

Executive Summary

ES.1 Background and Purpose

In 2013, the City of Worcester, Massachusetts (the City) began the process of developing a feasibility study to look at possible options for the removal of the Poor Farm Pond Dam (PFPD). The dam is owned by the City of Worcester and is located in the Town of Shrewsbury (Town) on the Worcester-Shrewsbury municipal boundary. The dam was constructed in the early 1800's likely for irrigation of the Home Farm on the site. Removal of the dam will eliminate potential liability and costs associated with ownership of the dam. Removal of the dam will also restore natural fluvial processes and improve riparian habitat in the dam impoundment and the adjacent reaches of the brook.

The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) awarded a \$138,300 grant to the City to conduct a feasibility study of the removal of the Poor Farm Pond Dam. The grant is part of the Sustainable Water Management Initiative (SWMI) program, which is an EEA effort to maintain healthy rivers and streams and improve degraded water resources. The SWMI grant program is aimed at assisting water suppliers with planning projects for specific watersheds, developing implementation projects to improve ecological conditions, and managing projects aimed at reducing the demand for water within a municipality or watershed.

Dam removal alternatives considered for this feasibility study included a partial dam removal and full dam removal.

ES.2 Physical Characteristics of the Site

A drainage area of approximately 3.7 square miles contributes flow to the PFPD, which impounds an area of approximately 2.8 acres ranging in depth from a few inches to about 4 feet. Sediment has accumulated behind the dam to a depth of 1-foot up to about 4 feet. Sediment depths and elevations were determined with a bathymetric survey of the impoundment and sediment sampling.

The dam is classified as intermediate size and a low hazard. The dam is about 110 feet long and 16 feet high with a spillway of about 16 feet. The dam is in poor condition with significant holes in the spillway apron and cracks and failures in the side training walls.

ES.3 Existing Resources

As part of this feasibility study, existing resources were identified in the areas around the Poor Farm Pond Dam. These resources included watersheds, water resources, wetlands, wildlife habitat, fisheries, floodplains, rare and sensitive habitats, historic and archeological resources, land uses, and nearby utilities. It was determined that removal of PFPD would not have a permanent negative effect on any of these resources and in fact would improve the quality of water resources and fisheries.

ES.4 Hazardous Waste Sites and Characterization of Sediment/Soil

Five sites regulated under the Massachusetts Contingency Plan (MCP) within 1.5 miles of the PFPD were identified and all sites have been either found to have No Significant Risk or closed out with an Activity and Use Limitation. A dam removal would not impact these sites.

Five locations were sampled for sediment and underlying soil characteristics. Four of the sample locations were within the impoundment area and one was upstream of the impoundment area. At each location, an upper sample was collected for sediment and a lower sample was collected into the native soil material. Sediment samples were tested for metals, volatile organic compounds, semi-volatile organic compounds, polychlorinated biphenyls (PCBs), total petroleum hydrocarbons and extractable petroleum hydrocarbons. The soil samples were tested for metals.

The sediment sample results were compared against human and ecological risk criteria. Some of the human risk criteria (principally metals) were exceeded if the sediment is left in place and drained so that it becomes soil. These levels, however, were only slightly exceeded. Since access to the site is limited it is anticipated there would be minimal exposure. In the case of arsenic, the concentrations found were consistent with background concentrations.

The sediment sample closest to the dam (PFD2) exceed ecological risk criteria and sediment should be removed prior to work in the dam area. The other sediment samples only exceeded a few specific analytes and would pose a very low ecological risk and may not need to be removed. However, because sampling was not extensive and potential regulatory positions are not solidified on removing sediments upstream of the immediate dam spillway, it was assumed that sediment would be removed along the proposed flood channel (see paragraph ES.7 below) for purposes of developing planning-level costs in this feasibility study. If the City, regulatory agencies, and affected stakeholders agree on release of the sediments downstream, the cost of dam removal could be lowered.

ES.5 Hydrologic and Hydraulic Analysis

A hydrologic and hydraulic analysis was conducted for the Poor Farm Brook and dam site starting about 1,200 feet upstream of the dam and ending where the brook enters Lake Quinsigamond. The analysis used the US Army Corps of Engineers HEC-RAS model and evaluated average day flow and the 100 year storm event. Under either partial or full removal alternatives considered, removal of the PFPD will have little or no impact on the flood stage from current conditions. In the area immediately upstream of the PFPD, removal will increase the channel flow velocities and lower the peak flood elevation.

ES.6 Sediment Transport and Evaluation

A sediment transport model (MBH's HEC-6T) was run using best available representative data on the native soils in the area. Site-specific information as to whether a non-erodible layer exists for the native material was not available. Lacking such information on the presence of a non-erodible layer of native material, the model showed rapid erosion to the lowest depth of the downstream end of the removed dam. Detailed boring information should be collected in final design to confirm the model

results. For the purposes of this feasibility study, it has been assumed that armoring the channel bottom will be necessary to resist further erosion after dam removal.

ES.7 Alternatives

Two alternatives were considered for removal of the Poor Farm Pond Dam; a partial removal, retaining some of the existing structure and a full removal to demolish the entire structure and move the channel slightly east.

The partial removal consists of removing the spillway, lowering the dam apron to the estimated natural stream grade, and repairing the side training walls. A full removal would demolish portions of the dam above finished grade and move the channel slightly east so that the west side of the channel could be stabilized with grading back to the existing grade without constructing retaining structures.

Under both alternatives, a flood channel approximately 14 feet wide would be excavated through the sediments to the natural stream bottom grade from the dam upstream to the existing natural channel. Within the flood channel, a flow channel would be constructed using “natural channel design techniques” to form a suitable armored bottom and habitat during average flows. There was discussion at the draft review meeting with regulators and stakeholders that the channel should be left to naturally re-establish its own channel. At this point in the feasibility study, sufficient data is not available to determine if a stable stream bottom could be reached with native materials. In addition, opinions differ as to whether releasing the sediments downstream poses an unacceptable outcome. As such, the project costs include removing sediments in the flood channel and constructing a flow channel. This is a conservative approach for decision-making purposes as to whether the project should proceed to implementation and further evaluation during preliminary design and permitting can agree on a definitive channel alternative and associated costs.

ES.8 Environmental Permitting

Permitting for this project is assumed to be conducted after the proposed revisions to the Massachusetts Wetlands Protection Act (310 CMR 10.00) have been finalized. These revisions are expected to establish a General Permit for Ecological Restoration for qualifying projects such as dam removal. Additional permits would be required prior to construction, but the overall process is anticipated to be simplified.

ES.9 Costs

The total opinion of probable project cost is estimated to be \$880,000 for the partial dam removal and \$980,000 for the full dam removal. A present worth analysis was conducted taking into account estimated annual costs and repair costs for each alternative over a 20-year planning period. The present worth of the partial dam removal is slightly greater than the full removal alternative, but at this level of study the costs can be considered equivalent. A breakdown of these costs is presented in the table below.

<i>Cost Item</i>	<i>Probable Cost Partial Dam Removal</i>	<i>Probable Cost Full Dam Removal</i>
Construction ¹	\$630,000	\$700,000
Escalation to Mid-Point of Construction ²	\$30,000	\$40,000
Project Contingency, Engineering and Implementation ³	\$220,000	\$240,000
Total	\$880,000	\$980,000
Present Worth of Alternative	\$1,084,000	\$1,005,000

Notes:

¹Construction includes construction contingency of 25%.

²Escalation to mid-point of construction assumes mid-point of construction occurs in March 2015. Escalation assumed to be 3% per year of the sum of the construction and construction contingency.

³Project contingency is 10% of the sum of the construction, and escalation to mid-point of construction. Engineering and Implementation is 20% of the sum of construction, and escalation to mid-point of construction.

ES.10 Preferred Alternative

A list of non-cost criteria was considered in addition to costs for selecting a preferred dam removal alternative under this feasibility study. Out of 10 criteria considered, only two were materially different between the alternatives. Lower liability for the future site with structures removed and slightly less complex construction with no structures to build or repair favored the full dam removal alternative. Given the nearly equivalent present worth cost, the full dam removal alternative is the preferred alternative of the City of Worcester.

Given the uncertainty of a natural brook environment, monitoring of the site will be necessary in the future. Additional work will also need to be conducted during design and permitting to finalize the balance between a fully natural brook restoration and engineered brook restoration. Comments were received by regulators and these will need to be fully evaluated in the design and permitting process should the City of Worcester decide to move forward with implementation.