during the 2024 survey.

[17] https://www.doc.govt.nz/globalassets/documents/conservation/native-animals/fish/otago-galaxiids/gollum-galaxias-facts.pdf

[18] Jellyman, D., Glova, G., Sykes, J. (2002) Movements and habitats of adult lamprey (*Geotria australis*) in two New Zealand waterways. *New Zealand Journal of Marine and Freshwater Research* 36(1): 53-65.

[19] Boubée, J., Chisnall, B., Watene, E., Williams, E., Roper, D. Haro, A. (2003) Enhancement and management of eel fisheries affected by hydroelectric dams in New Zealand. In D. A. Dixon (Ed). *Biology, management, and protection of catadromous eels*. American Fisheries Society Symposium Bethesda, Maryland, USA: 191-205.

[20] Kelso, J., Glova, G. (1993) Distribution, upstream migration and habitat selection of maturing lampreys, *Geotria australis*, in Pigeon Bay Stream, New Zealand. *Marine and Freshwater Research* 44(5): 749-759.

Other fish species

57. Torrentfish (Conservation status: Declining) are widely distributed in the lower Waiau catchment (below the MLC) including in the lower Waiau River mainstem**Error! Bookmark not defined.**. Torrentfish shelter between and beneath loose gravels and cobbles during the day in shallow, fast-flowing riffles, and rapids[21]. At night they move to slower-flowing areas to feed on aquatic insects[22].

58. The other native fish species found in the Waiau Arm and lower Waiau River have a 'Not Threatened' conservation status[2]. The non-native perch (Introduced and Naturalised) is found in the Waiau Arm and Lake Manapōuri**Error! Bookmark not defined.**.

ASSESSMENT METHODOLOGY

59. My assessment of environmental effects on freshwater fishes considered the potential effects of excavation during the MLC:IP construction, including disturbance during excavation and the effects of sediment discharge. Effects were considered within the Waiau Arm from the upstream extent of the MLC:IP site and downstream to MLC, and downstream in the lower Waiau River (the receiving environment).

60. I made the following assumptions about the excavation work required for the MLC:IP:

    (a) the existing flushing flow protocol[23] was developed with the intention of delivering better ecological outcomes for the lower Waiau River through management of undesirable periphyton growth with associated benefits for the freshwater environment;

[21] 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.
[22] 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.
[23] Water Permit 206156 condition 7 (Protocol for controlled releases of voluntary supplementary flows from the Manapōuri Lake Control (MLC) structure to the Lower Waiau River Final 13 April, amended 7 November 2014, 12 February 2016 and 16 November 2018).

(b) the MLC:IP will improve the conveyance and reliability of flow releases to the lower Waiau River including more effective flushing flows and recreational flows;

(c) almost 90% of the excavation work (by volume of material moved) will be completed out-of-stream;

(d) the MLC:IP will be completed within a 10-month window (January to October), with an overall construction period of approximately 4–5 months within this window;

(e) instream excavation will occur at 'breakout' points at the upstream and downstream extremities of the newly excavated parallel channel during the latter 5–7 weeks of the excavation. The earliest these breakout excavations will occur is mid-May; the latest is the end of September;

(f) the largest release of sediment will likely be during the 4-week period when the downstream breakout is completed;

(g) the excavation works will occur on up to 7 days per week and up to 24 hours per day basis;

(h) the overall effect (in terms of fine sediment released from the MLC:IP) will depend on flows and lake levels; and

(i) the greatest sediment-related effects of the works will be in the reach immediately downstream of the works, with the greatest effects of sediment on the receiving environment (lower Waiau River) being upstream of the Excelsior Creek confluence.

61. My assessment focuses on the potential effects of:

(a) bed disturbance, elevated deposited fine sediment, and suspended sediments (at times) on the fish community of the Waiau Arm in the MLC:IP area; and

(b) elevated suspended sediments and deposited fine sediment on the fish community in the lower Waiau River.

62. The assessment was guided by a synthesis of information on the existing environment (in terms of both fine sediment and biota; see the evidence of Drs Hoyle and Hogsden), a field survey and the outcome of a review of the literature.

63. The aims of the literature review were to:

(a) describe the primary habitats and current conservation status[2] of the species known to be in the Project area and lower Waiau River;

(b) confirm the general effects of suspended sediments and deposited fine sediment on the fish communities considered; and

(c) identify thresholds or gradients (of suspended sediment/turbidity/visual clarity or deposited fine sediment) that had specific effects on individual taxa or groups of taxa.

64. Using the review information, I considered how the fish species present in the affected area might be impacted by higher levels of suspended sediment (as anticipated from the MLC:IP). This process guided a final assessment of effect magnitude that also considered the intrinsic value of the taxa (e.g., rare/endangered vs common and widespread taxa) and the potential for recovery from any effects following the excavation.

65. My assessment of level of effect did not use a formal framework but is based on expert opinion combining ecological value (e.g., Conservation status) with type and duration of effect.

66. The assessment for each taxa was made relative to the existing ecosystem. This approach generally followed that set out in the EIANZ guidelines on Ecological Impact Assessment[24].

EFFECTS ON FRESHWATER FISH

67. Fish species found in the Waiau catchment with a 'Threatened' conservation status, were assessed for their sensitivity to increases in suspended and/or deposited fine

[24] Roper-Lindsay, J., Fuller S.A., Hooson, S., Sanders, M.D., Ussher, G.T. (2018) Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition.

sediments. The expected sensitivity of these species to elevated suspended sediment is summarised in Table 1.

68. The potential effects of the MLC:IP construction on these species can be divided into the direct effects on species in the Waiau Arm (i.e., disturbance because of the excavation works) and the indirect effects of increased suspended sediment and deposited fine sediment downstream in the lower Waiau River.

69. In general, fish are more likely to experience sublethal stress from suspended sediments rather than lethal stress. Most fish species are highly mobile and can avoid high sediment concentrations by moving into unaffected stream reaches[25]. However, any temporary reductions in macroinvertebrate abundance or diversity caused by increased suspended sediments or deposited fine sediment (see evidence of Dr Hogsden) could potentially reduce the availability of preferred prey for salmonids (i.e., mayflies, stoneflies, free-living caddisflies) or common prey for galaxiids (e.g., mayflies). This may have the effect of temporarily increasing competition for available food resources with an associated reduction in growth.

[25] Kemp, P., Sear, D., Collins, A., Naden, P., Jones, I. (2011) The impacts of fine sediment on riverine fish. *Hydrological Processes* 25(11): 1800-1821.

Table 1: Expected sensitivity to chronic exposure to elevated suspended sediment for fish species found in the Waiau catchment. Sediment sensitivity and hypothesised mechanisms are from Franklin et al. (2019)[3]. Species considered most at risk from the MLC:IP, based on their Conservation status, distribution, and sensitivity, are shaded red. Threatened species with high or unknown sensitivity, but the effects are on lower Waiau River (LWR) populations are shaded yellow.

Species	Conservation status	Sensitivity to elevated sediment	Expected spatial location of effects	Hypothesised mechanism(s)
Rainbow trout	Introduced & naturalised	High	MLC:IP area and LWR	Reduced habitat suitability, feeding, growth & spawning success
Brown trout	Introduced & naturalised	High	MLC:IP area and LWR	Reduced habitat suitability, feeding, growth & spawning success
Chinook salmon	Introduced & naturalised	Not classified	Unknown (few records in catchment)	Reduced habitat suitability & avoidance of the reach?
Longfin eel	At Risk-Declining	Medium	MLC:IP area and LWR	Reduced habitat suitability
Southern flathead galaxias	Threatened-Nationally Vulnerable	High	LWR	Reduced habitat suitability, feeding & growth
Gollum galaxias	Threatened-Nationally Vulnerable	High	LWR	Reduced habitat suitability, feeding & growth
Lamprey	Threatened-Nationally Vulnerable	Unknown	Adults are transitory, small area of larval habitat in MLC:IP area	Unknown
Torrentfish	At Risk-Declining	High	LWR	Reduced habitat suitability
Banded kōkopu	Not Threatened	High	LWR	Avoidance & reduced feeding
Redfin bully	Not Threatened	High	LWR	Reduced habitat suitability
Upland bully	Not Threatened	High	LWR	Reduced habitat suitability
Bluegill bully	At Risk-Declining	Medium	LWR	Reduced habitat suitability
Common bully	Not Threatened	Low	MLC:IP area and LWR	Unknown
Shortfin eel	Not Threatened	Low	MLC:IP area and LWR	Unknown
Īnanga	At Risk-Declining	High	LWR (lower reaches)	Reduced feeding & growth
Black flounder	Not Threatened	Not classified	LWR (lower reaches)	Unknown
Giant kōkopu	At Risk-Declining	Not classified	LWR (lower reaches)	Unknown
Yellow-eye mullet	Not Threatened	Not classified	LWR (lower reaches)	Unknown
Perch	Introduced & naturalised	Not classified	MLC:IP area	Unknown

Salmonids

70. Suitable spawning habitat for salmonids does not exist in the Waiau Arm, meaning the MLC:IP will not directly affect salmonid spawning in this area.

71. Salmonids are considered most sensitive to suspended sediment during the winter/early spring as this is when spawning and fry emergence occur. There is a risk that in low flow conditions, pre-spawning trout aggregating at the confluence of the Mararoa and Waiau Arm[8] between May and July will be exposed to elevated suspended sediment caused by the MLC:IP, depending on the timing of the breakout excavation.

72. Elevated suspended sediment (as well as noise disturbance) will likely induce avoidance behaviour in pre-spawning trout. They may leave the MLC:IP area by swimming up the Mararoa River to reach suitable spawning habitats. However, the extent and/or quality of suitable spawning habitats in the Mararoa River are currently unknown. Movement away from the lower Mararoa River assumes that there is a suitable flow regime to cue upstream movement. In another New Zealand river, maximum mean upstream daily movement of trout occurred during the peak of freshes[26].

73. Increased suspended sediment in the MLC:IP area may impede a portion of the pre-spawning salmonid population from migrating via the Waiau Arm to the Upper Waiau River for spawning. Given that the MLC:IP will likely be ongoing for approximately 4–5 months, the main migration season of salmonids (April–September) is expected to be affected. However, in the context of the entire Waiau catchment population[7] this effect is likely to be negligible, especially as sediment release is expected to be concentrated into the 5–7 weeks when work is carried out at the upstream and downstream breakout areas.

74. Pre-spawning salmonids (brown trout and rainbow trout) migrate upstream from April to September using the vertical slot fish way at the MLC for migration. Any modifications to the flow regime during the MLC:IP (e.g., additional flow to flush sediment) may affect fish pass effectiveness and salmonid access to the upper

[26] Venman, M.R., Dedual, M. (2005) Migratory behaviour of spawning rainbow trout (*Oncorhynchus mykiss*) in the Tongariro River, New Zealand, after habitat alteration. *New Zealand Journal of Marine and Freshwater Research* 39(4): 951-961.

Waiau and Mararoa catchments. I assume that fish whose passage is blocked at the MLC would migrate downstream to spawning habitat in the mainstem or tributaries.

75. Deposited fine sediment can clog the spawning substrates used by benthic-spawning fish species such as salmonids. However, existing deposited fine sediment cover within salmonid spawning habitats in the Waiau catchment is unknown[7]. Given the dearth of information on (a) deposited fine sediment throughout the Southland river network, and (b) the spatial distribution of preferred salmonid spawning grounds, it is difficult to conclusively evaluate the potential additive effects from the MLC:IP, particularly to populations in the lower Waiau River. However, I expect any additive effects of deposited fine sediment to spawning grounds to be negligible as most spawning will occur in the headwaters of any tributaries and the abundance of trout in the lower Waiau River is much lower than in the upper catchment[7].

76. Overall, I conclude that the expected magnitude of effects on salmonids will be **minor** due to:

(a) Minimal effects of elevated suspended sediments as salmonids are mobile, especially if the proposed sediment management framework (see evidence of Dr Hoyle) is adhered to;

(b) Minimal risk to spawning habitat as no spawning habitat is directly within the project area and little is available in the affected area downstream; and

(c) Timing of MLC:IP may partly coincide with salmonid migration, but there will be a negligible effect in the context of the whole catchment, assuming the highest sediment release is concentrated into 5–7 week period during the breakout excavations.

Longfin eels

77. Longfin eels are thought to have low sensitivity to increases in suspended sediment loading in rivers[3] because:

    (a) survey data from other New Zealand rivers show there is no relationship between the duration of turbid conditions in rivers and longfin eel occurrence[27];

    (b) longfin eel feeding is not greatly dependent on sight, and they can feed actively in turbid flood conditions[28];

    (c) the survival of juveniles is not affected by long-term exposure to very high turbidity[29].

78. Longfin eels are thought to be more sensitive to increases in deposited fine sediment than suspended sediments[3] because:

    (a) longfin eels are more common in areas with stony substrates[30];

    (b) significant reductions in biomass of resident eels was found because of increased deposited fine sediment in a New Zealand stream[31];

    (c) when deposited fine sediments are decreased, longfin eel densities increase substantially[32].

79. Even in highly modified habitats (including the Waiau Arm in the MLC:IP area), further habitat modifications can reduce instream habitat quality and displace eels. For example, Holmes et al. (2019) found that a 31% increase in deposited fine

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[27] Rowe, D.K., Hicks, D.M., Richardson, J. (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.

[28] 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.

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

[30] Glova, G.J., Jellyman, D.J., Bonnett, M.L. (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.

[31] 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.

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

sediment (from a mean value of 65%), one year after instream works in a Southland river, displaced eels for at least one year[31].

80. Deposited fine sediment cover in the Waiau Arm is not fully understood (see evidence of Dr Hoyle) and therefore the anticipated effects on longfin eels are difficult to resolve. Any degradation of the instream habitat in the lower Waiau Arm (within the Project area) due to increased deposited fine sediment may affect longfin eels, particularly under low flow conditions. Increased deposited fine sediment may reduce existing habitat quality by clogging the interstitial spaces on the stream bed used by juvenile eels, although I suspect that there is little habitat suitable for juvenile eels in the lower Waiau Arm.

81. Overall, I conclude that the expected magnitude of effects on longfin eels will be **minor** due to:

(a) Any potential effects of elevated suspended sediments and deposited fine sediment on eels being mitigated by adhering to the proposed sediment management framework (see evidence of Dr Hoyle);

(b) Instream works falling outside of the primary elver and migrant eel migration period (December to March); and

(c) The inclusion of a fish salvage programme in the Freshwater Fauna Management Plan for the MLC:IP.

Non-migratory galaxiids

82. Most non-migratory galaxiids have highly restricted ranges and movement that means any changes to their environment can be considered a threat.

83. Almost nothing is known about the effects of suspended sediment and deposited fine sediment on southern flathead and Gollum galaxias, but there is potential for deposited fine sediment to affect spawning habitat. Non-migratory galaxiids are benthic spawning species and deposited fine sediment will likely clog the interstitial spaces used for spawning[3].

84. Southern flathead and Gollum galaxias feed on small stream invertebrates such as mayflies and stoneflies[17]. There is potential for deposited fine sediment to temporarily affect the availability of these prey items (see evidence of Dr Hogsden).

85. Overall, I conclude that the expected magnitude of effects on non-migratory galaxiids will be **minor** given that:

(a) Any potential effects of elevated suspended sediments and deposited fine sediment on non-migratory galaxiids will be mitigated by adhering to the proposed sediment management framework (see evidence of Dr Hoyle);

(b) The period in which increased sediment is expected is relatively short; and

(c) While there are some records of non-migratory galaxiids from the lower Waiau mainstem, larger populations are found in tributary habitats, which will not be affected by the project.

Lamprey

86. The sensitivity of lamprey to elevated suspended sediments is not known in New Zealand[3], but elevated turbidity is considered a significant stimulus of migration activity[20].

87. Excavation of the downstream breakout area will have direct effects on the very small area of larval lamprey habitat present at the confluence of the Waiau Arm and the Mararoa River.

88. Lamprey spawning habitat in the lower Mararoa River will not be affected by the MLC:IP. Lamprey spawning habitat occurs downstream of the MLC in Excelsior Creek**Error! Bookmark not defined.**, but the ammocoete (larval) stage of the lamprey uses deposited fine sediment as a key habitat within streams[33]. Therefore, existing relatively high deposited fine sediment and the potential for short-term increases because of the MLC:IP, are unlikely to have any adverse effect on ammocoetes in the Waiau River upstream of Excelsior Creek.

89. Overall, I conclude that the expected magnitude of effects on lamprey will be **less than minor** given that:

(a) Adult lamprey are transitory through the MLC:IP area while migrating into the Mararoa catchment, with elevated turbidity possibly stimulating this migration;

[33] Jellyman, D., Glova, G. (2002) Habitat use by juvenile lampreys (*Geotria australis*) in a large New Zealand river. *New Zealand Journal of Marine and Freshwater Research* 36(3): 503-510.

(b) Adult lamprey do not feed while in freshwater. Any sediment-related effects on macroinvertebrates/small fish will not affect adult lamprey in the same way as they would other fish species;

(c) Larval (ammocoete) lamprey use deposited fine sediment as habitat; and

(d) The fish salvage plan in the Freshwater Fauna Management Plan for the MLC:IP will target ammocoetes in the downstream breakout area and will relocate these fish to known larval habitat in the Mararoa River upstream of the Weir Road bridge**Error! Bookmark not defined.**.

Other fish species

90. Elevated levels of deposited fine sediment will reduce torrentfish habitat quality and quantity (although it is less likely that fine sediment will deposit in fast-flowing riffles and rapids, refer to evidence of Dr Hoyle) and impact their food supply by infilling the interstitial spaces (gaps) between rocks in the riverbed[3]. However, the proposed sediment management framework (see evidence of Dr Hoyle) is based on naturally occurring levels and durations of sediment in the Mararoa River. Adherence to this framework is designed to limit the effects to be like those already experienced naturally by fish communities in the lower Waiau River. I conclude that the expected magnitude of effects on torrentfish should be **minor**.

91. Perch reduce their feeding rate in response to decreased water clarity when held in experimental tanks[34], but perch are non-territorial, mobile predators[35] that are likely to simply move to clearer water to feed if turbidity increases in the Waiau Arm near the MLC:IP. Perch spawning is unlikely to be affected by deposited fine sediment because they are known to spawn by attaching their egg strands to a wide range of substrates including sand, gravels, aquatic vegetation, and detritus[36]. I conclude that the expected magnitude of effects on perch will be **less than minor**.

[34] Estlander, S., Nurminen, L., Mrkvička, T., Olin, M., Rask, M., Lehtonen, H. (2015) Sex-dependent responses of perch to changes in water clarity and temperature. *Ecology of Freshwater Fish* 24: 544-552.
[35] Eklöv, P. (1992) Group foraging versus solitary foraging efficiency in piscivorous predators: the perch, *Perca fluviatilis*, and pike, *Esox lucius*, patterns. *Animal Behaviour* 44(2): 313-326.
[36] Čech, M., Peterka, J., Říha, M., Jůza, T., Kubečka, J. (2009) Distribution of egg strands of perch (*Perca fluviatilis* L.) with respect to depth and spawning substrate. *Hydrobiologia* 630: 105-114.

RESPONSES TO ISSUES IN SUBMISSIONS

92. I have read all the submissions lodged on the MLC:IP relevant to my area of expertise. To the extent not already addressed in my evidence, I will respond to submissions that raised freshwater fish issues or concerns.

93. The **Director-General of the Department of Conservation** (DOC) submission raises concerns regarding:

(a) Whether the available information on freshwater fish above and around the MLC, particularly for lamprey and non-migratory galaxiids, is adequate or recent enough to evaluate the effects of the MLC:IP[37];

(b) The potential for fish strandings and/or impingement or entrainment of fish during pumping operations for dewatering[37];

(c) The lack of details on the installation and maintenance of the permanent culvert to align with best practice from the New Zealand Fish Passage Guidelines[37];

(d) The impact of lighting spill-over and noise on predation/feeding and migratory cues of threatened fish species[37];

(e) The lack of information as to whether construction activities and associated sediment disturbance will be timed to avoid spawning periods for threatened fish species such lamprey and non-migratory galaxiids[37]; and

(f) The need for greater certainty about the content of the Freshwater Fauna Management Plan, such as what will occur, by when, what outcomes are to be achieved, who will be responsible and what enforcement mechanisms will be available.

Available information

94. In response to (a), it is my opinion that there are sufficient data available on fish communities, including lamprey and non-migratory galaxiids, in the Waiau Arm and lower Waiau River to assess the direct and indirect effects of the MLC:IP. A

[37] This submission point was resolved at the 2nd Pre-Hearing Meeting and DOC are no longer pursuing the matter. See s99 2nd Pre-Hearing Meeting Report APP-20233670.

combination of desktop investigations of data from the New Zealand Freshwater Fish Database and targeted surveys in 2021 and 2024 have established the ecological value and composition of freshwater fish communities in the Waiau Arm and lower Waiau River. This, coupled with existing knowledge of the sensitivity of species to suspended sediments and deposited fine sediment allow a valid assessment of the likely effects of the MLC:IP.

Dewatering

95. In response to (b), it is my understanding from Section 5.4.5 of the AEE that any dewatering will be done through pumping from excavated sumps or wells adjacent to the excavation and not directly from the parallel channel (see evidence of Dr Clunie). In my opinion, pumping ground water from excavated areas that have never had any direct connection to surface water will create no risk of impingement or entrainment for resident or transient fish in the Waiau Arm.

Culvert design and installation

96. In response to (c), I agree with the Department of Conservation's suggestion that a condition requires "*that New Zealand Fish Passage Guidelines best practice is followed in the design and construction of any culvert*". I note a proposed condition on this matter is addressed by Mr Murray in his evidence.

Lighting

97. In response to (d), it is my understanding (see evidence from Dr Clunie) that for most of the MLC:IP, there will be no lighting on the river-side of the bunding. The exception might be during the Stage 3 breakout excavation phase when the excavation face will be right at the river edge. However, by this stage, any resident fish near the excavation site will have been relocated by the fish salvage programme detailed in the Freshwater Fauna Management Plan.

98. Generally, lighting will be used in the establishment area (nearest edge >110 m from the Waiau Arm), the spoil area (nearest edge >35 m from the Mararoa River) and the Haul Road (remote from the Waiau Arm). Given this, it is my opinion that lighting will pose little risk to the predation/feeding and migratory cues of threatened fish species in the MLC:IP area.

Spawning

99. In response to (e), there is no evidence from the surveys that non-migratory galaxiids are present in the lower Waiau Arm, and the available habitat in the Project area appears unsuitable for non-migratory galaxiid species that are found elsewhere in the Waiau catchment (i.e., southern flathead and Gollum galaxias). Given this, it is my opinion that it is very unlikely that there will be any direct effects of the MLC:IP on the spawning of these species.

100. Southern flathead galaxiids have been found in the mainstem of the lower Waiau River. However, the proposed sediment management framework (see evidence of Dr Hoyle) is based on naturally occurring levels and durations of sediment in the Mararoa River. Adherence to this framework is designed to limit the effects to be like those already experienced naturally by fish communities in the lower Waiau River. Given this, it is my opinion that the indirect effects of the MLC:IP on spawning and the spawning habitat of these species will be minor.

Freshwater Fauna Management Plan content

101. In response to (f), Meridian and NIWA have had further discussions with the Department of Conservation after the 2nd Pre-hearing Meeting and have co-developed a Freshwater Fauna condition suite that details the content of the Freshwater Fauna Management Plan, key timings and specifics of fish salvage operations. It is my understanding that as a result of Meridian reaching agreement with the Department of Conservation on the Freshwater Fauna condition suite, that the Director-General of the Department of Conservation has withdrawn her right to be heard at the Hearing.

102. I note the submissions from the **Waiau Working Party** and the **Waiau Fisheries and Wildlife Habitat Enhancement Trust** suggest conditions requiring:

(a) Preconstruction inspection of areas that will be disturbed for freshwater fauna and relocation of these to suitable safe areas;

(b) That any fish that are accidentally removed from the river during excavations be returned to the Waiau Arm via an established methodology.

103. I agree that these measures are appropriate to minimise effects on site-attached fish in the Waiau Arm and that these steps, along with a salvage programme, should be incorporated into the Freshwater Fauna condition suite.

104. The submission from **Guardians of Lakes Manapōuri, Monowai and Te Anau**[38] is "*neutral*" towards the MLC:IP resource consent application and supportive of my recommendation on p 60 of Appendix D to the application to:

(a) Ensure the instream excavation phase [of the MLC:IP] does not commence until after mid-March to avoid effects on upstream migrating juvenile eels;

(b) Provide a salvage programme for any site-attached longfin eels (and kākahi – see evidence of Dr Hogsden) in the Waiau Arm.

105. I note that that the submission from **Oraka Aparima Rūnaka** is "*neutral*" towards the MLC:IP resource consent application and does not raise any issues regarding potential impacts on freshwater fish.

106. I note that the submission from **Waiau Rivercare Group Inc.** is "*generally supportive*" of the proposed MLC:IP and does not raise any issues regarding potential impacts on freshwater fish.

RESPONSE TO SECTION 42A REPORT

107. I have reviewed the Section 42A Officer's Report prepared by Bianca Sullivan, resource management consultant with Environment Matters Limited, on behalf of Environment Southland, and the supporting Technical Report prepared by Dr Greg Burrell (Instream Consulting Ltd).

108. I agree with Ms Sullivan's concluding statement in the Effects on Ecology section of the Section 42A Report that "*it is likely that the positive effects of providing additional flushing flows to the lower Waiau River will outweigh the largely temporary effects of the channel construction and maintenance*".

109. I agree with Ms Sullivan's statement in the Section 42A report that "*The health and well-being of the lower Waiau River would be prioritised through enabling the*

[38] I note that the legal standing of the Guardians of Lakes Manapōuri, Monowai & Te Anau to participate in these processes is disputed. This submission point has therefore been addressed in my evidence for completeness while this issue is outstanding.

provision of additional flushing flows, while the proposed mitigation ensures that the short term effects will be avoided, remedied or mitigated". Similarly, I agree with Dr Burrell's statement that "*there will be an overall positive effect* [of the MLC:IP] *provided various measures are put in place*". These measures include mitigation to manage turbidity and deposited fine sediment levels and the preparation of a Freshwater Fauna Management Plan.

110. Dr Burrell states that the volunteered condition "*requiring the preparation of a Freshwater Fauna Management Plan prior to commencing works in the water*" is "*sufficiently robust to minimise harm to freshwater fish and other fauna*". I agree with his statements that the effects of the parallel excavation "*will be minimised by capturing fish and other fauna (e.g., kākahi) within the construction footprint and relocating them upstream of the construction activities"* and that *"Relocation of fish and other freshwater fauna has become standard practice for minimising construction project effects in recent years and it is appropriate in this instance*".

111. In response to Dr Burrell's concern that "the proposed turbidity limits [thresholds] could result in more than double the historic measured values", I refer to Table 3-1 (Pg 25) of the Freshwater Ecology Report which is summarised in the 'Methodology for establishing suspended sediment thresholds' section of Dr Hoyle's evidence. The sediment management framework has been designed with best endeavours to try to keep turbidity and deposited fine sediment levels within the natural range that resident fauna are adapted to.

CONCLUSIONS

112. There are sufficient data available in relation to the fish community in the Waiau Arm to assess the direct effects of the MLC:IP construction. There are no records of Threatened smaller fish species in the Waiau Arm, and I consider it unlikely that they are present given the available habitat and food sources.

113. Subject to a Freshwater Fauna Management Plan (including fish salvage) that is tailored to all resident fish species, I consider that the risk to Threatened native fish species around the MLC:IP area is low, and the direct effects on these species will be no more than minor, and able to be managed via the proposed condition set attached to the evidence of Mr Murray.

114. There are sufficient data in relation to fish communities in the lower Waiau River to assess the indirect effects of the MLC:IP. Subject to adherence to the proposed sediment management framework (see evidence of Dr Hoyle), which is designed to limit indirect effects to within the natural range fish communities in the lower Waiau River are already adapted to, and instream excavation (including future maintenance work) occurring outside of key spawning and migration periods, I consider the risk to Threatened native fish species in the lower Waiau River is low, and the indirect effects on these species will be minor.

Mike Hickford

29 August 2024