FACTSHEET: Stream Crossing Maintenance and Replacement

1. Introduction

Stream crossings—culverts and bridges—are critical infrastructure for field and farm access. But if undersized or poorly installed, they can be a problem because they impede or block fish passage to important habitat and increase farm vulnerability to flood. In comparison, well-designed culverts and bridges allow proper drainage and fish passage.

2. Stream crossing maintenance BMPs

Many farms in Massachusetts utilize stream crossings, which require periodic maintenance. When these stream crossings are clogged or undersized, they impede fish migration and force floodwaters onto roads and fields. Culverts and bridges often become plugged or their capacity reduced because of debris or vegetative material. Headwalls may need occasional maintenance to prevent erosion and collapse. The following must be considered for culvert and bridge maintenance:

- Timing Limitations: When water is present, maintenance should occur from August 1 to September 30 when flows are low.
- Debris or vegetative material can be removed by hand without timing limitations to prevent the need for larger repairs.
- Maintenance work in watercourses is subject to Massachusetts Wetlands Protection Act requirements.
- Headwall repair should take place during the dry season when the work can be completed out of the water.
- If water is present when removing large quantities of debris, vegetation or accumulated sediments, additional measures must be taken to minimize impacts to aquatic life and water quality.

3. Stream crossing replacement

When replacing or installing a culvert in natural watercourses or modified natural watercourses, the design will largely be based on criteria necessary to ensure that flood waters may pass easily and fish may access their habitats.

a. Stream crossing location: Even the best-designed culvert or bridge has the potential to become a fish passage barrier, drainage barrier or maintenance headache. Location considerations include:
   - Make the culvert as short as possible without deviating from the direction of the upstream and downstream channel course by more than 30 degrees.
   - Choose an area with minimal and consistent stream gradient, not areas where the gradient is steep or transitioning.

b. No-Slope Design Option: Successful drainage and fish passage can be expected if the culvert is sufficiently large and is installed flat, allowing the natural movement of bedload to form a stable bed inside the culvert. Bedload is the sediments making up the watercourse bottom such as gravel and soils. Design criteria for a No-Slope culvert are:
   - Width equal to or greater than the average channel bed width at the elevation the culvert meets the streambed. Make the culvert the same width as the channel to maximize both water flow and fish passage.
   - A flat gradient. (No slope)

- The downstream invert is countersunk below the channel bed by a minimum of 20 percent of the culvert diameter or rise.
- The upstream invert is countersunk below the channel bed by a maximum of 40 percent of the culvert diameter or rise.
- The possibility of upstream headcut has been taken into account.
- There is adequate flood capacity.

c. Channel-bed Width: Use the average of at least three typical widths in free flowing and unconstrained areas upstream and downstream of the culvert location. For the purpose of culvert design, the channel-bed width is defined as the width of the bankfull channel. The bankfull channel is defined as the stage when water just begins to overflow into the active floodplain. Many incised streams or modified watercourses are no longer connected to the floodplain. In these situations the channel bed width may also be determined from the Active Channel Width and Ordinary High Water Mark (OHWM). The OHWM can usually be identified by physical scarring along the bank or shore, or by other distinctive signs such as the lower line of perennial vegetation. This scarring is the mark along the bank where the action of water is so common as to leave a natural line impressed on the bank. That line may be indicated by erosion, shelving, change in soil characteristics, destruction of terrestrial vegetation, presence of litter or debris, or other distinctive physical characteristics.

d. Channel Slope: The calculation for average channel slope is based on water-surface elevations and a distance along the channel that is at least 40 channel widths long, or 400 feet. Once these determinations are made, a culvert design can be finalized. In fish bearing watercourses it has become commonplace to fill the bottom 20% of the culvert with “fish gravel” to both stabilize the bed material and enhance a little fish habitat. It may be advisable to hire professional help to ensure an appropriate design and long lasting installation.

e. Concrete: If any concrete, cast-in-place concrete, or grouting works are to be undertaken, a high potential exists for concrete and/or concrete leachate to enter a watercourse. Concrete, concrete leachate, grout and other uncured concrete substances (e.g. concrete bags for headwall construction) are deleterious and highly toxic to fish and other aquatic organisms. To perform any concrete-related works, all water must be completely isolated prior to the commencement of any instream works. In addition, measures must be taken to prevent the incidence of concrete from entering a watercourse, ravine or storm sewer system for a minimum of 72 hours after the works have been completed. This is to ensure that the concrete has fully cured.

4. Summary of culvert replacement BMPs

- Timing Limitations: When water is present in the channel, culvert work below the waterline should occur between August 1 and September 30.
- A damaged culvert and associated fill should be removed from the watercourse and deposited upland so that it cannot re-enter the watercourse.
- The culvert should be placed on a flat gradient with the bottom of the culvert placed below the level of the streambed a minimum of 20 percent of the culvert diameter for a round culvert, and 20 percent of the culvert’s rise for an elliptical culvert. The 20 percent placement below the streambed shall be measured at the culvert outlet (see above for more details).

- The culvert should be constructed to pass the 100-year peak flow with consideration of the debris likely to be encountered.
- The culvert should be maintained free of debris to ensure unimpeded drainage and fish passage.
- Fill associated with the culvert installation and approach material should be structurally stable and shall be composed of material that, if eroded into the watercourse, shall not be detrimental to fish life.
- Fill associated with the culvert installation and approach material should be protected from erosion to the 100-year peak flow.
- When water is present in the channel, fish must be removed from the impacted area prior to any work.
- When water is present in the channel, measures must be implemented to ensure that contaminated water does not leave the work site.
- Leave riparian vegetation along the banks of the watercourse.
- All disturbed areas must be re-graded and stabilized by seeding or re-vegetating the riparian area upon completion. This helps to prevent surface erosion and/or sedimentation of the watercourse.

Example of a problem crossing, undersized, that gets clogged with woody debris and causes the stream to flood fields upstream during very high flows.