Lessons Learnt 003

Creation of rock weir and installation of culvert baffles to enable salmonid passage

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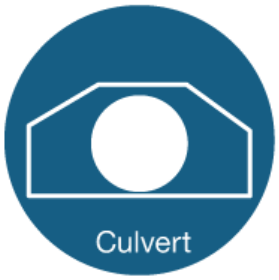
This case study forms part of a series that provides key information and guidance about how to potentially improve a fish passage barrier in a New Zealand waterway.

While providing fish passage is advantageous to most fish, removing or remediating a barrier can also affect fish populations by introducing invasive species to new areas.



STRUCTURE TYPE

IMPROVEMENT RATING*

What was the problem?

A 1200 mm diameter single barrel concrete road culvert was installed in Waiowhero Stream, Rotorua during a State Highway 5 road upgrade (Figure 1). This replaced an existing embedded culvert that provided effective fish passage. The new replacement culvert presented a problem for fish passage through being flush mounted, not embedded, and longer than the previous culvert; providing a lower water depth (i.e. 50 mm est.) and higher water velocities.

Restoration of salmonid access to upstream habitats was important as there are valuable trout spawning gravels upstream and a commercial tourist venture that relied on trout presence.

Figure1. New replacement culvert installed in Waiowhero Stream, Rotorua, early in remediation process showing shallow, high velocity water spilling from concrete apron.

What was the solution?

Opus consultants cemented around 80 cobble baffles (100 mm x 150 mm approx.) spaced 50-70 cm apart along the culvert base in an irregularly staggered pattern to break the flow, slow water velocity, raise water level and provide resting areas for fish.

Contractors and machinery were working on site at the time as the culvert was replacing a pre-existing structure. While no estimation of cost is provided, a retrofit to an existing culvert would require digger hire, rock, boulders (and transport), bidim cloth and several containers of epoxy to complete the install.

Downstream of the culvert apron, the contractors under Fish & Game supervision placed 6 large boulders (largest available) in an upstream facing 'V' weir (Figures 2 & 3) to provide adequate conditions needed for passage including:

- An increase in the water level of about 100-150 mm across the apron and through the culvert.
- A decrease of the water velocity (not measured) through the culvert and over the 'wing wall' apron so that fish could negotiate the culvert.
- The formation of a pool immediately downstream of the culvert as a result of the increased water level of 100-150 mm. The pool allowed trout to negotiate the obstacle by jumping.

* Improvement rating: 3/5 – Some improvement in upstream and downstream passage, and for target species/life stages.

Figure 2. New replacement culvert installed in Waiowhero Stream, Rotorua, with the upstream facing 'V' weir downstream (March 2010. Photo: John Meikle)

Figure 3. Side view of the upstream facing 'V' weir downstream of the culvert. (Photo: John Meikle)

Did it work?

No targeted monitoring of the retrofit was undertaken, but trout were observed negotiating the structure successfully and spawning upstream. Further investigations are needed to determine how effective the retrofit is for native fish species.

Lessons learnt

1. Cooperation and communication between agencies and councils is important in consideration of fish passage so that potential issues are resolved at project planning stages.
2. Effective fish passage can be provided, while also retaining an effective transit route.
3. New culvert installations should follow best-practice guidelines to ensure fish passage of salmonid and native fish species is provided, including installing oversized culverts that are embedded into the stream bed.
4. Monitoring of retrofitted structures is important to determine which species they have effectively provided passage for.
5. Baffles are an effective way to lower the water velocities within culverts and provide resting areas so fish can negotiate culverts in a range of flows.
6. Upstream facing 'V' weir design can be used to raise water levels downstream of structures and create a pool that salmonids can utilise during passage. However, best practice guidelines during culvert installation in the first place would have addressed this issue and allowed passage for all fish species.
7. Retrofit installation of culvert baffles and a rock weir can be successfully used to remediate poor culvert design and installation to improve salmonid passage.

For further information

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This is a revised/updated version, original was published in September 2015.