

# Works Within a Watercourse

## Culvert sizing and design

### Why is the design of a culvert so important?

When a culvert is placed in a stream it affects flows within the watercourse. Designing a culvert to the correct size to cope with the flow of the stream and installing devices that do not affect the streams natural features, whilst still retaining a useful culvert, are important components to be considered when constructing a culvert.

If designed appropriately, a culvert can have little to no effect on stream quality or ecology. However, if a culvert is poorly designed and installed the stream environment and the biota that inhabits it can be adversely affected.

### Sizing and design of culverts

Choosing the appropriate size and type of culvert used in a stream is vital to keeping sediment levels at natural levels and ensuring the stream maintains its natural characteristics, flow patterns and habitats for the organisms that depend on the streams environment. Sizing and design are also important to maintaining a successful culvert and for passage of aquatic biota. Refer to Auckland Regional Council: Technical Publication 131: Fish Passage Guidelines for the Auckland Region for further details on culvert design.

Key points of culvert design/installation include:

- All culverts should be sized to greater than or equal to average streambed width at the point where the culvert intersects the streambed.
- To allow for fish passage, > 20% of the culvert inlet should be set well below the current streambed.
- Average flow velocities of  $0.3 \text{ m s}^{-1}$  are desired.
- Baffles and spoilers may need to be installed to reduce velocities and provide resting areas for aquatic fauna.
- A roughened culvert surface may need to be installed to create surfaces for climbing fish species.
- Both the culverts gradient and alignment should be equal to the streams natural shape.
- Check bed material to assess erosion potential and install a notched weir if necessary to protect streambed.
- Armouring of the streambanks at the inlet and outlet of the culvert will prevent erosion.
- Contour inlet and outlet of culvert to stop bed erosion and turbulence in the stream flow.
- Suitable fish passage must be maintained by culvert installation.
- Remove any debris deposited in the culvert by storm events.

### Retrofitting established culverts

A key part of maintaining stream quality and ecology is the maintenance and monitoring of existing culverts. This allows for any adjustments or retrofitting to be undertaken to ensure the culvert is constructed to regulatory requirements.

Retrofitting is where another control is added to an existing culvert to guarantee that it is working correctly. Retrofitting is an effective way of restoring stream quality/ecology that has been reduced by the incorrect design and installation of a culvert.

Some of the main problems with existing culverts and how to fix them include:

- Adding a notched weir to a culvert that has an overhanging outlet and high velocity flows.
- Installing baffles or spoilers to slow a culvert with high velocity flow.
- Armouring streambanks to create a headwall to the culvert.
- Installing an access ramp or climbing structure to allow fish passage.
- Roughening the culvert bed to create varying flow velocities.
- Creating rock weirs to drown the culvert outlet.



Photo 1: A poorly constructed culvert with overhanging outlet.



Photo 2: A culvert successfully fitted with a rock headwall to allow fish passage

## Do I need a consent to install a culvert?

Consenting requirements are outlined in the Auckland Regional Plan: Air, Land and Water (Amended October 2004). A culvert may be installed as a Permitted Activity (i.e. consent is not required) if it meets a number of conditions. These conditions are outlined in Factsheet X, Consenting Requirements for Culverts.

## Further Information and References

The Auckland Regional Council has a number of technical publications relating to works within a watercourse including fish passage, sizing and design suggestions and appropriate models of stream diversions available for viewing at the Internet link: <http://www.arc.govt.nz/arc/about-arc/publications/> There are also further fact sheets available on related topics such as, Sediment Management: Site staging and stabilisation, Streamworks methodology and Fish passage or for further information contact the Stormwater/Sediment Management Team on (09) 366 2000.

Note: this factsheet does not constitute ARC approval; other consents and mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.