

## **Review of the NIWA NZ Fish Passage Guidelines**

The NIWA NZ Fish Passage Guidelines represent a significant step toward improving aquatic connectivity in New Zealand, with the intention of supporting the migration and survival of native fish species across human-made barriers such as culverts, weirs, and other instream structures. However, despite the guidelines' aims, there are a number of critical shortcomings that undermine their utility and scientific robustness—particularly when considered in the context of New Zealand's unique freshwater ecology and the structures commonly found in its waterways.

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### **1. Limited Relevance of Referenced Research to New Zealand Context**

A central concern with the guidelines is that much of the research cited originates from international contexts or deals with structural and ecological conditions that are not representative of New Zealand waterways. The emphasis on findings from regions with significantly different fish assemblages, hydrological regimes, and infrastructure types limits the relevance of the guidance when applied to the range of structures that dominate New Zealand's stream modification landscape.

Native fish in Aotearoa have evolved unique behavioural and physiological traits to cope with dynamic stream environments. Many are small-bodied, non-leaping, and rely on passive and active swimming strategies or a pseudo-climbing ability that differ markedly from northern hemisphere analogues. As such, the transferability of international findings—such as studies involving salmonids in large culverts or high-gradient systems—is questionable. The guidelines fail to sufficiently address this gap, applying overseas findings too broadly without clearly evaluating their applicability to native conditions.

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### **2. Unsubstantiated Cornerstones: Bed Material and Flow Velocity ("Need for Speed")**

Two core tenets of the guidelines are:

- The presumed need to replicate natural bed conditions within structures using bed material e.g. rocks, gravel, sediment to ensure fish passage.

- The idea that fish require swift navigation through culverts to avoid exhaustion or predation.

However, these cornerstones lack a robust, evidence-based foundation in the **New Zealand** context. The guidelines assert the importance of natural bed **simulation** within culverts but do not present conclusive local data showing improved passage success across a range of species and conditions when compared to other methods e.g. baffles. Similarly, the "need for speed" narrative—implying that shorter traversal times increase passage success—assumes energetic limitations and predator pressures that are not quantified for native species under field conditions. Nor do the guidelines discuss the positive benefits gained from **restpools** or complex flows.

Without rigorous, localised research to support these assertions, the guidance reads as more theoretical than practical, and risks encouraging costly design modifications that may not yield ecological benefit.

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### **3. Inconsistent Standards for Evidence-Based Science**

The guidelines make repeated references to the importance of evidence-based science, especially in evaluating the suitability of fish passage remediation tools. Yet, the standard for what qualifies as "evidence-based" is inconsistently applied.

For example, traditional or established approaches (e.g. the use of rock ramps or boulder clusters) are at times dismissed or downplayed due to a lack of peer-reviewed New Zealand studies, despite decades of anecdotal and field-level implementation by practitioners. Meanwhile, tools like the spoiler baffle—relatively new to New Zealand practice—are highlighted favourably despite a narrow research base and limited longitudinal data. This inconsistency suggests that the authors are selective in the criteria for accepting or rejecting methods, potentially skewing outcomes toward particular technologies.

This issue is compounded by the absence of a transparent framework for evaluating evidence. In ecological science, context, replication, and variability are key. A single study on a specific stream type, flow condition, or fish species cannot be extrapolated broadly without caution—yet this nuance is often missing.

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## **4. Potential Conflicts of Interest and Bias**

The role of NIWA as both a guideline author and a commercial research entity is not clearly disclosed in the document. This is a critical omission, as NIWA regularly bids for research and design contracts in the freshwater space, including for fish passage solutions.

Of particular concern is the promotion of spoiler baffles, which NIWA developed under contract for Auckland Council. Their inclusion and favourable positioning in the guidelines raises questions of impartiality. This presents a textbook case of potential confirmation bias, where research may be selectively interpreted or presented to support a pre-existing belief or product line. While the spoiler baffle may indeed have merit, the guideline's promotion of it without parallel comparison to other, equally valid tools is problematic and compromises the credibility of the recommendations. It should also be noted that a number of the reports cited in the guidelines were NIWA's own report and they, along with the guidelines, were only ever peer reviewed internally and then only by ecologists, and neither engineers nor fish passage practitioners.

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## **5. Overly Prescriptive Recommendations Lacking Sufficient Empirical Backing**

Despite the aforementioned gaps in research and data, the guidelines are highly prescriptive in their recommendations. Prescriptive design standards are appropriate when supported by broad-based empirical evidence that accounts for variability in field conditions. However, New Zealand's rivers and streams are highly heterogeneous—with differences in structure size, shape, gradient, flow regime, and sediment load.

Design guidance that does not reflect this diversity risks being inappropriately applied. For instance, a recommendation that applies to a 1.2m diameter pipe in a rural, lowland stream may be unsuitable for a 0.6m culvert in a steep, bed-rock stream, yet the guidelines often fail to differentiate.

To be effective and scientifically sound, research must systematically test solutions across a matrix of parameters:

- Culvert length, shape, material
- Flow velocity and depth variation
- Fish species, sizes, and behaviours

- Seasonal and diel (day-night) variability

The guidelines do not present this level of analysis, making their specific prescriptions difficult to justify from a scientific or engineering standpoint.

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## **6. Vague Monitoring Standards and Undefined Measures of Success**

As a design criteria, and thereby some measure of success, the guidelines devote considerable space to culvert design using mathematical equations that rely on presumed fish swim speeds along with measurable water velocities. This creates a substantial challenge as fish burst-swim capabilities are poorly understood in a dynamic environment, particularly where flows are complex and spot velocities are difficult to measure.

The guidelines encourage monitoring of "novel approaches" not covered or formally recommended in the document. This is a commendable inclusion—ongoing assessment is essential to fish passage success. However, the guidelines fall short of defining what success actually looks like.

Key metrics—such as passage rate, time-to-traverse, upstream dispersal, or reproductive outcomes—are not specified. Without these, practitioners and regulators are left to make subjective judgments on the effectiveness of a solution. This creates confusion and weakens accountability.

Furthermore, while several monitoring methodologies are suggested, there is no clear protocol or justification for:

- How long monitoring should be undertaken
- What sample sizes are required
- What environmental variables should be controlled or recorded

This leaves a critical implementation gap and may discourage innovation by placing an unclear burden of proof on those trialling new techniques.

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## **Conclusion**

The NIWA NZ Fish Passage Guidelines are an ambitious attempt to standardise fish passage remediation in New Zealand. Their intent—to protect and restore freshwater

biodiversity—is laudable. However, the document suffers from several critical flaws that must be addressed to ensure it can serve as a credible and practical resource for engineers, ecologists, and regulators.

Key among these concerns are:

- The reliance on poorly contextualised or international research
- The absence of New Zealand-specific, evidence-based support for key principles
- Inconsistent standards for accepting evidence
- Apparent conflict of interest in the promotion of certain tools
- A lack of rigorous metrics for monitoring and evaluation

The guidelines would benefit greatly from a more transparent, open, and inclusive approach to evidence assessment, one that values practitioner experience, current knowledge and encourages iterative improvement based on rigorous, wide-ranging field data. Until then, practitioners should apply the guidance cautiously, with an awareness of its limitations and potential biases.

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