Section 10

Preferred Alternative and Future Considerations

10.1 Preferred Alternative Analysis

This section evaluates several non-cost issues for the two Poor Farm Pond Dam removal alternatives (as identified in Section 7) considered suitable to meet the overall goals of this feasibility study. This section includes a discussion of the non-cost issues. The cost-only issues related to the project are included in Section 9.

The preferred alternative is identified based on the strengths and weaknesses of the non-cost factors, including the permitting considerations, and the costs.

10.1.1 Non-Cost Evaluation Criteria

A comparative matrix was developed for both alternatives. Ten major aspects of the dam removal project were selected for comparison:

- Safety liability for the City of Worcester
- Upstream and downstream issues
- Fisheries restoration
- Permitting requirements
- Existing resources
- Contaminated sediments
- Hydraulic conditions
- Water quality
- Constructability
- SWMI

All criteria were compared based on whether or not it was more or less advantageous to implement a partial or a full dam removal. Since these two alternatives are very similar, eight of the ten criteria show no advantage for either alternative. The definition and approach for each criterion is described below. Table 10-1 presents all of the criteria.

Table 10-1
Non-Cost Criteria Matrix for Removal Alternatives
Poor Farm Pond Dam

Item	*Partial Dam Removal*	*Full Dam Removal*
Safety liability for the City of Worcester	Liability still exists	Low liability – all structures removed
Upstream and downstream issues	No impact on bridges/structures, stream channel	
Fisheries restoration	Cold water fishery restored	
Permitting requirements	Permitting expected to be similar	
Existing resources	No permanent negative impacts on resources identified	
Contaminated sediments	Removal of sediments in upstream flood channel to prevent movement downstream	
Hydraulic conditions	Dam removal will not have adverse impacts to hydraulics of stream	
Water quality	Instream dissolved oxygen improved	
Constructability	More infrastructure construction and repair	Mostly civil and demolition work
SWMI	Habitat improvement credit equal	

Each individual criterion was considered individually to reflect the perceived advantages. The discussion below details the considerations included in the evaluation.

Safety Liability

Safety Liability: A safety liability for the City still exists for the partial dam removal option because much of the dam's superstructure will remain under this option. Although the structure would no longer be regulated as a dam by the Office of Dam Safety, the City would remain obligated to maintain the remaining structures and inspect them regularly. This obligation is eliminated under the full removal option because all structures would be removed.

Result: The full dam removal is preferred.

Upstream and Downstream Issues

Upstream and Downstream Issues: Under both alternatives, upstream and downstream issues with considerations for flooding, wetlands, channel protection, structures and erosion are considered. The impacts are considered to be equivalent for the two alternatives.

Result: Both alternatives are equal.

Fisheries Restoration

Fisheries Restoration: Under both alternatives, the channel will be designed to maximize the migration of cold water fish to upstream reaches of the watershed. The proposed changes to the channel throughout the site are considered to be equivalent for the two alternatives in terms of habitat restoration.

Result: Both alternatives are equal.

Permitting Requirements

Permitting Requirements: Under both alternatives, the permitting requirements are expected to be similar. The differences between the two options are not expected to trigger any additional or different permitting requirements.

Result: Both alternatives are equal.

Existing Resources

Existing Resources: Under both alternatives, the existing resources would not be negatively impacted on a permanent basis, and similar restoration of the natural resources is expected.

Result: Both alternatives are equal.

Contaminated Sediments

Contaminated Sediments: Under both alternatives, contaminated sediments in the stream channel would be taken away to prevent movement of these sediments downstream. The sediments that remain would be stabilized and planted with natural vegetation to further stabilize the area. Under both alternatives, the amount of sediment to be removed and stabilized is similar.

Result: Both alternatives are equal.

Hydraulic Conditions

Hydraulic Conditions: Under both alternatives, hydraulic conditions in the stream channel will be similar. Although the stream channel would be moved east approximately fifteen feet in the full removal alternative, the differences will be negligible. Removal of the dam will not have any adverse impacts to the hydraulics of the stream.

Result: Both alternatives are equal.

Water Quality

Water Quality: Under both alternatives, in-stream dissolved oxygen levels would be improved due to the restructuring of the stream channel and increased velocities through the site.

Result: Both alternatives are equal.

Constructability

Constructability: Under the partial dam removal alternative, more infrastructure construction and repair would need to take place to stabilize the abutments, training walls and retaining walls. Under the full dam removal alternative, additional site work including fill materials and regrading are necessary. The full dam removal adds a level of complexity to the project because of the additional site work and demolition. Site access is also more challenging because access will needed on the east and west side of the dam for the full removal.

The constructability of both options is feasible, but the full dam removal is a less complex project to implement because it is primarily a demolition and site grading project. The full dam removal and does not include superstructure repair and stabilization of crumbling infrastructure.

Result: The full dam removal is preferred.

SWMI

SWMI: Recently, the Commonwealth of Massachusetts launched the Sustainable Water Management Initiative (SWMI) to develop and implement water policy decisions that support ecological needs while meeting the needs of economic growth. The successful removal of the dam is an implementable management decision that would give an equal amount of SWMI habitat improvement credits under both alternatives.

Result: Both alternatives are equal.

10.2 Preferred Alternative

Based on both the non-cost issues presented in this section and the cost analysis presented in Section 9, the full dam removal is the preferred alternative for this project.

10.3 Future Steps

The technical evaluations and analyses in this feasibility study were used to determine the overall costs and impacts of removing the Poor Farm Pond Dam. Upon acceptance of this removal feasibility study and should the City of Worcester decide to move forward, it will need to begin the design process (Preliminary and Final Design). During the design process, the specifics of the project must be considered in greater depth than the feasibility study. To begin, the designers will consult the Executive Office of Energy and Environmental Affairs (EOEA) dam removal guidance document to supplement any other study needs. All of the interested state and local agencies will need to be contacted to determine the approach to the project that includes overall timing of the project, the best practices required to protect the environment (fish, wildlife and wetlands), timing of construction, planting and soil stabilization, appropriate sediment management plans (placement and disposal), additional soils/sediment sampling if required, and follow up investigations to determine if the desired result is achieved at the site.

10.3.1 Monitoring Plan/ Follow-Up Monitoring

Follow-up monitoring and maintenance of the Poor Farm Pond Dam site would be necessary to ensure that the restored area around the dam remains stable. The vegetation selected for restoration must

be checked to ensure that the selection is suitable for the actual field conditions. The project must also be monitored to ensure that colonization of the site by invasive species is kept to a minimum. A recommended monitoring schedule will consist of three to four visits during the first one or two growing seasons followed by semi-annual visits for two to three more years. This schedule may need to be adjusted depending on the degree to which control of invasive species may be necessary.

There are two types of monitoring at dam removal projects, post-construction monitoring and habitat/long term monitoring.

Post Construction Monitoring

The post construction monitoring should be completed the end of construction. It includes an evaluation the project site for any risks to infrastructure such as utilities, retaining walls, bridges, and culverts with an evaluation of the channel for excessive erosion or sediment deposition. A project evaluation would initially be completed by the contractor and construction manager immediately following project completion. However, the City would also conduct regular walkthroughs of the site. A checklist would be developed to assist in visual inspection, which might include vegetation growth, erosion, and scour around infrastructure, such as pipes, retaining walls, and abutments.

Habitat / Long Term Monitoring

Habitat and long term monitoring are also important for the success of the project. Photo stations could be set up as part of the monitoring to regularly photo document the site over time. Habitat monitoring would also be completed to assess the development of habitat features of particular interest at the project site. Since the dredging of sediment is not always necessary during a dam removal, the long term monitoring checklist will also include a detailed inspection to determine if the sediments left in place have stabilized. It will also be used to assess if the areas where the sediment was removed continues to remain free of sediments.

10.4 Additional Issues for Consideration

10.4.1 Agency Review Meeting – June 19, 2013

At the June 19, 2013 draft report meeting for the Poor Farm Pond Dam removal feasibility study, several additional issues were raised that may need to be further considered outside of the scope of this feasibility study. Those issues are listed below:

1. The Massachusetts Department of Fish and Wildlife and the Massachusetts Department of Ecological Restoration suggested allowing the natural stream (upstream of the dam) to develop rather than constructing any type of engineered channel. The suggestion was to remove the dam and allow the stream to naturally form. Once the natural channel is formed, the slopes could be stabilized in a second phase of construction (1-2 years later).

2. Both the Massachusetts Department of Fish and Wildlife and the Massachusetts Department of Ecological Restoration acknowledged that the above approach was only feasible if the sediments in Lake Quinsigamond were similar to the sediments at the Poor Farm Pond dam project site. It was acknowledged at this meeting that further investigations may be required to characterize the

sediments in Lake Quinsigamond. This approach would need to be approved by other state agencies and the public.

3. This feasibility study adopted a conservative approach to sediment management by utilizing an armored channel for the area upstream of the dam and stabilization measures for the sediments to be left in place. While this approach is appropriate, it could be less costly to create a more natural channel that is not armored provided that the sediments transported from the impoundment area were within acceptable limits (chemical testing and volume). For this to be appropriately assessed, the sediment transport model would need to be refined to include additional site-specific subsurface data and re-run.

4. The Massachusetts Department of Fish and Wildlife and the Massachusetts Department of Ecological Restoration also suggested implementing an appropriate follow up program to ensure that unwanted invasive species do not overrun the project site. These agencies noted that measures are available to minimize the establishment of invasive species after construction.

10.4.2 Supplemental Comments

The following comments were received from Richard Hartley, MassWildlife:

"Based on the information presented at the meeting today and in the Feasibility Study, to best protect the existing coldwater fishery within Poor Farm Brook and revert the current pond habitat back to potential coldwater habitat, the Division recommends either, the partial removal option or the full removal option without relocation of the stream bed. To the greatest degree practicable, the Division would like to see the channel reestablish itself naturally after several years of high flow events. To truly convert the ponded area back to coldwater habitat, plantings of shade trees within the riparian zone will be required to eventually created the canopy necessary to maintain colder water temperatures. Similarly, we would like to see the channel naturally establish itself upstream of the dam rather than creating a new channel. If the existing water main is to be relocated below the streambed, current technology exists to place interlocking concrete pads above the pipe flush with the streambed which eventually cover over as they are subjected to sediment deposition. Additionally, best management practices for erosion and sedimentation control must be adhered to for all phases of construction to minimize potential impacts to the fisheries resources. Traditional hay and/or straw bales should be avoided in favor of fiber rolls. To the greatest extent practicable, all in stream work should be conducted during low flow periods throughout the year. Times of year when stream flow is high due to extended rain and/or snow melt events should be avoided. Also, if the project will alter the streambed, we request that the existing grade be maintained. Within the riverfront areas, stream bank stabilization should incorporate bioengineering with natural materials such as vegetated geogrids, fiber rolls, live stakes and tree revetments in lieu of the use of hard structures such as rip rap, gabion baskets or retaining walls. Although stormwater impacts to the brook are outside of the scope of this project, if the goal is to restore coldwater fisheries habitat, currently, warmwater run-off into the brook, especially during summer storm events, is the single biggest impact resulting in frequent fish kills. Per DEP's stormwater management standards for critical areas such as coldwater fisheries resources, BMPs are required that assure no untreated or warmwater runoff from impervious surfaces directly enters these resources. Recent studies have shown that stormwater BMPs that allow standing, surface water function as "heat sinks" in summer and lose heat in winter. As such, retention and

detention ponds, vegetated swales and hydrodynamic separators also have little value as stormwater BMPs in the vicinity of coldwater resources. Stormwater systems that have been found to be most protective of these resources are subsurface, infiltration, gravel wetland and bioretention. Ideally, a chain of coldwater BMPs (e.g., bioretention to gravel wetland to an infiltration system) with deep infiltration and filtration capabilities will cool the stormwater to ground temperature in both summer and winter thereby providing the most effective long-term protection of the coldwater resources. Thank you for the opportunity to comment on this important project and we look forward to working with you and the City of Worcester to make sure we get the best outcome possible."

Response:

1. The issue of natural stream bed reformation was discussed in Section 10.4.1 above.

2. Leaving the stream bed in the same location under the full dam removal presents some slope grading and stability issues, which may require construction of a large retaining wall; this can be reconsidered during the design phase.

3. Erosion recommendations appear reasonable to implement.

4. It is intended that natural materials would be used to the greatest extent for stabilization; this would be detailed in the design phase.

5. Stormwater management issues, while important to water quality, will need to be discussed with other agencies and handled as part of the permitting process.

The following comments were received from Nick Wildman, Division of Ecological Restoration:

The following comments are based on the summary of the Feasibility Study presented by CDM Smith on behalf of the City in a meeting on June 19, 2013, the Site Reconnaissance Memo by Stantec in 2012, and a site visit by Nick Wildman made with DEP staff on June 19, 2013. The level of detail provided appears to be acceptable for a Feasibility Study-level. DER does not suggest the City or CDM undertake more analysis as part of the present scope, but offers most of the following as suggestions for future phases.

DER was not presented with a full draft Feasibility Study, but based on the presentation made by CDM Smith, DER understands that an estimated 3,500 CY of sediment are impounded behind the Poor Farm Pond Dam, 560 CY of which would be mobilized or need to be otherwise managed in a dam removal scenario.

From a channel and sediment management perspective, the partial removal and full removal options are identical. The full removal alternative would certainly facilitate treatment of the steep left bank and associated retaining walls, etc.

Following on comments made by Rich Hartley of the Division of Fisheries & Wildlife at the meeting, DER would advise further data collection and analysis of sediment management options other than offsite disposal. The City and its consultant should rely on guidance found in DEP's Dam Removal and the Wetlands Regulations document (http://www.mass.gov/dep/water/resources/dampol.pdf) as a basis. Sampling from Lake Quinsigamond sediments and other depositional areas downstream of the

dam might indicate levels of contamination similar to those found in the impounded sediment of Poor Farm Pond Dam. As an alternative, upland reuse might be feasible particularly in the upland to the east of the dam. DEP's Wetlands & Waterways Division should be consulted about the particulars regarding a Dredge Material Reuse Decision which would be required due to the elevated levels of some heavy metals in the sediment. Either downstream release or upland reuse could provide a substantial cost savings over offsite disposal. Upland reuse with a clean cap such as might be possible at Poor Farm Pond Dam was permitted for contaminated sediments at the Eel River Restoration site in Plymouth (DEP Transmittal # x224682).

Furthermore on the topic of contamination, it will be beneficial to revisit the contamination levels found in the sediments with regard to background concentrations of arsenic and other metals that may be naturally occurring in the project area soils. In addition, the City's consultant should evaluate sediment management options with regard to exposure risk and available institutional controls (e.g. deed restrictions) in addition to physical controls (e.g. capping or offsite disposal). A good project precedent might be the Town Brook Restoration Project (DEP Transmittal #x321450). In this case, a Dredge Material Reuse Decision authorized the reuse of formerly impounded sediments for planting medium based on institutional controls the prohibit the use of the land for activities that might increase risk of exposure to heavy metals (e.g. eating soil or vegetables farmed on the soil).

For ecological reasons we recommend minimizing hard channel construction to the extent possible. Further analysis should be undertaken and the input of fluvial geomorphologists should be sought regarding the proposed "armored channel" asserted to be necessary for the length of the restored channel through the impoundment. Removing this part of the project would likely reduce costs and allow for the self-establishment of the most geomorphically appropriate channel form. The approach to the restored channel must be in line with the sediment management plan as any post-implementation channel migration would certainly mobilize some mildly contaminated sediment. Accessing the impoundment for dredging and channel construction (regardless of the method) will be challenging due to the lack of a low-level outlet that could be opened allowing the sediments to drain and vegetation to establish in the sediments, stabilizing them. An alternative to this, if feasible and permittable, would be for City DPW staff to access the site on a periodic basis to slowly notch the dam over the course of weeks. If this was done in a controlled and gradual manner, the impounding capacity of the dam could be reduced with an effect similar to that of a low-level outlet. Construction access into the channel may require the use of swamp mats, or even the creation of a temporary haul road.

Channel stabilization may be advisable at the downstream end of the culvert under Route 70 if further modeling reveals significant scour potential there under the post-restoration condition. In addition to potential for damage to the culvert, the post-restoration condition should be evaluated for the potential of channel headcutting up to the culvert to result in a perched condition on the downstream end (detrimental to fish and wildlife. The Route 70 culvert is a concrete (assumed) box with a width of approximately eight feet on the downstream end. It does not appear to conform to the Massachusetts Stream Crossing Guidelines and there is significant spalling of the concrete on the downstream end. The upstream end of the culvert was not accessible in the June 19 visit to the site, however, it was noted that Poor Farm brook takes an abrupt right turn at the road enbankment. It appears that

concrete jersey barriers have been placed along the roadway embankment to protect against scour as the flow diverts to the right seeking the culvert opening.

Along those lines, further H&H modeling should examine flows greater than the 100-year storm to better inform design parameters such as restored channel width, lateral extent of the dam to be removed to avoid future impounding [maybe not fully possible?] and expected access to the floodplain, etc.

No planting plan was described in the materials presented. While it can be assumed that exposed sediments would vegetate quickly after dam removal, it can also be assumed that some or all of that colonization will be comprised of invasive species such as Japanese knotweed and Phragmites reed, which exist upstream. Future project design should include a plan for control of invasive species, at least for a reasonable time following implementation. Long-term eradication or control of invasives may not be feasible.

Notwithstanding several opportunities for cost savings that may be realized with further planning and design (instream or upland sediment management, reducing channel construction, pre-construction dewatering, gravity-assisted water management during construction as opposed to pumping, etc.) the probable costs presented on Page 7 of the presentation materials do not appear out of line given this stage of the design and the associated assumptions.

Another informal public meeting might be advisable following the next design iteration and before embarking on the permit process."

Response:

1. It is agreed that additional consideration should be made of sediment disposal options in concert with other regulating agencies. The ultimate goal is to achieve low human and ecological risk exposure while lowering the cost of the project as much as feasible.
2. With additional data collection, more evaluation needs to be made of natural channel restoration so as to control sediment migration within acceptable limits and re-establish a stable improved habitat.
3. It is rare to evaluate storms greater than 100-year return period for conveyance structures like culverts and brook channels, especially when there is little potential for areas of damage before the brook enters a large lake. When dealing with structures like dams, the Probable Maximum Flood (PMF) or ½ the PMF is often considered primarily due to potential downstream damage that could be caused by a dam failure and sudden release of the impounded volume. Once the Poor Farm Pond Dam is removed, the PMF or ½-PMF would not normally be considered in a hydraulic analysis.
4. It is agreed that re-vegetation of the impoundment area needs to be considerate of invasive species and a control plan may be appropriate.

10.5 Funding Opportunities

The Poor Farm Pond Dam is one of 29 dams owned by the City of Worcester. Funds for operation and maintenance of this dam are obtained from the general property tax levy. Given the ecological benefits associated with removal of the dam, as well as the forthcoming regulatory requirements that are likely under the Sustainable Water Management Initiative (SWMI), this dam removal project is an ideal candidate for funding support from various grant and loan programs. Table 10-2 presents a summary of potential funding sources that can be pursued should the City of Worcester proceed with implementation of the dam removal project at Poor Farm Pond dam.

Table 10-2
Summary of Dam Removal Funding Opportunities

Program Category/Program	*Description*	*Available Funding/ Deadlines*
National/Federal		
Challenge Grants National Fish and Wildlife Federation	Matching grants to projects that address priority actions promoting fish and wildlife conservation and habitats	Funding range $10,000 - $150,000
NOAA Community-Based Habitat Restoration National Marine Fisheries Service in Partnership with American Rivers, Nature Conservancy, Conservation Law Foundation, and others	Long-term national and regional partnerships to leverage funding to support community-based restoration efforts. In addition to financial assistance, provides restoration science and technical guidance, including assistance with environmental compliance, and monitoring. Grants available for Engineering Design and Construction.	Funding range $50,000 – $200,000 Application deadline and award amount varies by partner organization. Example: American Rivers/NOAA Restoring Rivers: Stream Barrier Removal Grants. Maximum award request $150,000. Applications due December, notice of award in March, funding provided in May.
National Fish and Wildlife Foundation Bring Back the Natives/More Fish Program	Funding for projects to restore, protect, and enhance native populations of sensitive or listed fish species, especially on lands on or adjacent to federal agency lands. Projects must identify measureable conservation outcomes for native fish species of special concern. Projects that address habitat alteration and lack of adequate instream flows are of particular interest. Projects benefitting selected fish species are priorities for funding, including native eastern brook trout and associated native aquatic species.	Up to $1,700,000 in grant funds is available. Grant awards generally range in size from $25,000 to $100,000, although grants greater than $100,000 will be considered. Annual grant cycle, RFP typically released in the spring. Applicants must provide non-federal match of at least $2 for every $1 of grant funds requested.

Program Category/Program	Description	Available Funding/ Deadlines
In-Kind Federal Assistance	In-kind non-monetary assistance in the form of Staff expertise in fisheries, aquatic ecosystem restoration, dam deconstruction.	
State		
Dam and Seawall Repair or Removal Fund Executive Office of Energy and Environmental Affairs (Chapter 448 of the Acts of 2012 and 301 CMR 15.00)	Grants and loans. High and significant hazard dams in poor or unsafe condition anticipated to receive highest priority. Most costs are eligible including engineering and construction. Preference to projects that are shovel-ready and have commitment of matching funds.	Draft regulations published April 26, 2013; comment period closed June 7, 2013. Anticipate final regulations and request for responses (RFR) will be published August 2; applications due September 1st of each year (August 29 in 2013).
Massachusetts Environmental Trust (MET) General Grant Program	Grants to organizations that have made a remarkable impact on protecting and enhancing the state's water resources. Requires collaboration between communities and conservation partners. Preference to projects that leverage additional funding or in-kind resources to maximize impact of MET funds.	Two stage application process - RFR published August of each year with letters of inquiry due in October. Selected applicants invited to submit full proposals in March of the following year. Announcement of grant awards is typically made in June. $600,000FY'13 grant budget; grants generally between $10,000 and $50,000 per year, per award.
Department of Fish and Game (DFG) Division of Ecological Restoration (DER) Wetlands and River Restoration and Revitalization Priority Projects	Grants to support sustainable river and wetland restoration projects that restore natural processes, remove ecosystem stressors, increase the resilience of the ecosystem, support river and wetland habitat, and promote passage of fish and wildlife through dam and other barrier removal. In-kind non-monetary technical assistance also available.	Average Grant Size: $5,000 to $ 55,000 Estimated Application Deadline: October

Program Category/Program	*Description*	*Available Funding/ Deadlines*
Executive Office of Energy & Environmental Affairs ***Department of Environmental Protection*** Sustainable Water Management Initiative Grant	Grants for withdrawal impact mitigation projects that are shovel-ready projects previously identified during a systematic planning process, meet the criteria as a mitigation project, and are able to achieve cost effective environmental improvements. Categories for mitigation projects include improvements to instream flow and habitat. Project design of sufficient detail must be submitted with application.	FY'13 $929,000 awarded among 11 projects. Maximum grant $139,000. Applications due December; grants awarded April. Unknown if SWMI grant program will be funded in FY'14.