



Embedded culverts are beneficial



Clayton Gillies photo

Workers install a closed-bottom, corrugated steel embedded culvert at Western Forest Product's Stillwater Operation near Powell River.

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During road construction, forest operators must often cross fish-bearing streams, making sure not to jeopardize fish and/or fish habitat. In the

past, the most popular method of protecting the integrity of a stream was to build a wooden box culvert over it, similar to a short-span bridge. Constructed from on-site logs, wooden box culverts are preferably made from the highly durable western redcedar. When a stream is too wide for wooden box culverts, managers must often build or install bridges.

In recent years, a closed-bottom, corrugated steel embedded culvert has become an alternative to the wooden box culvert. As with the wooden box culvert, the length of the embedded culvert allows it to maintain stream channel characteristics and promote fish passage. Corrugated steel embedded culverts may actually offer the following potential advantages over a wooden box culvert:

- A correctly installed embedded culvert has a much longer lifespan than a wooden box culvert, which may need to be replaced several times when the wood deteriorates. This is particularly beneficial if the road will be permanent.
- As harvesting in coastal British Columbia increasingly focusses on second-growth stands,



for crossing fish-bearing streams

less western redcedar is available and more smaller-diameter wood must be used for building wooden box culverts. In British Columbia's interior, most of the wood is too small in diameter to use in culvert construction. This issue is avoided with the use of steel in the embedded culverts. Additionally, a steel culvert's structural strength makes it useable when building roads with deep fills.

- Compared to a bridge, embedded culverts can provide more width on the road surface and on the stream channel than a bridge.

Design and planning considerations

Once forest operators have determined that an embedded culvert is the optimal choice for a site, they must consider several planning and design issues. For example, construction must occur during the "fish window" for the area, the time period in which construction will have the least deleterious effect on the fish and their habitat.

A well-designed site plan will aid installation—a culvert that is properly positioned will minimize erosion of stream banks. Benchmarks and reference points may be established during the site survey and referenced during installation to provide horizontal and vertical control of the culvert's position through the road.

Before installation, fish nets and/or traps are used both upstream and downstream of the site to exclude fish from the construction area. The site is then dewatered using pumps or diversion channels to minimize any effects on the stream.

Construction and embedding process

Most installation procedures for embedded culverts are similar. Rip rap is placed at either end of the excavation and set in the soil. Once an excavator places the culvert sections, the culverts are then filled with sand or gravel to the desired height. A fish monitor may be used to guide the appropriate placement of larger cobbles and rocks during the process of creating a simulated stream. Alternately projecting rock spurs from the sides towards the centre of the culvert creates a meandering channel during low flows. The spurs as well as randomly placed aggregate provide velocity shadows or resting areas for fish passing through the culvert. Ultimately, the simulated stream bed should blend into the existing stream channel at both the inlet and outlet of the culvert.

The tools used for embedding the culvert will depend on the size of the job. A culvert can be embedded manually using shovels, rakes, and wheelbarrows. Or, forest operators can use small-power machinery such as a skid-steer loader or track-powered wheelbarrow.

During installation, it is important to employ sediment-control techniques, such as using pumps and hoses to deliver seepage water containing sediment away from the stream. Fill material should contain enough fine material and sand to fill voids in the simulated streambed and maintain surface flow.

Gillies (2003) documents the installation of an embedded culvert across a tributary stream to Lewis Lake in coastal British Columbia. This culvert was 2.7 metres in diameter and 14 metres long. The total cost of the installation, including field surveys, design, habitat assessment, aggregate production, and delivery was \$29,600. The purchase and delivery of the culvert accounted for approximately one-third of the total installation cost.

Closed-bottom, corrugated steel embedded culverts are an excellent choice for culverts with high fills, stream crossings on corners, and skewed crossings. In each of these cases, building a bridge instead would be more costly. Embedded culverts provide forest managers with another option for stream crossings that does not jeopardize fish or fish habitat. 🌲



An operator infills a culvert with a power wheelbarrow.

References

Gillies, C.T. 2003. Forest Engineering Research Institute of Canada, Vancouver, B.C. *Advantage* 4(30). 11 pp.

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