MASSACHUSETTS RIVERWAYS PROGRAM
BOSTON, MASSACHUSETTS

MILL STREET (TEL-ELECTRIC) DAM
PITTSFIELD, MASSACHUSETTS
NATDAM NO. MA01970

DAM REMOVAL FEASIBILITY STUDY

FINAL REPORT

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1.0 PURPOSE OF STUDY

The purpose of this study is to assess the feasibility of the removal of the Mill Street dam, also known as the Tel-Electric dam, on the West Branch Housatonic River in Pittsfield, Massachusetts. The study has been conducted as one component of a grant proposal submitted by the City of Pittsfield to the Massachusetts SubCouncil, Housatonic River Natural Resource Damages (NRD) Fund (Round 1, 2005). Although this study may assist in obtaining funds under the NRD, it is an independent assessment and report, commissioned under the Massachusetts Riverways Program Priority Project process. The following excerpt taken from the NRD grant proposal explains the project purpose:

The City of Pittsfield, in partnership with the Massachusetts Riverways Program and the Berkshire Regional Planning Commission, is seeking to develop an integrated river restoration plan for the downtown portion of the West Branch of the Housatonic River. This will be a multi-year, multi-phase project with two main focus areas that include (1) development of a greenway plan for the river corridor from Wahconah Park to Clapp Park; and (2) the removal of the Mill Street dam which is located within the corridor. The goal of the West Branch Housatonic River Revitalization Project is to restore the river corridor to a more natural setting that can be used and enjoyed by the general public. The future envisioned for this river corridor is a series of linked green spaces available for public use amidst a densely developed urban neighborhood. Improvements to the natural environment, primarily through riparian habitat improvements, improved water quality and reduced flooding will in turn contribute to and stimulate ongoing neighborhood revitalization efforts in one of the City of Pittsfield’s most degraded neighborhoods. The project will require extensive neighborhood involvement and will detail an Action Strategy that will be implemented through the City of Pittsfield’s ongoing and future neighborhood revitalization efforts. The dam removal component will implement a recommendation of the MA Office of Dam Safety for the structurally unsound Mill Street Dam, removing a public
health and safety hazard leading to improved natural stream conditions, facilitating movement of resident aquatic species, improving water quality and enhancing public access along the West Branch.
2.0 INFORMATION GATHERING

Organization of this report and a summary of information gathered during its preparation are described below. Section 3 of the report provides a description of the existing conditions at the Mill Street dam and this reach of the West Branch of the Housatonic River. The dam removal alternatives that were studied are described in Section 4, which also includes discussion of the impounded sediments and sediment management issues, as well as background information pertinent to development of cost opinions for the removal alternatives. The preferred alternative is described in Section 5, and Sections 6 and 7 describe permitting requirements and additional studies needed, respectively.

References cited are listed herein in Appendix A, and Appendix B contains a summary of data and reports consulted in the preparation of the feasibility study for the removal of the Mill Street dam. Additional data were gathered during site visits on February 13, 2006 and March 13, 2006 – selected photos of the dam and vicinity are contained in Appendix C, and notes from the first site visit are in Appendix D. Maps developed for this report are in Appendix E. Preliminary drawings of the removal alternatives are included in Appendix F. Appendix G contains data from sediment testing. General costing information is in Section 4.6 of the report, and cost opinion details are contained in Appendix H.
3.0 SITE DESCRIPTION

3.1 Mill Street Dam

Limited information about the history of the Mill Street dam is known. According to the Massachusetts Department of Conservation and Recreation the dam was completed in 1920 and is presently owned by Mr. Kenneth Nash of Pittsfield, Massachusetts, who also owns the adjacent mill building. The construction of the dam may have been preceded by the construction of the railroad, including at least one of the river crossings (trestles) upstream of the dam. It is unknown if the Mill Street dam replaced another dam on the West Branch Housatonic River, or if it was the first dam to impound this reach. The dam was originally built to provide water power for a nearby mill.

The dam is approximately 20 feet high and 40 feet wide, with a 30 foot long, slightly curved spillway section. The crest of the main spillway is at elevation 986.7’. On river left (looking downstream), just upstream of the main spillway, is a side spillway with a width of 15 feet and a crest at elevation 985.2’. When the headpond is lower than elevation 986.7’, river flows only go over the side spillway, with the flows entering an abandoned 9-foot diameter penstock with invert elevation 978.6’ at the entrance. This penstock discharges perpendicular to the river just below the dam. When the headpond is above elevation 986.7’, the river flows over both the side and main spillways. An old gate opening through the dam’s abutment on river left was filled with concrete at an unknown date.

A boring through the dam’s main spillway verified that the dam is founded on bedrock (C.T. Male, 1985), and is constructed of masonry block overlain with concrete with a thickness of 11 inches at the crest. It is unknown if the dam was originally constructed of masonry block and later retrofitted with a concrete overlay, or if the concrete was part of the original construction.
The Massachusetts Department of Environmental Management inspected the dam on March 24, 2000 and found the dam to be in “poor condition” with “significant operational or maintenance deficiencies” (Mass. DEM, 2000).

3.2 River Crossings

Seven river crossings are in the vicinity of the Mill Street dam and the upstream impoundment. The concrete Mill Street bridge (Photo 5) crosses the West Branch Housatonic River approximately 200 feet downstream of the dam. A 39” diameter sewer line crosses the river between concrete abutments on the downstream side of the bridge.

Approximately 60 feet upstream of the Mill Street dam is an abandoned railroad trestle (Photo 7) that formerly supported one track. The age of the structure is unknown. The trestle is supported by steel piles with the depth of embedment unknown.

Approximately 120 feet upstream of the dam is a full-span railroad trestle (Photo 7) supporting two tracks. The span is supported by a steel truss structure between masonry abutments topped with concrete. Approximately 20 feet upstream of this trestle is a second full-span trestle with the span supported by a riveted steel beam structure. The two full-span trestles use the same masonry and concrete abutments. There is a date of 1910 on the concrete portion of the abutments, although the masonry portion may be older.

The West Street bridge (Photo 8) crosses the West Branch approximately 1,200 feet upstream of the Mill Street dam. The bridge is a concrete arch with a maximum clear width of 32’-6” and acts as a flow restriction during floods, creating a large drop across the structure between upstream and downstream water levels.
Two other bridges cross the West Branch, one 2,400 feet upstream of the Mill Street dam (Columbus Avenue bridge) and the other 3,900 feet upstream of the dam (Linden Avenue bridge). The Columbus Avenue bridge (Photo 9) has a date on it of 1996, and the Linden Avenue bridge (Photo 10) has a date of 1982, reflecting the dates when both bridges were rebuilt. Both bridges have wider spans and higher low-chord elevations than the West Street bridge, which is the principal hydraulic control for the river upstream of West Street.

### 3.3 Watershed Hydrology

Limited hydrologic information is available about the watershed of the West Branch Housatonic River. The West Branch is ungaged, with the nearest U.S. Geological Survey (USGS) streamgage located on the East Branch Housatonic River at Coltsville, Massachusetts, which has a contributing drainage area of 57.6 square miles.

Using Geographic Information System (GIS) coverages, it was determined that the drainage area at the dam is approximately 36.5 square miles (Map 1, Appendix E). The watershed upstream of the dam is considered to be “highly modified with dense residential and industrial development” (Mitchell, 2005), although significant forested areas do exist around the headwaters of the West Branch. The mean basin elevation is approximately 1,414 feet, with the slope of the West Branch upstream of the Mill Street dam approximately 43 feet/mile (0.8%) between the points 10% and 85% of the total stream length above the site. The slope is higher in the headwaters of the West Branch, but diminishes greatly near the confluence of the West Branch with the Southwest Branch. Downstream of the Mill Street dam, the slope is reportedly as low as 18 feet/mile, or 0.3% (Mitchell, 2005).

The West Branch basin contains two large impoundments, Pontoosuc Lake and Onota Lake. Pontoosuc Lake is approximately 480 acres, with a contributing watershed of 13,607 acres (21.3 square miles). Onota Lake is approximately 617 acres, with a contributing watershed of 6,345 acres (9.9 square miles). The lakes exert an unknown
amount of regulation on flows in the West Branch. However, based on the drainage areas, approximately 31.2 square miles (85%) of the basin upstream of the Mill Street dam also lie upstream of these lakes, so the lakes undoubtedly influence the hydrology (including low flows and floods) at the dam.

Peak flood flows have previously been calculated for the West Branch and reported in studies by C.T. Male (1985), the U.S. Army Corps of Engineers (COE) (1980) and others. The flood flows were reportedly calculated using Soil Conservation Service (SCS) methodology and programs, or the COE's HEC-1 program, with the models routing synthetic design storms through a basin. The C.T. Male report, utilizing HEC-1, listed peak flood flows of 1,085 cfs, 1,980 cfs and 2,550 cfs for the 10-year, 50-year and 100-year floods, respectively, and noted that the Corps had used a higher 100-year flood (3,150 cfs) in their study.

While floods greater than the 10-year flood are obviously important to study—with the 100-year flood being the “base flood” used in local floodplain regulation—smaller, higher frequency flows are more important for an understanding of the environmental restoration potential of projects like dam removals. In particular, the 2-year flood is often close to the ‘bankfull’ discharge for a stream or river. The bankfull discharge is the flow that has the most influence on stream morphology, including sediment transport, channel geometry (width, depth), substrate size and channel meandering. At higher flows, significant flow begins to be conveyed by the floodplain, with less influence on channel geometry.

Flood hydrology for the West Branch Housatonic River was estimated using regression equations published by the USGS (Wandle, 1983). For western Massachusetts, the equations use drainage area, mean basin elevation and channel slope to calculate peak flood flows for various recurrence intervals. The equations were developed for different regions in Massachusetts. Flood flows calculated using the equations are as follows:
### Flood Peak Flow (cfs)

<table>
<thead>
<tr>
<th>Flood</th>
<th>Peak Flow (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-year</td>
<td>1,246</td>
</tr>
<tr>
<td>5-year</td>
<td>2,013</td>
</tr>
<tr>
<td>10-year</td>
<td>2,642</td>
</tr>
<tr>
<td>25-year</td>
<td>3,611</td>
</tr>
<tr>
<td>50-year</td>
<td>4,516</td>
</tr>
<tr>
<td>100-year</td>
<td>5,538</td>
</tr>
</tbody>
</table>

Note that the peak flows are much greater than the 10-year, 50-year and 100-year floods used in the C.T. Male and Corps studies. The reason may be that the regression equations do not account for the significant drainage area upstream of the two large impoundments, Onota Lake and Pontoosuc Lake, which likely attenuate peak flood flows. Therefore, the regression equations are considered to be unreliable for estimating flood flows for several recurrence intervals.

The 1980 Corps study contains a probability plot calculated for the West Branch, which can be used to estimate peak flood flows for several recurrence intervals. As derived from the plot, the following are the approximate peak flows for the 2-year flood up to the 100-year flood. The report lists the drainage area as being 36.1 square miles, although the precise location is not identified.

### Flood Peak Flow (cfs)

<table>
<thead>
<tr>
<th>Flood</th>
<th>Peak Flow (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-year</td>
<td>580</td>
</tr>
<tr>
<td>5-year</td>
<td>1,000</td>
</tr>
<tr>
<td>10-year</td>
<td>1,350</td>
</tr>
<tr>
<td>25-year</td>
<td>1,900</td>
</tr>
<tr>
<td>50-year</td>
<td>2,430</td>
</tr>
<tr>
<td>100-year</td>
<td>3,150</td>
</tr>
</tbody>
</table>

The peak flows for the 10-year, 50-year and 100-year floods are slightly greater than the corresponding flows in the C.T. Male report. The calculated peak flows should be considered approximate, especially given that the significant drainage area regulated by ponds and wetlands in the basin is not accounted for in the regression equations. Therefore, the peak flow for the 2-year flood (580 cfs) derived from the Corps study is the best estimate that can be derived from existing information, and is considered to be more reliable than the estimated flow calculated using the regression equations for
western Massachusetts. The 2-year flood is of interest because it is influential on river morphology and sediment transport.

Annual mean flow was derived using data from the East Branch Housatonic River streamgage. For 69 years of record, the annual mean flow was 107 cfs, which equates to 1.86 cfsm (cfs per square mile of drainage area) at the streamgage. Using the same 1.86 cfsm for the West Branch Housatonic River, the annual mean flow would be 68 cfs. This is an approximation, but it is considered the best estimate of mean annual flow on the unaged West Branch.

3.4 Fisheries

The relative abundance and distribution of fishes found in the Housatonic River in reaches below and above the Mill Street dam, Pittsfield, Massachusetts can be inferred from information collected in relation to the upper Housatonic River Remediation Project and from other historical data and literature. Historical information on species occurrence can be drawn from McCabe (1943), Hartel et al. (2002) and others. Much of the quantitative information stems from more recent data collected within the Primary Study Area (PSA) below the confluence of the east and west branches of the River (Chadwick 1993; Woodlot 2002a and b). Specific objectives of the EPA (Woodlot) studies conducted during 1998 through 2000 were to characterize the fish community through species-habitat associations and to estimate relative biomass within specific reaches below Pittsfield. Sampling techniques included electrofishing, trot-line and netting. A review of historical literature was also performed.

Woodlot (2002b) summarized both the recent studies and the historical information available and reported a total of 41 fish species found in the Housatonic River in Massachusetts (Table 3.1 from Woodlot (2002b). Since the characteristics of the river change proceeding downstream below Pittsfield, the most recent data (1998-2000) collected directly downstream of the confluence of the east and west branches are likely to provide information most representative of species that may be found in the west
branch in the vicinity of the Mill Street dam. The dominant fish species found there are shown in Table Reach 5A (Woodlot, 2000a). White sucker were numerically dominant followed by cyprinids, bluegill, yellow perch and rock bass. Largemouth bass were also common. Other key species relative to the restoration project included smallmouth bass and brown and rainbow trout.

Fisheries data collected from the West Branch of the Housatonic River immediately above and below the Mill Street dam in 1999 and 2002 by the Massachusetts Division of Fisheries and Wildlife indicate a species assemblage in these reaches not unlike that found in the PSA. White sucker were numerically dominant followed by yellow perch and cyprinids. The occurrence of both brown and rainbow trout were reported as single individuals.

This assemblage of fish species when compared to information reported by the U.S. Department of Agriculture in 1975 suggests that the habitat no longer supports the cold water brown trout fishery once common to the Housatonic in the Pittsfield area (Isgur, 1975). While this is anecdotal information, Isgur suggested, even then, that increased flows, river restoration and modification of the Mill Street dam were warranted to restore natural river flows required for cold water trout habitat.

3.5 Wetlands & Terrestrial Wildlife

3.5.1 Wetlands

The portion of the West Branch of the Housatonic River that flows through the City of Pittsfield, Massachusetts was examined in a flood control study and report published in 1985 (C.T. Male Associates) that described the level of development and disturbance as high throughout the portion of the river approximately 0.9 miles above the Mill Street dam. The river, within the limits of the City of Pittsfield, is highly channelized due to development and historic land use (Woodlot, 2002b). The presence of residential development, power line
rights-of-way, sewage systems and fill materials has resulted in the loss of historic floodplain wetland areas associated with the riparian zone (Woodlot, 2002b). The shoreline extending north from the dam exhibits little or no wetland development, with only areas of recent sediment deposition supporting communities of cattail \((Typha spp.)\), pickerel weed \((Pontederia cordata)\) and purple loosestrife \((Lythrum salicaria)\) (C.T. Male Associates, 1985). The northern extent of the area impacted by the dam is associated with areas of forested and scrub shrub wetland located on the west bank. Wahconah Park is located to the east, containing areas of fill and a public baseball field. The west bank soils consist of Pittsfield loam, soils derived from calcareous till. The Wahconah Park area is situated on areas of Pittsfield-Urban land complex with 0-15% slope (NRCS, Web Soil Survey 1.0). Further soils and geologic information can be found in the previous ecological characterization report (Woodlot, 2002b).

The wetland areas associated with the Wahconah Park area provide flood water storage, which affects the timing and magnitude of flooding in the immediate area. The wetlands act to slow flood waters, resulting in high water across the relatively flat park area. The river gradient between Wahconah Park and the crest of the Mill Street dam is 1.6 feet; this change in elevation occurs over a distance of approximately 5,000 ft. (COE, 1980). The low gradient of the West Branch often results in high floodwaters within the bordering residential and commercial development.

Wetland areas located near Wahconah Park exhibit limited wildlife activity due to the urbanized surroundings. Aquatic wetland vegetation is dominated by cattail \((Typha latifolia\) and \(Typha angustifolia)\) and purple loosestrife (C.T. Male Associates, 1985). Hardwood floodplains (palustrine forested and mixed palustrine forested/scrub-shrub) (USFWS), characteristic of the Housatonic watershed, are also present with floodplain areas containing silver maple \((Acer saccharinum)\), box elder \((Acer negundo)\), eastern cottonwood, red maple \((Acer rubrum)\), and black ash \((Fraxinus nigra)\) (Woodlot, 2002b).
Complete descriptions of the wetland areas and species present can be found in the Flood Control Study completed by C.T. Male Associates (1985) and reports published by Woodlot (2002b) and Woodlot and IEI (2005). Non-native invasive plants, such as purple loosestrife, occur often within this section of the West Branch (Woodlot, 2002b). Surveys conducted by Woodlot (2002b) yielded 32 plant species listed as state conservation concerns known or suspected within the Housatonic watershed. Within the limits of Pittsfield and the West Branch survey area 6 plant species were identified as being listed as watch list, special concern, or state threatened (Woodlot, 2002b) and Woodlot and IEI (2005)). The 6 species present within the Pittsfield limits are presented in Table 1.

**Table 1. State Listed Plant Species in Pittsfield, MA**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Latin Name</th>
<th>State Status</th>
<th>Indicator*</th>
</tr>
</thead>
<tbody>
<tr>
<td>black maple</td>
<td><em>Acer nigrum</em></td>
<td>Special Concern</td>
<td>Not Listed</td>
</tr>
<tr>
<td>early blue cohosh</td>
<td><em>Caulophyllum giganteum</em></td>
<td>Watch List</td>
<td>Not Listed</td>
</tr>
<tr>
<td>mudflat spikesedge</td>
<td><em>Eleocharis intermedia</em></td>
<td>Special Concern</td>
<td>FACW+</td>
</tr>
<tr>
<td>downy wild-rye</td>
<td><em>Elymus villosus</em></td>
<td>Threatened</td>
<td>FACU-</td>
</tr>
<tr>
<td>variegated scouring-rush</td>
<td><em>Equisetum variegatum</em></td>
<td>Watch List</td>
<td>FACW</td>
</tr>
<tr>
<td>eastern black current</td>
<td><em>Ribes americanum</em></td>
<td>Watch List</td>
<td>FACW</td>
</tr>
</tbody>
</table>

*USFWS Wetland Indicator Status

3.5.2 Terrestrial Wildlife

The Mill Street dam vicinity has the potential for a wide variety of wildlife species. The flood control study completed by C.T. Male Associates identified species within the area by evidence or observation of activity. Wildlife noted included raccoons, muskrats, bullfrogs, and mallard ducks (1980). The wetland area was noted as having limited wildlife activity due in part to the urbanization of the immediate area. For a complete discussion on various species observed within the Housatonic watershed and Pittsfield sites refer to reports completed by Woodlot (2002b) and Woodlot and IEI (2005) and C.T. Male Associates (1985).
Mammals

Terrestrial wildlife usage in areas surrounding the Mill Street dam vicinity is limited due to the large amount of urban development within the immediate area (C.T. Male Associates, 1985). The project area has the potential to support up to 52 mammal species, all of which are well adapted to survival in urban development (Woodlot 2002b). Species include raccoon, meadow vole, gray squirrel, coyote, red fox, white-tailed deer and others. Rare mammals with the potential to be present within the survey area are listed in Table 2.

Table 2. Rare Mammals Potentially Present in Project Area

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Latin Name</th>
<th>State Status</th>
<th>Federal Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water shrew</td>
<td><em>Sorex palustris</em></td>
<td>Special Concern</td>
<td>n/a</td>
</tr>
<tr>
<td>Small-footed myotis</td>
<td><em>Myotis leibii</em></td>
<td>Special Concern</td>
<td>n/a</td>
</tr>
<tr>
<td>Southern bog lemming</td>
<td><em>Synaptomys cooperi</em></td>
<td>Special Concern</td>
<td>n/a</td>
</tr>
<tr>
<td>Indiana bat</td>
<td><em>Myotis sodalis</em></td>
<td>Endangered</td>
<td>Endangered</td>
</tr>
<tr>
<td>New England cottontail</td>
<td><em>Sylvilagus transitionalis</em></td>
<td>n/a</td>
<td>Under review for listing</td>
</tr>
</tbody>
</table>

Birds

Within the Housatonic watershed 122 passerine (song birds and forest birds), 19 raptors, and 32 water bird species were identified for a total of 173 bird species. Open areas such as agricultural fields, residential areas, and wet meadows have fewer species present as compared with naturally vegetated riparian corridors. The lack of species in these areas can be attributed to disturbance and lack of vertical structure. A number of ducks and geese utilize areas of open water along the West Branch. Birds requiring wetland habitat for nesting include red winged black birds and swamp sparrows (Woodlot, 2002b) and Woodlot and IEI (2005). Rare birds with the potential to be present within the survey area are tabulated in Table 3.
Table 3. Rare Birds Potentially Present in Project Area

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Latin Name</th>
<th>State Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>American bittern</td>
<td><em>Botaurus lentiginosus</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Least bittern</td>
<td><em>Ixobrychus exilis</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Pied-billed grebe</td>
<td><em>Podilymbus podiceps</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Bald eagle</td>
<td><em>Halaeetus leucocephalus</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Peregrine falcon</td>
<td><em>Falco perigrinus</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Northern harrier</td>
<td><em>Circus cyaneus</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Shapr-shinned hawk</td>
<td><em>Accipiter striatus</em></td>
<td>Special Concern</td>
</tr>
<tr>
<td>Barn owl</td>
<td><em>Tyto alba</em></td>
<td>Special Concern</td>
</tr>
<tr>
<td>Long-eared owl</td>
<td><em>Asio otus</em></td>
<td>Special Concern</td>
</tr>
<tr>
<td>Common moorhen</td>
<td><em>Gallinula chloropus</em></td>
<td>Special Concern</td>
</tr>
<tr>
<td>King rail</td>
<td><em>Rallus elegans</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Northern parula</td>
<td><em>Parula americana</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Blackpoll warbler</td>
<td><em>Dendroica striata</em></td>
<td>Special Concern</td>
</tr>
<tr>
<td>Mourning warbler</td>
<td><em>Oporornis philadelphia</em></td>
<td>Special Concern</td>
</tr>
<tr>
<td>Golden-winged warbler</td>
<td><em>Vermivora chrysoptera</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Sedge wren</td>
<td><em>Cistothorus Platensis</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Grasshopper sparrow</td>
<td><em>Ammodramus savannarum</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Henslow's sparrow</td>
<td><em>Ammodramus henslowii</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Vesper sparrow</td>
<td><em>Poecetes gramineus</em></td>
<td>Threatened</td>
</tr>
</tbody>
</table>

Herptiles

Herptile communities within the Housatonic watershed have the potential for up to 16 reptile species and 19 amphibian species, depending on the habitat available. Wood frogs and American toads were observed often in surveys conducted describing ecological characteristics of the Housatonic watershed (Woodlot, 2002b). For a complete discussion of herptile communities within the Housatonic watershed refer to reports completed by Woodlot (2002b) and Woodlot and IEI (2005). Rare amphibians and reptiles with the potential to be present within the survey area are listed in Table 4.
Table 4. Rare Amphibians and Reptiles Potentially Present in Project Area

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Latin Name</th>
<th>State Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spotted turtle</td>
<td><em>Clemmys guttata</em></td>
<td>Special Concern</td>
</tr>
<tr>
<td>Wood turtle</td>
<td><em>Clemmys insculpta</em></td>
<td>Special Concern</td>
</tr>
<tr>
<td>Bog turtle</td>
<td><em>Clemmys muhlenbergii</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Eastern box turtle</td>
<td><em>Terrapene carolina</em></td>
<td>Special Concern</td>
</tr>
<tr>
<td>Jefferson salamander</td>
<td><em>Ambystoma jeffersonianum</em></td>
<td>Special Concern</td>
</tr>
<tr>
<td>Blue-spotted salamander</td>
<td><em>Ambystoma laterale</em></td>
<td>Special Concern</td>
</tr>
<tr>
<td>Marbled salamander</td>
<td><em>Ambystoma opacum</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Spring salamander</td>
<td><em>Gyrinophilus porphyriticus</em></td>
<td>Special Concern</td>
</tr>
<tr>
<td>Four-toed salamander</td>
<td><em>Hemidactylium scutatum</em></td>
<td>Special Concern</td>
</tr>
</tbody>
</table>

1 This species will be removed from the list in July 2006.

Invertebrates

Terrestrial invertebrates within the watershed, and potentially the Mill Street dam vicinity, include various ground worms, spiders, ground beetles, centipedes and millipedes. The most common of these litter invertebrates are slugs and snails, as well as sow bugs (Woodlot, 2002b).

Riverine Macroinvertebrates

Relative species composition and abundance of stream macroinvertebrates serve as indicators of habitat type and overall ecological system health. Information from which to infer the macroinvertebrate communities likely to be found in the vicinity of the Mill Street dam is available from surveys conducted by the U.S. Environmental Protection Agency (Woodlot 2002b) and the Massachusetts Department of Environmental Protection (Mitchell 2005). The EPA studies were conducted during 1998 through 2000 and focused primarily on the PSA downstream of the Mill Street dam. Results were presented for freshwater mussels and dragonflies. Only three species of mussels were found within the PSA and all of these were well downstream of the confluence of the East and West Branches of the Housatonic River. None were reported from the survey station in Pittsfield downstream of the dam. As a result, it not possible to say with any certainty whether mussels are common or occur at all immediately...
above or below the Mill Street dam. By contrast, a total of 40 Odonate (dragonfly and damselfly) species were found within the PSA.

Mitchell (2005) reported results of macroinvertebrate sampling conducted within the Housatonic drainage during 1997 and 2002. These studies were part of the MA DEP biomonitoring program to derive basin-wide aquatic life use-support determinations. A total of 15 stations were sampled and results compared to biological communities at reference stations (considered to be “best-attainable” habitat) to assess relative system health within the drainage. Various indices of biotic integrity were calculated reflecting species richness, community balance, dominance, similarity and community food base.

One sample station was located within the West Branch just downstream of the Route 20 Bridge in Pittsfield, MA. The reach contained shallow riffles and runs with little structure. Mitchell (2005) described the habitat at this location as poor. It ranked the lowest of the 15 stations sampled due to siltation, habitat alteration and pathogens, all related to adjoining city development. The benthic community was rated slightly-impacted based on a degraded community structure when compared to the other sites as well as the reference sites. The total metric score was 24 compared to scores that reached 42 at non-impacted sampling stations. Its percent comparability to the reference stations was 57%. Contributing to these low scores was the dominance of the highly tolerant worm, *Nais variabilis.*

Neither of these cited studies collected information upstream of the dam. However, since the area is highly silted, the benthic community is most likely to consist of infauna adapted to sand substrates including annelids and small mollusks. Insects indicative of a free-flowing rock, rubble, cold-water stream are likely to be less common.
4.0 DAM REMOVAL ALTERNATIVES

4.1 Sediment Management Required for Dam Removal

4.1.1 Presence of Impounded Sediment

Based on topographic mapping and dam drawings presented as part of the C.T. Male flood study (1985), there is a large volume of impounded sediment just upstream of the dam. On the upstream face of the dam, the sediment is at an approximate elevation of 980’ (Appendix F, Drawing 2). Downstream of the dam, the minimum elevation of the scour pool at the base of the dam is at an approximate elevation of 967’, with the streambed rising to an approximate elevation of 971’ downstream of the scour pool. The depth of sediment at the dam, therefore, is estimated to be approximately 13 ft. Bed elevations in the vicinity of the railroad trestles (Figure 1) are close to the 980’ elevation of the sediment at the dam, suggesting that sediment is impounded in the vicinity of the trestles and probably extends farther upstream.

4.1.2 Potential for Sediment Mobilization After Dam Removal

In free-flowing rivers, natural fluctuations in flow affect sediment transport and serve to create unique and diverse habitats for aquatic biota. Dam removal often redistributes sediments trapped behind the dam, restoring the river and its riverine habitats to pre-dam conditions. If the Mill Street dam is removed, the 13 feet of sediment on the upstream face of the dam would obviously not be stable. Although the gradation of the accumulated sediments is unknown, substrates comprised of particle sizes smaller than cobbles would probably have difficulty maintaining bed slopes steeper than 1% to 2%. After removal of the dam a headcut would form and begin migrating upstream, flattening the bed slope in the reach as it erodes a channel through the impounded sediment. The rates of migration of the headcut progression upstream and sedimentation downstream...
depend on several factors, including slope, hydrology and the composition of the impounded sediments. Ultimately, the river may erode back to the channel geometry that existed prior to the reach being impounded.

Headcut migration can be very rapid, although the rate slows as the bed slope flattens. Impounded sediments that took years, or even decades, to accumulate could be mobilized within minutes or hours after dam removal. There are several undesirable consequences that can result from mobilizing sediments quickly, as follows:

- Excessive sedimentation can have deleterious effects on aquatic organisms, both while sediment is suspended and after deposition. Fine sediments deposited in downstream reaches can embed gravel and cobble substrates favored by many macroinvertebrate and fish species, and reduce the habitat available for these species through some or all life stages.

Limited information is available about the West Branch downstream of the Mill Street dam. A previous biological assessment (Mitchell, 2005) noted that “adequate substrates (primarily cobble and pebble) existed” at a surveyed reach of the West Branch downstream of Route 20, and that “substrates were dominated by cobble (60%), and sub-dominated by pebble (15%)”. If this area is representative of the West Branch downstream of the Mill Street dam, then there would be coarse substrates that could be subject to embedment with finer sediments previously impounded by the dam. The biological assessment also noted that “[e]mbeddedness was worse in 1997…than in 2002” and that “[s]ediment deposition was worse in 1997…than in 2002”. The deposition of fine sediments from the impoundment, therefore, could be a regression back to conditions that existed in 1997, or even worse.
• Excessive sedimentation can alter stream morphology by filling pools, embedding riffles, changing bed slope, and reducing the conveyance of channels and floodplains. This can result in river reaches that are unstable for long periods of time, with consequences such as excessive channel migration (meandering), streambed instability, and excessive bank erosion.

Again, limited information is available about the morphology of the West Branch downstream of the Mill Street dam. The reach surveyed in a previous biological assessment (Mitchell, 2005) “contained primarily shallow riffles and runs…with no deep pools or deep runs”. The assessment further noted that “[t]he depth of riffles was 0.1 meter, the depth of runs was 0.2 meters, and the depth of the pools was 0.25 meters”. These shallow features would easily be inundated by large amounts of fine sediment.

• Excessive sediment deposition can reduce the flood capacity of rivers, resulting in higher flood elevations. Structures such as downstream bridges can have their openings partially blocked by sediment, which can then trap woody debris and further reduce the hydraulic capacity of these structures.

Depending on the rate of transport of impounded sediment, significant deposition could occur immediately downstream of the Mill Street dam. The scour pool at the base of the dam, created and maintained by flow plunging over the spillway, would rapidly fill if the impounded sediments were quickly mobilized. If large amounts of sediment were deposited upstream of the Mill Street bridge, these deposits and any debris they trap could reduce the flow capacity of the bridge opening, which could then raise water levels upstream of the bridge.
• Headcuts and other streambed erosion can increase scour around upstream structures such as bridge pilings, piers and abutments, and cause structural damage.

The history of the railroad trestles upstream of the Mill Street dam is largely unknown. The first trestle upstream of the dam—for which the supported railroad tracks are no longer in use—is supported by steel piles, including single and double piles in the river. The depth of the piles is unknown, but this type of pile construction is often used for support in deep sediments, where the piles do not actually sit on bedrock or on large concrete footings. The use of single piles and double piles also suggests some level of deliberate design, since double piles are typically used in areas where the underlying soils provide less support. Therefore, this pile-supported trestle may have been built after the Mill Street dam was constructed, perhaps even after the impoundment had filled with sediment. This is largely conjecture, however, since the construction history of the pile-supported trestle is unknown. The structure would be subject to scouring around the piles after dam removal, as velocities increase with the shallower depths and impounded sediment is mobilized. Of all the structures upstream of the Mill Street dam, this pile-supported trestle is considered to be the most vulnerable to scour after dam removal, perhaps to the point of undermining the existing support. Since the trestle is abandoned, demolition and removal of this structure may be an option.

The two railroad trestles farther upstream span the river between masonry and concrete abutments, with no center (instream) piers. There is a date of 1910 on one of the trestles. According to data for the Mill Street dam supplied by the City of Pittsfield, the dam was completed in 1920. If these railroad trestles predate the construction of the dam, it may suggest that the trestles were constructed along a free-flowing reach of the river and were not designed to rely on impounded sediments for support or the
slower velocities (i.e., less scour energy) created by the dam’s backwater. The City of Pittsfield, however, is investigating whether the Mill Street dam may have replaced an earlier dam. Regardless of the historical timeline of construction of the dam and trestles, the depth of the abutments for the trestles is unknown.

In the event of dam removal, the lowering of water levels in the vicinity of the full-span trestles would actually reduce the frequency of flow against the structures. Abutment scour could still occur if significant quantities of channel sediments were removed or eroded. This would only have structural implications if the smaller volume of sediment allowed higher velocities to occur near the abutments (say, if the channel migrated against one of the abutments and undermined the abutment). Structural support could also be compromised if the trestles were designed using the mass of impounded sediment for bearing support. Overall, however, the scour potential for the abutments of full-span trestles is less than it would be for center (instream) piers.

- The re-suspension of contaminated sediments can increase contaminant levels in downstream reaches. Contaminants deep within impounded sediments are especially a concern, since mobilization and redistribution of these sediments can expose sessile benthic aquatic organisms—such as macroinvertebrates—to toxins that they may not have been exposed to prior to dam removal. To further exacerbate the problem, if deposited in sufficiently elevated concentrations, harmful compounds can bio-accumulate in tissues of benthic organism and the effects can be transferred through to upper trophic levels, e.g. fishes.

Limited (current) sediment data are available to analyze the potential migration of contaminants, although other sources of sediment characterization data do exist, e.g. United States Geological Survey.
(USGS) collected composite sediment samples. With respect to available and current data, as discussed later in the report (Section 4.1.4), a single sediment sample was collected from upstream of the Mill Street dam and analyzed for a suite of the compounds of concern (COC). The laboratory data indicate that the levels of certain compounds exceed thresholds for environmental toxicity. Examples of thresholds developed for freshwater ecosystems include the Consensus-based Threshold Effects Concentration (TEC) (MacDonald et al., 2000). Furthermore, the concentrations of the compounds analyzed are unusual for sediments in urban environments and clearly indicate a level of contamination. The aforementioned biological assessment (Mitchell, 2005) noted that the reach of the West Branch Housatonic River surveyed downstream of the dam had “obvious sources of [non-point source] pollution” such as “storm drains” and “roads” and that there were “problems with sediment deposition”. River reaches downstream of the dam, therefore, may be receiving urban runoff similar to the type of runoff that contaminated sediments in the Mill Street dam impoundment. Also, as discussed below, it is unlikely that the Mill Street dam is trapping all of the sediment that is migrating down the West Branch, with highly mobile sediments (e.g., contaminated fines such as silts, fine sands, clays and organics) making it past the dam to downstream reaches. Further sediment testing is required upstream and downstream of the dam to determine if contaminant levels differ.

- While some native riparian and floodplain vegetation relies on sediment deposition during seasonal high flows to replenish soils, excessive sedimentation can bury native plants and create disturbed areas likely to be colonized by invasive, non-indigenous plants.

As is discussed in more detail in the wetlands section above (Section 3.5.1), exotic invasive plant species such as purple loosestrife (Lythrum salicaria) exist in riparian areas along the West Branch Housatonic River.
Therefore, excessive sedimentation that creates favorable conditions for exotic invasive species is a concern.

4.1.3 Sediment Volume

The sediment volume impounded by the dam is unknown, and its characteristics must be inferred from the limited data available. Although the Mill Street dam has some backwater effect as far upstream as the wide floodplain near Wahconah Park, the upper reaches of the impoundment also have significant hydraulic control exerted by three bridges, especially the West Street bridge approximately 1,200 feet upstream of the Mill Street dam. As is discussed further in the hydraulics section, the C. T. Male report concluded that lowering the Mill Street dam by more than three feet will not further lower flood water levels upstream of the Mill Street dam, due to hydraulic control shifting to the relatively narrow West Street bridge after the impoundment is drawn down. The report also noted that increasing the flow area at West Street would require removing bedrock from the channel bed, implying that the bridge may have been built at a ledge outcropping and that the depth of sediment is relatively shallow at the bridge compared to the sediment depth (13 feet) at the Mill Street dam. Therefore, most of the hydraulic changes following dam removal—and the resulting mobilization of sediment—are anticipated to occur between the Mill Street dam and West Street.

According to the C.T. Male report, the bed elevation at the West Street bridge is at an approximate elevation of 984’. With the top of the sediment at an approximate elevation of 980’ at the Mill Street dam, there is a 4-ft drop in grade over the 1,200 ft between the dam and the West Street bridge, which equates to a slope of 0.3%. From the base of the dam at the scour pool (approximate elevation 967’) to the West Street bridge (elevation 984’), the differential in elevation is 17 ft, which equates to a slope of 1.4%. However, after dam removal the scour pool at the base of the dam would likely fill in with sediment and the bed elevation in
the vicinity of the dam would not go below the bed elevation just downstream, an approximate elevation of 971’. Between the Mill Street dam and the West Street bridge, the elevation differential of 13 ft (between elevations 984’ and 971’) over the 1,200 ft distance equates to a slope of 1.1%.

Assuming that minimal sediment would be mobilized upstream of West Street compared to the reach upstream of the dam, the depth of bed erosion could be a maximum of 13 ft at the dam, with the erosion getting shallower as one travels farther upstream, until there is little to no bed erosion at the West Street bridge. The average stream width in this reach is approximately 50 ft. The volume of sediment in this reach, i.e., the differential between the 0.3% and 1.1% slopes, is approximately 14,500 cubic yards. Not all of this volume is likely to be mobilized after dam removal, especially on the edges of the river. However, even if just half of this volume (7,250 cubic yards) is mobilized after dam removal, it still represents a large quantity of sediment. The weight of this sediment depends on its physical attributes. Assuming loose mixed sand with a dry unit weight of 99 lb/ft³, the weight of the 14,500 cubic yards of material would be approximately 19,400 tons. For 7,250 cubic yards of sediment, the weight would be approximately 9,700 tons.

To put sediment volumes into perspective, it is important to compare them with the sediment loads and yields for the river. This loading is unknown for the West Branch Housatonic, although there are published data for the larger Housatonic River watershed. The USGS (Bent, 2001, cited in Massachusetts Riverways, 2003) calculated sediment yields for the Housatonic River and some tributaries, with the yields varying between 21 tons/mile²/year and 147 tons/mile²/year. Based on GIS basin data, the drainage area in the vicinity of the dam is approximately 36.5 mile². Using the yields from elsewhere in the Housatonic River basin, the loadings for the West Branch would therefore be between 767 tons/year and 5,366 tons/year.
Sediment yield—which includes the sediment conveyed by stormwater—is not the same as sediment transport capacity, which is the ability of the river to move sediment. Sediment transport capacity is influenced by hydrology, channel and floodplain dimensions, and slope. If the sediment transport rates exceed the sediment yield, degradation (bed and streambank erosion) can occur. If the sediment transport rates are less than the sediment yield, deposition occurs, and is often evidenced by channels highly embedded with sands and fines, large bars on stream margins, and even islands of deposited sediment in mid-channel. Sediment transport can vary throughout a river, which is why sediment can be impounded upstream of dams while downstream river reaches are “starved” of sediment.

Even without an analysis of sediment transport capacity, a comparison of sediment quantities to sediment yields can be instructive, however. If 14,500 cubic yards (19,400 tons) of impounded sediment was mobilized quickly, within a single year, the yield would be nearly four times as great as the maximum yield (147 tons/mile$^2$/year) observed elsewhere in the Housatonic River watershed. This indicates that mobilizing and releasing the full quantity of impounded sediments in a short timeframe will likely result in much larger sediment inputs than the river typically receives from the basin. Downstream of the dam, the river could have several physical responses to this additional sediment, including the embedment of coarse substrates (gravels, cobbles) with fines, the loss of pool depth, excessive sediment build-up on floodplains, and instream depositions of sediment (bars and islands). Although this sediment would eventually work its way down through the watershed, the physical effects could take years to dissipate, depending on the magnitude and timing of high-flow events.
4.1.4 Sediment Contamination

Available Sediment Data

The available chemical analytical data for sediment in the vicinity of the Mill Street dam is summarized in Appendix G on Table 1 for bulk sediment analysis and on Table 2 for leachate sediment analysis.

One bulk sediment sample was collected in 2004 by the USGS in collaboration with the Massachusetts Riverways Program, as part of the Regional Impounded Sediment Quality Assessment (RISQA) program. The sample is described as obtained from the “Tel Electric Pond”, but no additional information is available on the specific location, depth, or physical attributes of the sediment sample. The data are apparently still considered provisional. For the purpose of this section, the sample is assumed to have been collected from the upstream reservoir of the impoundment. This sample was analyzed for metals, semi-volatile organic compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs).

One composite bulk sediment sample was collected in 1985 as part of the C.T. Male study. This sample is described as obtained from the “area just upstream of the Tel-Electric Dam”, but no additional information is available on the specific location, depth, or physical attributes of the sediment sample. This sample was analyzed for eight metals by the (no longer used) extraction procedure toxicity test (EP Tox) and PCBs for the purpose of characterizing disposal requirements for the sediments [the current accepted leaching procedure is toxicity characteristic leaching procedure (TCLP)].

Evaluation of Sampling Data

The bulk sediment sampling results are compared with the Massachusetts Department of Environmental Protection (MassDEP) sediment screening values (MassDEP 2006) or, if a sediment screening value was not available, the NOAA
Effects Range-Low (ER-L) value. MassDEP sediment screening values for organic constituents are the same as consensus-based threshold effects concentrations (TECs; MacDonald et al., 2000) and represent sediment concentrations below which adverse impacts are unlikely to occur. MassDEP sediment screening values for metals are the same as consensus-based probable effects concentrations (PECs; MacDonald et al. 2000) and represent a concentration above which adverse effects are expected to occur more often than not. ER-Ls are the 10th percentile values from a ranking of data compiled by NOAA (1999) and primarily rely on data from salt-water bodies.

Since these screening benchmarks were derived from data from different locations and with different contaminant profiles, they are not precise measures of toxicity. Site-specific factors, such as sediment organic carbon content and pH, will affect whether a given constituent concentration can exert a toxic effect or is bound up in an unavailable form within the sediment matrix. These screening levels, however, can provide an approximate measure of the potential toxicity of a sediment.

A number of constituents from the Mill Street dam area were detected at concentrations above the Consensus Based TEC’s (see table below). Of the compounds analyzed, two metals and a number of polycyclic aromatic hydrocarbons (PAHs), are above the sediment screening benchmark:

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Detected Concentration (mg/kg)</th>
<th>Consensus Based TEC Sediment Criteria (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromium (total)</td>
<td>529</td>
<td>43.4</td>
</tr>
<tr>
<td>Lead</td>
<td>276</td>
<td>35.8</td>
</tr>
<tr>
<td>Acenaphthene</td>
<td>0.46</td>
<td>0.016</td>
</tr>
<tr>
<td>Acenaphthylene</td>
<td>1.8</td>
<td>0.044</td>
</tr>
<tr>
<td>Anthracene</td>
<td>2.3</td>
<td>0.057</td>
</tr>
<tr>
<td>Benzo(a)anthracene</td>
<td>4.9</td>
<td>0.108</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>5.6</td>
<td>0.150</td>
</tr>
<tr>
<td>Chrysene</td>
<td>6.4</td>
<td>0.166</td>
</tr>
<tr>
<td>Constituent</td>
<td>Detected Concentration (mg/kg)</td>
<td>Consensus Based TEC Sediment Criteria (mg/kg)</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Dibenzo(a)anthracene</td>
<td>1.2</td>
<td>0.033</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>12</td>
<td>0.423</td>
</tr>
<tr>
<td>Fluorene</td>
<td>0.72</td>
<td>0.0774</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>0.34</td>
<td>0.180</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>7.4</td>
<td>0.200</td>
</tr>
<tr>
<td>Pyrene</td>
<td>11</td>
<td>0.195</td>
</tr>
<tr>
<td>Total PAHs</td>
<td>75.96</td>
<td>1.610</td>
</tr>
<tr>
<td>Chlordane (cis- and trans-)</td>
<td>0.008</td>
<td>0.00324</td>
</tr>
<tr>
<td>o,p’-DDD</td>
<td>0.026</td>
<td>0.00488 (for total DDDs)</td>
</tr>
<tr>
<td>p,p’-DDE</td>
<td>0.026</td>
<td>0.00316 (for total DDEs)</td>
</tr>
<tr>
<td>p,p’-DDT</td>
<td>0.017</td>
<td>0.00416 (for total DDTs)</td>
</tr>
<tr>
<td>PCBs (total)</td>
<td>0.810 (USGS) / 3.0 (C.T. Male)</td>
<td>0.0598</td>
</tr>
</tbody>
</table>

Results of EP Tox testing of the sediment on Table 2 (Appendix G) identified only one constituent in the leachate, mercury, at a concentration below its RCRA regulatory level for defining a hazardous waste. Mercury was not analyzed for in the bulk sediment sample. Exceedance or attainment of a RCRA regulatory level does not provide any information about the constituent’s potential ecological toxicity. It is important to note however, that the RCRA regulatory levels are based upon TCLP results and using the available EP--Tox data is only useful for an initial qualitative review.

**Interpretation of Sediment Data**

The presence of 19 constituents and one constituent group at concentrations above their sediment screening levels suggests that the Mill Street dam sediments may exert toxic effects on sediment-dwelling organisms.

The Massachusetts Riverways Program uses a parameter referred to as the Probable Effects Quotient (PEQ), to indicate potential toxicity of a sediment to sediment-dwelling organisms. This parameter is calculated as:

\[
PEQ = \sum \frac{C_{\text{sed},i}}{PEC_{i}}
\]
where:

\[
\text{PEQ} = \text{Probable effects quotient (unitless)} \\
C_{\text{sed}i} = \text{Concentration of constituent } i \text{ in bulk sediment (weight basis)} \\
\text{PEC}_i = \text{Probable effects concentration for constituent } i \text{ (weight basis)}
\]

If the PEQ (i.e., the sum of the ratio of a sediment constituent concentration to its PEC) exceeds one, the sediment is considered potentially toxic to aquatic organisms. As presented on Table 1 (Appendix G), a total PEQ of 61 is calculated for sediment from Mill Street dam. Constituent-specific PEQs greater than one were calculated for chromium, lead, eight individual PAHs, total PAHs, and PCBs. Note that only 22 of the 63 discrete constituents detected (excluding the chlordane isomers and total PAHs) have PECs with which to calculate this quotient. Therefore, the PEQ of 61 accounts for only about one-third of the constituents detected in the sediment samples.

While calculation of a PEQ of 61 suggests that sediment impounded by Mill Street dam can adversely affect sediment-dwelling organisms, its significance cannot be understood without knowledge of sediment constituent concentrations in upstream and downstream sections of the Housatonic River. To adequately assess the spatial distribution of contamination and the concentrations at which the COCs are present within the Housatonic River, additional sediment sampling at both upstream and downstream locations, in addition to the Mill Street impoundment is required.

4.1.5 Need for Sediment Management

The primary challenge for removal of the Mill Street dam is sediment management. The volume of sediment impounded by the dam is so great that removal of the dam has to be accompanied by sediment management through sediment removal and disposal, stabilization of impounded sediments, and/or the gradual release of impounded sediments downstream. As mentioned earlier, rapid mobilization of impounded sediment can have other consequences in addition to
excessive downstream sedimentation, including the movement of contaminants and the scour and eventual undermining of infrastructure such as bridge piers upstream of the dam.

Kleinschmidt analyzed three alternatives for dam removal, with the differences between them being mainly in how the impounded sediment is managed. All of the alternatives would need to be constructed during periods of low water (i.e., summer). The alternatives are discussed in Sections 4.2 through 4.4.

4.2 Alternative A – Sediment Removal & Dam Removal

Impounded sediment upstream of the dam would be dredged and disposed of off site prior to a removal of the dam. Contaminated sediments may require specialized removal and disposal within a MADEP approved landfill. The feasibility of this option depends on the nature of the sediment, its contamination, and the upstream extent of dredging required, which will require further analyses (sediment profiles and sampling). Sediment and dam removal may also require scour protection around bridge abutments and pilings, particularly for the three railroad trestles immediately upstream of the dam. The main intent of this option is to minimize the movement of impounded sediment—especially contaminated sediment—downstream.

4.2.1 Alterations to Dam Structure

The side spillway would be notched to draw down the water level of the impoundment, improving access to impounded sediments for their removal. Further demolition of the structure—including the side spillway, 9-foot diameter bypass pipe, east (left) abutment and main spillway—would occur after sediments upstream of the dam were removed for disposal. It is anticipated that most of the west abutment would remain, since this abutment does provide some protection of the adjacent mill building from floods and appears to be tied in with a retaining
wall on the west bank of the river upstream of the dam. Riprap could be provided at the base of this abutment to protect it from scour. On the east side, the side spillway and bypass intake area would be filled with excavated material and a natural streambank constructed with native plantings. There could also be an overlook area on the top of the bank with park benches and interpretive signage. Access for demolition would be from a temporary access road into the former impoundment from Mill Street, with river flow diverted through culverts under the access road during construction. The access road would be removed at the end of the project.

4.2.2 Hydraulic Changes

In the vicinity of the dam, water levels upstream of the dam following dam removal would approach the water levels currently seen just below the dam. The exact water surface profile for any flow will depend on the quantities of sediment removed and the restored channel geometry, but between the Mill Street dam and West Street the bed could have an average slope of up to 1.4%, based on elevations at the base of the dam and at the West Street bridge. This slope is an increase from the existing 0.3% bed slope upstream of the dam, so that local velocities would likely increase in this free-flowing reach after dam and sediment removal. Water level changes would be greatest in the vicinity of the dam and decrease farther upstream. The C.T. Male study (1985) noted that water levels upstream of West Street are influenced by the narrow opening of the West Street bridge, especially during floods, with some additional hydraulic control exerted by the Columbus Avenue and Linden Street bridges. The study predicted decreases in water levels near Wahconah Park of two feet or less for the 100-year flood if the crest of the dam were lowered by three feet. Kleinschmidt’s calculations for hydraulic control at the West Street bridge also show a similar drop in water levels (approximately 2 feet) upstream for low flows as well, further verifying that most of the hydraulic changes will occur in the 1,200-foot reach between the Mill Street dam and West Street.
Further details of hydraulic changes after dam removal for this alternative will be determined in a future phase of the feasibility study.

4.2.3 Scour

The increase in scour potential after dam removal is very dependent on the resulting hydraulic changes, including decreases in depth and flow area and increases in velocity and shear stress. Further details about the scour, therefore, will rely upon the detailed hydraulic modeling planned for a future phase of the feasibility study. However, it is apparent that scour is primarily a concern for the three railroad trestles just upstream of the Mill Street dam. The increase in velocity after dam removal is likely to increase the scour forces around piers and abutments, and the removal of bed material around the base of these structures can decrease structural support. As discussed earlier, the pile-supported railroad trestle is the most vulnerable to scour, especially the mid-channel piers which would see the highest velocities. There is also some concern that the trestle may have been constructed after the Mill Street dam was built, with the piles utilizing the impounded sediments for support. Sediment removal, therefore, could undermine this support and require that the pile-supported trestle either be removed or stabilized.

For the two full-span railroad trestles upstream of the pile-supported structure, there are no instream piers that could be fully encircled with flow at less than extreme floods, a situation which would have the greatest potential for scour. Although velocities would increase in the vicinity of the trestles after removal of the dam, the water levels would be lower overall, so that flow against the piers (abutments) would have a lower frequency of occurrence. The abutments are on the edges of the river, away from the area (mid-channel) where the greatest depths of sediment excavation would occur. There would be little to no sediment excavation required near the abutments, although protective rock riprap may need to be added for additional scour protection around the abutments.
There is limited information available about the physical nature of impounded sediments upstream of the dam, including around the trestles. However, it is likely that scour protection has been added to this reach in the past, perhaps even when the structures were constructed, as there appear to be a few boulders on the river bed around the piles supporting the trestle just upstream of the dam. This scour protection could be removed during the excavation of impounded sediment excavation and then replaced in the river at a lower bed elevation, but only if the impounded sediment is not necessary for pile support. If the trestle is relying on impounded sediment for support, then complete removal of this bridge structure may be required as part of this alternative.

4.2.4 Sediment Transport

Sediment transport is also related to the hydraulic changes that would occur after dam removal, including post-removal slope, bed material, and channel geometry, and will be estimated in a future phase of the feasibility study. Although the existing sediment transport capacity is unknown, the increase in bed slope and velocity would increase the size of the sediment that could be mobilized and transported by river flows. Water depths may not differ greatly from existing conditions; while the sediment removal would lower water levels, the bed elevation would also be lowered.

A general measure of shear stress, called tractive force, is sometimes used to predict the incipient diameter of particles that can be mobilized by a given flow. Tractive force is directly proportional to the depth of flow and the slope of the water surface. Assuming that the depth of flow does not change appreciably from existing conditions for this alternative, the incipient diameter will therefore be dependent on the water surface slope. If the change in water surface slope parallels the change in bed slope, as would be expected, the incipient diameter would increase. For example, a water surface slope that changes from 0.3% to 1.4% would represent a 367% increase in the tractive force. A particular flow that
can mobilize a sand particle with a diameter of 2 mm under existing conditions could begin to mobilize a gravel particle greater than 9 mm after dam removal. Although this is an example, the overall effect would be a coarsening of bed substrates, perhaps eroding soft materials back to the original river bed. Deposits of fine sediments may be highly mobile after dam removal, unless they are in an area (e.g., along the river margins) where they could be stabilized with vegetation. It is also likely that fine sediments not removed during dredging operations would be highly mobile.

The river downstream of the dam would see larger particles transported by flows, which could manifest itself with some changes in morphology. Features like bars, for example, could begin to be comprised of coarser sediments. The river may assume more structure downstream of the dam, with a low-flow channel meandering between bankfull features like point bars. Riffles could also be enhanced. The relatively featureless morphology described in the biological assessment (Mitchell, 2005) for the West Branch downstream of the dam could assume a more natural stream morphology, unless the transport of sediments from upstream of the dam occurred so quickly as to embed substrates downstream of the dam with large volumes of sediment.

4.2.5 Upstream Flooding Issues

Any lowering of the Mill Street dam will reduce flood levels upstream. The dam is considered “run-of-river” and does not have the capacity to store large volumes of water and attenuate flood flows, so that the magnitude of peak flows would not change. That is, removal of the Mill Street dam would not increase flooding downstream of the structure.

The C.T. Male study (1985) found that lowering the crest of the dam by three feet could lower 100-year flood levels upstream of Mill Street by up to two feet. However, additional lowering of the dam would not further reduce the flood
levels upstream of Mill Street, due to the Mill Street bridge exerting hydraulic control after dam removal.

The lowering of flood levels by approximately two feet upstream of the Mill Street bridge should help alleviate flooding near Wahconah Park. The flooding has been a concern for the City of Pittsfield for decades. Although flooding will always be a statistical probability for the area, the frequency of the flooding should decrease. The following table summarizes how the probability of flooding would change in the vicinity of Wahconah Park if flood levels dropped two feet from the flood levels published in the Flood Insurance Study for the City of Pittsfield (FEMA, 1987).

Table 5. Probability of Flood Elevation Changes near Wahconah Park Due to Lowering the Crest of the Dam

<table>
<thead>
<tr>
<th>Flood Elevation</th>
<th>Existing Return Interval</th>
<th>Proposed Return Interval*</th>
</tr>
</thead>
<tbody>
<tr>
<td>994’</td>
<td>10-year</td>
<td>32-year</td>
</tr>
<tr>
<td>996.5’</td>
<td>50-year</td>
<td>161-year</td>
</tr>
<tr>
<td>998’</td>
<td>100-year</td>
<td>500-year</td>
</tr>
<tr>
<td>1,000’</td>
<td>500-year</td>
<td>&gt; 500-year</td>
</tr>
</tbody>
</table>

* Assumes flood levels two feet lower for any given return interval, with return intervals approximated from probability plot.

In the immediate vicinity of the dam, flood levels upstream of the dam would approach the water levels on the downstream side of the dam after dam removal. From the flood levels published in the Flood Insurance Study, the following decreases at the dam are predicted.
Table 6. Flood Level Changes in the Vicinity of Mill Street Dam Due to Dam Removal

<table>
<thead>
<tr>
<th>Flood Event</th>
<th>Existing Flood Elevation</th>
<th>Proposed Flood Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-year</td>
<td>990’</td>
<td>974.5’</td>
</tr>
<tr>
<td>50-year</td>
<td>991.5’</td>
<td>976’</td>
</tr>
<tr>
<td>100-year</td>
<td>992.5’</td>
<td>977.5’</td>
</tr>
<tr>
<td>500-year</td>
<td>994’</td>
<td>980.5’</td>
</tr>
</tbody>
</table>

1 Approximate existing flood elevation at crest of dam.
2 Flood elevation after dam removal assumed same as existing tailwater flood elevation.

The decreases in flood level, therefore, could be as great as 15.5 feet immediately upstream of the dam. These decreases should be considered the upper limit, since in reality there would still be a water level drop through the dam location depending on how much of the structure is removed. However, the water levels would fall well below the elevation (989.5’) at which the mill building appears to be subject to flooding, based on existing survey data. Therefore, the dam removal would mitigate the flooding potential caused by the existing dam impoundment.

4.2.6 Fisheries and Macroinvertebrate Impacts

Restoring the river to its natural rock, rubble and gravel substrate by removing the dam and associated upstream sediment will likely change the fish and macroinvertebrate community structure within the reach. An increase of slope from the current 0.3% above the dam to 1.4% would provide additional velocity, resulting in a change to habitat characteristics. Organisms common to sand substrates such as annelid worms and small clams would be replaced by insect forms more typical of cold-water free-flowing streams. The larger insects such as dragonflies and damselflies will improve the overall energy base available for fish if sufficiently abundant. Similarly, habitat generalists, such as bluegill, yellow perch and largemouth bass are likely to become less dominant and superseded by cyprinids, smallmouth bass and trout species which are fluvial-dependent (Bain and Meixler, 2000; Armstrong, et al. 2001). Sediment removal will decrease spawning substrate available to centrarchids. Further, sediment

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removal is likely to limit the potential impact of contaminants on benthic organisms and decrease the bioaccumulation of contaminants and subsequent transfer through upper trophic levels. Taken together, these changes would have an overall positive effect on the river’s status relative to the biotic indices estimated by Mitchell (2005) when compared to the stations representing “best attainable” habitat quality.

4.2.7 Terrestrial Wildlife & Wetlands Impacts

The previous flood control study completed by C.T. Male Associates (1985) concluded that any alterations or changes related to lower water surface elevations would not negatively impact the wetland areas. In the event of complete removal of the dam water elevations would be slightly lower during flood events, and also lower during base flow conditions through the growing season. The reach of the West Branch affected by the potential dam removal is low-gradient, and existing conditions (i.e., existing fill and riverside development) do not support extensive riparian communities (C.T. Male Associates 1985; Woodlot, 2002b). Lower water elevations during the growing season under the dam removal scenario would allow for establishment and enhancement of emergent areas of wetland vegetation that were historically absent due to water depth (i.e., wetlands would likely be able to expand down-gradient within the actual river channel).

The existing wetland areas would be affected to some extent by a lower water surface elevation as they are currently maintained by a combination of overbank flows (i.e., floodplain inputs during periods of high water) and by runoff from contributing subwatersheds. The removal of the Mill Street dam would result in a decrease in the frequency and magnitude of flooding within the wetland communities. Upstream of the West Street bridge, low flow levels would be reduced by approximately 2’ after the dam removal before the bridge exerted hydraulic control and limited further drawdown. The outer margins and higher
micro-sites within the floodplain wetlands may therefore experience some minor changes in species composition and extent over time. The wetlands will continue to receive the same surface and shallow subsurface runoff inputs from the contributing subwatersheds, and would continue to intercept seasonal high groundwater levels related to the surrounding watershed. The wetlands would also continue to be subject to periodic (although less frequent) flooding. Minor shifts in species composition from more flood-tolerant species to species more typical of wetlands with less frequent river flooding are therefore possible. The majority of wetland areas would continue to be maintained by periods of high water and runoff inputs (C.T. Male Associates, 1985; COE, 1980). Wetland areas would still act to function as flood storage features and to improve water quality. Plant and wildlife communities within the project area would continue to persist, as the lower water levels would not negatively impact overall habitat. Communities of Rare, Threatened, and Endangered (RTE) species would not be affected by lower water levels, as wetlands would remain largely intact. Upland areas associated with the project would not be altered, leaving vernal pools and other habitats outside the floodplain unaffected. Removal of the dam would enhance shoreline emergent areas and habitat necessary to maintain mammal, avian, and herptile populations. Any losses of existing floodplain areas would likely be offset by enhancement of shoreline emergent areas related to the lower base flow water depths.

In order to ensure the establishment of native wetland vegetation in areas transitioning to emergent wetland areas, native plant species will be planted. Establishment of native vegetation will benefit expanding riparian areas by providing valuable wildlife functions as well as protect exposed substrates from erosion. A list compiled by Massachusetts Riverways (2006) lists a number of native plant species that would enhance riparian habitat and promote native colonization of these areas. Potential species include broadleaved cattail (*Typha latifolia*), softstem bulrush (*Scirpus validus*), hardstem bulrush (*Scirpus acutus*), river bulrush (*Scirpus fluviatilis*) and pickerelweed (*Pontederia cordata*). These
native species are commercially available for restoration planting. Many additional native, commercially available species suited to the subject area could also be added to a planting plan.

4.2.8 Cost Opinion

Alternative A.1 - Sediment Removal (100%) and Dam Removal

The total amount of impounded sediment upstream of the dam, estimated to be 14,500 cubic yards, would be dredged and placed in a dewatering basin to settle and dry, and then would be disposed of off site prior to removal of the dam. Contaminated sediments would require specialized removal and disposal of in a MADEP approved landfill. Furthermore, all liquids that settled out would have to be treated separately. Specifically, treatment of liquids that settled out from the sediments would involve pumping to a “frac-tank” or other suitable container. The liquid wastes would then also have to be transported a MADEP approved landfill if sampling found the liquid to be above applicable threshold criteria.

The disposal fees would differ for the contaminated and uncontaminated sediment, and this cost opinion assumes 30% contaminated and 70% uncontaminated sediment. The dredging costs are based on R.S. Means values, and the sedimentation basin, hauling, and landfill fees are based on additional research by Kleinschmidt. The unit costs for hauling and landfill fees are per ton. The volume was converted from cubic yards to tons using a sediment unit weight of 99 pounds per cubic foot, which assumes that the sediment has time to dry in the dewatering basin. Erosion control costs for this alternative are based on a riprap volume of 1 foot deep by 5 feet wide by 150 feet along both shores and staked hay bale sediment control. The accuracy of the cost opinion for this alternative depends on the nature of the sediment, its contamination, and the upstream extent of dredging required, which will require further analyses (sediment profiles and sampling). Sediment and dam removal may also require
scour protection around bridge abutments and pilings, particularly for the three railroad trestles immediately upstream of the dam.

**Alternative A.2 - Sediment Removal (50%) and Dam Removal**

This option is identical to Alternative A.1 with the exception that 50% of the total volume of impounded sediment upstream of the dam, estimated to be 7,250 cubic yards, would be dredged and placed in a dewatering basin to settle and dry, and then would be disposed of off site prior to removal of the dam. Contaminated sediments/liquids would be disposed of in a MADEP approved landfill as discussed above. All other assumptions and unit costs are the same.

4.3 **Alternative B – Constructed Riffle & Dam Removal**

Impounded sediment upstream of the dam would be partially dredged and a rock riffle (ramp) would be constructed upstream of the dam for grade control. The toe of the riffle would be a short distance downstream of the dam, with the riffle extending upstream. Two variations within Alternative B include: (1) Alternative B.1, a 5% riffle that ends just upstream of the abandoned, steel piling trestle, and (2) Alternative B.2, a 3% riffle that extends upstream beyond all three trestles. The main intent of the rock riffle is to provide grade control and limit the upstream extent of headcut (i.e., erosion of impounded material). The rock riffle also has the potential benefit of providing scour protection for the trestles. The riffle would be of similar construction to a rock ramp and would allow passage for aquatic organisms. As noted above (Section 3.1), a core sample of the dam obtained by C.T. Male (1985) encountered bedrock beneath the dam, indicating the possibility that a more pronounced riffle may have formerly existed at the dam site; such a feature could be recreated in final design. A rendering of an example of a constructed rock riffle is shown in Figure 1.
4.3.1 Alterations to Dam Structure

The side spillway would be notched to draw down the water level of the impoundment, improving access to impounded sediments for their removal. Further demolition of the structure--including the side spillway, 9-foot diameter bypass pipe, east (left) abutment and main spillway--would occur after sediments upstream of the dam were removed for disposal. The volume of sediment removed depends on the upstream extent of the constructed riffle, but would be far less than for Alternative A. For a constructed riffle with a 1:20 (5%) slope, approximately 740 cubic yards of sediment would need to be excavated. For a constructed riffle with a 1:30 (3.3%) slope, approximately 1,900 cubic yards of sediment would need to be excavated.

The constructed riffle would be built on the sloped bed. An underlayment of geotextile, secured by a gravel bedding, would be topped with large rock. Features of the constructed riffle would include rock weirs, a low-flow channel, and other instream boulder clusters. The intent of constructed riffles is to provide grade control over a long stream reach, so that fish passage can be restored. No construction (e.g., dredging) on the bed upstream of the constructed riffle would be required, thereby minimizing the extent of disturbance. Ideally, the riffles are constructed to resemble the morphology of other, natural riffles on the river, with similar slope, bankfull width, substrate size and instream boulder spacing. However, constructed riffles are often steeper than natural riffles elsewhere on the river, due to the need to minimize the area of disturbance and limit the volume (i.e., cost) of materials.

As with Alternative A, it is anticipated that most of the west abutment would remain with Alternative B, since this abutment does provide some protection of the adjacent mill building from floods and appears to be tied in with a retaining wall on the west bank of the river upstream of the dam. Riprap could be provided at the base of this abutment to protect it from scour. On the east side,
the side spillway and bypass intake area would be filled with excavated material and a natural streambank constructed with native plantings. There could also be an overlook area on the top of the bank with park benches and interpretive signage. Access for demolition would be from a temporary access road into the former impoundment from Mill Street, with river flow diverted through culverts under the access road during construction. The access road would be removed at the end of the project.

4.3.2 Hydraulic Changes

In the vicinity of the dam, water levels upstream of the dam following dam removal would approach the water levels currently seen just below the dam. The exact water surface profile for any flow will depend on the slope of the constructed riffle and the channel geometry, but between the Mill Street dam and the upstream end of the constructed riffle the bed slope would be either 1:30 (3.3%) or 1:20 (5%). Flatter slopes are possible if the constructed riffle is extended farther upstream. This slope is an increase from the existing 0.3% bed slope upstream of the dam, so that local velocities would likely increase after dam and sediment removal. Upstream of the constructed riffle, the existing bed slope would be unchanged.

Changes in water levels as previously described for Alternative A in Section 4.2.2 would also occur with Alternative B. Water level changes would likely be greatest in the 1,200-foot reach of the Housatonic River between the Mill Street dam and West Street.

Further details of hydraulic changes after dam removal for this alternative will be determined in a future phase of the feasibility study.
4.3.3 Scour

The constructed riffle could provide scour protection for the trestles. Both the 1:30 (3.3%) and 1:20 (5%) constructed riffles could provide scour protection for the pile-supported trestle. However, only the 1:30 (3.3%) constructed riffle provides rock scour protection across the channel in the vicinity of the two upstream, full-span trestles.

As discussed earlier, the pile-supported railroad trestle is the most vulnerable to scour, especially the mid-channel piers which would see the highest velocities. There is also some concern that the trestle may have been constructed after the Mill Street dam was built, with the piles utilizing the impounded sediments for support. While the constructed riffle could provide scour protection for the pile-supported trestle, it may still be desirable to remove this abandoned structure for safety or aesthetic reasons.

For the two full-span railroad trestles upstream of the pile-supported structure, there are no instream piers that could be fully encircled with flow at less than extreme floods, a situation which would have the greatest potential for scour. Although velocities would increase in the vicinity of the trestles after removal of the dam, the water levels would be lower overall, so that flow against the piers (abutments) would have a lower frequency of occurrence. The abutments are on the edges of the river, away from the area (mid-channel) where the greatest depths of sediment excavation would occur. There would be little to no sediment excavation required near the abutments, although protective rock riprap may need to be added for additional scour protection around the abutments, which the 1:30 (3.3%) constructed riffle could provide.

4.3.4 Sediment Transport

Sediment transport capacity would be greatest across the relatively steep slope of the constructed riffle. While constructed riffles can settle slightly after
construction, the rock in the riffles is sized so that the materials will not be transported downstream. Upstream of the constructed riffle, where no sediment would be excavated, the existing bed elevations would remain. However, the lower water level caused by the dam removal would increase velocities in the reach upstream of the constructed riffle, and potentially transport impounded sediments from reaches upstream of the riffle.

As discussed previously, a general measure of shear stress, called tractive force, is sometimes used to predict the incipient diameter of particles that can be mobilized by a given flow. Tractive force is directly proportional to the depth of flow and the slope of the water surface. For Alternative B the depth of flow would decrease from existing conditions, which would tend to lower the incipient diameter of mobilized particles. However, the corresponding increase in velocities would increase the water surface slope, which would thereby increase the tractive force. Typically, removing the backwater influence of a dam through its removal increases the tractive force, with fine, impounded sediments upstream of the structure mobilized at lower flows. Fine sediment deposits upstream of the constructed riffle, therefore, could begin to erode after dam removal, with some bed scour occurring, perhaps deepening the channel. As discussed previously, the hydraulic changes and increase in sediment transport capacity would be most significant downstream of the West Street bridge, due to the hydraulic control exerted by that narrow structure.

The river downstream of the dam would see larger particles transported by flows, but not to the extent of the potential morphological changes of Alternative A. If large volumes of fine sediments upstream of the constructed riffle were mobilized quickly, they could potentially embed features downstream of the dam like gravel and cobble riffles.
4.3.5 Upstream Flooding Issues

The previous discussion regarding flooding issues for Alternative A in Section 4.2.5 would also apply for Alternative B. Although further hydraulic analysis is required to determine how the constructed riffles would influence the lowering of flood levels upstream, it is assumed that the lowering of flood levels upstream of Mill Street should be similar for Alternative A and Alternative B.

Upstream of the dam, Alternative B would result in higher flood levels than Alternative A, due to the higher bed elevation resulting from the constructed riffle. However, further hydraulic analysis is required to compare the flood levels for these alternatives.

4.3.6 Fisheries and Macroinvertebrate Impacts

This alternative, although it is based on partial removal of the upstream sediments, would create a rock-riffle upstream and downstream of the dam following removal of the dam. Remaining sediments would be captured under the geotextile overlay. Due to the slope increase, both variations of Alternative B would likely result in increased velocities as compared to Alternative A. While cold water type species capable of traversing higher velocities may not be impacted, Alternative B may not be as beneficial to warm water species, such as darters.

4.3.7 Terrestrial Wildlife & Wetlands Impacts

The impacts to terrestrial wildlife and wetlands for Alternative B would be similar to those for Alternative A as described in Section 4.2.7.

The primary differences in the impacts between Alternative A and Alternative B would occur upstream of the railroad trestles, where there is a wide channel under existing impounded conditions and some vegetated bars and
islands. While Alternative A might dredge some of the soils in this reach, Alternative B would leave features like islands in place. With lower water levels, vegetation could change in composition from shallow marsh, emergent wetland species to wet meadow, floodplain species.

4.3.8 Cost Opinion

Alternative B.1 - Constructed Riffle at 5% Slope and Dam Removal

Impounded sediment upstream of the dam would be partially dredged, estimated to be 740 cubic yards, and disposed of in the same manner as described in the previous options. A rock riffle (ramp) would be constructed at a 5% slope in place of the dam and headpond for grade control. The toe of the riffle would be a short distance downstream of the dam, with the riffle extending just upstream of the abandoned, steel piling trestle. The volume of rock required for this construction was estimated to be 725 cubic yards. The main intent of the rock riffle is to provide grade control and limit the upstream extent of headcut \((i.e.,\) erosion of impounded material). The rock riffle also has the potential benefit of providing scour protection for the trestles and would allow passage for aquatic organisms. Erosion control costs for this option are based on staked hay bale sediment control.

Alternative B.2 - Constructed Riffle at 3% Slope and Dam Removal

This option is the same as Alternative B.1 with the exception that the rock riffle would be constructed at a 3% slope in place of the dam and headpond for grade control. The toe of the riffle would still be a short distance downstream of the dam, with the riffle extending upstream beyond all three railroad trestles. The volume of sediment to be removed was estimated to be 1,900 cubic yards and the volume of rock required was estimated to be 1,400 cubic yards.
4.4 **Alternative C – Staged Impoundment Drawdown & Dam Removal**

This option looks at a longer timeframe for dam removal, and relies on natural river processes to transport some of the impounded sediments. The existing side spillway on river left (looking downstream) would be notched and lowered to the sill elevation of the spillway pipe around the dam. This may be done in stages, lowering it a few feet each year. The intent would be to gradually flush clean sediments from the impoundment and lower water levels upstream of the dam, which would allow for the planting of native riparian species in newly exposed stream margins and floodplains. The river would be monitored for bed scour (upstream of dam), deposition (downstream of dam), sediment transport, colonization by vegetation, etc., with the river's response being incorporated into final dam removal design. The final dam removal—say, after five years—could still require elements of Alternative A (dredging) or Alternative B (constructed riffle for grade control). The main intent of this option is to allow for a dam removal after some natural conditions have been restored to the river, namely the restoration and establishment of riparian vegetation, the restoration of presently sediment-starved morphology downstream of the dam, and a smaller volume of impounded sediment, if not the restoration of some natural morphology (*i.e.*, pool-riffle sequencing) upstream of the dam. This option would also allow a drawdown of the impoundment that could immediately begin to minimize flooding upstream, which is of interest to the City of Pittsfield. Significant sediment sampling and testing will be required to verify that sediments to be flushed downstream have acceptable contaminant levels.

4.4.1 **Alterations to Dam Structure**

The side spillway would be notched to draw down the water level of the impoundment, improving access to impounded sediments for their removal. Depending on how aggressive the drawdown and sediment flushing is required to be, the entire side spillway could be removed down to the invert elevation of the 9-foot diameter bypass pipe at El. 978.6’. According to existing survey data, the crest of the side spillway is currently at El. 985.2’. The impoundment drawdown
would depend on river flow as the hydraulic control shifts from the side spillway to the bypass pipe entrance, but a drawdown of approximately 6 feet could occur under low flow conditions.

Further demolition of the structure—including the side spillway, 9-foot diameter bypass pipe, east (left) abutment and main spillway—would occur after sediments upstream of the dam were flushed downstream. The volume of sediment that would be removed by flushing depends on hydrology (especially the occurrence of high flow events) and the sediment yield of the watershed. However, it is expected that the sediment flushing would be done gradually—say over a five year period—to minimize downstream sedimentation and the embedment of substrates with fines.

As with Alternatives A and B, it is anticipated that most of the west abutment would remain, since this abutment does provide some protection of the adjacent mill building from floods and appears to be tied in with a retaining wall on the west bank of the river upstream of the dam. Riprap could be provided at the base of this abutment to protect it from scour. On the east side, the side spillway and bypass intake area would be filled and a natural streambank constructed with native plantings. There could also be an overlook area on the top of the bank with park benches and interpretive signage. Access for demolition would be from a temporary access road into the former impoundment from Mill Street, with river flow diverted through culverts under the access road during construction. The access road would be removed at the end of the project.

Even though sediments are being flushed downstream prior to dam removal under Alternative C, some sediment removal may still be required. The side spillway is upstream of the main spillway, so that when the side spillway is removed a channel will be eroded towards the bypass pipe, not the main spillway. It is likely that a sediment wedge on the upstream side of the dam (main spillway) will have to be excavated as part of the dam removal project.
4.4.2 Hydraulic Changes

The hydraulic changes would be similar to those for Alternative A, where the impounded sediments are dredged down to the former river bed. For Alternative C, it is assumed that the sediment would be flushed downstream, with the river bed reverting to a lower profile. It is expected that the water level changes described in Section 4.2.2 for Alternative A would also occur with Alternative C.

Further details of hydraulic changes after dam removal for this alternative will be determined in a future phase of the feasibility study.

4.4.3 Scour

The increase in scour potential after dam removal for Alternative C would be the same as described for Alternative A in Section 4.2.3.

4.4.4 Sediment Transport

Sediment transport is also related to the hydraulic changes that would occur after dam removal, including post-removal slope, bed material, and channel geometry, and will be estimated in a future phase of the feasibility study. Although the existing sediment transport capacity is unknown, the increase in bed slope and velocity would increase the size of the sediment that could be mobilized and transported by river flows. Water depths may not differ greatly from existing conditions. While the sediment flushing would lower water levels, the bed elevation would also be lowered.

Alternative C may see changes in sediment transport similar to those of Alternative A, although over a longer period of time. Alternative A would increase the river bed slope from the existing 0.3% to a new bed slope of 1.4%,
for example, by physically removing the impounded sediment, which would be more rapid than natural processes. With Alternative C, the bed slope would slowly increase as the sediments are flushed downstream. Between the West Street bridge (El. 984’) and the bypass pipe intake (El. 978.6’), a distance of 1,200 feet, the slope would be approximately 0.5%. This slope is not appreciably different from the existing slope, suggesting that the amount of sediment flushed from the impoundment would be severely limited by the elevation of the bypass pipe intake. Therefore, flushing more sediment from the impoundment, especially the sediment on the upstream face of the dam, could only be accomplished by lowering the main spillway.

A general measure of shear stress, called tractive force, is sometimes used to predict the incipient diameter of particles that can be mobilized by a given flow. Tractive force is directly proportional to the depth of flow and the slope of the water surface. Assuming that the depth of flow does not change appreciably from existing conditions for this alternative, the incipient diameter will therefore be dependent on the water surface slope. If the change in water surface slope parallels the change in bed slope, as would be expected, the incipient diameter would increase. For example, a water surface slope that changes from 0.3% to 1.4% would represent a 367% increase in the tractive force. A particular flow that can mobilize a sand particle with a diameter of 2 mm under existing conditions could begin to mobilize a gravel particle greater than 9 mm after dam removal. Although this is an example, the overall effect would be a coarsening of bed substrates, perhaps eroding soft materials back to the original river bed. Deposits of fine sediments may be highly mobile after dam removal, unless they are in an area (e.g., along the river margins) where they could be stabilized with vegetation. It is also likely that fine sediments not removed during dredging operations would be highly mobile.

As noted previously, the bed slope could not be increased appreciably with removal of the side spillway alone, since the bypass pipe intake (El. 978.6’) is still
nearly 12 feet higher than the elevation at the base of the dam (El. 967'). If removal of the side spillway increased the bed slope (and water surface slope) from 0.3% to 0.5%, and the depths remained similar to existing conditions as both the river bed elevations and water levels fell, the increase in tractive force would be 67%. A flow that can mobilize a sand particle with a diameter of 2 mm under existing conditions could begin to mobilize a gravel particle greater than 3 mm after dam removal, which is not a significant change. Therefore, Alternative C would be valuable for flushing finer sediments from the impoundment, but would require lowering the main spillway to flush the significant sediment deposit just upstream of the dam.

During the initial drawdown accomplished by the removal of the side spillway, the river downstream of the dam would see slightly larger particles transported by flows, which could manifest itself with some changes in morphology. Features like bars, for example, could begin to be comprised of coarser sediments. However, the increase in the incipient diameter would be small, due to the small increase in tractive force caused by the removal of the side spillway. The biggest change would be the volume of sediments mobilized, i.e., there would be more sediment but only slightly larger than the existing sediments that are being transported. Therefore, the biggest effect downstream of the Mill Street dam could be an embedment of substrates like gravels and cobbles with sediment flushed from the impoundment.

4.4.5 Upstream Flooding Issues

Any lowering of the Mill Street dam, including the lowering of the side spillway, will reduce flood levels upstream. The dam does not have the capacity to store large volumes of water and attenuate flood flows, so that the magnitude of peak flows would not change or increase flooding downstream of the structure.

Alternative C assumes that a removal of the Mill Street dam would eventually occur, similar to Alternatives A and B. Therefore, the mitigation for
upstream flooding would be similar for all alternatives, with the lowering of flood levels by approximately two feet upstream of the Mill Street bridge alleviating flooding near Wahconah Park. As described in Section 4.2.5 for Alternative A, the eventual dam removal would mitigate the flooding potential caused by the existing dam impoundment.

4.4.6 **Fisheries and Macroinvertebrate Impacts**

Staged drawdown and dam removal is only possible if sediment analyses indicate acceptable sediment contaminant levels. Assuming, however, that this option could proceed, there are consequences for habitat quality above and below the dam during and following the extended release of sediments. The delayed transition to a rock riffle habitat above the dam will affect the rate of corresponding changes to benthic biota and to fishes. Furthermore, the transition delay may be exacerbated as the habitat continues to change, thereby affecting the ability of benthic organisms to stabilize and provide a predictable forage for fishes. However, monitoring studies of the Kennebec River conducted by the Maine DEP following a dam removal documented relatively rapid colonization of fluvial substrates by benthic epifauna (Sue Davies, Maine DEP, personal communication).

Downstream of the dam, the released sediment loads will likely impact substrates for some time, embedding in rock rubble areas and/or accumulating in backwaters and bars. Habitat suitable for the more desirable insect macroinvertebrates will likely be affected until the overall sediment loads stabilize further downstream. By contrast, providing continuous free-flowing water following even partial dam removal will likely decrease water temperatures slightly and thereby improve summer macro-habitat suitability for smallmouth bass and trout species.

4.4.7 **Terrestrial Wildlife & Wetlands Impacts**
Since Alternative C eventually includes a removal of the Mill Street dam, the long-term impacts on terrestrial wildlife and wetlands are similar to those for the other alternatives. The only exception is that the initial drawdown under Alternative C, with the removal of the side spillway, provides an opportunity to restore native vegetation on exposed stream margins prior to removal of the entire dam. If the side spillway remains lowered for a few years before full dam removal, this vegetation could be very well established, thereby excluding invasive or exotic species from establishment, by the time the main spillway is finally removed. An initial planting could be monitored annually, with additional plants or different species added to find the right design for revegetation.

4.4.8 Cost Opinion

Alternative C - Staged Impoundment Drawdown and Sediment Release and Eventual Dam Removal

This alternative looks at a longer time frame for dam removal, and relies on natural river processes to help with the transport of some of the impounded sediments. The existing side spillway on river left (looking downstream) would be notched and lowered to the sill elevation of the penstock (pipe) around the dam. The costs for this spillway notch are based on R.S. Means per day costs for a crew and equipment to do the work. The intent would be to gradually flush clean sediments from the impoundment and lower water levels upstream of the dam. The river would be monitored for bed scour (upstream of dam), deposition (downstream of dam), sediment transport, colonization by vegetation, etc., with the river's response being incorporated into final dam removal design. A lump sum cost was estimated for the monitoring of the river. The final dam removal, which could be after five years, could still require elements of Alternative A (dredging) or Alternative B (constructed riffle for grade control).

4.5 Alternatives Not Studied In Detail
Several other options exist for removal of the Mill Street dam, but they have not been analyzed in detail by Kleinschmidt, mainly because they are clearly infeasible or would not result in the level of environmental restoration favored by Massachusetts Riverways. These options include the following:

4.5.1 Dam Repair

Repair of the dam is obviously an option for the dam owner, but there would be little to no environmental restoration benefit of this option beyond limiting the downstream migration of impounded sediments. Lowering the dam could restore some riparian floodplain and help mitigate some of the City of Pittsfield's flood concerns, but the benefits are much less than for a full removal.

4.5.2 Dam Repair & Installation of Fish Ladder

Some passage for resident fish species could be restored through repair of the dam and the installation of a fish ladder (e.g. Denil, pool-and-weir, or vertical slot), but the environmental benefits would be minimal. While those fish species (mainly warmwater species) that are strong enough swimmers to be able to use the ladder would benefit from restored access upstream, populations currently exist downstream and upstream of the dam, and there would be little net increase in available habitat.

4.5.3 Nature-like Bypass

Nature-like bypasses, or natural fishways, are constructed channels that convey flow around dams or other obstructions and allow for the upstream migration of aquatic organisms, especially fish. There is insufficient space at this site to construct such a fishway, without major relocation of existing infrastructure. On river right (looking downstream) a channel would be constrained by buildings and parking areas. On river left, a channel would
encroach on Mill Street and the sewer line. Moving or removing any of this infrastructure would be infeasible.

4.5.4  Rock Ramp Downstream of Dam

One option for restoring fish passage at a dam is to lower the crest of the dam and place a sloping riffle downstream of the structure, with the crest of the riffle at the crest of the dam. However, at the Mill Street dam, this option would raise the river bed downstream of the dam and consequently raise the flood levels downstream, thereby increasing the frequency and magnitude of the flooding of the mill building on river right. This is obviously not desirable for the building owner, who is also the dam owner, so this option is not feasible.

4.6  Cost Opinions – General Information

The text in Sections 4.2.8, 4.3.8, and 4.4.8 describes the opinions of cost for the Mill Street dam removal alternatives addressed in the feasibility study. These preliminary cost opinions are based on R.S. Means Heavy Construction Cost Data, 2006, and Kleinschmidt’s recent experience on projects that have gone to bid for construction. Details are provided in Appendix H.

Each alternative includes costs for removal of the dam, which was analyzed separately and then added to the cost opinion for each option in the summary table. In addition to the dam removal alternatives, cost opinions were provided for retaining wall repair along the existing building on the right side of the river looking downstream of the dam, including concrete filling of the tailrace under the building. A cost opinion was also provided for demolition of the first upstream railroad bridge. Costs for disposal of sediments were developed by consideration of sediment quality from other studies in the area and potential landfill costs. These may vary depending on results of further investigations of sediment quality and quantity.
Each option includes a mobilization and demobilization cost which is based on a percentage of the sum of the direct costs, as well as engineering judgment. Also included in the costs for each alternative, as well as the railroad bridge removal, is a cost for railroad engineering review and consultation time by the railroad company for the railroad bridges immediately upstream of the dam. The cost for this was estimated to be $15,000 from a range ($8,000 to $25,000) provided by CSX (2005). Each cost opinion also includes indirect costs as well as a contingency. These costs are based on a percentage of the direct costs and/or engineering judgment. The permitting was set at 25% (although costs could be as much as 30% or more for Alternative C), and contractor costs (including scheduling, in-house engineering/design, field office and equipment, and other misc. costs) were set at 15%. The engineering was based on a percentage ranging from 15% to 20%. The construction monitoring ranged from 10% to 20%. The contingency was set at 25% for all cases due to the many unknowns at this stage of the study. The cost opinions will be refined in the final design to reflect more accurate direct and indirect costs. The sections noted describe the opinions for the direct costs for each option.

4.6.1 Dam Removal

All of the alternatives have provisions for dam removal. The cost opinion for the dam removal is based on a full removal of the dam and related structures, although alternatives such as how much of the abutments to remove and whether to leave the base of the dam in place may be analyzed. Earthwork will need to be done to excavate around the left embankment and side spillway and an access road put in place, including gravel underlain with geotextile, and riprap erosion protection. These costs were based on estimated volumes of material in cubic yards for soil excavation and road placement. The cost of removal of the dam itself is based on the estimated volume of concrete in the dam and abutments and the volume of masonry block in the spillway. The volume of concrete is a rough estimate, since the dimensions of the abutments and side spillway are irregular and unknown. Costs are included for hauling away the rubble from the
demolition, as well as disposal costs for the concrete and masonry block rubble. Sediment control during the earthwork and demolition is included as a lump sum value.

After the demolition, the access road would have to be removed, and the left bank replaced and stabilized. The costs include cubic yard costs for the access road removal, costs to replace some of the excavated fill, and cubic yard costs for riprap along the shore, assuming 2 feet deep by 10 feet wide, by 50 feet long on the left bank. Also included are costs for loam and landscaping on the left bank and access area. Also included in the dam removal sheet are costs for the pre and post construction biomonitoring, which includes a field survey of the river and surrounding banks, riverbed profiling, and a data report. The costs are based on estimates for similar work proposed by Kleinschmidt on other projects. They include five 10-hour days at $2000/day labor (crew chief and 2 field technicians) plus $1000/day equipment, expenses, travel, and contingency for the IBI field survey, and two 10-hour days at $1000/day labor (crew chief and field tech) plus $500/day equipment, expenses, travel, etc. for the bed profiling. The cost of the data report is based on 40 hours at $50/hour for a junior biologist and 6 hours at $110/hour for a senior biologist plus report expenses. Appendix J presents a detailed scope of work for biomonitoring studies that was developed to provide objective information for the scientific evaluation of the dam removal over time.

4.6.2 Retaining Wall Repair Along Building and Tailrace Fill

Cost opinions were also provided for retaining wall repair along the existing building on the right side of the river looking downstream from the dam and for concrete filling of the tailrace under the building. Undermining and erosion of the retaining wall from the water is evident, as well as some surface deterioration. A cofferdam would likely need to be installed to do the work, as well as an access road from the left bank. Earthwork costs include costs per cubic
yard for installing and removing the access road and for bank stabilization. Demolition costs include demolition of an estimated 2 foot by 3 foot by 30 foot long section of deteriorating concrete, and disposing of the rubble on site. New concrete placed to repair the retaining wall was estimated to be 3 feet by 4 feet by 75 feet in volume. The volume of concrete needed to fill the tailrace under the building was estimated to be 12 feet by 18 feet by 6 feet deep. Cubic yard costs were also included for riprap protection along the repaired wall and filled tailrace to reduce future erosion of the concrete.

4.6.3 First Upstream Railroad Bridge Demolition

This cost opinion sheet is for removal of the abandoned first upstream railroad bridge, subject to approval by the rail company (the Mass GIS lists the owner as Housatonic Rail Company). The direct cost items for this work is steel demolition and steel pile demolition below the water surface by a diver team. The steel demolition was based on ten days of work for a crew including a 25 ton hydraulic crane and operator, with crew costs from R.S. Means. The diver costs are for five days of work for a diver team, including equipment, based on costs from recent Kleinschmidt projects.
5.0 PREFERRED ALTERNATIVE

The preferred alternative must ultimately fulfill the requirements established to improve natural stream conditions, facilitate movement of resident aquatic species, improve water quality and enhance public access along the West Branch of the Housatonic River. Each of the alternatives discussed in Section 4.0 is capable of contributing to fulfillment of the stated objectives, however the means by which each objective must be considered to identify the preferred alternative.

Because of the potentially large cost for management of the impounded sediments upstream of the Mill Street dam, it is recommended that the next phase of the feasibility evaluation concentrate on obtaining information to refine the estimate of the sediment quantity and quality. This will include at least 12 surface and near-surface samples and cores or sediments, with laboratory testing done to assess concentrations of PCBs, heavy metals, and other potential contaminants. Then the costs for the removal/restoration alternative should be reevaluated to determine their feasibility and preference.

Based on initial screening, Alternative A has been tentatively selected by project interests as preferable because it would be the “cleanest” and would provide the most thorough removal of sediments (“clean” or contaminated) from the river and avoid the risk for them to cause problems downstream. However, if the quantity of sediments is large or requires special handling and/or disposal method, complete removal (i.e. Alternative A) will be very costly and may not be feasible. In this case, Alternative B would likely be preferable; removal of a portion of the impounded sediments and construction of a rock riffle upstream from the dam site. This would stabilize and immobilize the sediments in place and proved protection for the railroad bridges. The remaining recommended milestones and project schedule are listed in Appendix I.
6.0 PERMITTING REQUIREMENTS

The permits that are expected to be required for removal of the Mill Street dam and restoration of this portion of the West Branch of the Housatonic River are as follows:

6.1 Local Permits

- **Local wetland protection bylaw or ordinance.**

- **Building Permit** – Permit from municipal building department.

- **Other local permits** may be required, such as a site plan review permit from the local planning board. The local building inspector should be consulted for other applicable municipal permits.

6.2 State Permits

- **310 CMR 10.00 et seq. Wetlands Protection Act** - The state permit process is administered by the local Conservation Commission (Commission) with additional review from the State’s Department of Environmental Protection. Expected applications will include a Notice of Intent (NOI). If the project is approved or approved with conditions, the Commission has up to 21 days to issue an Order of Conditions (OOC). Abutters, a group of 10 citizens, or the applicant have 10 days to appeal an approval to DEP. If the proposal is denied, the applicant can appeal the decision to DEP. If the project is appealed, DEP will issue a Superseding Order of Conditions (SOOC), either confirming or altering the original Order.

- **Massachusetts Contingency Plan (MCP), Massachusetts General Law, Chapter 21E** - Contaminated properties regulated under this law are often
called “21E sites”. The regulations adopted to implement Ch. 21E are called the Massachusetts Contingency Plan (MCP).

Contaminated sediments in a waterway are typically not subject to regulation under the MCP. The MADEP manages contaminated sediments below the high water mark during dredging activities through the 401 Water Quality Certification process as administered under 314 CMR 9.00 et seq.

While the regulatory permitting requirements of the MCP would not apply to the dredged sediments below the high water mark, upland placement for management, storage, transport, re-use, and disposal could become subject to CMP notification and threshold requirements under 310 CMR 40.0300 and 310 CMR 40.1600 unless the dredged sediments are managed in accordance with the requirements of 310 CMR 40.0317 (10), 310 CMR 19.000, and 314 CMR 9.00.

- **Section 106 Historical Certificate** - Issued by the Massachusetts Historical Commission. Dams that require Army Corps of Engineers review under Section 404 require approval from the Massachusetts Historical Commission.

- **Massachusetts Environmental Policy Act** - Massachusetts Environmental Policy Act Office (MEPA). An Environmental Notification Form is required for most dam removals; an Environmental Impact Report is also most likely to be required.

- **Chapter 91 Waterways License** - Massachusetts Department of Environmental Protection (MADEP). Dams are required to be licensed unless they were constructed prior to 1939 and not modified since 1984.
A Request for Determination that includes site and engineering plans is required for eligible dams.

- **401 Water Quality Certificate (MADEP)** - 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 involve these activities. Any project which must obtain a 404 permit from the Army Corps of Engineers must also obtain a 401 Water Quality Certification.

- **Application for Beneficial Use of Solid Waste Permit (MADEP)** - This permit from the Solid Waste Division is required if material from the dam is being reused for bank stabilization or on-site use.

- **Office of Dam Safety** – review and approval by the State Dam Safety Program under 302 C.M.R. 10.02 which authorizes the state to supervise dam removal.

**6.3 Federal Permits**

- **Clean Water Act, Section 404 - Dredge and Fill – U.S. Army Corps of Engineers (COE)** - Dam removal that includes discharge of fill in a water of the United States requires a permit issued by the COE subsequent to consultation/concurrence with the State Historic Preservation Officer and DEP review under Section 401.

- **National Pollutant Discharge Elimination System (NPDES)** - Environmental Protection Agency (EPA) - An NPDES Permit is required for discharges from construction sites including clearing, grading, and excavation activities.
• Federal Consultation – Endangered Species Act Section 7 Consultation –
  Need to consult with the U.S. Fish and Wildlife Service or National
  Marine Fisheries Service regarding the impact of the removal on these
  species.

6.4 Removal/Restoration Schedule Milestones

Milestones in the process to remove the dam and restore the adjacent reach of the
West Branch, including development of a Sediment Management Plan, final design of the
selected removal/restoration alternative, permitting, construction, and monitoring, are
summarized in two tables in Appendix I.
7.0  **FURTHER STUDIES REQUIRED**

As discussed above (Section 5), it is recommended that additional data be collected on the quantity and quality of the impounded sediments upstream of the dam, as well as the “ambient” sediments further upstream and downstream of the dam. The purpose of the additional sediment data is to allow refinement of the removal/restoration costs and final selection of a preferred removal/restoration alternative. The requirements for managing the impounded sediments have very large potential cost implications, so it will be important to define quality and quantity parameters of the sediment. The USEPA/COE document “Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual (USEPA/COE, 1998) will be used to establish the protocols for the quantity and quality of samples, as well as physical and chemical analyses, and biosassays, e.g. *C. tentans* or *H. azteca* survival assessments. A minimum of 12 surface and near-surface samples should be obtained, three upstream of the impoundment, six immediately upstream of the dam, and three at various distances downstream of the dam. Samples will be analyzed for compounds that are above applicable thresholds including PCBs/pesticides, SVOCs, PP-13 metals, pH, conductivity, and total organic carbon (TOC). Furthermore, samples will be analyzed by an approved laboratory using USEPA designated analytical methods. It may be desirable (or required, depending on funding-entity requirements) to conduct a source analysis to determine sources and Potentially Responsible Parties (PRPs) for contamination by PCBs or other contaminants.

In addition, samples from solid and liquid wastes that may potentially require off-site disposal will be analyzed for the compounds of concern, in addition to any additional compounds required by the selected landfill. Requirements for dewatering, stockpiling, treating, transporting, and disposing of dredged sediments will need to be determined, dependent on the quantity and quality of the sediments to be managed.

In addition, biomonitoring should be conducted prior to implementation of the removal/restoration to identify the “baseline,” and then it should be continued through and following the restoration in order to determine the effects on the biological community of the
removal/restoration. Appendix J presents a biomonitoring plan to functionally and structurally evaluate the effects of the dam removal over time.

Other studies that will be necessary to plan and design the dam removal and restoration include:

- hydrologic analyses to develop monthly and annual flow-duration curves and evaluate water-management issues relative to two large lakes (Pontoosuc and Onota) upstream of the dam;
- hydraulic data-collection and analyses to obtain better definition of the river bed and banks (i.e. bathymetric surveys) and refine the hydraulic modeling upstream of the dam;
- sediment mapping and profiling (in conjunction with the sediment analyses discussed in the above paragraphs); and
- refined scour analysis of the upstream reach, based on updated hydraulic modeling, sediment data, data on potentially structure foundations (depth, material, existing scour protection, local sediment characteristics).

Final engineering and design will require, at a minimum, development of:

- detailed topographic mapping in the area of the dam removal and river restoration; and
- a utility plan (showing existing utilities and any that will require relocation).
FIGURES
Figure 1. Rendering of an example constructed rock riffle at site of a proposed dam removal in Maine.
APPENDIX A

REFERENCES CITED
REFERENCES CITED


Massachusetts Dept. of Fisheries, Wildlife and Environmental Law Enforcement, Riverways Program (Massachusetts Riverways). 2003. Impounded Sediment and Dam Removal in


NRCS, Web Soil Survey – cited Sec. 4.5


APPENDIX B

SUMMARY OF AVAILABLE INFORMATION
Summary of Available Information for the Mill Street (Tel-Electric) Dam Removal Feasibility Study
(Housatonic River, Pittsfield, MA)
As of: March 22, 2006

A. Materials with Information Specific to Mill Street (Tel-Electric) Dam

1. Photos and Videos


2. Dam Removal and Engineering

a. Massachusetts Department of Fisheries and Wildlife and Environmental Law Enforcement. February 6, 2006. E-mail from L. Fontaine to T. Purinton (MA Riverways) (forwarded to J. Coffin and others at Kleinschmidt), with scanned copies of information from FWE’s file on the West Branch of the Housatonic River. Included the following attachment:

- PDF document “WB Housatonic file Part2.pdf”, consisting of:
  - February 4, 1975 letter from B. Isgur, State Conservationist with USDA, SCS, to J. Shepard, Director, Massachusetts Department of Fisheries and Game. Letter responds to request from City of Pittsfield DPW, Pittsfield Conservation Commission, and Mass. DFW, and discusses three major problem areas in the SW Branch of the Housatonic River:
    1) Streambank erosion
    2) Flooding of private property
    3) Fish habitat damages


This report provides the alternatives available for implementing water resource improvements on the West and Southwest Branches of the Housatonic River to prevent recurring flood damages resulting from major storm and insufficient discharge capacity. This report included hydrologic studies of the river basin combined with climatology to determine the river stages during floods of different magnitudes, and economic analysis to assess the cost of recurring property damage study to the property within the city of Pittsfield, MA. The alternatives were then compared to the hydrologic studies and economic analysis to determine the relationship of cost vs. benefits, acceptance of improvements by the interest groups, the environmental impacts, existing conditions, current and future economic condition, and the current and future social condition.

This report evaluates various aspects of flood protection along the West Branch of the Housatonic River and formulated a flood protection scheme. The report examined existing data and studies, economic and environmental impacts of flooding, the structural and flood control analysis of the Tel-Electric Dam, and feasibility studies on flood control technologies. Recommendations are given based upon a HEC-2 model that found that lowering the Tel-Electric Dam 3-ft, spot dredging, and the replacement of the West Street Bridge all provided significant reductions in upstream flood levels.


Letter related to the Notice of Inspection states that the Tel-Electric Dam is in overall poor condition. The inspector recorded pitting, cracks, gaps, spalls, delamination, erosion, and several flow vortices indicating short circuiting through the dam. The letter strongly encourages the owner(s) to pursue the removal of the dam. The dam structure was found to provide no known utility, is a liability to the owner, is dangerous to walkers and canoeists, and is in such poor condition it would require substantial funding to repair.


Letter related to the necessary steps and contacts to facilitate the removal of the Mill Street Dam. The letter addresses PCB contamination within the sediments, and that PCB contamination from upstream sources has likely collected in the impoundment. The necessary permits and state/federal contacts for these permits are listed throughout the letter, as well as possible sources of funding.


Discusses site visit observations of dam and condition, upstream bridge, and stormwater runoff and flooding issues.

3. Drawings, Maps and Additional Information

a. USGS. 1897. Topographic Map (15-minute series 1 : 62,500 scale, 20-ft. contours) of area of West Branch of Housatonic River (“Pittsfield sheet”). Obtained from UNH archive-map website

Drawing of the sewage works improvement (sewer line across river downstream of Mill St. Bridge, downstream of Mill Street dam), including site plan of vicinity.

c. GIS Maps of the West Branch Housatonic Restoration (2 Maps). Received from T. Matuszko at BRPC. February 13, 2006.

The plan view maps, on an aerial photo base, were prepared by Berkshire Regional Planning Commission (BRPC) and show the general area included in the West Branch Housatonic Restoration. One of the maps has street/road names, and the other displays public service, city of Pittsfield, MA, and Commonwealth of Massachusetts properties.

d. Property/Lot Map #G8 of Pittsfield, MA. Received from Parks Department, Department of Community Services. Received February 16, 2006, map date unknown.

The property/lot map identifies properties belonging to Nash Realty, Housatonic Railroad, Western Massachusetts Electric, Penn Central Railroad, and two properties belonging to the City of Pittsfield.

e. USGS. 2005(?). Provisional data of chemical testing of impounded sediment upstream of Tel-Electric dam. Provisional data subject to change - do not cite. Copy included with Bid Request form Massachusetts Riverways (1/12/06). 1 pg.

f. Drawing of West Street Bridge by L.C. Watson, C.E. (?), date unknown. Provided in digital form (7968-br001.tif) by e-mail from J. McGrath to M. Bernier, March 1, 2006.

4. Email Correspondence (Miscellaneous Information)

a. Elevation Data at Mill St. Dam. February 16, 2006. Riverways Program. T. Purinton to J. Coffin

This email provides a sample map of elevation data for the project area, which can be downloaded at MassGIS.


• This email provides a link for the project watershed flow data: www.rifls.org/basin.asp?watershedId=3

c. Series of emails from J. McGrath (including info. from D. Tagliaferro, S. Steenstrup, and A. Bonarrigo) to J. Coffin. February 16, 2006.

These emails contain information as to who/what agencies have topographic, flow, bathymetry, and other information on the West Branch of the Housatonic River.
• EPA does not have any flow or topographic data on the West Branch.
• There are no streamgages on the West Branch so flow information is limited.
• USACE did a flood reduction project in the mid 1980’s, and the report has hydrologic analysis, estimated flood flows, and some flood profiles.
• FEMA might have some topographic information based upon flood insurance work, but it is likely dated.


One email addresses the habitat around the site:
• The habitat was poor with very little structure, poor instream fish cover, no deep pools or runs, sparse riverbank vegetation, and the riparian zone width was abbreviated.
• It is a cold water (class B) stream, but not a good trout stream according to DFW.
• Most species would likely not use/prefer the denil ladder according to DFW.

e. Email from J. McGrath to M. Bernier (including message from P. Powers, City of Pittsfield Engineering) re: RR trestle upstream of Mill Street dam. March 1, 2006.

5. Mill Street Dam Removal Feasibility Study Products (by Kleinschmidt)


Notes related to kick-off meeting held on February 13, 2006 for the dam removal feasibility study. Meeting was attended by Massachusetts Riverways, City of Pittsfield, Berkshire Regional Planning Commission, and Kleinschmidt Associates representatives. Notes summarize discussions and several data sources.

b. Mill Street Dam Site Visit Notes. Jeff Coffin. February 13, 2006

Transcribed notes of observations of dam and several upstream locations (railroad bridges, West St. Bridge, Dorothy Amos Park, Columbus Ave. Bridge, Pitt Park, Linden Street Bridge and Wahconah Park). A general summary of photos taken is also included.

B. Materials of Regional Interest (e.g. Housatonic River)

1. Environmental and Ecological Studies


The report describes the distribution of fishes from the streams of Massachusetts, and area including the watersheds of the Connecticut, Hoosic, and Housatonic rivers. Included in the report is an attempt to explain the distribution of these fishes based upon the habits and habitats of various species. This analysis was conducted in the summer of 1940.

The objective of this study was to estimate the biomass within each reach of the primary study area for Largemouth bass, goldfish, common carp, bluegill sunfish, pumpkinseed sunfish, cyprinid species, brown bullhead, yellow perch, and white sucker. The fish were collected with electrofishing techniques. This report presents biomass estimates by reach, species, and size class. This data is now available for establishing model conditions, calibrating and validating model results, and can be used for present and future fishery management efforts.


This comprehensive report characterizes the ecosystems found within the Housatonic River within the towns of Pittsfield, Lenox, and Lee, Massachusetts. The study area is 12 miles (19-km) long and extends from Fred Gardner Park in Pittsfield downstream to Woods Pond Dam in Lee. This report supports ongoing evaluations in this portion of the Housatonic River. The study area included riverine habitat, adjacent floodplain wetlands, and uplands associated with the main stem of the river. The ecological characterization investigations were designed to support modeling, baseline human health, and ecological risk assessment efforts. Ecological characterizations were divided into eight work plans that included study objectives, methods, quality assurance and control protocols. The eight study plans were (1) rare plants and natural communities, (2) dragonflies, (3) freshwater mussels, (4) reptiles and amphibians, (5) raptors and waterfowl, (6) forest, marsh and wading birds, (7) small mammals, and (8) river otter, mink and bats. The results of these studies serve as an overall ecological characterization.


The Ecological Risk Assessment Report (ERA) evaluates the fate and transport of PCBs and other contaminants in the Housatonic River and floodplain and the potential routes of exposure and toxicological effects of PCBs and other contaminants; identifies both aquatic and terrestrial ecological endpoints to be assessed and representative species potentially at risk; and characterizes the risks for these animals. The report found that benthic invertebrates, amphibians and fish-eating mammals were at high risk for contamination; fish-eating birds, omnivorous and carnivorous animals, and some threatened and endangered species were at an intermediate to high risk for contamination;
fish were at a low to intermediate risk for contamination; and insectivorous birds were at a low risk for contamination.

e. Lake Management Plans – Onota and Pontoosuc Lakes. Digital copies, consisting of the following documents:


f. Massachusetts Department of Fisheries and Wildlife and Environmental Law Enforcement. February 6, 2006. E-mail from L. Fontaine to T. Purinton (MA Riverways) (forwarded to J. Coffin and others at Kleinschmidt), with scanned copies of information from FWE’s file on the West Branch of the Housatonic River. Included the following attachments:

- RBH Form (Rapid Bioassessment of Habitat?), field data sheet, for “Route 20 Crossing Down,” July 11, 2002. (2 pages)
- PDF Document “WB Housatonic file Part 1.pdf”. (17 pages), containing:
  - Excerpt of Table 2, fish sampling data, collected from the Housatonic River Drainage. 1970. (1 page)
  - Stream survey field data sheets, 6/19/84, for “Below Pontoosuc Lake Dam” and “Below Dam, Wahconah Street.” (2 pages)
  - Fish-sampling log, 10/12/99, Between Lake Pontoosuc and Woods Pond. (4 pages)
  - Fish-sampling log, 10/14/99, Hancock Road below spillway, Site 1. (3 pages)
  - Fish-sampling log, 10/14/99, Started below Keeler Street, Site 2. (2 pages)
  - Fish-sampling log, 10/14/99, Wahconah Street near dam, Site 3. (3 pages)
  - Fish-sampling log, 7/11/02, Rt. 20 bridge crossing downstream. (3 pages)

2. Drawings, Maps and Additional Information

a. CD containing the Onota and Pontoosuc Lake Plans. Received from Parks Department, Department of Community Services. February 16, 2006.

The compact disc contains Onota and Pontoosuc Lake plans and data.


C. General Dam Removal, Sediment Management, and Stream Restoration References

1. Dam Removal and Engineering


   This report summarizes the sampling, analysis, evaluation and management strategies associated with breaching or removing a dam and restoring riverine habitat in Massachusetts. The report examines each step of the dam removal or breach process from reasons why a dam would be removed or breached; developing an effective sediment-sampling plan; sediment transport dynamics; how to evaluate the results of the chemical testing to assess the effects contaminants on human and aquatic ecosystem health; examines ways to determine if any long term physical impacts will occur from releasing the sediment; creation of a sediment management plan; and information on sampling, results, and management summaries for multiple dam removal and breaches conducted in Massachusetts. In particular, this report examines the Old Berkshire Mill Dam Breach conducted in November of 2000, which is located on the East Branch of the Housatonic River in Dalton, MA.


   The Stream Crossing Handbook is designed as a supplement to sound engineering design of culverts and bridges, and explains the importance of properly designed bridges and culverts to local decision makers and advocates. The guidelines set forth in this handbook outline the minimum goals of fish and wildlife passage.

Interim report describing project purpose and approach, including location of existing sediment data (eight sites), types of watershed data utilized in RISQA model development, overview of initial (2004) impounded sediment quantity and quality data (11 sites), predictive equation based on preliminary data, listing of proposed locations for 2005 sampling (11 sites). The RISQA model is under development by the Massachusetts Riverways Program in collaboration with the USGS - it is a probabilistic model for predicting the potential for impounded sediment to cause toxicity to aquatic organisms.


D. Documents Related to Natural Resource Damage Assessment and Restoration Grant


The Restoration Plan was designed to address the entire Housatonic River watershed, not just the river itself. Recommendations on how to proceed with the restoration of the Housatonic River were to create an entity to oversee the restoration and distribution of the grants; monitor, control and remediate other forms of pollution through water quality controls; create educational programs to for adults, students and children to create a new generation of river stewards; create canoe access sites to promote the use of the river; perform appropriate debris removal from the river to clean and provide safety for those that use the river; select discrete sections in each town to promote recreational uses in these targeted locations; create a comprehensive management plan to nurture the growth of native wild species and stunt invasive non-native vegetation; acquire critical pieces of land on the river to ensure the natural restoration and long-term protection of the river; create a River Guardian program to promote community based stewardship of the river; lastly create a Watershed Management Plan to direct and monitor the quality and quantity of water volumes, flooding issues, and non-point contamination.


This organization is a product of the natural resource damage assessment and restoration process established under the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This authority is responsible for developing the Natural Resources Restoration Plan which will allocate the $15 million General Electric paid for natural resource damages do to PCB contamination. The Restoration Plan will evaluate a reasonable number of restoration alternatives and explain the rationale behind the choices made regarding the restoration projects that will be implemented.

This report provides the framework for the solicitation, evaluation, and selection of compensatory restoration projects for the Massachusetts portion of the Housatonic River Natural Resource Damages Assessment (NRDA) and restoration process. The report summarizes the natural resource damages and injuries, provides a description of the restoration goals and priorities, project solicitation process, and details the three stage evaluation process.


This report examines the alternatives for implementing a compensatory restoration program in the Massachusetts portion of the Housatonic River watershed. The compensatory projects are those which restore, rehabilitate, replace, and/or acquire the equivalent of injured natural resources and/or the services provided by those resources. NEPA and MEPA require that both the environmental and socioeconomic impacts are considered for each compensatory project, and ensure that the public is informed as to any programs or policies that may affect them. The alternatives listed in this report feature a mix of restoration approaches, including aquatic restoration, wildlife/terrestrial restoration, and enhancement of recreational opportunities, education/outreach initiatives, and a no-action alternative for the natural resource damages (NRD) funds.


Questions and answers provided for the Natural Resource Damages (NRD) program for the Housatonic River at the General Electric/Housatonic River Natural Resource Restoration Applicant Conference.
APPENDIX C

SITE PHOTOGRAPHS
MILL STREET DAM AND VICINITY
FEBRUARY 13 AND MARCH 13, 2006 SITE VISITS
Photo 1: Mill Street dam

Photo 2: Mill Street dam, railroad trestles in background.
Photo 3: View upstream at side spillway overflow crest, Mill Street dam.

Photo 4: View upstream at deteriorating wall below mill building along river downstream of dam.
Photo 5: Mill Street bridge, downstream of dam.

Photo 6: River reach downstream of Mill Street bridge.
Photo 7: Railroad bridges upstream of dam.

Photo 8: West Street bridge.
Photo 9: Columbus Avenue bridge.

Photo 10: Linden Street bridge.
APPENDIX D

SITE VISIT NOTES
INTRODUCTION

Today is Monday, February 13th, 2006. I am at Mill Street Dam, also known as Tel-Electric Dam in Pittsfield, MA. I was at a meeting this morning with Tim Purinton of Massachusetts Riverways, Jim McGrath of the City of Pittsfield (Parks Director), and Tom Matuszko of Berkshire Regional Planning Commission. We discussed the work that we will be doing on the feasibility study on the dam removal and sources of data that they have available.

A summary of the photos taken by location is provided at the end of these notes. Note that references herein to right and left are for a viewer looking downstream, unless noted otherwise.

MILLSTREET DAM AND VICINITY - GENERAL

I took an orientation tour of the dam with Tim and Jim, starting around 12:45pm. I am now looking at the area around the dam in a little more detail. I took a number of photos from the left abutment of the dam and those were the first 6 or 8 photos. I will give some description of that when I get back up there. After that, there are a couple of pictures of an aquatic mammal, either a mink or an otter (Tim wasn’t sure which), and then I took some photos of the bridge downstream of the dam. It is probably about 200 feet downstream of the dam.

DOWNSTREAM REACH

The bridge downstream of the dam is a concrete bridge that angles from the left to the right as you go downstream. That bridge would probably not be affected by the dam removal but they would like to make sure that the bridge maintains its integrity, what it has left. The railings of the bridge are in somewhat bad shape, it does need some maintenance.

Just downstream of that bridge there is a about a 4 foot steel pipe that crosses the river which must be either a water line or a sewer line. It’s probably about 20 or 30 feet downstream of the bridge and it’s about 5 feet over the present water level. Also, further downstream of that bridge is a riverine segment where the river kind of meanders and is pretty well vegetated. Tim was thinking that this area, this reach of the river would represent a river reach that would be worth replicating in the restoration reach upstream of the dam just in terms of gradient and shape. Right downstream of this little bridge it looks like it is fairly shallow. Right now, typically about 6 inches to a foot deep over much of the width and it’s hard to tell if there is a deeper channel in there or not and the concern would be about fish passage but also about recreation. Whether canoes would be able to travel through here at low water during the summer. And that is something that might want to be enhanced with part of the restoration and
we would probably need do some river surveys, hydrographic surveys or bathymetric surveys as a follow up. That would not be part of our present scope.

Also, just a little about the land use adjacent to the dam: on the right bank is a commercial building called Hawthorne Mills. I will take a photo of the downstream side of that which shows the name and it says it’s the office of Elnasco and Steel Realty and Security Self Storage. Those are the businesses in that old mill building there right next to the river. This building is owned by Ted Nash, who also owns the dam. And he is apparently willing to have the dam removed but he will of course be concerned that the building maintains its integrity.

On the left bank of the river there are two small buildings just downstream of the dam. One is called Pittsfield Fire Safety at 107 Mill Street and the other one does not have a name on it. Those are just downstream of the dam on the left bank. And then another few hundred feet down is a very large building which is The Eagle, a newspaper building. There is a gate that restricts access to The Eagle although it can be opened if they need access and apparently they want to maintain access across this bridge as a back way to get into the Eagle property for emergency vehicles and for fire safety.

**MILL STREET DAM**

Regarding the dam, it’s a stone masonry dam which is probably about 15 to 20 feet high. We do have some crude drawings of it. There is a report by C.T. Male done in 1985 that is a flood control study done for the city of Pittsfield and one of the options was to lower the height of the dam, take off part of the crest. That was intended to reduce flooding upstream. There is also a retaining wall or a flood wall downstream of the dam on the right bank that is next to the Hawthorne Building and it’s kind of crumbling, so that wall would need some repairs. There are both horizontal and vertical cracks in it.

There is a train going across the bridge right now. The train went over the track on the bridge and there are actually two railroad bridges upstream of the dam. I will get some pictures of them. The more downstream one, which is closer to the dam, is abandoned. It is not used. It has two tracks going over it and they kind of come together on the left bank. On the left bank they split and go a little further apart and then apparently going to the right bank they are closer together. That bridge has steel piles with concrete abutment on the left and I am not sure what kind of abutment on the right. I can’t see it too well. It looks like it goes back up to a concrete abutment pretty far up on the bank. And the further upstream bridge which is where the train is right now, has stone piers and some concrete further back on both abutments. There is a date of 1910 on the abutments. Actually on one of the piers it does say 1910 on the abutment and on the left abutment, further back from the river, it says 1911 on the second upstream railroad bridge.

Now I am walking around the dam. It consists of a concrete right abutment and with a little bit of wall that is 4 feet above the present water level. It looks like there is about 4 or 5 inches of water spilling over the dam right now. Reportedly in the summer time, when the river is low, there is no water spilling over the dam, it’s dry and somewhat ugly. There is a spillway that is actually kind of a bypass channel that goes around the left abutment of the dam and it has a concrete drop inlet to the left – it’s about 40 feet upstream of the dam crest and looks like there’s a provision for putting stop logs in if they wanted to although part of it is damaged or not in place. Then it drops into an opening and then it goes underground and comes out downstream.
of the dam, probably about 10 or 15 feet downstream. It looks like a large round pipe, probably about 10 foot diameter, and there is quite a bit of water gushing out of there right now. Most of the river flow is going that way. There is also a gate structure that looks abandoned just to the left of the spillway crest. There is a pinion from a former rack and pinion gate, and it does not appear to be operational. There is no rack sticking up right now to make it work. So that is most of the description of the dam.

The dam looks like it is about vertical on its downstream face, slightly curved in plan, and the top of the upstream crest has a batter that slopes down as you go upstream, so that the crest is near where it overfalls. And, then there are some concrete structures adjacent to the spillway that provide abutments. It’s hard to tell what there is for an intake to the mill or a raceway of that sort. There must be something that is upstream of the mill building that goes inside. It’s hard to tell from the left abutment of the dam. It kind of appears that flow is going underneath the mill building maybe about 10 or 15 feet downstream of the dam on the right side just as it flows across from the spillway exit. There is a little bit of flow going through that gate to the left of the spillway. You can see it coming out from the bottom. Not sure how much of the flow. Probably about less than 5% of the river flow. Looks like about maybe 2/3 of the river flow is going through that spillway and maybe 30% is going over the spillway. The 2/3 is through that spillway tunnel and the 30% is the overflow spillway and the remaining 3% is through the gate.

RAILROAD BRIDGES (UPSTREAM)

The first railroad bridge upstream of the dam consists of 5 sets of piers, steel pipe piles that go into the river bottom and the first 3 from the right are just one set, it’s an upstream and downstream pile separated about 16 feet apart, and the two to the left are double sets, two in tandem next to each other. It looks like about 15-20 feet apart going across the river. So the river must be about 75 feet across right here. The second railroad bridge does not have any piles in the river. It has stone abutments, it also has 2 sets of 2 each tracks. The downstream one is a steel truss bridge on a stone abutment on the left and also a stone abutment on the right. The more upstream one of those two, there is a concrete abutment on the left and then a concrete pier probably about 40 feet to the right of that, still on the left abutment, and then the right abutment is a stone structure with a concrete upper portion. And the concrete upper portion has a date of 1910 at the top. So that concrete was apparently added in 1910. The rock masonry must be older. I took a number of photos from on top of the railroad bridges looking downstream and upstream and looking across the bridges to get a feel for their width on both tracks.

Upstream of the second railroad bridge there is a series of apartment buildings. These are apparently owned by the city and they are low income or subsidized housing. They are on the right bank. The left bank has an industrial yard of some kind. It looks like a utility company or a construction company, somebody that has bucket lifts of some sort.

WEST STREET BRIDGE AND DOROTHY AMOS PARK

Next I stopped at the West Street Bridge, which is maybe quarter mile to half mile upstream of the railroad bridges. It is a concrete highway bridge, arched, and it appears to provide quite a constriction to the flow. It’s not very much flow area. At the present river flow,
it looks like the height above the water level is 5 or 6 feet and width at the water level is about 20 feet. There is a storm drain outfall just downstream of the bridge on the right bank. It looks like about a 1.5-2 foot diameter, corrugated pipe that come in. It is just flowing a trickle right now. Further downstream on the left bank, there is a 12 inch diameter tree, maybe a maple tree, that’s about half way chewed by beavers and just standing there. So, clearly, beavers are active in this area. There are quite a few other trunks on both banks of the river that have been chewed off by beavers. So that affects the vegetation around here on the upstream side of West Street on the left bank is Dorothy Amos Park. There is a sign on the downstream side of the park that says “Dorothy Amos Playground established 1975”. This was apparently restored after the fill had been replaced there quite a bit over many decades. After taking some photos of the downstream side of the West Street Bridge I replaced the chip in the camera. So the photo numbers will be little different from here on.

Upstream from the bridge, on the left bank in particular, almost all of the trees and trunks that are larger than 1 inch in diameter have been chewed by beavers. There are still some larger ones standing but there are an awful lot that are chewed off 6 to 12 inches off the ground, just outside the fence of the park. I walked up to the upper extent of the park and there are several transects, it looks like, with wooden stakes in the ground with orange flags on them. These must be sampling locations, it looks like about every 25 feet or so. There is a gate at the upstream end of the park that provides access for sampling people and downstream of the park the river widens out a little bit. It is apparent the park is built on fill that was placed onto the river. It appears there is a water line of some kind that goes across the river just on the upstream side of the bridge. It looks like it is about 8 inches outside diameter. They have some insulation on it so it might be 6 inch inside diameter or something like that by the bridge. The depth of the river upstream of the bridge looks like it averages about 2 feet and it looks like it is a maximum of 3 feet. There is a deep spot to the right of the center of the arch just on the upstream side of the bridge.

**COLUMBUS AVENUE BRIDGE AND PITT PARK**

Next upstream bridge, upstream of West Street is the Columbus Avenue bridge. This bridge has a date on the bridge that says 1996 - at the meeting today it was mentioned that it had been replaced in the 1990’s, as has the next upstream bridge. The West Street Bridge is pretty old. I didn’t notice a date on it. The river just downstream of this bridge is channelized. There are concrete walls on both sides. On the left side the top of the the wall is probably about 8 feet above the present water level. The wall on the right looks like about 5 feet. I can’t tell how far they extend downstream, the one on the right looks like it goes 50-100 feet. There is a lot of brush there so it is hard to tell. The one on the left goes farther, there are several houses on the bank there and it looks like the retaining wall goes down until the creek takes a turn to the left, which is about 300 feet long. Tim or Jim mentioned earlier that the large tree on the right bank upstream of this bridge is a willow tree, he thought, and it’s famous as the largest or the oldest tree in Massachusetts. It is pretty well established. The bridge itself is a concrete span and it has concrete abutments on both sides. It is probably about 8 feet above the present water level and it is probably about 40 feet across the bottom. The right bank slopes up, about a 2 to 1 slope. The left bank has a vertical concrete abutment.

On the left bank upstream of the bridge there is the River View Caribbean American Restaurant. It has a concrete retaining wall behind it that goes from the bridge upstream past the
restaurant; the wall looks like it pretty much goes past to about the third house past the restaurant and it stands about 5 or 6 feet above the present water level. The water here is an average depth of about 1.5 feet and a maximum of 2 feet of flow. Further upstream on the left bank past the third house the retaining wall goes from concrete to stone, that just forms a wall - it doesn’t seem to be a structural feature. Lots of vegetation on the bank and hanging over and some falling into the river on both sides. The park on the right bank upstream of the bridge is called Pitt Park – it goes upstream probably 500 feet or so. Beyond the upstream end of the park the river is fairly channelized. It looks like there is not a lot of vegetation that has fallen into it. Down along the park on the both sides of the river there are quite a few trees that have fallen in. They were leaning in or had actually fallen into the river. Some of them have been chewed by beavers, though there doesn’t seem to be quite as much recent beaver activity here as there was down at the Dorothy Amos Park. Along the right bank further upstream from the park, there are quite a few fairly small parcels along there up to the next street crossing and apparently a number of those have been acquired by the city in recent years because of non-payment of taxes. So these were suggested at the meeting this morning as possible access points for viewing the river. Not so much for going down to the river, just because they are so small and they may be a few feet above the river. They could be places where there could be a bench or something along that line.

**LINDEN STREET BRIDGE**

The next upstream bridge is called Linden Street bridge. There is a Shell gas station on the left bank just on the downstream side of the street going across the bridge. This bridge has a date on it of 1982, apparently when it was rebuilt. It is a concrete horizontal span that goes all the way across. There’s a storm drain culvert coming out of the right abutment just downstream of the bridge. It looks like about a 2 to 3 foot diameter, can’t quite tell. The present water level is about at the spring line of the pipe, about half way up. On the right bank here there is a concrete retaining wall behind the house lot that extends downstream probably about 80 to 100 feet and it’s about 4 to 5 feet tall above the current water level. The clear opening at this bridge right now looks like it’s about 5 feet above the present water level. The average depth is about 1 foot and the maximum depth looks like about 3 feet over near the right side. Substrate here is cobbles with sand mixed in as well. Fairly typical of the other bridges that I have looked at today, too. Looking upstream from the bridge you can just see the downstream end of the wetland area that’s across the river from Wahconah Park. It’s apparent from the wide expanse of vegetation that it is a wetland area. I will take a drive now up to the Wahconah Park area where the baseball field is, and that will be the end of the tour.

Now I am at Wahconah Baseball Park. The sign says “Historic Wahconah Park – Organized Baseball Since 1892”. Supposedly they recently discovered that baseball was played here a lot earlier than that - first place in America where it was played, some people say. It is a historic area. The problem at this park is that it floods. The low spot on the downstream side of the baseball stadium gets water in it when the river gets high, and it gets quite soggy. Right now it’s pretty wet just from rain or snow. The flooding could be contributed to from the dam or the bridges and it also could be contributed to by local drainage from up the hill coming down and flowing into this area. We will have to take a look at the C.T. Male flooding study that was done in 1985. That apparently addresses it somewhat. So there is interest in resolving this flooding issue. It is apparently a sore point among quite a few people locally. The baseball field itself does not flood because it is raised a few feet above the parking lot, 3 or 4 feet, although reportedly it does get soggy. There is also the wetland area up over across the river from here.
So it has historically been a wet area. Just taking a few photos for the general area showing the terrain and the park around the baseball stadium.

**CONCLUSION**

This is the end of the site visit today at West Branch of the Housatonic River for the Mill Street Dam Removal Study, February 13, 2006. Time now is about 3:45 pm.

**SUMMARY OF PHOTOS**

1-5 Dam and vicinity  
6-7 Weasel (?) on shore  
8-22 Bridge downstream of dam  
23-27 Dam and vicinity (downstream)  
28-50 Bridge and building downstream from dam  
51-60 Dam and spillway  
61-73 Upstream reach and railroad bridges  
74-77 Side spillway  
78-81 Left abutment  
82-93 Railroad bridges  
94-100 Side spillway  
101-164 Railroad bridges and impoundment (and some views of dam)  
165-174, 359-383 West Street bridge and Dorothy Amos Park  
384-418 Columbus Avenue bridge and Pitt Park  
419-433 Linden Street bridge  
434-441 Wahconah Park
Onota Lake
Pontoosuc Lake
Richmond Pond (east)
West Branch Housatonic River

Map 1. Drainage Area Above Mill St. Dam

West Branch Housatonic Sub Basin Watershed

8,000 4,000 0 8,000

Feet

West Branch Housatonic Sub Basin Watershed

Mill St. Dam

Richmond Pond (east)

Pontosuc Lake

Onota Lake

APPENDIX F

PRELIMINARY DRAWINGS, DAM REMOVAL ALTERNATIVES
### Table 1: Summary of SEDIMENT ANALYTICAL DATA

**Mill Street Dam**  
**Pittsfield, Massachusetts**

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<th>NOAA Effects Range-Low (ER-L) 4</th>
<th>Probable Effects Concentration (PEC-L) 5</th>
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<td>270</td>
<td>1,300</td>
<td>1,28</td>
<td>2.16</td>
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<td></td>
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<tr>
<td>Magnesium</td>
<td>mg/kg</td>
<td>1.42</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
</tr>
<tr>
<td>Manganese</td>
<td>mg/kg</td>
<td>695</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>mg/kg</td>
<td>2</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
</tr>
<tr>
<td>Nickel</td>
<td>mg/kg</td>
<td>31</td>
<td>49</td>
<td>48.6</td>
<td>0.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphorus</td>
<td>mg/kg</td>
<td>0.08</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
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<tr>
<td>Potassium</td>
<td>mg/kg</td>
<td>0.26</td>
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<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
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<tr>
<td>Scandium</td>
<td>mg/kg</td>
<td>2.7</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
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<tr>
<td>Sodium</td>
<td>mg/kg</td>
<td>0.07</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
</tr>
<tr>
<td>Strontium</td>
<td>mg/kg</td>
<td>24.8</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
</tr>
<tr>
<td>Titanium</td>
<td>mg/kg</td>
<td>0.02</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
</tr>
<tr>
<td>Vanadium</td>
<td>mg/kg</td>
<td>32</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
</tr>
<tr>
<td>Yttrium</td>
<td>mg/kg</td>
<td>9.4</td>
<td>--</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>mg/kg</td>
<td>32</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
<td>ne</td>
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<tr>
<td><strong>PECs</strong></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes:
- mg/kg = milligrams per kilogram.
- g/kg = microgram per kilogram.
- µg/kg = microgram per kilogram.
- "--" Not analyzed.
- "-" Not applicable or no data.
- NE = Not established.

1. Provisional USGS data provided by the Massachusetts Riverways Program (MRP). Data collection funded by MRP. Data are provisional and should not be cited.
6. PEQ (sum of (Csed-max/PEC)) = 61
**TABLE 2**

SUMMARY OF SEDIMENT EXTRACTION PROCEDURE TOXICITY TEST (EP TOX) ANALYTICAL DATA

Mill Street Dam

Pittsfield, Massachusetts

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Sampling Date</th>
<th>Units</th>
<th>CTM Sample No.</th>
<th>RCRA Regulatory Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>05/01/85</td>
<td>mg/L</td>
<td>0.005</td>
<td>U</td>
</tr>
<tr>
<td>Barium</td>
<td>05/01/85</td>
<td>mg/L</td>
<td>0.3</td>
<td>U</td>
</tr>
<tr>
<td>Cadmium</td>
<td>05/01/85</td>
<td>mg/L</td>
<td>0.002</td>
<td>U</td>
</tr>
<tr>
<td>Chromium (total)</td>
<td>05/01/85</td>
<td>mg/L</td>
<td>0.01</td>
<td>U</td>
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<tr>
<td>Lead</td>
<td>05/01/85</td>
<td>mg/L</td>
<td>0.01</td>
<td>U</td>
</tr>
<tr>
<td>Mercury</td>
<td>05/01/85</td>
<td>mg/L</td>
<td>0.0007</td>
<td>0.2</td>
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<tr>
<td>Selenium</td>
<td>05/01/85</td>
<td>mg/L</td>
<td>0.005</td>
<td>1</td>
</tr>
<tr>
<td>Silver</td>
<td>05/01/85</td>
<td>mg/L</td>
<td>0.01</td>
<td>5</td>
</tr>
</tbody>
</table>

mg/L = milligrams per liter
U = Not detected at quantitation limit presented.


APPENDIX H

COST OPINION DETAILS
## Option Description

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1</td>
<td>Sediment Removal Upstream 100% and Dam Removal</td>
<td>$1,875,000</td>
</tr>
<tr>
<td>A.2</td>
<td>Sediment Removal Upstream 50% and Dam Removal</td>
<td>$1,154,000</td>
</tr>
<tr>
<td>B.1</td>
<td>Reshape Stream with 1:20 Slope Constructed Riffle and Dam Removal</td>
<td>$494,000</td>
</tr>
<tr>
<td>B.2</td>
<td>Reshape Stream with 1:30 Slope Constructed Riffle and Dam Removal</td>
<td>$725,000</td>
</tr>
<tr>
<td>C</td>
<td>Staged Impoundment Drawdown with Sediment Release and Dam Removal</td>
<td>$314,000</td>
</tr>
<tr>
<td></td>
<td>Dam Removal (Cost Included in Above Alternatives)</td>
<td>$220,000</td>
</tr>
<tr>
<td></td>
<td>Retaining Wall Repair Along Building and Tailrace Fill</td>
<td>$118,000</td>
</tr>
<tr>
<td></td>
<td>First Upstream Railroad Bridge Demolition</td>
<td>$150,000</td>
</tr>
</tbody>
</table>
## Tel-Electric Dam Removal Feasibility Study

**Subject:** Option A.1 - Sediment Removal Upstream of Dam 100%

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Extension</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Mobilization and Demobilization</td>
<td>1</td>
<td>LS</td>
<td>$50,000</td>
<td>$50,000</td>
<td>$50,000</td>
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<tr>
<td>2.0</td>
<td>Sediment Removal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Dredge Sediment 100%</td>
<td>14,500</td>
<td>CY</td>
<td>$11.15</td>
<td>$161,675</td>
<td>$161,675</td>
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<tr>
<td>2.2</td>
<td>Sedimentation Basin and Removal</td>
<td>1</td>
<td>LS</td>
<td>$25,000</td>
<td>$25,000</td>
<td>$25,000</td>
</tr>
<tr>
<td>2.3</td>
<td>Haul Sediment to Landfill (no salvage)</td>
<td>19,379</td>
<td>TN</td>
<td>$15.00</td>
<td>$290,689</td>
<td>$290,689</td>
</tr>
<tr>
<td>2.4</td>
<td>Landfill Fees (70% Uncontaminated)</td>
<td>13,565</td>
<td>TN</td>
<td>$2.00</td>
<td>$27,131</td>
<td>$27,131</td>
</tr>
<tr>
<td>2.5</td>
<td>Landfill Fees (30% Contaminated)</td>
<td>5,814</td>
<td>TN</td>
<td>$35.00</td>
<td>$203,482</td>
<td>$203,482</td>
</tr>
<tr>
<td>2.6</td>
<td>Railroad Engineering Review/Consultation</td>
<td>1</td>
<td>LS</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
</tr>
<tr>
<td>3.0</td>
<td>Erosion Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Place Riprap along Shore (1’ deep x 5’ wide)</td>
<td>56</td>
<td>CY</td>
<td>$60.00</td>
<td>$3,360</td>
<td>$3,360</td>
</tr>
<tr>
<td>3.2</td>
<td>Staked Hay Bales Sediment Control</td>
<td>1</td>
<td>LS</td>
<td>$2,000</td>
<td>$2,000</td>
<td>$2,000</td>
</tr>
<tr>
<td>4.0</td>
<td>Railroad Engineering Review/Consultation</td>
<td>1</td>
<td>LS</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
</tr>
</tbody>
</table>

### Additional Costs

- **Permitting (25%)**
  - $195,000
- **Contractor Costs (15%)**
  - $117,000
- **Engineering**
  - $117,000
- **Construction Monitoring (15%)**
  - $117,000

**SUBTOTAL**

- $1,324,000

**Contingency**

- 25% $331,000

**TOTAL**

- $1,655,000
**Project:** Tel-Electric Dam Removal Feasibility Study  
**Subject:** Option A.2 - Sediment Removal Upstream of Dam 50%

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Extension</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 Mobilization and Demobilization</td>
<td>1</td>
<td>LS</td>
<td>$40,000</td>
<td>$40,000</td>
<td>$40,000</td>
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<tr>
<td>2.0 Sediment Removal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Dredge Sediment 50%</td>
<td>7,250</td>
<td>CY</td>
<td>$11.15</td>
<td>$80,838</td>
<td>$80,838</td>
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<tr>
<td>2.2 Sedimentation Basin and Removal</td>
<td>1</td>
<td>LS</td>
<td>$25,000</td>
<td>$25,000</td>
<td>$25,000</td>
</tr>
<tr>
<td>2.3 Haul Sediment to Landfill (no salvage)</td>
<td>9,690</td>
<td>TN</td>
<td>$15.00</td>
<td>$145,344</td>
<td>$145,344</td>
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<tr>
<td>2.4 Landfill Fees (70% Uncontaminated)</td>
<td>6,783</td>
<td>TN</td>
<td>$2.00</td>
<td>$13,565</td>
<td>$13,565</td>
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<tr>
<td>2.5 Landfill Fees (30% Contaminated)</td>
<td>2,907</td>
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<td>$101,741</td>
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<td>3.0 Erosion Control</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Place Riprap along Shore (1’ deep x 5’ wide)</td>
<td>56</td>
<td>CY</td>
<td>$60.00</td>
<td>$3,360</td>
<td>$3,360</td>
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<tr>
<td>3.2 Staked Hay Bales Sediment Control</td>
<td>1</td>
<td>LS</td>
<td>$2,000</td>
<td>$2,000</td>
<td>$2,000</td>
</tr>
<tr>
<td>4.0 Railroad Engineering Review/Consultation</td>
<td>1</td>
<td>LS</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
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Permitting (25%) $107,000  
Contractor Costs (15%) $64,000  
Engineering $85,000  
Construction Monitoring (15%) $64,000  

**SUBTOTAL** $747,000  
**Contingency 25%** $187,000  
**TOTAL** $934,000
# Tel-Electric Dam Removal Feasibility Study

**Subject:** Option B.1 - Reshape Stream with 1:20 Slope Constructed Riffle

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Extension</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 Mobilization and Demobilization</td>
<td>1</td>
<td>LS</td>
<td>$10,000</td>
<td></td>
<td>$10,000</td>
</tr>
<tr>
<td>2.0 Reshape Channel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Dredge Channel Sediment</td>
<td>740</td>
<td>CY</td>
<td>$11.15</td>
<td></td>
<td>$8,251</td>
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<tr>
<td>2.2 Sedimentation Basin and Removal</td>
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<td>LS</td>
<td>$20,000</td>
<td></td>
<td>$20,000</td>
</tr>
<tr>
<td>2.3 Haul Sediment to Landfill (no salvage)</td>
<td>989</td>
<td>TN</td>
<td>$15.00</td>
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<td>$14,835</td>
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<tr>
<td>2.4 Landfill Fees (70% Uncontaminated)</td>
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<td>TN</td>
<td>$2.00</td>
<td></td>
<td>$1,385</td>
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<tr>
<td>2.5 Landfill Fees (30% Contaminated)</td>
<td>297</td>
<td>TN</td>
<td>$35.00</td>
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<td>$10,385</td>
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<tr>
<td>2.6 Place Riprap</td>
<td>725</td>
<td>CY</td>
<td>$60.00</td>
<td></td>
<td>$43,500</td>
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<tr>
<td>3.0 Erosion Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Staked Hay Bales Sediment Control</td>
<td>1</td>
<td>LS</td>
<td>$2,000</td>
<td></td>
<td>$2,000</td>
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<tr>
<td>4.0 Railroad Engineering Review/Consultation</td>
<td>1</td>
<td>LS</td>
<td>$15,000</td>
<td></td>
<td>$15,000</td>
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</tbody>
</table>

**Permitting (25%)**

$31,000

**Contractor Costs (15%)**

$19,000

**Engineering**

$25,000

**Construction Monitoring (15%)**

$19,000

**SUBTOTAL**

$219,000

**Contingency**

25% $55,000

**TOTAL**

$274,000
## Tel-Electric Dam Removal Feasibility Study

**Subject:** Option B.2 - Reshape Stream with 1:30 Slope Constructed Riffle

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Extension</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 Mobilization and Demobilization</td>
<td></td>
<td>1</td>
<td>LS</td>
<td>$20,000</td>
<td>$20,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>2.0 Reshape Channel</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>$193,494</td>
</tr>
<tr>
<td>2.1 Dredge Channel Sediment</td>
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<td>1900</td>
<td>CY</td>
<td>$11.15</td>
<td>$21,185</td>
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</tr>
<tr>
<td>2.2 Sedimentation Basin and Removal</td>
<td></td>
<td>1</td>
<td>LS</td>
<td>$20,000</td>
<td>$20,000</td>
<td></td>
</tr>
<tr>
<td>2.3 Haul Sediment to Landfill (no salvage)</td>
<td></td>
<td>2,539</td>
<td>TN</td>
<td>$15.00</td>
<td>$38,090</td>
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</tr>
<tr>
<td>2.4 Landfill Fees (70% Uncontaminated)</td>
<td></td>
<td>1,778</td>
<td>TN</td>
<td>$2.00</td>
<td>$3,555</td>
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<tr>
<td>2.5 Landfill Fees (30% Contaminated)</td>
<td></td>
<td>762</td>
<td>TN</td>
<td>$35.00</td>
<td>$26,663</td>
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<tr>
<td>2.6 Place Riprap</td>
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<td>1400</td>
<td>CY</td>
<td>$60.00</td>
<td>$84,000</td>
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</tr>
<tr>
<td>3.0 Erosion Control</td>
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<td></td>
<td>$2,000</td>
</tr>
<tr>
<td>3.1 Staked Hay Bales Sediment Control</td>
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<td>LS</td>
<td>$2,000</td>
<td>$2,000</td>
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</tr>
<tr>
<td>4.0 Railroad Engineering Review/Consultation</td>
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<td>1</td>
<td>LS</td>
<td>$15,000</td>
<td>$15,000</td>
<td></td>
</tr>
</tbody>
</table>

**Permitting (25%)**

| Permitting (25%) | $58,000  |

| Contractor Costs (15%) | $35,000  |

| Engineering | $46,000  |

| Construction Monitoring (15%) | $35,000  |

**SUBTOTAL**

| SUBTOTAL | $404,000  |

**Contingency**

| Contingency | 25%       | $101,000  |

**TOTAL**

| TOTAL | $505,000  |
**Preliminary Opinion of Cost**

**Project:** Tel-Electric Dam Removal Feasibility Study  
**Subject:** Option C - Staged Impoundment Drawdown and Sediment Release

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Extension</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Mobilization and Demobilization</td>
<td>1</td>
<td>LS</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
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<td>2.0</td>
<td>Side Spillway Notch</td>
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<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Concrete Demolition</td>
<td>1</td>
<td>Day</td>
<td>$1,875</td>
<td>$1,875</td>
<td>$1,875</td>
</tr>
<tr>
<td>2.2</td>
<td>Concrete Disposal On Site</td>
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<td>$200</td>
<td>$200</td>
</tr>
<tr>
<td>3.0</td>
<td>Sediment Monitoring</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Sediment Monitoring</td>
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<td>LS</td>
<td>$20,000</td>
<td>$20,000</td>
<td>$20,000</td>
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<tr>
<td>4.0</td>
<td>Railroad Engineering Review/Consultation</td>
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<td>LS</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
</tr>
</tbody>
</table>

**Permitting (25%)**  
$11,000

**Contractor Costs (15%)**  
$6,000

**Engineering**  
$8,000

**Construction Monitoring (20%)**  
$8,000

**Subtotal**  
$75,000

**Contingency**  
25%  
$19,000

**Total**  
$94,000
**Preliminary Opinion of Cost**

**Project:** Tel-Electric Dam Removal Feasibility Study  
**Subject:** Dam Removal

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Extension</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 Mobilization and Demobilization</td>
<td>1</td>
<td>LS</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>2.0 Earthwork</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Excavation of Left Bank</td>
<td>370</td>
<td>CY</td>
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<td>$872</td>
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<td>133</td>
<td>CY</td>
<td>$50.00</td>
<td>$6,650</td>
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</tr>
<tr>
<td>3.0 Dam Removal</td>
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<td></td>
<td></td>
<td></td>
<td>$7,522</td>
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<td>3.1 Concrete Demolition</td>
<td>225</td>
<td>CY</td>
<td>$150</td>
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<td>260</td>
<td>CY</td>
<td>$50.00</td>
<td>$13,000</td>
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<td>3.3 Haul Rubble to Landfill (no salvage)</td>
<td>485</td>
<td>CY</td>
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<td>4.0 Replace River Bank</td>
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<td></td>
<td></td>
<td></td>
<td>$54,111</td>
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<tr>
<td>4.1 Access Road Removal</td>
<td>133</td>
<td>CY</td>
<td>$30.00</td>
<td>$3,990</td>
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<td>4.2 Replace Fill</td>
<td>1</td>
<td>LS</td>
<td>$500</td>
<td>$500</td>
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<tr>
<td>4.3 Place Riprap</td>
<td>37</td>
<td>CY</td>
<td>$60.00</td>
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<tr>
<td>4.4 Loam (furnish and spread 6&quot; deep)</td>
<td>125</td>
<td>SY</td>
<td>$12.88</td>
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<tr>
<td>4.5 Seed, Fertilize, Mulch</td>
<td>1</td>
<td>LS</td>
<td>$200</td>
<td>$200</td>
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<td>5.0 Sediment Control</td>
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<td></td>
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<td>$8,520</td>
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<td>5.1 Sediment Control</td>
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<td>6.0 Biomonitoring</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$22,250</td>
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<tr>
<td>6.1 Pre-survey Mobilization</td>
<td>1</td>
<td>LS</td>
<td>$1,500</td>
<td>$1,500</td>
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<td>6.2 IBI Field Survey (Labor and Equipment)</td>
<td>5</td>
<td>Day</td>
<td>$3,000</td>
<td>$15,000</td>
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<tr>
<td>6.3 Bed Profiling</td>
<td>2</td>
<td>Day</td>
<td>$1,500</td>
<td>$3,000</td>
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<tr>
<td>6.4 Data Report</td>
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<td>LS</td>
<td>$2,750</td>
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<tr>
<td>Permitting (25%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$26,000</td>
</tr>
<tr>
<td>Contractor Costs (15%)</td>
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<td></td>
<td></td>
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<td>$16,000</td>
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<tr>
<td>Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$21,000</td>
</tr>
<tr>
<td>Construction Monitoring (10%)</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**Subtotal** $176,000  
**Contingency 25%** $44,000  
**Total** $220,000
### Tel-Electric Dam Removal Feasibility Study

#### Retaining Wall Repair Along Building and Tailrace Fill

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Extension</th>
<th>Total</th>
</tr>
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<tr>
<td>1.0 Mobilization and Demobilization</td>
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<td>LS</td>
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<td>$5,000</td>
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<td>2.0 Downstream Cofferdam (5’ deep x 100’ long)</td>
<td>500</td>
<td>SF</td>
<td>$30.00</td>
<td>$15,000</td>
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<td>3.0 Earthwork</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Access Road and Stabilize Bank</td>
<td>70</td>
<td>CY</td>
<td>$30.00</td>
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<td>$2,100</td>
</tr>
<tr>
<td>3.2 Access Road Removal</td>
<td>70</td>
<td>CY</td>
<td>$15.00</td>
<td>$1,050</td>
<td>$1,050</td>
</tr>
<tr>
<td>4.0 Demolition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1 Demolition of Unsound Concrete</td>
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<td>CY</td>
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<tr>
<td>5.0 Concrete</td>
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</tr>
<tr>
<td>5.1 New concrete in retaining wall</td>
<td>33</td>
<td>CY</td>
<td>$371</td>
<td>$12,353</td>
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<td>5.2 New concrete in abandoned tailrace</td>
<td>48</td>
<td>CY</td>
<td>$371</td>
<td>$17,789</td>
<td>$17,789</td>
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<td>6.0 Riprap</td>
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<td>6.1 New Riprap Protection</td>
<td>12.5</td>
<td>CY</td>
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<td>$750</td>
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</table>

**Permitting (25%)**

$14,000

**Contractor Costs (15%)**

$8,000

**Engineering**

$11,000

**Construction Monitoring (10%)**

$6,000

**SUBTOTAL**

$94,000

**Contingency**

25% $24,000

**TOTAL**

$118,000
## Tel-Electric Dam Removal Feasibility Study

### First Upstream Railroad Bridge Demolition

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Extension</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Mobilization and Demobilization</td>
<td>1</td>
<td>LS</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>2.0</td>
<td>RR Bridge Demolition</td>
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<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Steel Demolition</td>
<td>10</td>
<td>Day</td>
<td>$3,300</td>
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<td>$48,000</td>
</tr>
<tr>
<td>2.2</td>
<td>Steel Pile Demo by Diver Team</td>
<td>5</td>
<td>Day</td>
<td>$3,000</td>
<td>$15,000</td>
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</tr>
<tr>
<td>3.0</td>
<td>Railroad Engineering Review/Consultation</td>
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<td>LS</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
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</tbody>
</table>

- **Permitting (25%)**  
  - $18,000

- **Contractor Costs (15%)**  
  - $11,000

- **Engineering**  
  - $11,000

- **Construction Monitoring (10%)**  
  - $7,000

**SUBTOTAL**  
- $120,000

**Contingency**  
- 25%  
- $30,000

**TOTAL**  
- $150,000
APPENDIX I

DAM REMOVAL SCHEDULE MILESTONES
# MILL STREET DAM REMOVAL AND WEST BRANCH HOUSATONIC RIVER RESTORATION

## PROJECT SCHEDULE – MILESTONES

| Year 1 | • Sediment Management Plan Development  
| | • Greenway Planning  
| | • PCB Source Study  
| | • Public Outreach  
| Year 2 | • Final Design – Dam Removal & River Restoration  
| | • Greenway Planning (continued)  
| | • Public Outreach (continued)  
| Year 3 | • Permitting  
| | • Greenway Planning (continued)  
| | • Public Outreach (continued)  
| | • Pre-Removal/Restoration Monitoring  
| Year 4 | • Pre-Restoration Monitoring (continued)  
| | • Dredging or Excavation of Sediment from Impoundment  
| | • Removal of Dam  
| Year 5 | • Post-Removal/Restoration Monitoring  
| | • River Restoration  
| Year 6 | • Post-Removal/Restoration Monitoring (continued)  

MILL STREET DAM REMOVAL AND
WEST BRANCH HOUSATONIC RIVER RESTORATION

DESCRIPTION OF PROJECT MILESTONES

Year 1
- **Sediment Management Plan Development** – Sampling; testing; determination of sediment quality, quantity, and distribution.
- **Greenway Planning** – Begin planning for the greenway, including determination of features and amenities, access and ownership issues.
- **PCB Source Study** – Test impounded PCBs to determine their source and cleanup responsibility.
- **Public Outreach** – Public meetings and dissemination of information through mailings and/or websites to gather input to aid in selection of preferred removal/restoration alternative.

Year 2
- **Final Design of Dam Removal and River Restoration** – Based on quantity, quality, and distribution of impounded sediments, feasibility of removing all the sediments, and the results of the hydraulic and scour analysis, select preferred alternative. Prepare final engineering design, including plans and specifications.
- **Greenway Planning (continued)** – Continue planning started in Year 1, begin design process, identify needs for permitting and acquisition of land or easements.
- **Public Outreach (continued)** – Continue public meetings and dissemination of information.

Year 3
- **Permitting** – Based on preferred removal/restoration alternative, submit applications for local, state, and federal permits.
- **Greenway Planning (continued)** – Continue planning for greenway features, complete designs, obtain title or easements, submit permit applications.
- **Public Outreach (continued)** – Continue public meetings and dissemination of information.
- **Pre-Removal/Restoration Monitoring** – Conduct monitoring of fish and other aquatic species to identify existing distribution and abundance.

Year 4
- **Pre-Restoration Monitoring (continued)** – Conduct additional monitoring of existing conditions to provide baseline for evaluation of restoration benefits.
- **Dredging or Excavation of Sediment from Impoundment** – Based on selected removal/restoration alternative, remove all or portion of sediment from affected area, as appropriate.
- **Removal of Dam** – Based on selected alternative, remove all or portion of dam.

Year 5
- **Post-Removal/Restoration Monitoring** – Conduct monitoring of fish and other aquatic species.
- **River Restoration** – Restore river channel and bank areas, including vegetation plantings, construct river overlook, place interpretive signs.

Year 6
- **Post-Removal/Restoration Monitoring (continued)** – Conduct further monitoring of aquatic species to assess effects of dam removal and river restoration.
APPENDIX J

BIOMONITORING APPROACH FOR DAM REMOVAL
INTRODUCTION

Regionally dam removal is an increasingly common river habitat restoration practice. Dam removal is promoted for a variety of reasons, such as restoring flow regime, geomorphic integrity (e.g. sediment transport), aquatic habitat, water quality and ecosystem or fishery resource values. In the case of the Mill Street Dam removal project each of these ecological benefits are expected. Sponsors of the Mill Street Dam removal have identified a number of desirable effects that removal will have on fish resources, such as open habitat connectivity for native fluvial species and increased ecosystem productivity potential. Although one can make inferences regarding expected or unexpected biological responses from qualitative, site specific anecdotal and subjective observations of other dam removal projects, quantitative monitoring methods are being developed at this site to provide project sponsors sufficient objective information upon which to scientifically evaluate the action over time.

As required in the request for responses we propose to monitor one structural and one functional parameter to provide this objective evaluation. This restoration effort seeks to also remediate contaminated sediments and will be done so under a strict regulatory framework, therefore pre-and post restoration sediment and water quality testing will be included in the monitoring and evaluation reports but is not considered a pro-active evaluation criteria for purposes of this section.

PROTOCOL FRAMEWORK FOR STRUCTURAL PARAMETER - Hydraulics

Given that the goal of the restoration is to reestablish natural hydrological conditions a comparison of pre and post restoration hydrology is proposed as the key structural parameter. Pre and post hydraulic modeling under variable, seasonal flow conditions is proposed for multiple years.

Hydraulic modeling coupled with pre and post longitudinal profiles of the river bed and cross sectional profiles will assist in evaluating this parameter. The longitudinal profile will extend through the project area from Mill Street Bridge through the existing impoundment past defined grade control. Representative cross sections at set intervals will be also be conducted. Cross sectional end points will be geo-referenced for repeat surveys.

Both cross-sectional and longitudinal profiles will be compared before and after project implementation to monitor changes in bed features, bank features, geomorphic stability, and sediment transport. All of these aspects are critical to the re-development of habitat following dam removal.
HEC-RAS will be used for hydraulic modeling. HEC-RAS is an industry standard river modeling software program developed at the Hydrologic Engineering Center (HEC) for the Army Corps of Engineers. The software allows the user to perform one-dimensional, gradually varied, and steady flow analysis. The steady flow component is capable of modeling sub critical, supercritical, and mixed flow regime water surface profiles. The effects of various obstructions, such as bridges and designed habitat structures in the river and floodplain, can be considered in the computations and evaluated compared to necessary hydraulic conditions for native species.

PROTOCOL FRAMEWORK FOR FUNCTIONAL PARAMETER – fish assemblage

The Index of Biotic Integrity (IBI) is a useful, flexible and established multi-metric assessment tool for measuring biological change to aquatic fluvial systems (Karr, et al. 1986)\(^1\). IBI methods have historically been most commonly employed to use fish abundance and distribution data to monitor and assess ecosystem-scale responses to water quality improvements or degradation, recently the method has been modified and used to measure responses to flow regime alteration. The IBI was initially developed in response to the desire to have an ecological assessment tool to meet the needs of government agencies, yet not sacrifice technical rigor and competence for cost-effectiveness. It is especially well-adapted to monitoring watershed-scale changes in fish assemblages, though it has also been adapted for aquatic macroinvertebrates and even terrestrial ecosystems. The IBI measures the structure and function of a faunal assemblage at multiple survey sites to determine, based on ecosystem niche structure, areas in need of remediation, and/or changes over time in response to restoration or a new impact. The ecosystem niches used in the assessment are user-defined by selecting indicator metrics based on local and eco-region factors. When incorporated with mapping, monitoring and modeling, the field-derived metric score can be compared to historic data, a spatial gradient in the study area, and also to an idealized model of the restoration target assemblage as a way to measure progress toward a restoration goal.

Metrics pertaining to fish assemblage response are a preferable evaluation technique, in part because:

- Improved fisheries are a goal of the Mill Street Dam removal
- Fish abundance, diversity and biomass are indicators of ecosystem productivity
- Information about fish is less abstract than other parameters when communicating results to the public

METHODOLOGIES BACKGROUND

As with any biological assessment technique IBI data must be collected in a methodical, consistently repeatable manner, using sampling methods that have minimal field bias for the species being assessed. In rivers, electrofishing is the preferred methodology for fish assemblage sampling.

Electrofishing at this site will be conducted by wading. Wading allows rapid collection of fish assemblage constituents along a widespread linear river corridor.

Survey work for HEC-RAS modeling, including longitudinal profiles and cross sections, will be conducted by qualified surveyors and the outcome of the model will be stamped by a professional engineer.

FIELD PROTOCOL SUMMARY

The overall geographic scope of the surveys will be pre-determined by project team consultation, and if necessary field-reconnoitered. All work for both the structural and functional parameters will be guided by a written Standard Operating Procedure (SOP) that will be pre-approved by the Massachusetts SubCouncil so that future monitoring can duplicate the same effort.

Field site selection is based on selecting habitats that are representative of local conditions, sufficiently large to accommodate sufficient sampling effort, consistently accessible, and geographically applicable to the impact or recovery issues at hand. For example fish sampling will entail establishing multiple sites within, upstream and downstream from the existing impounded water body, as well as in at least one river reach containing applicable reference conditions (such as a fluvial reach with no or minimal other limiting factors such as stressed water quality or degraded habitat in this case the Southwest Branch of the Housatonic may provide a proper reference). Sites can be spread apart, contiguous or staggered depending on site-specific condition.

Fish sampling will be scheduled to occur during late summer months to allow for capture of spring hatched young-of-year species, and also to link the fish assemblage to ambient water quality and flow conditions of late summer which often serve as a seasonally-occurring natural limiting factor.

Each survey site should be accurately geo-referenced so that future surveys can duplicate the effort. Data on ambient water quality (typically temperature, dissolved oxygen, pH and conductivity), river flow, cover and substrate type and quality, and other relevant physical factors that may dynamically influence fish distribution and abundance are recorded. Sampling time and distance is also recorded so that catch-per-unit effort can be determined.

At the conclusion of sampling, all fish are identified to species, enumerated, and mass weighed at the species or lifestage-level\(^2\). All fish are returned to the water body unless voucher specimens or individuals requiring lab identification are retained and preserved. In case-specific instances where fish stocking practices may dictate the presence or relative abundance of a species (e.g. trout) it is prudent to collect scale samples from individual as a means to determine wild or stocked origin of that part of the catch.

\(^2\) For species where multiple life stages and/or size classes are present and especially when differing lifestages may represent different niche uses and/or management concerns, enumeration and weighing should be done at this sub-level.
Data are recorded on standardized data sheets, and field-checked by the field crew chief at the end of the day so that omissions and/or questionable data points can be addressed while the information is fresh. Upon return to the office, original data sheets are copied and archived, and further QA/QC corrections are made on the working copies rather than originals.

For purposes of this proposal the monitoring and evaluation will be conducted by a qualified sub-contractor with technical assistance from Riverways and the Massachusetts SubCouncil.

CONTINGENCY PLAN AND DATA SHARING

If restoration benchmarks or targets are not being met an adaptive management approach will be employed. Examples of an adaptive management approach would include modifying stream structures to facilitate fish or aquatic species migration or re-examining the background or reference conditions to re-establish accurate target goals. Information from the monitoring and evaluation reports will be shared with partners and the general public. Fish assemblage data will be sent to Mass Division of Fisheries and Wildlife. This data will be compared to potential target fish community data developed by Division of Fisheries and Wildlife Staff. Information and reports will be made available electronically to the public. Public dissemination of information is especially important given that this dam removal project will be a pilot for the state.