*The Commonwealth of Massachusetts*
*Executive Office of Energy and Environmental Affairs*
*100 Cambridge Street, Suite 900*
*Boston, MA 02114*

Deval L. Patrick
GOVERNOR

Timothy P. Murray
LIEUTENANT GOVERNOR

Ian A. Bowles
SECRETARY

Tel: (617) 626-1000
Fax: (617) 626-1181
http://www.mass.gov/envir

Dear Friends of the Environment,

I am very excited to release a document that renews the Executive Office of Energy and Environmental Affairs' commitment to restoring riverine flows and aquatic habitat in the Commonwealth of Massachusetts.

Massachusetts has over 3,000 dams; the Blackstone watershed has the highest density of dams in the country. Our State is also blessed with rich natural resources and many species of plants and fish that are unique to our rivers and streams. While many of the dams provide important benefits in the form of water supply, flood control, and hydropower, many other dams are no longer serving the purpose for which they were built, but remain as decaying relics of our industrial past. They create ecological and hydrological hurdles. Dams that have served their life and are no longer functional need to be removed. That removal can be a win for everyone. It can restore rivers and streams to the vibrant, robust, complex habitats they once were; help revive fisheries that, because of dams, have been cut off from their historical spawning grounds; eliminate public safety hazards; and relieve owners of unwanted liability.

This guidance document will help dam removal proponents maneuver through the initial conceptualization of the project, the feasibility studies, the permitting process and the funding avenues with greater ease and clarity.

Sincerely,

Ian A. Bowles
Secretary

# Table of Contents

ACKNOWLEDGEMENTS ..... 1

PREAMBLE ..... 2

DAM REMOVAL IN MASSACHUSETTS ..... 2

GENERAL STEPS FOR DAM REMOVAL ..... 3

INITIAL RECONNAISSANCE ..... 6

FEASIBILITY STUDY ..... 8

WORKING WITH THE COMMUNITY ..... 11

FINAL ENGINEERING DESIGN ..... 13

PERMITTING DAM REMOVAL ..... 14

PROJECT IMPLEMENTATION AND CONSTRUCTION ..... 19

APPENDIX A: FREQUENTLY ASKED QUESTIONS ..... 21

APPENDIX B: FUNDING SOURCES FOR DAM REMOVAL ..... 23

APPENDIX C: FINDING ADDITIONAL ASSISTANCE ..... 26

APPENDIX D: FEDERAL CONSISTENCY REVIEW ..... 27

# Acknowledgements

The Executive Office of Energy and Environmental Affairs (EOEEA) is very grateful to the following people for providing unique insights to the issues, problems and challenges facing dam removal proponents in Massachusetts, and for providing potential solutions. We would also like to thank the many federal and state regulatory agencies for streamlining their internal processes and providing greater clarity on when their respective permits are required and what proponents need to submit.

Alison Bowden, The Nature Conservancy
Ariana Johnson, Department of Conservation and Recreation
Ben Lynch, Department of Environmental Protection
Brian Graber, American Rivers (formerly Department of Fish and Game)
Charles J. Katuska, Environmental Resources Management
David J. Cameron, Tighe and Bond
David Mendelsohn, Federal Emergency Management Agency
Deerin Babb-Brott, Massachusetts Environmental Policy Act
Deirdre Desmond, Department of Environmental Protection
Ed Bell, Massachusetts Historical Commission
Ed Reiner, US Environmental Protection Agency
Eric Hutchins, National Oceanic and Atmospheric Administration
Gerard Kennedy, Department of Agricultural Resources
Hunt Durey, Coastal Zone Management
Jack Buckley, Department of Fish and Game
Jenny Outman, Joint Committee on Environment, Natural Resources and Agriculture
Jessica Nordstrom, Senator Pacheco's Office
Jim MacBroom, Milone and Macbroom
Joan Kimball, Department of Fish and Game
Karen Adams, U S Army Corps of Engineers
Kathleen Baskin, Executive Office of Energy and Environmental Affairs
Ken Chin, Department of Environmental Protection
Laura Wildman, American Rivers
Lealdon Langley, Department of Environmental Protection
Leo Roy, Vanasse Hangen Brustlin, Inc.
Linda J. Orel, The Nature Conservancy
Lisa Rhodes, Department of Environmental Protection
Mark Mitsch, Weston and Sampson
Mark Primack, Wildland Trust
Mark Smith, The Nature Conservancy
Michael Armstrong, Department of Fish and Game
Michael Stroman, Department of Environmental Protection
Mike Misslin, Department of Conservation and Recreation
Nicholas Vontzalides, Department of Conservation and Recreation
Nicholas Zavolas, Massachusetts Environmental Policy Act
Paul Diodati, Department of Fish and Game
Sara Cohen, Department of Conservation and Recreation
Scott Soares, Department of Agricultural Resources
Shannon Ames, Senator Resor's Office
Stephanie Lindloff, American Rivers
Steve Pearlman, Neponset River Watershed Association
Steven Lipman, Department of Environmental Protection
Tim Purinton, Department of Fish and Game
Tim Smith, Coastal Zone Management
Vandana Rao, Executive Office of Energy and Environmental Affairs
William Gillmeister, Department of Agricultural Resources
William Salomaa, Department of Conservation and Recreation

A very special thanks to the Riverways Program staff at the Department of Fish and Game for their active involvement in dam removal across the state. Their technical expertise and key insights have been very instrumental in shaping this document. Also, many thanks to them for all the photos.

# Preamble

The Executive Office of Energy and Environmental Affairs (EOEEA) is committed to restoring natural river ecology, re-establishing river continuity, and maintaining public safety, while avoiding inadvertent or adverse impacts to important natural and cultural resources. EOEEA considers the removal of out-dated dams – dams whose negative impacts outweigh their benefits – to be a critical mechanism in achieving these goals. EOEEA, through its agencies, aims to make the dam removal process predictable and easy to understand. It is the intent of this document to provide guidance for the removal of dams that are dilapidated and no longer functional. For the most part, these would be smaller dams or run-of-river dams that impede the flow of water and obstruct habitat, and no longer provide significant benefits. This guidebook informs the public of what the removal of a dam entails, the process, parameters to be considered, permits required, funding available, and constituents involved. The guidebook also distills some of the national and local experience in dam removal to help achieve projects that restore the environment and protect infrastructure.

# Dam Removal in Massachusetts

Dams, in many forms, have been a part of our communities for centuries. By 1880, the six New England states had one third of the nation's water power, even though New England represents only two percent of the nation's land area. In Massachusetts, more than 3,000 dams dot the landscape, some of them originally built in the 17th to the 19th centuries to provide mechanical power for mills. Some dams represent significant achievements in the history of technology and engineering, or are important character-defining elements of historic areas. Yet, today, many of these dams no longer serve their originally intended purpose. Power is no longer generated from the majority of these small facilities, and most of the water-powered mills were abandoned or modified to use more modern power sources. Many dams are in varying stages of disrepair and in need of significant repair and maintenance to meet modern dam safety standards. Other dams are so dilapidated or have been so heavily modified or repeatedly replaced that they no longer retain their historical characteristics. While some dams continue to provide important societal benefits, such as hydropower, flood control, water supply, infrastructure support, or historical value, many others no longer provide the service for which they were constructed, but nevertheless remain in our rivers and streams. The placement, maintenance, and replacement of dams affect river flows, fish passage, and transportation upstream and down.

Dams also have had a tremendous impact on the ecology of our state's rivers and streams. Dams, big or small, generally impede the flow of water and obstruct the continuity of a riverine system. They also decrease oxygen levels in the water, obstruct the downstream movement of silt and nutrients, change river bottom characteristics, and alter the timing and quantity of river flow. Dams can cause river flow to slow down, allowing water temperatures to increase. This, in turn, can alter the fish populations living in streams or rivers. Also, many of the dams that are in a dilapidated condition and in need of repair are an economic burden on their owners. Dams can also be public safety hazards, causing sudden release of water to flow downstream thus causing flooding, bank erosion, property loss, and serious injury, and death. More and more dam owners are deciding that the cost and liability of owning an aging structure outweighs the benefits and are considering removing their structures. If managed well, removing a dam can benefit multiple interests by restoring ecosystem health, improving public safety, providing new recreational opportunities, and relieving a dam owner's economic burden.

However, evaluating infrastructure concerns, completing the best project for the environment, and navigating through the regulatory process, can make completing a dam removal project a daunting task for most project proponents. The Executive Office of Energy and Environmental Affairs (EOEEA), the Riverways Program in the Department of Fish & Game, and a multi-stakeholder task group of state and federal regulatory agencies, non-governmental organizations, and other river restoration practitioners, have collaborated in preparing this guidebook for dam removal project proponents to help organize and explain the process that goes into considering and implementing a dam removal project.

# General Steps for Dam Removal

The following lists the general steps in a dam removal project. These steps are intended to be very general because every dam removal process will have site-specific engineering, environmental, and community issues that may cause the process to differ. In some cases, not all of these steps will be necessary. Evaluate each step presented here to determine if it is necessary for your project. Also, these steps do not always conform to a set order. For example, stakeholder and pre-permitting meetings may need to be held earlier in some cases.

Prior to considering removal of a dam, there are certain things that one must consider. Does the dam currently serve any purpose or provide any benefits, such as:

- Power generation;
- Flood control;
- Recreation from the impoundment such as fishing, boating, swimming, etc.;
- Water supply or irrigation;
- Road, rail, or other utility crossing;
- A significant historic structure with integrity of materials, important design or technology elements, or which contributes importantly to the historical setting and character of the site or the area.

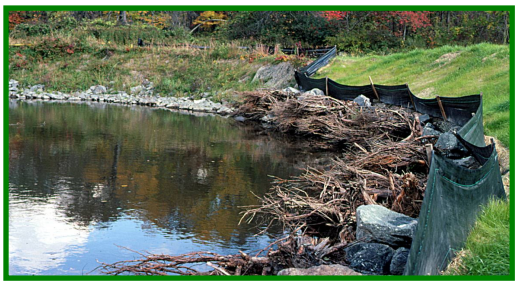
If the answer to the above is no and the dam no longer performs its originally intended purpose then it may be ripe for removal. Conversely, if the owner of a dam is interested in removal of the structure or if maintenance of the dam in perpetuity for these purposes is expensive, the structure could be ripe for removal.

While different projects have different timeframes, in general, expect projects to take two-and-a-half to three years from conception to completion: Year one for planning, feasibility, and pre-permitting; Year two for engineering design and permitting; Year three for implementation.

The following are steps that would be required in a typical dam removal project.

1) Initial Reconnaissance – determine breadth and scope of project

- Determine approximate dam age and history of modifications
- Determine dam owner and point of contact
- Determine current uses and legal rights associated with the dam and impoundment
- Assess land ownership around the impoundment and the dam structure
- Identify potential infrastructure impacts: utilities, roads, bridges, etc.
- Determine if the dam, impoundment, or adjacent land are in rare species habitat based on Natural Heritage and Endangered Species Program maps
- Determine potential "hooks" for funding possibilities – particularly, will the dam removal restore passage and habitat for anadromous species or for sportfish
- Assess historical land use to gauge sediment quality
- Assess community interests/concerns associated with potential impacts to water supply, flooding, recreation, historic, habitat



2) Site Visit and Planning Meeting

- Conduct a site visit with project proponent, dam owner, local, state, and federal agencies to plan next steps

3) Fundraising (See Appendix A for details)

- Develop a fundraising strategy and a list of potential grant sources
- Gather letters of support
- Apply for funding

4) Feasibility Study – assess scientific and engineering challenges and conceptual approaches

- Collect existing data
- Survey and map the site to prepare scaled plans and elevation drawings showing existing conditions
- Assess sediment quantity, quality, and mobility
- Assess hydrology and hydraulics
- Develop conceptual plans for:
  - Removal or modification of structures
  - sediment management
  - channel and riparian habitat restoration
- Analyze other site-specific issues such as utilities, infrastructure, wetland impacts, rare or endangered species, known historic or archaeological sites
  - Determine if the dam, impoundment, or adjacent land includes properties in the Inventory of Historic and Archaeological Assets of the Commonwealth by conducting research at the office of the Massachusetts Historical Commission (MHC)
  - Consult with the local historical commission (and local historic district commission if the project is within a local historic district) for information about properties in the proposed project area that may be historic but not yet included in the MHC's Inventory, and to begin to consider any local historical values. [Note: Almost every town government in Massachusetts has a local historical commission; the local commission is not the same as the local historical society (which is usually a private, non-profit organization).]
- Determine which federal, state, and local permits will be required and complete calculations necessary for those permits
- Pre-project monitoring
  - Gather and measure pre-project information on water quality, geomorphology, and ecology
  - Photograph the site extensively
- Develop cost estimates
- Develop conceptual drawings of proposed project approaches

5) Working with the Community

- Stakeholder/community meeting(s)
  - Meet with abutters and other stakeholders to review alternatives and seek to obtain local support for a preferred alternative
  - Community visioning and planning
- Pre-permitting meeting(s)
  - Contact and if possible, meet with local, state, and federal planners and environmental regulators, dam safety officials, and local historical commission and local historic district commission to clarify and confirm regulatory review requirements if necessary, and any additional information requirements needed by the agencies.

6) Final Engineering Design

- Develop engineering design plans for the preferred alternative, which may propose modification, or dam removal and stream restoration
- Develop Project Specifications that specify necessary construction equipment, material specifications and quantities, project sequencing, staging areas, and site access
- Provide an Engineer's Cost Estimate for construction

7) Permitting

- File all regulatory permits
- Attend public hearings
- Address public and regulatory agency comments and permitting conditions

8) Project Implementation and Construction

- Hire contractors
- Drawdown impoundment
- Address impoundment sediments as necessary
- Remove dam structure
- Stream channel restoration
- Impoundment revegetation

The following pages describe many of the above steps in more detail.

# Initial Reconnaissance

The initial reconnaissance phase is intended to determine the overall breadth of the project and the likely project challenges. At this phase, determine whether the project is simple and straightforward; or very complex, requiring such things as extensive community outreach, contaminated sediment remediation, and comprehensive environmental impact studies. Consider how each of the issues below will affect the cost and scale of the project.

### Dam and Land Ownership

- Determine the date of construction and history of repairs and modifications of the dam through research and consultation with a civil engineer and other expert consultants. Sometimes historical engineering drawings can be located which can provide important information for project planning and design.
- If the dam owner is not the project proponent, determine the dam owner and, if necessary, a point of contact for the dam owner. This may sound like a simple step, but in some cases dams have been abandoned for decades or land owners do not realize that they own dams. If the dam owner does not express an interest in or objects to removal, or is not under a dam safety order to repair or remove the dam, then the project will be challenging or even impossible to complete. Many dam owners will express interest in dam removal due to economic, liability, or even environmental reasons. Some simply no longer want the long-term responsibility of repairing and maintaining their structure.
- Preliminarily assess land ownership around the impoundment and the dam structure. Dam impoundments with abutting residential backyards, public beaches, and motorboats will be much more challenging community outreach efforts than dam impoundments entirely under the ownership of one entity that is interested in removal.

### Dam Uses

- Determine if the dam and impoundment are currently serving any purpose that will necessitate replacement of the use. Most dams in Massachusetts no longer serve the purpose for which they were designed, but many do provide important functions. Dams that provide water supply, hydropower, flood control, road, rail, or other utility crossing, are much less viable dam removal projects than those structures that do not provide these services. In some cases, these purposes can be replaced by other means. If the dam is a historically significant structure (for its important design or technology, or which contributes to the historical setting of the site or the area, but has not been so severely altered as to have lost its historical integrity), sensitive in-kind repair of the structure, or modifications that do not adversely affect its historical characteristics may be a feasible alternative to dam removal or replacement.

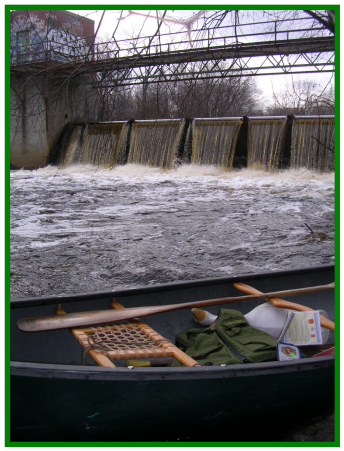
### Infrastructure

- Identify any potential infrastructure that could be impacted by dam removal. For example, if bridges cross any portion of the impoundment or downstream of the dam, an assessment will need to be made of potential scour during the feasibility study. In some places, water and sewer pipes or telecommunication cables cross through dams or through the impoundment and alternatives will need to be assessed for protecting or moving them. Some dams are attached to mill buildings or retaining walls, requiring a stability assessment during the feasibility phase.

### Rare Species

- Determine if the dam, impoundment, or adjacent land are in priority or estimated habitat for state listed species, based on maps published by the Natural Heritage & Endangered Species Program. If these habitats are present, projects can only proceed through close consultation with state and federal biologists.

### Sediment Quality



- Preliminarily assess the potential for contaminants trapped behind the dam by considering current and past upstream land uses such as industrial activity and road density. Information on water and sediment quality in the river may also be available from past environmental studies. Analyzing a sediment sample may even be useful at this reconnaissance phase, to understand the breadth of the project if other assessments are insufficient to determine the probability of contamination. The sample should be taken from the fine-grained portion of the impounded sediment and analyzed at a lab for heavy metals and organic constituents. Sediment screening standards are available from the Department of Environmental Protection. The need for contaminant cleanup can significantly increase project complexity and cost.

### Community Concerns

- Preliminarily assess potential community interests and concerns. Is the impoundment currently used for recreation? Is there an opportunity for a park or canoe access following dam removal? Is the dam structure an important historic resource for the site, neighborhood, or town? Have other parties expressed an interest in contributing to the long-term maintenance and liability of the dam structure?

### Funding Possibilities

- Determine potential "hooks" for funding possibilities. Foundations and agencies that provide grants for river restoration and dam removal have different interests. Some provide funds for projects that help anadromous fish such as herring or salmon or for other sportfish such as trout. Others will provide funds for private landowners working to improve habitat on their land. Based on these "hooks" some projects can be almost entirely funded by outside sources, while others will receive very little outside funding. With overall project costs typically in the hundred thousands, this is a critical first step.

The Riverways Program at the Department of Fish and Game can help provide technical assistance for evaluating site-specific reconnaissance issues.

# Feasibility Study

The feasibility study provides concept-level plans and quantitative information on environmental and engineering feasibility necessary to make final decisions on the project approach. The feasibility study can be extensive or minimal depending on the breadth of work identified during initial reconnaissance.
In some cases, the feasibility study can be part of the final engineering design. In most cases, it is done separately to allow for changes that may be necessary after consulting with regulators.

In Massachusetts, feasibility studies have cost between $15,000 and $145,000. In the simplest cases, projects have proceeded directly to engineering design without a separate feasibility study. However, in most cases, local, state, and federal agencies will require a good-faith effort to consider project alternatives that would avoid, minimize, or mitigate environmental impacts, including a no-action alternative.

## Selecting Effective Consultants

Typically feasibility studies are conducted by environmental consultants, and the choice of the consulting team is critical to project success. Because dams are in dynamic riverine environments and multidisciplinary issues such as sediment management, habitat restoration, and infrastructure protection must be addressed, a multidisciplinary consulting team is needed. There is always much more to a dam removal project than just removing a concrete structure. At a minimum, the consulting team must have expertise in engineering, environmental permitting, ecology, and fluvial geomorphology. This combination of skills is very rare in traditional environmental consulting and engineering firms. *Therefore, traditional engineering firms that lack some of these skills should expect to subconsult with a firm with specific river restoration experience or other required technical expertise*. An effective consulting team can greatly smooth the process, as regulators expect to see an understanding of all of these multidisciplinary issues in the analysis and design.

## Scoping the Feasibility Study

The feasibility study typically includes analyses necessary to develop alternatives for removing the structure, protecting infrastructure, restoring instream and riparian habitat, and managing sediment. While every case is site-specific, below are some general items that are frequently included in the feasibility study scope of work. Note that not every step is necessary for every project and a site-specific evaluation must be completed:

1) **Data Collection.** Collect and synthesize all available existing data on the dam, the river, and the surrounding landscape. These could include archival records of local, state, and federal agencies for existing maps and plans, past dam inspection reports, FEMA flood mapping, air photos, historic maps and photographs, fisheries data, planning department reports, and utilities mapping.

2) **Survey and Base Mapping.** A site survey by a professional is necessary to create a scaled topographic base map showing existing conditions to provide information necessary to assess engineering conditions and deficiencies, hydraulics and sediment management. In order to completely survey the site, the surveying team must get in the water! The surveying should include:
    a. topographic plans and cross section drawings of the river and adjacent land, cultural (the dam, roadways, buildings, utilities, etc.) and geographic features in the impoundment, downstream and upstream,
    b. a survey of the deepest part of the stream through the impoundment, downstream, and upstream (longitudinal profile),
    c. a survey of the impoundment bottom and the depth of soft sediment throughout the impoundment (bathymetry and depth to refusal),

d. a delineation and survey of the resource areas that will be affected as required in the Wetlands Protection Act and Army Corps of Engineers regulations, including: Land Under Water, Bordering Vegetated Wetland, Riverfront Area, Mean Annual High Water Line (or Ordinary High Water Line), and Bordering Land Subject to Flooding.

3) **Sediment Management Plan.** Quantitatively assess sediment quality and quantity. Develop a conceptual plan to manage sediment movement. Fundamental to this analysis is determining what portion of the sediment will transport downstream as a result of different management approaches. The consulting team must know how to complete this type of analysis and it is integral in the decision of who to hire for the work.

4) **Hydrology and Hydraulics Assessment**. Hydrology involves assessing the volume and frequency of flows in the river. Hydraulics involves assessing the velocity, scour potential, and depths of these flows. Assessing both is critical to determining how effectively the dam removal will allow for aquatic species passage; to assess potential flood impacts; and to assess potential impacts to surrounding infrastructure.

5) **Channel and Riparian Restoration Plan**. Assess alternatives for the structure and habitat within the stream channel and on exposed land in the former impoundment. This may include assessing whether the site will provide fish passage and should provide alternatives for habitat improvements.

6) **Fisheries**. Consult Division of Marine Fisheries when the dam removal involves an anadromous or catadromous fish run. Additionally, consult Mass Wildlife (Division of Fisheries and Wildlife) when the dam removal involves a coldwater fisheries resource or waterfowl breeding or feeding habitat; and in the Merrimack and Connecticut watersheds, when dam removal involves anadromous or catadromous fish runs.

7) **Preliminary Structure Removal Plan**. The final approach for removing the structure will be completed during the engineering design, but several issues should be considered during the feasibility phase as they can have a significant effect on the scope of the design. These include:

   a. assess the condition of the dam structure to determine safety concerns, potential demolition approaches, and whether there are usable gates or removable boards that can be used during the dam removal,
   b. assess access to the site and staging areas for construction equipment,
   c. assess site limitations, such as utilities or topographic constraints, and
   d. assess locations suitable for the disposal of dam rubble, as well as sediment removed from the site, if necessary.

8) **Pre-Project Monitoring.** The analysis done during the feasibility study should provide the baseline for future project monitoring. See the section on 'project monitoring' for more information.

9) **Site-Specific Conditions.** There are many additional site-specific conditions that may need to be evaluated during the feasibility study on a case-by-case basis. These could include:
   a. fish and wildlife habitat studies and wetland impact assessment,
   b. infrastructure protection plan – consider potential effects on utilities, bridges, culverts, retaining walls, wells, withdrawal pipes, etc.,
   c. assessment of replacing the current uses of the dam and impoundment,
   d. historic/archaeological assessment of the dam and surrounding area that may be affected by the project (use the MHC's Project Notification Form),

e. develop photo renderings of project alternatives as a tool if desired for community work (see section on community issues), and
f. develop recreation plan for parks, river walks, boating/fishing access.

10) **Permit Identification.** Determine which federal, state, and local permits will be required by assessing whether the project approach will exceed permitting thresholds. Complete the calculations and data collection necessary to fill out those permits.

11) **Technical Memorandum**. The Technical Memorandum should describe the above analysis. It should describe project alternatives to remove the dam, protect surrounding infrastructure, protect and restore wetland, riverine, and riparian habitat, and provide a recommended alternative.

12) **Conceptual Drawings**. Develop concept-level drawings of design alternatives for repairing, replacing, or removing structures and restoring the site. These concept-level drawings are often referred to as 10% design drawings.

13) **Cost Estimate.** Develop cost estimates to bring the recommended approach to completion, including costs of final design, permitting, construction and construction oversight. At this point in the process until the engineering design has been finalized, the cost estimate will be considered a 'probable cost' based on the consulting team's best judgment and past experience.

The Riverways Program at the Department of Fish and Game can provide sample scopes of work for dam removal feasibility studies and can assist with identifying issues to assess in your feasibility study.

# Working with the Community

With more than 3,000 structures in Massachusetts, dams are a central part of many Massachusetts communities. Some are historic and scenic structures, and decisions surrounding dams often raise strong feelings about preserving a sense of place, and tangible connections to local history and the landscape. Many impoundments are used for recreation or simply provide a pleasing view for adjacent landowners. In some cases, communities will strongly oppose the notion of dam removal. In other cases, the community will have no interest in the dam at all. In still other cases, the surrounding community may support improved water quality and the return of fish runs and riverine recreational opportunities. Whatever the case, the importance of working with the local community should not be underestimated.

Community interest in the site should be assessed in the early stages of project conception. Based on this initial assessment, project proponents should develop a plan for community presentations and participation.

## Public Participation

There are two primary ways to involve the community in dam removal projects: through mandatory regulatory hearings and through proactive public participation. If the community has an interest in the dam, then proactive approaches are critical to help the community understand and evaluate the changes that are proposed in the landscape. Having community members as active proponents of a dam removal will help ease the fear of change, will help create new community norms, and will smooth local decision making.

Even in cases where there is little community interest in a particular project, the local conservation commission will be involved as the first step in the regulatory process. Some conservation commissions do not often evaluate ecosystem restoration projects like dam removals, and therefore, may not have experience with permitting projects that restore the natural capacity of the ecosystem. Therefore project proponents should expect to present the ways that a well-managed dam removal can restore ecosystem health. The Riverways Program has realized success by involving conservation commissioners directly in project planning meetings. By inviting conservation commissioners to planning meetings, they have a stronger understanding of the project, the options that were considered, and the factors that comprise various project decisions.

**Stream Teams.** Forming a Stream Team around any local river issue is a great way to help community members gain a better understanding of river ecosystems and their needs. In turn, these new river advocates will lend a voice to river restoration. By looking at the river system as a whole, the Stream Team can help the community start a discussion about a vision for the stream and plan a long term strategy for restoration. The Riverways Program's Adopt-A-Stream Program can provide assistance with developing a Stream Team for your local stream.

## Public Visioning

A sense of loss is inherent in the notion of dam removal - an object is being removed. But dam removal projects can also bring a great deal of gain in terms of new recreation opportunities, restored ecosystem health, and a renewed connection to a free-flowing river. With some creative community visioning, the fear of loss can be turned into a sense of gain.

**Renderings.** Renderings can take the form of drawings or digitally-altered photographs showing "before" and "after" images of the site. They can help the community gain a better vision for how the restored river will look when a dam is removed. Renderings have been successfully used in situations where there is apprehension about the "look" of the restored river or where different removal options are being considered.

**Framing Effective Messages.** While many river advocates care deeply about the river, the fish and the wildlife it supports, for others these are small concerns. The perception of an idea such as dam removal is more important than the actual science that backs it up. It is important to think about the perceived benefits of dam removal for your audience. For many communities, public safety and the financial burden of failing infrastructure present a strong economic argument for dam removal, while in other places historical, cultural, social, practical, or recreational interests may weigh in the decision of dam removal. It is also important that community visioning is led by someone from the community and not by state or federal agency staff who will be perceived as an outsider. Agency partners can provide valuable scientific backup and support, including producing renderings and talking about alternatives, but local decisions should be made by those who will be affected by the outcome.

A good initial exercise in planning a community outreach strategy is to write down perceived benefits and barriers as viewed by the community so that they can be adequately addressed. Barriers might include the perceived loss of property values, the loss of a pond and recreational amenity, or simply a fear of change. With every loss, there can be a real or perceived gain, such as increased fishing opportunities or increased recreational opportunities in the form of a new walking trail through the old impoundment. Using examples and case studies from other Massachusetts communities or from other states can also help create a sense that dam removal is becoming a community norm.

Below are some good resources to use when planning community outreach:

1. *Taking a Second Look: Communities and Dam Removal* – video produced by Trout Unlimited, American Rivers, River Alliance of Wisconsin, Natural Resources Council of Maine, and Atlantic Salmon Federation, in cooperation with the National Park Service, Rivers, Trails and Conservation Assistance Program.
2. *Relics and Rivers: Dismantling Dams in. New England* – video produced by the National Oceanic and Atmospheric Administration.
3. *Dam Removal: A Citizen's Guide to Restoring Rivers*, River Alliance of Wisconsin and Trout Unlimited.
4. *Dam Removal Success Stories: Restoring Rivers Through Selective Removal of Dams that Don't Make Sense*, 1999, American Rivers, Friends of the Earth and Trout Unlimited.

# Final Engineering Design

The final design plans are the culmination of the feasibility analysis, project approach decision-making, stakeholder input, and regulator input. Engineering design plans and specifications should be completed in sufficient detail that a contractor can take the plans and complete the work. While that is the goal in terms of the level of detail, the designer should also be present on-site during construction to oversee the process. Just as with the feasibility study, the design team must be interdisciplinary to appropriately design all aspects of the project (see discussion in the feasibility study section on selecting effective consultants).

The design typically includes a set of drawings (the design plan), a set of detailed specifications, and a technical memorandum describing the analysis and approach.

Final engineering design has cost between $10,000 and $100,000 for Massachusetts projects.

**Engineering Design Plan.** The design drawings should show both dam removal and stream restoration plans. Plan sheets typically include base maps and drawings of:

- Existing site conditions
- Staging and access
- Removal plan
- Dewatering plan (sometimes completed by the contractor)
- Delineations of resource areas and resource protection treatments
- Proposed plan view
- Proposed cross sections
- Proposed longitudinal profile
- Erosion and sediment control treatments
- Infrastructure replacement/protection
- Habitat feature schematics

**Project Specifications.** The project specifications detail the construction work that will be completed. Typically specifications detail:

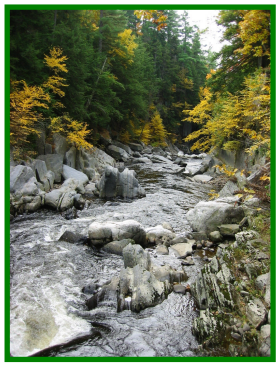
- Construction equipment needs
- Material specifications and quantities
- Project sequencing
- Staging area treatment
- Site access
- Dewatering
- Other site-specific details such as planting plans, traffic control, resource and infrastructure protection, etc.

Both the design plan and specifications should be stamped by a licensed Professional Engineer.

**Technical Memorandum.** The technical memorandum describes the analysis that goes into the design and details the rationale behind the project approach. If a technical memorandum is completed during the feasibility, this document may be nearly identical with revisions that were completed in the final design.

**Cost Estimate.** The design team should develop an itemized cost estimate based on the design and specifications. At this stage, the cost estimate is considered an Engineer's Opinion of Probable Cost based on the project specifications, until contractors bid on the project.

# Permitting Dam Removal



Local, state, and federal agencies have authority over dams, including dam removal, and ecological restoration. Depending on the nature of the dam and the site-specific conditions, multiple permit applications may be required to remove a dam. Timing for each permit varies and some permits, once the application is submitted, can take up to 90 days for the agency to review. The more thoroughly prepared the feasibility analysis and permit application, the less time it takes to receive approval. Note that in some cases, regulators may require additional information during the permitting review process. It is advisable when submitting information for environmental review to send it by certified mail, return receipt requested, so that you know when it was received and by when to expect a response based on that agency's regulatory timeline for review and response.

Costs to prepare permits can vary widely depending on project complexity. If the work is entirely completed by consultants (including completing paperwork, filing forms, and attending hearings, meetings, and site visits) permitting can cost between a few thousand and a hundred thousand dollars depending on site-specific permit requirements. Many of the filings and hearings can be completed by the proponent at significant cost savings if so inclined. Most permit applications require payment of fees, although some of these fees can be waived if the applicant is a municipality or state agency.

Some general recommendations:

- Consult with and work cooperatively with regulatory agencies.
- Invite agency personnel to the site prior to beginning the permitting process.
- Maintain communication with permitting agencies and respond completely and accurately to their questions or comments.
- Plan sufficient time to complete all the necessary consultations and regulatory processes.

## Permit Sequence

These are some general guidelines on the most likely steps that a proponent can follow to acquire all the permits required to remove a dam. This sequence is based on past experience. Detailed descriptions on each of the permits are outlined further below in the order they are listed here.

After completing the feasibility study and working through any issues with the local community, but prior to completing the final engineering, the following three determinations and filings should be made:

- Jurisdictional determination through a request letter to the Office of Dam Safety (ODS) at the Department of Conservation and Recreation (DCR)
- Project Notification Form (PNF) with the Massachusetts Historic Commission (MHC)
- Massachusetts Environmental Policy Act (MEPA) filing with an Environmental Notification Form – this would be necessary only if the ODS has deemed the dam to be jurisdictional or if other MEPA thresholds are triggered

Once the final engineering designs are complete, and the above determinations have been made, one or multiple of the following permits will be required. ***Note that not all the listed permits may be required at all dam removals; permits required will depend on the site-specific conditions***. Depending upon the size of the dam and degree of environmental impacts, the following applications for permits or certificates may be required. Typically, federal permit agencies require that state and local permits are filed first or receive approval before the federal permits and approvals. We recommend filing a Notice Of Intent with the local conservation commission as a first step. Also, depending on the site specific conditions, permits indicated with an asterix below can be filed concurrently; many of these permits contain the same information and filing them at the same time will help streamline the process and provide greater ease for the proponent.

1. Notice Of Intent (NOI) – One of the key permits at the local level is with the local conservation commission(s) (if a dam is in two separate communities then permit applications will need to be sent to each community). A filing of a NOI with the conservation commission in turn also alerts the MassDEP to the project. MassDEP then responds to the proponent outlining which specific MassDEP permits will be required.
2. MEPA- Environmental Impact Report (if applicable)
3. Massachusetts Endangered Species Act (MESA) (if applicable)*
4. 401 Water Quality Certificate (WQC)*
5. United States Army Corps of Engineers (USACE) 404*
6. Chapter 91 (if a full license is required all permits must be received before the issuance of this license)
7. Federal Consistency Review
8. National Pollutant Discharge Elimination System (NPDES)
9. Local Building or other Permits
10. Beneficial Use of Solid Waste Permit

The following is a description of all the permits in the sequence that they are listed above,

**Department of Conservation and Recreation (DCR)**, **Office of Dam Safety**
Jurisdictional Determination Chapter 253 Permit Application
http://www.mass.gov/dcr/pe/damSafety/
DCR regulates structures that meet the definition of "dams" in 302 CMR 10.03 and MGL c.253, s. 44. Any entity proposing to construct, repair, materially alter, breach or remove a dam, must file with the DCR Commissioner a notice for jurisdictional determination. If the structure qualifies as a dam, then an application for a permit to remove the dam must be submitted.

Any structure which is twenty-five (25) feet or more in height, or has a maximum impounding capacity of 50 acre feet or more, is considered a dam by DCR. The height of a dam is measured from the natural bed of the stream or watercourse measured at the downstream toe of the barrier, or from the lowest elevation of the outside limit of the barrier, up to the maximum water storage elevation. Structures smaller than this may also be considered a dam by DCR if the department determines that it needs to regulate the dam for public safety reasons. Any structure which is less than six (6) feet in height, or has a maximum storage capacity that is less than fifteen (15) acre-feet, will usually not be considered a dam by DCR. However, DCR may decide to regulate these structures if there are public safety reasons. In its determinations, DCR looks at factors such as: height, type of structure, condition of structure, volume of impoundment, and extent of downstream development.

**Massachusetts Historical Commission (MHC)** - Chapter 254/MEPA/Section 106 review
http://www.sec.state.ma.us/mhc/mhcrevcom/revcomidx.htm
The goal of MHC's review and consultation process is to encourage avoiding, minimizing, or mitigating adverse effects to significant historic and archaeological resources. If important cultural resources may be affected by the project, then a process to locate, identify, evaluate, and avoid or mitigate adverse project effects will be initiated. Projects that require a State or Federal permit, funding, license, or approval, require Massachusetts Historical Commission review ("Chapter 254" review under 950 CMR 71).

A Project Notification Form (PNF) (http://www.sec.state.ma.us/mhc/mhcform/formidx.htm) should be completed and submitted to the MHC. The PNF submittal should include a USGS locus map with the boundaries of the project area of potential effect clearly indicated, scaled project plans and drawings showing existing and proposed conditions, and current photographs keyed to the plans. For projects that require an Environmental Notification Form (ENF), MEPA requires that a copy of the ENF be sent to the MHC. The USACE also requires that a copy of their permit application be mailed to MHC for review. MHC may require supplemental information, and will only comment in writing, by regular mail.

**Massachusetts Environmental Policy Act** (MEPA)
http://www.mass.gov/envir/mepa/
MEPA review is required for projects that exceed the regulatory thresholds listed at 301 CMR 11.03 (http://www.mass.gov/envir/mepa/thirdlevelpages/meparegulations/meparegulations.htm). If the dam to be removed is jurisdictional (i.e. as determined by DCR-Office of Dam Safety - an applicant is recommend to file a jurisdictional determination permit application under Office of Dam Safety Chapter 253 to determine MEPA eligibility; alter one or more acres of salt marsh or bordering vegetated wetlands (bvw); ***or*** would endanger property or safety if they fail) and if structural alteration of the dam causes any decrease in impoundment capacity it would require an Environmental Notification Form and an Environmental Impact Report (EIR). (Note that other thresholds related to dams may also apply, depending on the specific activity proposed.) The requirement to prepare an EIR may be waived by the Secretary on the grounds that:
1) preparation of an EIR would result in an undue hardship for the proponent; 2) preparation of an EIR would not serve to avoid or minimize damage to the environment; 3) the project is not likely to cause damage to the environment; and 4) existing infrastructure exists to support the project. Proponents for dam removal projects should consult with the MEPA office early in the planning process to determine whether MEPA review is required, and if so, how the filing can be used to coordinate overall state agency review of the proposed activity, including any waiver request.

**Notice of Intent with local Conservation Commission - Wetlands Protection Act**
http://www.mass.gov/dep/water/approvals/wwforms.htm
The Wetlands Protection Act is administered by the local conservation commission with support from the Massachusetts Department of Environmental Protection (MassDEP). All dam removal applicants should file a Notice of Intent (NOI) under the Wetlands Protection Act with their local Conservation Commissions. Filing a NOI requires abutter notification, a posting in the local paper, payment of a fee and an appearance at one or multiple public hearing(s). All resource areas must be clearly demarcated on the plan and wetlands flagged in the field. The plan must also include calculations of area impacts to resource areas. Dam removals are often considered limited projects under 310 CMR, 10.53(4) and therefore are a permissible activity under the Wetlands Protection Act. Please refer to the guidance document prepared by DEP to assist local conservation commission in interpretation of this limited project provision.

A proponent may also need to comply with a local wetland protection bylaw (town) or ordinance (city). Check with your local conservation commission to determine if a local wetland law exists, what application forms are required, and what the process is for receiving a permit or approval.

**Massachusetts Endangered Species Act (MESA) - Natural Heritage and Endangered Species Program (NHESP)** http://www.mass.gov/dfwele/dfw/nhesp/nhenvmesa.htm
The Massachusetts Endangered Species Act (MESA) M.G.L. c.131A and regulations 321 CMR 10.00 protect state listed species and their habitats by prohibiting the "Take" of any plant or animal species listed as Endangered, Threatened, or of Special Concern by the MA Division of Fisheries & Wildlife. A "Take" includes protection of state listed species habitat, and is defined as, "in references to animals to harass, harm, pursue, hunt, shoot, hound, kill, trap, capture, collect, process, disrupt the nesting, breeding, feeding or migratory activity or attempt to engage in any such conduct, or to assist such conduct; and in reference to plants, it means to collect, pick, kill, transplant, cut or process or attempt to engage or to assist in any such conduct. Disruption of nesting, breeding, feeding or migratory activity may result from, but is not limited to, the modification, degradation or destruction of Habitat." Permits for taking state listed species in priority or estimated habitats for scientific, educational, conservation, or management purposes are subject to review.

Note: If a project falls within Priority Habitat of Rare Species and does not meet the MESA filing exemptions, proponents must file with the NHESP. Priority Habitat is defined as "the geographic extent of Habitat for state-listed species" as delineated by the Division pursuant to 321 CMR 10.12. There are three types of filings under MESA - MESA Information Request for rare species information, MESA Project Review, and the Application for a Conservation and Management Permit.

**401 Water Quality Certificate - Massachusetts Department of Environmental Protection**
http://www.mass.gov/dep/water/approvals/wwforms.htm
This Certificate is applicable for projects which involve filling or dredging of areas covered by the Clean Water Act, including Land Under Water and Wetlands. Most dam removal or breaching projects will involve these activities. Any project which must obtain a Section 404 permit from the Army Corps of Engineers (USACE) must also obtain a 401 Water Quality Certification. The Notice of Intent under the Wetland Protection Act serves to notify the state and MassDEP will indicate through this process if a 401 is required.

Note: The permit requires plans and information on dredge amounts and impacts. A 401 Water Quality Certificate (WQC) for dredging (BRP WW 07,08 Dredging) is classified into major and minor project based on whether or not the project will dredge more or less than 5,000 cubic yards. Projects that dredge less than 100 cubic yards may not require a certificate. Sediment quality testing is required if a certain percentage of excavated sediments is fine grain material (see MassDEP guidance for further details). The WQC has a 21-day comment period. Along with the WQC application package an applicant can publish the Chapter 91 notice (Chapter 91 Waterways License - see below). Additionally, the Chapter 91 permit plans can be used for the WQC application - specifications of both permit applications are similar (water levels, dredge elevations, cross-sections, etc.).

**US Army Corps of Engineers - Section 404 of the Clean Water Act and Section 10 of Rivers and Harbors Act of 1899**
Any discharge of dredged or fill material into waters of the United States requires a permit from USACE. Any work conducted in navigable waters comes under Section 10 jurisdiction and hence requires USACE approval. A USACE permit review includes consultation with the State Historic Preservation Officer, and Federally recognized Native American Tribes, CZM Federal consistency concurrence (see below), and MassDEP Section 401 Water Quality Certification (see above) in addition to coordination with federal resource agencies.

Note: The USACE application form and plan requirements, and the Programmatic General Permit (for expedited review of minimal impact projects) are available on the USACE website at http://www.nae.usace.army.mil/reg. Typically the USACE requires permit plans to be 8 ½" x 11" but for projects which can be authorized through the Programmatic General Permit a copy of the Chapter 91 or Water Quality Certification application is acceptable if the plans show the federal jurisdictional limits such as wetlands, and ordinary high water or high tide line and mean high water in tidally influenced areas.

**Chapter 91 Waterways License - MassDEP**
http://www.mass.gov/dep/water/approvals/wwforms.htm
Chapter 91 regulates activities in navigable waterways of the Commonwealth, and approval from this program is required if dredging is involved, even if the dredging will ultimately benefit navigation. Most perennial rivers and streams in the state are considered navigable.

For the most part dam removal does not need a Chapter 91 license [310 CMR 9.05(3)(m) and 310 CMR 9.22(1)] if no dredging is proposed. Proponents will simply be required to notify and seek a written approval, from MassDEP, of the dam removal. This should be done through a letter that includes the following information,

- geographical context of the dam
- the name of the river and municipality where it is located
- the precise location of the structure
- whether it is an authorized structure
- whether there are docks/piers or boat ramps in the upstream impoundment that could be affected
- description of the dam/previously authorized structure, i.e. size, height
- description of proposed removal

If dredging is involved in the removal of the dam, a Chapter 91 dredging permit is required. Dredging work can be completed under a simplified application with local planning board and building inspector notification. An applicant can publish the Chapter 91 notice along with the Water Quality Certification application package (401 permit - see above). Additionally, the Chapter 91 permit plans can be used for the WQC application - specifications of both permit applications are similar (water levels, dredge elevations, cross-sections, etc.). The Chapter 91 dredge permit has a 15- day comment period. Municipal sign off in the form of an Order of Conditions is required.

**Federal Consistency Review - Massachusetts Coastal Zone Management (MCZM)**
http://www.mass.gov/czm/fcr.htm
In projects where the removal of a dam is proposed in the Massachusetts coastal zone, federal consistency review from the Office of Coastal Zone Management (CZM) is required. Federal consistency review is the process required under the national Coastal Zone Management Act and federal regulations (15 CFR 930), that allows states with federally–approved Coastal Program Plans to review federal actions, licenses and permits (and other specific activities such as Outer Continental Shelf leases) to ensure that these actions, licenses and permits are consistent with state enforceable policies. For those proposals found to be within the Massachusetts Coastal Zone or affecting the Coastal Zone, the next consideration is whether any federal permits are required. If so, then federal consistency review by the CZM office is necessary. See Appendix D for a full description of this process.

**National Pollutant Discharge Elimination System (NPDES) - Environmental Protection Agency**
http://cfpub.epa.gov/npdes/stateinfo.cfm?&view=region&region_id=1
A NPDES Permit is required for discharges from large-scale construction sites, including clearing, grading, and excavation activities.

**Local Building and Other Permits**
A building permit application is often available at the city, town hall, or municipal website. Otherwise, an applicant should contact the municipality's building inspector to obtain an application and inquire as to whether a building permit is required. Other local permits may be required such as a site plan review permit from the planning board, or a Certificate of Appropriateness from the local historic district commission if the project is in a local historic district. The local building inspector usually serves as the zoning code enforcement officer and should be consulted for other applicable municipal permits.

**Beneficial Use of Solid Waste Permit - MassDEP**
Materials from a dam can be reused for bank stabilization or for on-site use. If the materials consist of uncontaminated earthen material only, rock and soil, they can be reused without any solid waste permit approvals. Be aware that other requirements may apply to the reuse of soil materials such as the Massachusetts Contingency Plan, 310 CMR 40.000. Reuse of materials from dams made of concrete, bricks or other masonry materials are subject to regulation under 310 CMR 16.05(3)(e) "Asphalt, Brick and Concrete Recycling Operations" (http://www.mass.gov/dep/recycle/laws/regulati.htm#sw) and the policy "Guide to Regulations for Using or Processing Asphalt, Brick & Concrete Rubble" (http://www.mass.gov/dep/recycle/laws/abc.htm). The regulation provides an exemption from solid waste permitting if the reuse is in accordance with the conditions of the exemption. However, if these conditions cannot be met a Beneficial Use Determination (BUD) permit will be required for the intended reuse.

Some key conditions of the exemption include:

- The concrete must be "clean", i.e. it cannot be painted or otherwise coated or contaminated.
- Concrete must be reduced to 6 inch size or less.
- Rebar must be removed.
- MassDEP must be notified 30 days before the concrete crushing begins.

# Project Implementation and Construction

Construction is most commonly bid out to qualified contractors. In some cases, town departments of public works or partnering corporations have qualified personnel and the appropriate equipment to complete some or all of the work. Regardless of who is driving the construction equipment, project construction should be overseen by the same team that designs the project. There is a small, but growing, number of contractors that have experience with habitat restoration projects and many of the nuances of infrastructure protection and habitat construction must be relayed on-site during construction. The specific permitting conditions must be adhered to rigorously as there are significant penalties for violation of local, state, and federal permits.

Construction has cost between $35,000 and $290,000 for Massachusetts projects.

While this document is not intended to guide the scientific and engineering aspects of dam removal, some key points to consider during the design and construction phase of projects include:

- The entire vertical extent of the dam structure should be removed from the stream. Rivers are dynamic systems and any solid concrete structure that is left in the bed of a river can eventually become a barrier again as river flows cause scour on the downstream side over time. In some cases, side abutments are left in place. In these cases, the hydraulics should be carefully modeled to ensure that the remaining abutments do not create a constriction and ultimately scour and cause high flow velocities.
- To effectively restore habitat, simulate natural portions of the surrounding stream or other nearby healthy streams to the extent possible. For example, if the stream channel upstream of the impoundment has a slight slope and the channel downstream of the dam has a slight slope, then as a general rule, the restored channel through the removed dam should not have a steep slope. However, this needs to be specifically evaluated on a case by case basis, as some dams are built on steep sections that differ from the surrounding stream, but simulating the surrounding stream is a good general rule as a starting point. Simulating the surrounding stream will allow whatever species that make use of the more natural sections of the stream to also make use of the restored sections.
- Remember, good habitat is diverse! Aquatic species need a range of complex habitats at different times in the season and for different life stages. Depending on the site, these habitats are provided by extensive streamside vegetation and complex instream features such as large wood and stream bed variation.
- Slowly draining the impoundment during dam removal:
  - Reduces the release of sediment downstream
  - Allows the bed of the impoundment and stream to drain and stabilize
  - Prevents a sudden release of water which could unnecessarily damage downstream infrastructure and/or habitat

  This can be accomplished by gradually removing boards from the control structure; slowly opening a low-level outlet if one exists; or by cutting incremental breaches into the dam structure and letting the water level lower after each increment.

- Carefully consider the need to proactively revegetate land that is exposed by the dam removal. While the Massachusetts environment is extremely effective at growing vegetation, often the first species that take root in exposed land are non-native or invasive.
- Project evaluation should initially be completed by the contractor and construction manager immediately following project completion. However, the project proponent should also complete regular project walk-throughs of the site. The proponent can develop a checklist of issues to visually inspect with the assistance of the project design team. The checklist might include a visual assessment of vegetation growth, erosion, and scour around infrastructure, such as pipes, retaining walls, and abutments.

# Appendix A: Frequently Asked Questions

***What will the restored river look like?***
The river channel that re-forms or is actively restored after a dam is removed will be a similar size and shape as the river upstream and downstream of the former impoundment. Sometimes the general shape of the old river channel can be seen in underwater patterns if you look at an aerial photograph of the impoundment. Some dams were built to increase the water level in a natural lake or pond and that natural lake will be restored after dam removal. Changes to the landscape will be more or less dramatic depending on the size of the structure, its purpose and the size and shape of the impoundment. Riverways has worked with citizen groups and engineers to create renderings of what the restored river channel will look like under different removal scenarios. These renderings can help the community to understand the process and make decisions about removal options.

***Will there be an increase in flooding?***
Only a small percentage of dams provide flood control benefits and those dams were expressly built for that purpose. Most dams do not significantly affect or control downstream flooding and therefore their removal will not cause a significant change in flooding downstream. In some cases, dam removal can actually decrease flooding upstream of the dam, and can eliminate a downstream hazard by removing the potential for a catastrophic breach of the structure.

***How long will it take the impoundment to revegetate?***
Depending on the time of year, revegetation of the sediment behind a dam begins within weeks of exposure to sunlight. It is important to keep an eye on invasive plants such as purple loosestrife during the first growing season, so that native plants can grow and out-compete unwanted species. A management plan may need to be developed in case on invasive species. Riverways has several before and after photos of dam removal sites that give a good indication of the rate of plant growth in impoundments.

***What happens to the fish and wildlife that were in the impoundment?***
Dams create artificial habitat by impounding water and altering river function. Impoundments trap sediment and create stagnant conditions with warmer water than the rest of the river system. Generally, much of the wildlife that uses an impoundment such as birds and turtles will quickly adapt to restored river conditions. Rivers typically provide more habitat variety and conditions for native species. Fish will be able to move upstream and make use of the full river for their life cycle. The restored river may also help bring back cold water fisheries such as trout, and will allow anadromous fish such as Atlantic salmon, smelt and river herring to use the river for spawning. While the fishery will certainly change, a greater variety of fish and fishing opportunities is likely to result.

***What about all the sediment behind the dam?***
One of the first steps for assessing dam removal feasibility is to assess the quality and amount of sediment behind a dam. If the sediment is contaminated, precautions will be necessary for removal and disposal or in-situ capping. Dredging of sediment is not always necessary during a dam removal and not all sediment that was trapped by the dam will flush downstream during removal. Typically a combined approach is taken of removing some sediment and stabilizing the rest through active revegetation and bioengineering. Sediment impacts below the dam are generally temporary and the river quickly readjusts to its new configuration. Bioengineering and stream channel reconstruction can help stabilize sediments in the former impoundment.

***Will there be wetland impacts?***
The wetland habitat behind a dam will change when the dam is removed. Depending on the surrounding topography, deep water marsh may become shallow marsh or wet meadow. Habitats such as red maple swamp may return. Rivers are also wetlands, and riparian areas have important habitat functions. While the total wetland area may change, the function of the natural ecosystem will be improved. Usually wetlands

above a dam are not self-sustaining (they are sustained by a human-made structure that must be maintained) and will gradually fill with sediment over time.

***What if the owner just breaches the dam?***
A dam owner may be required by the Office of Dam Safety to open their gates, breach or lower their dam for safety reasons. This action removes the pressure from impounded water on the dam structure to prevent a catastrophic failure. Many dam owners may not have the financial means to fully remove a structure and will leave the structure in the stream. Open gates can clog with debris and water can re-impound behind the structure creating an unstable habitat and safety concerns.

Breached structures can also continue to be passage barriers to fish, especially at low flows, and do not allow for full channel recovery above the dam. A better option is to fully remove the vertical extent of the structure and fully restore the channel and its banks as a natural system. Citizens should encourage dam owners to proactively deal with their dams before emergency situations arise so that the community has a chance to participate in the decision process.

***Who will own the exposed land?***
Because many dams were constructed by mill owners centuries ago, sorting out property ownership is not an easy task. A mill owner may have owned a dam and/or mill pond miles from the mill itself, and deeds for the dam may not always be attached to surrounding properties. Deeds and titles for the specific dam and/or legislative acts that provide for creating reservoirs will often show who owns the impoundment and the land under the water, and often this might be the municipality, especially if it is a municipally owned dam. Whether or not abutters have rights to the newly exposed land is something that would have to be sorted out on a case by case basis.

***What about property values?***
While the loss of one type of recreational and scenic resource may decrease value to some, to others, the restored river, improved water quality, and added open space increases the value of the site. Preliminary studies are showing that property values in some cases may actually increase long-term following dam removal, but every case is site-specific.

***Will removal of the dam affect important historic or archaeological resources?***
Some dams and their associated historic or archaeological resources (such as water-powered mills with stone-lined raceways and waterwheel pits etc.) are historically significant examples of colonial and early industrial development, have innovative technology or engineering, or were built as part of designed cultural landscapes (such as parks). Sometimes ancient Native American sites or early historic sites are present in a dam removal project area, and could be inadvertently affected by the activities and consequences of these projects. . If a dam proposed for removal is historically significant, alternatives to removal should be considered, such as repair of deteriorated elements, or modifications to the structure that are sensitive to the original construction. Some historic dams are so dilapidated or so heavily modified as to no longer retain their historical appearance or original design and function. Removal of dams that have lost their "historical integrity" is less problematic (and may be less controversial in the local community) than projects that adversely affect important cultural resources. Nevertheless, when there is no prudent and feasible alternative to removal, the history of historic dams can be appreciated thorough documentary and archaeological research, the preparation of archival documentation, and conveyed through interpretive signage, interpretive publications prepared for the general public, or other "mitigation" strategies that benefits the interested public.

***Is there money available to help remove the dam?***
There are several sources of federal and other funding available for dam removal, depending on the amount and type of habitat being restored. Rivers are seen as a public resource and especially where at-risk species such as Atlantic salmon are concerned, there are many parties interested in seeing habitat restoration.

# Appendix B: Funding Sources for Dam Removal

Dam removal projects often require a combination of different funding sources to piece together all of the necessary funding. Funders are more likely to fund projects with multiple partners, strong state support, and effectively completed initial assessments. Each funding source has different interests and project proponents need to determine which funding sources best fits your project's goals. Also, project proponents should carefully consider funding deadlines relative to the project schedule, as many funders have a time limit on using their funds.

Project proponents should not enter into a project with the expectation that the project will be free to them through the available funding sources. Most funders require matching contributions and are more likely to fund projects with a contributing owner. To date, dam removal projects in Massachusetts have ranged from $50,000 to $400,000 in total costs. The Riverways Program can provide assistance with determining which funding possibilities may apply to your project.

## National Sources

Open Rivers Initiative (NOAA)
http://conservationconference.noaa.gov/case/open_river.html
http://www.fedgrants.gov/Applicants/DOC/NOAA/GMC/NMFS-HCPO-2006-2000405/Grant.html
NOAA oversees a competitive grant program focused on community-driven, small dam and river barrier removals in coastal states to help repair vital riverine ecosystems, to benefit communities, and to enhance populations of key trust species. Funding range: $50,000-$250,000.

Gulf of Maine Council/ NOAA Partnership Habitat Restoration Grants
http://restoration.gulfofmaine.org/
The Gulf of Maine Council for the Marine Environment partners with NOAA to fund marine and anadromous fish habitat restoration projects around the Gulf of Maine. Typical Funding Range: $25,000-$75,000.

NOAA Community-Based Habitat Restoration Project Grants
http://www.nmfs.noaa.gov/habitat/restoration/projects_programs/crp/partners_funding/callforprojects.html
The program invites the public to submit proposals for available funding to implement grass-roots habitat restoration projects that will benefit living marine resources, including diadromous fish, under the NOAA Community-based Restoration Program. Funding range: $50,000-$200,000, October deadline. Funded Silk Mill dam removal in Becket.

NOAA/Ocean Trust/National Fisheries Institute
http://www.nmfs.noaa.gov/habitat/restoration/projects_programs/crp/partners/otnfi.html
NOAA partners with Ocean Trust to fund habitat restoration projects that enhance living marine resources around the coastal U.S. The applicant must be an individual, association or company in the fish and seafood industry. Funding range: $5,000-$20,000.

The Nature Conservancy/NOAA Habitat Restoration Partnership
http://nature.org/initiatives/marine/strategies/art9023.html
NOAA partners with The Nature Conservancy (TNC) to fund marine and anadromous fish habitat restoration projects around the coastal U.S. The applicant must be a TNC local chapter. Organizations that have project ideas should contact their local TNC chapter to discuss forming a partnership to apply for project funds under this request for proposals. Funding Range: $25,000-$85,000.

Trout Unlimited/NOAA Partnership
http://www.nmfs.noaa.gov/habitat/restoration/projects_programs/crp/partners/troutunlimited.html

Provides matching grants that require 1:1 match from a non-federal source or sources. Typical awards are from $10,000 to $100,000, and can cover any aspect of a habitat restoration project, including construction, engineering, planning, or outreach. There is no formal application process. Project must be sponsored by a TU chapter or State Council, or by TU staff.

American Rivers/NOAA Community-Based Restoration
http://www.nmfs.noaa.gov/habitat/restoration/projects_programs/crp/partners/americanrivers.html
NOAA partners with American Rivers to fund voluntary dam removal and fish passage projects. Funding range: $5,000-$25,000. Funded Robbins Dam removal in Plymouth/Wareham.

FishAmerica Foundation/NOAA
http://www.fishamerica.org/faf/projects/noaa.html
FishAmerica, in partnership with the NOAA Restoration Center provides funding for on-the-ground, community-based projects to restore habitat for marine and diadromous fish in the United States. Funding Range: $5,000-$50,000. Funded Billington Street dam removal in Plymouth

National Fish Passage Program (U.S. Fish and Wildlife Service)
http://www.fws.gov/fisheries/FWSMA/FishPassage/fpprgs/GetInvolved.htm
The U.S. Fish and Wildlife Service's National Fish Passage Program is a non-regulatory program that provides funding and technical assistance toward removing or bypassing barriers to fish movement. Contact: Region 5 – Northeast Dave Perkins 413/253-8405, David_Perkins@fws.gov

U.S. Fish and Wildlife Service Partners
http://www.fws.gov/partners/
The U.S. Fish and Wildlife Service's Partners for Fish and Wildlife program offers technical and financial assistance to private (non-federal) landowners to voluntarily restore wetlands and other fish and wildlife habitats on their land. Restoration projects include reestablishing fish passage for migratory fish by removing barriers (dams) to movement. Funded Silk Mill dam removal in Becket

National Fish Habitat Initiative Brook Trout Habitat Restoration Program
www.fishhabitat.org
NFHI is a nationwide strategy that harnesses the energies, expertise and existing partnerships of state and federal agencies and conservation organizations. The goal is to focus national attention and resources on common priorities to improve aquatic habitat health.

General Matching Grant Program (National Fish and Wildlife Foundation)
http://www.nfwf.org/guidelines.cfm
The National Fish and Wildlife Foundation operates a conservation grants program that awards matching grants to projects that: address priority actions promoting fish and wildlife conservation and the habitats on which they depend; work proactively to involve other conservation and community interests; leverage available funding; and evaluate project outcomes. Funding Range: $10,000-$150,000.
Funded Billington Street dam removal in Plymouth, and Silk Mill dam removal in Becket

Conservation Law Foundation/ NOAA Partnership
http://www.clf.org/programs/cases.asp?id=531
CLF launched this program to distribute funds for estuary restoration projects to communities in the Gulf of Maine. Typical Funding levels between $10,000.00 – 50,000.00

Wildlife Habitat Improvement Program (Natural Resources Conservation Service)
http://www.nrcs.usda.gov/programs/whip/
Funding awarded to projects that work to establish and improve fish and wildlife habitat. Contact local USDA Service Center for more information. Funded Billington Street dam removal in Plymouth

Corporate Wetlands Restoration Partnership (CWRP)
http://www.coastalamerica.gov/text/cwrp.html
CWRP leverages the collective resources, skills and processes of the private and public sectors through dam removal and river projects such as fill removal, channel clearing and enlarging, fish passage construction, and replanting. Funding pending Ballou dam removal in Becket.

U.S. Army Corps of Engineers
http://www.nae.usace.army.mil/pservices/206.htm
Aquatic Ecosystem Restoration – Section 206, Water Resources Development Act of 1996. Funds from this program can be utilized to remove lowhead dams as a way to improve water quality and fish and wildlife habitat. This funding source is listed under the Continuing Authorities Program.

Wildlife Restoration Act (Pittman-Robertson Act) Dept. of Interior-Fish and Wildlife Service
http://federalasst.fws.gov/wr/fawr.html
The purpose of this Act was to provide funding for the selection, restoration, rehabilitation and improvement of wildlife habitat, wildlife management research, and the distribution of information produced by the projects. Contact: The Division of Federal Assistance, FederalAid@fws.gov

National Trust for Historic Preservation Northeast Office
Provides several grant programs for maintenance and preservation of significant historic properties.
Brent_Leggs@nthp.org

## State Sources

Funding for dam removal in Massachusetts is determined on a case by case basis. Interested proponents should consult with the Riverways Program's River Restore.
http://www.mass.gov/dfwele/river/programs/riverrestore/riverrestore.htm

## Local Sources

Funding for fish passage and dam removal on municipal owned land may be funded through the Community Preservation Act (CPA). Check with your local planning department or Conservation Commission, or contact the Community Preservation Coalition.
http://www.communitypreservation.org

## Private Sources

Some private sources, such as family foundations or corporate foundations, have funded dam removals in other parts of the country and may have an interest in funding habitat restoration projects.

## Additional References

American Rivers' Paying for Dam Removal: A Guide to Selected Funding Sources
http://www.americanrivers.org/site/DocServer/pdr-color.pdf?docID=727

EPA Catalog of Funding Sources for Watershed Protection
http://www.epa.gov/owow/funding.html

River Alliance of Wisconsin's list of resources (scroll down to view Private funders):
http://www.wisconsinrivers.org/index.php?page=content&mode=view&id=8

River Network list of Funding Sources
http://www.rivernetwork.org/library/index.cfm?doc_id=114

# Appendix C: Finding Additional Assistance

For more information, contact the Riverways Program at 617-626-1540.

Through a competitive application process, the Riverways Program will provide more extensive technical assistance and in some cases funding for some projects based on habitat restoration priorities. For more information, see Riverways Priority Projects at http://www.mass.gov/dfwele/river/programs/stream/index.htm.

Other partners who provide on-the-ground assistance with dam removals in Massachusetts include:

1. NOAA Restoration Center, http://www.nmfs.noaa.gov/habitat/restoration/
2. US Fish & Wildlife Service Partners for Fish & Wildlife, http://ecos.fws.gov/partners/viewContent.do?viewPage=home
3. American Rivers, http://www.americanrivers.org/site/PageServer?pagename=AMR_Dam_Removal

In addition, the national Dam Removal Clearinghouse provides a wealth of additional information and project examples from around the country: http://www.lib.berkeley.edu/WRCA/damremoval/index.html

# Appendix D: Federal Consistency Review

In projects where the removal of a dam is proposed in the Massachusetts coastal zone, the following considerations should be taken into account relative to the Office of Coastal Zone Management (CZM) federal consistency review. Federal consistency review is the process required under the national Coastal Zone Management Act and federal regulations (15 CFR 930), that allows states with federally–approved Coastal Program Plans to review federal actions, licenses and permits (and other specific other activities such as Outer Continental Shelf leases) to ensure that these actions, licenses and permits are consistent with state enforceable policies. The Massachusetts enforceable policies can be found at: http://www.mass.gov/czm/policies.htm.

## Coastal Zone Boundary

An applicant should first determine whether a proposal is located within the defined Massachusetts Coastal Zone. While the entirety of the twenty-three communities on Cape Cod, Martha's Vineyard, Nantucket and the Elizabeth Islands are included within the boundary, in most cases only portions of the remaining coastal towns are. A written description of this boundary can be found at 301 CMR 21.99, or in the Massachusetts GIS files. Interested parties are also encouraged to contact the CZM Project Review Coordinator by telephone or at the address below for further assistance in making this initial determination.

## Federal License or Permit In or Affecting the Mass Coastal Zone

For those proposals found to be within the Massachusetts Coastal Zone or affecting the Coastal Zone, the next consideration is whether any of the permits listed below are required. If so, then federal consistency review by the CZM office is required.

*Listed Permits:*

1. Army Corps of Engineers:
   - Federal Water Pollution Control Act section 404 permit for the discharge of dredged or fill materials in navigable waters
   - River and Harbor Act section 10 permit for obstruction or alteration of navigable waters, or section 11 permit for establishment of harbor lines
   - Outer Continental Shelf Lands Act section 4(f) permit for artificial islands, installations or other devices permanently or temporarily attached to the seabed of the OCS
   - Marine Protection, Research and Sanctuaries Act section 103 permit for transportation of dredged material for the purposes of dumping in ocean waters

2. Department of Commerce:
   - Marine Protection, Research and Sanctuaries Act section 304(b) approval of activities affecting marine sanctuaries

3. Department of Interior:
   - Outer Continental Shelf Lands Act section 5(e) granting rights of way for oil and gas pipelines in the OCS
   - Endangered Species Act section 10 permits

4. Department of Transportation:
   - Deep Water Ports Act section 4 license
   - River and Harbor Act section 9 permit for construction or modification of bridge structures across navigable waters
   - Regattas and Marine Parade permits

5. Environmental Protection Agency:
   - Federal Water Pollution Control Act sections 402 NPDES; 404 ocean dumping authorizations; and, 102 and 104 ocean dumping permits issued in conjunction with the ACOE

6. Nuclear Regulatory Commission:
   - Energy Reorganization Act section 102 license for construction and operation of nuclear power plants

Unlisted Activities:
In addition to those licenses or permits listed above, activities that CZM believes will likely affect the land or water uses or resources of the Mass Coastal Zone may also be subject to review with approval from NOAA.

## Review Procedures

For projects subject to review an applicant must provide CZM with:

- a federal consistency certification that includes:
    - a brief of that statement in light of each of our program policies
    - a copy of the federal permit application or, in the case of an NPDES permit application, a copy of the draft permit
    - a copy of the final Secretarial Certificate if MEPA has jurisdiction
- and, any additional information specified in the Program Plan or program policies as necessary for the evaluation of the proposed activity

Following receipt of the consistency certification by CZM:

- The review period begins immediately upon conclusion of a completeness determination by CZM
- CZM concurrence with the certification may be presumed if CZM does not issue or request an extension within 6 months from the beginning of the review
- There is a required 21 day public comment period during the review period
- At three months into the review period CZM must inform the applicant of the status of the review if it is not yet complete
- Prior to the six month deadline the review may be extended to a date-certain by mutual agreement with the applicant

Note: CZM may not issue a concurrence until all required state licenses permits or certifications are received.

## Objections to Consistency Certifications

CZM may object to a federal consistency certification if applicable state authorizations are not received by the close of the six-month review period (unless extended by agreement), or the proposed activity is deemed to be inconsistent with the program policies. In these cases CZM must notify the applicant, the relevant federal permitting agency(ies) and the Director of NOAA's Office of Ocean and Coastal Resource Management of its objection. Such notification must include a description of how the project is inconsistent with the specific enforceable policies, and may describe alternative measures (if they exist) which, if adopted by the applicant may permit the proposed activity to be conducted in a manner consistent with the policies. If CZM proposes alternatives within the objection letter they must be described in sufficient detail to allow the applicant to determine whether to adopt it, abandon the proposal, or file an appeal.

Following receipt of notification of CZM objection, the federal agency may not issue the federal license or permit (except following appeal).

## Appeal of CZM Objection to a Consistency Certification

An appeal of a CZM objection may only be brought by the project applicant, and such objection may be over-ridden by the Secretary of Commerce only in cases where the activity is found to be consistent with the

objectives of the Act (Coastal Zone Management Act of 1972, as amended), or is necessary in the interest of national security.

A finding of consistency with the Act is made if:

- The activity furthers the national interest as articulated in sections 302 and 303 of the Act in a significant or substantial manner
- The national interest furthered by the activity outweighs the activity's adverse coastal effects, when those effects are considered separately or cumulatively, and
- There is no reasonable alternative which would permit the activity to be conducted in a manner consistent with the enforceable policies of the management program

An activity is necessary in the interest of national security if:

- a national defense or other national security interest would be significantly impaired were the activity not permitted to go forward as proposed

## Contact Information

Massachusetts Office of Coastal Zone Management
Project Review Coordinator
251 Causeway Street, Suite 800
Boston, MA 02114
Ph: 617-626-1219
Fax: 617-626-1240