Jobs For Nature fish passage remediation project: evaluation summary

Cawthron Report 4199

World-class science
for a better future

REVIEWED BY: Kati Doehring

APPROVED FOR RELEASE BY:
Roger Young

PROJECT NUMBER: 19519

ISSUE DATE: 26 November 2025

RECOMMENDED CITATION: Holmes R. 2025. Jobs For Nature fish passage remediation project: evaluation summary. Nelson: Cawthron Institute. Cawthron Report 4199. Prepared for Tasman District Council.

Jobs For Nature fish passage remediation project: evaluation summary

Robin Holmes

Prepared for Tasman District Council

CAWTHRON

Contents

Executive summary

Between 2021 and 2026, Tasman District Council, in partnership with the Ministry for the Environment, Olleycology Ltd and Kūmānu Environmental, delivered a major fish passage remediation project funded through the Jobs for Nature initiative. The project aimed to reconnect freshwater habitats in the Tasman Region by identifying and remediating instream barriers that prevent native migratory fish – such as īnanga, kōaro, longfin eel and redfin bully – from accessing upstream environments.

Achievements

The project assessed over 6,400 structures (culverts, weirs, dams, tide gates) for fish passage impacts. More than 950 barriers were remediated using practical, low-cost solutions, including flexible rubber ramps with mussel spat ropes at 'perched' culvert outlets and flexible weir baffles installed within culverts. Several remediation method evaluation studies were also completed.

Key findings

Flexible ramps combined with mussel spat rope and internal flexible weir baffles significantly improved passage for climbing fish species such as banded kōkopu and juvenile eels. These methods were relatively low cost and easy to install in small culverts with tight curvatures.

There was evidence for the flexible weir baffles substantially improving passage for īnanga through a 6 m experimental culvert at a 2% gradient, with partial effectiveness at slopes of up to 8%. However, the flexible ramp and mussel spat rope combination had limited success for improving passage for non-climbing fish species (including īnanga), except in locations with low culvert perch height (< 0.20 m). Floating ramps generally performed better in relation to improving īnanga passage.

Recommendations

Based on the results of this project, I recommend using flexible baffles and rope / ramp combinations in small, high-gradient waterbodies upstream of īnanga habitat (e.g. > 20 m elevation above sea level), where passage for climbing species is the priority.

In areas where īnanga or other non-climbing species are present in substantial numbers, floating ramps and spoiler baffles should be considered where installation is feasible and cost constraints preclude rock ramps or culvert replacement.

Future work should focus on regional-scale cost-benefit modelling of the different remediation options available. This work would help to optimise remediation investment to maximise upstream habitat access for multiple species at a regional scale within a given budget.

1. Introduction

Between 2021 and 2026, Tasman District Council (TDC), in partnership with the Ministry for the Environment (MfE), Olleycology Ltd and Kūmānu Environmental, led a major fish passage remediation project with funding from the Jobs for Nature (J4N) initiative. The goal was to reconnect freshwater habitats across the Tasman Region by identifying and improving instream barriers that prevent native migratory fish – such as īnanga, kōaro, longfin eel and redfin bully – from reaching upstream habitats.

Over the course of the project, more than 6,400 structures – including culverts, weirs, dams and tide gates – were assessed for their impact on fish passage. More than 950 barriers were then remediated. This regional-scale remediation project was made possible by implementing practical, low-cost remediation methods such as flexible rubber ramps (in combination with mussel spat ropes) at perched culvert outlets, and internally installed flexible weir baffles within culverts.

The project delivered substantial social and cultural benefits, which were in line with the broader J4N objectives. It also created employment opportunities for local workers and strengthened environmental stewardship in the region through training programmes and school involvement.[1]

1.1 Report aim

Alongside the approaches recommended in NIWA's fish passage guidelines (Franklin et al. 2024), alternative, relatively low-cost fish passage remediation methods were implemented during this project (methods described in Olley et al. 2022). The efficacy of each method was evaluated as part of TDC's J4N fish passage project. In this report I:

1. summarise the findings of the alternative method evaluation studies
2. discuss the strengths and limitations of the alternative methods
3. outline the specific fish barrier and catchment characteristics where these method variations appear to be well suited.

[1] See the MfE project page for further details: https://environment.govt.nz/what-you-can-do/stories/fish-passage-remediation-in-tasman-district-going-swimmingly-under-jobs-for-nature/

2. Fish passage remediation methods used in the J4N project

The following alternative methods, which are not recommended in the fish passage guidelines (Franklin et al. 2024), were widely used as part of TDC's J4N fish passage project:

Flexible 'weir baffles' for inside culverts

Flexible 'weir baffles' were screwed into the base of round culverts to reduce water velocity; the small weirs increase water depth and create resting zones for fish. This method was applied in culverts with gradients of up to 8% (see example in Figure 1).

Figure 1. Flexible 'weir baffles' installed inside a pipe culvert (Williams Creek).

Flexible ramps combined with mussel spat rope

Flexible ramps were fitted in combination with mussel spat rope (hereafter referred to as 'flexible ramp and rope') to provide textured surfaces that assist climbing species (e.g. kōaro, banded kōkopu and eels). These were typically installed at perched culvert outlets and other vertical barriers (see Figure 2).

Figure 2. Example of a flexible ramp and mussel spat rope combination to remediate a perched culvert (Williams Creek).

The most frequently used remediation methods were internal-culvert flexible weir baffles and flexible ramp and rope combinations. These approaches were typically deployed instead of the spoiler baffles and floating ramps, described and recommended in Franklin et al. (2024). This was because weir baffles were considered cheaper and easier to install in small culverts with limited crawl space and high curvature – typical of the first- and second-order streams at most of the remediation sites (note that spoiler baffles are not recommended for culverts < 1.2 m in diameter; Franklin et al. 2024). In addition, council culvert network owners raised concerns regarding the risk of reduced culvert flow capacity and culvert blockages with detached spoiler baffle plates (pers. comm., Trevor James, Principal Scientist, TDC). However, because these methods are not described in the fish passage guidelines and have had limited assessment of their efficacy, a series of evaluation studies were undertaken.

3. Evaluation study summaries

Throughout the project, a multiple-lines-of-evidence approach was used to assess the effectiveness of the new remediation methods. The evaluation study designs were complementary in that the different designs addressed different assumptions. The evaluation methods included:

1. Before-and-after *in situ* monitoring:
   a) with upstream trapping (Olley and Olley 2022; Olley and Olley 2023).
   b) with simultaneous upstream and downstream trapping (Olley et al. 2024).
   c) with sequentially ordered upstream trapping only, which tests both the flexible ramp and rope method and floating ramps (following the *in situ* sequential monitoring method outlined in Baker et al. 2024 and Olley et al. 2025).
2. Captured īnanga passage trials:
   a) before-and-after *in situ* monitoring using an experimental model field culvert to test efficacy of internal culvert weir baffles (Olley et al. 2024).
   b) *in situ* trials testing both flexible ramp and rope combinations and floating ramps (using a 'mark-recapture method', but without fish staining, as described in Baker et al. 2024 and Olley et al. 2025).

3.1 Before-and-after monitoring with upstream trapping only

Over the field season 2021/22, before-and-after *in situ* monitoring with upstream (culvert inlet) trapping was undertaken at Williams Creek culvert (perch height: 0.3 m). The culvert was remediated using flexible ramp and ropes at the outlet and internal weir baffles. Results indicated that fish passage improved substantially for juvenile banded kōkopu. Post-remediation trapping showed that approximately five times more banded kōkopu successfully negotiated the structure compared to pre-remediation monitoring (22 pre-remediation vs 102 post-remediation). Shortfin eel passage rates also increased by a small amount following remediation. In addition, a few īnanga were recorded upstream post-remediation, suggesting a potential minor improvement in passage for this non-climbing species (Olley and Olley 2022).

The study design could not account for differences in the number of fish attempting upstream migration during the pre- and post-remediation trapping periods. Nevertheless, the marked increase in banded kōkopu following remediation suggests that the combination of remediation methods is effective for this species. It should be noted that this experiment did not separate the effects of the flexible ramp and rope from baffle installation within the culvert, as both remediation actions were installed simultaneously.

3.2 Before-and-after monitoring with upstream and downstream trapping at Harley Creek

Over the summer field season 2022/23, the next experiment involved before-and-after *in situ* monitoring with simultaneous upstream and downstream trapping at the Harley Creek box culvert (perch height: 0.45 m). The perch culvert was remediated using flexible ramps and ropes (Figure 3); no internal baffles were installed, as velocities within the culvert were considered suitable for all fish species (Olley et al. 2023). Downstream trapping was used to check if the numbers of fish attempting to migrate past the structure differed between pre- and post-remediation monitoring periods, helping to partially control for a potentially uneven number of upstream migrating fish over the different experimental phases.

Figure 3. Flexible ramps with mussel spat ropes installed at Harley Creek culvert.

Prior to remediation, no fish were captured at the upstream culvert inlet during the 7 days of monitoring, indicating that the structure was a complete barrier to all species. Banded kōkopu were consistently captured in the downstream trap during both the pre- and post-remediation monitoring periods but were only recorded in the upstream trap after remediation. Following remediation, banded kōkopu were found upstream daily, with a total of 110 individuals captured over the 11-day monitoring period. Following remediation, small numbers of kōaro and longfin and shortfin eels were recorded, and counts were similar to those observed in the downstream trap. The remediation did not enable passage for īnanga.

Consistent with findings from Williams Creek, these results suggest that the flexible ramp and rope combination is effective at improving passage for climbing species such as banded kōkopu. This study design could not control for potential behavioural effects of downstream trapping on fish (prior to their attempt to migrate upstream past the culvert). It is plausible that the captured fish, which were held for up to a day in the downstream trap, had reduced climbing ability / motivation because of capture and handling stress. This implies that the results reported in this assessment are conservative and the culvert remediation method may be more successful for fish that have not been influenced / stressed by prior trapping. On the other hand, capture and handling stress has been observed to temporarily enhance motivation for upstream movement in salmonids by initiating aggressive burst swimming upon release (pers. comm., Dr Cindy Baker, Principal Scientist, Earth Sciences New Zealand). However, I cannot identify any mechanism by which downstream trapping could improve the climbing ability of juvenile galaxiids. For small galaxiids to climb even a small barrier, they require sustained effort over minutes to hours, meaning any immediate cortisol boost would be unlikely to provide an advantage. Accordingly, the results of this study are likely a conservative estimate of passage improvement at this site.

3.3 Controlled experimental field culvert

Over the 2023/24 field season, experimental model culvert trials were undertaken to isolate the effect of internal weir baffles from culvert perch-height remediation measures for īnanga passage (see Figure 4). The trials were undertaken at the same time of day (early morning) over 6 consecutive days.

Figure 4. Experimental model culvert to test efficacy of flexible weir baffles for īnanga passage.

Results showed that baffles significantly improved passage for captured īnanga that were released into a net at the base of the 6 m long model culvert – the outlet was at water level to ensure easy entry for the īnanga. When set at a 2% gradient, 72% of fish successfully reached the top of a baffled culvert within the first 30 minutes and 98% navigated the structure within 4 hours. This was relative to 30% ascending the culvert during the 2% gradient control trial (with no baffles) after 4 hours. At all gradients tested greater than 2% – during the control trials with no baffles installed – no īnanga negotiated the experimental culvert after 4 hours. When the gradient was set at 4% and 6%, the successful passage rate was 56% and 34%, respectively, after 1 hour, and 81% and 85%, respectively, after 4 hours. When the gradient was set at 8%, a total of 15% and 65% of fish reached the top in the culvert after 1 hour and 4 hours, respectively. This indicates that weir baffles are partially effective for slopes up to around 6–8% for juvenile īnanga in culverts up to 6 m long (Olley et al. 2024).

3.4 Before-and-after monitoring with upstream and downstream trapping

In the 2023/24 field season, field trials using simultaneous upstream and downstream trapping were repeated at three sites – the Williams Creek culvert site, Mulligan Creek and Shambala Creek. For the Williams Creek site, on this occasion, the flexible ramp and rope provided little improvement for climbing species such as banded kōkopu and eels, as they were able to negotiate the structure prior to remediation. It was speculated that this may have been due to the presence of the wetted headwall feature at the outlet, which enabled passage over the perch for climbing species in its unremedied state .

At the Mulligan Creek culvert (perch height: 0.7 m), 11 days of upstream pre-remediation monitoring showed that no fish migrated past the structure. Following remediation with flexible ramp and ropes, dozens of banded kōkopu successfully navigated the structure. Downstream trapping indicated similar numbers of fish were attempting upstream migration during both the pre- and post-remediation monitoring periods. In common with other intervention trial sites, īnanga could not migrate past the structure after flexible ramp and rope remediation.

Finally, in this same field season, the flexible ramp and rope combination was tested against floating ramps (installed as per Franklin et al. 2024) at a third site, the Shambala Creek culvert (perch height: approximately 0.5 m). Before-and-after monitoring was undertaken (without downstream trapping due to equipment theft). Prior to remediation, only one banded kōkopu was captured at the culvert inlet during the 19 days of monitoring. Following remediation with the flexible ramp and rope, 24 banded kōkopu and four shortfin eels were recorded over 11 days. After removing the flexible ramp and rope and installing the floating ramp, 11 banded kōkopu were captured over 11 days. These results indicate that both methods improved passage for banded kōkopu at this site, while neither appeared to enhance passage for īnanga, which were observed downstream in reasonable numbers.

3.5 Before-and-after monitoring with alternate sequential trapping

Over the 2024/25 field season, the project undertook experiments that addressed the possibility that downstream trapping interferes with upstream fish migration. The 'sequential trapping (without downstream trapping)' methodology, as described in Baker et al. (2024), was used to assess the efficacy of the flexible ramp and rope and floating ramps. Trials were conducted at the Dominion Stream box culvert, where internal culvert current velocities were adequate for all juvenile native fish species, eliminating the need for internal baffles. As such, this evaluation study isolated the effect of the culvert perch remediation methods (Olley et al. 2025).

Three remediation treatments were tested against a control (no remediation): (1) flexible ramp and rope combination, (2) single floating ramp, and (3) twin floating ramps (both floating ramps were installed as per fish passage guidelines Franklin et al. 2024, see Figure 5).

Figure 5. Three remediation treatments tested in sequential rotation at Dominion Stream, from left to right: flexible ramp and rope combination, single floating ramp, and twin floating ramp.

Each treatment or control was installed for a 24-hour period and then removed in sequential rotation over 40 days, resulting in 10 days of testing per treatment or control. Results were consistent with previous experimental designs: both remediation methods significantly improved passage rates for banded kōkopu, with the flexible ramp and rope combination performing significantly better than the single floating ramp but not the double floating ramp. Passage for īnanga was not improved by the flexible ramp and rope combination but was significantly enhanced by the floating ramps; there was no significant difference between one or two floating ramps.

Additionally, a captured īnanga trial was undertaken at Williams Creek following the study design detailed in Baker et al. 2024. The culvert perch height was altered from 0.15 m to 0.25 m, and the performance of the flexible ramp and rope was compared to the floating ramp. Approximately 50% of the 100 īnanga tested successfully negotiated a perch height of up to 0.20 m when remediated with the flexible ramp and rope. The rate of success dropped to 20% at 0.25 m. In contrast, the floating ramp performed relatively well at remediating a 0.25 m perch height, with approximately 70% of īnanga successfully negotiating the ramp.

4. Conclusion

The flexible baffle and flexible ramp and rope methods deployed during the J4N project appear to be appropriate for improving passage past culverts for juvenile climbing fish species, such as banded kōkopu and eels. These remediation approaches reportedly have a lower cost and are more practical to install than alternatives such as spoiler baffles and floating ramps, especially in small culverts with a high curvature. Weir baffles were effective at facilitating juvenile īnanga passage at a 2% slope in an experimental culvert, and were partially effective (after 1–4 hours) at slopes of up to 8%.

The J4N studies found that the flexible ramp and rope method is only effective at remediating perched culverts for non-climbing fish species, such as īnanga, in low perch-height situations. Floating ramps consistently performed better for īnanga. In a related study, Baker et al. (2024b) also tested the flexible ramp and rope method at Williams Creek using mark-recapture techniques with captured īnanga. They found that passage was not facilitated for this species at a perch height of about 0.18 m. In contrast, the J4N studies did find evidence for partial passage improvement for īnanga at low perch heights (< 0.20 m) at the same site (i.e. around 20–50% passage success). Overall, if a key objective at a barrier remediation site is facilitating passage for īnanga or other non-climbing species – for example, in most low-elevation (< 20 m) streams, where approximately 75% of īnanga records occur (Watson and Hickford 2023) – floating ramps or rock ramps should be used to remediate perches for access into the culvert (as described in Franklin et al. 2024).

In low culvert perch-height situations (i.e. < 0.20 m), the flexible ramps combined with mussel spat rope did provide passage for a proportion of īnanga in some of the captured fish trials. In small streams with limited upstream habitat, providing passage for a small proportion of īnanga (e.g. 30% of upstream migrants) may be sufficient to saturate available adult habitat with recruits. In these circumstances, these methods could be considered appropriate, if cost or practicality constraints limit deploying alternative methods that are more effective for non-climbing fish species (i.e. floating ramps).

4.1 Recommendations

With thousands of structures requiring remediation across the Tasman Region, funding will always fall short of addressing all passage barriers. Therefore, any substantial increase in cost or effort will reduce the scale of application. Managing a fixed budget and optimising the trade-off between site-level investment and opportunity cost at a regional scale requires a careful assessment. In lieu of such an investigation, I recommend that the weir baffles and flexible ramp and rope methods, tested in this J4N project, are suitable for small (e.g. first- and second-order) streams, upstream of īnanga habitat areas (e.g. most streams > 20 m elevation), where passage for climbing species is the priority. In areas where īnanga or other non-climbing species are likely present in substantial numbers, if culvert replacement or rock ramps are infeasible, floating ramps should be used in combination with spoiler baffles (where cost and practical constraints allow). Spoiler baffles are recommended for culverts of > 1.2 m diameter with < 2% gradient, as described in Franklin et al. (2024). In these circumstances, spoiler baffles are thought to perform better than weir baffles for the passage of small-bodied fish through a culvert, although it is recognised that further research is needed (Franklin and Baker 2025). In particular, future studies should directly compare different baffle methods for a variety of Aotearoa New Zealand fish species over a range of culvert slopes and lengths.

In the field, practitioners need to consider more than just efficacy for īnanga passage – cost and practicality are often key concerns when selecting remediation options. For example, over-engineering a structure to accommodate īnanga passage in a steep stream where only climbing species naturally occur may result in unnecessary time and effort. Further work should focus on modelling how to optimise site-level investment to maximise upstream habitat availability for multiple species at the regional scale. While spoiler baffles and floating ramps may be more effective for īnanga passage, habitat suitability for non-climbing species decreases with elevation and / or distance from the coast. Future projects should focus on determining how to apply a diverse portfolio of tools across different areas in a region or catchment. These studies should also consider factors such as species composition and upstream habitat potential, as well as the cost, time and practical aspects of installation. When undertaking a regional-scale assessment, other non-climbing inland species and their passage requirements should also be considered; for example, dwarf galaxias and bully species can have migratory requirements within the same stream system.

5. References

Baker C, Franklin P, Williams P. 2024a. Guidelines for monitoring fish passage success at instream structures and fishways. Hamilton: National Institute of Water and Atmospheric Research. NIWA Client Report No. 2024156HN. Prepared for Ministry for the Environment.

Baker CF, Williams P, Pyper N, Franklin PA. 2024b. Rubber ramp and spat rope did not facilitate upstream passage of a galaxiid through a perched culvert. Marine & Freshwater Research. 75(3): MF23207.

Franklin P, Baker CF. 2025. Culvert baffle design to improve fish passage for small-bodied fishes: A rapid evidence synthesis. Conservation Science and Practice. 7(7):e70082.

Franklin P, Baker C, Gee E, Bowie S, Melchior M, Egan E, Aghazadegan L, Vodjansky E. 2024. New Zealand fish passage guidelines. Version 2.0. Hamilton: National Institute of Water and Atmospheric Research. NIWA Client Report No. 2024157HN. Prepared for Ministry for the Environment.

Olley T, Hughes K, James T. 2022. Fish passage remediation training aid. Version 3.

Olley T, Olley R. 2022. Fish passage surveys: year 1 report. Nelson: Olleycology Ltd. Prepared for Tasman District Council.

Olley T, Olley R. 2023. Fish passage surveys: year 2 report. Nelson: Olleycology Ltd. Prepared for Tasman District Council.

Olley T, Olley R, Holmes R. 2024. Evaluation of fish passage remediation methods used in Tasman District's freshwater improvement fund programme. Nelson: Olleycology Ltd. Prepared for Tasman District Council.

Olley T, Olley R, Holmes R. 2025. Tasman District Council's Jobs for Nature fish passage evaluation report: 2024/25 season. Nelson: Olleycology Ltd. Prepared for Tasman District Council.

Watson A, Hickford M. 2023. Sustainable Wild Whitebait Fishery Project: West Coast adult whitebait habitat requirements: summary report. Christchurch: School of Biological Sciences, University of Canterbury.

World-class science for a better future.

CAWTHRON

98 Halifax Street East, Nelson 7010 | Private Bag 2, Nelson 7042 | New Zealand | Ph. +64 3 548 2319

cawthron.org.nz