Dam Removal and the Wetland Regulations

Massachusetts Department of Environmental Protection
Bureau of Resource Protection
Wetlands/Waterways Program
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I. Preface

This guidance is intended to encourage environmental improvements to rivers and streams anticipated to result from dam removal. The document provides guidance for conservation commissions and the Department of Environmental Protection, as the permitting authorities, in the application of the Massachusetts Wetlands Protection Act and its regulations. This guidance provides commissions with an overview of permitting issues and review considerations associated with dam removal projects. The Executive Office of Energy and Environmental Affairs (EOEEA), Riverways Program document entitled *Dam Removal in Massachusetts – A Basic Guide for Project Proponents*[1] contains a comprehensive review of other regulatory requirements associated with dam removal.

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Photo credits: Many thanks to the Riverways Program for the photos of the Town Brook Dam Removal in Plymouth, MA and the Ballou Dam Removal in Becket, MA; to Eric Hutchins of NOAA for the photos of the Town Brook Dam Removal; and to George Zoto, MassDEP.

[1] For more information regarding this document, contact the Riverways Program at 617/626-1540 or go to their website: www.mass.gov/dfwele/river/index.htm.

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II. Dam Removal and the Wetlands Protection Act

There are thousands of dams in Massachusetts, most originally constructed many years ago for a variety of reasons including mechanical milling, hydropower generation and flood control. Today, many of these dams are aging, no longer serving their original purpose, and have exceeded their expected lifespan, causing multiple concerns – most importantly, loss of life, property and environmental degradation.

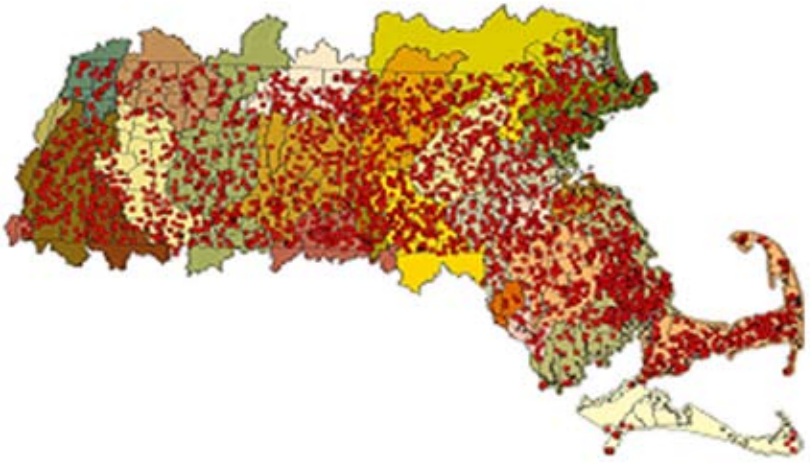
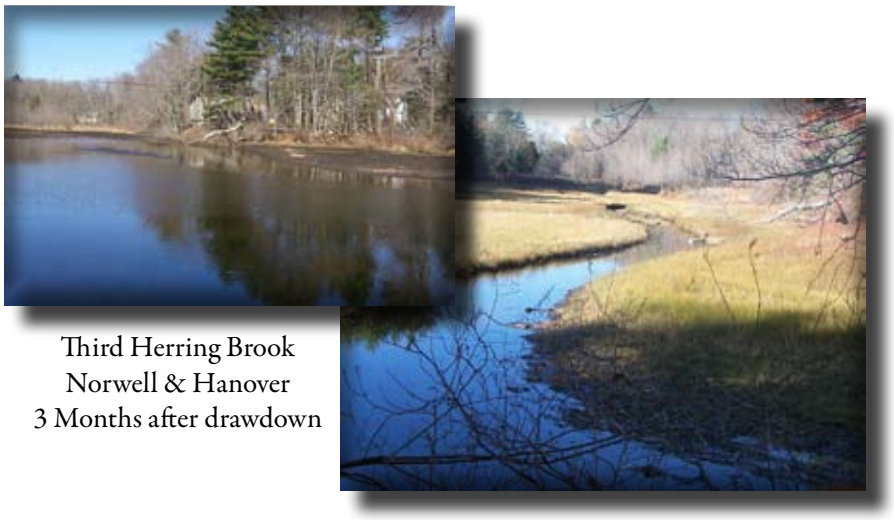


Figure 1: Over 3,000 Dams in Massachusetts in all 28 Watersheds

The Wetlands Protection Act (WPA), M.G.L. c. 131, s. 40, and the associated wetland regulations (310 CMR 10.00) acknowledge the importance of dam safety. The wetland regulations, (310 CMR 10.53 (3)(i)), provide for work on dams involving maintenance, repair and improvement (but not substantial enlargement). The WPA regulations also acknowledge the role of lake drawdown projects for the purposes of dam safety, but not if they involve breaching a dam and only if water levels are ultimately restored.

Across Massachusetts, decisions are being made on a regular basis as to how to best address dams that are in need of substantial repair. Along with the traditional options of repair, replacement or redesign, dam removal has become a viable option as a means to restore healthy wetland and riverine ecosystems. Ecosystem fragmentation caused by dams has been linked to declines in biodiversity. Dams act as barriers to fish movement by interrupting the migration of diadromous fish and the movement of resident aquatic species to habitat for spawning, nursery or refuge. Dams also transform free-flowing rivers to slow-moving water bodies by creating impoundments that can become sinks for contaminated sediment. Dams can also impact water quality by increasing summer water temperatures and reducing dissolved oxygen resulting in eutrophication and warming.



Third Herring Brook
Norwell & Hanover
3 Months after drawdown

While many dam removal projects are initiated to prevent damage to human life and property resulting from dam failure, other dam projects may

serve to restore the ecology of riverine systems. Although a handful of dam removal projects have been accomplished in Massachusetts, hundreds have been successfully completed nationwide. Dam removal projects can contribute to the restoration of aquatic habitats upstream and downstream by restoring the natural movement of water and sediment, and by reestablishing more natural temperatures and oxygen levels. Dam removal projects can also improve flood management, storm damage prevention, and prevention of pollution in cases where the dam is otherwise in disrepair and represents a hazard. Since these projects can serve to improve the natural capacity of a river to protect the many interests of the WPA, they may be (and have been) permitted under 310 CMR 10.53(4). During permitting review of dam removal projects under the Wetlands Regulations, it is recommended that the following guidance be incorporated.

Town Brook in Plymouth, MA
October 2003
After Dam Removal

III. Assessment

A Notice of Intent proposing a dam removal project should include assessments of the existing dam structure, sediment deposition and composition, and upstream and downstream river morphology. In general, assessment levels should depend upon site conditions and the scale of the project. Small dams with little sediment accumulation, no infrastructure risk, and no endangered species concerns require less analysis, whereas more complex projects should require more in-depth analysis. Initial assessment should determine if the dam, impoundment, adjacent land, and downstream stream reach are in rare species habitat based on the Natural Heritage and Endangered Species Program, Massachusetts Natural Heritage Atlas (12th or more recent Edition).[2]

The existing dam structure must first be evaluated, including the structure's materials and integrity. This is important as an aging, structurally unsound dam may fail during removal causing flooding and other damage downstream. Usable gates and low-flow outlets should be identified for possible use in a staged release (i.e. a controlled draw down that is done in phases). Historic records and photos can be helpful in identifying structural materials and methods that were used in the original construction. Also, removal of a dam, especially in developed areas, can affect nearby infrastructure such as bridges, sewers, and culverts. All utilities, structures and other infrastructure in the project area (as well as those upstream and downstream) that could be impacted by scour, sedimentation, or changes in flow velocity should be identified.

[2] http://www.mass.gov/dfwele/dfw/nhesp/nhenvmesa.htm

Initial assessment should also include a survey of impoundment bathymetry, and upstream and downstream channel characteristics. Data collection should provide, at a minimum, information on upstream and downstream channel features (including dimensions, streambed patterns, riffles, runs, and pools) as well as a longitudinal profile through the impoundment and downstream reach.[3]

Management of sediment accumulations behind a dam is often a significant component of a dam removal proposal, as the impoundment behind a dam can trap up to 95 percent of the sediment that enters from upstream. The need for sediment management must be specifically evaluated at each site because all dams behave differently. Some dams have very little sediment behind them and some have a lot. Differences also exist in the chemical quality of the sediment. Therefore, sediment deposition must be evaluated.

IV. Sediment Management and Transport

Sediment management is an important component of any dam removal proposal. The remobilization of sediment impounded behind dams can have physical (increased turbidity) and toxicological (exposure to contamination) effects. As such, methods of sediment management are contingent upon the physical and chemical composition of sediments.

There are three primary sediment management alternatives to be considered when dam removal is proposed: Sediment removal and disposal; In-stream management (sediment repositioning within the waterway); and in highly contaminated cases, capping or in situ remediation. Considerations for each alternative are described below, and plans should be developed in consultation with local, state and federal agencies and stakeholders. The Massachusetts Riverways Program document entitled *Impounded Sediment and Dam Removal in Massachusetts, A Decision-Making Framework Regarding Dam Removal and Sediment Management Options* (i.e. Impounded Sediment Document) dated June 2003 should be consulted.[4]

A. Sediment Removal and Disposal greater than 100 cy

Submission of the 401 Water Quality Certification Dredge Permit Form[5] is required for projects involving sediment removal and disposal of quantities greater than 100 cubic yards (cy). Sampling and disposal requirements are detailed in the 401 Water Quality Certification regulations.[6] Section 314 CMR 9.07 (2) requires two steps to determine whether further sediment analysis is required:

1. Due Diligence Review: Applicants must perform a "due diligence" review of past and present land use practices in the watershed, upstream of the dam, to determine the potential for the sediment contamination by concentrations of oil or hazardous materials, as defined in the Massachusetts Contingency Plan (MCP).[7] Such a review may include, but is not limited to, an analysis of records of the local Board of Health, Fire Department, and/or Department of Public Works, the Department's Bureau of Waste Site Cleanup, knowledge of historic land uses, information on prior dredging projects and discharges of pollutants in the project area watershed. Table 1 should be consulted for information on the due diligence review.
2. Sieve Analysis: An analysis must be conducted to determine if the sediment to be dredged contains less than 10% by weight of particles passing the No. 200 U.S. Standard Series Testing Sieve (nominal opening 0.0029 inches). Fine-grained sediments (i.e. those passing the #200

[3] To develop a longitudinal profile, a record of the downstream changes in elevation (i.e., slope), along the riverbed must be recorded at regular intervals.

[4] The document published by the MA Department of Fish & Game, Riverways Program, River Restore, in cooperation with MassDEP and others entitled *"Impounded Sediment and Dam Removal in MA - A Decision-Making Framework Regarding Dam Removal and Sediment Management Options"* dated June 2003, contains detailed guidance on handling sediments for dam removal projects. www.mass.gov/dfwele/river/pdf/damremoval_impounded_sediment.pdf

[5] BRP WW 07, 08 Dredging - www.mass.gov/dep/water/approvals/ww0789ap.doc

[6] 401 Water Quality Regulations - www.mass.gov/dep/service/regulations/314cmr09.pdf

[7] *See the MA Contingency Plan, 310 CMR 40.0000 - www.mass.gov/dep/cleanup/laws/mcptoc.htm*

sieve) have a higher potential for having chemical contaminant adsorpsion. Fine-grained sediments, whether or not contaminated, are also more likely to be transported as the river sediment load to distant points downstream and ultimately to the ocean. Since due diligence review does not always identify all potential sources of watershed contamination, the sieve analysis is required as a second test of potential contamination and to provide important information about the physical characteristics of the proposed dredge sediment (i.e. evenly or poorly graded sandy gravel, or highly silty material). The sieve analysis also helps to determine the suitability of sediment for reuse, dewatering specifications, and whether the downstream sediment transport is likely to result in turbidity that could be harmful to benthic or other aquatic organisms.

Table 1: Due Diligence Review Sources of Information

'Due Diligence Review' for Potential Contaminants –
Possible Sources of Information

- Existing and historic industrial use at the dam and impoundment
  - review Sanborn Fire Insurance Maps [http://sanborn.umi.com/] for industrial history of site
  - review local Historical Society information
- Existing and past land use in watershed and at site (e.g. urban areas, agricultural areas, etc.)
- Existing and past industry within the watershed and near the site
  - MA DEP - Source Water Assessment Program (SWAP): Land Use/Associated Contaminants Matrix (DRAFT February 1999) for reference
- Review of environmental databases in watershed with added focus within 1 mile of the site

  Federal Environmental Databases (See http://www.rtk.net/rtkdata.html)
  - Comprehensive Environmental Response, Compensation and Liability Information Services (CERCLIS) or Superfund Sites
  - Resource Conservation and Recovery Information System (RCRIS)
  - Toxic Release Inventory (TRI)
  - Emergency Response Notification System (ERNS) Database (e.g. toxic spills)
  - National Pollutant Discharge Elimination System (NPDES) permits

  Massachusetts Environmental Databases (available at regional DEP offices)
  - 21E Sites (MA Contingency Plan (MCP) – Hazardous Waste sites)
  - Underground Storage Tanks
  - State Landfill and/or Solid Waste Disposal Sites
  - SPILLS Database
  - DEP Regional Files Review

  Local-Municipal Files
  - Board of Health
  - Department of Public Works

Source: ***See page 15, Box 2*** *Impounded Sediment and Dam Removal in Massachusetts – A Decision-Making Framework Regarding Dam Removal and Sediment Management Options* dated June 2003. See footnote 4.

3. Findings of Due Diligence and Sieve Analyses: Once the Due Diligence and Sieve Analyses are completed, no chemical testing is required if the sediment to be dredged contains less than 10% by weight of particles passing the No. 200 U.S. Standard Series Testing Sieve (nominal opening 0.0029 inches), and if the "due diligence" review demonstrates, to the Department's satisfaction, that the area is unlikely to contain anthropogenic concentrations of oil or hazardous materials. If, however, due diligence review demonstrates that the area is likely to contain anthropogenic concentrations of oil or hazardous materials, or if sediment contains greater than 10% by weight of particles passing the No. 200 U.S. Standard Series Testing Sieve then chemical and physical testing must be conducted in accordance with 314 CMR 9.07 (2)(b) and performance standards and disposal requirements in 314 CMR 9.07 must be met.

B. Sediment Removal and Disposal Less than 100 cy [8]

Sediment removal and disposal of less than 100 cubic yards does not require the submittal of a 401 application, provided a Final Order of Conditions has been issued by the local Conservation Commission or MassDEP. In such cases, the proposed work must qualify for a USACOE Category One Programmatic General Permit (PGP). Nevertheless, this guidance document endeavors to promote consistent approvals of sediment management methods among the review authorities. Project proponents must demonstrate (and it is recommended that Conservation Commissions require evidence) that disposal of dredged sediment is managed in accordance with 314 CMR 9.07 (9), (10) and (11).

C. In-Stream Management (i.e. Sediment Repositioning)

In-stream management simply means allowing the river to naturally redistribute the impounded sediment downstream while forming its own channel through the former impoundment or while flowing through a newly constructed channel. In such cases, full dam removal can result in a large one-time sediment release depending on the quantity and mobility of trapped sediment. [9]

1. 401 Contaminant Screening: Because in-stream management involves sediment repositioning, it is considered 'dredging' under MassDEP's 401 Water Quality Certification Regulations (314 CMR 9.00) and project proponents should follow the guidelines above for sampling greater than 100 cy. These guidelines should be followed even if the amount of sediment estimated to be repositioned is less than 100 cy since the sediment will typically be released to downstream areas, and considerations pertaining to this management technique must include protection of downstream ecological and human resources that may contact the exposed sediment. If the due diligence or sieve analysis indicate further physical and chemical testing is needed, then testing should be completed by an environmental professional such as a Licensed Site Professional (LSP) with experience in site assessment prior to taking actions that will disturb or redistribute the sediments. The *Impounded Sediments Document*[10] contains detailed guidance on evaluating contaminant levels in impounded sediments. Depending on the levels of contaminants found in the sediments, alternative sediment management options should be considered. There are cases where dredging of sensitive habitat may do more harm than allowing the sediment to redistribute downstream. Therefore, careful consideration should be taken, weighing the advantages and disadvantages of dredging on the natural ecosystem.

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[8] Note that MassDEP is reviewing this threshold for modification and applicants should check the MassDEP website for future changes: www.mass.gov/dep/service/regulations/314cmr09.pdf

[9] As a general rule, the Army Corps of Engineers has determined that the discharge of substantial quantities of accumulated bottom sediment from or through a dam downstream waters constitutes a discharge of dredged material (and possibly of fill material) that requires a section 404 permit (see www.usace.army.mil/cw/cecwo/reg/rgls/rgl_05_04.pdf). For projects requiring a Section 404 permit, a 401 Water Quality Certification is also required.

[10] Footnote 4, Section III, Sediment Evaluation: Contaminant Screening

2. Massachusetts Contingency Plan (MCP) Responsibility for Exposed Sediments: Frequently dam removal results in the exposure of sediments that were previously under water. Upon exposure, (i.e. above high water mark), these sediments will qualify as soil under the MCP. The MCP does not have notification thresholds for contaminants in sediment. However, once contaminated sediment becomes exposed on the new shoreline, the former sediment would now be considered soil and the MCP has notification thresholds for contaminant levels in soil. The effect is that the property owner would now have a MCP notification obligation if the sampling of the soil exposed as the result of the dam removal is found to be above MCP reportable concentrations. When sediments will be exposed as a result of dam removal, testing of the material that will be exposed is recommended to prevent human and environmental contamination concerns and to avoid future liability for cleanup. Project proponents should contact MassDEP Wetland and/or Waste Site Clean Up Programs for guidance on testing and proper disposition of soils in these areas[11] as appropriate management techniques may exist for these scenarios.

3. Alternative Management Options at Highly Contaminated Sites: In highly contaminated situations[12] , alternatives such as removal and disposal, capping it with a layer of clean material (Confined Aquatic Disposal) or use of a containment structure (Confined Disposal Facility)[13] in place may need to be considered to insure the protection of both the ecological resources and people who may contact the exposed sediment. Dredging options must be evaluated in consultation with local, state and federal regulators, including staged, partial, or full removal sediments. Sometimes, sediments may be too contaminated to dredge, as dredging will resuspend a certain portion of sediments. In these situations, capping of "hot" sediments may be needed. If capping is being evaluated, it must be demonstrated that this action will reduce contaminant availability to aquatic and terrestrial ecosystems, and to humans. Long-term stability of the proposed cap should also be evaluated since the river current has the potential to erode the cap. In general, it should be demonstrated that capping won't unnecessarily disrupt the remaining ecosystem. Projects of this nature will require compliance with the Confined Disposal requirements at 314 CMR 9.07(8).

4. Quantity Assessment: If the due diligence and particle size tests demonstrate that contamination is unlikely, or if additional sampling and analysis concludes that the project will protect ecological and human resources; then a project may proceed with in-stream management of sediments, provided that the following matters are considered. Once a dam is removed, sediment will exit the impounded area and will move downstream with the release of impounded waters. Some sediment, though, will remain in the formerly impounded area. In addition to initial assessments of sediment particle size and potential contaminants, an evaluation should be made as to what quantity of materials will be "mobilized". The quantity that is mobilized is roughly equivalent to the length by the cross-sectional area of the stream that will form in the formerly impounded area.[14] Once the quantity of the sediment to be mobilized is determined, the morphological effects of sediment release should be evaluated. Although in-stream management restores the natural sediment transport functions including stream bed and flood plain development and nutrient transport that were interrupted by dam placement, a project should not result in any long-term changes in downstream morphology by filling natural pools or burying natural riffles.[15] Projects must include best management practices to avoid turbidity in upstream and downstream waters. Incremental or staged dam removal controls the rate of sediment transport and is often preferable. A staged removal can be accomplished by slowly drawing down the impoundment level either by utilizing an existing gate or by incrementally removing the dam structure. Consideration must also be given to avoiding work during time of year restrictions for aquatic species.

[11] See section III of the *Impounded Sediments Document* for Guidance on evaluating contaminants in exposed sediments (i.e., dewatered and stabilized in place).

[12] Note that highly contaminated situations are where levels of constituents exceed the MA Contingency Plan thresholds found at 310 CMR 40.0000 and also at www.mass.gov/dep/water/laws/ecoturss.pdf; or if indicated after following the contaminant screening section of the Impounded Sediments document.

[13] See 314 CMR 9.07(8) for further details.

[14] *"Impounded Sediment and Dam Removal in MA - A Decision-Making Framework Regarding Dam Removal and Sediment Management Options"* page 23, June 2003, contains detailed guidance on handling sediments for dam removal projects. www.mass.gov/dfwele/river/pdf/damremoval_impounded_sediment.pdf

V. Channel/Riparian Restoration

When a dam is removed, the impounded sediments are exposed and may become unstable and subject to erosion. Some of these sediments will move downstream; what remains may require stabilization to limit erosion. The upstream banks of the former stream channel may reappear and, while historically these banks were held in place by vegetation, upon re-emergence, that vegetation does not exist. The most important aspect of bank stabilization is having a channel configuration that is appropriate for the stream flow and sediment load of the stream. If the stream slope, cross section size and shape, and meander pattern fits the river system, then only minimal bank stabilization may be necessary. More extensive bank stabilization or bank reconfiguring through bioengineering techniques and grade control may be required in the short term until natural recolonization or where the exposed channel configuration does not match natural conditions.

Once a dam is removed, the affected channel characteristics will likely undergo change due to the reintroduction of the sediment-carrying function of the stream. Immediate channel reconfiguration will likely be limited to the extent of impounded sediments, but may cut into the original substrate. If channel cuts extend beyond the historic bank substrate, there may be a need for a grade control. There are many methods for providing grade control (e.g. cross vanes) however, it is most important that the method used is appropriate for the specific characteristics of the river or stream.

As part of the dam removal project and subsequent riparian restoration, aquatic habitat enhancements may be considered. These enhancements may include creating pools, adding boulders installing logs and enhancing irregular edges.

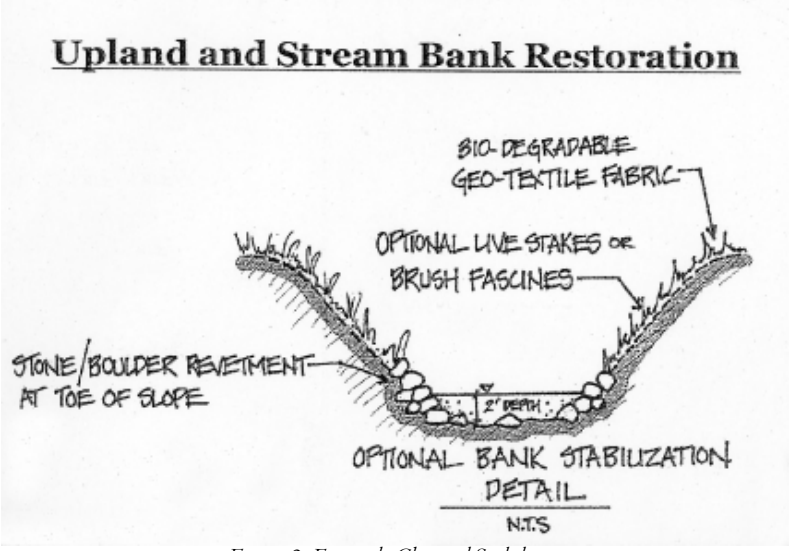

Figure 2: Example Channel Stabilization

VI. Weighing the Benefits and Impacts of Dam Removal

Because dam removal projects may be (and have been) considered as limited projects under 310 CMR 10.53(4), traditional mitigation requirements are discretionary. Due to the nature of these projects, the purpose of which is to improve the natural capacity of a resource area, the mitigation benefits include the general restoration of wetland resources and, specifically, the riverine ecosystem. During project review, applicants should document the benefits and impacts associated with dam removal. In doing so, the long-term benefits of a dam removal project are likely to outweigh the short-term impacts and the distinction should be addressed in

Boulders placed along the edge of restored stream channel to enhance fish passage upon removal of Ballou Dam in Becket, MA

the application. Although a project does not need to improve the natural capacity of the resource area to protect all of the interests of the WPA (e.g. flood control, storm damage prevention, protection of fisheries), it must improve at least one interest and it should minimize the adverse affect on the interests that are not targeted for improvement. The following are some examples.

- The regulations for bordering vegetated wetland (BVW) at 310 CMR 10.55 require a 1:1 replacement to loss ratio. While providing many benefits, dam removal may result in the loss of upstream BVW due to the changes in hydrology, and the requirement of BVW replacement may be a disincentive for a dam removal proponent. Because dam removals are limited projects, under 310 CMR 10.53(4), the issuing authority may waive the requirement for 1:1 replacement since these projects will restore or otherwise improve the natural capacity of resource areas to protect Wetland Act interests. Dam removals typically result in changes in the type or specific location of wetland resources. Often, when BVW is lost at one elevation around the impoundment, BVW will be established at a lower level associated with the restored, and highly productive riverfront area. In more developed areas where BVW cannot reestablish, the benefits may be in improved wildlife, fisheries and storm damage prevention functions of the free flowing river (see Sections below). In some cases, restoration of the stream channel in the immediate vicinity of the dam should be proposed and may include proactive bioengineering or revegetation to promote streambank stabilization. For instance, proactive efforts would be advisable when BVW is expected to be impacted within the footprint of the project or when the stream channel requires reconfiguration. In other cases, natural succession and revegetation may be adequate. In these cases, replanting is not required but projects should be conditioned to help prevent the growth of invasive species in the dewatered impoundment and to require regular monitoring.

- Dams fragment habitat. Many species that depend on flowing water, such as Atlantic salmon, brook trout, river herring, shad and sturgeon have suffered dramatic population declines, in part due to the loss of flowing water and riverine habitat caused by dams and the loss of access to upstream spawning habitat. The removal of a dam reconnects the upstream and down stream river lengths, significantly expanding the area and quality of land under water for fisheries habitat. While the presence of additional dams upstream or downstream may limit the extent of restoration, dam removal can still provide benefits, even on limited reaches of rivers.

- Dam removal can significantly improve the fisheries and prevention of pollution interests of land under water by restoring natural riverine thermal regimes that support cold water fisheries habitat. Trout and other cold water species have very restrictive temperature requirements for survival, growth and reproduction. Impoundments increase summer water temperatures significantly by creating larger, slower moving water surface areas exposed to sun. Warmer temperatures decrease the dissolved oxygen content of the water both in the impoundment and for some distance downstream of the dam. Dam removal can eliminate thermal pollution and associated water quality problems along miles of resource area.

- Dam removal can significantly improve the flood control and storm damage prevention functions of wetland resource areas by restoring the natural ability of the riverine system to moderate flow and absorb floodwaters. Except for dams specifically designed for flood control, most dams do not provide flood control benefits and their removal may actually alleviate upstream flooding while eliminating potential catastrophic dam failures. An unanticipated failure of a dam will result in much more severe impacts than a prudently planned dam removal. Preservation of human-made ponds formed as a result of a dam require dam maintenance in perpetuity. Unless there is a reason to preserve the human-made impoundment, such as

an endangered species living in the impoundment[16], prevention of erosion of contaminated sediments or to protect against downstream flooding, then replacement of the "impoundment" wetland with a "riverine" wetland may be preferable in order to restore the natural ecosystem functions. As part of dam removal planning, down stream hydrology should be assessed both short-term (during the actual dam removal and a few days after) and long-term (permanent hydraulic change). The hydrolgic assessment must include an analysis as to whether the dam removed will increase the horizontal or vertical extent of flooding downstream.

VII. Wetland Impacts

In some cases, the loss of upstream wetlands may be offset by the overall benefits of the river restoration. For example, in some cases, dam removals have resulted in new or even increased amounts of wetlands overall. The effects of the changed hydrology and sediment and nutrient transport on upstream or downstream receptors (e.g. rare or endangered species, vegetated wetlands, drinking water supplies, groundwater tables, spawning areas or other habitat features for species of fish, shellfish, reptiles and amphibians) should be evaluated and mitigation measures proposed as necessary.

Short-term impacts may include increased turbidity, altered flows, and disturbances from heavy equipment. These disruptions, though short-term, should be timed appropriately to lessen impacts. Dam removal should be timed so as to avoid coinciding with fish spawning runs. Applicants should be aware that time-of-year restrictions are commonly required for projects through Section 404 Dredge and Fill permits administered by the Army Corps of Engineers, WQC issued by MassDEP, and Orders of Conditions issued by local conservation commissions. Consultation with the Division of Marine Fisheries (coastal) and/or the Division of Fish and Wildlife (inland) is recommended.

VIII. Design and Construction Details

A plan showing the dam removal and site restoration design, along with a discussion of construction techniques and equipment staging areas are required in a permit application. Because dams are located within dynamic riverine environments, a multidisciplinary consulting team with expertise in such diverse areas as engineering, hydraulics, aquatic biology and fluvial geomorphology should be consulted during project planning to minimize short and long-term adverse impacts and ensure successful long-term ecosystem restoration.[17]

Application details should include:

- A plan prepared in accordance with the additional information requirements for the Notice of Intent Site Plan as detailed in the Notice of Intent instructions (WPA Form 3: Notice of Intent) at: http://www.mass.gov/dep/water/approvals/wwforms.htm.
- Existing wetlands shown on a plan along with anticipated changes. See USGS maps or DEP Orthophotos at: http://maps.massgis.state.ma.us/WETLANDS12K/viewer.htm (Note that while maps and photos may be used to show upstream and downstream resources, field delineation should be conducted in the immediate vicinity of the dam).
- A typical drawing showing how the area will be dewatered (if required) prior to dam removal to prevent flooding and limit downstream sedimentation. The plan should address use of low-level outlets, or, if not available, the use of siphons for dewatering. Stockpiling locations and stabilization of dewatered materials should also be addressed.
- Methods of dam removal and associated structures should be discussed, including methods for demolition of concrete, if applicable.

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[16] In the case of State Listed Rare Wetlands Wildlife, the Massachusetts Endangered Species Act (MESA) and its regulations will be triggered. MESA, in the case of an endangered species taking, can require mitigation and issuance of a permit.

[17] For more information regarding this document, contact the Riverways Program at 617/626-1540 or go to their website: www.mass.gov/dfwele/river/index.htm

- Sediment management practices as required by 314 CMR 9.00 and discussed in Section 3: Sediment Management above(e.g. dredge, in-stream channel and bank stabilization)
- Specifications detailing stream channel and bank restoration in the vicinity of the dam removal.
- Type and location of erosion and sedimentation control measures to be implemented to protect resource areas.
- Description of the sequencing of construction activities (e.g. clearing first, silt fence installation next, dewatering)
- Minimization of impact on aquatic organisms can be achieved by a controlled drawdown rate, a plan to move species before the start of construction, or a fish salvage plan if disconnected pooled water is anticipated during dewatering.
- Invasive vegetative species monitoring and control plan.

IX. Monitoring

There are two levels of monitoring at dam removal projects, post-construction monitoring and habitat monitoring. The first should be completed at all projects and includes periodically evaluating the project site for any risks to infrastructure such as utilities, retaining walls, bridges, and culverts, and evaluating the river channel for excessive erosion or sediment deposition. Photo stations should be set up to periodically create photo documentation of the site over time. Habitat monitoring can also be completed to assess the development of habitat features of particular interest at the project site. These features could include measurement of changes in vegetation (particularly invasive species), sediment, stream channel geometry, hydrology, fisheries and wildlife.[18]

Concrete demolition at the Ballou Dam after a precision dam cut away from the adjacent retaining walls in Becket, MA.

X. Dam Removal as 10.58(5) Mitigation

The Wetlands Protection Act Regulations include a section on Redevelopment of the Riverfront Area found at 10.58(5). This section provides for the redevelopment of previously developed or degraded riverfront areas. In some cases, applicants may choose to restore or otherwise mitigate riverfront area (See Section 10.58 (5)(g)). Dam removal is a form of river restoration, so such a proposal may be considered a mitigation project by the issuing authority under 10.58(5) *Redevelopment.*

[18] Barrier removal monitoring standards are being developed by the Gulf of Maine Council for the Marine Environement in conjunction with the MA Riverways Program. Contact the Riverways Program for details.