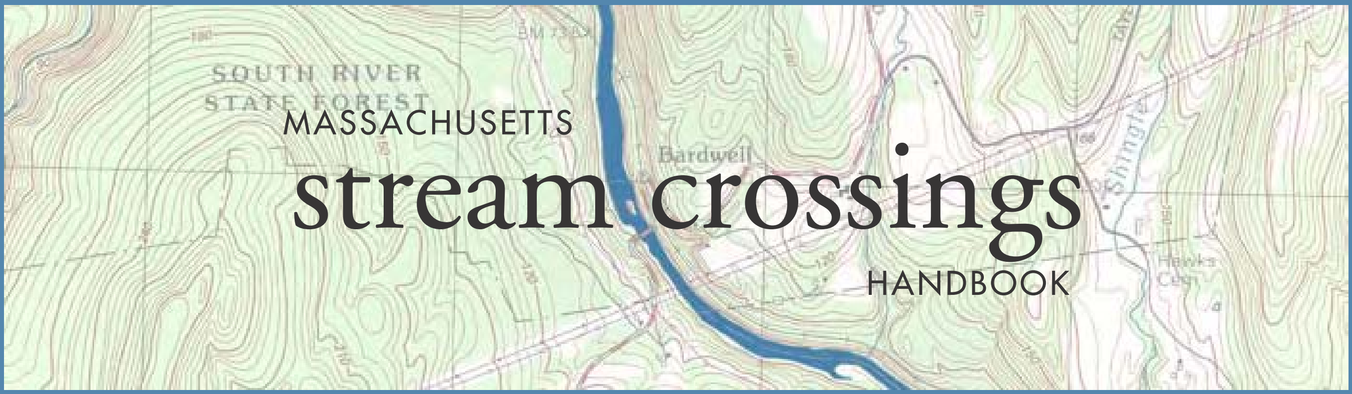
MASSACHUSETTS

stream crossings

HANDBOOK



MASSACHUSETTS RIVERWAYS PROGRAM

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS • DEPARTMENT OF FISH AND GAME

Acknowledgements

The Massachusetts Riverways Program, a division of the Department of Fish and Game, promotes the restoration, protection, and ecological integrity of the Commonwealth's rivers, streams, and adjacent lands.

This Stream Crossing Handbook is designed to inform local decision makers and advocates about the importance of properly designed and maintained culverts and bridges for fish and wildlife passage. The guidelines presented in this handbook are intended as a supplement, and not as a replacement, to sound engineering design of culverts and bridges. These guidelines describe minimum goals for fish and wildlife passage; additional design considerations are needed to ensure structural stability and effective passage of flood waters.

River Continuity is aimed at reducing impediments to movement of fish, wildlife and other aquatic life that require instream passage. The River Continuity Partnership is a collaborative effort with the Riverways Program, the University of Massachusetts Extension, The Nature Conservancy, and other nonprofit and agency partners. The Stream Crossing Standards presented in this booklet were developed by the River Continuity Partnership with contributions from state agencies, local and regional nonprofits, and private consultants. The standards were adopted by the Army Corps of Engineers in the Massachusetts Programmatic General Permit in January 2005.

Special thanks to the partners who helped edit and review this booklet, including local highway personnel, conservation commissioners, nonprofit and state agency personnel. Special thanks to those who contributed photographs for this publication.

 For more information on Stream Continuity, please see www.streamcontinuity.org

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June 2005

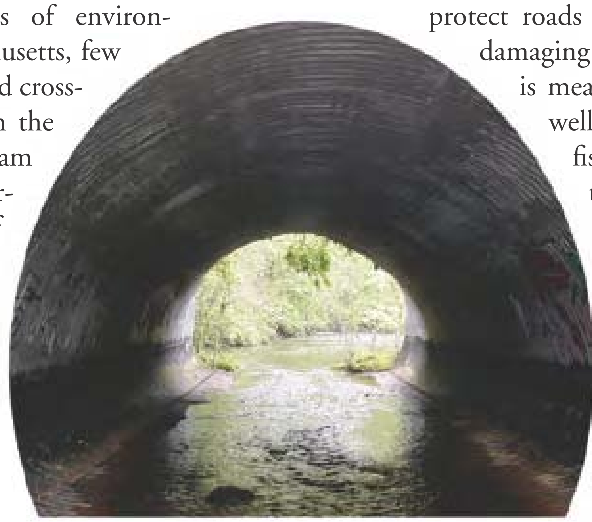
Riverways Program

Ethan Nedeau photo

INTRODUCTION

Massachusetts' citizens have traditionally been very proud—and protective—of their streams and rivers, recognizing the many benefits of healthy ecosystems. They conduct stream cleanups, set aside conservation land to protect streams, and celebrate the return of anadromous fish each spring. People value streams for different reasons: some enjoy fishing for native trout, others enjoy kayaking, and others simply enjoy sitting quietly on a stream bank. No matter what the reasons, resource managers in Massachusetts are proud to work in a state that demonstrates broad support for stream protection and restoration.

Although public awareness of environmental issues is high in Massachusetts, few people consider the effects of road crossings and other infrastructure on the quality of stream habitat. Stream conditions may be quite different upstream and downstream of a road crossing, and a crossing may look different during low or high water. The design and condition of a stream crossing determine whether a stream behaves naturally and whether animals can migrate along the stream corridor.



Ethan Nedeau photo

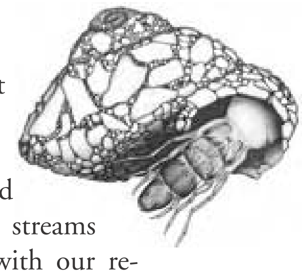
Stream continuity has not often been considered in the design and construction of stream crossings (culverts and bridges). Many crossings are barriers to fish and wildlife. Even crossings that were not barriers when originally constructed may now be barriers because of stream erosion, mechanical breakdown of the crossings, or changes in the upstream or downstream channel shape.

Fortunately, we have learned how to design stream crossings that allow wildlife unrestricted access to a watershed, maintain natural stream conditions, and help protect roads and property from some of the damaging effects of floods. This booklet is meant to communicate the basis for well-designed stream crossings for fish and wildlife and allow people to evaluate existing crossings to decide whether they should be replaced. Town conservation commissions, highway departments, town engineers, and the public should use this booklet to help protect and restore stream continuity throughout Massachusetts.

Stream Continuity and Natural Communities

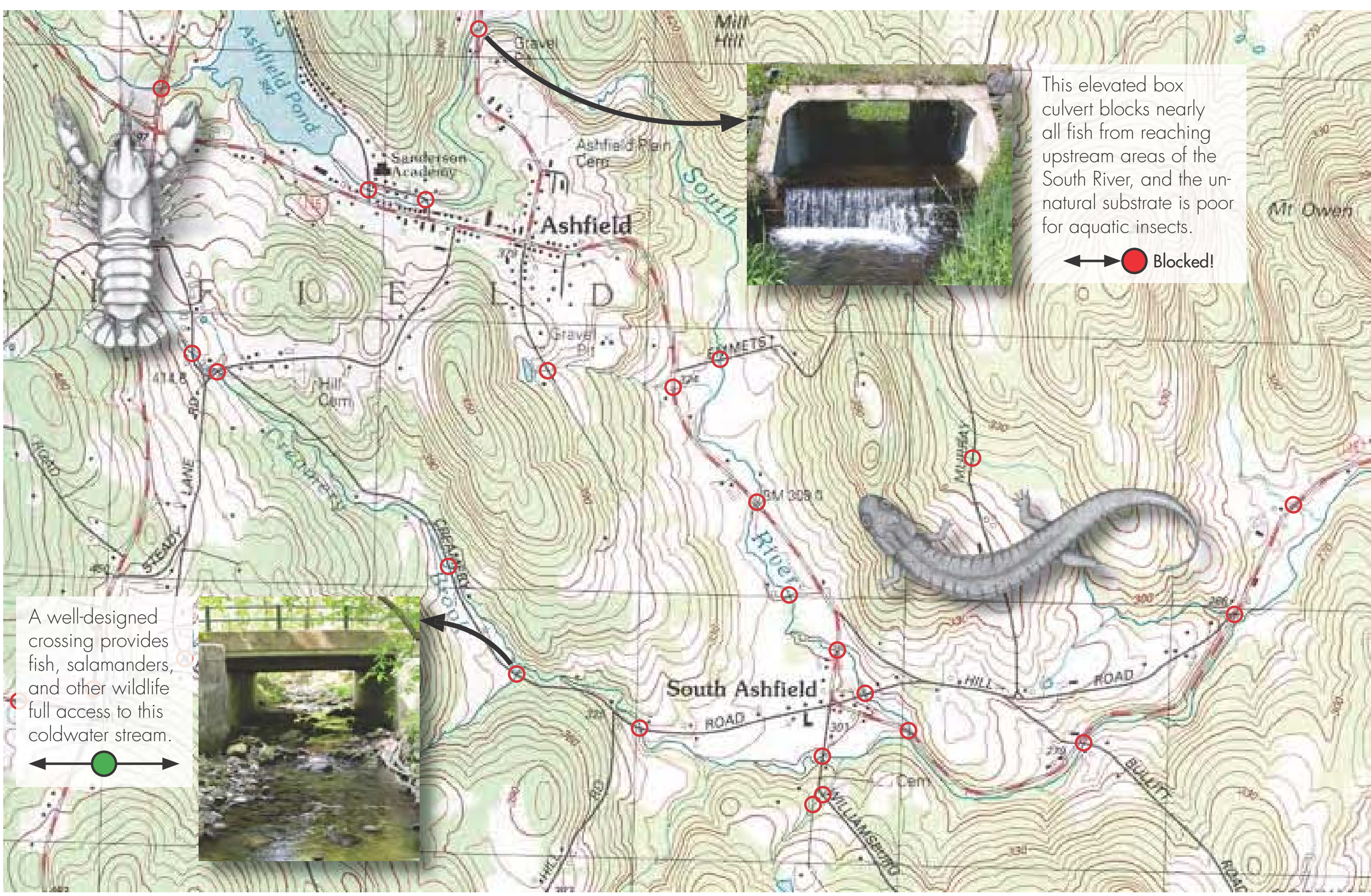
Many species inhabit streams and adjacent forests and wetlands. Effective stream protection requires that we consider the needs of all species including invertebrates such as crayfish and insects, fish such as brook trout and eels, amphibians such as spring salamanders, reptiles such as wood turtles, and mammals such as muskrats and otters. Streams—and the interconnectedness of different parts of a stream or watershed—are essential to these animals. Many riparian animals, such as amphibians and reptiles, are more tolerant of stream discontinuity yet may be affected by road crossings, especially if forced to cross roads where they are vulnerable to traffic and other dangers. For reasons as simple as escaping random disaster or as complex as maintaining genetic diversity, animals living in or along streams need to be able to move unimpeded through the watershed.

Consider the roads you regularly drive to complete your day-to-day tasks. What if the roads you drive on were suddenly permanently blocked so that you could not get to important places? This may sound absurd to us, but this is analogous to what we have done to species that inhabit streams throughout Massachusetts. Through the combined effects of dams and poorly designed bridges and culverts, we have partitioned streams and forced wildlife to cope with our restrictions. Here are a few examples to consider:



snail-case caddisfly

- **Access to coldwater habitats:** Small streams with groundwater seeps and springs provide coldwater refuge during the summer. Species such as brook trout will travel to these areas and congregate there. Fish that can't make it there—perhaps because of barriers we created—may be more susceptible to heat stress and mortality. If barriers restrict the size of a refuge, then animals may be overcrowded and vulnerable to disease, predators, and even anglers.
- **Access to feeding areas:** Different habitats provide different feeding opportunities throughout a day or season, and species regularly travel to exploit these resources. Striped bass and sea-run trout swim up tidal



This elevated box culvert blocks nearly all fish from reaching upstream areas of the South River, and the unnatural substrate is poor for aquatic insects.

A well-designed crossing provides fish, salamanders, and other wildlife full access to this coldwater stream.

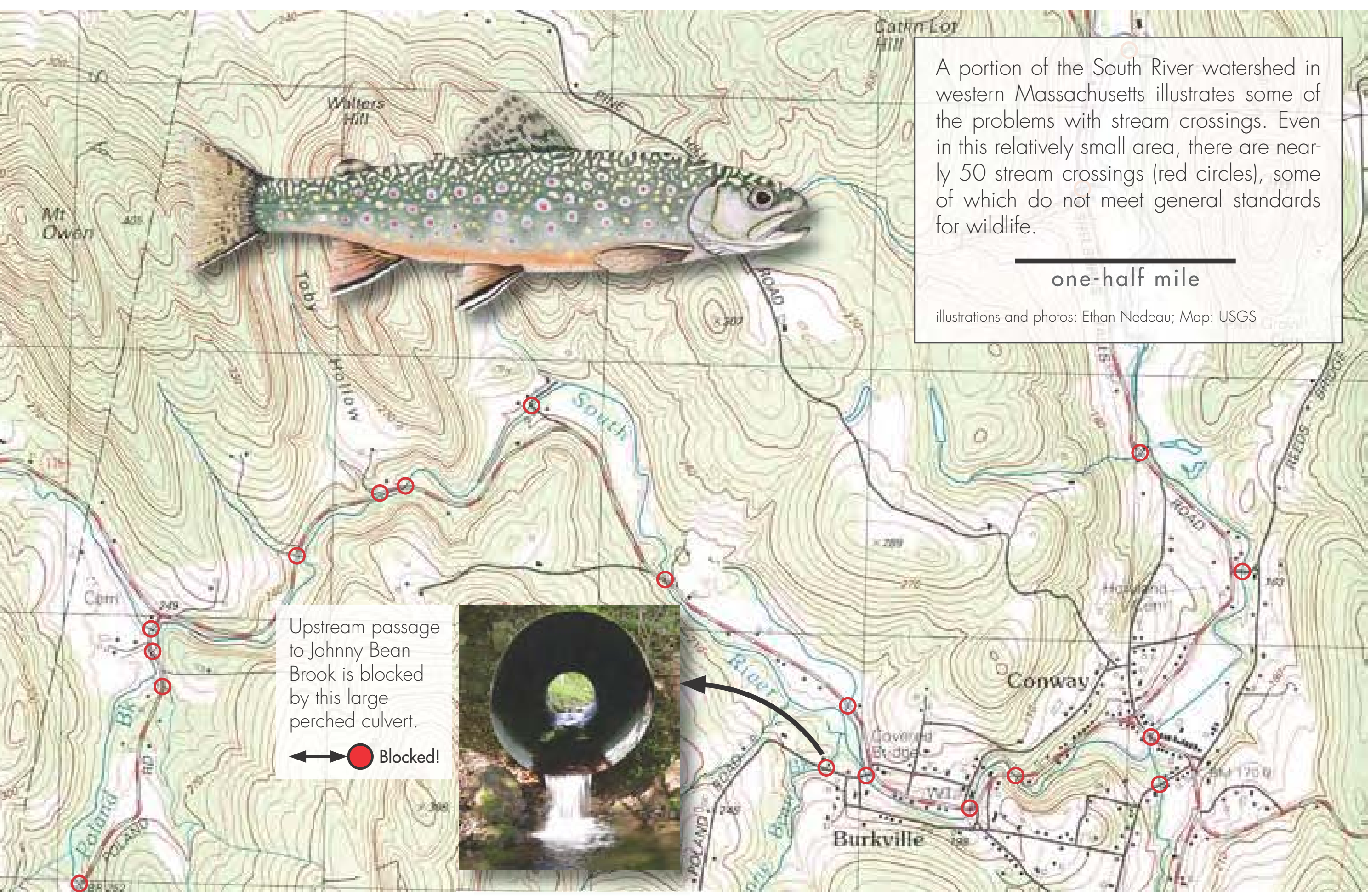
Jane Winn photo

Turtles, salamanders, and other wildlife often must cross roads. Well-designed stream crossings will give them a safer route. This wood turtle can't climb the curb.

creeks to feed during high tide. Insect communities in small ponds and riparian wetlands can be abundant at times, and stream fish will move into these habitats to feed. Restricting access to prime feeding areas will ultimately hurt the fishery.

- **Access to breeding and spawning areas:** Some species need to travel miles to reach spawning areas in streams. The best examples are anadromous species that live in the ocean but spawn in freshwater, such as Atlantic salmon, alewife, shad, lamprey eels, and sea-run trout. Fish may encounter many barriers when adults travel to spawning areas, offspring disperse into juvenile and eventually adult habitat, and juvenile anadromous species swim to the ocean.
- **Natural dispersal:** Some salamanders, turtles and frogs spend most of their lives near streams and travel in and along a stream's length. Poorly designed crossings may force them to climb over an embankment and cross a road, where they are vulnerable to road mortality and predators. Freshwater mussels disperse by having larvae that attach to the fins of a fish, so if a stream crossing blocks fish then it may also prevent upstream dispersal of mussels. If a stream is damaged by a catastrophic event (such as pollution, flooding, or severe drought), then natural dispersal will return the stream to a healthy productive environment.

In addition to effects on wildlife movement, many stream crossings degrade nearby habitat, making conditions inhospitable for some native plants and animals. The effects can be even greater in tidal creeks. By limiting tidal flow, restrictions alter water levels and chemistry, diminish sources of ocean nutrients, and can degrade entire upstream aquatic systems.



A portion of the South River watershed in western Massachusetts illustrates some of the problems with stream crossings. Even in this relatively small area, there are nearly 50 stream crossings (red circles), some of which do not meet general standards for wildlife.

illustrations and photos: Ethan Nedeau; Map: USGS

Upstream passage to Johnny Bean Brook is blocked by this large perched culvert.

Recognizing Problems

Three stream crossing problems—undersized crossings, shallow crossings, and crossings that are perched—can be barriers to fish and wildlife and lead to several common consequences. Recognizing poor stream crossings and their consequences is an important step in evaluating whether crossings should be fixed or replaced.

Right: In Washington state, a chum salmon crosses the road because the stream crossing was blocked by floodwaters.

Harley Soltes/The Seattle Times

STREAM CROSSING PROBLEMS

UNDERSIZED CROSSINGS

Undersized crossings restrict natural stream flow, particularly during floods, causing several problems, including scouring and erosion, high flow velocity, clogging and ponding. Crossings should be large enough to pass fish, wildlife and floods.

SHALLOW CROSSINGS

Shallow crossings have water depths too low for many organisms to move through them and may lack appropriate bed material. Crossings should have an open bottom or should be sunk into the streambed to allow for substrate and water depths that are similar to the surrounding stream.

PERCHED CROSSINGS

Perched crossings are above the level of the stream bottom at the downstream end. Perching can result from either improper installation or from years of downstream bed erosion. Crossings should be open-bottomed or sunk in the bed to prevent perching.

COMMON CONSEQUENCES OF POOR STREAM CROSSINGS

Scott Jackson photo

Low Flow

Low flow is a problem for species movement within the stream. Fish and other aquatic organisms need to have sufficient water depths to move through a stream crossing. Low velocities may lead to stagnant conditions within the crossing.

Causes: shallow crossings, perched crossings

Ethan Nedeau photo

Unnatural Bed Materials

Metal and concrete are not appropriate materials for species that travel along the streambed. The substrate (rocks and other material on the bed of the crossing) should match the natural substrate of the surrounding stream in order to maintain natural conditions and not disrupt the stream continuity.

Causes: shallow crossings, perched crossings

Riverways photo

Scouring and Erosion

In undersized crossings, high water velocities may scour natural substrates in and downstream of the crossing, degrading habitat for fish and other wildlife. High water velocities and related flow alterations may also erode streambanks. Scour pools often develop downstream of perched culverts and may undercut the culvert.

Causes: undersized crossings, perched crossings

Unknown photo

High Flow

Water velocity is higher in a constricted crossing than it is upstream or downstream. This high flow degrades wildlife habitat and weakens the structural integrity of crossings. During floods, undersized crossings may be filled with fast-moving water. Many of the problems with poorly designed crossings are heightened during floods.

Cause: undersized crossings

Scott Jackson photo

Clogging

Some crossings—especially undersized ones—can become clogged by woody debris, leaves, and other material. This may exacerbate the impact of floods and make a crossing impassable to wildlife. Costly, routine maintenance may be required to prevent this problem.

Cause: undersized crossings

Ethan Nedeau photo

Ponding

Ponding is the backup of water upstream of an undersized crossing. It may occur year-round, during seasonal high water or floods, or when they become clogged. Ponding can lead to property damage, road and bank erosion, and severe changes in upstream habitat. It may also create new wetlands that may not be desirable.

Causes: undersized crossings, perched crossings

Scott Jackson photo

Crossing Guidelines

Safe and stable stream crossings can accommodate wildlife and protect stream health while reducing expensive erosion and structural damage. One goal of this booklet is to provide real, easily attainable solutions. Regulations for Massachusetts now require that all new crossings adhere to the stream crossing guidelines presented in this booklet (Army Corps of Engineers Massachusetts Programmatic General Permit, January 2005). We also encourage towns to evaluate existing crossings and consider replacing or retrofitting them.

Crossings should be essentially "invisible" to fish and wildlife—they should maintain appropriate flow and substrate through the crossing and not constrict a stream. At the same time, designs should be efficient and cost-effective. The standards are required for new permanent crossings (e.g., roads, railways, bike paths) on fish-bearing streams and rivers, and must be used as guidelines for upgrading existing crossings. They are applicable but not required in streams that dry out seasonally. Standards are not intended for temporary crossings such as temporary logging roads, or for drainage systems designed to convey storm water or wastewater.

Site constraints may make it difficult to follow these standards. Shallow bedrock can make it impractical to embed culverts, and the road layout and surrounding landscape may make it impossible to attain the recommended standards for height and openness. In those situations, a site assessment will be necessary to determine how to achieve fish and wildlife passage. Site-specific information and good professional judgment should always be used to develop practical and effective crossing designs.

> Regulations for Massachusetts now require that all new crossings adhere to the General Standards presented in this booklet.

All crossings should be designed according to one of two sets of standards: General and Optimum. The two standards balance the cost and logistics of crossing designs with the degree of stream protection warranted in sensitive habitats. Local highway departments and construction professionals have considerable creativity, expertise, and local knowledge that will enable them to design effective crossings. Conservation commissioners have a good understanding of the natural resources in their towns and the level of protection that may be required in certain areas. Thus, standards are written in a way to allow for flexibility.

Stream Crossing Standards

General standards provide for fish passage, stream continuity, and some wildlife passage. All permanent crossings must meet general standards.

Optimum standards provide for fish passage, stream continuity, and wildlife passage. Optimum standards should be used in areas of statewide or regional significance for their contribution to landscape connectedness or in streams that provide critical habitat for rare or endangered species.

STREAM CROSSING STANDARDS

Stream crossing standards are based on six important variables (see page 8 for common measurements). While the specifics of the regulations listed below may change over time, the crossing guidelines presented throughout this handbook remain effective for fish and wildlife.

1. TYPE OF CROSSING

- **General:** Open arches or bridges are preferred over culverts
- **Optimum:** Open arches or bridges required unless there is a compelling reason why culverts would provide greater environmental benefits

2. CULVERTS

- Culverts should be embedded (sunk into stream) at least one foot for box culverts and pipe arches, or at least 25% of the pipe diameter for pipe culverts.
- If pipe culverts cannot be embedded this deep, then they should not be used.

3. WIDTH

- **General:** The crossing should be at least 1.2 times the bankfull width of the stream
- **Optimum:** The crossing should be at least 1.2 times the bankfull width of the stream and should span the banks to allow for dry wildlife passage during at least ten months of the year

4. OPENNESS

- **General:** Openness ratio (cross-sectional area/crossing length) of at least 0.25 meters (m). The crossing should be wide and high relative to its length.
- **Optimum:** Openness ratio of at least 0.5m and minimum height of 4 feet. If local conditions significantly reduce wildlife passage near the crossing (e.g., steep embankments and physical barriers) then the openness ratio should be 0.75m and the minimum height should be 6 feet.

5. SUBSTRATE

- Natural bottom substrate should be used within the crossing and it should match the upstream and downstream substrates. The substrate and design should resist displacement during floods and maintain an appropriate bottom during normal flows.

6. DEPTH AND VELOCITY

- At low flows, water depths and water velocities should be the same as they are in natural areas upstream and downstream of the crossing.

Scott Jackson photo

A Well Designed Crossing

Large size suitable for handling flood flows

Open-arch design considered optimum under most conditions

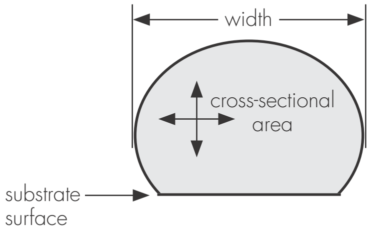
Openness ratio greater than 0.5m, suitable for most settings

Greater than 1.2x stream width maintains dry banks for wildlife passage

Water depth and velocity match conditions upstream and downstream

Natural substrates create good conditions for stream-dwelling animals

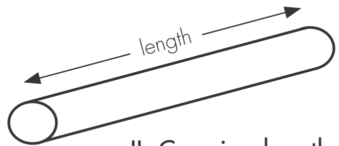
COMMON STREAM CROSSING MEASUREMENTS



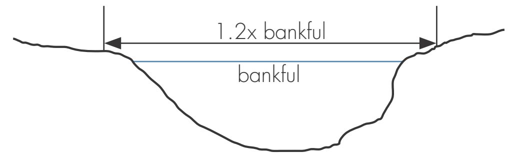
I. Culvert width and cross-sectional area

$$\text{Openness} = \frac{\text{cross-sectional area}}{\text{crossing length}}$$

(all measurements in meters)

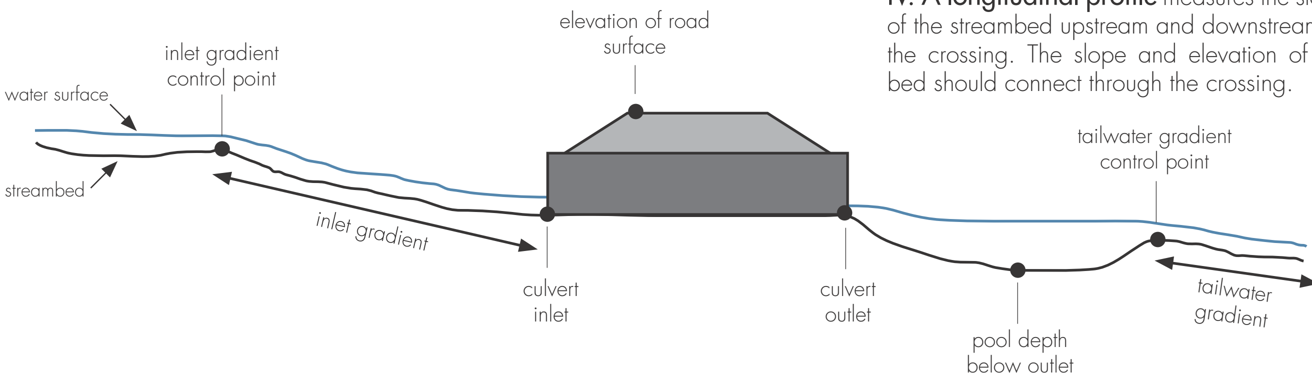


II. Crossing length



III. Stream width

IV. A longitudinal profile measures the slope of the streambed upstream and downstream of the crossing. The slope and elevation of the bed should connect through the crossing.



Replacing or Retrofitting Crossings

Most stream crossings in Massachusetts were designed and installed at a time when the environmental impacts of such crossings were not understood. Even effective—but aged—crossings may need to be upgraded or replaced because they have weathered decades of floods and erosion. Periodic upgrading of bridges, culverts, and roads is often required to keep crossings safe and effective.

Repairing or replacing deteriorated culverts is not always as straightforward as installing a larger pipe. Streams may naturally adapt to problems caused by poorly designed or degraded crossings.

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

The benefits of retrofitting or replacing a crossing should be weighed against the costs of the project and the environmental consequences. If feasible, a culvert should be replaced. Careful analysis—drawing on the expertise of engineers, construction professionals, and conservation commissioners—should consider the following:

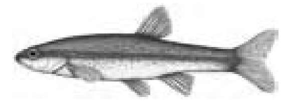
- Potential for downstream flooding
- Effect on upstream, downstream, and riparian habitat
- Potential for erosion, including headcutting (progressive channel erosion upstream of culvert)
- Overall effect on stream stability

When replacement is desirable, the standards for new crossings should be adhered to as much possible. Crossings should be designed to weather a large flood safely. Otherwise, erosion will occur and the crossing will need to be fixed or replaced again. In some cases a retrofit may be more appropriate, leaving the current culvert in place and adjusting the streambed to eliminate perching, or adding bed material inside the culvert to create a more natural streambed.

For a replacement culvert, a longitudinal profile of the streambed, both upstream and downstream of the culvert, should be completed to determine how well the up and downstream streambed slopes and elevations match. If there is a significant difference, there is a potential for significant erosion of the streambed, particularly if the new culvert is larger, and additional considerations will have to be taken in the design.

CASE STUDY

Reconnecting Bronson Brook



Blacknose dace

Double box culvert at Dingle Road (Inter-Fluve Inc. photo)

Perched culvert at Cummington Road (Riverways photo)

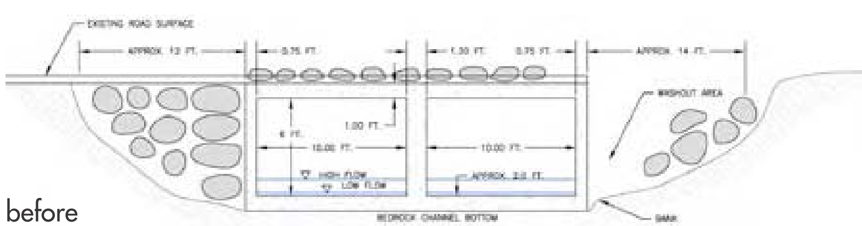
A stream restoration project in Bronson Brook in Worthington, Massachusetts will restore continuity in a high quality coldwater stream by replacing and retrofitting two culverts. A flood in 2003 destroyed the road around the undersized Dingle Road culvert and badly damaged the stream banks; the road has been closed ever since.

The Dingle Road crossing is a double box culvert set on bedrock. The crossing is perched above the streambed about one foot and the flood created a gap in the road around the culvert. A nearby crossing at Cummington Road is structurally sound, but perched about one foot above the downstream pool. River Continuity volunteers identified the Dingle Road and Cummington Road crossings as barriers to wildlife movement and have used these sites as model River Continuity projects.

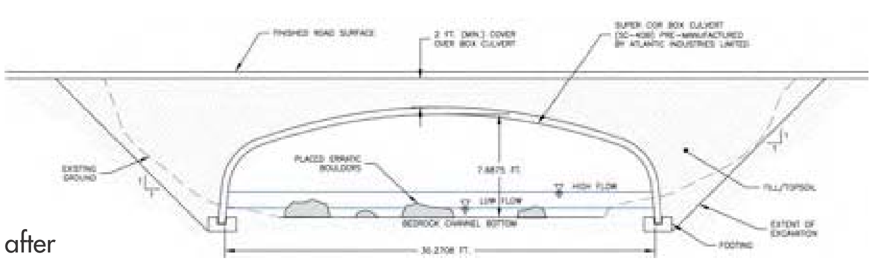
Many local partners are interested in this project because Bronson Brook is an important resource for Eastern brook trout, blacknose dace, Atlantic salmon, and other coldwater species. Partners met to discuss the options and costs and decided that replacement with an open bottom arch culvert was the best choice for Dingle Road. An open bottom arch allows for natural flows through the crossing and reduces the chance of woody material catching and blocking the culvert, thereby reducing the chance of another flood overtopping the culvert.

At Cummington Road, partners decided to retrofit the crossing because it was already large enough to pass flood flows and it was structurally sound. They will build a downstream riffle to raise the water level high enough to eliminate perching, and install retention sills within the culvert to retain natural bed materials. Fish and salamanders won't be the only ones to benefit—the project will ultimately reduce maintenance costs for the town, reconnect access for residential and emergency vehicles, and protect municipal and private infrastructure.

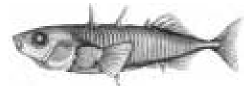
Project partners: Massachusetts Riverways Program, Town of Worthington, Division of Fisheries & Wildlife, Natural Resources Conservation Service (USDA), Westfield Wild & Scenic Committee, Westfield River Watershed Association, The Nature Conservancy, and Inter-Fluve Inc.



The double box culvert at Dingle Road will be replaced with a large open-bottom arch with natural bed materials. The local trout and salmon population can't wait...



CASE STUDY
Tidal Restrictions: Unique Opportunities


Three-spine stickleback


Old tidal restriction before replacement (MA CZM photo)


New box culvert that allows full tidal flushing (MA CZM photo)

Crossings of tidal creeks and salt marshes deserve special consideration because of their unique tidal dynamics and effects on upstream habitats. Crossings that are too small to pass the full tidal range are known as tidal restrictions, and their impacts can be severe. By limiting tidal flow like the choke point of an hourglass, restrictions alter water levels and chemistry, diminish sources of ocean nutrients, and can degrade entire upstream aquatic systems. They often block the passage of fish and other aquatic life into important habitats and create favorable conditions for invasive species such as Phragmites. Installing a larger culvert or bridge restores the natural tidal flow needed to support healthy marsh habitats.

Hammetts Cove, Marion, Massachusetts

The Hammetts Cove site consists of a municipal road that crosses a tidal creek. The creek used to flow through an old pipe that severely restricted the tidal range because it was too small (above left). The restriction caused severe degradation in six acres of upstream salt marsh that was being taken over by invasive species (*Phragmites*), woody trees and shrubs. Assessment at the site included a tidal range survey to measure the tidal cycle upstream and downstream of the culvert. In 2001, town officials partnered with federal and state restoration programs to replace the old pipe with a larger concrete box culvert that was sized to pass the full tidal range. This significantly enhanced tidal flushing to the upstream salt marsh and will restore fish passage, reduce invasive species, and increase native salt marsh vegetation.

Project Parters: Massachusetts Office of Coastal Zone Management, Town of Marion, U.S. Fish and Wildlife Service, Natural Resources Conservation Service, Buzzards Bay Project, Sippican Lands Trust

Conservation Targets

The choice for a crossing design will depend in part on whether a stream has statewide or regional significance for landscape-level connectedness or provides critical habitat for rare or endangered species. In 2001, Massachusetts Division of Fisheries and Wildlife produced *Biomap: Guiding Land Protection for Biodiversity in Massachusetts*. They followed this in 2003 with *Living Waters: Guiding the Protection of Freshwater Biodiversity in Massachusetts*. These publications identify areas that need to be protected to preserve Massachusetts' non-marine biodiversity, and allow local groups to proactively identify conservation targets within their jurisdictions.

Biomap and *Living Waters* defined **core habitat** based on presence of rare plants, rare animals, and exemplary habitats. For each core habitat, they designated a **critical supporting watershed** (or landscape) needed to sustain a core habitat. Detailed town maps and databases that document the presence of core habitats and critical supporting watersheds throughout Massachusetts are available to determine whether a particular location should receive special protection.

When evaluating an existing stream crossing or planning a new one, project managers should coordinate with local conservation commissions.

- **Core habitat**: Optimum standards required
- **Critical supporting watersheds**: Optimum standards strongly recommended; general standards required

Tim Watts photo

Technical Concerns

This document presents minimum needs for fish and wildlife and is not intended to be an engineering design manual. Qualified personnel should carefully consider engineering design and construction techniques for each crossing. Hydraulic analyses are conducted to ensure that a crossing is sufficient for passing floods and will not cause water to scour the streambed or crossing. Structural analyses are necessary to ensure that crossings are safe, particularly for new bridges. For replacement crossings, the slope of the streambed upstream and downstream of the crossing should be compared (known as a longitudinal profile) to ensure that the slope and elevation of the bed connects through the crossing. If it does not connect, excessive streambed erosion can result upstream of the culvert (known as a headcut) or other problems can arise. Qualified consultants can provide technical assistance on all of these issues.

Conclusion

Most Massachusetts citizens agree that protecting the environment, while accommodating a growing population and sustaining the economy, is a priority. The transportation infrastructure is essential to our way of life, and because that infrastructure cuts across natural ecosystems, it is imperative that we find ways to minimize adverse effects on habitats and wildlife.

Stream crossing designs have improved in recent years through the collaborative efforts of engineers, construction professionals, and environmental scientists. Safe and stable stream crossings can accommodate wildlife and protect stream health while reducing expensive erosion and structural damage. Further, federal regulations for Massachusetts require that all new stream crossings meet minimum design standards.

This booklet is intended to raise awareness about stream crossings and river continuity, and to introduce new standards for stream crossings. Qualified personnel can provide guidance on technical considerations that this booklet does not address (see left). By adhering to the crossing standards in the *Massachusetts Stream Crossings Handbook*, town conservation commissioners, highway departments, and town engineers can play a vital role in protecting and restoring stream continuity in Massachusetts.

Getting More Information

Technical Guidance and Assistance

The Stream Continuity website, maintained by UMass Extension, has up-to-date guidelines and crossing standards and information on crossing problems, the ecological importance of river continuity, and further resources. Staff at the Massachusetts Riverways Program are also available to provide suggestions and guidance to improve fish and wildlife movement through stream crossings.

When dealing with a coastal tidal restriction, please contact the Massachusetts Wetlands Restoration Program (WRP) in the Office of Coastal Zone Management. Many sources of assistance and funding are available. For more information, contact WRP at:
Phone: 617-626-1200
Email: wetlands.restoration@state.ma.us

Further Reading

Barbour, H., T. Simmons, P. Swain, and H. Woolsey. 1998. Our Irreplaceable Heritage: Protecting Biodiversity in Massachusetts. Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife, and Massachusetts Chapter of The Nature Conservancy. Boston, MA.

Natural Heritage and Endangered Species Program. 2001. Biomap: Guiding Land Conservation for Biodiversity in Massachusetts. Massachusetts Division of Fisheries and Wildlife, Westborough, MA.

Natural Heritage and Endangered Species Program. 2003. Living Waters: Guiding the Protection of Freshwater Biodiversity in Massachusetts. Massachusetts Division of Fisheries and Wildlife, Westborough, MA.

Washington Department of Fish and Wildlife. Design of Road Culverts for Fish Passage (web-based document) www.wdfw.wa.gov/hab/engineer/cm/culvert_manual_final.pdf

Web Sites

Stream Continuity - UMass Extension
www.streamcontinuity.org

Massachusetts Riverways Program
www.massriverways.org

Massachusetts Natural Heritage and Endangered Species Program
www.mass.gov/dfwele/dfw/nhesp/nhesp.htm

Massachusetts Office of Coastal Zone Management
www.mass.gov/czm/

Massachusetts Division of Fisheries and Wildlife
www.masswildlife.org

Massachusetts Wetlands Restoration Program
www.mass.gov/czm/wrp/