Maintaining the Integrity of River and Stream Ecosystems with the Massachusetts River and Stream Continuity Partnership

Overview

Maintaining the integrity of river and stream ecosystems is critical to aquatic organism and wildlife passage and climate resilience, as these resources provide buffering from extreme weather events and strengthen habitat connectivity allowing aquatic species to move within a watershed as they adapt to changing climatic conditions. Massachusetts is enhancing ecosystem connectivity across the State by instituting practical and effective road stream crossing designs and identifying areas for protection through the River and Stream Continuity Partnership.

Program Partners: Massachusetts Department of Environmental Protection (MassDEP), Massachusetts Department of Fish and Game (DFG), UMass Extension, others

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Background

Increasing storm severity and flooding incidence, coupled with on-going development activities, due to climate change presents challenges for stream hydrology and the conveyance of flood waters. Preserving aquatic connectivity under these conditions is critical for maintaining long-term ecosystem health and processes; as manmade barriers (bridges, culverts, road crossings, etc) often lead to ecosystem fragmentation, decreased organism mobility, and the disruption of key ecosystem functions. In 2000, a variety of State agencies and organizations concerned about the impact of road stream crossings on fish and other aquatic organism passage came together to create the Massachusetts River and Stream Continuity Partnership (RSCP). The goal of the RSCP is to construct transportation infrastructure that does not fragment or undermine the ecological integrity of the land, as well as improve the connectivity of terrestrial and aquatic habitats so species can migrate as the climate changes. Inspired by Massachusetts' stream continuity work, expert partners throughout thirteen states and various organizations formed the North Atlantic Aquatic Connectivity Collaborative (NAACC) in 2015 to address aquatic connectivity on a regional scale.

The Massachusetts River & Stream Continuity Partnership (RSCP)

Under the RSCP, the State has successfully updated their River and Stream Crossing Standards, implemented a volunteer stream crossings assessment program, and assisted municipalities with projects to upgrade or replace deficient structures.

Massachusetts River and Stream Crossing Standards: In a participatory effort, RSCP developed new performance standards for culverts and other stream crossing structures, as well as tools to prioritize where crossings should be replaced. The goal of the revised standards was to facilitate river and stream continuity, as well as fish and wildlife passage, while considering the impacts of climate change in new culvert and stream crossing designs. RSCP partners referred to information on fish and wildlife passage requirements, culvert design, and methods for evaluating barriers to develop the standards. Two levels of the standards were established for the replacement of existing crossings-a general and more stringent optimum standard that allows for greater passage of all wildlife. However, new crossings must fully meet the optimum standards.

Although regulators have flexibility in the stringency of adoption for replacement crossings, the revised performance standards set a minimum criterion for achieving wildlife passage and water resource continuity. For the optimum standard, Massachusetts proposed a stream simulation approach- a whole ecosystem method focused on maintaining habitat variety and quality, connectivity, and natural ecosystem processes. Structure design under both levels of the standards must consider channel type and long profile, and account for variability over the

life of a structure. The U.S. Army Corps of Engineers' Massachusetts General Permit and the Massachusetts 401 Water Quality Certification require that the stream crossing standards be met. The 2014 updated State Wetlands Protection Act regulations additionally require all new stream crossings to meet the revised performance standards, and to the maximum extent practicable for replacement crossings.

Massachusetts further stresses that structure design be based on sound engineering and, to the extent possible, account for the potential effects of climate change on future storm characteristics (e.g., more intense and frequent precipitation) and stream hydrology over the life of the structure. Recent studies have shown these structures to be more resilient than traditionally designed structures to the potential effects of climate change. The Northeast Regional Climate Center and Natural Resource Conservation Service provide a web-based tool for extreme precipitation analysis to consider future flow changes, which is used by DEP to reference regional extreme rainfall maps as precipitation events are a critical component of structure design.

Massachusetts developed tools to help consistently identify where habitat must be protected and prioritize stream crossing improvements. The Conservation Assessment and Prioritization System (CAPs) produced the first statewide assessment of ecological integrity. CAPs evaluates and compares the impacts of development projects on habitat conditions, and examines the potential benefits of conservation or restoration actions. The maps generated by CAPs are used by the Critical Linkages Project (CLP) to detect areas of high connectivity value and where the optimum standards should be applied. Building upon CAPs, CLP assesses the connectivity restoration potential for culvert replacements, dam removals, and construction of passage structures. By generating an "Aquatic Connectedness" score, CLP pinpoints the best opportunities to improve aquatic connectedness and restore landscape connectivity. Managers can use these tools to ensure the most critical crossings are replaced to meet the performance standards, and prioritize projects in key habitat connectivity areas.

The Stream Crossing Assessment Protocol and Volunteer Training: The NAACC developed a unified field protocol for the volunteer assessment of stream crossings, including data forms, instructions, and training materials. The Scoring Stream Road Crossings document explains the rapid assessment method for evaluating aquatic passage at road stream crossings for a wide range of river and stream organisms. A system for scoring crossing structures by their effects on aquatic continuity and organism passage, based on the volunteer assessments, is also outlined. Mapping the "aquatic passability scores" can help identify which crossings are minor or major barriers. The data collected by the surveys are now stored and georeferenced in an online database.

DER provides workshops and other educational materials to help explain the concept of ecological continuity and the State standards. DER offers training to local, watershed, and regional groups to assess and determine the location and extent of mobility barriers. The *Stream Crossing Handbook* and Poster are designed to provide guidance and educate local decision makers on the importance of properly designed stream crossings. In support of the State's sound engineering design requirements for culverts and bridges, the *Handbook* includes guidelines describing minimum goals for fish and wildlife passage (besides other design concerns) to ensure structural stability and effective passage of flood waters. The *Handbook* has been a useful resource for town governments while permitting, designing and maintaining stream crossings.

DER's Stream Continuity Program is helping municipalities replace undersized, unsafe culverts with those that improve stream connectivity, fish and wildlife access, and storm resilience. They are presently working with communities to develop a culvert engineering and design, permitting, and construction Toolkit to help municipalities meet the State standards. Toolkit elements include Request for Proposals and Scopes of Work for culvert replacement projects. Trainings for local road managers are held in conjunction with a suite of culvert replacement case studies throughout the State. Town road managers partnering with DER on these Long-Term Culvert Replacement Training Projects receive intensive technical assistance and incentive grant funding, and in turn agree to offer trainings and serve as culvert replacement mentors to surrounding towns. The Program also provides general technical assistance to municipalities for engineering, design, and construction of replacement culverts for meeting upgraded design criteria.

Incorporating Climate Change into the Continuity Effort: Massachusetts contributed to the development of NAACC's Climate-Friendly Stream Crossings Toolkit that outlines key steps for addressing aquatic connectivity and considering climate adaptation during infrastructure redesign. The Toolkit offers a variety of educational and informational materials for diverse audiences, such as a short video explaining the importance of climate-friendly culverts. A key piece of the Toolkit provides guidance on tools and approaches for assessing vulnerability of stream crossing structures due to flooding and structure failure. Vulnerability assessments can also be overlaid with fish passage analyses to identify sites where structure replacement can result in multiple benefits.

Moreover, DER has conducted several studies to evaluate and quantify the economic and community benefits produced by the Division's restoration and stream barrier removal projects, as well as the economic benefits of four ecosystem services enhanced by DER projects. The latter study found that restoring aquatic habitats and the services they provide – flood protection, improved water quality, climate change mitigation, and increased landscape appeal – can generate significant economic value. DER has also initiated demo projects to mitigate known barriers on high-priority streams, and designed a new tool to assess the Green House Gas impacts of restoration projects.