Retrofit vs. Replacement Options and Selection
for Fish and Wildlife Passage

Replace Culverts:	Retrofit Culverts:
If the crossing is structurally poor or degraded	If the crossing is structurally sound
If the crossing is undersized for flood flows	If the crossing is large enough for flood flows
If the crossing cannot be fixed to allow wildlife passage	If the retrofit will allow wildlife passage
If the replacement will not impact critical wetlands	If the replacement will negatively affect critical wetlands
If the replacement is within a project's budget	If the replacement cost is too high

Gradient control weirs are usually constructed with large boulders. They are typically placed downstream of the culvert outlet and are used to back-up water through a culvert or reduce an excessive drop at a culvert outlet. Care must be exercised to ensure that gradient control weirs do not block fish passage during low flows.

Baffles can be used to facilitate fish passage by creating a series of pools with drops to increase water depth and decrease water velocities. Baffles can increase debris clogging and accumulation and therefore require periodic maintenance.

Fishways can be utilized where baffles or gradient control weirs are not viable retrofit options.

Photos and information were compiled from: The Stream Crossing Guidelines, February 2008. The Connecticut Department of Environmental Protection Inland Fisheries Division Habitat Conservation and Enhancement Program. Cover photos by: Scott Jackson, Harley Soltes/The Seattle Times, Jane Winn, and the Massachusetts Riverways Program Stream Crossing Handbook, June 2005.

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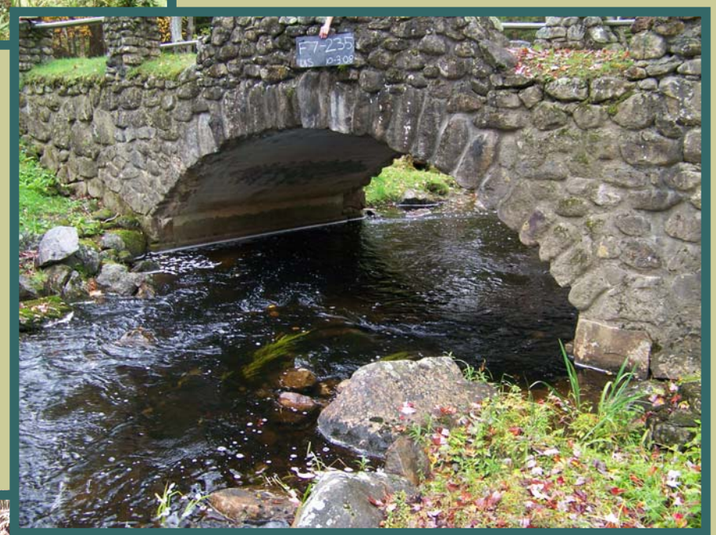
Fish and Wildlife Friendly Culvert Restoration Guidance



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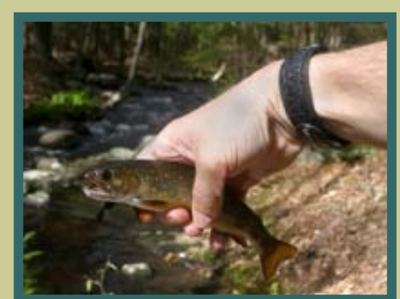

Culvert Selection Guide
For Fish and Wildlife Passage

Fish and Wildlife Friendly Culverts:	Non-Fish and Wildlife Friendly Culverts:
Are submerged into the stream bed	Are perched above the stream bed
Allow for natural substrate in the culvert	Don't allow for natural substrate in the culvert
Allow for good water depth	Are too shallow for aquatic organisms
Are 1.2X the bankfull* stream width	Are less than 1.2X the bankfull* stream width
Minimize the culvert length	Have an excessive culvert length
Maintain the stream's velocity	Increase or decrease the stream's velocity
Use large culverts for wide streams	Use multiple small culverts for wide streams

When it comes to aquatic connectivity, some culverts work well. They let water flow under roads *and* allow fish and other organisms to move freely up- and downstream.

Other culverts don't work so well. They block the movement of fish and other organisms between up- and downstream habitats.

Non-fish and wildlife-friendly culverts can be restored to allow for safe fish and wildlife passage. This can be done by retrofitting or replacing existing culverts.
Please see Page 4 for more information on replacing vs. retrofitting culverts.

* Bankfull refers to the flow stage of a river in which the stream completely fills its channel and the elevation of the water surface coincides with the bank margins. (From the McGraw-Hill Dictionary of Scientific and Technical Terms, 6th edition, published by The McGraw-Hill Companies, Inc.)

Quick Guide to Culvert Replacements
For Fish and Wildlife Passage

Preferred

Adequate

Inadequate

	Preferred	Adequate	Inadequate
STYLE	Open Bottom Culvert	Pipe Arch Culvert or Large Culvert	Small Round Culvert
MATERIAL	Concrete, plastic, and non-corrosive metals are preferred	Concrete, plastic, and non-corrosive metals are preferred	Metal that can rust
TEXTURE	Natural substrate	Corrugated (if embedded)	Smooth
WIDTH	Culvert width at least 1.2X the bankfull* width of the stream	Culvert width at least 1.2X the bankfull* width of the stream	Less than 1.2X the bankfull* width of the stream
CULVERT ALIGNMENT	Culvert aligned with stream direction.	Culvert aligned with stream direction.	Culvert alignment skewed with regards to stream direction.
INSTALLATION	Open bottom culverts are good for stream gradients greater than 3%.	Embed in substrate at least 1 ft for pipe arch culvert or 25% for large round culverts. Gradient should closely match upstream and downstream and not exceed 3%.	Small culvert not embedded into substrate. Gradient of culvert significantly different from upstream and downstream gradients.