U.S. Army Corps of Engineers

New England District
Concord, Massachusetts

Technical Support Services
General Electric (GE) Housatonic River Project
Pittsfield, Massachusetts

Contract No. DACA31-96-D-0006

FINAL DRAFT

ENGINEERING EVALUATION/COST ANALYSIS FOR THE UPPER REACH OF THE HOUSATONIC RIVER

VOLUME I - TEXT

Task Order No. 0013

DCN: GEP4-012400-AACJ

11 February 2000

99P-2783-1

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GENERAL ELECTRIC (GE) HOUSATONIC RIVER PROJECT PITTSFIELD, MASSACHUSETTS

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LIST OF ACRONYMS

AOS	apparent open size
ARARs	Applicable or Relevant and Appropriate Requirements
ARCS	Assessment and Remediation of Contaminated Sediments
ASTs	aboveground storage tanks
AWQC	ambient water quality criteria
BAT	Best Available Technology
BBL	Blasland, Bouck & Lee, Inc.
BCT	Best Conventional Technology
BMPs	Best Management Practices
CENAE	New England District of the U.S. Army Corps of Engineers
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
cfs	cubic feet per second
CMR	Code of Maryland Regulations
CSFs	Cancer Slope Factors
DNAPL	dense nonaqueous phase liquid
DRET	Dredging Elutriate Test
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
EREs	Environmental Restrictions and Easements
ER-L	Effect Range-Low
ER-M	Effect Range-Median
FES	fabric encapsulated soil
fps	ft per second
FS	factor of safety
ft	feet, foot
GE	General Electric Company
H	height
HDPE	high-density polyethylene
HROs	Habitat Restoration Objectives
HRS	Hazard Ranking System
in.	inch
IRA	Immediate Response Action
ISCs	in situ caps
lb	pound
LDRs	land disposal restrictions

LIST OF ACRONYMS
(Continued)

LEL	Lowest Effect Level
MADEP	Massachusetts Department of Environmental Protection
MCP	Massachusetts Contingency Plan
MHD	Massachusetts Highway Department
NAPL	nonaqueous phase liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFPA	National Fire Protection Association
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanographic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRD	Natural Resource Damage
OMEE	Ontario Ministry for the Environment and Energy
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PEDA	Pittsfield Economic Development Authority
PPE	personal protective equipment
ppm	parts per million
PRGs	Preliminary Remediation Goals
psf	per square foot
PVC	polyvinyl chloride
RAGS	Risk Assessment Guidance for Superfund
RBP	Rapid Bioassessment Protocol
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RI/FS	Remedial Investigation/Feasibility Study
SARA	Superfund Amendments and Reauthorization Act
SBLT	Sequential Batch Leaching Test
SEL	Severe Effect Level
SOW	Statement of Work
SPT	Standard Penetration Test
START	Superfund Technical Assistance and Response Team
STM	Short-Term Measure
SVOCs	semivolatile organic compounds

LIST OF ACRONYMS
(Continued)

T&E	threatened or endangered
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxic Characteristic Leaching Procedure
TEFs	Toxic Equivalency Factors
TEQ	Toxic Equivalent
TOC	total organic carbon
TRM	turf-reinforcement mat
TSCA	Toxic Substances Control Act
UCLs	Upper Confidence Limits
USACE	U.S. Army Corps of Engineers
USTs	underground storage tanks
VOCs	volatile organic compounds
yd^3	cubic yards

EXECUTIVE SUMMARY

This report summarizes the results of an Engineering Evaluation/Cost Analysis (EE/CA) conducted for the Upper Reach of the Housatonic River from the Lyman Street Bridge to the confluence of the East and West Branches of the Housatonic River. This 1.5-mile stretch of river, referred to as the EE/CA Reach in this report, passes through the City of Pittsfield, MA, and is immediately downstream of the General Electric (GE) manufacturing facility in Pittsfield. The EE/CA is limited to the evaluation of removal actions, technologies, and restoration regarding riverbank soils and sediments in the EE/CA Reach.

Numerous studies have been conducted on the river including sediment, soil, fish tissue, and benthic organisms collected from the river. These studies indicate that polychlorinated biphenyl (PCB) contamination exists in the Housatonic River from the outfall of Unkamet Brook (upstream of the EE/CA Reach) to the Massachusetts-Connecticut state line and beyond. The U.S. Environmental Protection Agency (EPA) has determined that a Non-Time-Critical Removal Action is needed to address unacceptable risks or threats to human health and ecological receptors in the Upper Reach of the Housatonic River in Pittsfield, MA. This determination was documented in the 26 May 1998 Combined Action and EE/CA Approval Memorandum (Action Memorandum) (Tagliaferro, 00-0158).

Through the EE/CA process, EPA is authorized to evaluate alternatives to mitigate the human health and environmental threat posed by the existing high levels of PCBs and other hazardous substances in river sediments and banks of the EE/CA Reach. In the Action Memorandum, EPA demonstrated that actual or threatened releases of hazardous substances from this site may present an imminent and substantial danger to public health or welfare or to the environment, if not addressed by implementing the response actions selected in the Action Memorandum (00-0158).

Roy F. Weston, Inc. (WESTON®), under contract to the New England District of the U.S. Army Corps of Engineers (CENAE), prepared the EE/CA for the site. The purpose of this report is to present the results of the EE/CA process to provide the information necessary for selecting the most appropriate alternative that meets the stated removal action objectives.

ES.1 SITE DESCRIPTION AND HISTORY

The Housatonic River is located in the center of a rural area where farming was the main occupation from 1761 through the late 19th century. However, during the industrial revolution, manufacturing developed along the streams and rivers in the area. Pittsfield's manufacturing base grew to include machinery and electrical transformers during the early 20th century (ChemRisk, 02-0166). GE initiated operations at the facility, near the upstream end of the site, in 1903. Three manufacturing divisions at the GE facility (Transformer, Ordnance, and Plastics) have used areas near the site (Blasland, Bouck & Lee, Inc. [BBL], 01-0024).

The Housatonic River flowed through the City of Pittsfield in its natural state until the late 1930s or early 1940s when the U.S. Army Corps of Engineers (USACE) channelized the river within the City of Pittsfield, isolating oxbows from the main river channel (BBL, 06-0001). From the late 1940s until approximately the 1980s, these oxbows were backfilled with various materials (BBL, 06-0001, 05-0005, 01-0027). In addition, the Massachusetts Department of Public Works undertook flood control work based on reports by USACE. Work within the site area included the East Branch within the City of Pittsfield and the riverbanks above and below Woods Pond. The river's course is relatively unaffected in areas downstream of the city.

In the late 1960s, a PCB storage tank associated with GE Building 68 collapsed and released an estimated 1,000 gallons of liquid PCBs to the riverbank, surface water, and sediments. Visual contamination, including trap rock and sediments, was removed following the release; however, subsequent investigations in this area identified additional material, including DNAPL, that was not removed during the immediate response action. Additional releases of PCBs to the environment include spills at the GE facility onto the ground resulting in contamination of soil (some of which was used as fill at the facility and at off-site areas throughout Pittsfield), surface water runoff to Silver Lake and the river, and groundwater.

ES.2 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

The source, nature, and extent of contamination in the EE/CA Reach has been assessed in this report based upon historical and recent investigations performed by GE, EPA, and others, including those performed as part of this EE/CA. The sources of contamination in the EE/CA

Reach include the GE facility; the 0.5-mile stretch of river immediately upstream of the EE/CA Reach (known as the Removal Reach); Silver Lake, which discharges into the river in the EE/CA Reach; and former oxbow areas A, B, and C, which abut the river in the EE/CA Reach. Source areas will be investigated under the terms of the Consent Decree (00-0388, 00-0389, 00-0390), which was lodged in Federal District Court on 7 October 1999.

Source control measures are currently being planned under the *Statement of Work for Removal Actions Outside the River* (SOW) (00-0389). This SOW was developed in accordance with the Consent Decree. Areas targeted for action under this SOW include several areas within the GE plant property, former oxbow areas, the Allendale schoolyard, the Housatonic River floodplain, and Silver Lake. Additionally, certain source control measures have already been completed or are scheduled to be completed by 31 May 2001. These include the installation of impermeable sheetpiling along the riverbank adjacent to the East Street Area II portion of the 0.5-mile reach, the installation of automated DNAPL recovery systems at the Newell Street parking lot (adjacent to the 0.5-mile reach), and the installation of impermeable sheetpiling along the riverbank adjacent to the Lyman Street portion of the 0.5-mile reach. Additional information on these and other activities to control nonaqueous phase liquids (NAPL), as discussed in the Action Memorandum, can be found in separate work plans prepared by GE (see Annex II of the *Statement of Work for Removal Actions Outside the River* [00-0389] for a list of GE Work Plans and EPA approval letters). Alternatives described in the EE/CA assume that these source control measures will be effectively implemented prior to initiating work in the EE/CA Reach.

The additional investigations conducted as part of this EE/CA included sediment and riverbank soil sampling, geotechnical soil borings, and specialty sampling (wipe samples, dredge elutriate testing, sequential batch leaching tests, porewater analysis, and particle size versus PCB contamination analysis). The historic and recent investigations confirmed the findings in the Action Memorandum (00-0158) that PCBs are present in sediment and bank soils throughout the EE/CA Reach at levels that pose threats to public health and the environment.

ES.3 REMOVAL ACTION OBJECTIVES AND CLEANUP CRITERIA

EPA guidance (*Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*, EPA/540-R-93-057, 99-0012) provides for the development of removal action objectives to form the basis for evaluating alternatives. The Action Memorandum (00-0158) demonstrated that high levels of PCBs were detected in surficial sediments, bank soils, and floodplain samples throughout the subject area. The concentrations of PCBs greatly exceed cleanup levels considered protective of human health including the 1-ppm preliminary remediation goal for residential areas specified in EPA OSWER Directive 9355.4-01; EPA's PCB Spill Cleanup Policy, 40 CFR Part 761 (10 ppm in residential areas - if capped, 25 ppm in industrial areas); and Massachusetts Department of Environmental Protection's (MADEP) default (Method 1) cleanup standard for residential and industrial soils of 2 ppm. In addition, the *Upper Reach - Housatonic River Ecological Risk Assessment* (99-0085) identified numerous exceedances of ambient water quality criteria and various sediment benchmarks and guidelines. Based upon this evaluation, the following removal action objectives were established:

- Remove, treat, and/or manage PCB-contaminated river sediments to prevent human exposures exceeding risk-based levels by the dermal adsorption and incidental ingestion routes.
- Remove, treat, and/or manage PCB-contaminated river sediments to prevent ecological exposures exceeding risk-based levels.
- Remove, treat, and/or manage PCB-contaminated riverbank soils to prevent human exposures exceeding risk-based levels by the dermal adsorption and incidental ingestion routes.
- Remove, treat, and/or manage PCB-contaminated riverbank soils to prevent ecological exposures exceeding risk-based levels.
- Eliminate or mitigate existing riverbank soil and sediment sources of contamination to the EE/CA Reach of the Housatonic River.
- Prevent recontamination of previously remediated areas and further contamination of other areas.
- Prevent the downstream migration of contaminated sediments and bank soils.
- Minimize long- and short-term impacts on wetland and floodplain areas.
- Enhance habitat (riparian and aquatic) in a manner consistent with the above objectives.

To achieve these objectives, EPA has established cleanup criteria for total PCBs in bank soils in the EE/CA Reach based on human and ecological exposure exceeding risk-based levels (EPA, 00-0386 and 00-0387). These memoranda concerning cleanup criteria are provided in Appendix Q. The criteria are as follows:

- Riverbank soils adjacent to recreational or commercial properties are classified as recreational use. The recreational use criterion will be 10 ppm in the 0- to 1-ft interval and 10 ppm in the 1- to 3-ft interval. In areas where there is a potential for future exposures that are inconsistent with recreational use (i.e., future residential use) or where exposures may occur at depths greater than 3 ft, Environmental Restrictions and Easements (EREs) will be obtained.

- Riverbanks on residential properties will be remediated to the residential use criterion of 2 ppm to at least a depth of 3 ft. However, prior to the EE/CA removal action, additional soil analytical data will be gathered at depths greater than 3 ft on each residential property. Based on these data, a determination will be made whether additional excavation is warranted or the application of an ERE is necessary.

EPA is establishing a PCB cleanup standard of 10 mg/kg for all bank areas that are not in residential use (i.e., part of a residential property). In establishing this cleanup standard for the EE/CA, EPA has considered the *Evaluation of Human Health Risks from Exposure to Elevated Levels of PCBs in Housatonic River Sediment, Bank Soils, and Floodplain Soils* (00-0315) and other site-specific information on exposures. Specific changes to the exposure assumptions include consideration of the exposure frequency (i.e., 3 days per week during warmer months) for nonresidential portions of the riverbank. For banks in residential use, EPA has established the cleanup standard at 2 mg/kg. This level is the Massachusetts DEP's default standard for Method 1 soils (unrestricted use). The risk justification and calculations associated with this cleanup standard can be found in the 4 August 1999 risk justification memo found in Appendix D to the Consent Decree.

The cleanup criterion for sediment is 1 ppm. Sediment is defined as the material below the mean annual high-water line. Above the mean annual high-water line, the soils are defined as riverbank soils.

PCB contamination shall be removed based on the 95% Upper Confidence Limit (UCL) of the mean PCB concentrations in the sediments and bank soils. In addition, where Appendix IX contamination is not co-located with PCB contamination, the limits of the PCB excavation will be extended to remove exceedances for the Appendix IX contaminants.

ES.4 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

Numerous technologies to contain, remove, and/or treat the PCB contamination have been identified and screened based on the effectiveness, implementability, and relative cost of the technologies evaluated. General response actions were developed to achieve the removal action objectives. Candidate technologies were identified for each of the general response actions based upon a review of literature, vendor information, performance data, and consultation with remediation and construction professionals. The general response actions are as follows:

- River diversion.
- Sediment and riverbank soil removal.
- In situ treatment and containment.
- Ex situ treatment.
- Ex situ containment/disposal.
- Riverbed/riverbank restoration.

To produce a site-specific inventory of potentially applicable technologies, the candidate technologies for each response action were evaluated with respect to criteria that fall under the broad groupings of implementability, effectiveness, and cost. Criteria within these three groupings are identified in the *EPA Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA* (99-0012). Additional criteria were considered based upon their relevance to the project and site-specific conditions.

ES.4.1 River Diversion and Sediment and Riverbank Soil Removal

River diversion and sediment and riverbank soil removal technologies are interrelated. For example, dry excavation would be performed only if the river was diverted, whereas river diversion is not required for wet excavation. In addition, there are general characteristics of sections of the river that potentially dictate the diversion or removal technology that can be implemented in these sections.

The river diversion and sediment and riverbank soil removal technologies retained for detailed alternatives evaluation include sheetpiling and pumped bypass of the excavation areas and removal by conventional excavation equipment in the “wet” and in the “dry.” Wet excavation involves excavating sediments from below the water surface (no diversion is used). Dry excavation involves diverting the river around the work areas, dewatering the work area, and then excavating the "dry" riverbed.

ES.4.2 In Situ Treatment and Containment

No applicable in situ treatment technologies were identified. The in situ containment method considered for this site is in situ capping. In situ capping involves placing a cap of isolating material over the contaminated sediment to prevent further transport of contaminated material. The cap may be constructed of clean soils, sand and gravel, riprap, and geotextiles. In cases such as the EE/CA Reach where impairment of the river's hydraulic capacity is not acceptable, some volume of contaminated materials must be removed prior to cap placement.

ES.4.3 Ex Situ Treatment

Ex situ treatment methods considered include chemical immobilization, biological treatment, physical/chemical treatment technologies (soil washing and solvent extraction), stabilization/solidification, chemical dechlorination, and thermal treatment (incineration and thermal desorption). Of these treatment methods, thermal desorption, solvent extraction, and soil washing were retained as technically feasible technologies for this project. Because insufficient information is currently available to properly evaluate soil washing for this project, this technology was not incorporated into alternatives presented in Section 5.

ES.4.4 Ex Situ Containment/Disposal

Excavated soil and sediment, whether these materials are treated or not, may be disposed of at an approved off-site facility or the material may be consolidated on GE property in Pittsfield.

As described in the Consent Decree (00-0388), excavated materials may be permanently consolidated at designated areas at the GE facility. All materials to be consolidated at the Hill 78 Consolidation Area shall contain less than 50 ppm PCBs and shall not constitute hazardous waste under RCRA. No asbestos-containing materials required by applicable law to be removed from buildings or structures prior to demolition, free liquids, "free product," intact drums and capacitors, or other equipment that contains liquid PCBs within its internal components shall be placed in the consolidation areas. If such materials are encountered, they will be disposed of appropriately off-site.

ES.4.5 Summary of Retained Technologies

River diversion, excavation, treatment, and consolidation and disposal technologies that were incorporated into removal alternatives for the EE/CA Reach were as follows:

River Diversion Technologies

- Intrusive open channel diversion (sheetpiling)
- Pumped bypass piping system

Sediment Removal Technologies

- Wet excavation
- Dry excavation

Treatment and Disposal Technologies

- Thermal desorption
- Solvent extraction
- Placement in consolidation areas (up to 50,000 yd^3) on the GE facility
- Disposal off-site at permitted disposal facilities as appropriate

ES.5 HABITAT RESTORATION

Habitat restoration is necessary to meet applicable and relevant regulations as part of the response action and to meet the natural resource damage (NRD) objectives in accordance with the Consent Decree (00-0388) among GE, the Trustees, EPA, the Commonwealth of Massachusetts, and the State of Connecticut. It is also necessary to stabilize the regraded riverbed and riverbank from the forces of erosion. The habitat restoration must be conducted in a cost-effective and ecologically sound manner that achieves both the response and NRD objectives.

In accordance with the Consent Decree (00-0388), restoration objectives for the EE/CA Reach of the river are consistent with the objectives for restoration of the 0.5-mile removal reach. These objectives are as follows:

- Implement the removal action for the EE/CA Reach as approved by EPA.
- Perform the restoration, including the enhancement of the river sediments and banks in accordance with the Consent Decree among GE, the Trustees, EPA, the Commonwealth of Massachusetts, and the State of Connecticut, to increase the diversity and productivity to support a midreach stream community.
- Restoration of the riverbank shall provide overlying cover as required to support the midreach stream community and to enhance the bank vegetation by reestablishing plantings with native species.
- The removal and restoration actions shall prevent erosion of residual PCB-contaminated bank soils and river sediments, which would result in recontamination or transport of PCBs, and which could impair the river restoration by impacting ecological receptors.

The restoration objectives will be met through a combination of regrading, vegetation, bioengineering, and potential installation of habitat improvements (e.g., low-stage dams, current deflectors, and boulders). The placement of habitat improvements and regrading will be conducted such that the flood elevations in the river are not significantly affected and flood storage is not reduced.

ES.6 ALTERNATIVES EVALUATION

A series of three base alternatives, all of which have four treatment/consolidation/disposal options, were evaluated in the EE/CA. Each alternative involves excavation of contaminated sediments and riverbank soils to achieve the cleanup criteria and habitat restoration/streambank stabilization. Although the base alternatives were developed to address the entire EE/CA Reach, the final alternative may include a combination of the base alternatives that could be implemented on a subreach basis. This is to allow the removal contractor the flexibility to perform the removal action by taking into account technical capabilities, seasonal variability, potential residential disruption, and lessons learned during upstream removal activities. EPA anticipates that for some subreaches only one base alternative may be appropriate while for other subreaches multiple base alternatives could be used. For example, sheetpiling is an inappropriate river diversion for subreaches 4-1, 4-2, 4-3, and 4-4A (see Table 4.1-1 and Subsection 5.3.1.2). However, sheetpiling may be the preferred diversion method for some subreaches or one of two or three acceptable diversion methods for other subreaches.

The three base alternatives developed for detailed analysis are:

- **Base Alternative 1, Wet Excavation—**Wet excavation to meet cleanup criteria (as determined on a subreach basis and as defined in Section 3). Riverbank and riverbed restoration. This alternative involves no river diversion.

- **Base Alternative 2, Dry Excavation: Sheetpiling and Pumping Bypass—**Dry excavation to meet cleanup criteria. Open channel river diversion using sheetpiling, except in the cobble reaches or inaccessible areas where the flow would be diverted from the river channel by pumping through a piping bypass. Riverbank and riverbed restoration.

- **Base Alternative 3, Dry Excavation: Pumping Bypass—**Dry excavation to meet cleanup criteria. Diversion of flow from the river channel by pumping through a piping bypass along the entire length of EE/CA Reach. Riverbank and riverbed restoration.

Each of these three base alternatives was evaluated with the following four treatment/consolidation/disposal options:

A. Consolidation of up to 50,000 yd^3 of contaminated soils and sediments at designated consolidation areas at GE with off-site treatment/disposal of excess material.

B. Off-site disposal of all excavated material.

C. Treatment of excavated material at the GE facility using thermal desorption, with off-site disposal of all treated material.

D. Treatment of excavated material at the GE facility using solvent extraction, with off-site disposal of all treated material.

The evaluation of the alternatives produced the following conclusions:

- Each alternative will result in the overall protection of human health and the environment through removal of riverbank soils and sediments to achieve cleanup criteria and implementation of engineering controls.

- Each alternative will also comply with the identified applicable or relevant and appropriate requirements (ARARs).

- Each alternative has been found to be implementable as all use conventional and proven technologies; however, each alternative poses construction problems during implementation. These problems can be adequately addressed by implementing appropriate engineering controls.

- Each alternative will require significant construction activities in the river and restoration of the impacted habitats. Likewise, each alternative will have short-term impacts to the surrounding community because of the nature and extent of construction work along the river.

ES.7 REMEDIATION SCHEDULE

The removal action for the EE/CA Reach of the Housatonic River will proceed as soon as practicable after determination of the action that best satisfies the evaluation criteria (i.e., effectiveness, implementability, and cost). The potential for recontamination from removal activities upgradient of the EE/CA Reach will be minimized by completing the removal action in the first 0.5 mile and establishing source controls prior to initiating work in the EE/CA Reach. Additional consideration must be made to control potential recontamination from the Silver Lake outfall, oxbow areas, and floodplain soils.

The *Removal Action Work Plan – Upper ½-Mile Reach of Housatonic River* (BBL, 07-0020) stated that removal in the first 0.5 mile would be initiated as soon as September 1999 and was expected to take at least 1.5 to 2 years. Site preparation activities for the 0.5-mile removal action began in October 1999 and soil excavation and removal began in late November 1999. The completion of the first 0.5-mile removal action, excluding restoration, is expected to be complete by spring 2001. Site preparation activities for the EE/CA Reach are planned to be performed prior to completion of in-stream construction activities by GE. This will allow EPA to commence excavation in the EE/CA Reach upon completion of GE's in-stream construction activities.

The time to execute a removal action on the EE/CA Reach is estimated to take from 2 to 3 years from the start of construction when considering the limitations of the construction season and the adverse effects from significant precipitation events. A more accurate estimate of the schedule can be prepared once the final removal action is selected and the date of completion of upgradient controls is known.

ES.8 RECOMMENDED REMOVAL ALTERNATIVE

EPA, with input from the public and applicable stakeholders, will select the removal alternative to be implemented. With the selection of a proposed removal action, the design details associated with the removal action can be developed. The design details will allow for a better approximation of removal action costs and the removal action schedule, and will identify potential post-removal activities (e.g., monitoring and maintenance requirements).

1. INTRODUCTION

1.1 PURPOSE

The U.S. Environmental Protection Agency (EPA) determined that a Non-Time-Critical Removal Action is needed to address human health concerns associated with polychlorinated biphenyls (PCBs) in a portion of the Upper Reach of the Housatonic River. The bases for this determination were presented in the 26 May 1998 Combined Action and EE/CA Approval Memorandum (Action Memorandum, 00-0158) (Appendix A).

To make this determination, EPA requested assistance from the United States Army Corps of Engineers (USACE) in evaluating options for remediation of the Housatonic River and associated floodplains. USACE documented its evaluation in a report titled *Memorandum for the Record, Subject: The Remediation and Restoration of the Housatonic River (Newell Street to the Confluence with the West Branch), Pittsfield, MA*, by Mark J. Otis, 6 May 1998 (00-0327). This memo describes USACE's evaluation of the following six alternatives:

- No action.
- Monitored natural attenuation.
- Capping.
- Removal of all contaminated sediments and soils.
- Removal of 2 ft of contaminated sediments and bank soils.
- Removal of 2 ft of contaminated soils, capping the residual contamination, and backfilling to grade.

EPA evaluated these options and determined that no action and monitored natural attenuation are not viable options because the human health and environmental threats currently posed by the PCB-contaminated soils and sediments warrant immediate action. Additionally, USACE estimated that monitored natural attenuation would not result in acceptable PCB levels in the sediments for approximately 500 years.

USACE contracted Roy F. Weston, Inc. (WESTON®) to perform an Engineering Evaluation/Cost Analysis (EE/CA) for a 1½-mile portion of the Upper Reach of the Housatonic River. This report presents the results of the EE/CA. This EE/CA was prepared in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986; the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR 300; and *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (99-0012).

The purpose of this report is to present the results of the EE/CA process and provide EPA with the information necessary to select the most appropriate alternative that meets the stated removal action objectives.

1.1.1 Basis for EE/CA

This EE/CA, which evaluates non-time-critical removal actions for a portion of the Upper Reach of the Housatonic River site, is being performed because of contamination historically released from the GE facility (Action Memorandum, 00-0158). Through the EE/CA process, EPA is authorized to evaluate alternatives to mitigate the human health and environmental threat posed by the existing high levels of PCBs and other hazardous substances in river sediments and riverbank soils for the 1½-mile portion of the Upper Reach (from Lyman Street to the confluence of the East and West Branches of the Housatonic River). This portion of the river will be referred to as the EE/CA Reach in the remainder of this report. In the Action Memorandum, EPA demonstrated, through evaluation of human health and ecological risks posed at the site, that actual or threatened releases of hazardous substances from this site may present an imminent and substantial danger to public health or welfare or to the environment.

1.1.2 EE/CA Approach

As stated in EPA's *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (99-0012), CERCLA and the NCP define removal actions to include "the cleanup or removal of released hazardous substances from the environment, such actions as may be necessary to monitor, assess, and evaluate the release or threat of release of hazardous substances, the disposal of removed material, or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release." EPA categorizes removal actions as emergency, time-critical, and non-time-critical, based on the type of situation, the urgency and threat of the release or potential release, and the subsequent time frame in which the action must be initiated. Emergency and time-critical removal actions respond to releases requiring action within 6 months; non-time-critical removal actions respond to releases requiring action that can start later than 6 months after the determination that a response is necessary.

The steps involved in the Non-Time Critical Removal Action Process are as follows:

1. A removal site evaluation is conducted.

2. An Approval Memorandum is generated. This memorandum secures EPA management approval and funding for the EE/CA; documents that the site meets the criteria for a non-time-critical removal action; and provides detailed information regarding site background and threats to public health, welfare, or the environment posed by the site. The Approval Memorandum for the EE/CA Reach was submitted on 26 May 1998 and is presented in Appendix A.

3. An EE/CA identifying the removal action objectives and analyzing the alternatives that may be used to satisfy these objectives on the basis of effectiveness, implementability, and cost must be completed.

4. A public notice describing the EE/CA and announcing a public comment period must be published.

5. Following the public comment period, a removal action alternative is selected and an Action Memorandum is issued.

6. The removal action alternative is implemented per the Action Memorandum. Typically a remedial design or removal action work plan containing construction-level details is prepared.

7. After the removal action is completed, the site is restored and closed out.

8. Post-removal site controls, if needed, are implemented.

See Figure 1.1-1 for a graphical representation of this process.

1.1.3 Comparison of EE/CA and RI/FS Processes

The EE/CA process for a removal action and the development of the CERCLA Remedial Investigation/Feasibility Study (RI/FS) for a remedial action are different processes leading to the same end: a comparative analysis of alternatives. In the EE/CA process, the Approval Memorandum documents the finding of actual or threatened release and an imminent and substantial endangerment to human health and the environment. EPA has therefore determined that a removal action is necessary and that the no action and monitored natural attenuation alternatives are inappropriate. The EE/CA develops alternative methods to remove the contamination, treat or dispose of the material, and restore the removal area. These alternatives are evaluated based on three criteria: effectiveness, implementability, and cost. EPA recommends the appropriate removal action alternative.

After the EE/CA is completed and submitted for public comment, EPA selects the appropriate removal action alternative to be implemented at the site. The selected removal action alternative is presented by EPA in an action memorandum. To implement the alternative presented in the action memorandum, the conceptual-level detail in the EE/CA must be further developed. Typically, a remedial design or removal action work plan containing construction-level detail is prepared. In these documents the materials, sizes, excavation depths, restoration plan, etc., presented in the EE/CA are finalized.

By contrast, the RI/FS sets out to develop and evaluate a wide spectrum of remedial alternatives, including no action and monitored natural attenuation (if appropriate to the site). The use of treatment technologies, removal alternatives, and restoration methods would also be considered. These alternatives are then evaluated based on nine criteria. EPA then recommends the appropriate remedial alternative.

Table 1.1-1 provides a point-by-point comparison of the EE/CA and RI/FS processes.

1.2 EPA SUMMARY OF AGREEMENT

The following information consists of excerpts from the 7 October 1999 EPA Summary of Agreement (00-0393):

On October 7, 1999, representatives of U.S. Environmental Protection Agency; U.S. Department of Justice; the Commonwealth of Massachusetts Department of Environmental Protection, Office of the Attorney General and Executive Office of Environmental Affairs; the State of Connecticut Department of Environmental Protection and Office of the Attorney General; the U.S. Department of Interior; the National Oceanic and Atmospheric Administration; the City of Pittsfield; the Pittsfield Economic Development Authority and the General Electric Company (GE) reached a comprehensive agreement relating to the cleanup of GE's Pittsfield facility, certain off-site properties and the Housatonic River.

The detailed terms of this agreement are incorporated in a Consent Decree which was lodged on October 7, 1999, with the United States District Court of Massachusetts, Western Division, located in Springfield, Massachusetts.

The Consent Decree provides for cleanup of the Housatonic River and associated areas, cleanup of the General Electric Plant facility, environmental restoration of the Housatonic River, compensation for natural resource damages, and government recovery of past and future response costs. In addition, a Definitive Economic Development Agreement among GE, the City of Pittsfield, and the Pittsfield Economic Development Authority (PEDA) provides for economic redevelopment of the GE Plant facility. That agreement will become effective upon entry of the Consent Decree.

This Consent Decree covers the GE Plant Site, including Silver Lake and Unkamet Brook, the former oxbows (including Newell Street commercial properties), the Housatonic River sediments, banks, and floodplain properties downstream of the GE Plant Site, and the Allendale School. With the exception of the residential properties within the former oxbows, this agreement does not cover cleanup of residential properties in Pittsfield or elsewhere that received GE wastes for use as fill. These properties are covered by a separate Administrative Consent Order between Massachusetts and GE. More than 100 residential fill properties will have been cleaned up by the end of the 1999 construction season. Residential fill properties remain a high priority and will continue on an expedited sampling and cleanup schedule.

Highlights of the Consent Decree which relate to the EE/CA Reach include:

1. GE to perform cleanups except on the 1½-Mile EE/CA Reach of Housatonic River.

2. Material and debris excavated from areas subject to this Consent Decree, excluding the River below two miles, are to be consolidated on the GE facility subject to the following:

    a. No disposal of regulated TSCA waste or RCRA hazardous waste in the Hill 78 Consolidation Area.

b. No on-site disposal of drums, capacitors, equipment, free product or asbestos required to be removed as part of the building demolition.

c. Area and height limitations of the consolidation areas are as follows: Hill 78- 5.6 acre footprint and 1,050 foot maximum elevation, Building 71- 4.4 acre footprint and 1,048 foot maximum elevation, Merrill Road/New York Ave- 1.6 acre footprint and 1,027 foot maximum elevation. Elevation is based on National Geodetic Vertical Datum (NGVD). For reference purposes, current elevation of the top of Hill 78 (including the material from the Allendale School) is 1,049 feet.

d. Capping and long-term monitoring of units.

3. Two options for non-GE owned properties; a) cleanup that is protective of current use with Environmental Restrictions and Easements (EREs) utilized, with consent of the owner, to maintain current use, or b) a conditional solution which also provides a cleanup that is protective of current use but, instead of EREs, requires additional cleanup if the use of the property changes.

4. The parties have established a management architecture for project implementation involving EPA, state regulatory agencies, GE, and, as appropriate, PEDA, the City and the Trustees to ensure that all aspects of the project are managed in a fully collaborative and cooperative manner, to plan work and to cooperatively head off problems and disputes before they arise.

5. Public to provide input throughout implementation of the work.

The Consolidation Areas at Hill 78 and Building 71 will be designed, constructed, and managed to eliminate risk of exposure to materials in the consolidation units through a combination of engineering controls and long-term monitoring.

- Install a protective cap over Hill 78 and Building 71 Consolidation Areas.

- Establish an extensive groundwater monitoring system to monitor the groundwater surrounding the landfill.

- Install a liner and leachate collection system for Building 71 Consolidation Area.

- Design both areas with human health and environmental protection, as well as configuration limitations, in mind.

- An additional area at New York Ave/Merrill Road may be utilized and will be designed in a similar manner to the Building 71 Consolidation Area.

- Investigation process to begin 18 months from entry of the Consent Decree. After completion of the investigation, cleanup work will begin.

The Removal Action in the Upper ½ Mile Reach will achieve a clean-up that is protective of human health and the environment within the Upper ½-Mile Reach and to prevent further downstream migration of contaminants. GE will undertake the following in the Upper ½-Mile Reach (Newell Street Bridge to the Lyman Street Bridge):

a. Remove and restore sediments per final design work plan already submitted by GE and approved by EPA.

b. Remove and restore bank soils to achieve 10 ppm average in top foot and 15 ppm average at 1-3 feet.

The Removal Action in the EE/CA Reach from the Lyman Street Bridge to the Confluence of the East and West Branches (includes sediments and riverbanks) will achieve a clean-up that is protective of human health and the environment within the EE/CA Reach and to prevent downstream migration of contaminants.

a. EPA is currently conducting and GE is funding an Engineering Evaluation/Cost Analysis (EE/CA) of the alternatives for cleanup of the EE/CA Reach.

b. EPA will select response actions for the EE/CA Reach after the completion of the EE/CA and after consultation with GE, affected property owners in the EE/CA Reach floodplain, and the Citizens' Coordinating Council, and review by EPA's National Remedy Review Board.

c. EPA will implement the selected response action. The costs will be shared by GE and EPA with the amount of funding dependent on the overall costs.

The objective of the Restoration of Natural Resources is to compensate the public for natural resource damages by cleaning up valuable resource areas to the extent practicable. Primary restoration will be composed of the response actions agreed upon for the Housatonic River, Silver Lake, Unkamet Brook and associated wetlands and floodplains.

To compensate the public for natural resource damages that could not be addressed through the clean-up, compensatory restoration will be composed of the following elements:

1. GE will pay $15 million, plus interest, to be administered by the natural resource trustees (U.S. Department of Interior, National Oceanic and Atmospheric Administration, Commonwealth of Massachusetts, State of Connecticut), with appropriate public input, for natural resource projects.

2. GE will fund restoration/enhancement activities in connection with the EE/CA Reach Removal Action as part of cost share for habitat improvements (pool/riffle structure in riverbed, enhancement of vegetation on banks) in conjunction with response action to be performed by EPA.

3. GE will coordinate with the Trustees and EPA in the design, implementation, and maintenance plans for the restoration/enhancement activities.

1.3 REPORT ORGANIZATION

This EE/CA is organized as follows:

Volume I of V

- Section 1 presents the purpose of this report including the basis and approach of the EE/CA.
- Section 2 describes the site characterization process undertaken as part of the EE/CA including site description; site history; summary of previous site actions; and presentation of the analytical, engineering, and survey data. A summary of the human health and ecological risks found at the site, based on EPA's previous evaluations, is also included.
- Section 3 identifies the removal action objectives including a description of the regulatory basis, statutory limits, and regulatory considerations.
- Section 4 includes identification and screening of removal, treatment, consolidation, and disposal technologies. The screening is conducted on the basis of effectiveness, implementability, and cost. Potential habitat restoration technologies for the aquatic and riparian environment are presented as well.
- Section 5 includes identification and comparative analysis of the removal action alternatives.
- Section 6 presents the proposed removal action included in the Action Memorandum. This section will be prepared following the public comment period.
- Tables and figures are presented following the text in individual table and figure sections (Sections 7 and 8, respectively).
- Section 9 presents the references cited in this EE/CA Report.

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- Appendix A presents the Combined Action and EE/CA Approval Memorandum, 26 May 1998 (00-0158).
- Appendix B presents the EE/CA cost estimates.
- Appendix C presents the Applicable or Relevant and Appropriate Requirements (ARARs) tables as referenced in Section 3 of this report.

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- Appendix D presents historic site information.
- Appendix E presents grain size analysis data.
- Appendix F presents boring logs and geotechnical laboratory results.
- Appendix G presents sediment data.

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- Appendix H presents riverbank soil data.
- Appendix I presents specialty analytical data.

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- Appendix J presents Appendix IX analytical data.
- Appendix K presents the *Housatonic River and Riparian Community Characterization: Lyman Street to the Confluence* (Habitat Assessment) (00-0377) prepared by Woodlot Alternatives (May 1999).
- Appendix L presents restoration design scenarios.
- Appendix M presents the cap design and construction evaluation.
- Appendix N presents the riverbank stability evaluation.
- Appendix O presents excavation and backfill volume calculations and assumptions.
- Appendix P presents the restoration monitoring plan outline.
- Appendix Q presents miscellaneous information.

2. SITE CHARACTERIZATION

This section presents the conceptual model of the EE/CA Reach of the Housatonic River and documents the existing condition of the river and its watershed. The information contained in this section was used as the basis for the evaluation of removal alternatives presented in subsequent sections.

2.1 SITE DESCRIPTION AND BACKGROUND

This EE/CA covers the 1½-mile stretch of the Upper Reach of the East Branch of the Housatonic River from the downstream side of the Lyman Street Bridge to the confluence with the West Branch, in Pittsfield, MA (the EE/CA Reach). Figure 2.1-1 shows the EE/CA Reach and the general vicinity, including the location of the GE facility.

The Housatonic River is located in the center of an area where farming was the main occupation from 1761 through the late 19^{th} century. However, during the industrial revolution, manufacturing developed along the streams and rivers in the area. The manufacture of paper and textiles began within the City of Pittsfield and the area to the south of the city during the late 19^{th} century. The city’s manufacturing base grew to include machinery and electrical transformers during the early 20^{th} century (Massachusetts Dept. of Housing & Community Development, 00-0385). GE began operations at its facility, near the current upstream end of the facility, in 1903. The facility has been used by three of GE’s manufacturing divisions (Transformer, Ordnance, and Plastics) (Blasland, Bouck & Lee, Inc., [BBL] 01-0024). Hazardous substances historically associated with the GE facility have included polychlorinated biphenyls (PCBs), dioxins, furans, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and inorganic constituents.

The GE facility in Pittsfield has historically been the major handler of PCBs in western Massachusetts, and is the only known source of PCB wastes in the Housatonic River sediments and floodplain between Pittsfield and Lenox. Although GE conducted many activities at the Pittsfield facility throughout the years, the activities of the Transformer Division were the likely primary source of PCB contamination. GE’s Transformer Division activities included the construction and repair of electrical transformers using dielectric fluids, some of which contained PCBs (primarily Aroclors-1254 and -1260). GE manufactured and serviced electrical transformers containing PCBs at this facility from approximately 1932 through 1977.

According to GE's reports, from 1932 through 1977, miscellaneous releases of PCBs reached the wastewater and storm systems associated with the facility and were subsequently conveyed to the East Branch of the Housatonic River and to Silver Lake (BBL, 04-0004).

During the early 1940s, efforts to straighten the Pittsfield reach of the Housatonic River by the City of Pittsfield and USACE resulted in the isolation of 11 former oxbows from the river channel. These areas were filled, in part, with materials from GE that were later discovered to contain PCBs and other hazardous substances.

Berkshire Gas (formerly Pittsfield Coal Gas Company) operated a coal/oil gas manufacturing plant along East Street within the current GE facility from 1902 to 1955 (Berkshire Gas, 01-0300). General Electric bought the property, which is located within East Street Area II, from Berkshire Gas in 1970. As a by-product of gas manufacturing, coal/oil tars as well as heavy residual sludges were produced at the plant. Both the sludges and the coal/oil tars contain primarily polycyclic aromatic hydrocarbons (PAHs). Berkshire Gas reported the disposal of sludges in Oxbow H and both tar and sludges in the Pittsfield Landfill (just upstream of the current GE facility). The results of recent GE investigations suggest that dense nonaqueous phase liquid (DNAPL) detected at East Street Area II near the banks of the Housatonic River consists of coal/oil tars.

In or around 1968, a 1,000-gallon PCB storage tank located in Building 68 of the Pittsfield GE facility collapsed, releasing liquid Aroclor-1260 onto the riverbank soil and into the Housatonic River. Based on visual observation, Aroclor-contaminated soils and sediments were excavated by GE and eventually landfilled; however, significant contamination remained as a result of this release. An additional removal action was performed in 1997 as a result of EPA investigations into the area. This removal action is discussed in detail in Subsection 2.2.1.

As industrial development occurred, and the demand for water power, water supplies, and hydroelectric power increased, multiple dams were constructed on the Housatonic River. There are currently a total of 13 dams on the river in Massachusetts and five dams on the river in Connecticut (00-0385). There are five dams on the Housatonic River above the confluence with the West Branch. A sixth dam was once located within the EE/CA Reach. This dam (discussed in more detail in Subsection 2.1.2.6.1) was located just upstream of Dawes Avenue and was removed in the 1960s.

The Housatonic River flowed through the City of Pittsfield in its natural state until the early 1940s, when the USACE channelized the river within the City of Pittsfield. The Massachusetts Department of Public Works also assisted with the flood control work, based on reports by USACE. Work in the vicinity of the EE/CA Reach included the East Branch within the City of Pittsfield and the riverbanks above and below Woods Pond. The river's course is relatively unaffected (except for the aforementioned dams) in areas downstream of the city.

The population of Pittsfield grew steadily until the 1960s as agriculture was abandoned for industrial and manufacturing jobs. Consequently, residential housing units within Pittsfield were constructed in many floodplains (i.e., areas adjacent to the river that were logistically viable for construction) that were formerly used for agricultural production (00-0385).

2.1.1 Site Location and Description of Subreaches

The EE/CA Reach has been subdivided into 11 subreaches for the purposes of this report. Subdivision of the EE/CA Reach into the 11 subreaches was based on a number of parameters including:

- Sediment Thickness and Texture
- Predominant Habitat Type
- Average Water Depth
- Bank Height, Slope, and Cover
- River Grade/Gradient
- Subsurface Geology
- Adjacent Land Use
- Accessibility
- Utilities/Constructability

The subreaches presented by GE in the *Supplemental Phase II/RCRA Facility Investigation Report* prepared by BBL (04-0004) were used as a starting point for the subdivision. The GE subreaches were reviewed based on the above criteria and modified slightly as a result. GE Subreaches 4-4 and 4-5 were further subdivided based on variations in substrate and predominant habitat. The designations “A” and “B” were added to the GE title for the modified subreaches. The table below lists the subreaches and the corresponding starting and ending transect numbers. The locations of the subreaches are shown in Figure 2.1-2. The physical characteristics of each subreach will be described in detail in Subsection 2.1.3. The distribution of PCBs as well as other compounds of concern in bank soils and river sediments has been conducted on a subreach basis, as was the evaluation of certain removal technologies.

List of Subreaches
Housatonic River, Pittsfield, MA

Subreach Designation	Starting Transect Number	Ending Transect Number
3-8	T064	T080
3-9	T080	T092
3-10	T092	T106
4-1	T106	T114
4-2	T114	T130
4-3	T130	T150
4-4A	T150	T156
4-4B	T156	T168
4-5A	T168	T184
4-5B	T184	T196
4-6	T196	T212

2.1.2 Watershed Characteristics

The watershed for the East Branch of the Housatonic River consists of approximately 70 square miles and includes the towns of Dalton and Hinsdale, as well as portions of Windsor and Pittsfield, MA. The majority of the region is sparsely populated agricultural and undeveloped land, except for the downtown Pittsfield area, Dalton, and other population centers. The major characteristics of the watershed are discussed in more detail below.

2.1.2.1 Population

Results of the 1990 U.S. Census indicate that the population of the four towns included in the watershed totals approximately 55,000 people, with the majority (about 46,000) located in Pittsfield. The population is largely concentrated along the Housatonic River in rural economic centers (Dalton and Hinsdale) and the urban center of Pittsfield. In general, the area between these population centers is sparsely populated. Population density varies from less than 30 people/square mile in Windsor to more than 1,100 people/square mile in Pittsfield. The population of Berkshire County, which includes the East Branch watershed, decreased by less than 1% between 1997 and 1998, suggesting a relatively stable population, although predictions through 2020 suggest a decreasing population over the long-term.

2.1.2.2 Land Use

Land use across the watershed is described as largely rural agricultural except in the urban area of Pittsfield, where it is considered industrial/commercial. The majority of the land in the watershed is either undeveloped or used for produce and dairy farming. The hilly upland areas are predominantly undeveloped. The majority of the agricultural use is in the flatter lowland areas adjacent to the river or its tributaries. Industrial and commercial activities within the watershed are largely confined to the City of Pittsfield, which contains several heavy manufacturing facilities (including GE, General Dynamics [formerly Martin Marietta], and U.S. Generating Company [formerly Altresco Power] generating facility) and a large supporting commercial base. Several paper mills were also located within the watershed (Crane Paper in Dalton and others farther upstream). The density of suburban housing is significantly higher in Pittsfield than in neighboring towns like Dalton and Hinsdale.

2.1.2.3 Climate

New England is located along the boundary between two predominant air circulation patterns known as the Mid-Latitude Westerlies and the Polar Easterlies. The boundary between these two air masses migrates north and south over the course of the year, resulting in variable weather conditions. Storms that form over the northern Pacific Ocean travel with the jet stream from west to east along that boundary and impact New England. Frontal weather patterns associated with the north/south migration of the boundary between the air masses also affect New England's weather.

The watershed is characterized by a temperate climate with warm, humid summers and cold, snowy winters. Precipitation falls in the form of rain in the summer and snow in the winter. The average annual precipitation is approximately 46 inches per year, and is roughly evenly distributed throughout the year. The late summer months of July, August, and September are slightly drier, on average, than the other months. Conversely, the spring months of March, April, and May are slightly wetter than average. Of the 46 inches of precipitation roughly 47% (21.5 inches) is lost to evapotranspiration, with the remainder running off into the Housatonic River and its tributaries.

The mean annual temperature is approximately 46 $^{\circ}$F, based on data from the Pittsfield Municipal Airport. The mean summer temperature is 68 $^{\circ}$F, and the mean winter temperature is 28 $^{\circ}$F. The prevailing wind direction is from the west.

2.1.2.4 Regional Geologic Setting

The Housatonic River is located within the Taconic region of the New England Physiographic Province of the Eastern United States. This region is characterized by rough glaciated terrain with hilltops rising to elevations on the order of 2,000 ft and relatively narrow stream valleys. The Housatonic River valley is one of the larger stream valleys in the region and divides the region into the Berkshire Highlands to the east and the Taconic Hills to the west.

2.1.2.4.1 Bedrock

The bedrock geology of the region is characterized by moderately folded autochthonous carbonate rocks of Cambrian-Ordovician age overlain by highly-folded parautochthonous and allochthonous amphibolites, gneisses, and schists of Proterozoic (late-Precambrian) to Cambrian age. In general, the more erosion-resistant gneisses and schists form the higher elevation hills, while the valleys are underlain by the softer carbonate rocks. The Housatonic River Valley is predominantly underlain by various members of the Stockbridge Formation, which include a variety of calcitic and dolomitic marbles with minor quartzite stringers. The upland areas to the east are composed predominantly of the basement gneisses and schists of the Berkshire massif including the Washington and Tyringham gneisses and their cover rocks including the Dalton and Cheshire metaquartzites. The upland areas to the west of the Housatonic River valley are composed predominantly of the phyllites and schists of the Nassau and Everett Formations and the Greylock Schist.

The tectonic history of this region is complex, dominated by the mountain-building episode of the Taconic Orogeny. During the late-Ordovician period, as the carbonate rocks of the Stockbridge Formation and the clastic rocks of the Dalton and Cheshire Formations were being deposited, the Proto-Atlantic Ocean (located east of the EE/CA Reach at the time) began to close. Offshore, deep-marine rocks of the Everett and Woolumsac Formations were pushed upward and westward to form the Taconic Hills to the west of the EE/CA Reach. As the continental plates continued to close in, the late Ordovician, older rocks (Proterozoic-Y) of the Washington and Tyringham Gneisses, along with more-recently deposited Cambrian-Ordovician age rocks overlying them (cover rocks of the Cheshire and Dalton Formations), were also pushed upward and westward, forming the Berkshire massif. Subsequent uplift, erosion of the overlying cover rocks, and further (although relatively minor) deformation of these rocks during the Acadian Orogeny in the Devonian period has resulted in the current bedrock geology.

2.1.2.4.2 Overburden

The overburden geology of the region is typical of continental glaciated terrain and is characterized by till-covered uplands dissected by alluvium-filled stream valleys. The glacial deposits are Pleistocene in age and include till and various alluvial deposits. The till is typically gray to dark brown depending on the locale, and moderately to very dense with varying amounts of sand, gravel, and cobbles in a fine-grained (silt and/or clay) matrix. The till is typically found directly overlying bedrock in most areas and is usually exposed in the upland areas. The thickness of the till can vary widely from nonexistent to over 50 ft, but is generally found to be 10 to 20 ft thick. In stream valleys, the till is typically overlain by alluvial (glacio-fluvial) deposits consisting of sand and gravel with lesser amounts of silt and clay. The composition and thickness of the alluvium is highly variable across the region, with maximum thicknesses in the range of several hundred feet in some of the deeper valleys. The glacial alluvium can be locally overlain by Recent alluvium, which represents the reworking of the glacially deposited material by younger rivers and streams. Artificial fill is also present in widely varying textures and thicknesses in areas where cultural development is present.

The overburden deposits were initially formed approximately 10,000 to 15,000 years ago, as the Wisconsin glacial stage came to a close with the final retreat of the continental glaciers that had covered the landscape with several thousand feet of ice for nearly 100,000 years. The retreating ice sheet left the landscape covered with a relatively thin veneer of poorly sorted material (till) that had been scoured from the bedrock surface as the glaciers advanced. The tremendous weight of the overlying ice sheet tended to compact the material into the dense till evident today. As the glaciers retreated, meltwaters flowing from them eroded and redistributed the material, sorting out the various grain sizes and depositing them as glacial alluvium in different areas depending upon the energy in the system (coarse-grained material in areas of fast-flowing water, and fine-grained materials in slow-moving water or lakes). After the glaciers had retreated, precipitation falling on the landscape maintained the flow in many of the rivers and streams initially formed by glacial meltwaters. The continued flow in these watercourses tended to alternately erode and redeposit the glacial alluvium, resulting in the Recent deposits we find today. Finally, as cultural development overspread the area, excavated upland areas have been excavated and lowland areas have been filled to facilitate construction of buildings and roads.

2.1.2.5 Hydrology

The hydrology of the region includes both groundwater and surface water. Both are discussed below.

2.1.2.5.1 Groundwater

Groundwater exists in both bedrock and overburden in the Housatonic River Valley. Groundwater in the bedrock exists predominantly in fractures. Regional tectonic events as described above have left the bedrock in the vicinity of the EE/CA Reach somewhat fractured and faulted, providing an extensive network of pathways for groundwater movement and storage (fracture porosity). In addition, groundwater flow through the carbonate rocks of the Stockbridge

Formation has enhanced the permeability and porosity of these rocks by dissolving the fracture faces (solution porosity).

Bedrock groundwater in the vicinity of the EE/CA Reach is used for economic purposes. The U.S. Generating Company facility, located adjacent to the GE facility, uses four bedrock wells screened in the Stockbridge Formation to provide cooling water for its power-generating process. Pumping rates for the four wells range from 150 gpm to 600 gpm, indicating the Stockbridge Formation can provide significant amounts of water. Although the City of Pittsfield uses surface water reservoirs to supply the city with potable water, residents in outlying rural areas use the bedrock as a water source. The residential wells are typically several hundred feet deep and tap the gneisses and schists underlying the upland areas. Yields for the residential wells are typically in the range of 5 to 10 gpm.

Due to the limited number of wells screened in the bedrock within the EE/CA Reach, little is known about groundwater flow directions or gradients in that zone. Based on limited data from subsurface investigations performed at the GE facility north of the EE/CA Reach, it is believed that the vertical gradient between the overburden and bedrock is upward, that is, groundwater in the bedrock is discharging to the overburden. The overlying low-permeability till unit may act as a confining or semiconfining unit for the bedrock. Little information is available regarding the transmissivity of the bedrock, although from the well yield information discussed above, it is apparent that the Stockbridge Formation is significantly more transmissive than the surrounding schists and gneisses of the upland areas.

The large number of overburden monitoring wells near the GE facility are a good source of information regarding overburden groundwater. Groundwater in the overburden is typically found in the alluvium within 5 to 10 ft of the ground surface under unconfined conditions. Groundwater in the overburden is not used for economic purposes in the vicinity of the EE/CA Reach.

In general, groundwater flow in the overburden is toward the Housatonic River, which acts as the predominant groundwater discharge point for the region. Horizontal hydraulic gradients vary widely in the vicinity of the EE/CA Reach, with a range of two orders of magnitude, from approximately 0.1 to 0.001. Groundwater flow direction and gradient in the overburden are impacted on a local basis by the various groundwater remediation activities ongoing at the GE facility.

Numerous slug tests have been performed on monitoring wells and several long-term pumping tests have been conducted at various locations on the GE facility. The results of these tests indicate the hydraulic conductivity of the overburden varies widely, ranging from approximately $1x10^{-6}$ cm/sec (0.003 ft/day) in the till to $2x10^{-2}$ cm/sec (57 ft/day) in the alluvium. In general, the hydraulic conductivity of the alluvium is two to three orders of magnitude greater than that of the till.

Vertical gradients in the overburden are typically upward within the valley and increase in magnitude as the Housatonic River is approached. This is consistent with the observation that the Housatonic River is the regional groundwater discharge point. A year-long vertical gradient assessment was conducted in the Unkamet Brook area and it was observed that the vertical gradients remained upward throughout the year, but that small, local downward gradients can occur immediately adjacent to the Housatonic River in the shallow zone during floods. This temporary reversal was attributed to bank storage of surface water during floods and does not have any long-term effects on groundwater flow patterns.

2.1.2.5.2 Surface Water

The East Branch of the Housatonic River drains an area of approximately 70 square miles located predominantly north and east of Pittsfield. Major tributaries of the Housatonic River in this region include Unkamet Brook, Wahconah Falls Brook, Cleveland Brook, and Bennett Brook. Major lakes and reservoirs located in the watershed include Windsor Reservoir, Cleveland Reservoir, Plunkett Reservoir, and Ashmere Lake.

The United States Geological Survey maintains a streamflow gauging station in the Housatonic River approximately 1 mile north of the GE Facility at Coltsville, MA. Measurements have been collected daily at this location since 1936. The Housatonic River drains an area of approximately 58 square miles above the Coltsville Station. The statistics presented in this section are based on those 60+ years of records. Flows in the EE/CA Reach can be expected to be approximately 15%

to 20% higher than those measured at the Coltsville Station based on a ratio of the drainage areas.

The Average Daily Discharge Flow in the Housatonic River at the Coltsville station averages 107 cubic feet per second (cfs), with a minimum average daily flow of 4.4 cfs and a maximum average daily flow of 4,460 cfs. The 80% average daily flow (the average daily flow that is reached or exceeded 80% of the time) is 31 cfs. Similarly, the 50% and 20% average daily flows are 60 cfs and 142 cfs, respectively. Figure 2.1-3 is a chart of the average daily flow at the Coltsville Station from 1936 to 1996. The annual peak discharge for the Housatonic River at the Coltsville Station ranged from 394 cfs in 1965 to 6,400 cfs in 1938. Figure 2.1-4 is a chart illustrating the annual peak discharge at the Coltsville Station from 1936 to 1996.

The Housatonic River is characterized as a “flashy” river in that it responds quickly to precipitation, rising rapidly after the start of a rainstorm and quickly returning to baseflow after the cessation of precipitation. Figure 2.1-5 presents a hydrograph of the river for the period of 6 January 1996 to 20 February 1996 illustrating the river’s response to a series of precipitation events. The region received approximately 3.75 inches of rain in a 10-day period after a prolonged dry spell, including over an inch on 20, 25, and 28 January 1996.

Silver Lake, located west of Subreach 3-8, has a surface area of approximately 26 acres and a maximum depth of about 30 ft. The lake receives stormwater runoff from several municipal outfalls, including one that drains a portion of the GE facility. Direct surface water runoff from several other adjacent properties also enters Silver Lake. The lake is hydraulically connected to the EE/CA Reach (in Subreach 3-8) via a 48-inch-diameter concrete drainage culvert with an inlet riser. The culvert has a maximum flow capacity of about 50 cfs. The water level in the lake is controlled by the elevation of the inlet riser crest at the edge of the lake. Additional investigation regarding surface water and/or groundwater communication between Silver Lake and the Housatonic River may be required during design to confirm that recontamination of the EE/CA Reach from Silver Lake is not an issue.

2.1.2.5.3 Groundwater-Surface Water Interaction

As indicated above, the Housatonic River is the predominant groundwater discharge point for the region. This means that most groundwater within the Housatonic River basin eventually discharges into the Housatonic River, either by direct subsurface flow through the river bottom sediments, or by discharging into smaller tributaries that then flow to the Housatonic River. Only groundwater that is lost to evapotranspiration, is removed by pumping, or leaves the drainage basin via underflow does not eventually reach the Housatonic River.

Although a gaining stream (one that receives groundwater inflow) over most of its length, the Housatonic River does lose water locally in areas where it is dammed. The Woods Pond area of the river, located approximately 5 miles downstream of the EE/CA Reach, is such a location. The Woods Pond Dam tends to back up flow in the river, resulting in an artificially high water level, which causes a locally downward hydraulic gradient. This condition is increased by the pumping of three industrial supply wells near the dam.

2.1.2.6 Historic Morphology

The historic morphology of the Housatonic River was evaluated by reviewing old maps and aerial photographs and comparing them to recent information to document changes in the river width and course. The only significant changes to the river appear to have been as a result of manmade influences. The course of the river between Unkamet Brook and the Elm Street Bridge (which includes the upper three subreaches of the EE/CA) was straightened by the U.S. Army Corps of Engineers (USACE) in the early 1940s, and the Dale Bros. Dam, located just upstream of the Dawes Avenue Bridge, was removed in 1966.

Aerial photographs from 1941, 1952, 1972, and 1985 were obtained from the public files at DEP's Western Regional Office in Springfield, MA. Copies of the photographs are presented in Appendix D. Examination of these aerial photographs suggests that the course of the river within the EE/CA Reach has changed little, if at all, since the straightening by USACE in the early 1940s. A historic map of the river, produced by the City of Pittsfield and presented in Appendix D, shows the original course of the river as well as the straightened channel. The location of the Dale Bros. Dam is also shown on this map.

Discussions with representatives of the City of Pittsfield Department of Public Works indicate that the City does not regularly perform erosion-control activities within the EE/CA Reach. They indicated that the only erosion-control measures required within the past 20 years consisted of minor repairs around bridge pilings. This suggests that the river is stable within the EE/CA Reach.

2.1.2.6.1 Dale Bros. Dam

The Dale Bros. Dam, also referred to as the Van Sickler Dam, was first constructed sometime prior to 1778 by Deacon Crofoot "some few rods south of the Elm Street Bridge" (Berkshire Eagle, 00-0384). The dam was used to store water that was needed to power a nearby sawmill. In 1832, the sawmill was converted to a textile mill and in 1845 the dam was moved south to a location approximately 250 ft upstream of the Dawes Avenue Bridge.

In 1953, the City of Pittsfield entered into an agreement with Dale Bros. Laundry to keep the gates of the dam open at all times. The City wanted the gates open "so as to alleviate an odor nuisance in the summer months and to make for a free flow of the river in the winter when the city dumps raw sewage into the river in the Lyman Street section (00-0384)." In 1962, the dam was purchased by the City amid concerns regarding the amount of money paid to Dale Bros. to keep the gates open.

The dam was removed by the Mercer Construction Company in 1966 under contract to the City "to prevent sludge from building up on the banks, to improve drainage for land north of Elm Street, and to reduce water leakage into old sewer pipes (00-0384)." According to Mr. Fred Mercer of the Mercer Construction Company, the concrete dam was removed by blasting and there was no significant water or sediment buildup behind the dam because the gates had been open for a number of years. The concrete footings and granite buttresses of the dam can still be seen today.

2.1.2.6.2 USACE Straightening

In the early 1940s, USACE straightened a section of the Housatonic River beginning just south of Unkamet Brook and extending south to just above the Elm Street Bridge. Several oxbows were isolated and filled in with dredge spoils from the river or other materials, including some from the GE facility. The straightening was conducted to improve river flow through the City of Pittsfield and to minimize the potential for flooding in this area.

2.1.3 Subreach Characteristics

This subsection describes various physical aspects of the Housatonic River including river morphology, the texture of the stream bottom, the local geologic setting, predominant land uses along the river, and the types of wildlife habitat. These attributes will be discussed on a subreach basis. Table 2.1-1 summarizes the various aspects of the river by subreach.

2.1.3.1 Morphology

The river morphology is best illustrated on a series of topographic maps developed using survey data collected by USACE as part of the EE/CA. USACE surveyed the river and banks at approximate 50-ft intervals corresponding to the sampling transects, producing 143 cross sections of the river over the EE/CA Reach. This information was used to create a topographic representation of the river from top of bank to top of bank across the river with a 1-ft contour interval. The topography was projected onto maps showing plan features (buildings, roads, vegetation, etc.) provided by EPA and derived by BBL from aerial photographs taken in 1990. Property lines and easements were provided by EPA and were derived from tax boundary information obtained by BBL from the local municipalities. The resulting base map for the river was used to evaluate removal strategies in the river. Figures 2.1-6A through 2.1-6D were developed from the base map but do not include all of the detailed information included on the base map.

It must be noted that the topography developed does not fully represent the full detail of the river and bank topography. Local irregularities in the topography and physical features between the surveyed cross sections were not captured by the survey. The base map is adequate for the purposes of this EE/CA. However, a detailed survey is necessary before the recommended removal alternative is implemented.

The existing morphology of the Housatonic River in the EE/CA Reach is characterized by a single main channel with low to moderate sinuosity. The only bend in the river within the EE/CA Reach of any real significance is a near-90 degree bend within Subreach 4-4B. The remainder of the river is relatively straight.

The width of the river ranges from 30 to 65 ft depending on the flow. At times of low to average flow, the depth ranges from less than 1 ft in the riffle areas between Elm Street and Dawes Avenue to approximately 3 ft at the confluence with the West Branch although pockets as deep as 4 ft are present. The width-to-depth ratio ranges between 15 and 25, which is considered moderate to high.

The slope of the riverbed is very gentle, dropping only about 10 ft over the 7,550 ft of the EE/CA Reach. The majority of the 10-ft drop in elevation takes place over the middle third of the reach, between Elm Street and Dawes Avenue. The remaining two-thirds of the distance accounts for only a 2-ft change in elevation.

The height and slope of the banks along the river vary widely between Lyman Street and the confluence. The banks typically range between 6 and 20 ft high, but can be locally higher or lower. Banks in the upper portion of the EE/CA Reach (north of Dawes Avenue) are typically higher, ranging from 8 to nearly 30 ft in some areas. The banks are generally lower to the south of Dawes Avenue where they typically range between 4 and 16 ft high. In general the banks slope quite steeply, ranging from 5 horizontal on 1 vertical (5:1) to nearly 1:1. The banks south of Dawes Avenue, especially the west bank, have the most gentle slope, often less than 5:1. Conversely, the banks north of Dawes Avenue, particularly the east bank, are generally quite steep, with near-vertical slopes in some places. Supporting structures including armoring and retaining walls are common in this area.

2.1.3.2 Streambed Composition

Sediment samples collected for PCB analysis were also analyzed for grain size distribution via sieve analysis and hydrometer (ASTM methods D421 and D422, respectively). Results from these analyses are summarized in Table 2.1-2 and are broken out by subreach. The complete set of grain size distribution results are included in Appendix E.

In general, the bed of the Housatonic River in the EE/CA Reach is relatively coarse-grained, containing less than 10% fines (silt and clay). The predominant component of the river substrate is medium to coarse sand and fine to medium gravel. Subreaches 4-1, 4-2, and 4-3, between Elm Street and Dawes Avenue, are more coarse-grained than the remainder of the river and are characterized by abundant cobbles. This is likely due to the increased slope of the river bottom in this area, which results in an increased flow velocity that tends to wash out the finer material.

To better assess the composition of the riverbed within Subreaches 4-1, 4-2, 4-3, and 4-4A, a series of "cobble test plots" were conducted. Twelve cobble test plots were conducted between 22 June 1999 and 9 July 1999. Locations are shown in Figure 2.1-7. The test plots consisted of an approximately 3-ft by 3-ft area that was delineated in the field using a bottomless "box" (frame) created by fastening pieces of 2-in. by 12-in. dimensional lumber together. A similar box was placed adjacent to the sample box to hold the removed cobbles. Once the test plot had been located, a length of ½-inch rebar was driven into the sediment (one time) using a small sledge hammer to assess the depth to refusal. The box was then installed and the cobbles were manually removed from the test plot and placed into the screen box for storage. Material smaller than about 2 inches in diameter was removed from the test plot using shovels and placed in a 32-gallon plastic container. As the excavation was deepened, the test plot box was pushed lower to support the sidewalls and keep adjacent cobbles and sediment from entering the hole. This process continued until a total depth of l to 1.5 ft was reached (maximum practical depth to which the excavation could be extended using hand tools). The volume of the removed finer grained sediment was estimated based on the level of the filled container and a sample was collected for PCB analysis at the field laboratory.

In addition to the sediment sample, two wipe samples were collected from one of the cobbles removed from the surface of the test plot and submitted to the field laboratory for PCB analysis. One wipe sample was obtained from the top of the cobble (the side exposed to the flowing water) and one was obtained from the bottom of the cobble (the side buried in the stream bottom). The total depth of the excavation was measured to the nearest 0.1 ft. Once completed, the test plot box was removed and the material was placed back into the excavation, returning the location to its original grade and texture.

The data collected from the cobble test plots were used to assess the ratio of cobbles to sediment within the reach between Elm Street and Dawes Avenue. The results are summarized in Table 2.1-3 and suggest that the riverbed in this region of the river is composed of approximately 45% cobbles (2 inches to 12 inches in diameter) by volume, and 55% sediment (by volume) composed predominantly of coarse sand and fine to medium gravel, although Subreach 4-1 does contain a higher component of fine sand. The PCB sediment sampling and wipe sampling results are presented and discussed in Subsection 2.3.6.

The thickness of bottom sediment was evaluated by pushing a length of ½-inch diameter rebar into the riverbed at 50-ft intervals (transects) along the river perpendicular to the river flow direction, using manual pressure only. This procedure was performed at five locations across the riverbed from the west bank to the east bank for each transect. Penetration depth of the rebar into the riverbed was recorded and plotted on a map of the river. Figure 2.1-8 shows the distribution of sediment thickness values. This figure indicates that sediment thickness in the upper and lower end of EE/CA Reach ranges from about 2 to 4 ft, but is limited to approximately 1 ft within Subreaches 4-1, 4-2, and 4-3, between Elm Street and Dawes Avenue. The rebar method likely underestimates the thickness of river sediment because it uses only manual pressure to advance the rebar. Subsequent investigations (barge borings and cobble test plots), predominately within Subreaches 4-1, 4-2, and 4-3, have indicated that the actual sediment thickness in these subreaches is more likely 2 to 3 ft.

2.1.3.3 Geologic Setting

A limited geotechnical investigation was undertaken to evaluate the geologic setting along the EE/CA Reach. Eight soil borings were drilled along the banks of the river between 10 May 1999 and 13 May 1999 to characterize subsurface geologic conditions. The borings were drilled using 6¼-inch-diameter hollow-stem augers turned by a truck-mounted drilling rig and were advanced to refusal or to an elevation approximately 20 ft below the riverbed. Soil samples were collected at roughly 2½-ft intervals using a split-spoon sampler and Standard Penetration Test (SPT) procedures. The collected soil samples were logged in the field by a WESTON geologist. Selected samples were submitted for geotechnical analyses including grain size distribution, moisture content, specific gravity, and organic content.

In addition to the eight bank borings, seven shallow borings were also drilled through the riverbed using a barge-mounted drilling rig between 2 June 1999 and 4 June 1999. The barge borings were advanced using case and wash methods to a depth of 10 ft below the riverbed. Where refusal was encountered at a depth of less than 10 ft, 5 ft of coring was conducted to confirm bedrock. Soil samples were collected continuously using SPT methods. Soil samples were divided into discrete 1-ft intervals and analyzed for PCBs, grain size, and total organic carbon (TOC).

Geologic information was also obtained from logs of geotechnical borings drilled by the City of Pittsfield and the Massachusetts Highway Department (MHD) in support of bridge construction/repair efforts at the Pomeroy Avenue and Dawes Avenue crossings. The borings at the Pomeroy Avenue Bridge were drilled in the fall of 1936. The borings at the Dawes Avenue Bridge were drilled in May 1995.

The locations of the geotechnical bank borings and the riverbed barge borings are shown in Figure 2.1-9. Copies of the geologic logs for all WESTON borings and historical logs from the borings drilled by the City and MHD are included in Appendix F. This information was used to develop the geologic setting described below.

The Housatonic River forms a relatively wide valley that separates the Berkshire Highlands, rising approximately 1,000 ft above the river to the east, from the Taconic Hills, which rise to a similar height to the west.

Bedrock in the Housatonic River valley in the vicinity of the EE/CA Reach is mapped as predominantly white, coarsely crystalline, well-layered calcitic marble of the Stockbridge Formation, although stringers of sandy zones have been observed. Rock cores from the river barge borings confirm bedrock as the Stockbridge Formation, describing it as a calcitic brown sandstone. The depth of bedrock below the riverbed varies widely along the length of the EE/CA Reach ranging from more than 40 ft at the north and south ends of the EE/CA Reach, to less than 2 ft between Elm Street and Dawes Avenue. A generalized geologic cross section along the course of the river is shown in Figure 2.1-9. It should be noted that this cross section is somewhat schematic in that many of the borings used to construct it were offset from the river channel by as much as 150 ft.

Overburden in the vicinity of the EE/CA Reach includes till, glacial alluvium, Recent alluvium, and fill, and ranges in thickness from less than 2 ft to more than 250 ft. In general, the till overlies bedrock and is believed to range in thickness from 10 ft to more than 50 ft. Limited data are available on the thickness of the till because very few borings were actually drilled through it. The vast majority of the soil borings and monitoring wells drilled in the vicinity of the EE/CA Reach were terminated shortly after encountering the till. The till is very dense with SPT blow counts averaging 80 blows per foot. Although somewhat heterogeneous, the till is generally described as brown silt with varying amounts of sand, gravel, and clay. The gravel typically consists of angular fragments of marble bedrock. Typical grain size distribution of the till, based on sieve and hydrometer analyses, is 40% silt, 30% clay, 20% sand, and 10% gravel.

The glacial and Recent alluvium in the EE/CA Reach are nearly indistinguishable because there is little difference in texture. The alluvium is extremely variable in composition ranging from silty sand to coarse sand and gravel and is typically found overlying the till. The alluvium ranges in thickness from about 20 ft near Silver Lake to more than 200 ft near Unkamet Brook, north of the EE/CA Reach. Peat deposits of Recent age have also been encountered locally, typically at depth in the filled oxbows, likely representing the former bottoms of those water bodies. The alluvium is typically of medium to low density with SPT blow counts on the order of 10 to 60 blows per ft. Cobbles are common in the Recent alluvium, predominantly in the area between Elm Street and Dawes Avenue.

The fill is also highly variable in composition although the major component is sand with lesser amounts of gravel, cinders, ash, glass, brick, etc. The fill is encountered in discontinuous lenses overlying the alluvium in most developed areas of the EE/CA Reach. The thickness of the fill varies from nonexistent to more than 20 ft in some of the deeper oxbows.

2.1.3.4 Land Use/Access

Land use along the EE/CA Reach is somewhat variable, with residential and commercial uses the most predominant. For the purposes of this EE/CA, however, only two land uses will be considered: residential and recreational. Residential land use includes all properties that contain a building used as a habitat at least part of the year. All other properties including industrial, commercial, agricultural, or undeveloped are considered recreational. The following table summarizes the land use characteristics of each subreach based on the current uses of properties abutting the river as determined by a windshield survey. The percentages reflect the footage of river frontage used for the stated purpose.

Summary of Land Use by Subreach
EE/CA Reach, Housatonic River, Pittsfield, MA

SUBREACH	EAST % Residential/ % Recreational	WEST % Residential/ % Recreational	Total % Residential/ % Recreational
TOTAL EECA	35% / 65%	32% / 68%	34% / 66%
3-8	22% / 78%	0% / 100%	11% / 89%
3-9	0% / 100%	0% / 100%	0% / 100%
3-10	14% / 86%	0% / 100%	7% / 93%
4-1	100% / 0%	0% / 100%	50% / 50%
4-2	12.5% / 87.5%	25% / 75%	19% / 81%
4-3	0% / 100%	60% / 40%	30% / 70%
4-4A	100% / 0%	100% / 0%	100% / 0%
4-4B	100% / 0%	100% / 0%	100% / 0%
4-5A	75% / 25%	100% / 0%	87.5% / 12.5%
4-5B	67% / 33%	0% / 100%	33% / 67%
4-6	0% / 100%	0% / 100%	0% / 100%

Access to the river along the EE/CA Reach for construction purposes is also variable, although most subreaches do have some form of access. It should be noted, however, that the land abutting the majority of the river is privately owned and access agreements will be required for construction activities. This section addresses only physical access constraints, and does not discuss the likelihood of obtaining access agreements from specific property owners.

The west bank of Subreaches 3-8 and 3-9 abuts the rear of several commercial properties that could be used to access those subreaches. The east bank of those same two subreaches is undeveloped agricultural land (although possibly zoned as “commercial-warehousing-storage”) that would also provide easy access and has the added advantage of not interrupting the business of a property owner. Bank heights and widths are similar on both sides of the river for these subreaches.

Subreach 3-10 is bordered on both sides by commercial properties, with a high, steep bank on the east side. Preferred access to this subreach is from the west bank, where the banks are lower and less steep, although they are forested.

Subreaches 4-1, 4-2, and 4-3 are paralleled by public roadways for at least a portion of their length on one bank or the other. The roadways on the east bank are smaller, less-traveled roads and therefore may represent the preferred access. Access to Subreach 4-1 may be limited by the steepness of the bank in this area and may likely be best accessed from below, along the riverbed itself.

Subreaches 4-4A, 4-4B, and 4-5A are located in a densely populated residential area with little or no direct access from a public road. The only access to these areas of the river will be through a residential property. The east bank of the river, just north of the Pomeroy Avenue Bridge, appears to be the best location to access these subreaches. The banks along this area are generally low and are not overly steep.

Subreaches 4-5B and 4-6 border a city-owned park (Fred Garner Park) on the west bank. This area has low, gently sloped banks that provide excellent access to these subreaches.

2.1.3.5 Habitat Assessment

Woodlot Alternatives, Inc., conducted an assessment of the stream and riparian habitat and vegetation. The field effort was conducted from 10 November to 13 November 1998. The purpose of this assessment was to identify current ecologic conditions in and along the river. The assessment was used to identify habitat deficiencies and opportunities to enhance habitat with the restoration of the river.

The data collected included estimated percent instream cover provided by boulders and large woody debris and estimated percent cover of various substrate types (boulder, cobble, gravel, and fine sediment). A qualitative description of the plant community, including identification of the dominant species for each stratum (canopy, understory and vines, and herbaceous) and species distribution on the bank relative to elevation and water level, was also prepared. The area was also surveyed for rare species and rare species habitat. A copy of the report prepared by

Woodlot Alternatives, Inc., including a set of seven detailed maps showing the type and distribution of the various aquatic and riparian habitats is included in Appendix K (Woodlot Alternatives, Inc., 00-0377). The maps also include pictures of the river from various vantage points.

2.1.3.5.1 Aquatic Habitat Assessment

The Housatonic River channel in the EE/CA Reach ranges from 30 to 65 ft wide with water depths of generally 1 to 3 ft. Sections as deep as 4 ft are present. The riverbed elevation drops approximately 10 ft over the 1½-mile EE/CA Reach, equating to an average 6.7-ft drop per mile, although as mentioned previously, most of this drop occurs between Elm Street and Dawes Avenue. The substrate is typically sand and small cobbles, with little vegetation occurring in the river channel.

Vegetation occurring in the EE/CA Reach is restricted to the few areas where upland slopes gradually into the river channel. In such areas, old sandbars and cobble shores are the common substrate on which plants were found. Reed canarygrass (*Phalaris arundinacea*) and creeping bentgrass (*Agrostis stolonifera*) are the most common herbs found on the shores of the river. Infrequent herbs include water scorpion-grass (*Myosotis scorpioides*), purple loosestrife (*Lythrum salicaria*), eastern willow-herb (*Epilobium coloratum*), coltsfoot (*Tussilago farfara*), and common water-purselane (*Ludwigia palustris*).

The stretch of river from Lyman Street to Elm Street is morphologically the most uniform and provides little structure, except for numerous fallen trees. The stream bottom tends to be featureless and composed of fine sands. Instream structure is more diverse from Elm Street to just upstream of Pomeroy Avenue. There was an abundance of riffle habitat, large rocks, ledges, and deeper pools. The majority of the river from upstream of Pomeroy Avenue to the confluence is dominated by uniform run habitat with little instream structure, except for the large numbers of downed trees and logs. Only the lower end of this portion of the EE/CA Reach contains structural diversity, such as gravel bars and small riffle sections. The general lack of instream structural diversity in major sections of the EE/CA Reach provides ample habitat enhancement opportunity following potential remediation activities.

2.1.3.5.2 Riparian Habitat Assessment

The riparian communities of the EE/CA Reach are best described as a narrow, largely continuous band of floodplain forest composed of fast-growing trees. Only four bridges and a section of shoreline stabilization (gabions) break the forest corridor in this 1½-mile stretch. Although no stumps were seen, the young age of most trees (mean = 33 years), and the minor amounts of both standing dead trees and downed woody material, suggest these forests were cleared in the recent past.

Because of the proximity of urban and residential sprawl, the vegetation of the riparian communities has a significant non-native component. The lianas and shrub strata possessed the highest ratio of non-native to native species in the EE/CA Reach. Frequently the entire layers were composed of introduced or escaped plants. Morrow's honeysuckle (*Lonicera morrowii*), multiflora rose (*Rosa multiflora*), oriental bittersweet (*Celastrus orbiculata*), and common buckthorn (*Rhamnus cathartica*) were the dominant, non-native species. In one area downstream of Lyman Street, giant knotweed (*Fallopia sachilinensis*) and Japanese knotweed (*Fallopia japonica*) formed large, dense thickets. Other common woody exotics included ninebark (*Physocarpus opulifolius*), wintercreeper euonymus (*Euonymus fortunei*), common privet (*Ligustrum vulgare*), and European spindle-tree (*Euonymus europaea*). The herbaceous layer varied in abundance with non-native species. Approximately 25% to 50% of the total cover of this stratum was non-native plants. Common herbaceous exotics included wood bluegrass (*Poa nemoralis*), field-garlic (*Alliaria petiolata*), dame's rocket (*Hesperis matronalis*), and celandine (*Chelidonium majus*). A comprehensive list of the existing dominant native trees, shrubs, and herbaceous plants present in the EE/CA Reach is included in Appendix K.

Floodplain forest was the dominant community in the EE/CA Reach and formed a largely continuous strip of forest from the Lyman Street Bridge to the confluence of the East Branch and West Branch. Best described as a high floodplain, the forest typically grew on a flat or gently sloped terrace 4 to 12 ft above the normal flow level. Often, the edge of the community dropped precipitously into the river course with exposed soil and roots at the channel edge. The width of the community varied with location and side of the river. The floodplain forest on the west side of the river ranged in width from 6 to 175 ft, with most of the community less than 40 ft wide. This side of the river showed a higher level of industrial and residential encroachment on the riparian areas than the other shore. The floodplain forest on the east side of the river ranged in width from 25 to 225 ft, with much of the community exceeding 40 ft in width. The sizes of the riparian communities on this side of the river were largely affected by residential influences.

2.1.3.5.3 Habitat Summary

The abundance of non-native plants provides both challenges and possibilities for potential remediation actions. If contaminated soils are to be removed, the exposed substrate will be a prime germination medium for many non-native plants and the proximity of urban and residential areas will also provide a source for non-native plants. However, restoration activities could promote the development of a native, natural community to replace the existing one that contains many alien species. Remediation activities may require extensive non-native species control for a number of growing seasons to ensure that these species do not become well established.

The plant communities provide a vegetated travel corridor for many species of wildlife moving to and from less developed habitats to the north and south. Maintaining and/or restoring and enhancing this function is an important management concern.

The most significant aspect of the riparian community habitat is the structural diversity it adds to the local landscape. Cottonwood trees up to 80 ft tall are not uncommon. These and other canopy trees provide nesting/denning habitat for small mammals, songbirds, and insects (which are consumed by fish in the stream). The trees also provide migratory bird feeding and roosting habitat and serve as a visual barrier between the river and riparian corridor and the adjacent urban development.

Finfish are likely to migrate into this section of river from upstream and downstream areas. The scarcity of vegetated wetland habitat and the previous impacts of channelization reduce the overall value of the system for fish and freshwater mussels. In addition, existing water quality in this reach may be compromised by urban runoff, and possibly by discharges of toxins (as evidenced by the presence of containment booms in the river near Lyman Street). Discharge of toxins from the ½-mile Source Reach will be addressed by GE during the ongoing remediation. None of the records reviewed indicate the persistence of freshwater mussel populations in this section of river. Additionally, no live freshwater mussels were observed in this section during the 1998 field surveys.

The river and its associated riparian forest provide habitat for wildlife species that tolerate or utilize urban areas. Most of the songbird species are well known for their use of urban areas and/or backyard feeders. Many of the mammals observed in the EE/CA Reach are species that use residential areas as sources of food and/or shelter.

2.2 PREVIOUS REMOVAL ACTIONS

Several removal actions have been undertaken by GE to address river bank and sediment contamination within the Housatonic River and adjacent residential properties. These include sediment removal in the vicinity of Building 68 at the GE facility and soil removal at a series of residential properties along Deming Street that abut the Housatonic River. In addition, GE began removal of PCB-containing sediment and bank soils from the ½-Mile Source Reach of the Housatonic River in late 1999. This section briefly summarizes those activities.

2.2.1 Building 68 Area

Building 68 is located along the west bank of the Housatonic River within GE's facility upstream of the EE/CA Reach. In the late 1960s, a PCB storage tank associated with Building 68 that contained liquid PCB Aroclor-1260 collapsed, releasing a portion of its contents onto bank soils and river sediments. It was estimated that approximately 1,000 gallons of liquid PCBs were released to the river bank. Because the liquid PCB contained in the tank was heated and it quickly cooled and solidified upon release from the tank, migration of the material was limited. However, some of the solidified material did enter the river and settled to the bottom. Visual contamination, including impacted trap rock and sediment, were removed at the time of the release. However, subsequent investigations in this area identified additional material, including DNAPL, that was not removed during the immediate response action.

A supplemental cleanup action was undertaken by GE during the summer and early fall of 1997. The sediment removal was conducted by driving sheetpiling into the river bottom to divert river water around the excavation. The excavation was divided into seven "cells" that were excavated in series. Cells that had yet to be excavated were used to stockpile removed sediments, allowing them to drain. The sediment removal was completed first, before beginning work on the bank soils. The only exception to this was a small area of saturated soils on the bank that had to be removed prior to work in the river as a result of stability issues. Sediment and riverbank soils were removed using a long-reach excavator. All of the sediment and a majority of the riverbank soils were taken off-site to a TSCA landfill. The remainder of the riverbank soils failed TCLP for lead and were sent to a RCRA/TSCA landfill and stabilized with cement. Two of the seven cells were excavated to a depth 2 to 4 ft deeper than planned as a result of higher than expected concentrations of PCBs at depth. The deepest part of the excavation extended to 8 ft below the river bottom. The planned excavation volumes for sediment and riverbank soils at Building 68 were 1,250 yd^3 and 1,000 yd^3, respectively. The actual quantities of material excavated and disposed of off-site were 5,000 yd^3 (9,509 tons) for sediment and 2,330 yd^3 (3,513 tons) for bank soils. The volumes were estimated as “in-place” cubic yards and the weights were determined by measurements at the off-site disposal facility.

Restoration of the area was accomplished by backfilling the excavations with clean fill to a level approximately 16 inches below the initial grade. A 10-inch-thick layer of riprap was placed over the fill and a 6-inch layer of sand was installed as the final cover.

2.2.2 Other Removal Actions

Floodplain and bank sampling performed by GE indicated several residential properties within the EE/CA Reach contained elevated concentrations of PCBs that required an Immediate Response Action (IRA) under the Massachusetts Contingency Plan (MCP). IRAs on properties abutting the Housatonic River were completed in three areas: a series of residential properties off of Deming Street (west bank of the river in Subreach 4-3), a single residence on the west bank north of the Pomeroy Avenue Bridge, and a single residence on the east bank immediately south of the Lyman Street Bridge in Subreach 3-8. IRAs were also conducted on several residential properties that did not directly abut the Housatonic River. These IRAs will not be discussed further in this EE/CA. Additional information regarding these IRAs can be found in the Administrative Record for the May 1998 Combined Action and EE/CA Approval Memorandum.

The IRA at the Deming Street properties was conducted between October 1996 and January 1997. Areas of elevated PCB concentration were removed using a long-reach excavator and were placed in watertight roll-off boxes for subsequent off-site incineration or disposal at a TSCA landfill as appropriate, based on their PCB content. A total of 2,227 tons of material were removed from the properties. Upon completion of the removal action, the properties were restored by filling the excavation with clean fill to the pre-existing grade. The bank along the Housatonic River was restored by installing a reno-mattress below the high water level and placing 12-inch-diameter fiber rolls on the slope above that. In areas where the current might tend to erode the bank, a gabion basket system was installed to protect that area. Stone riprap was also used in selected areas to help prevent erosion of the restored bank.

The removal action at residential property near the Pomeroy Avenue Bridge targeted a lawn area that did not extend down to the Housatonic River. Thus, no riverbank soils were removed and no restoration of the riverbank or riverbed was conducted at this location. An unknown volume of PCB-impacted soil was removed for off-site disposal. The excavation was backfilled with clean material from an off-site source and the lawn area was restored.

The removal action at the Lyman Street property was conducted in a manner similar to the removal action conducted for the Deming Street properties. The restoration varied slightly from that for the Deming Street properties in that no gabions were installed and larger (12-inch-diameter) riprap was used, extending most of the way up the slope. A screen of juniper trees was installed at the top of the bank to minimize views of the industrial area on the west bank at this location.

GE conducted an IRA at Oxbow C in several investigation and removal stages between October 1995 and October 1997 (BBL, 06-0006). Based on PCB concentrations exceeding 30 ppm detected in surface soils at the site, which is located within 500 ft of a residence, an IRA soil removal action was performed between 22 September and 31 October 1997. Approximately 130 cubic yards of surface soil (i.e., top 6 inches) were removed from a 7,200-ft^2 area within the Oxbow C site.

2.2.3 1999 Removal Action

The removal action for the ½-Mile Source Reach involves removal and restoration of select sediments and bank soils from portions of the Housatonic River. The removal action is summarized below, and is described in detail in GE's *Removal Action Work Plan – Upper ½ Mile of Housatonic River*, August 1999 (07-0020). The removal action was initiated by GE in mid-October 1999 and is currently in progress.

GE proposes to remove and restore (i.e., replace with cap and armor) certain river sediments in the ½-Mile Source Reach. Within this reach, the vertical extent of removal in the majority of those areas where removal will occur will be up to 2 ft, with removal to a depth of 2.5 ft proposed for one area. In areas of low PCB concentrations, no action is planned. For example, a stretch of the Housatonic River downstream of Newell Street contains sediment with little to no detectable levels of PCBs, and no action is required in this section.

The sediment removal areas were developed in conjunction with EPA and MADEP, based on a detailed review of the relative concentration of PCBs in both the Housatonic River sediments and adjacent riverbank soils. It is anticipated that approximately 8,100 yd^3 of sediment will be removed. The general sediment removal and restoration approach involves diverting the Housatonic River around established work areas in a phased, area-by-area approach primarily using a water diversion/containment structure such as steel sheetpiling or other appropriate means; dewatering the work cell in which work will be performed; treating the water as required; and performing sediment removal, replacement, and restoration activities. The removed sediment will be permanently consolidated with other GE site-related materials at EPA-approved locations at the GE facility. Following removal, the sediment removal areas will be capped and armored using a multilayer cap system. Aquatic enhancement structures will subsequently be installed as part of the ½-Mile Source Reach restoration activities.

The current spatial average PCB concentration for the top foot of sediment in the ½-Mile Source Reach is approximately 55 ppm. Following implementation of the sediment removal and replacement activities, the sediment with the highest PCB concentrations will have been removed and the spatial average PCB concentration in the surficial sediment (top foot) will be reduced to less than 1 ppm. The proposed sediment replacement activities are intended to isolate any remaining PCB-containing sediment and minimize the potential for resuspension of sediments, desorption of PCB from the sediments into the water column, and direct contact of humans and biological receptors with PCB-containing sediment.

Bank soil removal activities in the ½-Mile Source Reach will be conducted in coordination with the sediment removal and restoration activities. For the riverbank soils, this will involve the removal of bank soils to a maximum depth of 3 ft, as necessary, to achieve spatial average PCB concentrations less than 10 ppm in the top foot and less than 15 ppm in the 1- to 3-ft depth increment. The bank soil removal actions will achieve these average PCB concentrations in each of seven riverbank averaging areas specified by the EPA. In addition, GE will remove and/or stabilize bank soil along portions of the bottom or the "toe of banks," as agreed to by GE, EPA, and MADEP. Following removal, the soil removal areas will be backfilled and the bank habitat will be restored using an engineered soil and vegetative cover, except along the lower banks at the toe of the slope, where armor stone will be placed on the bank surface for erosion protection. As with the sediments, the removed soil will be permanently consolidated with other GE site-related materials at EPA-approved locations at the GE facility.

It is estimated that the bank soil removal activities involve the removal of approximately 4,300 yd^3 of bank soil and the replacement and restoration of approximately 52,000 ft^2 of bank area. An additional 340 yd^3 of bank soil will be removed between the sheetpiling and the river at East Street Area 2 to help complete source control activities in that area. The current spatial average PCB concentrations for the top foot and 1- to 3-ft depth increment in the ½-Mile Source Reach are approximately 198 ppm and 87 ppm, respectively. Following implementation of the bank soil removal and restoration activities, the bank soils with the highest PCB concentrations will have been removed and the spatial average PCB concentrations will be reduced to less than 10 ppm in the top foot and less than 15 ppm in the 1- to 3-ft depth increment, both in the overall ½-Mile Source Reach and in each of the averaging areas specified by EPA.

Certain habitat restoration measures will also be conducted along the ½-Mile Source Reach to restore and enhance the existing habitat. The habitat restoration will include both aquatic habitat and riparian habitat. The focus of the aquatic habitat restoration/enhancement activities will be to increase the variability in water flow and depth, and provide additional in-stream cover. These objectives will be met through the placement of engineering devices such as low-stage dams, current deflectors, and boulders to improve the aquatic habitat. Placement of the aquatic habitat structures will be designed so as not to significantly affect flood elevations or the flood storage capacity of the Housatonic River. The objective of the riparian habitat restoration is to restore and enhance the riparian corridor in terms of vegetation and potential wildlife use. Specific tasks will include regrading the disturbed banks as necessary and planting the ½-Mile Source Reach with a variety of native plant species of better habitation value than those currently present.

2.3 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

This subsection discusses the source, nature, and extent of contamination in the EE/CA Reach as determined from historical and recent investigations performed by GE, EPA, and others, including those performed as part of the EE/CA. The section starts with a brief discussion of historic GE operations in Pittsfield and the status of the removal action in the ½-Mile Source Reach, and then moves into a description and presentation of the data collected during the EE/CA. Interpretation and summary of the data, focusing on the extent and distribution of PCBs within the sediment and bank soil, is presented at the end of the subsection.

The additional investigations conducted as part of the EE/CA included sediment and riverbank soil sampling. Sampling was conducted from August 1998 to July 1999 in accordance with the EE/CA Work Plan (Roy F. Weston, Inc., 07-0001) and addenda. The primary objectives of the investigation were as follows:

- To further define the nature and extent of the river sediments and riverbank soils in the EE/CA Reach with respect to PCBs and other contaminants to support the identification and analysis of appropriate response actions.
- To determine soil and sediment geotechnical parameters that may affect the selection of response actions.
- To collect data and information on the setting and physical characteristics that may affect implementation of the response action.

An evaluation of the data available prior to this field investigation of the EE/CA Reach is presented in the EE/CA Work Plan (Roy F. Weston, Inc., 07-0001). The evaluation includes a summary of available data from previous reports. Sampling of sediments and riverbank soils is discussed separately in the following subsections.

2.3.1 Historic GE Operations/Status of Source Reach

The overall GE Housatonic River Project consists of the 254-acre GE plant site including Silver Lake, Unkamet Brook, and Oxbows; the Housatonic River sediments, riverbanks, and associated floodplain properties downstream of the GE plant site; and the Allendale School. The hazardous substances associated with the GE Housatonic River Project include PCBs, dioxins, furans, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and inorganic constituents.

The GE facility has been used for industrial purposes since the turn of the century, when industries such as the Stanley Electric Company and the Berkshire Gas Company and its predecessors occupied portions of the property in the Merrill Street area (BBL, 01-0024). GE initiated operations on the property in 1903. The area has been used by three manufacturing divisions at the GE facility (Transformer, Ordnance, and Plastics) (01-0024).

The majority of Pittsfield's 46,000 residents reside within 1 mile of the Housatonic River and Unkamet Brook (Schmidl, 00-0155). The Housatonic River is used for recreation, including fishing, boating, and swimming (EPA, 02-0085). The Housatonic River has been closed to fishing for human consumption since 1982 due to the presence of PCBs in fish (02-0085).

Potential sources of contamination to the Housatonic River are located on or near property currently or formerly operated by GE, including 11 former oxbows of the Housatonic River that have been landfilled with hazardous materials; soil contaminated with hazardous substances, including PCBs, VOCs, and SVOCs, due to spills from a number of aboveground storage tanks (ASTs), underground storage tanks (USTs), and facility oil pipelines currently or formerly located on GE property north of the Housatonic River in the vicinity of East Street; two landfills located on GE property; a former waste stabilization basin located adjacent to Unkamet Brook; and Silver Lake, which has received contaminated stormwater runoff from the GE facility since the 1940s; as well as sediment in the Housatonic River itself. These potential sources, including Hill 78, will be addressed through the Consent Decree.

Contamination, particularly PCBs, which are very persistent in the environment, has also been detected in the sediments and soils of the 10-year floodplain of the Housatonic River downstream from the GE facility to the Connecticut state line and beyond. Analyses of samples collected upstream of the GE facility revealed trace or non-detectable concentrations of Aroclor-1254 or -1260 in the sediment (04-0007). Beginning at the confluence of Unkamet Brook and the Housatonic River, either Aroclor-1254, or -1260, or both, as well as other hazardous substances, have been detected in samples collected at the GE facility, and from within the banks and floodplain of the Housatonic River (BBL, 06-0001, 05-0003, 05-0005, 01-0024, 01-0027). The highest concentrations of Aroclor-1254 and -1260 have been detected in the vicinity of the GE facility, downstream of the former Building 68 PCB spill (BBL 01-0020, 01-0022, 01-0024).

Surface water runoff from the sources described above, flooding of those sources by the Housatonic River, and/or migration of nonaqueous phase liquids and groundwater discharge from those sources have been interpreted as the cause of the sediment contamination in the Housatonic River. Migration and redistribution of sediments contaminated with Aroclor-1254 and -1260 and other hazardous materials within the Housatonic River have further resulted in contamination detected in the floodplain downstream from the GE facility (BBL, 04-0007, 06-0001, 01-0147).

Additional historic information is provided below by location.

2.3.1.1 GE Plant Site

The GE Plant Site includes mostly GE property located between Tyler Street/Dalton Avenue on the north, Unkamet Brook on the east, Merrill Road and the Housatonic River on the south, and Lyman Street and Silver Lake on the west. The GE Plant Site is the site located most upstream relative to the Housatonic River. The site is traversed by Merrill Road, East Street, and several sets of railroad tracks (BBL, 01-0025). The majority of the GE Plant Site is located on GE-owned property (01-0025). A very small portion of the GE Plant Site, located in the southeast corner of the intersection of Newell Street and East Streets, is privately owned (01-0025). At least five areas of past waste disposal or PCB-contaminated fill disposal have been identified at the GE Plant: the Interior Landfill, the Former Waste Stabilization Basin, the Hill 78 Landfill, and Former Oxbows D and H. The history of these locations is briefly described below.

2.3.1.2 Interior Landfill

The Interior Landfill, covering approximately 14 acres, was operated by GE until the late 1970s (BBL, 01-0020). The landfill is bordered by Dalton Avenue to the north, Merrill Road to the south, wetlands on the eastern edge of the landfill, and regularly maintained lawn with some small trees on the western edge of the landfill (EPA, 02-0085). An asphalt paved parking lot covers the western portion of the landfill, which is separated from Unkamet Brook by a maintained lawn and ornamental trees (01-0020, 02-0085). Unkamet Brook bisects the landfill and flows directly to the Housatonic River. The Interior Landfill lies within the Unkamet Brook 10-year floodplain (01-0020).

Available information documents that soil, excavated as part of the construction of GE Buildings OP-1 and OP-2 in 1940 and 1941, was disposed of in the landfill along with wastes related to bushing operations conducted in GE Buildings 51 and 59 (01-0020). Additionally, excavations performed during the rerouting of Unkamet Brook in the late 1970s indicated the presence of capacitors that had evidently been disposed of in the Interior Landfill (01-0020).

2.3.1.3 Former Waste Stabilization Basin

A Former Waste Stabilization Basin is located west of Unkamet Brook, south of the western portion of the Interior Landfill, and north of Merrill Road on the GE facility (BBL, 01-0021). Sometime in the 1940s, the Former Waste Stabilization Basin was formed by the construction of earthen embankments in an existing bog area adjacent to Merrill Road and Unkamet Brook (01-0021). For more than 40 years, process wastewater effluent, non-contact cooling water, and stormwater were discharged into the basin and then into Unkamet Brook. In December 1979, in accordance with an agreement between GE and MADEP, the discharge of process wastewater to the Waste Stabilization Basin was discontinued (01-0021).

From 1979 to 1980, GE conducted an investigation to characterize the sediments within the former Waste Stabilization Basin (01-0020). Source sample analytical results indicated the presence of VOCs, SVOCs, PCBs, and inorganic constituents.

In 1981, standing liquids and the sludge within the Basin were removed and reportedly disposed of in a secure, permitted landfill. Following the removal of these materials, the Basin was backfilled with gravel, capped with soil, and seeded (01-0021).

2.3.1.4 Hill 78 Landfill

The Hill 78 Landfill is located in the central portion of GE's Pittsfield facility, north of Merrill Road, south of Allendale School and Tyler Street Extension, east of GE Building 78, and west of the GE parking lot (Geraghty & Miller, 01-0017). A surface water drainage swale originates approximately 220 ft south of the landfill, where a 42-inch reinforced concrete pipe emerges from the ground (01-0017; Blasland & Bouck Engineers, P.C., 03-0007). Discharge from the pipe and drainage swale ultimately discharge into the Housatonic River (01-0017).

The 3.5-acre landfill has been used by GE since the early 1940s for the disposal of excavated soils, plant demolition and construction debris, and other solid wastes (01-0017). Interviews with former employees revealed that drums containing PCB-contaminated soil were disposed of in the landfill during the 1950s and 1960s (01-0017). The most common disposal method was dumping of debris from trucks onto the ground surface (01-0017). From approximately the mid- to late-1970s to 1990, materials placed in the landfill included soils and construction debris containing PCBs at concentrations less than 50 parts per million (ppm) (01-0017). This practice was discontinued in 1990 at MADEP's request, and a MADEP-approved cover was placed over the landfill as a short-term measure (STM) (01-0017). Expansion of this area is being evaluated as a potential location for consolidation of the material excavated from the EE/CA Reach and the ½-Mile Source Reach.

2.3.1.5 Underground Storage Tanks

Information provided by GE documents the presence of several underground storage tanks (USTs) on and near the western portion of the GE Plant (East Street Areas I and II) (BBL, 01-0024). Materials documented to have been stored within these USTs include (but are not limited to) 10-C mineral oil dielectric fluid, coal tar liquors, PCB-containing wastewater, corrosives, insulating fluids, solvents, pyranol (PCB dielectric fluid), kerosene, varnish, fuel oil, and Solvesso-100 (01-0024). In addition to buildings and storage tanks, a network of pipes and tunnels underlies the western portion of the GE Plant (01-0024), connecting various manufacturing shops and tanks.

GE has owned and operated several buildings on and near the eastern portion of the GE Plant (East Street Area I). In addition to buildings, 18 USTs (including a tank farm area with 14 USTs between 20,000 and 25,000 gallons and one 100,000-gallon AST) have been documented within this area (BBL, 01-0025). Materials documented to have been stored within these USTs include (but are not limited to) 10-C mineral oil dielectric fluid, Solvesso-100, and waste aqueous phosphate (phosphoric acid) (01-0025). A network of subsurface pipes and tunnels has also been identified within this area, which conveyed the contents of the tank farm to their use areas in surrounding buildings (01-0025). GE indicated that PCBs detected in soils in this part of the GE facility resulted from limited interconnections between PCB and mineral oil distribution systems (01-0025).

UST and/or pipeline-related releases or contaminated fill are potentially related to areas of LNAPL and DNAPL, which are present in the East Street Area 2, Lyman Street Parking Lot, and East Street Area 1 areas of the GE Plant. Another major potential source of DNAPL within the GE Plant is the PCB spill at Building 68 that resulted from an AST rupture immediately adjacent to the river in or around 1968.

The GE Plant Site is the most significant source of PCBs and other contaminants to the Housatonic River. There have been documented releases of LNAPL and DNAPL, discharges of industrial effluent, and placement of industrial waste and coal tar in oxbows. Contaminated groundwater likely continues to discharge to the river in some areas. Sediments impacted by these factors likely migrate downstream during periods of high flow and become redeposited within the EE/CA Reach.

2.3.1.6 Housatonic River

The Housatonic River site includes sediments and streambank materials of the Housatonic River that are contaminated with hazardous substances, especially PCBs. Numerous studies conducted since 1982 have included sediment, fish tissue, and benthic organism samples collected from the Housatonic River. The samples, analyzed for PCBs, indicate that PCB contamination exists in the Housatonic River from approximately the outfall of Unkamet Brook to the Connecticut state line (approximately 56 river-miles downstream of the GE facility) and beyond (BBL, 04-0007). The section of the Housatonic River with the most significant PCB contamination is a 12-mile stretch of the river beginning at the confluence of Unkamet Brook and the East Branch in Pittsfield and ending at Woods Pond in Housatonic, MA (Golder Associates and BBL, 01-0155).

The release of PCBs and other hazardous substances to the Housatonic River is mostly attributable to releases from the sources located within the GE Plant Site, Silver Lake, and former oxbows areas. These releases have occurred due to surficial runoff, as well as discharge of contaminated groundwater and free product to the Housatonic River, best documented within the GE Plant.

GE has reached an agreement with EPA and MADEP to perform a removal action addressing the first ½ mile of the Housatonic River (the ½-mile Source Reach). The removal action includes the removal and on-site disposal of PCB-impacted riverbank soil and sediment. This work is described in more detail in Subsection 2.2.3. The ½-Mile Source Reach removal action was initiated by GE in mid-October 1999.

2.3.1.7 Silver Lake

Silver Lake has been the subject of numerous investigations performed by GE since the mid-1970s (BBL, 04-0007). Recent studies have been performed under a Consent Order issued to GE by MADEP in May 1990.

Silver Lake was used by GE in the 1940s for testing torpedoes, and the testing rails are still visible on the northeastern side of the lake. Silver Lake is hydraulically connected to the EE/CA Reach of the Housatonic River by an overflow weir and a 48-inch-diameter concrete conduit (BBL, 04-0003) and is a potential source of PCBs found in the EE/CA Reach. A potential groundwater connection may also exist between Silver Lake and the Housatonic River that will be investigated as part of the design.

2.3.1.8 Former Oxbows

Prior to the 1940s, the stretch of the Housatonic River that flows through Pittsfield was characterized as a meandering stream. As such, the river contained a series of alternating bends or oxbows, as well as lowland areas in this stretch. In the 1940s, rechannelization of the river by USACE isolated a total of 11 oxbows (BBL, 06-0001). Over a period of approximately 40 years following the rechannelization of the river, the majority of the oxbows were backfilled with various materials (BBL, 06-0001, 05-0005, 01-0027). Each of the oxbows was assigned a letter designation (A through K) by GE.

Six of the oxbows (Oxbow Areas D, E, F, G, H, and I) are located within the GE Plant Site and have been investigated as part of the studies performed on that portion of the project. Oxbows D and H are within East Street Area 2, Oxbow E is in the Lyman Street area, and Oxbows F, G, and I are in the Newell Street area.

The remaining five oxbows are not associated with any portions of the GE Plant Site and have been investigated as distinct entities. Oxbows J and K are located between East Street and Goodrich Pond, upstream of the ½-Mile Source Reach. Oxbows A, B, and C are all located within the upper third of the EE/CA Reach. All of the oxbows abut the river and are considered sources of contaminants found in the EE/CA Reach.

Soil samples collected from some of the former oxbows indicate the presence of VOCs, SVOCs, pesticides, PCBs, and metals above reference criteria (06-0001, 01-0027). Soil samples have been collected that documented PCBs in soil less than 2 ft below the land surface (EPA, 02-0085, BBL, 01-0024, 05-0005). LNAPL, DNAPL, and coal tar have also been identified in some oxbows. Oxbows D through K are located upstream of the EE/CA Reach and thus are the responsibility of GE and will be addressed under the Consent Decree where necessary. Oxbows A through C are within the EE/CA Reach and as such are discussed further below.

Former Oxbows A and C are located along the south bank of the Housatonic River, west of the Lyman Street Bridge and east of the Elm Street Bridge. Former Oxbow B is located along the north bank of the Housatonic River, west of the Lyman Street Bridge and east of the Elm Street Bridge (BBL, 06-0001). Investigations at these three oxbows indicate the presence of VOCs, SVOCs, and PCBs. PCB concentrations in soil samples were as high as 750 ppm (BBL, 06-0001). Oxbow C had the highest concentrations of PCBs in soil and groundwater.

The riverbanks of Oxbows A and C will be addressed by the EE/CA action and the floodplain areas of Oxbows A and C will be addressed under the Consent Decree where necessary.

2.3.2 PCB Sources Within the EE/CA Reach

As indicated above, several of the areas known to have received PCB-containing materials are found within the EE/CA Reach. These include Silver Lake, which discharges to the Housatonic River via a concrete culvert in Subreach 3-8, and Oxbows A, B, and C, which directly abut Subreaches 3-8, 3-9, and 3-10. In addition, DNAPL was recently found in subsurface soils on the west bank of the river, just south of the Lyman Street Bridge in Subreach 3-8. GE is currently investigating the extent of this DNAPL and its potential impact to the Housatonic River. A map showing the locations of these three source areas is presented as Figure 2.3-1.

2.3.3 River Sediment

This EE/CA uses sediment quality data collected by GE and USACE/EPA. A total of 764 sediment samples were collected from the EE/CA Reach including 82 by GE between July 1980 and May 1996, and 682 by EPA under the interagency agreement with USACE between October 1998 and July 1999. The GE samples were collected from random locations in response to various EPA and MADEP directives and were analyzed for total PCBs and in some cases, selected Aroclors.

The EPA sediment sampling program included collecting samples for chemical and physical analysis at 100-ft intervals (transects) along the axis of the river, where possible, throughout the EE/CA Reach. Sampling for chemical analysis is described in the EE/CA Work Plan (07-0001) and was conducted in accordance with methods described in the Field Sampling Plan (Roy F. Weston, Inc., 00-0334) and their addenda. Samples for chemical analysis were collected at three approximately equidistant points on every transect (right side, mid-channel, and left side). Samples were collected at 0.5-ft intervals to a depth of 2 ft. Additional samples were collected at selected locations to maximum depth obtainable with manual equipment. All sediment samples were analyzed for PCBs and total organic carbon (TOC). All samples were analyzed for PCBs in the on-site field laboratory. In addition, 10% of the samples were submitted to an off-site (fixed) laboratory for confirmatory PCB analysis. Samples were also analyzed for Groundwater Monitoring List Parameters as listed in 40 CFR Part 264, Appendix IX (Appendix IX) parameters at the off-site laboratory at a rate of 1 in 10. Approximately 2% of the total number of samples were also analyzed for pesticides.

Locations of the sediment samples used in this EE/CA (including both GE and EPA samples) are shown in Figures 2.3-2A through 2.3-2K. Comprehensive data tables presenting the results of all PCB sediment sampling are presented in Appendix G. These tabulated results also include the individual PCB Aroclors. Samples not yielding detectable levels of PCBs are shown in Appendix G as the detection limit followed by the letter “U.”

As shown in Figures 2.3-2A through 2.3-2K, sediment samples were collected and analyzed for PCBs at 100-ft transects along the entire EE/CA Reach. In the area of the river from Elm Street to Dawes Avenue, the physical characteristics of the riverbed prevented sampling at all of the proposed locations. In this portion of the river, the riverbed is extremely rocky (large cobbles and boulders cover the riverbed), and therefore, samples could not be obtained consistently due to the lack of sediment and the tight spaces between the boulders in which the sediment is located. Samples were collected in accordance with the EE/CA Work Plan where possible. To supplement the limited number of samples that were able to be collected using the standard sediment sampling method, a series of cobble test plot samples and streambed barge-boring samples were collected. The procedures used to collect these samples are discussed in Subsections 2.1.3.2 and 2.1.3.3.

2.3.4 Riverbank Soils

This EE/CA uses riverbank soil quality data collected under three programs: historical GE data collected between August 1992 and July 1996; samples collected by EPA under the Superfund Technical Assistance and Response Team (START) contract between September and December 1998; and those collected by EPA under the interagency agreement with USACE during October and November 1998. A total of 1,523 samples were used in the preparation of this EE/CA, including 38 collected by GE, 791 collected by EPA-START, and 694 collected by EPA under the interagency agreement with USACE. Samples collected by EPA-START were split by EPA, with the split samples analyzed at their fixed laboratory in Lexington, Massachusetts. EPA-START samples were analyzed at a field laboratory in Pittsfield that was set up under the START contract.

Because of the historical detection of PCBs in riverbank soils, the risks posed by their presence, and the concern with recontamination of the river by contaminants in the bank soils, data were required to better define the extent of contamination of the riverbank soils along the EE/CA Reach. Bank samples were collected along the same 100-ft transects used for sediment sampling. Sampling locations on the transect included:

- Bottom of bank (water’s edge).
- Midbank.
- Top of bank.

Samples were collected perpendicular to the slope of the riverbank. Samples were collected at depths of 0 to 0.5, 1 to 1.5, and 2 to 2.5 ft and analyzed for PCBs. Sampling methods used in the EE/CA Reach are described in the Field Sampling Plan (00-0334). All samples were analyzed for PCBs in the on-site field laboratory. In addition, 10% of the samples were submitted to an off-site (fixed) laboratory for confirmatory PCB analysis. Samples were also analyzed for Appendix IX+3 at the off-site laboratory at a rate of 1 in 10. Approximately 2% of the total number of samples were also analyzed for pesticides.

Locations and total PCB analytical results for the riverbank soil samples used in this EE/CA (including GE, EPA-START, and EPA samples) are shown in Figures 2.3-3A through 2.3-3K. The figures do not include the results of the EPA split samples sent to the off-site laboratory. Only the results from the field laboratory were used in developing the maps. Comprehensive data tables presenting the results of all PCB riverbank soil sampling are presented in Appendix H. These tabulated results also include the individual PCB Aroclors. Samples not yielding detectable levels of PCBs are shown in Appendix H as the detection limit followed by the letter “U.”

2.3.5 Summary of PCB Distribution

The distribution of total PCBs in sediment and riverbank soils was assessed in accordance with the EPA OSWER *Supplemental Guidance to Risk Assessment Guidance for Superfund (RAGS): Calculating the Concentration Term* (99-0003). The arithmetic average and 95% Upper Confidence Limits (UCLs) for sediment were calculated for specific depth intervals within each subreach. For riverbank soils, these values were calculated for the two predominant land uses (residential and recreational) for each bank within each subreach. When calculating average concentrations and UCLs, a value of one half of the detection limit was used for samples not showing detectable levels of PCBs (U-flag). Estimated (J-flag) results were used at the estimated values. If the calculated UCL was higher than the maximum PCB concentration for a particular depth interval (due to a limited data set and/or high variability in the observed data), the maximum observed concentration was used in lieu of the UCL. The calculated averages and UCLs are summarized in Tables 2.3-1 and 2.3-2. Table 2.3-1 also provides the number of samples used for the calculations and the percentage of samples within each category that exceed the cleanup criteria.

Cleanup criterion for the sediment are discussed in detail in Section 3. The sediment cleanup criteria is 1 ppm. The average PCB concentration data and UCLs for sediment suggest the majority of the PCBs are contained within the upper 3 ft of sediment. Both the average PCB concentration and the UCL drop off significantly below the 3-ft depth, although isolated areas of high concentrations are found at depths greater than 3 ft. It should be noted, however, that the number of samples below the 3-ft depth within any given subreach is very limited (see Table 2.3-1). In some subreaches, sediments exceeding the cleanup goal did not extend below 2 (subreach 3-9) to 2.5 ft (subreach 4-5B). The limited number of samples collected in Subreaches 4-1, 4-2, and 4-3, combined with the high variability in observed PCB concentrations, has resulted in relatively high UCLs for those subreaches. Bedrock was encountered at an average depth of approximately 2 ft in those subreaches (4-1 through 4-3), although isolated deeper pockets may exist.

Development of cleanup criteria for riverbank soils is discussed in detail in Subsection 3.4. The riverbank soil cleanup criteria varies by land use. The residential cleanup criteria is 2 ppm for the top 3 ft of soil. The recreational cleanup criteria is 10 ppm in the top 1 ft and 10 ppm for the 1- to 3-ft depth. Comparison of the average PCB concentrations and the UCLs to the cleanup criteria on a subreach basis indicates that, except for four areas (east bank of Subreach 3-10 and the west bank of Subreaches 4-1, 4-2, and 4-5A), riverbank soils along the entire EE/CA Reach exceed the applicable cleanup criteria to the maximum depth of interest (3 ft). Additional evaluation of the required depth of remediation is discussed in Section 3.

The total mass of PCBs in the sediment and riverbank soils was also estimated for various depth intervals to evaluate how the PCBs were distributed along the EE/CA Reach and to assess the significance of the PCBs related to the cobbles within Subreaches 4-1, 4-2, and 4-3. The mass of PCBs was estimated by converting the average concentrations listed in Table 2.3-1 to a mass number by using the bulk density results from sediment samples within the EE/CA and an estimated volume of sediment within each subreach. The bulk density value used in the PCB mass calculation was 113.6 lb/ft^3, representing the average of six samples collected from the EE/CA Reach. The bulk density results ranged from 106.3 lb/ft^3 to 121.6 lb/ft^3. The PCB mass data are summarized in Table 2.3-3. The calculated total mass of PCBs in the EE/CA Reach is approximately 3,100 kg, with slightly more than half of that amount (1,700 kg) found in the sediment (the remainder is found in the riverbank soils). However, it should be noted that this estimate is based on average values and assumed sediment depths as described in other sections of this report. The actual mass of PCBs within the EE/CA Reach may be different. The values presented in Table 2.3-3 are intended to provide a relative distribution of PCB mass for comparative purposes only. The mass of PCB associated with the cobbles in Subreaches 4-1, 4-2, and 4-3 was estimated from the wipe sample results (see Subsection 2.3.6), assuming an average cobble size of 2 inches in diameter (a conservative assumption). The total mass of PCBs associated with the cobbles in those subreaches is approximately 85 grams.

2.3.6 Specialty Samples

A number of specialty samples were collected to help evaluate the behavior of PCBs in the river and to assist in evaluating different removal alternatives. Sampling was conducted in accordance with the EE/CA Work Plan (07-0001) and Field Sampling Plan (00-0334) and their addenda. The types of specialty samples collected included wipe samples of cobbles from the riverbed to assess the mass of PCBs associated with cobbles in the river, the Dredging Elutriate Test (DRET) and pore water testing to assess the concentration of PCBs that may be suspended in the water column during sediment removal actions, and particle size versus PCB concentration to evaluate where PCBs are most prevalent in the sediment. A total of 24 wipe samples were collected in association with the cobble test plot sampling described in Subsection 2.1.3.2. A total of six samples were collected and analyzed for elutriate testing, pore water, and particle size versus contaminant concentration. The locations of the specialty samples are shown in Figure 2.1-7. The results of the cobble wipe samples are summarized in Table 2.1-3. Tables 2.3-4 and 2.3-5 present the results of the elutriate/pore water test results and particle size versus PCB concentration test results, respectively. The specialty sample analytical results are included in Appendix I.

The wipe sample results were used to assess the significance of PCBs associated with the cobbles in Subreaches 4-1, 4-2, and 4-3. As described above, the total mass of PCBs associated with the cobbles in those subreaches (assuming an average cobble size of 2 inches in diameter) is 85 grams.

The impact to ecological receptors from the cobbles was estimated by converting the PCB per unit area result provided by the wipe sampling to a concentration. The description of the cobbles suggests a thin biofilm in some places and a more active periphyton community in others. A literature search was conducted that provided information on typical biomass estimates for epilithic (attached to rocks) periphyton in streams. Literature values indicated a median value of 5 g/m^2 dry weight (Biggs, 99-0234). Assuming a periphyton biomass of 5 g algae/m^2, a wipe sample with 1 μg PCB / 100cm^2 would represent a concentration of 20 μg PCB/g periphyton. Further, a 1-mg PCB/kg benchmark at a periphyton biomass of 5 g/m^2 would result in an estimated wipe sample threshold of 0.05 μg/100cm^2, which is below the detection limit of the method. It should be noted that this analysis has a high degree of uncertainty and represents only a very rough estimate. Further field testing of the cobbles is required to provide an estimate with a more reasonable degree of certainty.

A similar preliminary analysis of the human health risk from the cobbles was also conducted. The analysis evaluated the risk associated with exposure through wading in the cobble reaches.

The PCBs associated with the cobbles may adhere to the skin and PCBs may subsequently be absorbed through the skin to the systemic circulation following contact by a female child (aged 5 to 12 yrs) wading in the cobble area. Carcinogenic effects from chronic exposure, and noncancer effects from subchronic exposure, were evaluated. The wipe sample value for carcinogenic effects was estimated as 4 μg/100 cm^2 and for noncancer effects was estimated at 40 μg/ 100 cm^2. Comparison of these criteria to the wipe sampling results (average less than 2 μg/cm^2) indicates the cobbles are not a threat to human health.

The DRET and pore water analytical results were reviewed separately to develop estimates of mass of PCB that would potentially be lost into the river during wet excavation of sediment. The results from these two tests are reported in μg PCB/L; however, the liquid that was analyzed was developed using different methodologies. The DRET test uses 10 grams of wet sediment mixed in 1 liter of river water. The pore water test analyzes pore water extracted from the sediment, without dilution. The results of these tests were evaluated by comparing concentration in the "extract" to water quality benchmarks (1 μg/L for protection of aquatic life from acute effects, and 0.014 μg/L for chronic effects). The results of each test have also been normalized on the basis of mass of PCB released per cubic yard of excavated sediment.

The unfiltered supernatant from the DRET test is intended to simulate the concentration of contaminants expected in the water column immediately surrounding the dredge (excavation) site during removal. The concentration of total PCB in the DRET test water exceeded 1 μg/L in seven of the eight samples analyzed. The estimated mass of total (unfiltered) PCB released ranged from 0.3 g/yd^3 to 4.4 g/yd^3 of excavated sediment (see Appendix Q). The filtered supernatant from the DRET test is intended to simulate the concentration of contaminants that has been released in either a dissolved or colloidal form, and is unlikely to be controlled once released. The concentration of PCB exceeded 1 μg/L in one of the eight filtered samples and exceeded 0.014 μg/L in five of the eight filtered samples. Based on these data, between 0.001 and 0.35 g PCB would be released into the river as soluble PCB for each cubic yard of sediment excavated by dredging or by excavation in the wet (see Appendix Q).

The pore water test results indicated, not surprisingly, that loss of PCB from pore water to the river during excavation is not as significant as the loss of PCB associated with the solids. The pore water PCB concentrations ranged from 1.9 to 16 μg/L. Release of pore water during excavation would amount to release of between 0.00001 and .001 g/yd^3 of excavated sediment (see Appendix Q).

A separate analysis of potential PCB release during wet excavation was performed using sediment geotechnical data (grain size, bulk density, dry density and water content from 28 EE/CA reach sediment samples), and the 95% UCL of the mean PCB concentration in sediment in the EE/CA reach. Two parameters (percent "fines" in sediment and percent of fines *released* during dredging) were varied to produce a range of estimates of PCB released per cubic yard of excavated sediment. The minimum, average, and maximum percent fines (i.e., grain size less than 0.075 mm) were 2%, 7%, and 15%, using the 28 EE/CA Reach sediment samples. The minimum, midrange, and maximum percent of fines released during dredging was assumed to be 5%, 10%, and 15%. These calculations indicated that between 0.03 and 0.7 g PCB would be lost per cubic yard of excavated sediment (see Appendix Q). Simplified dilution calculations were performed, assuming minimum, midrange, and maximum flow in the Housatonic River (40, 70, and 100 cfs, respectively) and assuming that all of the PCB released during dredging would reach Woods Pond. Based on these assumptions, the concentration of PCB in the river upstream of Woods Pond would increase by between 0.03and 1.5 μg/L during the excavation (see Appendix Q).

The particle size versus PCB concentration test results for samples from six locations within the EE/CA Reach are presented in Table 2.3-5. It is typically expected that PCB concentrations in the finer-grained sediments would be higher than PCB concentrations in coarser-grained sediments. However, for the EE/CA sediments, the mean PCB concentration in sediment passing a 0.075-mm nominal sieve size (very fine sand, silt, and clay) was 17.1 mg/kg, and the mean PCB concentration in the sand and fine gravel was 49.9 mg/kg. Sand and fine gravel was the predominant grain size fraction, representing over 75% of the sediment mass. As a result, 97% of the PCB mass in these EE/CA Reach samples was contained in the sand and fine gravel fraction. This pattern of higher-than-expected PCB mass associated with the sand and fine gravel fraction, although unexpected, is consistent with results of fractionation tests conducted on over 45 samples from the Housatonic River between Pomeroy Avenue and Woods Pond. As noted above, sediments in the Housatonic River are generally coarse-grained, with more than three-quarters of the sediment in the sand-to-fine-gravel range.

In summary, the specialty analyses performed were useful in providing a range of estimates of PCBs that may be lost during wet excavation. Modeling could be used to provide more accurate estimates, if wet excavation is selected as the preferred removal alternative. For instance, more sophisticated analysis could simulate transport and deposition of fine sediment at the various stream velocities expected during excavation. Engineered controls such as silt curtains could be used to decrease the amount of PCB lost, but could not be expected to prevent releases of PCBs during wet excavation and during installation and removal of sheetpiles for river diversion to allow dry excavation.

2.3.7 Appendix IX Data

In addition to the sediment and riverbank soil PCB sampling described above, a total of 181 samples (including 59 sediment and 122 riverbank soil samples) were analyzed for EPA Appendix IX-Groundwater Monitoring List (Appendix IX) constituents including organochlorine pesticides, SVOCs, dioxins, furans, and inorganics. Two percent of all sediment and riverbank soils samples were also analyzed for Appendix IX organophosphate pesticides and herbicides. The Appendix IX sediment and riverbank soil sampling locations are shown in Figure 2.3-4. Analytical results are presented in Appendix J.

In addition, 28 samples were also analyzed using the RCRA disposal Toxic Characteristic Leaching Procedure (TCLP) methodology to provide data necessary to evaluate disposal options for the excavated materials. Only two compounds were found above detection levels; barium and lead. Only lead, in one of the 28 samples, exceeded EPA TCLP criteria with a concentration of 22.7 mg/L. This result is believed to be anomalous, in that none of the total lead results reported in the Appendix IX data exceeded 100 mg/kg and thus would not fail the TCLP test.

2.3.7.1 Sediment Samples

The average and maximum concentration for each Appendix IX constituent that was detected in the EE/CA Reach are provided in Table 2.3-6 on a subreach basis. The Appendix IX data were compared against three screening criteria: Massachusetts Contingency Plan (MCP) S-2 Soil Standards, Ontario Ministry of the Environment and Energy (OMEE) Lowest Effect Level (LEL) values, and OMEE Severe Effect Level (SEL) values. The OMEE Sediment Quality Guidelines define three levels of chronic effects on benthic organisms. The no-effect level is defined as the level at which no toxic effects have been observed on aquatic organisms and food chain biomagnification is not expected. The LEL indicates a level of sediment contamination that can be tolerated by most benthic organisms. The SEL indicates a level of contamination at which pronounced disturbance of sediment-dwelling organisms will occur and the contaminant concentration will be detrimental to the majority of benthic species (Persaud, et al., 99-0015). For this assessment, both LELs and SELs were used to assist in evaluating potential effects on the benthic community. The comparison was made on a subreach basis and used the average concentration for each parameter (calculated using half the detection level in the case of a non-detect).

The only pesticide found to exceed the screening criteria was 4,4-DDD, and it was limited to Subreach 4-2. SVOCs (anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno (1,2,3-c,d)pyrene, phenanthrene, and pyrene) were detected above the screening levels at depths of up to 1.5 ft. Total PAHs also exceeded screening criteria up to 1.5 ft in depth. The number of samples exceeding screening criteria decreased with sample depth over the entire EE/CA Reach. The majority of the SVOC exceedances occurred in Subreaches 4-3, 4-4A, 4-5A, and 4-6.

The most common SVOCs were benzo(g,h,i)perylene, dibenzo(a,h)anthracene, dibenzo(a,h)anthracene, indeno (1,2,3-c,d)pyrene, and pyrene, which all exceeded the screening criteria in at least 8 of the 11 subreaches. Antimony, lead, copper, and nickel were the only metals where the average exceeded the screening criteria. Of these, copper was the most prevalent, exceeding screening criteria in 5 of the 11 subreaches. Nickel and antimony exceeded screening criteria in only one subreach (nickel in 4-4B and antimony in 4-6). Lead exceeded the screening criteria in two subreaches. In all cases, the metals exceedances were in shallow samples, less than 1.5 ft deep.

In summary, concentrations of SVOCs, selected metals, and the pesticide 4,4-DDD were detected in sediment samples collected from the EE/CA Reach above screening criteria. In general, the upper section of the EE/CA Reach (above the Elm Street Bridge) contained fewer exceedances of the screening criteria. It should be noted that the 59 sediment samples analyzed for Appendix IX constituents were all collected from the upper 2 ft and as such are within the proposed depth of remediation (see Section 3 for proposed excavation depths). No Appendix IX data are available for sediments below the proposed excavation. Limited additional Appendix IX sampling at depths greater than the proposed excavation may be conducted during predesign activities to confirm that sediments left in place do not exceed the screening criteria.

2.3.7.2 Riverbank Samples

The majority of the 122 Appendix IX riverbank soil samples were collected from areas that will be excavated to address PCB concentrations that exceed cleanup criteria. A total of 23 Appendix IX samples were collected from areas and/or depths that do not require excavation due to PCBs. These 23 samples were compared to EPA Region IX Preliminary Remediation Goals (PRGs), background concentrations, and MCP S-2 soil cleanup standards. The comparison was made on an individual sample basis. The observed concentration for each parameter was compared to the PRG. If the observed concentration exceeded the PRG, it was compared to the average background concentration and the maximum background concentration. If the observed concentration exceeded both background values (average and maximum), or if the observed concentration exceeded either background concentration by greater than 150%, the result was compared to the MCP S-2 soil cleanup standards. Compounds that failed the background comparison and the comparison to MCP S-2 soil cleanup standards were flagged as requiring remediation. The observed concentrations for detected compounds as well as the results of the comparison to screening criteria are presented in Table 2.3-7.

Dioxins and furans were evaluated separately. To evaluate the dioxins and furans, a total Toxic Equivalent (TEQ) concentration was calculated for each sample using the consensus Toxic Equivalency Factors (TEFs) published by the World Health Organization. The maximum TEQ concentrations for each subreach were compared to EPA-approved PRGs for dioxin/furan TEQs in recreational areas. The PRG, which was based on the dioxin PRG established by EPA for residential areas in EPA OSWER Directive 9200.4-26 (13 April 1998) (EPA, 99-0102), is 1.0 µg/kg.

The results of the comparison to screening criteria are summarized in Table 2.3-8. No pesticides were found to exceed the screening criteria as described above. Beryllium was the only metal that exceeded the screening criteria and that was only for one sample in Subreach 4-5A. Several SVOCs were detected in riverbank soils at concentrations exceeding screening levels at depths of up to 2.5 ft (maximum depth sampled). SVOCs found above screening levels include benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, chrysene, and indeno(1,2,3-c,d)pyrene. Both benzo(a)anthracene and benzo(a)pyrene exceeded screening criteria in 13 of the 23 samples. Benzo(b)fluoranthene exceeded the screening criteria in 11 of the 23 samples. Indeno(1,2,3-c,d)pyrene exceeded the screening criteria in 6 of the 23 samples and dibenzo(a,h)anthracene exceeded the screening criteria in 8 of the 23 samples. Subreaches 3-10, 4-2, 4-3, 4-5A, and 4-5B had the highest frequency of exceedances. Dioxins and furans were not detected at concentrations in excess of screening criteria. In all cases, exceedances of specific samples were noted to a depth of 2.5 ft, the deepest depth sampled.

In summary, SVOCs and beryllium were detected in riverbank soil samples collected from the EE/CA Reach. These compounds were found at all depths sampled. Beryllium exceeded the screening criteria only in Subreach 4-5A. Selected SVOCs were found to exceed the screening criteria in all subreaches except Subreach 3-9. Appendix IX compounds were found to exceed screening criteria in areas not included within the areas of riverbank soils that exceed the PCB screening criteria; thus, removal actions must be expanded to also remedy the Appendix IX constituents. Since no Appendix IX data are available below a depth of 2.5 ft, limited additional sampling for Appendix IX constituents at greater depths is warranted to confirm that the proposed excavation depths will be protective.

2.3.8 Oil Sample

On 21 June 1999 while logging cobble locations with the GPS unit, WESTON staff observed NAPL perched on top of sediment located under 4 to 5 inches of water. On 24 June 1999, WESTON sampled the location, which is approximately 15 ft downstream of transect 122 along the west bank of the river. It appeared that product was flowing from the bank into surface water and possibly entering the river via groundwater flow. The sample was stained completely black with a heavy sheen and strong coal tar pitch odor. When the sediment or edge of bank in the vicinity of the sample location was disturbed, a sheen was produced on surface water.

The oil sample (H2-SE000457-0-0000) was analyzed for PCBs and GC fingerprint analysis. Results of the PCB analysis showed no detectable PCBs. It must be noted that there was an increased detection limit on the PCB analysis because of the presence of the oil. The analysis detected dibenzofuran, which indicates the sampled material could be a coal tar. GC fingerprint analysis indicated that the oil fingerprint is consistent with weathered No. 6 fuel oil (AKA bunker fuel) or coal tar. Further investigation to characterize the nature and extent of this potential source area will be conducted as part of predesign activities. The results of the laboratory analysis of the oil sample are included in Appendix I. These results have also been provided to MADEP for its consideration.

Review of the aerial photographs in the vicinity of Elm Street indicates that approximately 350 ft upgradient of the sample location (on the west bank at transect 118) was a large, circular brick building, approximately 85 ft in diameter, containing an above-ground tank. This building appears in photos from 1941 and reportedly burned down in 1991.

2.4 STREAMLINED RISK ASSESSMENT

Site risks, as described in this section, include human health risks and ecological risks for the entire upper reach of the Housatonic River, including the ½-Mile Source Reach and the EE/CA Reach. Human health risks are described in the Action Memorandum (00-0158) and in the *Evaluation of Human Health Risks from Exposure to Elevated Levels of PCBs in Housatonic River Sediment, Bank Soils and Floodplain Soils in Reaches 3-1 to 4-6 (Newell Street to the Confluence of the East and West Branches)*, 14 May 1998 (00-0315), and the ecological risks are described in the Action Memorandum (00-0158) and in the *Upper Reach – Housatonic River Ecological Risk Assessment*, May 1998 (99-0085). For purposes of this EE/CA, no additional site-specific human health or ecological risk assessment information was considered. The analytical results of samples collected since the preparation of these reports are consistent with the data used in these risk evaluations and inclusion of the new data would not appreciably change the conclusions. GE has commented on the Action Memorandum (00-0158) and the human and ecological risk evaluations, EPA has responded, and GE's comments and EPA's responses are in the Administrative Record.

2.4.1 Human Health Risk Assessment

An evaluation of the risk to human health posed by exposure to elevated levels in PCBs in Housatonic River sediments, riverbank soils, and floodplain soils was prepared in May 1998 (00-0315). The human health risk assessment considered potential exposure of three different groups—youths (aged 9 to 18) who walk and play in and near the river on a regular basis (identified as youth trespassers), young children (aged 5 to 12) who contact PCBs in soils and sediments adjacent to their residence while playing or wading (identified as child waders), and very young children (aged 1 to 6 years) who contact PCBs in soils and sediments while playing at his or her residence and wading at the river's edge (identified as child residents). The human health risk assessment included the entire Upper Reach of the Housatonic River beginning at Newell Street and ending at the confluence of the East and West Branches.

Elevated levels of PCBs have been found in Housatonic River sediments and soils throughout the Upper Reach. According to the Human Health Risk Assessment, PCBs have historically been detected in surficial sediments at levels as high as 905 mg/kg. In surficial riverbank soils, PCBs have been found at levels as high as 5800 mg/kg. PCBs have also been found at high levels (over 1,000 mg/kg) in subsurface sediments and bank soils throughout the area. Moreover, PCBs have been detected in surficial floodplain soils at levels as high as 160 mg/kg. The EE/CA sampling discussed in this report was conducted after the preparation of the Human Health Risk Assessment; therefore, these results were not considered in the risk assessment. However, these EE/CA sampling data are consistent with the data used in the risk evaluations.

The Human Health Risk Assessment evaluated the potential cancer and noncancer risks from hypothetical exposure to PCBs in soils and sediments. Cancer risks for PCBs were evaluated using the 95% upper confidence limit of the linear-slope factor (or cancer slope factor) of 2 $(mg/kg/day)^{-1}$ (00-0315). Chronic noncancer risks were evaluated using the EPA-published Reference Dose (RfD) of 2×10^{-5} mg/kg/day for Aroclor-1254. Reference doses for Aroclor-

1254 were used because they are closest to being applicable to the type of PCB mixture found in the Housatonic River (Aroclor-1254 and -1260) (00-0315).

The effects occurring at the lowest dose (critical effects) for the chronic and subchronic RfDs are immunological and reproductive effects. The Human Health Risk Assessment also cites PCB effects demonstrated in many animals including severe acne, cancer, liver damage, and reproductive and developmental effects. Monkeys, which are physiologically more similar to humans than other animals, have developed adverse immunological and neurological effects, as well as skin and eye irritations after being fed PCBs. Studies of PCB-exposed workers show that PCBs can cause skin problems such as acne and rashes and eye irritation. There are also studies that have reported neurological, behavioral, and developmental abnormalities in children born to mothers who ate PCB-contaminated fish. However, in these studies, the mothers' exposures to PCBs were estimated and not measured directly. Neurobehavioral effects reported in these studies are similar to effects seen in monkeys (00-0315).

In the area of the river from Newell Street to Elm Street, exposure to PCB-contaminated soil was evaluated for a hypothetical youth trespasser (aged 9 to 18 years) who walks and plays 2 days per week in riverbank and floodplain soils from April to October. Exposure pathways that were evaluated included dermal absorption and incidental ingestion of PCBs.

From Elm Street to Dawes Avenue, exposure was evaluated for a hypothetical child wader (aged 5 to 12 years) who wades in the water and plays in floodplain and riverbank soils and sediments 5 days per week from June through August. Exposure for a child who plays in the riverbank and floodplain soils 5 days per week from April to October was also evaluated.

From Dawes Avenue to the confluence, exposure for a very young child (aged 1 to 6 years) was evaluated for contacting riverbank and floodplain soils and sediments at the water's edge while wading and hypothetically playing 5 times per week from June through August.

As summarized in the Action Memorandum (00-0158), the following cancer and noncancer risks were calculated for each subreach in the Human Health Risk Assessment:

Cancer and Noncancer Risks for Subreaches in the Human Health Risk Assessment

	Soil	Sediment
Newell Street to Elm Street		
Hazard Index (subchronic noncancer risk)	200	3
Hazard Index (chronic noncancer risk)	200	4
Excess Lifetime Cancer Risk	$1x10^{-3}$	2×10^{-5}
Elm Street to Dawes Avenue		
Hazard Index (subchronic noncancer risk)	70	200
Hazard Index (chronic noncancer risk)	90	100
Excess Lifetime Cancer Risk	$4x10^{-4}$	5×10^{-4}
Dawes Avenue to the Confluence		
Hazard Index (subchronic noncancer risk)	20	9
Hazard Index (chronic noncancer risk)	30	6
Excess Lifetime Cancer Risk	$7x10^{-5}$	2×10^{-5}

A hazard index greater than 1 is the threshold above which EPA is justified in taking an action based on noncancer health risks. As seen in the table above, chronic and subchronic hazard indices exceed this action level for all three subreaches within the EE/CA Reach. Further, EPA is justified in taking action when the excess lifetime cancer risk exceeds the range of 10^{-6} to 10^{-4}. In two of the subreaches evaluated, this level is exceeded.

The Human Health Risk Assessment concludes that "short-term exposures to elevated levels of PCBs in Housatonic River floodplain soils, riverbank soils, and river sediments in Reaches 3-1 to 4-6 (Newell Street to the confluence) in Pittsfield, Massachusetts, present significant risks to human health" (00-0315).

2.4.2 Ecological Risk Assessment

An Ecological Risk Assessment was conducted for the Upper Reach of the Housatonic River (Newell Street to the confluence of the East and West Branches). An evaluation of the ecological significance posed by exposure to elevated levels of PCBs in Housatonic River sediments, surface water, fish tissue, and avian and mammalian receptor modeling was prepared in May 1998 (*Upper Reach—Housatonic River Ecological Risk Assessment*, 99-0085). The EE/CA sampling discussed in this report was conducted after preparation of the Ecological Risk Assessment; therefore, these results were not considered in the risk assessment. However, these EE/CA sampling data are consistent with the data used in the risk evaluations.

The *Upper Reach—Housatonic River Ecological Risk Assessment* (99-0085) identifies numerous exceedances of ambient water quality criteria (AWQC) and various sediment benchmarks and guidelines as identified below.

A total of 110 surficial sediment samples were collected in the Upper Reach. At all 110 locations PCB concentrations exceeded the National Oceanographic and Atmospheric Administration (NOAA) Effect Range-Low (ER-L) guideline and 106 of 110 samples exceeded NOAA's Effect Range-Median (ER-M) guideline. The ER-L is a concentration equivalent to the lower 10^{th} percentile of the range of reported values associated with biological effects, a concentration below which effects were rarely observed. The ER-M represents the 50^{th} percentile of the data in which effects were observed, a concentration above which adverse effects were frequently or always observed or predicted with most aquatic species tested (Long, et al., 99-0014). For this assessment, ER-Ls and ER-Ms were used in conjunction with OMEE guidelines to evaluate potential impacts of PCB contamination on the benthic community within the Upper Reach.

The OMEE sediment guideline for the lowest effect level (LEL) for PCBs was exceeded in 108 of 110 samples and the severe effect level (SEL) was exceeded in 70 of 110 samples. The SEL is a value at which pronounced disturbance of the sediment-dwelling community could be expected, affecting the majority of benthic species (99-0015). Sediments with these concentrations are considered "heavily contaminated."

EPA's sediment quality criteria value calculated for PCBs using the equilibrium partitioning methodology resulted in 108 exceedances in the 110 samples.

Seventy-two surface water samples (excluding duplicate samples) were compared with EPA's chronic freshwater ambient water quality criteria. All 40 samples in the potentially affected reach of the river that had detected concentrations of PCBs exceeded the chronic AWQC. During the 12-month period from June 1996 through May 1997 (during which GE conducted surface water monitoring for 10 of the 12 months), surface water samples collected from the Elm Street Bridge exceeded the AWQC for the sampling period. By comparison, surface water samples collected during the same period at the upstream control location exceeded the AWQC for PCBs on five occasions. (Note: samples collected after May 1997 were not evaluated because work in the river associated with the Building 68 Removal Action began in June 1997.)

Fish sampling in the Housatonic River has confirmed that there is an actual exposure of "animals and the food chain" to PCBs. The data indicated that the average concentration of PCBs in adult largemouth bass in Woods Pond (which is approximately 12 miles downstream of the GE facility) is 87 ppm, while the PCB concentrations range from 13.2 to 206 ppm. Young-of-the-year fish that were collected by GE in 1994 and 1996 in the vicinity of New Lenox Road (approximately 5 miles downstream of the Upper Reach) have concentrations of PCBs ranging from 21 to 36 ppm.

A number of exposure assumptions were used in the avian and mammalian exposure models to estimate the daily intake of PCBs in the kingfisher, great blue heron, and river otter. Comparison of the estimated doses of PCBs to the kingfisher and the great blue heron foraging the Upper Reach of the Housatonic River with avian toxicity studies of Aroclor-1254 indicated an exceedance of reproductive LOAELs derived for the kingfisher and great blue heron. The estimated daily dose of PCBs exceeded the reproductive LOAEL by approximately a factor of three for the great blue heron and a factor of four for the kingfisher. Comparison of the estimated doses of PCBs to the river otter foraging in the Upper Reach of the Housatonic River with mammalian toxicity studies of Aroclor-1254 indicated that many of the RTVs (based on reproductive endpoints) were exceeded. The potential for ecological effects to occur in avian species using the Upper Reach of the Housatonic River is considered possible to probable, and for semiaquatic mammalian species is considered likely.

It has been extensively documented in the peer-reviewed literature that PCBs in the ecosystem cause a variety of adverse effects to ecological receptors, including death, birth defects, reproductive failure and impairment, liver damage, tumors, behavioral modifications (such as abandonment of nest building activities), and a "wasting" syndrome (Aulerich et al., [99-0218]; Eisler, [99-0220]). Furthermore, the *Upper Reach—Housatonic River Ecological Risk Assessment* (99-0085) states that as a result of PCB contamination, the potential for adverse effects on the fish, birds (e.g., kingfisher and blue heron), and semiaquatic mammals (e.g., the river otter) in the Upper Reach of the Housatonic River is likely.

3. IDENTIFICATION OF REMOVAL ACTION SCOPE, GOALS, AND OBJECTIVES

3.1 STATUTORY LIMITS ON REMOVAL ACTIONS

CERCLA Section 104(c)(1) set limits of $2 million and 12 months for Superfund-financed removal actions. Cost and implementation time exemptions may be granted if EPA determines that the removal action is necessary to mitigate an immediate risk to human health, welfare, or the environment or that the removal action is otherwise appropriate and consistent with anticipated long-term remedial action. Funds expended to conduct an EE/CA are CERCLA §104(b)(1) monies and are not counted toward the $2 million statutory limit for removal actions.

The Consent Decree (00-0388) describes the agreement between EPA and GE for funding for the remediation of the EE/CA Reach. Because EPA may be paying more than $2 million in its cost share and because EPA will be performing the work, it appears that a consistency exemption may be needed ("*Final Guidance on Implementation of the Consistency Exemption to the Statutory Limits on Removal Actions," OSWER Publication 9360.0-12A, dated 12 June 1989,* (99-0328).

The EE/CA remedy is anticipated to be the final remedy for the 1½-mile EE/CA Reach of the Upper Housatonic River. Remedial decisions will be made for the rest of the Housatonic River and the actions under analysis are consistent with any conceivable long-term remedial action for the rest of the Housatonic River. Consequently, the removal action for the EE/CA Reach will contribute to the efficient, cost-effective performance of a long-term remedial action for the Housatonic River.

3.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Potential ARARs (applicable or relevant and appropriate requirements) have been screened to aid in technology and alternative evaluation. For this response, on-site actions must comply with the substantive requirements of any identified ARARs, to the extent practicable considering the exigencies of the situation. On-site actions do not have to comply with the corresponding administrative requirements such as permit applications, reporting, and recordkeeping. Off-site actions must comply with all legally applicable requirements.

ARARs are divided into the following categories:

- **Chemical-specific requirements** are health- or risk-based concentration limits or ranges in various environmental media for specific hazardous substances, pollutants, or contaminants.
- **Action-specific requirements** are controls or restrictions on particular types of activities, such as hazardous waste management or wastewater treatment. Examples of action-specific requirements would be state and federal air emissions standards as applied to an in situ soil vapor extraction treatment unit.
- **Location-specific requirements** are restrictions on activities that are based on the characteristics of a site or its immediate environment. An example would be restrictions on work performed in wetlands or wetland buffers. In this example, the location-specific requirements necessitate restoration of wetlands impacted by remedial activities.

The potential chemical-, location-, and action-specific ARARs for the EE/CA Reach of the Housatonic River are summarized in Tables C-1, C-2, and C-3 of Appendix C, respectively. The tables also provide a citation and a synopsis of each ARAR and are intended to be consistent with those ARARs cited for the ½-Mile Source Reach.

3.3 REMOVAL ACTION OBJECTIVES

EPA guidance (*Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*, 99-0012) provides for the development of removal action objectives to form the basis for evaluating alternatives. According to the guidance, “removal action objectives generally consist of medium-specific goals for protecting human health and the environment. The objectives should be as specific as possible but not so specific that the range of alternatives that can be developed is unduly limited. Removal action objectives should identify, for example, the contaminants of concern and exposure route(s) and receptor(s).”

The Action Memorandum (Tagliaferro, 00-0158) demonstrated that high levels of PCBs were detected in surficial sediments, bank soils, and floodplain samples throughout the subject area. The concentrations of PCBs greatly exceed cleanup levels considered protective of human health, including the 1-ppm preliminary remediation goal for residential areas specified in EPA OSWER Directive 9355.4-01; EPA's PCB Spill Cleanup Policy, 40 CFR Part 761 (10 ppm in residential areas—if capped, 25 ppm in industrial areas); and MADEP's default (Method 1) cleanup standard for residential and industrial soils of 2 ppm. In addition, the *Upper Reach – Housatonic River Ecological Risk Assessment* (99-0085) identified numerous exceedances of ambient water quality criteria and various sediment benchmarks and guidelines. Based on this evaluation, the following preliminary removal action objectives have been established:

- Remove, treat, and/or manage PCB-contaminated river sediments to prevent human exposures exceeding risk-based levels by the dermal adsorption and incidental ingestion routes.
- Remove, treat, and/or manage PCB-contaminated river sediments to prevent ecological exposures exceeding risk-based levels.
- Remove, treat, and/or manage PCB-contaminated riverbank soils to prevent human exposures exceeding risk-based levels by the dermal adsorption and incidental ingestion routes.
- Remove, treat, and/or manage PCB-contaminated riverbank soils to prevent ecological exposures exceeding risk-based levels.
- Eliminate or mitigate existing riverbank soil and sediment sources of contamination to the EE/CA Reach of the Housatonic River.
- Prevent recontamination of previously remediated areas and further contamination of other areas.
- Prevent the downstream migration of contaminated sediments and bank soils.
- Minimize long- and short-term impacts on wetland and floodplain areas.
- Enhance habitat (riparian and aquatic) in a manner consistent with the above objectives.

The EE/CA Reach habitat restoration objectives are listed below. As specified in the Consent Decree (00-0388), these objectives are similar to those established by the natural resource trustees (the "Trustees") for the ½-Mile Source Reach.

- Implement the Removal Action for the EE/CA Reach as approved by EPA.
- Perform the restoration, including the enhancement of the river sediment and bank habitat in accordance with the Consent Decree (00-0388) among GE, the Trustees,

EPA, the Commonwealth of Massachusetts, and the State of Connecticut, to increase the diversity and productivity of the biological community in this reach.

- Restore the riverbank to provide overlying cover, in accordance with the Consent Decree (00-0388) among GE, the Trustees, EPA, the Commonwealth of Massachusetts, and the State of Connecticut, and to enhance the bank vegetation by reestablishing plantings using native species.

- Minimize the potential for erosion of residual PCB-containing bank soils and river sediments that would result in recontamination of river sediments or transport of PCBs, and which could impair the river restoration by adversely impacting the ecological receptors.

In addition to ecological and human health risks calculated using PCB sampling results, risks posed by Appendix IX compounds were evaluated. Appendix IX constituents in soils have been evaluated in relation to the GE background data set, EPA Region IX criteria for soils, and MCP soil criteria. Appendix IX constituents in sediments have been evaluated against the Ontario Ministry for the Environment and Energy (OMEE) lowest effect level (LEL) for sediments (see Subsection 2.3.7). Analytical data indicate that Appendix IX contamination exceeding the sediment criterion is co-located with PCB contamination and will be mitigated by the removal of PCB-contaminated sediment. Also, except for some riverbank soils in five subreaches (totaling approximately 1,500 yd^3), Appendix IX contamination in soil is also co-located with PCB contamination.

3.4 DETERMINATION OF REMOVAL ACTION SCOPE

Removal activities for this EE/CA are limited to riverbank soils and sediments in the 1½-mile reach of the Housatonic River from Lyman Street to the confluence of the East and West branches. For the purpose of this EE/CA, the top of the bank is defined as the highest point of the bank slope where the "slope breaks down."

The EE/CA Reach is composed of many individual residential, commercial, and recreational properties that abut the Housatonic River. Long-term maintenance of the riverbanks within this reach is necessary to meet the removal action objectives of eliminating or mitigating existing riverbank sources of contamination and preventing the downstream migration of contaminated bank soils. Because the EE/CA Reach is made up of many individual properties, long-term maintenance following the removal action will involve significant access issues. In addition, if maintenance inspections identify areas where riverbanks must be repaired to prevent downstream migration of contamination, further neighborhood disruptions will occur. EPA's cleanup criteria identified below, along with the use of the 95% UCL to determine removal limits, and the restoration plans identified in Subsections 4.6, 5.2.1.6, and 5.2.1.7, reflect EPA's desire to reduce the level of the effort required for long-term inspection and maintenance of the banks.

EPA has established cleanup criteria for total PCBs in bank soils in the EE/CA Reach based on human and ecological exposure exceeding risk-based levels (EPA, 00-0387 and 07-0029) (see Appendix O). These criteria are as follows:

- Riverbank soils adjacent to recreational or commercial properties are classified as recreational use. The recreational use criteria will be 10 ppm in the top 12 inches and 10 ppm in the next 2 ft. In areas where there is a potential for future exposures that are inconsistent with recreational use (i.e., future residential use) or where exposures may occur at depths greater than 3 ft, Environmental Restrictions and Easements (EREs) will be obtained.

- Riverbanks on residential properties will be remediated to the residential use criterion of 2 ppm to at least a depth of 3 ft. However, prior to the EE/CA removal action, additional soil analytical data will be gathered at depths greater than 3 ft on each residential property. Based on these data, a determination will be made as to whether additional excavation is warranted or application of an ERE is necessary.

EPA is establishing a PCB cleanup standard of 10 mg/kg for all bank areas that are not in residential use (i.e., part of a residential property). In establishing this cleanup standard for the EE/CA, EPA has considered the *Evaluation of Human Health Risks from Exposure to Elevated Levels of PCBs in Housatonic River Sediment, Bank Soils, and Floodplain Soils* (00-0315) and other site-specific information on exposures. Specific changes to the exposure assumptions include consideration of the exposure frequency (i.e., 3 days per week during warmer months) for nonresidential portions of the riverbank. For banks in residential use, EPA has established the cleanup standard at 2 mg/kg. This level is the Massachusetts DEP's default standard for Method 1 soils (unrestricted use). The risk justification and calculations associated with this cleanup standard can be found in the 4 August 1999 risk justification memo found in Appendix D to the Consent Decree.

The cleanup criterion for sediment is 1 ppm. Sediment is defined as the material below the mean annual high-water line. Above the mean annual high-water line, the soils are defined as riverbank soils. This sediment cleanup criterion is based on evaluation of effects of PCBs on river ecological receptors and determination of adverse effect thresholds as described and referenced in an EPA Memorandum dated February 2000 (07-0029).

PCB contamination shall be removed based on the 95% Upper Confidence Limit (UCL) of the mean PCB concentrations in the sediments and bank soils. The 95% UCL was calculated in accordance with the procedures outlined in *Supplemental Guidance to RAGS: Calculating the Concentration Term* (99-0003). Use of the 95% UCL is based on the goal of providing a reasonable level of assurance that material exceeding applicable standards has been removed where data tend to be variable in space and time.

Where Appendix IX contamination is not co-located with PCB contamination, the limits of the PCB excavation will be extended to remove exceedances for the Appendix IX contaminants. Subsection 3.4.1 provides an explanation of the methodology used to determine the soil and sediment volumes to be excavated.

3.4.1 Determination of Excavation Volumes

Sediment and riverbank soil volumes requiring removal to meet the cleanup goals were estimated for use in cost estimating for the EE/CA report. Table 3.4-1 provides a summary by subreach of the depths of excavation and the sediment and riverbank soil volumes to be removed. A more detailed list of the specific areas to be excavated and the associated specific excavation depths for sediment and riverbank soil by subreach is provided in Table 3.4-2.

Different approaches were used for estimating the volume of sediment and riverbank soils that require removal because of fundamental differences in the cleanup criteria, the distribution of PCBs and Appendix IX contaminants, and the removal methods for each medium. The approaches used for identifying contamination requiring removal and the rationale for the approaches is presented in Subsection 3.4.1.1 for sediment and 3.4.1.2 for riverbank soil.

3.4.1.1 Sediment

The volume of sediment exceeding the PCB cleanup criteria outlined in Subsection 3.4 was estimated on a subreach basis. The method used to determine the depth of excavation for sediments was a direct comparison of the 95% UCL of the mean PCB concentration to the cleanup criterion. The cleanup criterion (1 ppm) was compared to the calculated 95% UCL of the mean for each 1-ft depth interval (see Subsection 2.3.5 and Table 2.3-2) for each subreach. In general, areas where the 95% UCL of the mean PCB concentration exceeded the cleanup level for the corresponding depth interval were determined to require excavation. In one area, an isolated pocket of contamination was found at depth (2.1 ppm PCB at 6.0 to 6.5 ft; 45.7 ppm PCB at 7.0 to 7.5 ft) but was located below sediment not exceeding the cleanup criterion. In this area, the excavation depth was not extended to include this deeper contamination due to its relative isolation, the lack of sufficient data at this depth to develop concentration trends or averages, and the marginal additional benefit excavating this area would provide. The depth to which sediment removal is required in each subreach to meet the cleanup criterion is depicted in Figure 3.4-1. The volume of sediment impacted within each subreach is presented in Table 3.4-1. The 95% UCL of the mean PCB concentration for sediment below the proposed excavation depths are presented in Table 3.4-3 in 1-ft depth intervals. The data presented in Table 3.4-3 confirm that the proposed excavation depths are adequately protective.

In general Appendix IX constituents exceeding applicable standards are co-located with areas already requiring excavation based on PCB results. However, additional data regarding Appendix IX constituents and PCB concentrations in aggrading bar areas will need to be collected during a predesign investigation to confirm the proposed excavation areas and depths. In addition, since all Appendix IX data for the EE/CA Reach correspond to the top 2 ft of sediment, limited sampling at depths greater than 2 ft within the EE/CA Reach (excluding Subreaches 4-1, 4-2, and 4-3) is suggested to confirm that elevated concentrations of Appendix IX constituents do not exist below the proposed excavation depths.

3.4.1.2 Riverbank Soils

The volume of riverbank soils exceeding the PCB cleanup criteria was estimated using a 3-tiered approach. The logic for this approach is presented as a flow chart in Figure 3.4-2. Initially, a direct comparison of the 95% UCL of the mean PCB concentration to the cleanup criteria was conducted on a subreach basis. This initial tier of the analysis was conducted by comparing the 95% UCL of the mean PCB concentration for various depth intervals to the cleanup criteria (see

Table 2.3-2). Because the cleanup criteria vary based on land use (residential versus recreational), the data were compiled based on the land use within each subreach.

The second tier of analysis consisted of examining the riverbank soil data on a non-subreach basis to determine if there were areas within a subreach or crossing a subreach boundary that did not require removal. The non-subreach-specific analysis was conducted by visually examining the data posting maps (Figures 2.3-3A through 2.3-3K), and identifying specific stretches where there were few exceedances of the cleanup criteria. Four such stretches, each with a minimum length of 300 ft, were identified. The 300-ft minimum length criterion is considered a reasonable lower limit for this tier of the analysis based on the frequency of sampling points. Consideration of shorter river lengths would typically result in increasingly divergent UCL calculation results, and diminishing benefits due to higher unit construction costs. Once the non-subreach-specific stretches were identified, the 95% UCL of the mean PCB concentration was calculated for each and the results were compared to the appropriate cleanup criteria (based on depth and land use). Table 3.4-4 presents the results of this analysis. One additional area not requiring complete removal was identified as a result of this analysis.

The third tier of evaluating the riverbank soils data involved further analysis of the subreaches and depth intervals that have fewer than 25% of the samples exceeding the cleanup criteria (see Table 2.3-1). There were a total of 11 such areas, four of which were addressed (found to not require removal) in the first tier evaluation and one of which was addressed in the second tier evaluation. Thus, a total of six areas were evaluated under this third tier. The evaluation included identifying the locations of the samples that exceeded the cleanup criteria within each area and assessing whether it would be feasible to remove only selected zones or depth intervals within those areas, leaving a reasonable amount of material that did not require removal. This evaluation was largely based on the spatial distribution of the exceedances. In cases where the exceedances were more or less evenly distributed over the area and depth intervals, no benefit was gained by selectively removing the exceedances. In areas where the exceedances were clumped together either horizontally or vertically, a "hotspot" removal was recommended in lieu of removing the entire area.

Of the six areas evaluated, three were deemed suitable for limited hotspot removal. Table 3.4-5 lists all of the areas evaluated as part of the third tier as well as the areas targeted for hotspot removal. Table 3.4-6 provides a summary of riverbank soil PCB concentrations that will remain in each subreach where hotspot removal is conducted.

In addition to the PCB data evaluation described above, the Appendix IX data were evaluated to determine if areas not slated for excavation based on PCB concentrations would require excavation for Appendix IX exceedances. Based on the evaluation, three subreaches (4-2 West Bank, 4-3 East Bank, and 4-5B East Bank) were identified where Appendix IX exceedances were present in areas where excavation for PCB removal was not required. Due to the relatively sparse nature of Appendix IX data, an Appendix IX exceedance was conservatively assumed to require excavation for the full bank height for the subreach and to the depth where the exceedance was located, unless additional data points were present showing no Appendix IX exceedance for a given depth interval and bank area within that subreach.

Table 3.4-2 provides a summary of the proposed excavation areas and associated depths to meet the PCB cleanup criteria for riverbank soils on a subreach basis. The locations of these areas and the depth of excavation in each area are shown in Figure 3.4-3. The volume of riverbank soil impacted within each subreach is presented in Table 3.4-1. It is noted that the data presented in Tables 2.3-2, 3.4-4, and 3.4-5 demonstrate that in all recreational bank areas, soil PCB concentrations will meet the bank cleanup (10 ppm for 0 to 3 ft).

As mentioned above, additional soil sampling at depth will be necessary prior to EE/CA Reach removal activities on residential properties. Currently, it is recommended that one boring per property be advanced to a maximum depth of 6 ft. Soil sampling for PCB analysis would be conducted every other 6 inches within the boring below 3 ft.

3.5 DETERMINATION OF REMOVAL ACTION SCHEDULE

The removal action for the EE/CA Reach of the Housatonic River from Lyman Street to the confluence with the West Branch will begin as soon as practicable after EPA determines the action that best satisfies the evaluation criteria. The potential for recontamination from removal activities upgradient of the EE/CA Reach will be minimized by completing the removal action in the first ½ mile and establishing source controls prior to initiating work in the EE/CA Reach. Additional consideration must be given to control of potential recontamination from the Silver Lake outfall, oxbow areas, and floodplain soils.

With the completion of removal work upgradient of the site and the installation of source controls, the removal action will proceed downstream, starting at the upper limit of the EE/CA Reach (Lyman Street). Work will be conducted during anticipated low-flow periods in the river and when excavation and restoration work can be safely conducted and controlled. This would typically limit work to early summer (June) through late winter (March). Removal work may not be able to be performed during high-flow periods (spring) without more extensive diversions or controls. Backfilling during wet or cold weather is not easily controlled and may result in poor performance of the restoration; therefore, work during winter may need to be suspended if extreme winter weather occurs during the removal action. Similarly, work will need to be suspended in anticipation of any severe weather conditions.

The *Removal Action Work Plan – Upper ½-Mile Reach of Housatonic River* (07-0020) states that removal in the first ½ mile is expected to take 1.5 to 2 years. Site preparation activities for the Upper ½-Mile Reach Removal Action began in October 1999, and excavation activities began in November 1999. Based on GE's current schedule, completion of the first ½-mile removal action should occur by approximately spring 2001.

To expedite the removal action for the EE/CA Reach, a number of pre-construction and site preparation activities, such as acquiring necessary access or access agreements, ordering and mobilization of equipment, tree clearing, and surveying could be started before completion of the ½-mile remediation. These steps would minimize downtime between completion of the ½-mile project and startup of the EE/CA Reach removal.

The time to execute a removal action on the EE/CA Reach is estimated to range from 2 to 3 years when considering the limitations of the construction season and the adverse effects from significant precipitation events. A more accurate time estimate can be prepared once the recommended removal action is approved and the date of completion of upgradient controls is known.

4. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section identifies and screens technologies that address the removal action objectives discussed in Subsection 3.3. Subsection 4.1 provides a description of the EE/CA technology screening process and how it has been implemented in this EE/CA study. Subsection 4.2 describes river diversion and sediment/soil removal technologies. In situ treatment/containment, ex situ treatment, and ex situ consolidation/disposal technologies are discussed in Subsections 4.3, 4.4, and 4.5, respectively. Subsection 4.6 provides a description of riverbank and riverbed restoration technologies that could be used to restore the river channel after contaminated sediments and bank soils have been removed. A summary of the results of the technology screening is provided in Subsection 4.7.

4.1 SCREENING CRITERIA

General response actions were developed to achieve the removal action objectives described in Section 3. The response actions developed for the EE/CA Reach are as follows:

- River diversion.
- Sediment and riverbank soil removal.
- In situ treatment/containment.
- Ex situ treatment.
- Ex situ consolidation/disposal.
- Riverbed/riverbank restoration.

Candidate technologies were identified for each of these general response actions based on a review of literature, vendor information, performance data, and discussions with remediation and construction professionals. To produce a site-specific inventory of potentially applicable technologies, the candidate technologies for each response action were evaluated with respect to criteria that fall under the broad groupings of implementability, effectiveness, and cost. Criteria within these three groupings are identified in the EE/CA guidance (99-0012). Additional criteria have been considered based on their relevance to the project and site-specific conditions. Those criteria that do not apply to a general response action or do not provide any differentiation between technologies have not been presented in the screening tables for space reasons.

Candidate technologies were initially screened on a general level. As described in the following paragraphs, some candidate technologies were eliminated prior to the detailed screening. The following tables present the detailed screening information:

- Table 4.1-1 – Screening of River Diversion Technologies
- Table 4.1-2 – Screening of Sediment and Riverbank Soil Removal Technologies
- Table 4.1-3a – Screening of Treatment/In Situ Containment Technologies
- Table 4.1-3b – Screening of Consolidation/Disposal Technologies
- Table 4.1-4 – Potential Riverbank Restoration Technologies
- Table 4.1-5 – Potential Riverbed Restoration Technologies
- Table 4.1-6 – Summary of Retained Technologies Following Technology Screening

Tables 4.1-1, 4.1-2, 4.1-3a, and 4.1-3b present the detailed evaluation of the screening criteria and a screening status, Retained or Not Retained. When a technology is shown as not retained, a brief explanation of the basic reasoning for eliminating the technology is provided in the table. If a technology is shown as Not Retained at the end of one of these tables, it is eliminated from further consideration for the total EE/CA Reach. Retained technologies, combined into comprehensive removal action alternatives, are described in Section 5.

Subreach-level screening was considered for all of the general response actions. Based on this evaluation, subreach-level screening was determined to be necessary for river diversion and sediment removal response actions because of varying riverbed and riverbank conditions along the EE/CA Reach that would preclude use of certain technologies in specific areas. This subreach-level screening is included in Tables 4.1-1 and 4.1-2 by referring to groupings of subreaches. However, the ex situ treatment and consolidation/disposal response actions were not highly dependent on the physical characteristics of the subreaches and were evaluated for the EE/CA Reach as a whole. The restoration response action is also not dependent on the overall physical characteristics of the subreaches; however, restoration technologies were determined to be dependent on characteristics of riverbank slopes and the riverbed. Therefore, these technologies apply to specific areas of subreaches, rather than to an entire subreach and, as such, Tables 4.1-4 and 4.1-5 are identification rather than screening tables. The subsections below provide the descriptions of the technologies evaluated for each general response action and the evaluation criteria.

4.2 RIVER DIVERSION AND SEDIMENT AND RIVERBANK SOIL REMOVAL TECHNOLOGIES

The river diversion and sediment and riverbank soil removal general response actions are presented together in this subsection because they are interrelated. (For example, dry excavation would be performed only if the river was diverted, whereas river diversion is not required for wet excavation.) The river diversion technologies considered are presented in Subsection 4.2.1. The sediment and riverbank soil removal technologies are presented in Subsection 4.2.2. In addition, the general characteristics of subreaches or groups of subreaches influence the choice of river diversion or sediment removal technology. As the screening was performed, the applicability of each of the river diversion and sediment/soil removal technologies to individual subreaches or groups of subreaches was evaluated. If the effectiveness or implementability of the technology was sensitive to the characteristics of any particular subreach, this was noted in Tables 4.1-1 and 4.1-2. At the end of these tables, the specific subreaches for which each technology has been retained are noted. All of the diversion and removal technologies described in the paragraphs below are included in the detailed screening tables.

In screening the technologies with regard to individual subreaches, it was observed that the subreaches could be generally grouped according to similar characteristics and applicability of technologies. These groupings were made based on the depth to bedrock below the river channel, the presence or absence of cobbles, the slope of the riverbanks, the presence of a floodplain area adjacent to the river channel, and whether the properties adjacent to the river were developed or relatively undeveloped. These subreach groupings are as follows:

- Subreaches 3-8, 3-9, 3-10 (relatively steep banks, sediment depths > 3 ft).
- Subreaches 4-1, 4-2, 4-3, 4-4A (cobble reaches with shallow bedrock).
- Subreaches 4-4B, 4-5A, 4-5B, 4-6 (floodplain and undeveloped areas).

Table 4.1-1 presents the results of screening of river diversion technologies, and Table 4.1-2 presents the results of screening of sediment/soil removal technologies. Figure 4.2-1 provides a graphic representation and summary of the river diversion and sediment/soil removal technology screening.

4.2.1 River Diversion

River diversion technologies include methods to reroute river water around areas where sediment removal will occur. Five general types of river diversion methods were evaluated:

- Open channel diversion (intrusive—sheetpiling).
- Open channel diversion (nonintrusive).
- Gravity feed bypass piping.
- Bypass pump and piping.
- Alternate river channel.

The above-listed technologies are normally used to create “dry” conditions for sediment removal. To fully “dry” out the riverbed, dewatering to prevent infiltration of groundwater would also be necessary in combination with one of the five diversion technologies listed above.

These methods are described in greater detail below.

4.2.1.1 Open Channel Diversion (Intrusive—Sheetpiling)

Open channel diversion methods rely on using a portion of the existing riverbed to maintain flow. The river flow is diverted to approximately half or less of the channel width, while the remainder of the riverbed is “in the dry,” to allow sediment removal to proceed. The intrusive option evaluated for open channel diversion is sheetpiling. Sheetpiling consists of interlocking sections of steel that are driven into the earth to form a wall. The sheetpile would be driven through the sediment to isolate one section of the river at a time. Water would then be pumped from the isolated section to allow sediment removal in the dry. An essential requirement of this method is that an adequate depth of overburden must be present in the channel to support the sheetpiling. GE has performed installation of sheetpiling in the Source Reach for river diversion purposes.

4.2.1.2 Open Channel Diversion (Nonintrusive)

Nonintrusive open channel diversion methods also use the existing riverbed to carry the entire flow through a narrower channel created by the diversion structures. The main difference between nonintrusive and intrusive open channel diversion methods is that the diversion structures used in nonintrusive methods contact the river bottom rather than extending into the underlying sediment. Nonintrusive methods cut off flow to the active work cell by sealing against the riverbed and include options such as porta-dams, water-filled dams, jersey barriers, and concrete blocks. These methods can be used irrespective of the depth of overburden. However, because they rely on their mass for stability against the river flow and to seal against the riverbed, they have practical size limitations. Because of these size limitations, these methods are sensitive to overtopping during increased river flow and infiltration of river flow from beneath the barrier. In some circumstances, nonintrusive diversion structures may be used to reduce the stream velocity in a local area of the stream rather than to divert the entire stream flow around an isolated area in the stream.

4.2.1.3 Gravity Feed Bypass Pipe

A gravity feed bypass pipe would also use the existing channel to convey water. However, instead of water flowing in a restricted portion of the channel, water would run through a gravity pipe placed in the channel. The river would first require damming to divert river flow into the gravity feed pipe. The pipe would be placed in the river channel and would run some distance downstream to allow a sufficiently large work area to be dewatered. At the downstream end, the river would also be dammed and an outlet structure for the pipe installed. The gravity feed pipe can be constructed of rigid or flexible pipe materials. Preliminary calculations have indicated that two 400-ft long pipes each with a diameter of 4 ft placed on the riverbed could accommodate a flow of 120 cfs while increasing the river depth upstream of the dam from approximately 2 ft to approximately 4.25 ft. Using the same pipe configuration, a storm flow of approximately 490 cfs would cause the river depth to increase to approximately 7.5 ft (based on an analysis for "inlet control" alone). A diversion longer than 400 ft would cause head loss through the pipe to increase, resulting in a greater depth of water behind the upstream dam. Because the pipes must be placed within the riverbed, a portion of the excavation cannot be completed while the pipes are present. A second set of pipes must be installed following excavation in the first half of the riverbed and water diverted to it, so that the first set of pipes can be removed. Following removal of the first pipes, sediment in the second half of the channel that was previously not accessible can be excavated. Following completion of the riverbed excavation, the diversion structure will be removed and installed at a section of river farther downstream.

4.2.1.4 Bypass Pump and Piping

Similar to the gravity feed pipe option, 100 % of the river water would be diverted by pumping the water through a pipe, around the active work area, to a downstream discharge location. The river would be dammed above and below the work area to keep water out. A wet well and a series of pumps would be installed at the upstream dam. The bypass pipe could be placed outside of the river channel so that it would not interfere with work in the river. Temporary access would be required along the top of the bank to run the bypass piping. Water would be pumped through the pipe to a discharge point just downstream of the second dam. The entire 1 ½-mile EE/CA Reach could be diverted or shorter sections could be completed sequentially. It is assumed that no more than 1,500 ft of river would be diverted at any one time to reduce the risk of overtopping during periods of high flow, which could result in potential recontamination of previously cleaned areas.

It is assumed that the pumps would be diesel powered due to uncertainties and potential difficulties associated with installing sufficient electrical power at multiple locations along the river. However, if it is determined during design that adequate electrical service can be cost-effectively provided along the entire EE/CA Reach, then electrical pumps should be considered because they could potentially produce fewer short-term adverse impacts during the removal action.

4.2.1.5 Alternate River Channel

With the alternate river channel option, a new channel would be constructed to carry water outside of the existing river channel. Both underground and aboveground options were evaluated. An aboveground alternate channel would be constructed at available areas near the existing channel and diverted to either another water body (e.g., the West Branch of Housatonic River) or to a point downstream. The underground channel would be constructed as a tunnel through bedrock. It would be installed in a straight line from the upstream end of the EE/CA Reach to the downstream end and would be constructed beneath existing roadways, utilities, and structures. In both the aboveground and underground options, the riverbed would be "dry," allowing dry excavation to proceed.

4.2.2 Sediment and Riverbank Soil Removal Technologies

The removal of contaminated sediments from the riverbed can be accomplished by one or a combination of methods. Methods evaluated as part of this EE/CA include wet excavation, dredging from a barge, and dry excavation. Removal of riverbank soils can be accomplished by dry excavation. These methods are described in greater detail below.

4.2.2.1 Wet Excavation

Wet excavation is a method that would use standard excavation equipment to remove sediment "in the wet." River diversion would not be necessary. Wet excavation could be accomplished by excavating with a long-reach or standard-reach excavator from the top of or partially down the riverbank, from an access road constructed at the base of the riverbank, or from an access road constructed within the riverbed itself. Working within a flowing river would create some implementation difficulties that would need to be addressed by the use of engineering controls. Excavation, riverbed restoration, and backfilling/capping would be somewhat impeded by reduced visibility, resettlement of suspended contaminated sediment into the excavated area, and the various impacts from the river velocity. Some open channel nonintrusive diversion structures may be applicable to control of sediment mobilization during wet excavation (see Subsection 4.2.1.2). In addition, maintaining bank stability during excavation near the toe of the slope will need to be addressed by conservative excavation procedures, slope monitoring, and rapid backfilling (see Appendix N).

4.2.2.2 Dredging from a Barge

This option would include damming the river to raise the water level enough to place a barge-mounted hydraulic or mechanical dredge on the river. River damming would be required because of the normally shallow river depths (1 to 3 ft) along the EE/CA Reach. All excavation would therefore take place "in the wet." Water flow in the river would be maintained by allowing water to overflow from the dam once the desired depth of water in the dammed portion of river is achieved. The river would likely require damming in several places as the excavation moves down the river due to the variability in bank height along the EE/CA Reach.

Mechanical dredges used may be excavating machines such as the grapple dredge, dragline, dipper, and environmental bucket-ladder, or standard excavators and clamshells. Excavated material is typically placed onto barges or into trucks for transport to a drying area. Hydraulic dredges are self-contained units that handle both excavation and transfer by pumping the material to the disposal area or temporary holding facility. The material to be excavated is first loosened and mixed with water by a cutting head, by agitation with water jets, or by a suction head and then pumped as a slurry through a pipeline to the point of discharge. Many of the implementation issues identified for wet excavation would also be relevant for dredging from a barge, including bank stability concerns and slope monitoring.

4.2.2.3 Dry Excavation

River diversion would be necessary to perform dry excavation. Standard excavation equipment would be used to excavate contaminated sediments from the riverbed. Dry excavation would be expected to have good quality control because visibility and sediment resettlement issues would not be significant when working in the dry. However, during installation and removal of sheetpiles, some potential for resuspension of PCBs would exist due to disturbance of the riverbed. Also, overtopping during high river flow periods would possibly contaminate previously excavated areas and could transport suspended sediment to downstream locations, although the height of the sheetpiles can be selected to reduce overtopping occurrences. As with "wet" methods, toe of bank stability will be an ongoing issue during excavation and will need to be addressed during implementation by slope monitoring and rapid backfilling at the toe of the bank. Dry excavation has been used in previous Housatonic River excavation work.

4.2.3 River Diversion and Sediment/Soil Removal Screening

Figure 4.2-1 is a summary chart of the results of the river diversion and sediment/soil removal technologies screening. The detailed screening evaluations are presented in Tables 4.1-1 and 4.1-2. A small number of the screening criteria were found to have a significant impact on the decision not to retain technologies. More significant screening criteria are as follows:

- Access constraints/space for equipment or alternate river channel.
- Depth of bedrock.
- Ability to remove materials from riverbed and bank.
- Water depth.
- Sensitivity to variable river flows.
- Presence of cobbly areas.
- Compatibility with bank restoration work.
- Ease of cap construction.
- Cost.
- Dewatering of sediments.
- Other factors.

The screening decisions for the response actions discussed in Subsections 4.2.1 and 4.2.2 are largely directed by these considerations, and relevant evaluation results are highlighted in bold in the tables where applicable.

4.2.4 Conclusions

In general, two of the five evaluated river diversion technologies (sheetpiling and pumped bypass) were retained, and two of the three evaluated sediment removal technologies (wet excavation and dry excavation) were retained. For Subreaches 3-8, 3-9, 3-10, 4-4B, 4-5A, 4-5B, and 4-6 (all reaches except cobbly Subreaches 4-1, 4-2, 4-3, and 4-4A), a sheetpile diversion method (with dry excavation) was retained. For the entire EE/CA Reach, including the cobbly subreaches (4-1, 4-2, 4-3, and 4-4A), a pumping bypass system (with dry excavation) was retained. Wet excavation was also retained for the entire EE/CA Reach.

4.2.4.1 River Diversion Technologies

Three river diversion technologies (nonintrusive barriers, gravity bypass, and an alternative channel) were not retained for inclusion in alternatives developed in Section 5. The rationale for not retaining these technologies is presented in detail in Table 4.1-1 and summarized below.

- Nonintrusive barriers rely on their mass to divert flow and seal against the riverbed. They are ideally suited for use in smooth riverbeds and, because of height limitations, for relatively shallow water levels. They would not adequately seal at the bottom of the barriers in the cobble subreaches and would be prone to more frequent overtopping along the entire EE/CA Reach at relatively shallower water levels compared to intrusive barriers. The excavation cells would also have to be overlapped to provide adequate distance between the barriers and the edge of the excavation and to allow sediment beneath the wide base of the nonintrusive barriers to be removed and replaced.

- A gravity bypass system relies on damming the river to divert the river flow through the bypass pipe. The impact of raising the river water level for the extended period of time needed to complete the removal action has not been evaluated in detail. Potential impacts would include decreased flood capacity of the river channel due to the increased water height, impacts on the habitat along the lower riverbanks, and greater erosion of the middle to upper riverbanks. The pipe diameter (approximately 4 ft in diameter for a dual pipe system) and the dam structure required would be sized to prevent the river from overtopping its banks in common flooding events but small enough to be practically installed and maneuvered as the excavation moves down the river. Unlike a pumped bypass, which can bypass outside the channel and requires only one set of pipes, a second gravity bypass pipe system would have to be installed after remediating one side of the riverbed. Thus the first bypass pipe could be removed and sediment beneath and around the pipe excavated and replaced.

- Constructing an alternative river channel presents many administrative and technical challenges that are not likely to be overcome whether the channel is constructed above or below ground level. The riverbanks in the general vicinity of the river have been developed and contain structures and utilities that would need to be relocated to construct an alternative river route. Construction of the channel would generate a large volume of potentially contaminated soil that would require treatment or disposal. Even if access could be obtained for an alternative channel, the cost of the venture would be significantly greater than other solutions and would provide no significant benefits to offset the costs.

4.2.4.2 Sediment Removal Technologies

Dredging from a barge appears generally unsuitable for this project because of the shallow river depth, which requires that the river be dammed, and the coarse nature of the sediments, including cobbles present throughout Subreaches 4-1, 4-2, 4-3, and 4-4A. Therefore, dredging from a barge has been eliminated from further consideration.

Because wet excavation does not require river diversion, it is recognized that upfront pre-construction coordination to obtain access or access agreements may be significantly less than for dry excavation, which requires river diversion. If the required access points are not readily available, installing the river diversion system will become more time-consuming and costly. Wet excavation, therefore, may have advantages over dry excavation with respect to administrative feasibility.

Dry excavation has some technical advantages over wet excavation under normal operating conditions including a generally reduced potential for sediment resuspension and more stable bank slopes. Dry excavation also has quality control advantages over wet excavation, including the ability to excavate contaminated sediment more accurately (because of better visibility) and to better control the deposition of contaminated sediment in areas previously excavated. However, during overtopping resulting from high-flow events, recontamination of previously excavated areas and resuspension and downstream transport of contaminated sediment would occur for dry excavation. Installation and removal of sheetpiles would also create opportunities for resuspension of sediment. Engineering controls will be required with both dry and wet excavation to minimize the potential downstream transport of re-suspended sediment.

The relative advantages and disadvantages of these methods will be discussed in more detail in the detailed evaluation of alternatives (Section 5).

4.3 IN SITU TREATMENT/CONTAINMENT TECHNOLOGIES FOR SOILS AND SEDIMENTS

In situ treatment/containment technologies evaluated include containment, chemical immobilization, and biological treatment. These technologies are discussed in further detail in Subsections 4.3.1 to 4.3.4. These subsections present an initial screening of each technology that eliminates the less promising technologies and allows a more detailed screening of only the most promising technologies. Only those technologies that passed this initial screening were retained for further evaluation in the detailed screening provided in Table 4.1-3a.

4.3.1 In Situ Containment

The in situ containment method considered for the EE/CA Reach is in situ capping. In situ capping involves placing isolating and adsorptive material over contaminated soil or sediment to prevent direct exposure of human and ecological receptors to the contaminated material, and to minimize erosion and the subsequent downstream migration of contaminated material to other areas. The cap would consist of a combination of layers that may include clean sediments or soil, sand, gravel, erosion protection layer, a sorptive layer, and geotextile (99-0153).

4.3.1.1 In Situ Containment of Bank Soil

The sorptive layer would be designed to mitigate the migration of contamination from the contaminated soils remaining at depth following excavation of the bank soils. Contaminants mobilized through the lower portion of the banks by periodic flooding and precipitation would be adsorbed to the carbon within the sorptive layer. After passing through the sorptive layer, groundwater, free of contaminants, would then discharge to the river. The thickness of the sorptive layer required would depend on the concentration of PCBs in the soil beneath the cap. The actual cap layers required and the relative positions and thicknesses of the cap layers would be determined during design of the removal action. Erosion protection layers would be required in capped areas of the riverbanks to prevent erosion of the banks and the cap. Refer to Appendix M for a conceptual cap design and a more detailed discussion of the cap requirements. Detailed screening of capping of lower banks is documented and summarized in Table 4.1-3a.

4.3.1.2 In Situ Containment of River Sediment

The sorptive layer would be designed to mitigate upward migration of contamination from the contaminated sediments remaining below the cap. Contaminants mobilized from the lower sediment by the upward flow of groundwater would be adsorbed to the carbon content within the sorptive layer. Groundwater free of contaminants would then discharge to the river. As described in GE's August 1999 *Removal Action Work Plan for the Upper ½ Mile*, the thickness of the sorptive layer would be 6 to 12 inches depending on the residual PCB concentrations in the 1-ft interval immediately below the sorptive layer (07-0020).

The thickness of the other cap layers would total 24 inches, including the erosion protection layer. Riverbed erosion protection material would be required in capped areas of the riverbed to prevent erosion of the cap. Refer to Appendix M for a conceptual cap design and a more detailed discussion of the cap requirements. This conceptual design is intended to minimize inspection and maintenance requirements of the riverbed in the EE/CA Reach.

4.3.1.2.1 Excavation to Capping Depth

To maintain the hydraulic capacity of the Housatonic River, a volume of sediment and riverbank soils equal to or greater than the volume of the cap would have to be removed prior to cap installation. This excavated material would require appropriate treatment and/or consolidation/ disposal.

An iterative procedure has been implemented to estimate the volume of sediment that would need to be excavated from each subreach to install a cap. The procedure is depicted as a decision flow chart in Figure 4.3-1. As shown in this figure, the concentration of PCBs remaining in the 1-ft interval immediately beneath the cap determines the thickness of the sorptive layer required (either 6 inches or 12 inches). Implementing this procedure for each subreach with data from the tables in Section 2 allows the estimation of the volume that must be excavated in each subreach to install a protective cap. The minimum excavation depth required to install a cap is 2.5 ft, which includes an 18-inch erosion protection layer, 6 inches of a sand and gravel bedding layer, and 6 inches of sorptive material. Table 4.3-1 summarizes the 95% UCL of the mean PCB concentrations for the 2.5-ft to 3.5-ft and 3- to 4-ft depth intervals for each subreach, and depth of excavation to meet cleanup goals based on these calculations. Appendix M contains a conceptual cap design and a discussion and evaluation of the in situ cap.

A comparison of the “excavation to capping” volumes and the excavation volumes necessary to achieve the cleanup goals without the need for a sediment cap was performed for each subreach. Based on this comparison, it was determined that the only location where the excavation volume for capping would be less than the excavation volume to reach cleanup goals is the last 200 ft of Subreach 4-6 (transects 210 to 212). In this subreach, the additional excavation to meet cleanup goals would be an additional foot (from 2.5 to 3.5 ft depth) of excavation in the last 200 ft of the subreach. Therefore, the difference in excavation volume between excavating to meet sediment cleanup criteria and excavating enough material to install a cap is approximately 400 to 500 yd^3.

The detailed screening of sediment/bank capping is documented and summarized in Table 4.1-3a.

4.3.2 Chemical Immobilization

In situ chemical immobilization consists of adding stabilizing reagents to the in-place soils or sediments to reduce the mobility of the contaminants. Potential reagents that could be used include cement, pozzolanic, thermoplastic, sulfide, and organic polymers. A treatability study would be required before implementation to determine the proper reagent and mix ratios. Additionally, an appropriate in situ mixing method (such as use of an auger) would have to be developed.

In general, stabilization effectiveness for organics may be limited. In addition, the stabilization process may alter the physical characteristics of the sediments or soils and consequently affect the ecological habitat properties. Finally, the mixing process for chemical incorporation may result in additional contaminant resuspension and transport downstream. Therefore, chemical immobilization will not be considered further and is not included in the detailed screening.

4.3.3 Biological Treatment

In situ biological treatment is a potentially low-cost and efficient remediation technology that can be applied to contaminated soils and sediments. Biological treatment is based on biological degradation of the target compounds by microorganisms. The microorganisms can be native (indigenous) or selectively adapted. Biodegradation can occur aerobically (with oxygen) or anaerobically (without oxygen). Although PCBs have been shown to be generally resistant to biodegradation, research has demonstrated that both aerobic and anaerobic biodegradation does occur to a limited extent, depending on the specific PCBs to be treated.

For in situ biological treatment, naturally occurring biological processes may be enhanced. Typically, these enhancements include seeding the contaminated media with appropriate populations of microorganisms, controlling pH, adding supplemental cosubstrates and nutrients, and providing or removing oxygen.

Anaerobic biological treatment for PCBs occurs primarily by dechlorination. The reaction, however, has been shown to be slow. Incorporation of amendments through mixing would likely result in sediment resuspension, thus allowing additional contamination to be transported downstream.

Aerobic biological treatment involves oxidation reactions in which oxygen is the terminal electron acceptor. Microorganism growth rate and substrate utilization are significantly greater than those found in anaerobic treatment because the oxidation process yields more energy. However, aerobic treatment of PCBs is still slow compared to conventional treatment methods. Aerobic biodegradation applies primarily to lower chlorinated congeners. A practical constraint to implementing this technology is the difficulty of introducing oxygen and amendment materials to the sediments and soil. As in the case of anaerobic biological treatment, the mixing action would likely result in sediment resuspension.

Because of their limited demonstrated effectiveness on PCBs, limited commercial availability, and the possibility of additional resuspension of sediment and associated contaminants, in situ biological treatment techniques will not be considered further and are not included in the detailed screening.

4.3.4 In Situ Technologies–Summary of Detailed Screening Results

As stated above and shown in Table 4.1-3a, only one of the in situ treatment/containment options, in situ capping, was subjected to detailed screening. In situ capping was evaluated for both the riverbed and the riverbanks.

In situ sediment capping has been conducted in still water bodies on a full-scale basis in many instances with good success. For this removal action, the required thickness of the cap was estimated using the site-specific characteristics of the river and assumptions related to contaminant migration through the cap. The required thickness of the cap is up to 3 ft (see Appendix M). Based on the 95% UCL calculations and associated evaluation, capping is only applicable for Subreach 4-6 because it is the only subreach where the PCB cleanup criterion in the 1-ft depth interval immediately beneath the proposed cap is exceeded. In addition, because the exceedance was due to only one data point at the end of Subreach 4-6, excavation to 3.5 ft throughout the last 200 ft of the subreach will meet the cleanup criterion. Based on the relatively insignificant difference (approx. 400 yd^3) between the volume of sediment removal required to install the cap and that to excavate to depths that achieve the cleanup goals without the need for a cap, the short-term economic benefits of a riverbed cap are not significant. Further, the additional ongoing operation and maintenance costs associated with a riverbed cap would be significant. Finally, the properties abutting the river along the EE/CA Reach are predominantly private properties. The potential administrative difficulties and inconveniences associated with maintaining long-term access to the river to maintain the riverbed cap are considered onerous. For these reasons, an in situ containment technology for the riverbed has not been retained for incorporation into removal alternatives.

A riverbank cap would be beneficial in minimizing migration of PCB contamination from lower bank soils. The cost of the necessary sorptive layer is not likely to be significantly more than the cost of a non-sorptive layer. Erosion protection measures will be required for the lower portion of the banks in all circumstances to prevent erosion of the lower banks and potential collapse of the banks. Therefore, the costs for these protective measures for the banks will be required whether or not a sorptive layer is incorporated into the cap design. Based on these considerations, an in situ cap incorporating a sorptive layer has been retained for incorporation into alternatives developed in Section 5.

4.4 EX SITU TREATMENT TECHNOLOGIES FOR SOILS AND SEDIMENTS

Ex situ treatment technologies require excavation of materials from the riverbed and riverbanks and treatment outside of the river. Ex situ treatment technologies evaluated included physical/chemical, thermal, and biological methods.

4.4.1 Physical/Chemical Treatment

Physical treatment technologies primarily involve unit operations in which change is brought about by means of or through the application of physical forces. Separation technologies, such as gravity separation or filtration, are examples of physical treatment technologies. Chemical treatment technologies involve unit operations in which change is brought about by means of or through chemical reaction. Chemical unit processes are usually used in conjunction with physical processes to enhance contaminant removal, immobilization, or degradation. Physical/chemical treatment technologies evaluated include soil washing, solvent extraction, stabilization/ solidification, and chemical dechlorination.

4.4.1.1 Soil Washing

Soil washing is a physical or physical/chemical process that reduces the volume of soil material requiring further treatment and/or disposal by separating and/or removing organic contaminants that adhere to organic matter and fine particles within a soil matrix. The affected soils are subjected to a multistage physical separation and washing system where standard soil separation technologies (e.g., cyclone) and surfactants are used to separate the contaminants and the finer particles from the coarser soil materials. The wash stream containing most of the contamination then undergoes additional treatment.

Soil washing has been successfully used to remove PCBs from soil and sediment at the pilot-scale; however, limited full-scale applications for PCBs have been designed and implemented for sediment. The applicability of conventional soil washing depends on the particle size distribution of the medium and the proportion of the contamination in the oversize, coarse, and fine particle fractions. Soil washing processes vary by vendor; however, typically the contaminated fines are separated from the rest of the medium, resulting in a reduction in the volume of materials requiring additional treatment and/or disposal. Therefore, in general, the higher the percentage of fines for a given soil, the less cost-effective soil washing becomes. In the case of the EE/CA sediments (see fractionation data, Table 2.3-5), over 90% of the PCBs are present in the sand fraction on a total mass basis. The sand fraction also constitutes the majority of the contaminated media. The percentage of fines averages 4% in the sediments and 30% in the bank soils, but these fines contain only a small fraction of the PCB contamination. Further study of the relationship between grain size and PCB concentration is required for EE/CA soils and sediments to determine whether a specific soil washing process will be feasible at the full-scale level.

A treatability study would also be required to identify the optimal washing reagents, estimate the amount of residual waste volumes to be created, and quantify the effectiveness for the specific site contaminants and grain size distribution. Due to its potential applicability at the site, soil washing will be retained for detailed screening in Table 4.1-3a.

4.4.1.2 Solvent Extraction

Solvent extraction is a process by which contaminants are extracted from the soil or sediment using chemical solvents. The process involves contacting the solvent with the contaminated soil or sediment long enough to extract the contaminants. The solvent is then removed from the soil or sediment and the contaminants are separated from the solvent as a concentrated wastestream that typically requires further treatment and/or disposal.

Typically, the effectiveness of the process for a particular application depends on such factors as particle size distribution, moisture content, pH, and cation exchange capacity. Soils and sediments with high moisture content generally should be dewatered before processing to prevent water buildup in the solvent, which reduces process efficiency. A treatability study with site soils and sediments would be required prior to implementation of this technology.

Because this process has been successfully used to treat PCBs in soils and sediments at the full-scale level, this technology will be included for detailed screening in Table 4.1-3a.

4.4.1.3 Stabilization/Solidification

Stabilization/solidification is a technology that immobilizes contaminants in the soils or sediments using chemical treatment while potentially improving the handling characteristics of the material. Several types of solidification/stabilization reagents are available including cement, pozzolanic, thermoplastic, sulfide, and organic polymers. Solidification/stabilization results in a net volume increase in the treated materials and changes in their physical properties. Treated materials would still require disposal in an appropriate facility. Solidification/stabilization would not reduce the concentration of contaminants but would immobilize the contaminants and render them inaccessible.

Before implementation, a treatability study would be required to determine the types and amounts of chemical additions required for stabilization/solidification. In general, stabilization/solidification is effective at reducing leachability of inorganic contaminants but would not provide any benefit for disposal of treated EE/CA Reach soils and sediments, which contain principally PCBs. Therefore, this technology will not be further considered and is not included in the detailed screening.

4.4.1.4 Chemical Dechlorination

Chemical dechlorination is a technology that uses reagents to remove the chlorine atoms from chlorinated organic contaminants, degrading them to less toxic compounds. Several different dechlorination treatment processes have been developed for treatment of contaminated soils/sediments. The processes differ by the method of dechlorination treatment and by the types of residuals remaining following treatment. The process has generally been used to treat small volumes of PCB-contaminated soil. None of the dechlorination treatment processes have been implemented at a scale that, in a reasonable time frame (3 to 4 years), could treat the volume of PCB-contaminated materials expected to be excavated from the EE/CA Reach.

A treatability study would be required prior to implementation to verify the effectiveness of the process and establish design and operating parameters for the full-scale treatment system. Because the process has been used only to a limited degree for PCB contamination treatment at hazardous waste sites, this technology will not be considered further and is not included in the detailed screening.

4.4.2 Thermal Treatment

Thermal treatment technologies use heat as the primary mechanism for removal/volatilization and/or destruction of chemical contamination in soils and sediments. Thermal treatment processes evaluated include incineration and thermal desorption.

4.4.2.1 Incineration

Incineration is a controlled high-temperature process that uses combustion to destroy contaminants of concern, resulting in a reduction in volume and/or toxicity of the contaminated medium. Incineration is commercially available and has been proven effective for PCB destruction in soils and sediments.

The incineration system generally includes the waste feed system, the kiln or furnace where combustion occurs, the auxiliary fuel feed system, an afterburner that destroys gaseous products produced within the incinerator, and applicable air pollution control systems. Contaminated soils or sediments are heated in a rotary kiln or multiple-hearth furnace to an operating temperature of approximately 1,800 to 2,000 °F for the incineration of PCBs. The noncombustible by-product is expected to exhibit low leachability for organic contaminants and remain environmentally stable.

Because incineration is a proven treatment technology for treatment of PCBs, it will be retained for detailed screening in Table 4.1-3a.

4.4.2.2 Thermal Desorption

Thermal desorption is a process in which the contaminants are separated from the soil or sediment matrix at a lower temperature than that used for incineration. In addition, the material being treated does not come in direct contact with the flame, thereby preventing combustion and the potential for producing toxic by-products of combustion. The process operates by heating the soil/sediment matrix to temperatures near the boiling point of the target contaminant, causing the contaminant to volatilize from the soil or sediment. Process temperatures generally from 800 to 1,200 °F are required to volatilize PCBs. Volatilized contaminants can then be captured or destroyed in any number of off-gas treatment processes, including activated carbon, condensers, or off-gas catalytic oxidation.

Thermal desorption systems have been proven effective for treatment of PCB-contaminated soils and sediments at full-scale. Subsequent processing of wastestreams generated from the treatment process would be required to destroy or dispose of the contaminant stream. Because of its proven effectiveness, thermal desorption will be retained for detailed screening in Table 4.1-3a.

4.4.3 Biological Treatment

Ex situ biological treatment processes operate under the same principles as the in situ processes described above. Ex situ processes can be accomplished aerobically, anaerobically, or with a sequential combination of anaerobic and aerobic treatment. Soils or sediments would be excavated and processed at the GE facility. Treatability studies would be required prior to implementation of this option to determine the appropriate amendments and processing times required.

As in the case of in situ biological treatment, processing times are expected to be lengthy for chlorinated contaminants—on the order of months to several years. The biologically treated soils and sediments would require appropriate disposal. Because of the potential need for multiple processing steps, the potentially long treatment time required, and the lack of full-scale operations demonstrating the effectiveness of this technology for chlorinated compounds, ex situ biological treatment will not be retained for further consideration and is not included in the detailed screening.

4.4.4 Ex Situ Treatment Technologies – Summary of Detailed Screening Results

As shown in the detailed screening in Table 4.1-3a, three of the four ex situ treatment technologies (solvent extraction, soil washing and thermal desorption) have been retained as potentially applicable technologies for the EE/CA Reach following the detailed screening. Incineration was not retained. Only solvent extraction and thermal desorption will be incorporated into alternatives in Section 5. Solvent extraction was selected over soil washing as a second representative physical/chemical process option for inclusion in removal action alternatives because of uncertainties related to the applicability of soil washing for this site.

Both solvent extraction and thermal desorption are proven technologies that have been implemented at full scale for PCBs in soils and sediments. Solvent extraction and thermal desorption are relatively moderate in cost and do not have characteristics that would make them publicly unacceptable. Incineration is relatively more costly and is often vigorously opposed by local residents when proposed as an on-site treatment method for PCBs. The ability of soil washing to effectively reduce the volume of contaminated media given the type of PCB distribution seen in EE/CA Reach sediments is uncertain. In addition, soil washing is an unproven technology at full scale for PCBs in sediments. Based on these factors and others discussed in Table 4.1-3a, there is not enough information currently available to further evaluate soil washing. However, due to its potential applicability, soil washing has not been eliminated from further consideration. If further study of the contaminant distribution relative to grain size for this site is undertaken and proves the applicability of soil washing, it can be further evaluated in comparison to solvent extraction and thermal desorption. The alternatives developed in Section 5 incorporate only solvent extraction and thermal desorption. For the purposes of this EE/CA, these two technologies adequately represent the range of treatment alternatives available.

4.5 EX SITU CONSOLIDATION/DISPOSAL

Ex situ consolidation/disposal includes both consolidation at designated areas on the GE facility and off-site disposal options.

4.5.1 Off-Site Disposal

Off-site disposal involves the transport of contaminated material, principally soils and sediments, to an off-site treatment/disposal facility. Depending on PCB concentrations, hazardous waste characteristics, and other acceptance criteria, the soils and sediments may need to be treated/disposed of in various types of off-site facilities. Therefore, a wide range of options for off-site disposal will be retained for further evaluation (see Table 4.1-3b). The retained options are summarized in the following subsections.

4.5.1.1 Reuse of Material as Landfill Cover

Excavated and/or treated material that meets the Commonwealth of Massachusetts criteria for reuse as landfill cover may be segregated for disposal at any of several municipal landfills in western Massachusetts. The material may be used for daily and intermediate cover, or pre-capping contour material without obtaining MADEP approval. A survey of several lined municipal landfills in western Massachusetts indicates that there is a market for cover material.

For lined landfills, it is possible to obtain approval from MADEP for reuse of material that exceeds the reuse criteria, but this option should not be relied upon.

Based on MADEP Policy COMM-97-001, Reuse and Disposal of Contaminated Soil at Massachusetts Landfills, the Massachusetts landfill cover criteria of most concern for material from this site include the following:

1. Total PCBs must be less than 2 mg/kg.
2. Total SVOCs must be less than 100 mg/kg.
3. Total VOCs must be less than 10 mg/kg.
4. Listed or characteristic hazardous wastes are not allowed.

The above criteria are based on average concentrations in soil. Additional criteria exist for arsenic, cadmium, chromium, lead, and mercury and for total petroleum hydrocarbons and electrical conductivity, but based on a review of site data, it is unlikely that material from the site would exceed these criteria.

Material potentially suitable for reuse as landfill cover includes excavated material that meets the criteria without treatment or material treated at the GE facility to meet the criteria. Following sampling to confirm their character, these materials may be used for landfill cover. However, material devoid of organic content, such as gravel or thermally treated soils, will need to be fortified with an organic supplement to make the material acceptable as landfill cover.

Reuse of suitable material as landfill cover is attractive because it is a low-cost disposal option. Also, because there is a market locally, the transportation costs may be significantly lower than other off-site disposal options.

4.5.1.2 Disposal at a RCRA Subtitle D Landfill

Based on a review of site data, the majority of the material excavated at the site is expected to contain PCB concentrations of less than 50 mg/kg. This material is not regulated under TSCA and is, therefore, suitable for disposal in a RCRA Subtitle D landfill provided that the material meets the landfill's acceptance criteria. Acceptance criteria of concern for the material from this site include PCB, lead, dioxin, and furan concentrations, and water content. Acceptance criteria are based on total PCB, lead, dioxin, or furan concentrations in the material; TCLP lead concentration (in an extract from the material); and passing the paint filter test (no free liquid).

There are numerous Subtitle D landfills in the northeast that would be potential disposal locations for the majority of the material excavated from the site. These landfills would be the least expensive land disposal option for nonhazardous excavated material with PCB concentrations between 2 mg/kg and 50 mg/kg.

4.5.1.3 Disposal at a RCRA Subtitle C Landfill

A RCRA Subtitle C landfill is designed and permitted to receive hazardous waste for disposal. Some of the soils and sediments excavated from the EE/CA Reach may be hazardous. Based on a review of the site data, approximately 10% of the riverbank materials have total lead concentrations ranging from 100 mg/kg to approximately 1,000 mg/kg. A total lead concentration of more than 100 mg/kg in soil could theoretically produce enough leachable lead to exceed the 5 mg/L TCLP criterion, which is indicative of a characteristic hazardous waste that must be managed by RCRA. No TCLP analyses were performed on riverbank samples. One of 28 sediment samples analyzed for TCLP contaminants proved to be hazardous for lead only. No other contaminants identified in the site data had concentrations that would be characteristic of hazardous waste. A RCRA Subtitle C landfill would also be a potential disposal option for excavated material with PCB concentrations less than 50 mg/kg; however, RCRA Subtitle C landfills are more rigorously designed than RCRA Subtitle D landfills and therefore may accept more highly contaminated wastes, subject to their permit conditions. Consequently, disposal at RCRA Subtitle C landfills is generally more expensive than disposal at RCRA Subtitle D landfills.

There are several Subtitle C landfills in the northeast that would be potential disposal locations for the majority of the material excavated from the site. However, because the disposal costs at a RCRA C landfill are greater than at a RCRA D landfill (assuming equal transportation costs), only that fraction of riverbank soil with the hazardous lead concentrations or other hazardous characteristics (if identified) may most appropriately be disposed of at a RCRA C landfill.

4.5.1.4 Disposal at a TSCA-Approved Landfill

Based on a review of site data, approximately 20% of the samples analyzed for PCBs contain PCB concentrations in excess of 50 mg/kg. Material with this PCB concentration is regulated under TSCA and, therefore, must be disposed of in accordance with TSCA requirements. One option is direct disposal in a TSCA-approved landfill without treatment. A TSCA-approved landfill could accept for disposal all the nonhazardous material excavated from the site (with PCBs above and below 50 mg/kg). However, because the disposal cost at a TSCA landfill is greater than at a RCRA D landfill, it may be significantly less expensive to sample the excavated materials and segregate them into separate disposal categories based on their PCB concentration.

There are only a limited number of TSCA-approved landfills in the northeast. TSCA landfills in other parts of the country that are accessible by railroad could be cost-effective disposal options if excavated material can be loaded onto railroad cars in the site vicinity. A rail spur is available at Building 100 on GE property, which is approximately 1 mile from the northern limit of the EE/CA reach.

4.5.1.5 Off-Site Treatment and Disposal

In addition to direct landfill disposal, options exist for off-site treatment of excavated material with subsequent disposal at an appropriate landfill. This alternative would satisfy the statutory preference for treatment by transferring the burden of treatment to a licensed facility that is accustomed to treating this type of remediation waste. Thermal desorption or incineration are two types of treatment technologies suitable for the excavated materials and available at treatment facilities. Following treatment, the treated material would be disposed at an appropriate facility in accordance with applicable federal and state requirements.

For EE/CA alternatives that include treatment at the GE facility, residuals may be created that would most appropriately be treated off-site to satisfy TSCA requirements. One such residual is concentrated PCB liquid from condensation and separation of treatment vapors in a thermal desorption unit (or from solvent extraction treatment). These liquids are regulated by TSCA and, because of their expected PCB concentrations, would need to be incinerated at a TSCA-permitted facility.

4.5.1.6 Disposal of Debris

Debris will be generated as part of the EE/CA remediation. EPA defines debris as manufactured objects, plant or animal matter, or natural geologic material with a size of 60 mm (approximately 2 ¼ inches) or greater. Material likely to require disposal as debris will include items such as silt fences, hay bales, PPE, other remediation waste, and vegetation. In the cobble subreaches, as much as 45% by volume of the excavated riverbed material is estimated to be larger than 60 mm in diameter. Much of this debris is contaminated with PCBs. A portion of this debris could be decontaminated and returned to the riverbed; however, debris that cannot be cleaned sufficiently well, or would otherwise not be reused or consolidated at the site, would need to be disposed of off-site. Depending on the residual contaminant concentrations on the debris and specific landfill acceptance criteria, it may be possible to dispose of the debris in the on-site consolidation areas, a debris landfill, a RCRA C or D landfill, or a TSCA landfill; however, the material will need to meet land disposal restrictions for disposal off-site.

4.5.2 On-Site Consolidation at GE Facility, Pittsfield

As described in the "Statement of Work for Removal Actions Outside the River" (00-0389), excavated materials may be permanently consolidated at the GE facility located in Pittsfield, MA. According to Appendix K of the Consent Decree (00-0388), GE must reserve capacity in the on-plant consolidation areas for 50,000 yd^3 of material from the EE/CA Reach. Appendix K also states that if GE does not make available the required 50,000 yd^3 capacity, EPA may dispose of the material at an off-site facility solely at GE's cost. Material consolidated at the GE facility is not required to achieve the LDRs; however, this EE/CA assumes that all material consolidated at the GE consolidation areas will be dewatered first. Materials not regulated under TSCA or classified as hazardous waste under RCRA regulations may be placed in the former Hill 78 landfill. The Building 71 consolidation area can receive both TSCA and RCRA regulated remediation wastes. Full or partially filled drums, intact capacitors, or related equipment that could potentially contain PCBs, liquids, or free product cannot be placed in the Building 71 consolidation area or the Hill 78 Landfill and, if excavated, will be sent to an off-site treatment/disposal facility.

4.5.3 Ex Situ Consolidation/Disposal Technologies – Summary of Detailed Screening Results

Table 4.1-3b provides the detailed screening of options for consolidation at the GE facility and off-site disposal. As shown in the table, both consolidation at GE and off-site disposal have been retained for incorporation into alternatives in Section 5. Placement of contaminated soils and sediments excavated from the EE/CA Reach in a consolidation area at the GE facility is allowed by the Consent Decree (00-0388), up to a limit of 50,000 yd^3. However, off-site disposal is a proven technology that will be required because the total volume of material to be excavated and removed is greater than the volume to be consolidated at the GE facilities, and on-site reuse of material is not assumed. Off-site disposal will likely have greater public acceptance than consolidation at the GE facility, and although not a destructive method, would result in effective elimination of site risks associated with the soils. Therefore, two disposal options to be evaluated in Section 5 include off-site disposal. Option A includes 50,000 yd^3 to the on-site consolidation areas with the excess disposed of at off-site facilities. Option B includes all material being disposed of at off-site facilities.

4.6 RESTORATION

This subsection provides a description of riverbank and riverbed restoration technologies that could be used to restore the river channel after contaminated sediments and riverbank soils have been removed. This discussion differs from others in Section 4 in that it involves no attempt to screen the restoration technologies; it presents only an overview of the likely technologies to be used.

The riverbank and riverbed will be damaged during remedial activities, so riverbank and riverbed restoration will be necessary to meet ARARs as part of the response action and also to fulfill the terms of the Consent Decree (00-0388) regarding natural resource damages between GE, the

Trustees, EPA, the Commonwealth of Massachusetts, and the State of Connecticut. The technologies described in this section illustrate the variety of potential options for riverbank and riverbed restoration in the EE/CA Reach.

Restoration must be conducted in a cost-effective and ecologically sound manner that achieves both response action and habitat restoration objectives. Restoration activities will be constrained by the existing site characteristics and by the need to have a stable riverbed and banks to minimize the potential future erosion of the river channel and potential release of PCBs left in place at depth. Rivers are a dynamic environment that under natural conditions change shape and location constantly in response to changing flows, season, storm events, and upstream land use. In addition, the riverbank and riverbed are interrelated, so that actions on one will impact the other. For example, increasing the flow in one area may impact bank stability in other areas. Therefore, the restoration of the riverbank and riverbed must be linked and considered together.

A survey of existing conditions has been conducted by Woodlot Alternatives, Inc. (Appendix K), and has been summarized in Subsection 2.1.3.5 of this report. The data collected represent existing conditions and will be used to identify valuable aquatic and riparian habitat features that may be replaced in-kind, versus less valuable features that should be replaced with other, more worthy features to achieve project goals.

The Habitat Restoration Objectives (HROs) are defined in Subsection 3.3 of this report. The HROs and associated performance standards for habitat restoration/enhancement will provide details concerning specific species, density of plantings, and other guidelines for determination of the final restoration design.

After implementation, restoration technologies that alter aquatic and riparian habitats require different levels of monitoring and maintenance for project success. Monitoring may occur after storms or floods, or seasonally or annually depending on project design elements. Maintenance may include irrigation, application of nutrients, insecticide or fungicide, and repair of damaged areas due to flood, herbivores, or erosion.

Some maintenance levels can be reduced by various design features. The potential need for irrigation may be mitigated by the selection of drought-tolerant plants and planting in the spring (when drought conditions are unlikely) or when the plants are dormant (fall season). Fences and barricades can help prevent the damage caused by herbivores. As a rule, habitat restoration and riverbank stabilization projects that incorporate revegetation and bioengineering elements should have provisions for repair work immediately after the first few storm events for several years after installation. The hard structures incorporated into the stabilization generally minimize erosion and require less maintenance.

4.6.1 Riverbank Restoration Technologies

The proposed riverbank restoration is intended to mitigate damage created by removal activity and improve the existing condition of the riverbank habitat. The following technologies for riverbank restoration are being considered:

- Revegetation with native species.
- Bioengineered structures.
- Hard structures.

These technologies may be implemented independently or combined to address the needs of specific locations. Table 4.1-4 presents these riverbank restoration technologies and provides guidelines for their application.

Within the EE/CA Reach, the abundance of non-native plants provides both challenges and possibilities for potential remedial actions. When contaminated soils are removed, the exposed substrate will be a prime germination medium for many non-native plants. Restoration activities should promote the development of a native, natural community to replace the existing one that contains many non-native species. Remediation activities may require non-native species control for a number of growing seasons to ensure that these species do not reestablish.

Existing tree and boulder (nesting/denning) spaces should be protected to the extent feasible without jeopardizing compliance with the removal objectives and creating unnecessary obstacles to the removal action. Such preservation will reduce restoration needs, reduce erosion, provide added geotechnical stability to the banks, and accelerate the recovery of the riverbank habitat after restoration. However, in removal areas the vast majority of the trees and shrubs will be cleared for access or to reach the underlying contamination designated for removal. This will leave much of the riverbanks bare and prone to erosion and collapse. As such, these banks will need to be stabilized by a combination of regrading (reducing steep slopes and removing undercut banks) and stabilization technology.

The existing banks vary in height from a few feet to over 30 ft and have slopes ranging from near vertical to a ratio of 5H:1V. Typically the slopes are approximately 2H:1V and about 15 ft tall. Neglecting the force of erosion (water running along the toe of slope or down the slope), an earthen slope composed of silty or clayey sands, as observed throughout the EE/CA Reach, will be stable at slopes up to 2.25H:1V without additional slope reinforcement (reference Appendix N). To prevent erosion, either an engineered material is placed on the slope (e.g., stone or concrete revetment), a bioengineered structure is installed, or vegetation is established. For areas where the finished slope after removal and restoration will be 2.25H:1V or less, native vegetation or conservation plantings will be established on the banks (see Appendix L – Restoration Design Scenarios). Areas that currently are steeper than 2.25H:1V but where little overexcavation is required to achieve a 2.25H:1V will be regraded to 2.25H:1V (see Figure 4.6-1) or otherwise stabilized. Slopes up to 2H:1V can be achieved if additional long-term stability is provided by the erosion protection layer placed on the 2H:1V slope. In areas where a 2H:1V slope cannot be achieved due to space limitations, an earth-retaining hard structure as discussed in Subsection 4.6.1.3 will be required to stabilize the riverbank.

The different stabilization technologies previously used in this river system are revegetation, bioengineered structures (a combination of both structural components and vegetative elements), and hard structures (riprap, stone, concrete or polyethylene cells, and earth-retaining structures). These methods are described further below.

4.6.1.1 Revegetation

Vegetation can function as erosion protection and provide a degree of geotechnical stability to a bank slope by reinforcing the soil. Grassy vegetation and the roots of brushy or woody vegetation function as a sort of erosion protection. Revegetation has demonstrated satisfactory performance while requiring only basic design and planning in many situations. New plantings may be easily integrated with any vegetation remaining after the removal action. Since revegetation has a natural appearance, community perception is likely to be favorable. All areas not receiving structural controls (riprap, concrete revetment, or retaining structure) or bioengineered controls will be seeded with native grass species and mulched. The use of mulch nettings and turf reinforcement will be considered on areas of steep slopes or where accelerated erosion is anticipated or observed.

Native trees and shrubs will also be planted in areas where the roots and tree structure will not have a negative impact on other restoration practices or on the stability of the restored riverbanks. Examples of native trees, shrubs, and grasses and their appropriate habitat are listed in the following table.

Native Trees, Shrubs, and Grasses and Their Habitats

Scientific Name	Common Name	Habitat
Trees		
Ilex opaca	American Holly	Upper bank zone
Populus deltoides	Eastern Cottonwood	Riparian zone
Salix nigra	Black Willow	Riparian zone
Shrubs		
Alnus rugosa/serrulata	Speckled/Smooth Alder	Low to mid bank zone
Cephalanthus occidentalis	Button Bush	Low bank zone
Cornus amomum	Silky Dogwood	All bank zones
Grasses		
Agrostis stolonifera, var. palustris	Creeping/Marsh Bentgrass	Low to mid bank zones
Dichanthelium clandestinum	Deertongue Grass	Mid to upper bank zone
Schizachyrium scoparium	Little Bluestem	Upper bank zone

Source: *Western Massachusetts Streambank Protection Guide* (99-0242).

Gentle slopes are most amenable to revegetation. Slopes of 2.25H:1V or less are easily replanted and maintained. Low, very gentle slopes (3H:1V or less) do not require access for maintenance.

Banks greater than 10 ft tall can pose problems for maintenance, regrading, and revegetating. Access agreements may need to be obtained in order to conduct maintenance.

The velocity of the river at a particular location will impact the success of revegetation. Velocities less than 3 to 4 ft per second (fps) and sheer forces less than 4 pounds per square foot (psf) typically are favorable to revegetation. Areas with higher velocities or areas subject to erosion would not be favorable for revegetation since the root structures would be unable to withstand the flow of the water. Many plants are susceptible to failures and erosion caused by ice scour and jab impacts and should not be placed near bridges, storm drains, utilities, and adjacent structures where there is an unacceptable risk of slope failure. After installation, weak spots in the vegetation will be identified and repaired.

Seasonal variations and weather affect revegetation efforts. Revegetation should occur during favorable planting seasons (e.g., spring or fall). Advance planning and ordering of specific species, sizes, and quantities are required to ensure that the desired vegetation is readily available. Severe weather conditions such as drought, frost, and high winds may reduce the plantings' chances of survival. Periodic inspection would be required for revegetated areas to determine if replacement is necessary. Periodic maintenance may also be necessary to remove, repair damage caused by, and possibly replant fallen trees.

Revegetation, where practical, is expected to achieve all of the HROs discussed in Subsection 3.3. Though favorable, the long-term effectiveness of revegetation depends on proper maintenance and preventing erosion of the bank. Revegetation is expected to improve the water quality (by minimizing the runoff of particulates) and the habitat, although time is required for establishment.

4.6.1.2 Bioengineered Structures

Slopes that cannot be regraded to a stable slope or are susceptible to moderate erosion may be candidates for bioengineering techniques. These techniques include the following:

- Wattling (Figure 4.6-2)
- Live fascines (similar to Wattling, Figure 4.6-2)

- Brush layering (Figure 4.6-3)
- Brush matting (Figure 4.6-4)
- Live staking (Figure 4.6-5)

Coir mats and rolls are made from coconut fibers and are used to create a biodegradable matrix through which new vegetation can grow. The coir will hold the new plantings in place, protect the surface soil from erosion as the plantings mature, and will reinforce the root system of the plantings, further stabilizing the soil. Additional support may be gained by wrapping the soil in coir fabric and placing it in lifts along the slope. This method is referred to as fabric encapsulated soil (FES) and is generally appropriate for slopes between 1H:1V and 3H:1V.

Wattling is the placement of groups of bundles of twigs, whips, or withes in shallow trenches on the contour of a slope. Wattles stabilize the slope by slowing water movement down the slope, increasing infiltration, trapping slope sediments, and increasing soil stability within the root system of the newly planted vegetation. This technique is applicable to slopes of 1H:1V or less.

Live fascines are similar to wattles except live cut branches are used in the bundles. They provide long-term stability since the live cuttings will root and grow. Therefore, native species should be used for live fascines. Live fascines are appropriate for slopes of up to 1H:1V.

Brush layering is typically used above the flow line of riverbanks. Long branches are placed with the cut ends into the slope and are used on bulldozed terraces.

Brush matting is a mulch or mattress of hardwood brush layered on a slope and fixed with stakes and wire. The matting protects the soil surface from erosion and provides mulch for seeding and plants until new vegetation is established. This should be used only on slopes of 1.5H:1V or less to prevent failure. It is applicable where river velocities are less than 6 fps. Brush matting should be able to survive temporary inundation but not scour or undercutting.

Live staking is the driving of large stakes or poles into the bank typically at the waterline at 1 ft on center. The poles are capable of growing and rooting, creating a very thick brush barrier that stabilizes the bank and quickly restores riverbank habitat. They may also be used to stake down mats or other erosion prevention devices. Native species should be used for live staking.

Bioengineered structures are easily combined with natural vegetation. However, they are susceptible to ice scour and jab impacts. Hard erosion protection material (stone or revetment) will replace bioengineered structures up the bank to an elevation of about 6 ft above the average flow level to protect the riverbanks from debris, ice, and erosion at areas with sufficient flow velocity or shear forces. Bioengineered structures are dependent on weather conditions for success, require periodic inspections and maintenance, and require advance planning for purchasing vegetative materials in large quantities. After installation, weak spots in the bioengineered stabilization will be identified and repaired so that over time the bioengineered system will gain strength.

4.6.1.3 Hard Structures

Slopes that cannot be regraded to a stable slope or are susceptible to excessive erosion may require stabilization by hard structures. Riprap placement is a common method to control erosion on slopes as steep as 1.5H:1V; however, riprap does not stabilize the bank against failure (e.g., rotation failure). Concrete revetment is another potential erosion prevention method and is more economical than stone when stones larger than 18 inches are required for erosion protection. Deflectors made of stone or concrete can be used to direct erosive water flow away from a vulnerable riverbank.

In the EE/CA Reach, bank slopes steeper than 2.25H:1V (such as those found at locations within Subreaches 4-1, 4-2, and 4-3) will in many cases require the use of earth-retaining structures (Appendix N) in order to maintain the same top of slope. Previous restoration along this section of river has incorporated gabion baskets to stabilize steep banks. In addition, the use of steel sheetpile walls, standard metal-bin type retaining walls, concrete retaining walls, cemented stone masonry retaining walls, and modular block walls could be considered.

Hard structures would also be used where storm drains discharge into the river. Typically stone outlets or concrete energy impact structures would be used. At the bridge crossings (under and immediately adjacent to the bridges), higher flow velocities are expected and vegetation cannot be established in the shade under the bridge. In these locations stone, concrete revetment, or concrete paving in accordance with local highway department standards may be used.

Hard structures are extremely durable and not easily affected by outside influences such as weather, scour, and runoff, and they provide excellent erosion protection. Hard structures provide only limited habitat since they exclude vegetation and may limit denning by some animals. For example, animals will be unable to burrow, and less vegetation will diminish cover and food sources.

4.6.2 Riverbed Restoration Technologies

The proposed riverbed restoration is intended to mitigate damage created by removal activity and improve upon the existing condition of the riverbed habitat where possible. Effective riverbed restoration will need to consider flow variables, sediment movement, inflow from the watershed, and the potential for future release of PCBs not remediated during the removal action. The riverbed restoration will be most effective if it is designed to imitate and work with natural forces and is coordinated with the riverbank restoration. A thorough understanding of the geomorphology of the river system upstream and downstream of the EE/CA Reach is necessary for successful riverbed restoration. A combination of various technologies may be used, if appropriate. The following approaches to riverbed restoration are being considered:

- Improving substrate conditions.
- Erosion protection systems.
- Pool/riffle construction.
- Aquatic cover.

Table 4.1-5 presents these riverbed restoration technologies and provides guidelines for their application.

4.6.2.1 Pool/Riffle Construction

Pools and riffles are naturally occurring features in low-gradient river systems. Pools are areas of slow-moving, deep water, whereas riffles are areas of fast-moving, shallow water. Both provide necessary habitat for aquatic species. Together they work to dissipate stream energy and improve sediment transport. The existing pool and riffle characteristics noted in the habitat assessment will be re-created to the extent feasible (see Figure 4.6-6). Natural pool spacings are usually between five to seven bankfull channel widths. This relationship needs to be applied or some created pools that are spaced too close will fill in.

Current deflectors, low-profile dams, and rock weirs are structures that have been demonstrated to re-create or enhance pool and riffle characteristics. Current deflectors are stone structures placed along a riverbank that project into the channel. Deflectors function by constricting and diverting water flow so that river meanders and pools are formed as a result of the scouring and transport of fine sediment and gravel (see Figure 4.6-7). Low-profile dams and rock weirs are stone structures placed across the channel to create pools upstream by damming the water, and downstream through scour of a plunge pool. Substrate consisting of bedrock or boulders, steep gradients (greater than 5%), and stream morphology (e.g., meanders, bar development) would limit extent of pools and riffles. Low-profile dams also help control grade variations by dissipating energy. Grade variations may occur where the channel slope is altered due to soil cleanup efforts.

Allowances for sedimentation and scour must be incorporated into the design of pools and riffles because inordinate sedimentation will quickly load the pools. The degree of sedimentation depends on the locations of created pools and riffles, the structures used, and the characteristics of the riverbed material. Construction of pools in areas of fine-grained sediments or cobbles is not recommended due to the potential for excessive sedimentation in the pools, shortening their design life. Fine-grained reaches may have low gradients and may have low velocities during high discharges. When the flow reaches these areas, sediment will quickly settle out, filling in the pools. Pools and riffles should have design allowances for scour and sedimentation depending on reach characteristics such as height and rock size. They should be designed and constructed carefully if the removal action provides for excavation only to capping depth, since scouring and instability may lead to exposure of PCBs that remain after the removal action.

Alterations to the flow in the river must be carefully considered when selecting structures for installation in the restored river. Pools will be constructed where a reduction of river velocity is desired. Riffles will be constructed where areas of swift flowing water ($\leq$ 4 fps) are desired. The type of structure used (e.g., excavated pool or rock weir) will depend on site conditions and design velocities. Obstructions to flow may cause local scour or flow instability that may expose PCBs left in place at depth and must be accounted for in the restoration design.

4.6.2.2 Aquatic Cover

Aquatic cover is necessary to provide shelter and feeding areas for fish and aquatic macroinvertebrates. Under natural conditions, cover is provided by logs, rocks, turbulence, aquatic plants, and overhanging vegetation.

Coarse material can provide cover. Boulders or clusters of boulders are often used as cover since they create hiding spaces and provide refuge from high flows (see Figure 4.6-8). They are most effective when secured to the riverbed in the middle of the channel, in flow exceeding 2 fps, and in wide, shallow areas with gravel or rocky beds. Therefore, they should be placed in riffles or at the downstream end of pools. In deep sections, they are useful in providing cover and improving the substrate. In areas of finer sediments such as sands or silts, they are less effective and tend to be buried. The boulders should be large enough to remain in-place during storm events and have irregular surfaces to provide “pockets” or hiding spaces for fish at a variety of discharge flows. Aquatic plants and overhanging vegetation also provide cover and are valuable nutrient source areas for aquatic species.

Some species also prefer areas of slow-moving water that can be created by weirs or sills and current deflectors. Weirs will create pool habitat while also controlling bed erosion and adding hydraulic diversity to uniform channels. Weirs should not be placed in areas of sandy substrate since there is a risk of failure due to undermining or blow out. When placed downstream of narrow, deep channels or if the center is lower than the sides, scour pools may form below the weir. Pools provide enhanced fish cover due to turbulence and deep water. When designing weirs the height should be such that water flows over the top at low flow but high enough to create plunge. If the weirs are built too high, water could get backed up, especially during high flows.

4.6.2.3 Erosion Protection

Providing erosion protection for the riverbed involves securing the bed with riprap, stones, or various forms of concrete. Larger material (stone and concrete) is most effective in preventing erosion in areas of high velocity and/or scour potential though it is feasible for areas of any velocity in the EE/CA Reach. In areas with PCB-contaminated sediments left in place at depth, it would provide long-term, secure erosion protection. The potential for downstream scour may increase due to increased flow velocities because of changes in channel cross section, slope, and/or bed roughness. Additional erosion protection material may need to be placed to stabilize the channel cross section. Refer to Appendix M for a conceptual design of erosion protection.

Services, equipment, and materials are readily available depending on the type of erosion protection desired. Rounded or weathered stones would be less available and less desirable than rough quarried stone. Several companies manufacture different types of concrete erosion protection devices commonly designed to interlink or form a mat, making them stronger and more stable than riprap. Many designs incorporate gaps or spaces for revegetation but it is often difficult to plant in these areas because the underlying fill may not be suitable and the vegetation is often damaged during installation and thus tends to have high mortality rates.

An erosion protection layer will provide some habitat, but it would not necessarily increase the diversity of the river community. Some erosion protection materials may be aesthetically undesirable to the community.

4.6.2.4 Improving Substrate Conditions

The habitat assessment conducted by Woodlot (see Appendix K) indicated a lack of in-stream structural diversity in large sections of the EE/CA Reach. Since different species thrive in different river substrates, a variety of substrate conditions should exist in order to accommodate biodiversity. The new substrates should range from silty mud to vegetation to gravel and rocks. Some species require sand and/or mud for burrowing. Fine-grained materials should be placed in areas designed for flow less than 2 fps. Other species require rocks or vegetation for shelter and/or for laying eggs. The use of gravel or riprap (large stone) can provide a stable riverbed and enhance macroinvertebrate habitat and fish reproduction. Gravel would typically be placed in areas of flow velocities less than 3 fps, whereas riprap would be used in areas of greater velocities. Local flow velocities will be calculated throughout the EE/CA Reach and selection of backfill material (fine materials, sands, gravels, or stone) will be determined during the design of the removal and restoration plan. For the purposes of the EE/CA, a stone riprap erosion protection layer is assumed. Some native aquatic plants can be introduced to improve habitat quality.

The new substrates will be affected by any in-stream structure. The effects of these structures on potential substrate movement should be considered in the restoration design. For example, coarse-grained materials or rocks should be used in cobble/riffle areas to reduce potential for washout. Areas downstream of pools created by scour will accumulate the clean gravel washed out of the pools.

Substrate improvement and construction of variable substrates will be directly limited by whether an area is completely remediated.

4.7 SUMMARY OF RETAINED TECHNOLOGIES

This subsection contains a summary of the technologies retained for use in the alternatives evaluation presented in Section 5. The summary is organized by general response action. Retained technologies are summarized in Table 4.1-6.

4.7.1 River Diversion

Two of the five river diversion technologies were retained for use along specific subreaches or the entire EE/CA Reach. These technologies are sheetpiling and pumped bypass. Sheetpiling is not applicable to the cobble subreaches because of the presence of shallow bedrock. Pumped bypass is applicable to all subreaches of the EE/CA Reach.

4.7.2 Sediment Removal

Two of the three sediment removal technologies, wet excavation and dry excavation, were retained. Dredging from a barge was not retained. Wet excavation requires no river diversion technology, whereas dry excavation requires that the river be partially or completely diverted. Upon examination of these technologies on a subreach basis, it was found that they are potentially applicable to all subreaches of the EE/CA Reach.

4.7.3 Treatment and Consolidation/Disposal Technologies

Of the treatment technologies that were screened in detail in Table 4.1-3a, soil washing, solvent extraction and thermal desorption were found to be applicable to and potentially cost-effective for the EE/CA sediments and soils. Although soil washing was retained, it will not be incorporated into alternatives evaluated in detail in Section 5 because there is not enough information currently available to further evaluate soil washing. Solvent extraction has been selected as the representative physical/chemical treatment process option to be evaluated in alternatives in Section 5. Incineration was eliminated due to its relatively high cost and likely negative public perception. One containment technology, in situ capping, was retained for application to bank soils but was not retained for use in the riverbed. A cap for the riverbed was not retained for further consideration because of the relatively insignificant difference in the volumes for excavation to meet cleanup goals versus excavation required for a cap, and the significant costs and access issues associated with long-term maintenance and monitoring for a cap.

Both consolidation at the GE facility and off-site disposal were retained for further consideration. These technologies are not sensitive to subreach characteristics. All of the off-site disposal options evaluated have been retained due to the following:

- The total volume of material to be excavated from the EE/CA Reach will likely exceed the maximum amount that can be placed in the consolidation areas at GE (currently 50,000 yd^3).
- Both TSCA and non-TSCA regulated PCB remediation wastes are likely to be present.
- The possible presence of RCRA hazardous remediation wastes.

4.7.4 Restoration

Three bank and four riverbed restoration technology groupings were identified as potentially applicable to the entire EE/CA Reach. Upon examination, it was found that restoration technologies are applicable to certain physical characteristics of the river system that vary within each subreach; therefore, these technologies apply to specific areas within the EE/CA Reach rather than to individual subreaches. Therefore, all technologies were retained for use in their respective applicable areas of the bank and riverbed (identified in Section 5). Application of each of these restoration technologies to specific areas of the EE/CA Reach will be discussed in the detailed evaluation of alternatives conducted in Section 5.

5. IDENTIFICATION AND ANALYSIS OF REMOVAL ALTERNATIVES FOR THE EE/CA REACH

This section presents the removal action alternatives developed following technology identification and screening, provides detailed descriptions and criteria analysis of these alternatives, and presents a comparative analysis of the alternatives to support selection of a preferred alternative. The detailed analysis of alternatives was developed in accordance with EPA *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (99-0012).

The technologies that were retained at the conclusion of the technology screening described in Section 4 were as follows:

River Diversion Technologies:

1. Intrusive open channel diversion (sheetpiling).
2. Diversion of flow by pumping through bypass piping.

Sediment Removal Technologies:

1. Wet excavation using an excavator.
2. Dry excavation with a standard excavator.

Treatment/Containment Technologies:

1. Thermal desorption.
2. Solvent extraction.
3. In situ capping for bank soils.

Consolidation/Disposal Technologies:

1. Consolidation at the GE facility in designated consolidation areas (up to 50,000 yd^3).
2. Disposal off-site at Toxic Substances Control Act (TSCA) and non-TSCA facilities, as appropriate.

Potential Bank Restoration Technologies:

1. Revegetation with native species.
2. Bioengineered structures.
3. Hard structures.

Potential Riverbed Restoration Technologies:

1. Improving substrate conditions.
2. Erosion protection systems.
3. Pool/riffle construction.
4. Aquatic cover.

Three base alternatives (all of which have multiple treatment or consolidation/disposal options) were developed to address the entire EE/CA Reach by combining one or more technologies from each of the above categories. All of the alternatives involve excavating sediment and bank soil to achieve the cleanup criteria. Not all possible combinations of technologies are provided; however, each retained technology is included in at least one of the alternatives evaluated. The alternatives developed for analysis include selected combinations of excavation removal technologies, river diversion technologies, consolidation/disposal technologies, and treatment/containment technologies. Restoration technologies are assumed to be consistent among all alternatives and include riverbank and riverbed restoration technologies. Although the base alternatives were developed to address the entire EE/CA reach, the actual removal action implemented by the removal contractor may include a combination of the base alternatives on a subreach basis. This approach will allow the removal contractor greater flexibility when performing the removal action by taking into account technical capabilities, seasonal variability, potential residential disruption, and information available on upstream removal activities. EPA anticipates that for some subreaches only one base alternative may be appropriate while for other subreaches multiple base alternatives could be used. For example, sheetpiling is an inappropriate river diversion technology for subreaches 4-1, 4-2, 4-3, and 4-4A (see Table 4.1-1 and Subsection 5.3.1.2). However, sheetpiling may be the preferred diversion method for some subreaches or one of two to three acceptable diversion methods for other subreaches.

Removal Alternatives

The three base alternatives developed for detailed analysis are:

- **Base Alternative 1, Wet Excavation—**Wet excavation to meet cleanup criteria (as determined on a subreach basis and as defined in Section 3). Riverbank and riverbed restoration. This alternative involves no river diversion.

- **Base Alternative 2, Dry Excavation: Sheetpiling and Pumping Bypass**—Dry excavation to meet cleanup criteria. Open channel river diversion using sheetpiling, except in the cobble reaches or inaccessible areas where the flow would be diverted from the river channel by pumping through a piping bypass. Riverbank and riverbed restoration.

- **Base Alternative 3, Dry Excavation: Pumping Bypass—**Dry excavation to meet cleanup criteria. Diversion of flow from the river channel by pumping through a piping bypass along the entire length of EE/CA Reach. Riverbank and riverbed restoration.

Each of these three base alternatives will be evaluated with the following four treatment/consolidation/disposal options:

A. Consolidation of up to 50,000 yd^3 of contaminated soils and sediments at designated consolidation areas at GE with off-site treatment/disposal of excess material.

B. Off-site disposal of all excavated material.

C. Treatment of excavated material at the GE facility using thermal desorption, with off-site disposal of all material.

D. Treatment of excavated material at the GE facility using solvent extraction, with off-site disposal of all material.

5.1 ALTERNATIVES EVALUATION CRITERIA

The alternatives evaluation criteria fall into three broad categories—effectiveness, implementability, and cost. These three categories include a number of subcriteria that are used for the detailed evaluation of each alternative. Subsections 5.1.1, 5.1.2, and 5.1.3 define each of the subcriteria. Many of these individual subcriteria were previously used in Section 4 in the Technology Identification and Screening tables. These evaluations will not be repeated in Section 5 for individual alternatives. Only the most significant aspects of the broad categories of effectiveness, implementability, and cost are presented in the individual evaluations for each of the alternatives to enable decisionmakers to readily assess the significant relative advantages and disadvantages for each alternative. These evaluations (including subcriteria) are compiled in Subsection 5.5, Comparison of Alternatives.

5.1.1 Effectiveness

As stated in the EPA guidance (99-0012), the effectiveness of an alternative refers to its ability to meet the removal action objectives within the scope of the action. Evaluation of the alternative's effectiveness includes consideration of the following:

- **Overall Protection of Human Health and the Environment—**Addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.
- **Compliance with ARARs—**Addresses whether or not a remedy will meet all of the applicable or relevant and appropriate federal and state environmental statutes and requirements or whether grounds exist for a waiver.
- **Long-Term Effectiveness and Permanence—**Refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met.
- **Reduction of Toxicity, Mobility, or Volume Through Treatment—**Refers to the anticipated performance of the treatment technologies a remedy may use.
- **Short-Term Effectiveness—**Addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period until the cleanup goals are achieved.

5.1.2 Implementability

As stated in the EPA guidance (99-0012), the implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The following factors are included in this criterion:

- **Technical Feasibility—**Refers to the technical issues involved in the implementation of an alternative, for example, ease of construction and operation and maintenance requirements.
- **Availability of Services and Materials—**Evaluates the availability of resources such as personnel; specific equipment; treatment, storage, and disposal capacity and location; and analytical services needed to implement the alternative and maintain the removal schedule.

- **Administrative Feasibility—**Evaluates those activities needed to coordinate with other offices and agencies including statutory limits, waivers, and requirements for permits for off-site actions.
- **State Acceptance—**Indicates whether the state agency concurs, opposes, or has no comment on the proposed alternative.
- **Community Acceptance—**Acceptance of the proposed alternative by the community will also be considered.

5.1.3 Cost

Each removal action alternative will be evaluated to determine its projected cost. The following cost items will be considered:

- **Direct Capital Costs—**Includes construction, equipment and material, land and site acquisition, buildings and services, relocation, transportation and disposal, and treatment system operating costs as well as contingency allowances.
- **Indirect Capital Costs—**Includes engineering and design expenses, legal fees and license or permit costs, and startup and shakedown costs.
- **Annual Costs—**Includes operational and maintenance costs, and post-removal costs for auxiliary materials and energy, disposal of residuals, monitoring, and support.

For costs that are anticipated to continue beyond 12 months, present-worth costs will be determined based on the time to completion, a 0% escalation rate, and a 7% discount rate. The total present-worth costs for each alternative will be compared.

5.2 BASE ALTERNATIVE 1—WET EXCAVATION TO MEET CLEANUP CRITERIA

A general description of this base alternative is presented in Subsection 5.2.1. Detailed descriptions of the various elements that comprise this alternative are presented in Subsections 5.2.1.1 through 5.2.1.8. The four consolidation/treatment/disposal options that will be evaluated with Base Alternative 1 are presented in Subsection 5.2.1.9. A detailed evaluation of Base Alternative 1, together with the four treatment/consolidation/disposal options, is presented in Subsection 5.2.2. The detailed evaluation is based on the criteria presented in Subsection 5.1.

5.2.1 Base Alternative 1 Description

Base Alternative 1 involves the excavation of contaminated sediments and bank soils without diverting the river. The bank soils and riverbed sediments would be excavated to the extent necessary to meet the cleanup criteria. Excavation would be conducted using standard or long-reach excavation equipment staged on access roads within the river channel or at the top of the bank. A riverbank excavation rate of approximately 300 yd^3 per day is anticipated based on site conditions and professional judgment. A riverbed excavation rate of approximately 150 yd^3 per day is expected. Engineering controls would be required to minimize the amount of fine sediments resuspended and transported downstream beyond the EE/CA Reach. Excavated sediments and wet bank soil would require dewatering before disposal to meet facility disposal requirements. After being stockpiled and characterized, excavated bank soils and riverbed sediments would be transported to the appropriate treatment, consolidation, or disposal facility. Generally, the riverbed would be backfilled with material similar to the material removed and restored to meet the habitat restoration objectives, including the installation of erosion protection materials as needed. The riverbanks would be backfilled with appropriate material but would also generally be lined to an elevation of 6 ft above the average river water level with erosion protection materials as needed. The upper riverbanks would be restored to meet the habitat restoration objectives.

5.2.1.1 Mobilization, Site Preparation, and River Access

These items include all work items required to mobilize equipment and materials to the site, set up temporary office and storage/laydown facilities, complete administrative activities necessary to secure access to the riverbanks and riverbed, and prepare the site for the removal action.

It is anticipated that there would be pre-construction activities required to secure necessary access. These activities would require completion well in advance of the start of the removal action. To access the river and provide areas for the staging of equipment, materials, and labor, access to space adjacent to the river must be acquired. Obtaining the necessary access or access agreements at a minimum would require coordination among GE, the City of Pittsfield, the EPA, the U.S. Army Corps of Engineers, and local residents, businesses, and organizations.

All utilities would be located prior to construction as part of a predesign survey task. The local utility companies would be requested to field locate the lines. Currently it is anticipated that electric, telecommunication, water, gas, sanitary sewer, and storm sewer utilities may be impacted.

The wet excavation alternative is structured to minimize the size and number of access points required by using the riverbed as a temporary access road for construction equipment. Access to the riverbanks and the riverbed would be required to perform the removal action. In general, it is assumed that access agreements may be required to enter the river and work along the banks and that the access points would be located at or near bridges (Lyman, Elm, Dawes, and Pomeroy), although additional access points may be required. After completion of the removal action, the temporary access areas would be restored to conditions similar to the original conditions or to meet the habitat restoration objectives, if appropriate.

As part of the preparatory activities, soils and sediments targeted for excavation that were found by prior sampling and analysis to contain PCB concentrations greater than 50 mg/kg during site characterization would be delineated. The locations of these TSCA-regulated soils and sediments would be surveyed and staked. Once excavation activities begin, the TSCA-regulated materials would be kept segregated from the non-TSCA materials. Similarly, material that is classified as RCRA C or RCRA D based on previous sampling would also be staked out.

Following pre-construction activities and setup of temporary construction facilities, site preparation activities would begin. First, temporary construction elements including temporary access roads, and storage and laydown areas would be laid out and constructed. Site preparation would also include erosion and sedimentation controls and site security fencing.

Vegetation clearing would occur only in those areas necessary to conduct stream and bank excavation and construct temporary access roads and facilities. Clearing would be performed as the removal action progresses rather than initially clearing all required areas of the site. Any rubble, rock gabions, or tree roots cleared as part of the removal activities would be reduced in size so they can be easily managed during hauling activities. Open holes located in staging areas resulting from clearing and grubbing activities would be temporarily backfilled and compacted. Remaining vegetation would be chipped and used as mulch or shipped off-site for disposal, as appropriate. Silt fence and hay bales would be installed around cleared areas where necessary to reduce siltation of the river.

Wherever contamination is proposed to be removed, temporary fencing would be located along the top of the riverbank on both sides of the river and warning signs would be posted in the riverbank area. Warning tape would be used to supplement temporary fences where shorter-term activities are occurring. Sign-in/sign-out sheets would be maintained at each entrance. All on-site personnel and site visitors would be required to sign in upon entering the site and sign out upon leaving.

Decontamination facilities would be provided for all vehicles that are loaded with contaminated materials or that enter contaminated areas. Each contaminated transport vehicle would proceed through the decontamination area and be cleaned prior to leaving the work zone. It would be the responsibility of the contractor to verify that the roads and bridges are appropriate to carry the anticipated loads.

5.2.1.2 Excavation

For Base Alternative 1, riverbed sediments would be removed by wet excavation starting at the upstream end of the EE/CA Reach and proceeding downstream. The depth of sediment removal would vary for each subreach and could vary within each subreach depending on the depth of contaminated material. Sediment removal would be conducted to meet the cleanup criteria in all subreaches. The tables in Section 3 provide depths and volumes of sediment to be removed by subreach.

To satisfy the removal action objectives, riverbank soils will be excavated up to a depth of 3 ft to meet the recreational or residential cleanup criteria, as appropriate. In some bank areas along the EE/CA Reach, where contaminant concentrations are below the cleanup criteria, removal will not be required. However, slope stability concerns may result in the removal of additional soil volume to achieve stable bank slopes.

Wet excavation would not be conducted during periods of high river flow because of the following factors:

- The threat to the health and safety of the workers will be increased if they must be in the river during high-flow events.
- Much of the equipment would not be operable in the increased water depth.
- The increased river velocity during high-flow events will have the potential to “wash out” the contents of the excavator bucket. This will increase the potential downstream migration of contaminated sediments.
- The river water will be more turbid (cloudy) during high-flow (storm) events. This turbidity will decrease the excavator operator’s visibility of the riverbed.

5.2.1.2.1 Excavation of Riverbank Soils

Bank excavation would generally be performed following excavation of adjacent sediment to avoid recontaminating the banks while removing the sediment. Riverbank soils (defined as soils above the mean annual high waterline in the river channel) would not normally be expected to be wet and would be excavated using standard or long-reach excavation equipment staged at the top of the bank or in the river (the same equipment could be used to excavate sediments).

Slope stability analysis indicates that a maximum allowable slope for long-term stability without reinforcing the slope is 2.25H:1V (Appendix N). Along some lengths of the riverbank, sufficient area is available to cut the bank back temporarily to a 2.25H:1V slope (see Figure 5.2-1). At other areas, such as along Deming Street and Caledonia Street, sufficient area is not available due to the presence of structures and roadways. In these and other areas where a 2.25H:1V cannot be achieved, a temporary slope of 2H:1V will be considered when excavation and restoration can be completed in the same day. The 2H:1V slope must be reinforced to maintain long-term stability. If a 2H:1V slope cannot be maintained, temporary structural stabilization of the bank will be required to prevent bank failure (Appendix N). Final restoration in these areas would include construction of retaining wall structures. In all locations, the existing top of bank location will be maintained or restored.

There are limited PCB characterization data for soils deeper than 3 ft; therefore, in areas where overexcavation is required to achieve bank stability, efforts would be made to segregate the uncharacterized soils from those known to be contaminated. All excavated soils would be stockpiled and characterized as appropriate prior to treatment, consolidation, or disposal.

Transport trucks would use existing roadways, access routes and temporary roadways, and access roads within the river itself where necessary.

5.2.1.2.2 Excavation of Riverbed Sediments

Wet excavation of sediments in the river channel can be accomplished using a number of strategies. As discussed in Section 4, wet excavation involves excavating the river while it is still flowing, without using diversion to create a dry riverbed. Depending on many factors, including bank height, bank slope, accessibility of areas adjacent to banks, and water depth, wet excavation can be performed using different equipment staged at different locations. For example, where bank height is not excessive, a standard or long-reach excavator could be placed on the top of the bank to excavate contaminated sediments. Depending on the width of the channel, the excavator could possibly reach across the entire channel to excavate sediments. At areas where the bank is excessively high or access is unavailable at the top of the bank, a staging area and access road could be installed partially down the bank to enable the excavator to reach sediments.

In areas where the channel is too wide to be excavated from the bank, sediment excavation could be accomplished from within the river itself using a temporarily constructed access road, if necessary. Depending on access limitations, the roadbed may be constructed from downstream to upstream over unexcavated areas or from upstream to downstream over areas that had been previously excavated and backfilled. In the latter case, initial sediment excavation and restoration may need to be performed from the bank in preparation for road construction. For road construction from downstream to upstream areas, the road would be constructed over the unexcavated riverbed. Excavation and restoration of the riverbed would be performed from the roadbed, in directions both parallel and perpendicular to the river.

The road would be partially submerged to allow flow to pass over the road. The road would be constructed of stone capable of supporting excavation equipment and hauling vehicles while maintaining some degree of flow through the submerged portion of the road. As the excavation and restoration of the riverbed proceeds, the road would be removed or lengthened, as required, in the downstream direction, allowing the equipment to proceed downstream. As a segment of river is completed, the material from the road would be excavated, stockpiled, and sampled before being reused, if appropriate, in the riverbed for road construction or backfill.

To reduce sediment resuspension during excavation, engineering controls would be required at the point of excavation. Generally, jersey barriers will be temporarily placed in the river immediately upstream of the point of excavation and perpendicular to the river flow direction. The purpose of the barriers is to reduce the river velocity at the point of excavation, not to create a dry riverbed. As the excavation moves across the river channel, the jersey barriers will be moved to deflect the river velocity at the new point of excavation. In addition, turbidity barriers and/or rock check dams would be used downstream of the excavation to remove additional silt from the water. These barriers would work by either filtering the water or slowing the velocity of the water sufficiently to allow fine particles to settle.

The excavated sediment and associated free water would be loaded into watertight, lined dump trucks for transport to the central dewatering facility. These sediments will be managed separately from the drier riverbank soils.

5.2.1.3 Confirmation Sampling

Over 750 samples of riverbed sediments have been collected by GE and EPA along the EE/CA Reach and analyzed for PCBs. This large database of information has been used to identify the volumes of sediment that need to be removed to attain the cleanup criterion that will provide the level of protection prescribed in the Remedial Action Objectives. Any contaminated sediment left in place at depth will be covered with a clean sediment layer that will effectively isolate any contamination from the surficial sediment and provide a substrate capable of mitigating the upward migration of contamination. Therefore, confirmation sampling is not included for the riverbed sediments left in place.

Similarly, over 1,500 samples from both banks in the EE/CA have been obtained in order to determine the amount of excavation required to meet the bank cleanup criteria. This characterization effort has purposely been limited to the first 3 ft of soil. In the majority of locations, 3 ft of bank soil will be removed and replaced with clean fill, effectively isolating the soil left in place. In other areas where removal is more limited, existing soil already meets the applicable cleanup criteria on a subreach basis. In general, the soil below the 3-ft depth will remain isolated, and, based on the requirements of the cleanup criteria, would not require further confirmation sampling. However, on the lower third of the banks, in residential areas, and in areas to be overexcavated for bank stability purposes, additional data at depth (below 3 ft) will be required to assess residential exposures and to assess the potential for PCBs to be transported through the lower bank soils. These data are proposed to be gathered during the predesign stage prior to construction and will be evaluated in conjunction with a bank cap design and residential risk evaluation.

5.2.1.4 Handling, Transportation, and Stockpile Management

It is assumed that at the point of excavation, significantly oversized material will be sorted from bulk soil and sediment to facilitate subsequent material-handling operations. To the extent possible, using existing data, excavated soil and sediment with PCB concentrations greater than 50 mg/kg (TSCA-regulated material) will be segregated from material with PCB concentrations less than 50 mg/kg. Also, because the riverbank soil is expected to be significantly drier than the sediment, bank soil will generally be excavated, transported, stockpiled, and managed separately from sediment.

The excavated soil or sediment will be loaded directly from the excavator into lined dump trucks for transport to a central dewatering facility. The oversize material will be collected at the point of excavation, then loaded into lined dump trucks and delivered separately from soils and sediments to the dewatering facility. The daily volume of excavated material would be placed in stockpiles located at the central processing facility. In general, newly excavated material would not be consolidated with stockpiles containing almost dry material. Separate stockpiles would be created for soil, sediment, and oversize material, and for those categories of material assumed to be TSCA-regulated, RCRA-regulated, and non-regulated. Previously compiled sampling results will be used to preliminarily identify each material type at the time of excavation.

The stockpiles will need to be carefully managed to maintain the required material segregation. It will be important to avoid mixing non-TSCA or non-RCRA material with TSCA-regulated material or hazardous waste. Also, new material delivered to the dewatering facility must be directed to the appropriate stockpile to avoid adding the new material to a stockpile that has been nearly fully dewatered. To the extent that material of any category (TSCA, RCRA, or unregulated) can be consolidated at the Building 71 consolidation area at GE (up to 25,000 yd^3), the segregation of material is not necessary. However, in order to minimize the cost of off-site disposal, the amount of TSCA- and RCRA-regulated waste shipped off-site for disposal must be minimized, making segregation and proper characterization necessary. Similarly, soils and sediments that are RCRA hazardous, but not TSCA-regulated, are not likely to have lower off-site disposal costs following thermal desorption or solvent extraction treatment at the GE facility. Consequently, segregation of RCRA hazardous materials from the treatment processing streams would result in lower overall costs.

5.2.1.5 Dewatering of Excavated Materials

It is assumed that a suitable location for construction of a central dewatering system and subsequent material handling facilities can be found on the GE facility. For cost estimating purposes, 24 dewatering areas each 40 ft by 40 ft have been assumed (see Appendix Q). Allowing for adequate access space, it is estimated that approximately 2 acres would be required for staging and dewatering of the excavated materials before they are transported to the consolidation or treatment areas at GE, or to an off-site disposal facility. It was assumed that the distance from the point of excavation to the dewatering facilities would range from approximately one-half mile to 2 miles.

For cost estimating purposes, it was assumed that each dewatering area would have a perforated polyvinyl chloride (PVC) piping system surrounded by crushed stone and would be underlain by an impermeable 20-mil to 30-mil geomembrane liner. A 6-inch layer of sand and geotextile bedding fabric would underlie the liner. Water draining from the piles would flow on the liner to the piping system and to a sump for collection and treatment. Jersey barriers, soil berms, or other confining structures would be constructed around each dewatering area, with the liner wrapped over the confining structure and secured in trenches surrounding the dewatering area. The stockpiles would be covered when necessary with 10-mil flexible geomembrane liner secured in the trenches. If a more secure dewatering area is required, preengineered temporary structures, consisting of a PVC-coated polyester fabric on an aluminum frame, could be used, but have not been assumed for costing purposes. Alternative methods for constructing the dewatering areas that could allow cost savings will be evaluated during the design process.

A gravity dewatering system is expected to be sufficient to meet the needs of the project, especially for sediment. However, if necessary, mechanical dewatering may be used to process the soil and sediment to achieve a moisture content suitable for off-site disposal or placement at the OPCA. For cost estimating purposes, use of gravity dewatering methods only is assumed.

A significant volume of water would be generated during the dewatering process. The saturated sediment delivered to the central dewatering facility is expected to contain approximately 20% moisture and may drain to a 10 to 12% moisture content. At a rate of 150 yd^3 of sediment excavated per day (wet excavation), approximately 5,000 gallons of water per day may be produced from the saturated sediment alone (refer to Appendix Q). If these sediments are allowed to drain freely for a short time period at the excavation cell, this volume would be reduced, resulting in a cost savings. Including river water removed with the saturated sediment and water drained from bank soils, up to several million gallons of water could be produced and will likely require treatment and disposal over the time period required to complete the removal action. The drained water would be collected in common sumps and pumped into portable holding tanks for settling of sediment particles, if necessary, and then pumped through a water treatment system composed of bag filters and activated carbon. For cost estimating purposes, it was assumed this system would be capable of treating 100 gpm. During the design process, use of available treatment capacity at GE's existing water treatment plan (64G) will be evaluated as a potential cost saving measure.

For the purpose of this EE/CA, it was assumed that the treated water would be discharged back to the Housatonic River in accordance with the substantive requirements of any ARARs required to conduct the work. Initial discharge to the river would likely require analysis for the full suite of Target Compound List (TCL) and Target Analyte List (TAL) compounds and water quality parameters such as pH, total organic carbon, chemical oxygen demand, total suspended solids, and temperature. Subsequent discharges may require only a reduced list of analytes.

5.2.1.6 Restoration of Riverbed

Following the excavation of contaminated sediments, the riverbed will be restored using erosion protection materials, and, where feasible, sand and gravel layers to mimic the existing grain size distribution in each subreach. Erosion protection will also be placed generally at the toe of the slope and up the banks to an elevation up to 6 ft above the average water level. This elevation was established based on the elevation for the 2-year storm flow of 1,880 cfs. These riverbed restoration materials, as well as potential alternative protective materials, are described in more detail below and in Appendix M. Approximately 37,000 yd^3 of clean fill or erosion protection material will be required for riverbed restoration (see Appendix O). Selected areas of the riverbed will also be restored as appropriate with features that will increase species diversity and productivity. These enhanced features include pools, riffles, deflectors, and weirs as discussed below and in Appendix L. It is noted that the EE/CA cost estimates conservatively include costs for placing erosion protection materials everywhere in the riverbed. This will potentially change during the final design.

5.2.1.6.1 Sand and Gravel Layer

The sand and gravel layer is composed of predominantly granular material up to a maximum particle size of about 3 inches. The sand and gravel will be placed to a thickness necessary to restore the original riverbed elevation. The sand and gravel layers will be designed to mimic the existing grain size distribution in each subreach.

5.2.1.6.2 Erosion Protection Materials

The erosion protection materials are intended to provide protection for the sand and gravel layer from the forces of erosion, debris impact, and ice flow at the toe of slope, the lower banks, and in selected areas of the EE/CA Reach. When erosion protection is used in the riverbed, the materials will be composed of cobbles or riprap up to about 12 inches in average dimension. The material will be placed over the sand and gravel layer to a thickness necessary to restore the original riverbed elevation. In areas of higher water velocity, the erosion protection at the toe of slope and lower banks may be an articulated concrete revetment system in place of larger riprap. The revetment system would likely be about 10 inches thick. The difference in thickness between the materials will be compensated for by placing additional sand and gravel. The erosion protection will be extended from the riverbed to a point on the banks above an appropriate flood level (based on the 2-year storm) and anchored. As noted previously, the EE/CA cost estimates for each alternative currently include costs for applying erosion protection for the entire riverbed.

5.2.1.6.3 Aquatic Habitat Enhancement

The objectives of enhanced riverbed restoration are not only to replace the bed and thus minimize sediment resuspension and the potential release of buried contamination, but also to provide aquatic habitat enhancement. The restored bed should contain a variety of structural features and added habitat components in order to increase species diversity and productivity. These structures include rock weirs, rock spurs, single-wing deflectors, and in-stream boulders. A more detailed description of the structures proposed for enhanced riverbed restoration is provided in Appendix L.

Generally, at this stage in the restoration design process, it is assumed that the same substrate material as that proposed for standard riverbed restoration will be used in the bed construction for enhanced habitat restoration. However, riverbed enhancement structures must be constructed on stable substrate material (e.g., coarse gravel rather than sand to prevent undermining of the structure). Over time, natural deposition may create a variety of substrate conditions. Based on further assessment of the particular type of habitat to be enhanced, substrate variations and improvements will be considered.

For cost estimating purposes only, an approach was developed for riverbed enhancement. More detailed, specific habitat restoration objectives will need to be developed before an enhanced riverbed design can be developed. This approach includes specific numbers of structures for cobble and non-cobble subreaches.

For non-cobble subreaches, single-wing deflectors and rock spurs will be used in straight and bending sections of the riverbed, respectively. Single-wing rock deflectors are placed on an angle of 30° to 95°, either upstream or downstream, depending on the objective. Deflectors can vary in length from 5 to 20 ft and are triangular shaped, with the low end toward the middle of the river. Deflectors are used to create hiding cover, dissipate stream energy, divert flows, create small pools, and sort sediments. Spacing of these structures can vary depending on the objectives. An assumed spacing of 100 ft was used for estimating purposes. Rock spurs are rectangular-shaped, short structures generally less than 5 ft long with a spacing of 2 times the length of the spur. The assumed spacing was 10 ft for a 5-ft spur. Rock spurs are angled upstream at a 45° angle and are generally installed on the outside portions of channel bends. Spurs create in-stream cover and protect streambanks.

For cobble subreaches (4-1 to 4-3), applicable structures include rock weirs, in-stream boulders, and rock spurs. Rock spurs would be used as discussed above for the non-cobble subreaches. Rock weirs would be used to reestablish pools currently existing and to provide additional pools. Currently, there are five pools in the cobble subreaches. For estimating purposes, it was assumed that the number of pools would be increased to seven. Pools would be constructed at natural spacings of five to seven bankfull channel widths (approximately 200 to 300 ft). Rock weirs are also installed to control stream grade, dissipate stream energy, sort sediments, and provide aquatic habitat.

Rock weirs are typically W-shaped for wide channels (>40 ft) and V-shaped for narrow channels. Weirs are installed in straight portions of the channel to heights of approximately one-third below bankfull height. In-stream boulders are placed in clusters or alone and are used to create small scour areas downstream, provide cover for aquatic organisms, and dissipate stream energy by adding channel roughness. Boulders must be placed on a stable bed; otherwise, erosion will occur around the boulder and it will fall into the eroded hole. For estimating purposes, it is assumed that thirty 2- to 3-ft-diameter boulders would be placed in clusters or as isolated boulders for every 100 ft of stream length.

5.2.1.7 Restoration of Riverbanks

Following excavation of contaminated soils along the riverbanks, restoration will be required to minimize erosion and the potential release of remaining buried contaminated soils, and to re-establish riparian habitat. There are no analytical data on riverbank soil PCB concentrations at depths greater than 3 ft. However, based on the concentrations observed in the 2- to 3-ft-depth interval in the banks, PCB concentrations below the 3-ft depth in the banks may exceed cleanup concentrations. In the lower bank areas of all subreaches, the potential exists for transport of PCBs from underlying contaminated soils into the clean backfill due to groundwater flow from the contaminated soil, through the clean backfill, and into the river and riverbed sediments.

It may, therefore, be necessary to install a sorptive soil layer (silty sand with a minimum TOC of 0.5%) as part of the backfilling and reconstruction of the lower bank areas. This layer may extend approximately 6 ft (vertical) above the average daily water level in all subreaches. However, because of an absence of analytical data to enter into the model, a preliminary cap design for the banks has not been completed for this EE/CA. The alternatives include costs associated with substituting a 6-inch sorptive soil layer in place of common riverbank backfill for the lower bank areas. Where bank soils do not need to be removed because they already meet the cleanup goals, a sorptive soil layer will not be installed.

It may be necessary as part of a predesign task or during the EE/CA removal action design to gather additional PCB data at depth in the lower bank areas to support modeling of PCB transport and confirmation of an appropriate sorptive layer thickness.

Restoration of riverbanks will be performed from the point where the riverbed armoring ends (determined by the 2-year storm water level) to the top of the bank. The three methods of riverbank restoration discussed in Subsection 4.6 (revegetation, bioengineering, and hard structures) will be used along bank slopes where appropriate.

Soils on the riverbanks are generally finer than the riverbed sediment and are composed of 18% fines (silt and clay), on average. The predominant grain size in the riverbank soil is fine sand, which composes approximately 50% of the material. Less than 10% of the riverbank soil is made up of coarse sand and gravel.

Stabilization of the banks is a primary concern for all slopes. Potential structural impacts of adjacent buildings and structures must also be considered. Wherever possible, pre-excavation grades will be replaced unless altered for purposes of slope stability or structural integrity. Approximately 50,000 yd^3 of clean fill or erosion protection material will be required for riverbank restoration (see Appendix O).

Appendix L presents a description of bank restoration techniques for the different slope characteristics represented in the EE/CA Reach. The completed riverbank slope will determine the restoration technique to be used. All restoration techniques rely on some amount of revegetation. Appropriate native vegetation will be determined based on drought resistance, inundation tolerance, root depth, and structural diversity.

Shallow slopes flatter than 3H:1V will be revegetated. Bioengineering or hard structures may be used on shallow slopes in areas of high erosion potential, such as areas of high water velocity or shear forces. Where appropriate, terraces may be established to minimize erosion and to provide locations for establishment of riparian vegetation. Figure L-1, in Appendix L, illustrates a conceptual design of a typical cross section for slopes less than 3H:1V.

In general, for medium slopes between 3H:1V and 2.25H:1V, bioengineering techniques will be used for stabilization and restoration. A typical bioengineered bank cross section is illustrated in Figure L-2, in Appendix L.

Slopes steeper than 2.25H:1V will rely primarily on hard structures for stabilization and restoration or armor on slopes for the lower banks. A typical cross section is shown in Figure L-3.

Figures L-1 through L-3 depict the restored bank at three points in time: immediately after completion of restoration work, after 5 years of growth, and after 20 years of growth. Detailed descriptions of all of the cross sections are presented in Appendix L.

Based on the slope stability analysis (Appendix N) using the available information regarding geotechnical properties of the soil, slopes steeper than 2.25H:1V would be regraded to no steeper than 2.25H:1V wherever possible, while maintaining the existing top of slope location. Where space is limited due to buildings or utilities, retaining walls would be constructed to a height where the remaining slope could be established at 2.25H:1V.

Monitoring of restoration structures and for erosion impacts will be required to determine if the restoration objective has been met. Monitoring will be performed annually for 5 years. Following the first 5 years, monitoring will be performed once every 5 years for the next 15 years. Additional monitoring will be required following flooding or major storm events. Riparian habitat monitoring (for vegetative cover) will be required for approximately 20 years. Riparian habitat monitoring will be conducted three times a year for the first 3 years, twice a year for the next 2 years, and once a year for the next 15 years. A monitoring plan outline that provides details on monitoring objectives, methods, and schedules is provided in Appendix P. Maintenance will also be performed as determined necessary to replace unsuccessful plantings and structures.

5.2.1.8 Sampling of Stockpiles

Where possible, excavated material will be segregated into separate stockpiles based on existing in situ sampling results. For cost calculations for this EE/CA, it has been assumed that all soil and sediment destined for treatment at the GE facility, consolidation at the GE consolidation areas, or disposal at an off-site disposal facility would require chemical analyses to characterize it before treatment, consolidation, or disposal. Composite or grab samples would be collected from each stockpile to characterize the material in accordance with the treatment, consolidation or disposal requirements. It has been assumed that the stockpiles would initially be sampled and analyzed for a full suite of organic and inorganic compounds, TCLP metals and organics, and free water to characterize the material and confirm the in situ sampling results. Following the initial characterization, analyses would be tailored to the contaminants of concern. However, the exact parameters to be sampled for waste profiling purposes would be determined by the requirements of the receiving facility or the treatment system. For cost estimating purposes, it was assumed that, following initial characterization, ongoing sampling would involve analyzing for PCBs at a rate of 1 sample per 100 yd^3. During the design process, evaluation of the above stockpile sampling program will be made to determine if additional cost savings are possible while maintaining project schedule and quality goals.

5.2.1.9 Consolidation, Disposal, and Treatment Options

Each base alternative has been evaluated with each of four consolidation, disposal, or treatment options. The following four options have been considered:

A. Consolidation of up to 50,000 yd^3 of contaminated soils and sediments at designated consolidation areas at GE with off-site treatment/disposal of excess material.

B. Off-site disposal of all excavated material.

C. Treatment of all suitable material at the GE facility using thermal desorption, with off-site disposal of all material.

D. Treatment of all suitable material at the GE facility using solvent extraction, with off-site disposal of all material.

The above options have been chosen in order to represent the possible range of consolidation/treatment/disposal costs. There are other possible combinations of consolidation/treatment/disposal that have not been specifically evaluated. The cost tables and appendices provide cost details that can be used to assess the relative merits of additional combinations of consolidation/treatment/disposal technologies other than Options A, B, C, and D.

5.2.1.9.1 Option A—Consolidation at GE with Disposal of Excess at Off-Site Facilities

The "Detailed Work Plan for On-Plant Consolidation Areas" (BBL, 01-0306) describes areas at the GE facility that may accept wastes excavated from the EE/CA Reach. For this EE/CA, it has been assumed that up to 50,000 yd^3 of material, with an upper limit of 25,000 yd^3 of Resource Conservation and Recovery Act (RCRA)- or TSCA-regulated material, may be consolidated at consolidation areas at the GE facility. The most cost-effective approach, which this alternative assumes, is to use the maximum capacity of 50,000 yd^3 available at GE, and to maximize the consolidation of TSCA- and RCRA-regulated material at GE. Excess material will be managed for disposal as RCRA waste, TSCA waste, solid (remediation) waste, and as landfill cover, depending on the results of the characterization sampling. As described in Appendix K to the Consent Decree (00-0390), GE shall spread and compact material brought to the On-Plant Consolidation Area (OPCA). Pursuant to Appendix K, GE shall bear this cost of spreading and compacting EE/CA material when GE is conducting spreading and compacting work as part of GE's OPCA activities. The base cost of Option A does not include spreading and compaction at the OPCA; however, in a note at the end of the cost tables for each base alternative, an add-on cost to perform all the spreading and compacting of EE/CA Reach materials has been provided. This add-on cost is provided as a conservative contingency in the event that GE performs this work outside of its own OPCA activities and the agencies must bear this cost.

Based on a review of the existing sampling data for the EE/CA Reach, quantities of excavated soil and sediment were estimated for each of these waste categories. The estimate is based on the percentage of samples that have the characteristics for each of the categories. For RCRA wastes, either TCLP data or samples with contaminant concentrations large enough to reasonably constitute hazardous characteristics were used. The total volume of excavated contaminated material is approximately 89,700 yd^3. Of this total, approximately 12,100 yd^3 may be TSCA waste; 2,800 yd^3 may be RCRA waste; and 74,800 yd^3 (including oversized materials) may be nonhazardous, non-TSCA remediation waste. For Option A, this EE/CA assumes that up to 25,000 yd^3 of TSCA and RCRA waste and up to 25,000 yd^3 of the remediation waste will be consolidated at the GE consolidation areas. The remainder of the remediation waste (39,700 yd^3 not consolidated at GE) will be transported to appropriate off-site facilities for treatment/disposal.

5.2.1.9.2 Option B—Off-Site Disposal of All Excavated Material

Dewatered materials will be characterized as discussed in Subsection 5.2.1.8 and shipped to the appropriate off-site facilities. No treatment will be performed at the GE facility following dewatering of excavated materials. The total volume of excavated contaminated material is approximately 89,700 yd^3. Of this total, 8,600 yd^3 may be landfilled off-site as TSCA waste; 2,800 yd^3 may be treated off-site as RCRA waste; and 74,800 yd^3 (including oversized materials) may be landfilled off-site as non-hazardous, non-TSCA remediation waste.

5.2.1.9.3 Option C—Thermal Desorption Treatment with Off-Site Disposal

Option C includes treatment of soils and sediments at the GE facility using thermal desorption followed by disposal of all material at appropriate off-site facilities. Thermal desorption has been used extensively on a full-scale level to treat PCBs and other organic contaminants in sediment. Treated PCB levels of less than 2 mg/kg are routinely achievable for sediment with initial concentrations of several thousand mg/kg PCBs. In the thermal desorption process, PCB contaminants are removed from the contaminated matrix by heating to approximately 800 °F to 1,200 °F and causing volatilization. In this process the contaminant molecules are not altered, as opposed to incineration, which chemically changes contaminants by oxidation. A conceptual process flow diagram is shown in Figure 5.2-2.

Setup of the thermal desorption system will require standard construction techniques to prepare the site. Various vendors have different site requirements. Some systems are trailer-mounted while others require some erection at the site. If necessary, site preparation would include clearing and grubbing, and compaction in preparation for pouring a concrete foundation pad to support the thermal treatment system and related equipment. At a minimum, a stable, flat surface is required for the treatment system.

Thermal desorption treatment systems typically consist of the following components:

- A material heating chamber, with a vapor collection system to collect the desorbed contaminants and water vapor.
- A condenser and separation system to convert the collected vapors to the liquid phase and separate the water from the concentrated contaminants.
- A treated soil and sediment cooling (or quench) system.
- An air treatment system to control emissions of contaminants, including particulates, from the exhaust stack.
- A water treatment system to clean the condensed water prior to discharge.

Residuals produced include treated soil and sediment, treated water, contaminated treatment media and fines (e.g., baghouse filters, spent activated carbon) from air and water treatment, and a highly concentrated contaminated condensate stream.

A treatability test would be required on representative site material to determine the treatment efficiency and parameters, and to determine the quantity and quality of the treatment residuals produced in the process.

Several thermal desorption units were evaluated. These units can treat 5 to 15 tons of material per hour, depending on feed characteristics such as contaminant concentration, percent moisture, and particle size (percent fines). A high concentration of fine sediment particles decreases the processing rate because the fines can result in agglomeration of sediment that traps contaminants within the sediment matrix. High moisture content decreases the processing rate because water has a high specific heat, thereby requiring an increase in retention time to allow the water to be boiled off prior to desorbing the contaminants.

To optimize treatment system economics, it would be necessary to balance the upfront costs with the desire to process the soil in as short a time as possible. To avoid stockpiling large volumes of soil for long periods of time, the treatment system should be able to process an amount equal to the volume expected to be excavated on a daily basis. For this study, it is assumed that a treatment system with a capacity of 10 tons per hour, not including scheduled and unscheduled maintenance, would be constructed. This treatment system, including ancillary processing equipment, would require an area of approximately 30,000 ft^2. Pretreatment and post-treatment material stockpiling areas associated with the treatment system would require an additional 30,000 to 40,000 ft^2.

The treatment plant would be installed on a concrete pad. The pad would be installed as part of the site preparation activities. The pad would be surrounded by a buffer area of curbed asphalt and an 8-ft-high security fence. The plant area also would be supplied with potable process water and three-phase 480-volt electricity. Large hydraulic motors may require 4,160-volt electrical power.

Figure 5.2-2 shows the primary streams generated from this process, including the treated soil and sediment, the concentrated organic waste stream containing the PCBs, and the water removed from the soil and sediment. Approximately 89,700 yd^3 (approximately 148,000 tons) of material would be excavated and transported to the central dewatering facility. The amount of contaminated material destined for treatment, after separating out free water, material suitable for landfill cover without treatment, and RCRA hazardous waste, is estimated to be 86,940 yd^3. At an assumed thermal treatment processing rate of 10 tons per hour, the contaminated material could be treated in approximately 21 months (assuming a 24-hour per day, 7-day work week, 30% downtime, and a bulk density of 1.5 tons per yard).

Following thermal treatment, the treated soil and sediment would be dry and clean. Most of the treated material (approximately 76,400 yd^3) would be suitable for reuse off-site as landfill daily cover following some degree of organic enhancement. As a contingency for the possibility that not all treated material may be accepted as landfill cover, a small portion of the treated volume is assumed to require landfill disposal off-site. RCRA hazardous waste would be shipped off-site for treatment and disposal.

Thermal treatment systems can be provided in several configurations, depending on the vendor. Heat is applied indirectly to contaminated materials, either by heating the carrier gas stream that is passed over the contaminated sediment (which desorbs contaminants into the gas), or by heating the sediment using a rotary kiln or thermal screw (which desorbs contaminants from the heated sediment into a carrier gas). This indirect heat removes contaminants without incinerating them. The treatment system includes a cooling stage, either through a quench step or some other heat recovery method. Ideally, the heat removed from the processed material following desorption would be recovered to preheat material that is entering the thermal desorption unit.

The carrier gas, containing desorbed contaminants and vaporized moisture, is then collected and cooled, allowing the water vapor and contaminants to condense. Particulates are removed using conventional treatment (e.g., cyclone, baghouse fabric filters), and can be fed back into the sediment influent during system operation to minimize the volume of treatment residuals generated. Non-condensable organic vapors are removed by passing the carrier gas through vapor-phase activated carbon canisters. The condensed water and contaminants are gravity separated following condensation. Conventional oil/water treatment techniques are used. The water would be polished using activated carbon prior to discharge or disposal. For the purpose of this EE/CA, it was assumed that the treated water would be discharged to the Housatonic River along with other treated water discharges generated during remedial activities.

It is anticipated that collected particulates and spent carbon may be generated by both vapor-phase treatment to remove non-condensable organics and by water polishing prior to discharge and that both of these wastes may be combined into a single waste stream. Mass balance calculations indicate that approximately 2,000 gallons of oily, concentrated PCB waste will be generated during the thermal desorption process. This wastestream would be shipped off-site for incineration at a TSCA-licensed facility following waste characterization. Used personal protective equipment (PPE) generated by personnel performing excavation, materials handling, treatment system operation, and sampling activities would be collected, classified, and shipped off-site for disposal in accordance with its waste type.

The polished water stream would require analysis for water quality parameters and contaminant concentrations prior to discharge in conformance with the substantive requirements of any ARARs. Likewise, the stack discharge would require air monitoring to ensure that unacceptable levels of airborne contaminants are not being discharged. Air emissions would likely be monitored through the use of a continuous-emissions monitoring system. Finally, treatment residuals, such as the condensed contaminant stream and recovered particulates, filters and spent carbon, would require analysis for waste classification prior to off-site disposal.

Treated material will be sampled and analyzed for PCBs to confirm treatment effectiveness. One sample of treated material would be collected per 12-hour work shift and analyzed for PCBs using a field test kit. Additional sampling would be required for off-site disposal. The exact parameters to be sampled for waste profiling purposes would be determined by the requirements of the receiving facility. For the purposes of this EE/CA, characterization sampling for the off-site disposal would be performed at the rate of one sample per 100 yd^3. Material not meeting the treatment criteria of 2 mg/kg PCBs (for off-site use as landfill cover) may be retreated.

5.2.1.9.4 Option D—Solvent Extraction Treatment with Off-Site Disposal

Soil and sediment with organic contamination exceeding criteria for off-site disposal as daily cover will be treated at the GE facility using solvent extraction . Subsequently, all excavated material will be disposed of at appropriate off-site facilities. Solvent extraction has been proven to effectively remove PCBs and other organic contaminants from soils and sediments in numerous full-scale remedial operations. Commercially available systems have been able to consistently attain PCB target concentrations below 2 mg/kg for soils and sediments with initial concentrations of several hundred mg/kg.

Solvent extraction is a physical/chemical process that removes the organic contaminants that adhere to the organic matter and particles within the soil matrix. This technology does not destroy the PCBs; rather, it removes the PCBs from the soil and concentrates them in a waste product that must be disposed of off-site. The process occurs in specially constructed treatment systems. The process can be performed using a modular treatment unit design temporarily installed at the site, or in below-ground cells constructed for processing of the contaminated material and the extraction solvent.

Solvent extraction is generally a two- or three-step process depending on the specific process. In the first step, the solvent is contacted with the soil. This is done in a fully enclosed contact vessel in a batch process. Both actively mixed and passive flow-through contact vessel designs are used. Untreated and treated soil is typically moved in and out of the contact vessels with front-end loaders or similar earth-moving equipment. Some vendors require oversize particles (greater than 1 inch) to be screened out before treatment, whereas others indicate that much larger particle sizes can be treated.

When the solvent contacts the soil, the PCBs and other organic contaminants desorb from the soil and are solubilized into the solvent. This occurs because the PCBs and other organic contaminants in the soil have a high affinity for the solvents used. Typically, proprietary, low-toxicity organic solvents are used. After the solvent has contacted the soil for a sufficient period of time to desorb the contaminants, the solvent is separated from the soil. Multiple contact cycles may be required to remove contaminants to target levels. The separation is accomplished using gravity settling, centrifuges, and other physical separation techniques. A portion of the soil pore water also will separate from the soil during this operation. The contaminant-laden solvent stream and any water is then passed to the second process step.

The second step in this process is to separate the organic contaminants, water, and the solvent into three separate liquid streams. This separation is performed with distillation or other similar separation technologies. The PCBs and other organic contaminants are concentrated into a wastestream that is sent off-site for disposal. This wastestream will likely require off-site incineration due to the high PCB concentrations anticipated. The water stream may be added back to the soil or discharged after treatment. The separated solvent is recycled back into the process. The process is a closed loop where the solvent used is recovered and reused over and over again. Solvent recovery rates are approximately 90 to 99%; however, a high percentage of fine soils would decrease recovery rates or increase the number of contact cycles.

Typically, after the solvent and liquids have been removed by gravity from the soil, the soil is heated and a vacuum applied to remove and recover as much of the solvent as possible from the soil. Additional porewater is also driven from the soil during this step. The vapor from heating the soil is condensed and sent to the liquid stream separator.

Following these steps, the soil is a dry, clean, treated soil. The soil can then be shipped off-site and possibly used as daily cover at an off-site landfill. The soil can contain parts per million (ppm) concentrations of the solvent.

Figure 5.2-3 presents a conceptual process flow diagram. The figure shows the primary streams generated from this process, including the treated soil, the concentrated organic wastestream containing the PCBs, and the solvent.

It is assumed that the soil treatment area would be no more than approximately 2 miles from the excavation at the EE/CA Reach.

For purposes of this discussion, a specific process was selected, although there are a number of various solvent extraction processes commercially available. Prior to constructing a treatment plant at the site, a bench-scale treatability test would need to be conducted on the soils and sediments. This test would help to determine the detailed configuration of the plant as well as the flow rates and required extraction times. Most solvent extraction plant designs are modular in nature. Therefore, plant capacity can be as small or as large as desired, ranging up to 500 tons per day. The larger the plant, the quicker the plant can process the soil, but the higher the up-front mobilization and site preparation costs. To optimize plant economics, it would be necessary to balance the up-front costs with the desire to process the soil in as short a time as possible. To avoid stockpiling large volumes of soil for long periods of time, the plant should be able to process an amount equal to the volume expected to be excavated on a daily basis.

Approximately 89,700 yd^3 of excavated material would be transported to the central dewatering facility. The amount of contaminated material destined for treatment, after separating out free water and RCRA hazardous waste, is estimated to be 86,940 yd^3. At an assumed daily treatment capacity of approximately 200 yd^3 per day, the contaminated material could be treated in approximately 20 months (assuming a 24-hour per day, 7-day work week, 30% downtime, and a bulk density of 1.5 tons per yard).

Following thermal treatment, the treated soil and sediment would be dry and clean. Most of the treated material (approximately 76,400 yd^3) would be suitable for reuse off-site as landfill daily cover following some degree of organic enhancement. As a contingency for the possibility that not all treated material may be accepted as landfill cover, a small portion of the treated volume is assumed to require landfill disposal off-site. RCRA hazardous waste would be shipped off-site for treatment and disposal.

The treatment plant would be installed on a concrete pad. The pad would be installed as part of the site preparation activities. The pad would be surrounded by a buffer area of curbed asphalt and an 8-ft-high security fence. The plant area also would be supplied with potable process water, three-phase, 480-volt electricity, and a fire hydrant for firewater. Large hydraulic motors may require 4,160-volt electrical power. The area required for the treatment plant would be approximately 1 acre. Approximately one additional acre would be required for pretreatment and post-treatment stockpiling to facilitate material handling. An existing asphalt parking lot may be used if available.

The soil and sediment would be transferred from the central dewatering facility to a pretreatment stockpile. Material from the stockpiles would be loaded into the treatment system with a front-end loader. The process itself is a completely enclosed system. The soil/sediment is sealed in a contact vessel before the addition of any solvent. The vessels are not opened again until the solvent has been removed from the soil following the soil-heating process. Air emissions would be small and limited to one outside vent. Emissions are prevented by using a nitrogen blanket and a slight negative pressure. The vent has several emission prevention devices such as condensers, a scrubber, and continually monitored carbon beds. If contamination is detected, the system automatically shuts down. The process will yield a clean soil or sediment as well as a liquid concentrated PCB stream. Solvent is recovered and reused in the process.

Clean water generated during the process may be returned to the soil or sediment, if appropriate, to restore some of its original moisture content. The treated material then would be placed in a treated material stockpile by a front-end loader and covered with plastic until it is transported off-site for disposal. The treated material would need to be sampled to ensure that it meets treatment goals. Typically, sampling would be conducted by the contractor performing the solvent extraction.

The concentrated PCB-containing oil waste product would be pumped directly into 55-gallon drums as it is generated. Once full, drums would be stored for less than 90 days on a bermed and covered drum storage pad until they are transported for off-site disposal. It is expected that the concentration of PCBs in this wastestream would exceed 500 ppm. Therefore, according to

Section 761.60 of 40 CFR Part 761, the concentrated PCB wastestream would have to be disposed of at an off-site TSCA-approved incinerator.

To estimate the volume of concentrated PCB solution that would be generated, a mass balance can be calculated using the concentration of extractable organics. For costing purposes, it is assumed that approximately 2,000 gallons (0.016 gallons per ton of treated material) of the concentrated PCB stream, with an assumed concentration of approximately 33% PCBs, would be generated. This estimate is based on an average PCB concentration of 30.8 ppm for the riverbank soils and 28.5 ppm for the sediments.

5.2.2 Alternative 1 Evaluations

5.2.2.1 Base Alternative 1 Effectiveness

For Base Alternative 1, contaminated river sediments would be excavated using a wet excavation technique. Because the riverbed will not be dewatered before performing the excavation, contaminated sediments would be expected to become resuspended during excavation and migrate downstream. Engineering controls will be used to minimize the impact of the river velocity, thereby reducing sediment resuspension at the point of excavation and migration downstream. Resuspended contaminated sediment that settles within the EE/CA Reach will be removed as the excavation activity moves downstream. Engineering controls, such as sediment dams, will minimize the migration of resuspended materials from the EE/CA Reach. The results of the DRET analyses indicate that the mass of PCBs that could be resuspended is relatively high. This means that despite local engineering controls for mitigation of sediment resuspension, PCBs are likely to be mobilized downriver to some degree during wet excavation.

Because all excavation will be performed beneath flowing water, quality control will be difficult. Reduced visibility, resettlement of sediment into the active excavation, and scouring of the active excavation will make it difficult to control the depth of excavation. Some contaminated material may be left behind in some areas and over-excavation of clean sediments may occur in other areas. Similarly, quality control during placement of bed materials will be difficult. To ensure the effectiveness of this alternative, it may be necessary to apply a safety factor during excavation and backfilling, resulting in greater excavation and fill volumes.

Residents living near the EE/CA Reach would experience increased truck traffic and noise during remedial activities. Approximately 10 round-trip truck trips per day would be required to transport excavated material from the river to the dewatering/stockpile area, and 10 round trips to transport clean fill materials to the river. Therefore, truck traffic would increase by approximately 20 round trips per day during excavation, backfilling, and restoration activities.

The estimated time to complete the base alternative is 22 months. This estimate includes time for mobilization and demobilization in addition to the excavation, dewatering, and restoration time. The estimate includes allowances for lost production time due to scheduled and unscheduled maintenance and unfavorable weather conditions, such as storm events, that would prevent working in the river. Implementation of the treatment/consolidation/disposal option selected is expected to occur concurrently with the base alternative and will not significantly impact the completion time.

5.2.2.2 Effectiveness of Options A, B, C, and D

Treatment, consolidation, and disposal technology options were evaluated in detail in Tables 4.1-3a and 4.1-3b during technology screening in Section 4. Four treatment/consolidation/disposal options have been developed for evaluation together with the three base alternatives, as described in Section 5. Option A is for consolidation of contaminated soils and sediments at approved consolidation areas at GE with off-site treatment/disposal of material in excess of the capacity of the consolidation areas. Option B is for off-site treatment/disposal of all excavated material. No consolidation or treatment of material to reduce contaminant concentrations would be conducted at GE with this option. Option C involves thermal desorption treatment at the GE facility of suitable contaminated soils and sediments with off-site treatment/disposal of all material. No material would be consolidated at GE with this option. Option D involves solvent extraction treatment at the GE facility of suitable contaminated soils and sediments with off-site treatment/disposal of all material. No material would be consolidated at GE with this option. A summary of the effectiveness evaluation for each of these four options is presented in Subsections 5.2.2.2.1 through 5.2.2.2.4.

5.2.2.2.1 Effectiveness of Option A – Consolidation at GE with Disposal of Excess at Off-Site Facilities

EPA determined the disposal of certain Housatonic River soils and sediment in the consolidation area is protective of human health and the environment. This determination is documented in EPA's Action Memorandum, dated 4 August 1999, "Request for Removal Actions Outside the River at the GE/Housatonic River Site, Pittsfield, Massachusetts" (00-0387). ARARs for the consolidation areas were approved by EPA in its letter to GE dated 17 September 1999 (00-0392). Subsection 4.5.1 identifies the various off-site facilities (predominantly landfills) expected to be used to dispose of or treat wastes not consolidated at GE.

This option will be protective of human health and the environment in the long term with proper construction of the consolidation areas and adequate diligence in operating, maintaining, and controlling the consolidation areas. Lined landfills with leachate collection systems are commonly used for disposal of TSCA- or RCRA-regulated wastes. No reduction in the toxicity, volume, or mobility of the wastes by treatment will be achieved with this option, except for the possible treatment of leachate at the GE facility or the possible treatment of waste sent to off-site treatment/disposal facilities. This option is expected to comply with ARARs.

Truck traffic and noise associated with consolidation at the GE consolidation areas would have minimal impact on the local residents. Approximately four roundtrip truck trips per day on average would be required for off-site transport of excess material. Once the capacity of the consolidation areas is reached, the truck traffic would approximately double.

5.2.2.2.2 Effectiveness of Option B—Off-Site Disposal of All Excavated Material

Based on the results of sampling and analysis completed at the site, regulated and non-regulated waste materials are expected to be excavated. Subsection 4.5.1 identifies the various off-site facilities (predominantly landfills) expected to be used to dispose of or treat wastes from the site. Lined landfills with leachate collection systems are commonly used for disposal of TSCA- or RCRA-regulated wastes.

No reduction in the toxicity, volume, or mobility of the wastes by treatment will be achieved with this option, except for the possible treatment of RCRA hazardous wastes to achieve land disposal restrictions (LDRs) prior to disposal. This option will be protective of human health and the environment in the long term with adequate diligence in operation, maintenance, and control by the off-site facilities. A positive long-term effect would be achieved for the local community because all material would be transported away from the site and its vicinity.

Approximately 10 roundtrip truck trips per day on average would be required for off-site transport of all excavated material. This traffic and the associated noise would have some impact on the community in the short term.

5.2.2.2.3 Effectiveness of Option C—Thermal Desorption Treatment with Off-Site Disposal

Based on the results of sampling and analysis completed at the site, soils and sediments with both organic and inorganic contamination are expected to be excavated. Thermal desorption is generally only effective for organic contaminants, so any soils and sediments with only inorganic contamination will not be treated. This option reduces the toxicity, volume, or mobility of the contaminated soils and sediments by treatment, which is preferred by statute. Following treatment, most soils and sediments are expected to meet the contamination criteria for reuse as landfill cover. Materials that do not achieve these criteria are expected to be disposed of as remediation wastes, except for any RCRA hazardous wastes, which will require disposal in a RCRA C landfill and possibly treatment to meet LDRs.

This option will be protective of human health and the environment in the long term with adequate diligence in operation, maintenance, and control by the off-site facilities. A positive long-term effect would be achieved for the local community because all material would be transported away from the site and its vicinity. This option is expected to comply with ARARs.

Truck traffic and noise associated with transfer of material to the treatment area at the GE facility would have minimal or no impact on the local residents. Engineering controls would be used to minimize short-term impacts of noise, odors, and air pollution associated with the treatment system at GE. Approximately 10 roundtrip truck trips per day on average would be required for off-site transport of all excavated material. This traffic and the associated noise would have some impact on the community in the short term.

Disposal of treated and untreated materials at properly designed off-site facilities provides the highest degree of long-term effectiveness and permanence with respect to the ability to manage untreated and treated residuals.

Short-term impacts associated with the thermal desorption treatment option includes noise from the treatment process, additional handling of contaminated materials during pretreatment and post-treatment activities, and potential vapor emissions from treatment units, including off-gases and solvent vapors. Potential short-term impacts include direct exposure and inhalation of airborne dust and vapors by remediation workers and the local community if not properly controlled. Inhalation, ingestion, and dermal contact would be minimized by utilization of the appropriate protective clothing and equipment, following proper health and safety procedures during treatment activities, and use of engineering controls. Stockpiles would be covered to minimize the generation of airborne dust. Dust from the treated sediment could be minimized by adding moisture.

An air monitoring program would be implemented to evaluate the potential for air emissions from the operation of the thermal desorption system. Continuous emissions monitoring is available, as required, to confirm that the gas discharged from the stack meets all applicable and relevant and appropriate emissions limits. If necessary, the treatment system would be installed within a treatment building to further reduce the amount of particulate and vapor emissions.

Thermal desorption would produce concentrated PCB-containing oily wastestreams that will likely require off-site incineration. There is a potential risk to residents and workers from handling and transporting the concentrated PCB wastestream to a TSCA-permitted incinerator. To the extent possible, this risk would be minimized by careful planning of transportation activities; use of an experienced, licensed hauler of hazardous wastes following Department of Transportation regulations; and incineration of the wastes at a state-of-the-art and TSCA-permitted incineration facility.

Options C and D provide a similar level of reduction of toxicity, mobility, and volume. For both treatment options, there would be a significant and permanent reduction in the toxicity, mobility, and volume of the waste. A significant portion of the PCBs in the EE/CA Reach would be removed and ultimately destroyed by the off-site incineration process required for the concentrated wastestreams generated by both solvent extraction and thermal desorption. These processes are irreversible.

5.2.2.2.4 Effectiveness of Option D—Solvent Extraction Treatment with Off-Site Disposal

The effectiveness discussion for this option is identical to that for Option C, with the exception of the chemical handling issues identified in this subsection.

For the solvent extraction treatment option, a short-term risk consideration is the presence of large volumes of flammable solvent to be used at the site. The treatment system is designed using standard petroleum industry plant practices following National Fire Protection Association (NFPA) 36 Guidelines. Oxygen is prevented from entering the closed system by a nitrogen blanket, which is continuously bled into the system, and by inducing a slightly negative pressure. All equipment motors are explosion proof. In addition, there would be a curbed asphalt buffer zone around the soil treatment facility to further reduce risks from spills.

5.2.2.3 Base Alternative 1 Implementability

The wet excavation alternative is intended to minimize temporary construction access requirements and eliminate the costs of river diversion. By using the existing river channel as an access way and avoiding the need for a river diversion system, extensive access requirements through business and residential properties are not anticipated. Access will be required for staging areas; however, these areas are not expected to be in locations where access agreements may be difficult to obtain. This alternative will minimize impacts to adjoining properties by keeping much of the construction-related activity within the river.

The total estimated area required at the GE facility for the equipment and facilities necessary to implement this base alternative is 3 acres. This total includes allowances for dewatering facilities, support trailers, support vehicle parking, equipment parking, and decontamination facilities. Depending on the consolidation/disposal/treatment option selected, the required area may increase.

Excavation rates for wet excavation are expected to be adversely impacted by the quality control problems that must be overcome for work being conducted beneath the water. The requirements for accurately controlling/monitoring excavation and backfill operations underwater are relatively time-consuming and difficult to implement. For wet excavation, a normal riverbed excavation rate of 150 yd^3 per day is anticipated. In addition, a 30% downtime allowance is anticipated to account for scheduled and unscheduled maintenance and weather-related shutdowns. The riverbank excavation rate is estimated at 300 yd^3 per day with a 5% downtime allowance. In addition, daily excavation rates are expected to be even lower and quality control more difficult at the cobble subreaches due to the difficulty of removing sediment from pockets in the irregular surface of the bedrock.

Analysis of bank stability during wet excavation (see Appendix N) indicates that bank stability will be a potential problem. Instability created by excavating banks with moving water at the toe of the slope could result in multiple slope failures. Slope failures could result not only in excess excavation/construction costs, but also damage to structures near the tops of banks, and additional transport of PCBs downriver. Constant monitoring of the riverbank for excessive erosion and potential bank instability by the contractor is required to minimize the potential for failure. Should excessive erosion or potential bank instability be noted, the contractor must respond immediately to control the situation, which could require the stoppage of work and placement of stone at the toe of slope.

5.2.2.4 Implementability of Options A, B, C, and D

Treatment, consolidation, and disposal technology options were evaluated in detail in Tables 4.1-3a and 4.1-3b during technology screening in Section 4. Four treatment/consolidation/disposal options have been developed for evaluation together with the three base alternatives, as described in Section 5. A summary of the implementability evaluation for each of these options is presented in Subsections 5.2.2.4.1 through 5.2.2.4.4.

5.2.2.4.1 Implementability of Option A—Consolidation at GE with Disposal of Excess at Off-Site Facilities

The Consent Decree allows the consolidation of TSCA- and RCRA-regulated and unregulated soils and sediments at specified areas at the GE facility. Subsection 4.5.2 describes some of the limitations imposed on these consolidation areas. As described in Appendix K of the Consent Decree (00-0390), "1 ½ Mile Reach Access and Services Agreement," GE is required to provide up to 50,000 yd^3 of capacity for soil and sediment from the EE/CA removal action in the OPCAs. If GE does not make available the required 50,000-yd^3 capacity, EPA may dispose of the material at an off-site facility solely at GE's cost.

Excess excavated material (more than the capacity of the consolidation areas) will be transported to off-site facilities for treatment/disposal as required. Subsection 4.5.1 identifies the various off-site facilities expected to be used to dispose of or treat wastes not consolidated at GE. These off-site facilities are expected to be available to receive any quantity of excavated material that cannot be consolidated at GE. However, significant reduction in the capacity of the consolidation areas at GE by the time the EE/CA removal action is implemented would adversely impact the feasibility of this option.

5.2.2.4.2 Implementability of Option B—Off-Site Disposal of All Excavated Material

All excavated material will be transported to off-site facilities for treatment/disposal as required. Subsection 4.5.1 identifies the various off-site facilities (predominantly landfills) expected to be used to dispose of or treat wastes. These off-site facilities are expected to be available when need to receive any quantity of excavated material.

5.2.2.4.3 Implementability of Option C—Thermal Desorption Treatment with Off-Site Disposal

The thermal desorption technology is both technologically viable and commercially available and can be implemented using conventional technologies. Thermal desorption, including the ancillary condensing/refrigerating and water and air treatment technologies, are proven, reliable, and commercially available. There are a minimum of four technology vendors who have used thermal desorption technology at full scale to successfully treat sediments and soils contaminated with PCBs.

Thermal desorption treatment systems can have difficulty removing contaminants in fine-grained soils, especially clays that remain clumped together and do not reach required desorption temperatures. Also, dewatering of sediments will be critical to the implementability of thermal desorption. If sufficient dewatering cannot be achieved, the treatment system may not be able to remove PCBs to the required concentrations or extreme operating conditions (residence times) that may be needed.

For thermal desorption, another limitation may be cold weather. Some of the ancillary processes used are temperature dependent and may have reduced efficiency during severe cold weather. Additional energy input and insulated vessels may offset this potential problem.

To implement Option C, adequate land and utilities must be made available at the GE facility. The estimated area required for the equipment and facilities necessary to implement thermal desorption treatment only is approximately 2 acres. This is in addition to the area required for the base alternatives. Electrical and water services, as described previously for this option, must be available.

Administratively, there may be some local public opposition to on-site thermal treatment technologies by nearby residents because of association with higher temperature incineration. Also, achieving consensus among state and local regulators for operation of the thermal treatment system and its associated discharges will require additional effort but is feasible.

Following treatment, most soils and sediments are expected to meet the contamination criteria for reuse as landfill cover. Materials that do not achieve these criteria are expected to be disposed of off-site as remediation wastes, except for any RCRA hazardous wastes, which will require disposal in a RCRA C landfill and possibly treatment to meet LDRs. These off-site facilities are expected to be available when needed to receive any quantity of excavated material.

5.2.2.4.4 Implementability of Option D—Solvent Extraction Treatment with Off-Site Disposal

The solvent extraction treatment technology could be mobilized to and installed at the GE facility. The technology has been demonstrated to reduce PCB concentrations to below 2 mg/kg at several similar full-scale remediation projects. Maximum concentrations at these other sites have been as high as 40,000 mg/kg, higher than the maximum concentration of 8,635 mg/kg found in the EE/CA Reach. Reliable test methods have been developed to measure the concentration of residual PCBs and solvents in the treated soils to monitor the effectiveness of the treatment technology. Vendors are available to provide the necessary equipment and services to conduct the work.

Solvent extraction treatment plants can be expanded easily. Therefore, it is possible to modify a solvent extraction plant to a higher capacity if the plant would need to treat additional soil or sediments.

There are limitations in implementing the solvent extraction technology. For example, solvent extraction will be less effective or will require additional processing for soils containing a high percentage of fine and clay particles. The riverbanks contain from 13 to 27% silt and clay, whereas the sediments contain only 0 to 5% silt and clay. The small particles can cause problems in physically separating the contaminants from the soil. A bench-scale treatability test should determine if this would be problematic. Another limitation for solvent extraction may be cold weather. Some of the ancillary processes used are temperature dependent and may have reduced efficiency during severe cold weather. Additional energy input and insulated vessels may offset this potential problem.

To implement Option D, adequate land and utilities must be made available at the GE facility. The estimated area required for the equipment and facilities necessary to implement solvent extraction treatment is only approximately 2 acres. This is in addition to the area required for the base alternatives. Electrical and water services, as described previously for this option, must be available.

The solvent extraction facility is expected to meet the substantive requirements of permitting programs. The primary vendors selling solvent extraction services have already obtained nationwide TSCA permits to process PCBs with concentrations exceeding 50 mg/kg. Water and air treatment systems can be designed to meet site-specific requirements. No permits will be required.

Following treatment, most soils and sediments are expected to meet the contamination criteria for reuse as landfill cover. Materials that do not achieve these criteria are expected to be disposed of off-site as remediation wastes, except for any RCRA hazardous wastes, which will require disposal in a RCRA C landfill and possibly treatment to meet LDRs. These off-site facilities are expected to be available when needed to receive any quantity of excavated material.

5.2.2.5 Cost of Alternatives 1A, 1B, 1C, and 1D

The total estimated costs for Base Alternative 1 when implemented with each of the four treatment/consolidation/disposal options are summarized below. Alternative 1A is wet excavation with consolidation of some material at the GE consolidation areas and disposal of excess material off-site. Alternative 1B is wet excavation with disposal of all material off-site. Alternative 1C is wet excavation with thermal desorption treatment of material at GE and disposal of all material off-site. Alternative 1D is wet excavation with solvent extraction treatment of material at GE and disposal of all material off-site. The detailed cost estimates and backup are provided in Appendix B.

Cost Item	Alternative 1A	Alternative 1B	Alternative 1C	Alternative 1D
Actual Capital Costs	$32,099,100	$48,005,000	$72,656,600	$62,847,700
Actual Operating and Maintenance Costs	$1,826,000	$1,826,000	$1,826,000	$1,826,000
Total Actual Costs	$33,925,100	$49,831,000	$74,482,600	$64,673,700
Total Present Worth Costs	**$31,251,000**	**$46,171,000**	**$69,294,000**	**$60,093,000**

For disposal Option A, it was assumed that spreading and compaction of the 50,000 yd^3 of materials at GE's OPCAs will be performed by GE. As a contingency in case GE is not performing this work as a normal part of OPCA operations while EE/CA materials are being delivered to the OPCAs, a cost for spreading and compaction of these materials has been developed. The total additional estimated cost of these activities is $601,000. The cost is in addition to the Option A costs in this cost table and the other cost tables in Section 5.

5.3 BASE ALTERNATIVE 2—DRY EXCAVATION TO MEET CLEANUP CRITERIA/ DIVERSION BY SHEETPILING AND PUMPING BYPASS

A general description of this base alternative is presented in Subsection 5.3.1. Detailed descriptions of the various elements that comprise this alternative are presented in Subsections

5.3.1.1 through 5.3.1.8. The four consolidation/treatment/disposal options that will be evaluated with Base Alternative 1 are presented in Subsection 5.3.1.9. A detailed evaluation of Base Alternative 2, together with the four treatment/consolidation/disposal options, is presented in Subsection 5.3.2. The detailed evaluation is based on the criteria presented in Subsection 5.1. To avoid repetition, portions of the evaluation for this alternative that are identical to Alternative 1 and Options A, B, C, and D refer back to the Alternative 1 description and evaluation.

5.3.1 Base Alternative 2 Description

Base Alternative 2 differs from Base Alternative 1 in that it involves dry excavation of sediments in all subreaches. River diversion would be required for this alternative. Sheetpiling (an open channel intrusive method) would be used to divert the river in the first three and last four subreaches, whereas in the middle four cobble subreaches, the flow would be diverted from the river channel by pumping through a piping bypass. Bank soils and riverbed sediments would be excavated to meet cleanup criteria using standard or long-reach excavation equipment staged in the river, on access roads within the river channel, or at the top of the bank. Bank stability considerations may require additional excavation to create temporary or permanent bank slopes that will be stable. Generally, the riverbed would be backfilled with material similar to the material removed and restored to meet the habitat restoration objectives, including the installation of erosion protection materials as needed. The riverbanks would be backfilled with appropriate material but would also generally be lined to an elevation of 6 ft above the average river water level with erosion protection materials as needed. The upper riverbanks would be restored to meet the habitat restoration objectives.

Excavated sediments and wet bank soil would require dewatering to remove free water before consolidation or disposal and before treatment to improve treatment efficiency. After dewatering and characterization sampling, excavated bank soils and riverbed sediments would be transported to the appropriate treatment, consolidation, or disposal facility.

5.3.1.1 Mobilization, Site Preparation, and River Access

Mobilization, site preparation, and river access would be performed similarly to the description in Subsection 5.2.1.1 for Base Alternative 1; however, more lead time would likely be needed because more access points would be required along the river. Therefore, access requirements would be more extensive for this alternative than for the wet excavation alternative. Access would need to be sufficient at the non-cobble subreaches to allow a large crane (up to 150 tons) to access the river from the top of the riverbank to install sheetpiling. Access or access agreements would also be required for placement of the pumping bypass system, including a staging area for the pumps and area along roadways and riverbanks for discharge lines. In general, for the sheetpiling/pumping bypass alternative, it is assumed that the maximum requirements would be 30-ft-wide access routes/areas, measured from the top-of-bank, on both sides of the river to provide room for excavation equipment, water treatment equipment, and hauling of materials. Water treatment equipment would be centrally located for treatment of water from several excavation cells. At these locations, the access route/area could potentially be widened to accommodate the water treatment equipment. The access routes/areas would require a total of 10 acres along the entire EE/CA Reach, not including areas for laydown, bypass pumps, access to the river, and parking. Access routes would likely vary in size based on available space. Typically, a 15-ft-width was used as a minimum width for one-way traffic and a 25- to 30-ft width was used for two-way traffic. Limits of the access areas are indicated on Figures 2.1-6A through 2.1-6D along with dimensions and the intended use (access, staging, or construction). These figures were developed for conceptual purposes only and the limits shown are subject to change based on the selected removal action and predesign investigations.

5.3.1.2 Installation of Sheetpiling

Open channel diversion will be used for stream diversion at subreaches that do not have significant cobbles or shallow bedrock that would interfere with the driving of sheetpiling. Generally, open channel diversion would be accomplished by installing steel sheetpiling with hot-rolled watertight interlocks. The sheets would extend up the riverbanks to an elevation that provides adequate hydraulic free board based upon the 1-year, 24-hour rainfall event. The sheetpiling would be designed for the hydrostatic forces placed against the cofferdam formed by the sheets. It is anticipated that the sheetpiling would be installed to an approximate depth of 15 to 25 ft, which will depend on the geotechnical characteristics of the overburden materials through the EE/CA Reach. Sheeted areas would be constructed with sizes and intervals along the river that are most conducive to sheeting installation, river geometry, elevations of existing banks of the river, existing physical features (utilities, homes, businesses, etc.), and river restoration. For the purpose of this EE/CA, a 400-ft-long interval length is assumed. Work would be performed first on one bank and then on the opposite bank, so that both sides of the river would be remediated and restored as work progressed downstream. In areas where it is not possible to use sheetpiling (i.e., cobbly subreaches), a temporary river bypass system consisting of diesel bypass pumps and pipe would be used (see Subsection 5.3.1.3).

A riverbed excavation rate for sheetpiling of 250 yd^3 per excavation day is anticipated based on site conditions and professional judgment. A riverbank excavation rate of 300 yd^3 per excavation day is also anticipated. For riverbed excavation, a downtime allowance of 10% will be applied to account for routine operation and maintenance, storm events, and other weather-related issues. For riverbank excavation, the allowance is 5%.

5.3.1.2.1 Conceptual Sequence of Construction

Work would proceed in a downstream direction from Lyman Street following this general sequence of construction:

1. Construct access roads and staging/storage/laydown areas (see mobilization description, proposed locations shown on Figures 2.1-6A through 2.1-6D) along both sides of the river to accommodate remediation operations and installation of sheetpiling for each cell. Field verify limits of bridge foundations, locate all underground and aboveground utilities, and verify depth to bedrock where necessary prior to installation of sheetpiling.

2. Beginning at the upstream end of the EE/CA Reach, install sheetpiling longitudinally on the approximate centerline of the river channel cross section. Install lateral sheetpiling extending perpendicularly across the half channel section at the upstream and downstream locations to provide a complete watertight enclosure for each cell created.

3. Areas on the outboard side of the sheetpiling, where the river is diverted, would have an accelerated velocity due to the decrease in hydraulic area. The increased velocity may cause the existing river sediment to resuspend. Engineering controls would be used to help control resuspension of sediments from the riverbed and bank. For example, a flexible turf-reinforcement mat (TRM) could be placed over the outboard side of the sheetpile just prior to the river water diversion. The TRM would be anchored as recommended by the manufacturer to prevent river water from “uplifting” the mat. The mat would remain in place during excavation operations within the sheetpiled area then removed when the sheetpiling is moved laterally or downstream.

4. Dewater the first cell enclosure created. The water in the cell will be pumped out, until the water level is approximately 6 inches above the riverbed, and discharged directly into the river. Remaining water will be pumped and treated as discussed in Item 6 below.

5. Excavate contaminated sediment from the riverbed to the required limits. All excavated material would be loaded into (separate) lined or watertight dump trucks, and transported to the central dewatering facility, where it would be allowed to dewater before being sampled and transported to the consolidation, disposal, or treatment facility.

6. During excavation, backfilling, and restoration activities, any water from the excavation area resulting from seepage along the sheetpile wall or the bottom of the excavation would be collected and conveyed to a portable treatment unit located at a nearby staging area on or at the top of the riverbank (see Subsection 5.3.1.4).

7. Upon completion of sediment excavation in a cell, begin restoration activities for the riverbed (see descriptions for Base Alternative 1, which also apply to Base Alternative 2).

8. Following excavation and restoration of the riverbed, repeat the process for riverbank excavation and restoration.

9. Following approval of the remediated and restored cell, the flow diversion sheetpiling will be relocated. The next cell created would be on the opposite side of the channel. The typical flow diversion changeover sequence from one side of the river to the other is as follows:

    a. Begin removal of sheetpiling from the upstream and downstream lateral sections of cell 1. Sheet removal from the upstream and downstream ends of cell 1 would be coordinated so that downstream water levels do not flow back into the remediated cell. As piling is removed from the upstream end of cell 1, begin installation of lateral sheetpiling across the upstream end of cell 2.

    b. Complete sheetpiling installation at the upstream end of cell 2 (full channel flow is now diverted through the remediated cell 1).

    c. Complete sheetpiling installation at the downstream end of cell 2.

    d. Dewater cell 2 and resume removal operations in it.

    e. After adjacent (side by side) cells are remediated and restored to the full width of the river channel, TRMs or other controls could be placed and longitudinal sheetpiling installation would be advanced downstream as the upstream sheets are being removed from the completed cells.

Additional items that need to be considered and addressed during design and construction include the following: temporarily diverting surface drainage from dewatered cells, intercepting storm drain inflow across or around affected cells, and installing temporary supplemental surface stabilization materials along the existing channel slopes to control additional erosion caused by restricted flow/reduced channel section along the longitudinal sheetpiling.

5.3.1.3 Installation of Pumping Bypass

To divert water around the cobble subreaches (4-1, 4-2, 4-3, and 4-4A), a pumping bypass would be installed following completion of Subreaches 3-8, 3-9, and 3-10. The capacity of the pumping bypass system was selected to match the annual average daily flow rate at the EE/CA Reach, which is approximately 120 cfs (54,000 gpm). For costing purposes, the system would consist of 10 diesel-powered 12-inch centrifugal pumps (with two backups) capable of handling river water with up to 3.5-inch-diameter solids (based on pump capacity) at a flow rate of approximately 5,400 gpm each. Intake lines would be set in baffled, riprap-lined sumps constructed in the river just upstream of the area to be diverted. On the effluent side of the pumps, the discharge lines would be manifolded together into two 36-inch-diameter high-density polyethylene (HDPE) discharge lines. An area approximately 100 ft by 35 ft along the riverbank would be required for the pumps. The two discharge lines would be installed along the bank or along the edges of roadways. A pipe size transition to 48-inch diameter would be made prior to the discharge point. The discharge point in the river would be lined with riprap to prevent erosion and resuspension of contaminated sediments. The river would be coffered with an earthen dam just downstream of the sumps and just upstream of the discharge point to isolate the work area.

It is assumed that at any one time a maximum of 1,500 ft of river can be diverted. This length was selected based on factors including total length of time required to complete remediation, available space for staging the pumping system, and typical storm flow rates and return intervals for the river. However, a shorter or longer diversion distance could be selected for any given pumping capacity. The selected pumping bypass system can handle up to 120 cfs of river flow, which would not be exceeded approximately 70% of the time. When flows are expected to significantly exceed 120 cfs, all equipment would be removed from the river, the bypass system would be shut down, and work would stop until the river flow returned to normal conditions.

A riverbed excavation rate for pumping bypass of 300 yd^3 per excavation day has been assumed based on site conditions and professional judgment. The riverbank excavation rate assumed is also 300 yd^3 per excavation day. The cited riverbed excavation rate would be reduced by the amount of downtime resulting from storm events and routine operation and maintenance requirements (assumed to be 30% of the duration of the work in this river stretch). However, the downtime associated with riverbank excavation was assumed to be only 5% to account for operation and maintenance and weather issues.

During periods of high flow and work shutdown, water would run through the active excavation area, increasing the possibility of recontamination of previously clean areas. The shorter the length of diversion that is selected for remediation, the less likely that any one given excavation cell would experience river flows exceeding the capacity of the pumping system. However, if a shorter diversion is selected, the system would require setup and breakdown at more locations along the entire EE/CA Reach. For the purpose of this EE/CA, the pumped bypass diversion length is assumed to be approximately 1,500 ft.

5.3.1.4 Dewatering of Riverbed

Dewatering of coffered excavation areas (cells) would be required prior to and during excavation. The volume of water anticipated to be generated from dewatering activities includes existing river water trapped in the coffered cell, groundwater inflow, seepage through the sheetpile walls or earthen dams, direct precipitation, and run-on. Pumps capable of handling solids up to 3 inches in diameter would be used to remove the river water from the cells. Only the last 6 inches of the water initially captured in the cell and any subsequent seepage and run-on will require treatment. It is assumed that the treatment system would have a capacity of 300 gpm and would consist of centrifugal pumps, portable holding tanks, bag filters, activated carbon canisters, and intake and discharge lines. This flow rate is based on previous activities performed at the Building 68 and ½-mile removal actions and was selected for cost estimating purposes as a conservative measure. Actual dewatering rates could vary widely; however, this flow rate will cover a majority of flow rates encountered. Treated water generated from this operation would be monitored and discharged back to the river downstream of the diverted area, if discharge limits are met. However, it is possible that limited treatment would be required following an initial settling step in portable holding tanks. The need for such treatment would be determined by performing monitoring of the influent water.

5.3.1.5 Dry Excavation of Sediments and Soils

Dry excavation would be performed using standard or long-reach excavators. The equipment would be placed at the top of, partially down, or at the toe of riverbanks for bank excavation. The location of the excavation equipment would depend on the height and steepness of riverbank slopes, available access at the top of the bank, and ability to construct haul roads within the river. Riverbank excavation would be performed as described in Subsection 5.2.1.2.

Excavation of sediments in individual sheetpiled cells would be performed in the sequence described above in Subsection 5.3.1.2. Excavators would be located along the riverbank adjacent to the active cell or in the riverbed. Sediments would be placed directly into lined/watertight trucks for transport to the dewatering facility. The water content of the excavated riverbed sediments is expected to be much higher than that of the riverbank soils. Because a different level of dewatering may be required for the sediments, it is assumed that the wet sediments would be segregated from the drier riverbank soils during transport and dewatering.

Because a pumping bypass is proposed for the cobble subreaches, excavation would be performed across the entire channel at once in these subreaches, rather than performing the excavation in halves, as is required for the sheetpile diversion. Excavation in these bypassed areas would be performed first in the riverbed and then on the banks. An earthen dam would be installed at the head and at the end of the bypassed river section to maintain a dry riverbed in the bypassed river section. Excavation would be performed in 500-ft-long cells within the 1,500-ft bypassed river section. An earthen dam would be installed within the bypassed section to delineate the cell to be excavated and to minimize the recontamination of the remediated cells during overtopping events caused by high river flow rates. Upon completion of all three 500-ft cells within the bypassed section, flow would be returned to the river by removing the upstream and downstream coffer dams. The pumping bypass system would be moved to the downstream end of the completed 1,500-ft section. New upstream and downstream coffer dams would be installed to delineate an unremediated area of the riverbed, and work would begin in the next section. The total length of Subreaches 4-1 through 4-4A is 2,500 ft; therefore, the implementation would involve dividing the overall 2,500-ft length into two pumped bypass sections.

5.3.1.6 Confirmation Sampling

Confirmation sampling would not be performed for the reasons discussed in Subsection 5.2.1.3. Predesign activities would be required as described in Subsection 5.2.1.3.

5.3.1.7 Handling, Transportation, and Stockpile Management

Handling, transportation, and stockpile management would be performed as discussed in Subsection 5.2.1.4.

5.3.1.8 Dewatering of Excavated Materials

Dewatering of excavated materials would be performed as discussed in Subsection 5.2.1.5. Although dry excavation is being performed for this alternative, sediments would likely still be saturated. However, river water would not be removed in the excavator bucket together with sediment as in the wet excavation alternative. Therefore, it is expected that the quantity of water generated from dewatering activities will not be as large as for the wet excavation alternative.

5.3.1.9 Restoration of Riverbed

The riverbed would be restored as described in Subsection 5.2.1.6.

5.3.1.10 Restoration of Riverbanks

The riverbanks would be restored as described in Subsection 5.2.1.7.

5.3.1.11 Sampling of Stockpiles

Stockpiles of excavated material (sediment and soils) would be sampled as described in Subsection 5.2.1.8.

5.3.1.12 Consolidation, Disposal, and Treatment Options

Each base alternative has been evaluated with each of four consolidation, disposal, or treatment options. The following four options have been considered:

A. Consolidation of up to 50,000 yd^3 of contaminated soils and sediments at designated consolidation areas at GE with off-site treatment/disposal of excess material.

B. Off-site disposal of all excavated material.

C. Treatment of all suitable material at the GE facility using thermal desorption, with off-site disposal of all material.

D. Treatment of all suitable material at the GE facility using solvent extraction, with off-site disposal of all material.

5.3.1.12.1 Option A—Consolidation at GE with Disposal of Excess at Off-Site Facilities

Consolidation of excavated materials at GE and off-site disposal of excess material would be performed as described in Subsection 5.2.1.9.1.

5.3.1.12.2 Option B—Off-Site Disposal of All Excavated Material

Off-site disposal of excavated materials would be performed as described in Subsection 5.2.1.9.2.

5.3.1.12.3 Option C—Thermal Desorption Treatment with Off-Site Disposal

Thermal desorption treatment with off-site disposal of excavated materials would be performed as described in Subsection 5.2.1.9.3.

5.3.1.12.4 Option D—Solvent Extraction Treatment with Off-Site Disposal

Solvent extraction treatment with off-site disposal of excavated materials would be performed as described in Subsection 5.2.1.9.4.

5.3.2 Alternative 2 Evaluations

5.3.2.1 Base Alternative 2 Effectiveness

For Base Alternative 2, contaminated river sediments would be excavated using a dry excavation technique. Because water would not be flowing in the area of active excavation, resuspension of contaminated sediments and migration of contamination to downstream receptors would be minimal during excavation. Disturbance of the riverbed and potential resuspension of PCB contaminated sediment will occur during driving and removal of the sheetpiles. Engineering controls will be necessary to mitigate the effects of this disturbance and the resuspension it may cause. Disturbance will also occur during construction and removal of the earthen dams used for bypass pumping. Sediment scour in the bypass pump discharge area will be controlled using appropriately sited riprap. In addition, due to the fluctuating nature of the Housatonic River's response to storms, overtopping of the pumping bypass system is likely to occur during the remediation. This may cause resuspension of contaminated material in unfinished areas of the active excavation. The higher the design flow rate for the pumping system, the less likely that overtopping will occur for any given single diversion.

Because excavation will be performed "in the dry," quality control for the limits of excavation will not be difficult. Excavating accurately to the depths required to meet cleanup goals should not present significant difficulty.

This alternative will cause short-term impacts to adjoining properties due to truck traffic and noise during remedial activities. On days when excavation is occurring, approximately 20 round-trip truck trips per day would be required to transport excavated material from the river to the dewatering/stockpile area, and 20 round-trips per day to transport clean fill materials to the river. Therefore, truck traffic would increase by approximately 40 roundtrips per day during excavation, backfilling, and restoration activities.

Significant noise and vibration impacts on properties in the vicinity of the construction activity can be expected from the sheetpiling operations. It will not be possible to mitigate these impacts with engineering controls. If necessary, the hours of operation can be controlled. Additional impacts from noise and air pollution associated with the bypass pumps can also be expected. However, these impacts can be mitigated with engineering controls. Enclosures can be constructed around the pumps and mufflers installed on the exhaust lines to significantly reduce the noise impacts. Exhaust treatment equipment (carbon canisters) would reduce the impacts from air pollution. In addition, the design process should evaluate the possible use of electric pumps as a method of reducing noise and air emissions.

The estimated time to complete Base Alternative 2 is 34 months. This estimate includes time for mobilization and demobilization in addition to the excavation, dewatering, and restoration time. The estimate includes allowances for lost production time due to scheduled and unscheduled maintenance and unfavorable weather conditions, such as storm events, that would prevent working in the river. Implementation of the treatment/consolidation/disposal option selected is expected to occur concurrently with the base alternative and will not significantly impact the completion time.

5.3.2.2 Effectiveness of Options A, B, C, and D

The effectiveness of each of the four options was presented in Subsection 5.2.2.2 and does not change when combined with different base alternatives.

5.3.2.3 Base Alternative 2 Implementability

The dry excavation alternative with sheetpiling will require a number of temporary access points because a large crane will need access along the riverbanks to install the sheetpiling. Access through business and residential properties may require access agreements, potentially delaying the project. Access areas will also be required for the pumping bypass system and other staging areas; however, these areas are not expected to be in locations where access may be difficult to obtain.

The total estimated area required at the GE facility for the equipment and facilities necessary to implement this alternative is 3 acres. This total includes allowances for dewatering facilities, support trailers, support vehicle parking, equipment parking, and decontamination facilities. In addition, approximately 3,500 ft^2 would be required at several locations (sequentially) in the vicinity of the river for the bypass pumping system. Also, more than 10 acres along the riverbanks of the EE/CA Reach would be needed for primary access routes. Depending on the consolidation/disposal/treatment option selected, the required area may increase.

Excavation rates when using sheetpiles are not expected to be routinely impacted by the river because the sheetpiles will be set at the elevation of the 1-year storm. Therefore, overtopping may occur only once per year, on average.

In the cobble subreaches (4 out of 11 subreaches), where the bypass pumping system will be used, daily excavation rates are expected to be lower due to the difficulty of removing sediment from pockets in the irregular surface of the bedrock. In addition, the project productivity rate will be more dependent on river flows and weather conditions. The bypass system assumed for the EE/CA is capable of handling up to 120 cfs. River flows are typically less than this value 70% of the time (based on the USGS-Coltsville gauging station data); therefore, there will be time periods when the flow is above this value. During these times remediation work will not be performed. For pumping bypass, this may require that construction be performed 7 days per week when the river is low enough to operate the pumping system, limiting the work to the summer and fall months.

5.3.2.4 Implementability of Options A, B, C, and D

The implementability of the four options was presented in Subsection 5.2.2.4.

5.3.2.5 Cost of Alternatives 2A, 2B, 2C, and 2D

The total estimated costs for Base Alternative 2 when implemented with each of the four treatment/consolidation/disposal options are summarized below. Alternative 2A is dry excavation using sheetpiling and pumping bypass with consolidation of some material at the GE consolidation areas and disposal of excess material off-site. Alternative 2B is dry excavation using sheetpiling and pumping bypass with disposal of all material off-site. Alternative 2C is dry excavation using sheetpiling and pumping bypass with thermal desorption treatment of material at GE and disposal of all material off-site. Alternative 2D is dry excavation using sheetpiling and pumping bypass with solvent extraction treatment of material at GE and disposal of all material off-site. The detailed cost estimates and backup are provided in Appendix B.

Cost Item	Alternative 2A	Alternative 2B	Alternative 2C	Alternative 2D
Actual Capital Costs	$40,215,800	$56,121,700	$80,773,300	$70,964,400
Actual Operating and Maintenance Costs	$1,826,000	$1,826,000	$1,826,000	$1,826,000
Total Actual Costs	$42,041,800	$57,947,700	$82,599,300	$72,790,400
Total Present Worth Costs	**$37,570,000**	**$51,979,000**	**$74,309,000**	**$65,424,000**

For disposal Option A, it was assumed that spreading and compaction of the 50,000 yd^3 of materials at GE’s OPCAs will be performed by GE. As a contingency in case GE is not performing this work as a normal part of OPCA operations while EE/CA materials are being delivered to the OPCAs, a cost for spreading and compaction of these materials has been developed. The total additional estimated cost of these activities is $601,000. The cost is in addition to the Option A costs in this cost table and the other cost tables in Section 5.

5.4 BASE ALTERNATIVE 3—DRY EXCAVATION TO MEET CLEANUP CRITERIA/ DIVERSION BY PUMPING BYPASS

A general description of this base alternative is presented in Subsection 5.4.1. Detailed descriptions of the various elements that comprise this alternative are presented in Subsections 5.4.1.1 through 5.4.1.8. The four consolidation/treatment/disposal options that will be evaluated with Base Alternative 1 are presented in Subsection 5.4.1.9. A detailed evaluation of Base Alternative 3, together with the four treatment/consolidation/disposal options, is presented in Subsection 5.4.2. The detailed evaluation is based on the criteria presented in Subsection 5.1.

5.4.1 Base Alternative 3 Description

Base Alternative 3 is identical to Base Alternative 2 except that Base Alternative 3 uses pumping bypass as the river diversion method for the entire EE/CA Reach rather than for only the four cobble subreaches. An excavation rate of 300 yd^3 per excavation day for the riverbed and riverbanks is also anticipated for this alternative based on site conditions and professional judgment. However, because of the limited capacity of the bypass pumping system, a downtime allowance of 30% has been applied to riverbed excavation to account for overtopping, routine operation and maintenance, and other weather-related issues. For riverbank excavation, the downtime allowance is only 5%.

5.4.1.1 Mobilization, Site Preparation, and River Access

Mobilization, site preparation, and river access would be performed similarly to the discussion in Subsection 5.3.1.1 for Base Alternative 2. Access points for installation of sheetpiling would not be required for this alternative; however, additional access areas for the bypass pumps and the bypass piping would be required compared to Base Alternative 2.

5.4.1.2 Pumping Bypass Along Entire EE/CA Reach

The pumping bypass system would be installed and operated as discussed in Subsection 5.3.1.3. The main difference between Base Alternative 3 and Base Alternative 2 is that the pumping bypass system would be used for the entire EE/CA Reach rather than only the cobble subreaches. This requires that the system be set up and moved approximately 6 times to cover the EE/CA Reach, assuming a 1,500-ft diversion length is used.

5.4.1.3 Dewatering of Riverbed

Dewatering of the riverbed would be performed following diversion of the river and during remediation of sediments as described in Subsection 5.3.1.4, except that sheetpiling will not be used.

5.4.1.4 Dry Excavation of Sediments and Soils

Excavation would be performed as discussed in Subsection 5.3.1.5 for diversion using bypass pumping.

5.4.1.5 Confirmation Sampling

Confirmation sampling would not be performed for the reasons discussed in Subsection 5.2.1.3.

5.4.1.6 Handling, Transportation, and Stockpile Management

Handling, transportation, and stockpile management would be performed as described in Subsection 5.2.1.4.

5.4.1.7 Dewatering of Excavated Materials

Dewatering of excavated materials would be performed as described in Subsection 5.3.1.8.

5.4.1.8 Restoration of Riverbed

Riverbed restoration would be performed as described in Subsection 5.2.1.6.

5.4.1.9 Restoration of Riverbanks

Riverbank restoration would be performed as described in Subsection 5.2.1.7.

5.4.1.10 Sampling of Stockpiles

Stockpile sampling would be performed as described in Subsection 5.2.1.8.

5.4.1.11 Consolidation, Disposal, and Treatment Options

Each base alternative has been evaluated with each of four consolidation, disposal, or treatment options. The following four options have been considered:

A. Consolidation of up to 50,000 yd^3 of contaminated soils and sediments at designated consolidation areas at GE with off-site treatment/disposal of excess material.

B. Off-site disposal of all excavated material.

C. Treatment of all suitable material at the GE facility using thermal desorption, with off-site disposal of all material.

D. Treatment of all suitable material at the GE facility using solvent extraction, with off-site disposal of all.

5.4.1.11.1 Option A—Consolidation at GE with Disposal of Excess at Off-Site Facilities

Consolidation of excavated materials at GE and off-site disposal of excess material would be performed as described in Subsection 5.2.1.9.1.

5.4.1.11.2 Option B—Off-Site Disposal of All Excavated Material

Off-site disposal of excavated materials would be performed as described in Subsection 5.2.1.9.2.

5.4.1.11.3 Option C—Thermal Desorption Treatment with Off-Site Disposal

Thermal desorption treatment with off-site disposal of excavated materials would be performed as described in Subsection 5.2.1.9.3.

5.4.1.11.4 Option D—Solvent Extraction Treatment with Off-Site Disposal

Solvent extraction treatment with off-site disposal of excavated materials would be performed as described in Subsection 5.2.1.9.4.

5.4.2 Alternative 3 Evaluations

5.4.2.1 Base Alternative 3 Effectiveness

For Base Alternative 3, contaminated river sediments would be excavated using a dry excavation technique. Because water would not be flowing in the area of active excavation, resuspension of contaminated sediments and migration of contamination to downstream receptors would be minimal. However, due to the fluctuating nature of the Housatonic River's response to storms, overtopping of the pumping bypass system is likely to occur during the remediation. This may cause resuspension of contaminated material in unfinished areas of the active excavation. The higher the design flow rate for the pumping system, the less likely overtopping will occur for any given single diversion.

Disturbance will also occur during construction and removal of the earthen dams used for bypass pumping. Sediment scour in the bypass pump discharge area will be controlled using appropriately sited riprap.

Because excavation will be performed "in the dry," quality control for the limits of excavation will not be difficult. Excavating accurately to the depths required to meet cleanup goals should not present significant difficulty.

This alternative will cause short-term impacts to adjoining properties due to truck traffic and noise during remedial activities. On days when excavation is occurring, approximately 20 round-trip truck trips per day would be required to transport excavated material from the river to the dewatering/stockpile area, and 20 roundtrips per day to transport clean fill materials to the river. Therefore, truck traffic would increase by approximately 40 roundtrips per day during excavation, backfilling, and restoration activities.

Impacts on properties in the vicinity of the construction activity from noise and air pollution associated with the bypass pumps can be expected. However, these impacts can be mitigated with engineering controls. Enclosures can be constructed around the pumps and mufflers installed on the exhaust lines to significantly reduce the noise impacts. Exhaust treatment equipment would reduce the impacts from air pollution.

The estimated time to complete the base alternative is 23 months. This estimate includes time for mobilization and demobilization in addition to the excavation, dewatering, and restoration time. The estimate includes allowances for lost production time due to scheduled and unscheduled maintenance and unfavorable weather conditions, such as storm events, that would prevent working in the river. Implementation of the treatment/consolidation/disposal option selected is expected to occur concurrently with the base alternative and will not significantly impact the completion time.

5.4.2.2 Effectiveness of Options A, B, C, and D

The effectiveness of each of the four options was presented in Subsection 5.2.2.2 and does not change when combined with different base alternatives.

5.4.2.3 Base Alternative 3 Implementability

The dry excavation alternative with pumping bypass along the entire length of the EE/CA will require access areas for staging the bypass pumps and access along the top of the banks to route bypass piping and for dewatering pumps and water treatment equipment. However, these areas are not expected to be in locations where access may be difficult to obtain.

The total estimated area required for the equipment and facilities necessary to implement this alternative is 3 acres. This total includes allowances for dewatering facilities, support trailers, support vehicle parking, and equipment parking. In addition, approximately 3,500 ft^2 would be required at several locations (sequentially) in the vicinity of the river for the bypass pumping system. Also, more than 10 acres along the riverbanks of the EE/CA Reach would be needed for primary access routes. Depending on the consolidation/disposal/treatment option selected, the required area may increase.

Productivity rates for dry excavation are not expected to be routinely impacted by the river because all work will be conducted “in the dry,” creating fewer quality control issues. For dry excavation, an average productivity rate of 300 yd^3 per day is anticipated except when working in the cobble reaches where a lower production rate is anticipated due to the irregular surface of the bedrock, as described in Subsection 5.3.2.3. In addition, a 30% downtime allowance is anticipated to account for scheduled and unscheduled maintenance and weather-related shutdowns. The pumping bypass allows for continuous full channel excavation rather than half-channel excavation. This is expected to result in increased productivity in the absence of overtopping.

For the bypass pumping system, the project productivity rate will depend on river flows and weather conditions. The bypass system assumed for the EE/CA is capable of handling up to 120 cfs. River flows are generally less than this value 70% of the time; therefore, there will be time periods when the flow is above this value. During these times remediation work will not be performed. This may require that construction be performed 7 days per week when the river is low enough to operate the pumping system, limiting the work to the summer and fall months. Because a single river diversion distance of 1,500 ft was selected, the entire pumping system will require breakdown and setup at approximately five locations to complete the removal action. The longer this distance is, the more likely overtopping will occur in that bypassed area since the diversion will be in place for a longer period of time. To minimize recontamination of remediated areas within the diversion area, cells will be created within the diversion area with earthen dams.

5.4.2.4 Implementability of Options A, B, C, and D

The implementability of the four options was presented in Subsection 5.2.2.4.

5.4.2.5 Cost of Alternatives 3A, 3B, 3C, and 3D

The total estimated costs for Base Alternative 3 when implemented with each of the four treatment/consolidation/disposal options are summarized below. Alternative 3A is dry excavation using only pumping bypass with consolidation of some material at the GE consolidation areas and disposal of excess material off-site. Alternative 3B is dry excavation using only pumping bypass with disposal of all material off-site. Alternative 3C is dry excavation using only pumping bypass with thermal desorption treatment of material at GE and disposal of all material off-site. Alternative 3D is dry excavation using only pumping bypass with solvent extraction treatment of material at GE and disposal of all material off-site. The detailed cost estimates and backup are provided in Appendix B.

Cost Item	Alternative 3A	Alternative 3B	Alternative 3C	Alternative 3D
Actual Capital Costs	$36,801,400	$52,707,300	$77,358,900	$67,550,000
Actual Operations and Maintenance Costs	$1,826,000	$1,826,000	$1,826,000	$1,826,000
Total Actual Costs	$38,627,400	$54,533,300	$79,184,900	$69,376,000
Total Present Worth Costs	**$35,461,000**	**$50,295,000**	**$73,284,000**	**$64,137,000**

For disposal Option A, it was assumed that spreading and compaction of the 50,000 yd^3 of materials at GE's OPCAs will be performed by GE. As a contingency in case GE is not performing this work as a normal part of OPCA operations while EE/CA materials are being delivered to the OPCAs, a cost for spreading and compaction of these materials has been developed. The total additional estimated cost of these activities is $601,000. The cost is in addition to the Option A costs in this cost table and the other cost tables in Section 5.

5.5 COMPARISON OF ALTERNATIVES

This subsection provides a comparison of the alternatives, using the criteria outlined in Subsection 5.1. These criteria are:

1. Effectiveness

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume Through Treatment
- Short-Term Effectiveness

2. Implementability

- Technical Feasibility
- Availability of Services and Materials
- Administrative Feasibility
- State Acceptance
- Community Acceptance

3. Cost

- Direct Capital Costs
- Indirect Capital Costs
- Annual Costs

In the comparative analysis of the alternatives developed for this EE/CA, all of the criteria above will be considered, with the exceptions of State Acceptance and Community Acceptance. These two criteria will be evaluated at a later time based on comments and input from the state regulatory community and the public. These comments will be received during the public comment period for the EE/CA. Documentation of state and community acceptance issues will be provided in the Action Memorandum for the Preferred Alternative.

The alternatives undergoing comparative analysis were described in detail in Subsections 5.2 through 5.4.

The following subsections compare the alternatives using each of the evaluation criteria previously described. Figures 5.5-1 and 5.5-2 summarize the comparative analysis for the three base alternatives and the four disposal options, respectively.

5.5.1 Effectiveness

The effectiveness of an alternative refers to its ability to meet the objectives within the scope of the removal action. Subsections 5.5.1.1 through 5.5.1.5 compare the effectiveness of the alternatives.

5.5.1.1 Protection of Human Health and the Environment

Base Alternative 1 involves wet excavation of sediment, which, under normal conditions, has a greater potential than the dry-excavation-based alternatives for resuspension and mobilization of contaminated sediments to downstream locations. However, engineering controls can be used to reduce the impacts from the river velocity (e.g., jersey barriers) and to mitigate the downstream transport of resuspended sediment (e.g., sediment dams). Similarly, engineering controls would be effective in minimizing the impact of installing and removing sheetpiling and of overtopping events for the dry excavation alternatives, which also have the potential for mobilizing contamination. Consequently, each base alternative will result in overall protection of human health and the environment through removal of river sediments and bank soils to achieve cleanup goals and implementation of engineering controls.

For Alternatives 1A, 2A, and 3A, it has been assumed that up to 50,000 yd^3 of contaminated material will be consolidated at the nearby GE consolidation areas. Proper operation, maintenance, and control of the consolidation facilities will protect their integrity and minimize the potential for migration of contamination. The volume of soils and sediments exceeding the capacity of the consolidation areas for Alternatives 1A, 2A, and 3A and all material for Alternatives 1B, 2B, and 3B will be sent off-site to appropriate licensed treatment/disposal facilities. It is anticipated that these facilities will be operated as required to be protective of human health and the environment.

For the six alternatives involving treatment at the GE facility to reduce PCB concentrations (Alternatives 1C, 1D, 2C, 2D, 3C, and 3D), the overall protectiveness would be greater than for the alternatives that do not involve treatment because PCB constituents in treatment residuals would ultimately be destroyed in an off-site incinerator. Engineering controls would be incorporated into the treatment systems to reduce risks to site workers and mitigate migration of contaminants to the environment; however, some incrementally greater risk would be expected from the additional handling and discharges associated with the treatment systems. This additional risk from treatment operations would be offset compared to off-site disposal options because of the increased risk associated with the transportation of untreated soils and sediments to off-site facilities.

5.5.1.2 Compliance with ARARs

All alternatives are expected to comply with ARARs as stated in the ARARs table attached as Appendix C. ARARs for the consolidation areas were approved by EPA in its letter to GE dated 17 September 1999 (00-0392).

All alternatives involve some degree of riverbed and bank restoration, following sediment and bank soil removal, and therefore are in compliance with ARARs pertaining to ecosystem/habitat protection and preservation.

5.5.1.3 Long-Term Effectiveness and Permanence

All the alternatives evaluated will achieve protection of human health and the environment following removal of sediment and banksoil exceeding the cleanup criteria; however, some contamination will be left in place at depth. Alternative 1 is potentially less effective than Alternatives 2 and 3 because of the difficult quality control during excavation and backfilling. The permanence of each of the alternatives will, to a degree, depend on the engineering controls implemented to stabilize the riverbanks to prevent future releases of contaminants due to bank erosion. Where practical, engineering controls will be implemented to minimize leaching from soil via groundwater to surface soil, surface water, and riverbed sediment.

The cleanup criteria for the bank soils are dependent on the land use. Residential properties have a stricter cleanup criterion than recreational property. Consequently, the long-term effectiveness of all the alternatives for recreational properties is dependent on maintaining the currently designated land use in the future. All of the alternatives assume that the river banks in recreational properties cannot be developed in the future as residential property. If recreational properties are allowed to become residential properties, then additional remediation may be required to be protective for the new use.

For Alternatives 1A, 2A, and 3A, it has been assumed that up to 50,000 yd^3 of contaminated material will be consolidated at the nearby GE consolidation areas. Proper operation, maintenance, and control of the consolidation facilities will protect their integrity, and minimize the potential for migration of contamination over the long term. The volume of soils and sediments exceeding the capacity of the consolidation areas in Alternatives 1A, 2A, and 3A and all material for Alternatives 1B, 2B, and 3B will be sent off-site to appropriate licensed treatment/disposal facilities. It is anticipated that these facilities will be operated as required to effectively contain contamination for the long term. For the six alternatives involving treatment at the GE facility to reduce PCB concentrations (Alternatives 1C, 1D, 2C, 2D, 3C, and 3D), the long-term effectiveness and permanence would be greater than for the alternatives that do not involve treatment because PCB constituents in treatment residuals would ultimately be destroyed in an off-site incinerator.

5.5.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The toxicity and volume of the contaminated sediments and soils will be reduced through implementation of Alternatives 1C, 1D, 2C, 2D, 3C, and 3D. These alternatives involve thermal desorption or solvent extraction treatment of excavated soils and sediments and ultimate destruction of the contaminants by off-site incineration of residuals at a TSCA facility. The destruction of PCBs is irreversible for these treatment alternatives.

No reduction in the toxicity, mobility, or volume of contaminated soils and sediments would be achieved with Alternatives 1A, 1B, 2A, 2B, 3A, and 3B unless off-site treatment is required to meet land disposal requirements. Off-site treatment would be expected only for a small volume (less than 3%) of the excavated materials.

5.5.1.5 Short-Term Effectiveness

During implementation of each alternative, potential impacts associated with excavation and handling of the contaminated soil/sediment include contaminant mobilization, fugitive dust emissions, noise and vibration exposure, increased truck traffic, and the possibility for spills or other releases during materials handling and operations. These impacts would affect the surrounding community, the environment, and site workers to varying degrees during implementation of the removal action.

Base Alternative 1 involves wet excavation of sediment, which, under normal conditions, has a greater potential than the dry-excavation alternatives for resuspension and mobilization of contaminated sediments to downstream locations. This could result in downstream exposure of human and ecological receptors to surface water/sediments containing concentrations of PCBs in excess of levels considered protective of human health and the environment. Engineering controls can be used to reduce the impacts from the river velocity (e.g., jersey barriers) and to mitigate the downstream transport of resuspended sediment (e.g., sediment dams).

For Base Alternatives 2 and 3, river flow in some or all of the EE/CA subreaches will be diverted using a pumping bypass. During storm events, overtopping of the bypass system may occur, resulting in resuspension of sediment. Engineering controls, such as sediment dams and turbidity barriers, would be used to minimize these impacts on remediated cells.

Similarly, for Base Alternative 2, which uses sheetpiling to divert the river in some subreaches, storm events could cause overtopping of the sheetpiling system, resulting in resuspension of sediment; however, this is expected to occur infrequently. In addition, some riverbed disturbance and potential resuspension of PCBs could occur while driving and removing sheetpiles. Engineering controls would also be effective in minimizing the impact of sheetpile driving and overtopping events for this base alternative.

In the short term, Base Alternative 1 would result in a greater mass of PCB release from the EE/CA Reach than Alternatives 2 and 3. Base Alternative 2 may be the least affected by rainfall events because the sheetpiles can be economically sized to meet flow conditions occurring in the river the majority of the time. Increasing the size of the pumping bypass system to avoid overtopping for a greater percentage of the project time will result in a more significant cost addition than that required for modification of the sheetpiling. For Base Alternative 1, rainfall events may cause work in the river to stop due to the increased depth and velocity of the water.

Alternatives 1C, 1D, 2C, 2D, 3C, and 3D, involving treatment at the GE facility, would create additional exposure for the community, the environment, and site workers to emissions and noise. In addition, site workers have additional opportunities for exposure to contaminated soil/sediment during materials handling associated with treatment. Engineering controls would be implemented and incorporated into the treatment systems to reduce risks to site workers and mitigate migration of contaminants to the environment; however, some incrementally greater risk would be expected from the additional handling and discharges associated with the treatment systems. This additional risk from treatment operations would be offset compared to off-site disposal options because of the increased risk associated with the transportation of untreated soils and sediments to off-site facilities.

Base Alternative 2 would create the greatest amount of noise and vibration exposure during installation and removal of the sheetpiles for river diversion. Engineering controls would not be effective in reducing the noise for nearby residents or businesses, although hearing protection would be effective for site workers. Also, engineering controls would not be effective for vibration problems associated with sheetpile installation and removal. This will be a significant problem in areas along the EE/CA Reach where residences or businesses are located near riverbanks. Some restriction on the time of day when sheetpiling activities will be allowed may be required.

Base Alternatives 2 and 3, which use diesel pumps for river diversion, would create potential noise and air pollution impacts 24 hours per day; however, engineering controls such as enclosures, mufflers, and exhaust treatment equipment would minimize the adverse impacts. Also, the heavy use of diesel fuel in proximity to the river creates a risk of releases. Electric pumps, which may be a viable alternative to diesel pumps, would create less noise and pollution.

All alternatives include dewatering operations at the GE facility, which requires the transportation by truck of wet soils and sediments from the points of excavation to the GE facility. The existing roads in the vicinity of the excavation areas downstream of Elm Street are relatively narrow and designed for residential use. Hauling material to the GE facility for dewatering and staging will likely create traffic problems, potential safety concerns, and nuisance noise and air pollution. These impacts cannot be easily mitigated. Alternatives 1A, 2A, and 3A would have the fewest truck trips and associated short-term impacts on local residents.

For all alternatives, water from dewatering operations would be treated prior to discharge to the river to protect the river water quality. These discharges would be routinely sampled to monitor the performance of the water treatment systems.

Base Alternatives 1 and 3 could be implemented in a shorter time period than Base Alternative 2. However, short-term impacts, as described above, would be present for all alternatives during the entire implementation period at varying degrees of intensity, and would depend on the effectiveness of engineering controls, where practical, to mitigate the impacts.

5.5.2 IMPLEMENTABILITY

The implementability of an alternative addresses the technical and administrative feasibility of executing the alternative. Subsections 5.5.2.1 through 5.5.2.3 compare the implementability of the alternatives. Community and state acceptance criteria will be evaluated after the receipt of comments following a public hearing on the proposed alternative.

5.5.2.1 Technical Feasibility

None of the alternatives evaluated involves the use of innovative or unproven technologies; however, each alternative involves constructability issues that must be addressed to successfully implement the alternative.

For Base Alternative 1, wet excavation, there are difficulties associated with controlling the sediment excavation depth below the water surface, minimizing recontamination of the excavated area, mitigating the downstream transport of contaminated sediments, and installation of restoration backfill. Control of underwater excavation and backfill activities requires greater sophistication compared to control of work performed under Base Alternatives 2 and 3. Downstream transport problems can be overcome to a degree with engineering controls, such as jersey barriers to minimize the impact of the river velocity on excavation and backfilling activities and sediment dams to mitigate the transport of contaminated sediment from the EE/CA Reach. Contamination that is mobilized to downstream areas within the EE/CA Reach will be removed as the excavation activity progresses downstream. Contamination that is mobilized beyond the EE/CA Reach will not be removed under this alternative.

For Base Alternatives 2 and 3, overtopping events could cause recontamination of already remediated areas and potentially transport contaminated sediments downstream. For Base Alternative 2, removal of sheetpiles would likely bring any contamination at depth to the surface, where it would be transported downstream by the flowing river. Also, for Base Alternatives 2 and 3, failure of the diversion structures, especially during storm events, would allow contaminated sediments to migrate downstream. Conservative design of the diversion structures and engineering controls, such as sediment dams, would be used to mitigate these potential problems.

Base Alternatives 2 and 3 require the use of a pumping bypass system for river diversion. Further evaluation during design of the adequacy of available electrical service for electric pumps should be conducted as a possible mitigation measure for noise and emission impacts; for the purposes of this EE/CA, diesel pumps have been evaluated. Diesel pumps will require frequent monitoring of fuel levels and refueling to properly maintain the pumping capacity. For either diesel or electrical pumps, suction lift requirements will dictate that the pumps be installed at an elevation within a few feet above the river elevation. This will impose construction limitations on the bypass system and may put the bypass system in some jeopardy from flooding during significant storm events.

For all alternatives, technical feasibility is adversely impacted by riverbank stability concerns and the potential collapse that could result from excavating saturated riverbed sediment at the toe of the riverbank slope. Bank instability is expected to be more of a concern for Base Alternative 1 than for the other alternatives because of the erosion effects of the flowing river on the toe of the slope. However, engineering controls and bank slope monitoring, for all alternatives, would be expected to be effective in preventing or minimizing slope failures during construction.

The ability to implement Alternatives 1A, 2A, and 3A will depend on the availability of capacity in the two consolidation areas for contaminated soils and sediments from the EE/CA Reach. Because several other removal actions associated with PCB contamination along the Housatonic River will precede the EE/CA Removal Action, the capacity limitations of the consolidation areas may be reached before this EE/CA removal action is completed.

Any monitoring of Hill 78/Building 71 consolidation areas at GE will be conducted by other parties, and is not included in the scope or cost estimates of any of the alternatives evaluated in this EE/CA. Only Alternatives 1A, 2A, and 3A would involve consolidation at GE and require monitoring of the consolidation areas.

For all alternatives, riverbank restoration will generally be performed from the point where the riverbed erosion protection material ends to the top of the bank. Restoration will include establishing a vegetative cover and planting the specified species. Activities should occur during the appropriate seasons (generally spring) to maximize the survival of plantings. Significant effort will be required to monitor and nourish the planted species and to minimize the impacts from invasive species. Unfavorable weather would be one of several factors that could adversely impact survival rates. Some replanting is expected to achieve the anticipated restoration goals.

Access will be required to perform the necessary monitoring, which is expected to last up to 20 years. These issues would be similar for all three base alternatives.

5.5.2.2 Availability of Services and Materials

For the excavation portion of each alternative, it is presumed that the same equipment and materials will be used. For river diversion/piping alternatives, piping material and sufficiently large pumps would be required, whereas for river diversion alternatives involving sheetpiling, sheetpile material and associated heavy equipment would be required in addition to pump and piping equipment and materials. All alternatives will require large amounts of fill material, gravel, riprap, and topsoil to complete site restoration; however, these materials are generally available and should not present difficulties when completing the removal action.

Riverbank restoration materials, notably plants, are not readily available in the quantities required for this project; however, this limitation applies to all alternatives.

The treatment systems required for Alternatives 1C, 1D, 2C, 2D, 3C, and 3D are somewhat less common than the materials required for excavation, transportation, and disposal, but the equipment is available through vendors, who can also supply the necessary expertise for operating the systems.

5.5.2.3 Administrative Feasibility

Access routes to and along the river will be required for each alternative to provide access for excavation equipment, material transport trucks, and site workers. Base Alternative 1, involving wet excavation, will require the fewest number of access points, assuming that the river could serve as an access route (for all alternatives). Base Alternative 2, involving the use of sheetpiling) would likely require the greatest number of access points (for driving sheetpiling into the riverbed) and the largest access areas (for storage of sheetpiles). In addition, access areas along the top of the riverbank in the cobble reach area will be required for routing the bypass piping, and additional area will be required (at two or more locations along the cobble reach) for locating the bypass pumps. Base Alternative 3 will require access along the top of the riverbank throughout the entire EE/CA Reach for routing the bypass piping and at several locations along the EE/CA Reach for locating the bypass pumps.

All of the alternatives will require access to approximately 2 to 2.5 acres of land at the GE facility to construct dewatering/stockpiling facilities. In addition, treatment Alternatives 1C, 1D, 2C, 2D, 3C, and 3D will require an additional 1.5 to 2 acres of land for treatment-related operations.

Because this non-time critical removal action is proceeding under CERCLA, state permits are not required for the work in the river. The work, however, will meet all ARARs as described in Appendix C. In all cases, coordination with federal, state, and local agencies, such as EPA, MADEP, U.S. Fish and Wildlife Service, and the local conservation commission will be conducted.

5.5.3 Cost

A summary of the total costs for each of the three base alternatives and the four disposal options is given in Tables 5.5-3 and 5.5-4, respectively. Table 5.5-5 lists the total actual and present value costs for each of the possible combinations of base alternatives and consolidation/disposal/treatment options.

From Table 5.5-3, the total actual costs for the base alternatives range from approximately $22 million for Base Alternative 1–Wet Excavation to approximately $30 million for Base Alternative 2–Dry Excavation/Sheetpiling. Base Alternative 3 – Dry Excavation/Pumped Bypass falls in the middle of this range at approximately $27 million. However, both Base Alternative 1 and Base Alternative 3 are more susceptible to cost changes than Base Alternative 2, because they are more likely to experience shutdowns or slowdowns in wet weather. In the case of wet excavation (Base Alternative 1), even moderately higher than normal river flows will likely make excavation/backfilling more difficult and prone to more significant quality control problems. In the case of pumped bypass (Base Alternative 3), the pumps will handle only a river flow of up to approximately 120 cfs, which in a period of wet weather could be exceeded a large percentage of the time. Wet excavation costs could also potentially increase if increased excavation is needed to remove sediment falling into the excavation area, and if additional backfill is needed to address uncertainty in the necessary backfill volume and loss during placement.

The consolidation/disposal/treatment options (Table 5.5-4) have a much greater variability in total cost, with Option A–Consolidation at GE at the low end of the range (approximately $12 million), and Treatment Options C and D at the high end of the range ($53 million and $43 million, respectively). However, Consolidation Option A relies on the availability of capacity in the consolidation areas. If that capacity is not available, the cost of the alternatives using this option will be significantly greater.

The total costs for each base alternative/disposal option combination shown in Table 5.5-5 reflect the above cost ranges. The overall range of actual costs is from approximately $34 million (Alternative 1A–Wet Excavation and Consolidation at GE) to approximately $83 million (Alternative 2C–Dry Excavation/Sheetpiling and Thermal Desorption Treatment). Alternatives 1A, 2A, and 3A, all involving consolidation at GE, are clustered at the low end of the range ($34 to $42 million), whereas Alternatives 1C, 1D, 2C, 2D, 3C, and 3D, all involving on-site treatment, are clustered at the high end of this range ($65 to $83 million).

In summary, the total actual cost range for EE/CA alternatives is from approximately $34 million to $83 million. The most significant cost factor is the choice of disposal option, as Option A–Consolidation at GE is approximately $16 million less expensive than the next nearest option (Option B–Off-Site Disposal). In comparison, the total range of actual costs between all three base alternatives is only approximately $6 million. Although Alternative 1A is the least expensive alternative, Alternatives 1B and 1C are not significantly more expensive on a percentage basis.

6. RECOMMENDED REMOVAL ACTION ALTERNATIVE

EPA, with input from the public and applicable stakeholders, will select the appropriate alternative that meets the removal action objectives.

SECTION 1

TABLES

Table 1.1-1

Comparison of EE/CA to RI/FS

EE/CA PROCESS	RI/FS PROCESS*
1. EE/CA Approval Memorandum ▪ Secure management approval and funding for EE/CA ▪ Include finding of actual or threatened release and, if present, an imminent and substantial endangerment and general site information and costs ▪ Document that situation meets NCP criteria and action is non-time-critical	**1a. Pre-RI/FS Scoping** ▪ Collect existing data ▪ Visit site/identify areas of concern ▪ Generate statement of work
	1b. RI/FS Scoping ▪ Collect/analyze existing data ▪ Determine need for/implement additional studies ▪ Develop preliminary remedial action alternatives/objectives ▪ Evaluate need for treatability studies ▪ Begin preliminary identification of ARARs ▪ Identify data needs/data quality objectives ▪ Design data collection program ▪ Develop work plan ▪ Identify health and safety protocols
EE/CA	**REMEDIAL INVESTIGATION**
2. EE/CA Executive Summary ▪ Identifies threat ▪ Describes removal action objectives ▪ Summarizes recommended action	
3. Site Characterization ▪ Collect site description and background ▪ Identify previous removal actions ▪ Determine source, nature, and extent of contamination ▪ Collect analytical data ▪ Perform streamlined risk evaluation ▪ Identify contaminant- and location-specific ARARs	**2. Site Characterization** ▪ Investigate site physical characteristics ▪ Define sources of contamination ▪ Determine nature and extent of contamination ▪ Conduct laboratory analyses ▪ Conduct data analyses ▪ Conduct baseline risk assessment ▪ Identify contaminant- and location-specific ARARs ▪ Define remedial action goals ▪ Draft RI Report
4. Identification of Removal Action Objectives ▪ Evaluate statutory limits ▪ Determine scope of removal action ▪ Determine schedule of removal action	

Table 1.1-1

Comparison of EE/CA to RI/FS
(Continued)

EE/CA PROCESS	**RI/FS PROCESS***
	FEASIBILITY STUDY
5. Identification and Analysis of Removal Action Alternatives ▪ Identify treatment technologies (presumptive remedy and treatability studies, as appropriate) ▪ Evaluate effectiveness – Overall protection of human health and the environment – Compliance with ARARs – Long-term effectiveness and permanence – Reduction of toxicity, mobility, or volume through treatment – Short-term effectiveness ▪ Evaluate implementability – Technical feasibility – Administrative feasibility – Availability of services and materials – State acceptance – Community acceptance ▪ Evaluate cost	**3a. Development of Alternatives** ▪ Remedial action objectives ▪ General response actions ▪ Volumes or areas of media ▪ Screen technology and process options ▪ Process options identification ▪ Technology alternatives ▪ Action-specific ARARs **3b. Screening of Alternatives** ▪ Effectiveness ▪ Implementability ▪ Cost ▪ Innovative technologies **3c. Performance of Treatability Studies** ▪ Data requirements ▪ Bench- or pilot-scale study ▪ Treatability test work plan ▪ Documentation of results **4. Detailed Analysis of Alternatives** ▪ Overall protection of human health and environment ▪ Compliance with ARARs ▪ Long-term effectiveness and performance ▪ Reduction of toxicity, mobility, or volume through treatment ▪ Short-term effectiveness ▪ Implementability ▪ Cost ▪ State acceptance ▪ Community acceptance (analyze alternatives against these nine criteria)
6. Comparative Analysis of Removal Action Alternatives (See criteria above) Compare alternatives	**5. Comparative Analysis**: (See criteria above) Compare alternatives
7. Recommended Removal Action Alternative (summarized in Action Memorandum) [Public comment period on EE/CA of at least 30 days]	**6. Preferred Remedial Alternative (summarized in Proposed Plan)** [Public comment period of at least 30 days]

* OSWER Publication 9355.3-01. *Guidance for Conducting Remedial Investigations and Feasibility Studies (RI/FS) Under CERCLA*. (October 1988). EPA/540-G-89/004. PB89-184626. (99-0001).

Source: *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (99-0012).

SECTION 2

TABLES

Table 2.1-1

Summary of Physical Characteristics
EE/CA Reach of the Housatonic River
Pittsfield, Massachusetts

Subreach	Total Distance (ft)	Average Width (ft)	Transects Included	Average Sediment Thickness (ft)	Predominant Habitat	Water Depth (ft)	Predominant Substrate Grain Size[a]	Bank Height (ft)	Bank Slope[b]	West Bank Development	East Bank Development	Average PCB Conc. (ppm)	River Bottom Grade Start/ End/Slope(%)
3-8	800	36	(Lyman St)T064-T080	2-4	Run	2-3	SP/SW	8-10	3:1 4:1	Comm/Ind	Rec/Undev	8.8	968/968/flat
3-9	600	46	T081-T092	2-3	Run	2-3	SP/SW	8-12	2.5 :1 5:1	Res/Comm	Rec/Undev	102.4	968/968/flat
3-10	700	43	T093-T106(Elm St)	2-4	Run	2-3	SP/SW	10-18	1.5 :1 4:1	Comm/Undev	Comm/Res	14.2	968/968/flat
4-1	400	40	T107-T114	0-2	Riffle/Run	1-2/2-4	Cobbles	18-20	1 :1 2 :1	Road	Res	74.4	968/966/0.5
4-2	800	43	T115-T130	0-4	Riffle	1-3	Cobbles	20-28	2 :1 3.5 :1	Road	Res	17.5	966/962/0.5
4-3	1000	43	T131-T150 (Dawes Ave)	0-2	Riffle	0.5-1.5	Cobbles	16-18	1.5 :1 6.5 :1	Res	Road	81.1	962/960/0.2
4-4A	300	38	T151-T156	1-3	Riffle	1-1.5	SW/SP	6-14	1.5 :1 6.5 :1	Res	Res	6.3	960/960/flat
4-4B	600	32	T157-T168	1-3	Run	2-3	SW/SP	6-14	1.5 :1 6.5 :1	Res	Undev	18.7	960/958/0.3
4-5A	800	42	T169-T184 (Pomeroy Ave)	1-3	Run	2-3	SW/SP	4-12	1 :1 6.5 :1	Undev/Res	Res/Comm	9.7	958/958/flat
4-5B	600	44	T185-T196	1-4	Run	2-3	SW/SP	4-12	1 :1 6.5 :1	Rec	Res	35.9	958/958/flat
4-6	800	47	T197-T212(confluence)	1-6	Run	2-3	SP/GP	6-20	1 :1 5 :1	Undev	Undev	9.1	958/958/flat

Notes: [a] Grain size classifications are defined as follows: SP = poorly graded sand, SW = well-graded sand, GP = poorly graded gravel.
[b] Bank slope is highly variable in most areas so a range of slopes has been provided.

Table 2.1-2
Summary of Grain Size Distribution Results
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Grain Size Distribution in Sediments

Subreach	Gravel (> 2mm) %	Coarse Sand (2 - 0.85 mm) %	Medium Sand (0.85 - 0.25 mm) %	Fine Sand (0.25 - 0.05 mm) %	Clay and Silt (<0.05 mm) %
3-8	21.4	27.4	28.3	17.0	4.5
3-9	16.5	26.0	28.7	23.0	4.9
3-10	9.6	24.3	36.6	23.5	5.0
4-1	20.0	27.0	29.3	23.7	0.0
4-2	15.7	43.2	29.4	5.8	4.6
4-3	33.0	38.0	23.0	4.8	0.8
4-4A	32.5	27.3	29.2	9.4	0.9
4-4B	14.3	33.2	35.8	14.5	1.6
4-5A	24.3	38.7	28.8	8.1	0.1
4-5B	24.6	40.4	26.3	8.3	0.4
4-6	26.3	35.5	28.6	9.4	0.0

Grain Size Distribution in Riverbank Soils

Subreach	Gravel (> 2mm) %	Coarse Sand (2 - 0.85 mm) %	Medium Sand (0.85 - 0.25 mm) %	Fine Sand (0.25 - 0.05 mm) %	Clay and Silt (<0.05 mm) %
3-10	16.1	9.4	13.7	40.9	16.5
3-8	5.6	7.2	10.8	53.9	20.8
3-9	12.8	6.6	13.2	44.2	20.4
4-1	29.7	11.7	22.9	17.8	13.4
4-2	14.6	7.7	13.0	39.6	20.4
4-3	5.6	2.2	21.2	50.9	17.1
4-4A	0.8	1.6	9.1	60.2	28.3
4-4B	8.1	7.3	19.2	45.1	20.3
4-5A	5.3	0.4	4.4	57.4	26.7
4-5B	0.4	0.8	13.1	69.5	13.1
4-6	1.4	3.1	11.2	65.9	15.8

Note: Sediment grain size data apply only to the sediment between cobbles. Material larger than approximately 0.25 inch was manually removed from the sample before analysis.

Table 2.1-3

Summary of Cobble Sampling Results
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Transect	Subreach	Depth of Excavation (inches)	Volume of Sediment (ft^3) (measured)	Volume of Excavation (ft^3) (measured)	Volume of Cobbles (ft^3) (calculated)	Percent Sediment (%)	Percent Cobbles (%)	Cobble Description	Cobble Wipe Sample Results [a] (µg/100 cm^2 of PCB)	Sediment Thickness (inches)	Total PCBs in Sediment (ppm)	Observations
106	4-1	15	5.9	11.3	5.4	52	48	6" to 12" near surface, 2" to 6" at depth.	0.8 0.5 U	23	15.5	Two asphalt pipes containing oily sediment were found
110	4-1	10	9.1	7.5	na	approx. 80%	approx. 20%	6" to 12" near surface, 2" to 4" at depth.	1.3 0.5 U	27	649	Tar globules noted at 10", moderate sheen noted from 4" to 10". Sediment entering excavation from outside the test box via sluffing. Percentages based on visual observations.
110	4-1	14	3.2	10.5	7.3	30	70	Variable cobble size from 6" to 12".	0.74 0.5 U	22	3.34	Moderate sheen noted at 8"
112	4-1	14	3.5	10.5	7.0	33	67	Variable cobble size from 4" to 12".	4.1 0.5 U	22	5.0	Moderate sheen observed at 8"
116	4-1	12	4.0	9.0	5.0	44	56	Variable cobble size from 4" to 12".	0.59 0.60	24	20.4	Heavy sheen/free oil throughout
122	4-2	12	4.3	9.0	4.7	48	52	Variable cobble size from 2" to 8".	3.8 0.5 U	31	0.5 U	Heavy sheen/free oil throughout, strong coal-tar creosote odor
126	4-2	14	8.0	10.5	2.5	76	24	Variable cobble size from 4" to 10".	0.60 0.5 U	24	5.34	Oil/sheen observed at 14"
130	4-2	14	4.3	10.5	6.2	41	59	Mostly small cobbles 2" to 4" with brick fragments.	2.7 3.8	41	4.4	Slight sheen from rebar
136	4-3	12	4.3	9.0	4.7	48	52	Variable cobble size from 4" to 10".	14.0 0.6	36	6.84	Minor sheen observed at 12"
144	4-3	17	3.5	12.8	9.3	27	73	Mostly small cobbles 2" to 6" with abundant coal slag.	9.4 0.57	34	111.0 / 13.9 [b]	Heavy sheen/free oil throughout
146	4-3	14	8.6	10.5	1.9	82	18	Mostly small cobbles 2" to 4".	0.5 U 0.5 U	25	93.3	No sheen or odor observed
152	4-4A	18	12.8	13.5	0.7	95	5	Mostly small cobbles 2" to 6" with some brick fragments.	0.62 0.5 U	50	3.22	Minor sheen observed at 10.5"

U = Non-detect result at reporting limit shown.

[a] Upper value represents result from top of cobble wipe sample, while bottom value represents result from bottom of cobble wipe sample.

[b] Result listed first represents shallow sample, while second result represents the deep sample.

Table 2.3-1

Summary of Average PCB Concentrations
EE/CA Reach of the Housatonic River
Pittsfield, Massachusetts

Sediment Data

Subreach	All Depths			0 to 1 ft			1 to 2 ft			2 to 3 ft			3 to 4 ft			> 4 ft		
	Aver. Conc.	% Exceed	No. Samples	Aver. Conc.	% Exceed	No. Samples	Aver. Conc.	% Exceed	No. Samples	Aver. Conc.	% Exceed	No. Samples	Aver. Conc.	% Exceed	No. Samples	Aver. Conc.	% Exceed	No. Samples
Total Reach	28.5	58%	764	21.3	72%	381	59.9	60%	215	6.5	34%	76	1.9	7%	58	2.8	9%	34
3-8	8.8	54%	121	13.4	83%	53	5.8	40%	40	7.7	31%	16	0.3	0%	10	0.3	0%	2
3-9	102.4	37%	89	9.4	60%	40	312.0	32%	28	0.3	0%	8	0.3	0%	7	0.3	0%	6
3-10	14.2	59%	80	13.9	78%	40	18.1	46%	24	14.6	43%	7	0.4	0%	4	9.9	40%	5
4-1	74.4	83%	12	86.5	80%	10	13.7	100%	2	refusal			refusal			refusal		
4-2	17.5	65%	37	12.6	60%	25	29.9	67%	6	21.4	67%	3	30.5	100%	2	29.0	100%	1
4-3	81.1	93%	28	93.2	96%	24	8.0	75%	4	refusal			refusal			refusal		
4-4A	6.3	46%	26	14.2	100%	11	3.2	100%	1	ns			0.4	0%	3	0.3	0%	11
4-4B	18.7	65%	81	25.5	85%	40	22.2	74%	19	5.7	33%	15	0.3	0%	6	0.3	0%	1
4-5A	9.7	61%	92	6.6	64%	47	17.9	77%	30	3.8	30%	10	0.3	0%	4	0.3	0%	1
4-5B	35.9	60%	86	29.3	65%	40	69.7	81%	26	12.5[a]	50%[a]	8	0.5[b]	10%[b]	10	0.3[c]	0%[c]	2
4-6	9.1	55%	112	7.8	59%	51	15.7	71%	35	6.0[a]	67%[a]	9	1.7[b]	8%[b]	12	0.3[c]	0%[c]	5

Notes:
All PCB concentrations given in mg/kg.
"ns" indicates there were no samples collected from this interval.
"refusal" indicates bedrock was encountered at or above that depth interval.
[a] value represents samples collected from the 2- to 2.5-ft interval within that subreach.
[b] value represents samples collected from the 2.5- to 3.5-ft interval within that subreach.
[c] value represents samples collected from >3.5-ft interval within that subreach.

Table 2.3-1

Summary of Average PCB Concentrations
EE/CA Reach of the Housatonic River
Pittsfield, Massachusetts
(Continued)

East River Bank Data

Subreach	Recreational						Residential		
	0 to 1 ft			1 to 3 ft			0 to 3 ft		
	Aver. Conc.	% Exceed	No. Samples	Aver. Conc.	% Exceed	No. Samples	Aver. Conc.	% Exceed	No. Samples
3-8	18.1	35%	17	25.2	33%	30	dna		
3-9	22.1	72%	18	21.3	67%	33	dna		
3-10	14.0	50%	12	1.5	0%	8	5.6	52%	27
4-1	dna			dna			17.5	45%	20
4-2	23.1	41%	22	26.5	24%	34	dna		
4-3	16.2	50%	50	17.1	29%	93	62.0	100%	1
4-4A	dna			dna			46.6	96%	45
4-4B	dna			dna			62.0	88%	72
4-5A	18.2	67%	9	15.0	50%	16	46.2	74%	168
4-5B	62.7	100%	1	78.3	100%	3	9.3	23%	93
4-6	24.9	40%	25	24.2	52%	46	dna		

West River Bank Data

Subreach	Recreational						Residential		
	0 to 1 ft			1 to 3 ft			0 to 3 ft		
	Aver. Conc.	% Exceed	No. Samples	Aver. Conc.	% Exceed	No. Samples	Aver. Conc.	% Exceed	No. Samples
3-8	15.9	39%	26	25.1	44%	45	dna		
3-9	21.1	63%	8	13.7	36%	14	38.0	100%	1
3-10	dna			dna			dna		
4-1	5.5	22%	9	1.2	0%	7	dna		
4-2	30.2	21%	24	2.8	8%	26	8.8	83%	6
4-3	16.6	53%	15	31.1	67%	12	1.2	40%	5
4-4A	dna			dna			32.3	92%	106
4-4B	dna			dna			41.4	32%	144
4-5A	6.4	33%	3	3.1	0%	6	71.5	97%	33
4-5B	18.9	59%	34	51.3	52%	62	dna		
4-6	16.8	37%	35	49.1	37%	60	dna		

Notes:
"dna" indicates this category does not apply to the data set.

Table 2.3-2

Summary of 95% UCL PCB Concentrations
EE/CA Reach of the Housatonic River
Pittsfield, Massachusetts

Sediment Data

Subreach	All Depths	0 to 1 ft	1 to 2 ft	2 to 3 ft	3 to 4 ft	> 4 ft
Total Reach	19.8	25.7	33.2	9.4	1.2	1.8
3-8	16.3	30.0	17.7	42.6	0.4	0.3 (M)
3-9	9.9	17.1	76.1	0.5	0.3	0.3
3-10	23.2	26.2	52.5	79.8 (M)	0.8 (M)	45.7 (M)
4-1	649 (M)	649 (M)	25 (M)	refusal	refusal	refusal
4-2	110 (M)	74.9	110 (M)	32 (M)	40 (M)	29 (M)
4-3	266.0	362	13.9 (M)	refusal	refusal	refusal
4-4A	8.1	45 (M)	3.2 (M)	ns	0.6 (M)	0.3
4-4B	62.9	87.5	153 (M)	30 (M)	0.4	0.3 (M)
4-5A	14.8	13.2	53.5	18 (M)	0.4	0.3 (M)
4-5B	66.2	162	647	81 (M)[a]	0.8[b]	0.3 (M)[c]
4-6	18.1	19.6	58.8	30 (M)[a]	5.4[b]	0.5[c]

Note: All concentrations are in mg/kg.
"M" indicates the calculated 95% UCL exceeded the maximum value for the data set or there were less than three data points (the calculations require a minimum of three data points), and so the maximum value was substituted for the 95% UCL.
"ns" indicates there were no samples collected from this interval.
"refusal" indicates bedrock was encountered at or above that depth interval.
[a] value represents samples collected from the 2- to 2.5-ft interval within that subreach.
[b] value represents samples collected from the 2.5- to 3.5-ft interval within that subreach.
[c] value represents samples collected from >3.5-ft interval within that subreach.

Table 2.3-2

Summary of 95% UCL PCB Concentrations
EE/CA Reach of the Housatonic River
Pittsfield, Massachusetts

East River Bank Data

Subreach	Recreational		Residential
	0 to 1 ft	1 to 3 ft	0 to 3 ft
3-8	100 (M)	238 (M)	dna
3-9	38.3	32.4	dna
3-10	53.3 (M)	7.1 (M)	18.1
4-1	dna	dna	33.6
4-2	109.9	104.8	dna
4-3	82.9 (M)	140.5	62.0 (M)
4-4A	dna	dna	85.2
4-4B	dna	dna	209.4
4-5A	37.0 (M)	76.0 (M)	154.8
4-5B	62.7 (M)	95.0 (M)	8.0
4-6	96.0	87.9	dna

West River Bank Data

Subreach	Recreational		Residential
	0 to 1 ft	1 to 3 ft	0 to 3 ft
3-8	35.9	73.1	dna
3-9	72.7 (M)	52 (M)	38 (M)
3-10	dna	dna	dna
4-1	16.4 (M)	5.2 (M)	dna
4-2	127.5	4.9	20 (M)
4-3	43 (M)	170 (M)	2.4 (M)
4-4A	dna	dna	46.9
4-4B	dna	dna	137.9
4-5A	13.0 (M)	5.2 (M)	129.7
4-5B	36.6	437 (M)	dna
4-6	117 (M)	566 (M)	dna

Note: All concentrations are in mg/kg.
"M" indicates the calculated 95% UCL exceeded the maximum value for the data set or there were less than three data points (the calculations require a minimum of three data points), and so the maximum value was substituted for the 95% UCL.
"dna" indicates this category does not apply to the data set.

Table 2.3-3

Summary of PCB Mass Distribution
EE/CA Reach of the Housatonic River
Pittsfield, Massachusetts

PCB Mass in Sediment (kg)

Subreach	All Depths	0 to 1 ft	1 to 2 ft	2 to 3 ft	3 to 4 ft	> 4 ft
Total Reach	1,702	495	877	177	69	84
3-8	67	30	15	20	1	1
3-9	573	20	550	1	1	1
3-10	116	30	35	30	1	20
4-1	80	70	10	na	na	na
4-2	245	25	60	40	60	60
4-3	285	210	20	55	na	na
4-4A	12	10	2	na	< 1	< 1
4-4B	73	35	30	8	< 1	< 1
4-5A	49	10	30	7	1	1
4-5B	145	40	95	10	< 1	< 1
4-6	57	15	30	6	5	1

PCB Mass in Riverbank Soils (kg)

Subreach	0 to 3 ft	0 to 1 ft	1 to 2 ft	2 to 3 ft
Total Reach	1,440	380	537	523
3-8	160	40	60	60
3-9	110	40	40	30
3-10	27	15	5	7
4-1	23	20	2	1
4-2	180	75	35	70
4-3	165	50	75	40
4-4A	80	15	30	35
4-4B	220	35	95	90
4-5A	195	35	75	85
4-5B	130	25	65	40
4-6	150	30	55	65

Notes: na = no data available for this interval.
PCB mass estimates for Subreaches 4-1, 4-2, and 4-3 include sediment mass only (no cobbles).
The total mass of PCBs associated with the cobbles in Subreaches 4-1, 4-2, and 4-3 is less than 85 grams, assuming an average cobble diameter of 2 inches.

Table 2.3-4

Summary of DRET and Pore Water Results
EE/CA Reach of the Housatonic River
Pittsfield, Massachusetts

Sample Location	Pore Water PCB Concentration (µg/L)	Unfiltered Elutriate PCB Concentration (µg/L)	Filtered Elutriate PCB Concentration (µg/L)
H2-SE000011	na	0.44 J	0.01 UJ
H2-SE000011 (duplicate)	na	4.6 J	0.36 J
H2-SE000011 (triplicate)	na	1.1 J	0.01 UJ
H2-SE000018	1.9 J	13.0 J	0.09 J
H2-SE000021	na	2.6 J	0.04 J
H2-SE000022	na	130 J	2.3 J
H2-SE000025	11.0 J	4.2 J	0.02 J
H2-SE000025 (duplicate)	16.0 J	na	na
H2-SE000032	6.8 J	1.9 J	0.01 UJ

U = below detection limit. J = estimated value (detected below quantitation limit).
na = Not analyzed

Table 2.3-5

Summary of PCB Fractionation Data
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Field Sample Number	Location Compared to	Parameter	Gravel	Sand & Fine Gravel	Silt & Clay
H2-SD010701-0-0000	H2-SE000011	PCB, mg/kg	0.18	3.9	5.6
		% of total soil	12.1	84.3	3.6
		% of total PCB	1%	94%	6%
H2-SD010701-0-0010	H2-SE000011	PCB, mg/kg	0.18	3.9	5.6
		% of total soil	7.1	81.0	11.9
		% of total PCB	0%	82%	17%
H2-SD010701-0-0015	H2-SE000011	PCB, mg/kg	0.18	3.9	5.6
		% of total soil	39.2	57.0	3.8
		% of total PCB	3%	89%	8%
H2-SD011003-0-0000	H2-SE000018	PCB, mg/kg	3.20	36.0	26.0
		% of total soil	0.0	75.1	24.9
		% of total PCB	0%	81%	19%
H2-SD011003-0-0010	H2-SE000018	PCB, mg/kg	3.20	36.0	26.0
		% of total soil	0.0	81.2	18.8
		% of total PCB	0%	86%	14%
H2-SD021401-0-0005	H2-SE000022	PCB, mg/kg	0.22	180.0	1.9
		% of total soil	32.7	66.2	1.1
		% of total PCB	0%	100%	0%
H2-SD021522-0-0000	H2-SE000021	PCB, mg/kg	0.41	9.7	5.1
		% of total soil	24.7	74.7	0.6
		% of total PCB	1%	98%	0%
H2-SD021603-0-0000	H2-SE000025	PCB, mg/kg	2.40	50.0	47.0
		% of total soil	35.8	62.4	1.8
		% of total PCB	3%	95%	3%
H2-SD021603-0-0010	H2-SE000025	PCB, mg/kg	2.40	50.0	47.0
		% of total soil	14.7	84.3	1.0
		% of total PCB	1%	98%	1%
H2-SD021881-0-0000	H2-SE000032	PCB, mg/kg	na	20.0	17.0
		% of total soil	3.0	96.0	1.0
		% of total PCB	na	99%	1%
H2-SD021881-0-0005	H2-SE000032	PCB, mg/kg	na	20.0	17.0
		% of total soil	1.0	98.0	1.0
		% of total PCB	na	99%	1%
H2-SD021881-0-0010	H2-SE000032	PCB, mg/kg	na	20.0	17.0
		% of total soil	6.9	85.2	7.9
		% of total PCB	na	93%	7%
H2-SD021881-0-0015	H2-SE000032	PCB, mg/kg	na	20.0	17.0
		% of total soil	13.0	78.0	9.0
		% of total PCB	na	91%	9%
H2-SD021881-0-0020	H2-SE000032	PCB, mg/kg	na	20.0	17.0
		% of total soil	49.0	50.0	1.0
		% of total PCB	na	98%	2%
	Average	PCB, mg/kg	1.28	49.9	17.1
		% of total soil	17.1	76.7	6.2
		% of total PCB	1%	97%	3%

Notes: "na" indicates PCB analysis was not conducted on this grain size type. "Gravel" represents the fraction of soil that did not pass a nominal 1/4-inch sieve. "Sand and fine gravel" represents the fraction of soil that passed the 1/4-inch sieve, but did not pass the #200 sieve. "Silt and clay" represents the fraction of soil that passed the #200 sieve.

Table 2.3-6

Summary of Appendix IX Results for Sediment
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Subreach 3-8		Subreach 3-9		Subreach 3-10		Subreach 4-1	
		Average Conc.	Maximum Conc.	Average Conc.	Maximum Conc.	Average Conc.	Maximum Conc.	Average Conc.	Maximum Conc.
BETA-BHC	mg/kg					0.0031	0.0031		
DELTA-BHC	mg/kg					0.0029	0.0029		
4,4'-DDD	mg/kg								
1,2,4,5-TETRACHLOROBENZENE	mg/kg	0.05	0.07	0.04	0.04	0.02	0.02		
1,2,4-TRICHLOROBENZENE	mg/kg	0.64	1.7	0.06	0.1	0.22	0.31		
1,2-DICHLOROBENZENE	mg/kg	0.04	0.04						
1,3-DICHLOROBENZENE	mg/kg	0.21	0.21	0.03	0.03	0.05	0.05	0.03	0.03
1,4-DICHLOROBENZENE	mg/kg	0.21	0.72	0.1	0.17	0.08	0.18	0.13	0.13
2,6-DINITROTOLUENE	mg/kg							0.06	0.08
2-METHYLNAPHTHALENE	mg/kg	0.06	0.06	0.08	0.14	0.03	0.03		
2-METHYLPHENOL (O-CRESOL)	mg/kg								
3-METHYLCHOLANTHRENE	mg/kg								
4-METHYLPHENOL	mg/kg								
ACENAPHTHENE	mg/kg	0.11	0.37	0.04	0.08	0.03	0.03		
ACENAPTHYLENE	mg/kg	0.04	0.04	0.05	0.08				
ANTHRACENE	mg/kg	0.06	0.14	0.06	0.12	0.06	0.08	0.05	0.05
ARAMITE	mg/kg	0.08	0.08						
BENZO(A)ANTHRACENE	mg/kg	0.27	0.6	0.32	0.96	0.18	0.3	0.28	0.35
BENZO(A)PYRENE	mg/kg	0.24	0.51	0.33	1.1	0.17	0.29	0.3	0.38
BENZO(B)FLUORANTHENE	mg/kg	0.18	0.35	0.23	0.66	0.16	0.3	0.3	0.37
BENZO(GHI)PERYLENE	mg/kg	0.2	0.37	0.31	0.69	0.12	0.15	0.21	0.28
BENZO(K)FLUORANTHENE	mg/kg	0.22	0.46	0.29	0.81	0.16	0.27	0.27	0.35
BIS(2-ETHYLHEXYL) PHTHALATE	mg/kg	3.6	3.6			0.09	0.16		
BUTYLBENZYLPHTHALATE	mg/kg								
CHRYSENE	mg/kg	0.34	0.78	0.38	1.1	0.2	0.33	0.33	0.4
DIBENZO(A,H)ANTHRACENE	mg/kg	0.05	0.1	0.07	0.19	0.06	0.08	0.07	0.1
DIBENZOFURAN	mg/kg			0.02	0.04	0.02	0.02		
DI-N-BUTYL PHTHALATE	mg/kg					0.09	0.11		
DI-N-OCTYL PHTHALATE	mg/kg							0.04	0.04
FLUORANTHENE	mg/kg	0.53	1.3	0.72	1.6	0.37	0.52	0.41	0.71
FLUORENE	mg/kg	0.07	0.26	0.06	0.1	0.03	0.04	0.02	0.03
INDENO(1,2,3-C,D)PYRENE	mg/kg	0.19	0.35	0.27	0.6	0.12	0.16	0.22	0.29
NAPHTHALENE	mg/kg	0.09	0.14	0.18	0.3	0.08	0.14	0.03	0.03
PENTACHLOROBENZENE	mg/kg	0.13	0.13	0.08	0.13	0.06	0.07		
PHENANTHRENE	mg/kg	0.29	0.7	0.43	0.91	0.25	0.4	0.32	0.36
PHENOL	mg/kg								
PYRENE	mg/kg	0.62	1.5	0.96	2.4	0.41	0.71	0.59	1.2
PYRIDINE	mg/kg								
TEQ 2,3,7,8-TCDD (EPA)	mg/kg	0.000019	0.00005	0.000012	0.000051	0.00005	0.00021		
TEQ 2,3,7,8-TCDD (MADEP)	mg/kg	0.000032	0.000073	0.000019	0.000076	0.000006	0.000026		
SULFIDE	mg/kg	20.78	32.6			335	335	406.25	793
ANTIMONY	mg/kg	70.1	70.1			1.4	1.4		
ARSENIC	mg/kg	1.57	2.6	1.23	1.6	1.84	3.6	3.87	6.6
BARIUM	mg/kg	8.24	12.4	7.42	12.1	15.33	33.7	20.27	31.2
BERYLLIUM	mg/kg	0.09	0.12	0.12	0.12	0.14	0.2	0.19	0.24
CHROMIUM	mg/kg	7.48	11.7	5.02	7.2	6.03	8.1	9.87	15.8
COBALT	mg/kg	4.59	5.6	3.83	5.7	5.26	7.2	7.97	13.9
COPPER	mg/kg	40.23	232	10.97	15.9	11.23	15.1	31.9	47.5
LEAD	mg/kg	122.29	869	12.84	20	9.39	13.4	34.67	63
MERCURY	mg/kg	0.04	0.07	0.04	0.05	0.06	0.06	0.14	0.23
NICKEL	mg/kg	9.15	9.8	7.08	10.4	8.43	12.6	10.97	17.6
SELENIUM	mg/kg			0.55	0.62				
SILVER	mg/kg			0.1	0.1				
THALLIUM	mg/kg					0.58	0.58	1.2	1.2
TIN	mg/kg	100.67	290	2.25	3.5	10.6	10.6	15.2	15.2
VANADIUM	mg/kg	5.29	6.1	3.8	6.1	5.64	9.4	8.53	14
ZINC	mg/kg	59.05	146	35.63	54.3	43.56	77	54.6	72.1

Notes: Blank cells indicate that the compound was not detected in that subreach above the laboratory detection limit. Laboratory detection levels for each compound are presented in Appendix J of this report.

Table 2.3-6

Summary of Appendix IX Results for Sediment
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Subreach 4-2		Subreach 4-3		Subreach 4-4A		Subreach 4-4B	
		Average Conc.	Maximum Conc.	Average Conc.	Maximum Conc.	Average Conc.	Maximum Conc.	Average Conc.	Maximum Conc.
BETA-BHC	mg/kg								
DELTA-BHC	mg/kg								
4,4'-DDD	mg/kg	0.02	0.02						
1,2,4,5-TETRACHLOROBENZENE	mg/kg								
1,2,4-TRICHLOROBENZENE	mg/kg			0.03	0.03			0.05	0.11
1,2-DICHLOROBENZENE	mg/kg								
1,3-DICHLOROBENZENE	mg/kg							0.03	0.03
1,4-DICHLOROBENZENE	mg/kg			0.06	0.06			0.1	0.16
2,6-DINITROTOLUENE	mg/kg							0.07	0.07
2-METHYLNAPHTHALENE	mg/kg			0.08	0.08	0.05	0.09	0.09	0.18
2-METHYLPHENOL (O-CRESOL)	mg/kg								
3-METHYLCHOLANTHRENE	mg/kg							0.03	0.03
4-METHYLPHENOL	mg/kg							0.03	0.04
ACENAPHTHENE	mg/kg			0.12	0.12	0.08	0.14	0.17	0.47
ACENAPTHYLENE	mg/kg			0.17	0.17	0.08	0.14	0.07	0.12
ANTHRACENE	mg/kg			0.98	0.98	0.61	1	0.54	1.1
ARAMITE	mg/kg								
BENZO(A)ANTHRACENE	mg/kg			1.3	1.3	0.86	1.6	1.4	3.6
BENZO(A)PYRENE	mg/kg			0.98	0.98	0.66	1.2	1.19	3.1
BENZO(B)FLUORANTHENE	mg/kg			0.63	0.63	0.52	0.96	0.96	2.5
BENZO(GHI)PERYLENE	mg/kg			0.45	0.45	0.33	0.6	0.63	1.3
BENZO(K)FLUORANTHENE	mg/kg			0.93	0.93	0.61	1.1	1	2.6
BIS(2-ETHYLHEXYL) PHTHALATE	mg/kg								
BUTYLBENZYLPHTHALATE	mg/kg							0.51	0.51
CHRYSENE	mg/kg			1.1	1.1	0.78	1.4	1.33	3.3
DIBENZO(A,H)ANTHRACENE	mg/kg			0.19	0.19	0.13	0.25	0.25	0.57
DIBENZOFURAN	mg/kg			0.33	0.33	0.13	0.17	0.12	0.18
DI-N-BUTYL PHTHALATE	mg/kg								
DI-N-OCTYL PHTHALATE	mg/kg								
FLUORANTHENE	mg/kg			2.8	2.8	1.83	3.4	2.33	4.6
FLUORENE	mg/kg			0.59	0.59	0.25	0.36	0.25	0.43
INDENO(1,2,3-C,D)PYRENE	mg/kg			0.51	0.51	0.36	0.67	0.68	1.5
NAPHTHALENE	mg/kg			0.16	0.16	0.09	0.15	0.16	0.36
PENTACHLOROBENZENE	mg/kg					0.05	0.05	0.04	0.06
PHENANTHRENE	mg/kg			2.8	2.8	1.63	2.6	1.78	3.4
PHENOL	mg/kg								
PYRENE	mg/kg			3.2	3.2	2.15	4.2	2.6	4.8
PYRIDINE	mg/kg								
TEQ 2,3,7,8-TCDD (EPA)	mg/kg			0.0000047	0.0000047	0.000014	0.000034	8.8E-06	0.00002
TEQ 2,3,7,8-TCDD (MADEP)	mg/kg			0.0000079	0.0000079	0.000023	0.000054	1.77E-05	3.77E-05
SULFIDE	mg/kg							69.75	132
ANTIMONY	mg/kg							0.69	0.76
ARSENIC	mg/kg			1.6	1.6	2.33	4	2.6	3.9
BARIUM	mg/kg			6.8	6.8	9.9	15.7	15.88	24.7
BERYLLIUM	mg/kg			0.09	0.09	0.12	0.13	0.25	0.77
CHROMIUM	mg/kg			5	5	8.1	9.5	8.82	11.9
COBALT	mg/kg					3.87	4.9	43.9	200
COPPER	mg/kg			14.9	14.9	17.3	26	28.58	65.2
LEAD	mg/kg			12.6	12.6	23.8	30.6	20.58	27.4
MERCURY	mg/kg					0.07	0.07	0.04	0.05
NICKEL	mg/kg			6.4	6.4	7.57	8.9	31.75	142
SELENIUM	mg/kg					0.24	0.24	0.46	0.46
SILVER	mg/kg								
THALLIUM	mg/kg								
TIN	mg/kg							10.2	10.2
VANADIUM	mg/kg								
ZINC	mg/kg			33.9	33.9	40.07	42.5	72.32	163

Notes: Blank cells indicate that the compound was not detected in that subreach above the laboratory detection limit. Laboratory detection levels for each compound are presented in Appendix J of this report.

Table 2.3-6

Summary of Appendix IX Results for Sediment
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Subreach 4-5A		Subreach 4-5B		Subreach 4-6	
		Average Conc.	Maximum Conc.	Average Conc.	Maximum Conc.	Average Conc.	Maximum Conc.
BETA-BHC	mg/kg						
DELTA-BHC	mg/kg						
4,4'-DDD	mg/kg						
1,2,4,5-TETRACHLOROBENZENE	mg/kg	0.03	0.04			0.08	0.12
1,2,4-TRICHLOROBENZENE	mg/kg	0.08	0.16	0.05	0.07	0.33	0.81
1,2-DICHLOROBENZENE	mg/kg			0.02	0.02		
1,3-DICHLOROBENZENE	mg/kg					0.09	0.16
1,4-DICHLOROBENZENE	mg/kg	0.05	0.09	0.04	0.06	0.23	0.66
2,6-DINITROTOLUENE	mg/kg	0.07	0.07				
2-METHYLNAPHTHALENE	mg/kg	0.15	0.52	1.21	6.3	0.68	2.6
2-METHYLPHENOL (O-CRESOL)	mg/kg			0.18	0.18		
3-METHYLCHOLANTHRENE	mg/kg						
4-METHYLPHENOL	mg/kg			0.32	0.61		
ACENAPHTHENE	mg/kg	0.17	0.39	1.8	10	1.03	2.8
ACENAPTHYLENE	mg/kg	0.1	0.22	0.15	0.36	0.2	0.64
ANTHRACENE	mg/kg	0.59	2.1	2.72	14	1.7	5.3
ARAMITE	mg/kg						
BENZO(A)ANTHRACENE	mg/kg	1.12	3	7.42	40	2.61	6.5
BENZO(A)PYRENE	mg/kg	0.91	2.5	7.44	41	2.07	5.3
BENZO(B)FLUORANTHENE	mg/kg	0.7	1.9	7.14	40	1.47	3.8
BENZO(GHI)PERYLENE	mg/kg	0.49	1.3	5.31	25	1.12	3.4
BENZO(K)FLUORANTHENE	mg/kg	0.83	2.2	6.4	35	1.73	4.3
BIS(2-ETHYLHEXYL) PHTHALATE	mg/kg	0.08	0.08	0.17	0.32		
BUTYLBENZYLPHTHALATE	mg/kg	0.02	0.02	0.02	0.02		
CHRYSENE	mg/kg	1.07	3	8.35	46	2.48	6.5
DIBENZO(A,H)ANTHRACENE	mg/kg	0.17	0.44	1.37	7.6	0.36	0.94
DIBENZOFURAN	mg/kg	0.21	0.62	2.33	13	0.87	2.2
DI-N-BUTYL PHTHALATE	mg/kg	0.17	0.18	0.19	0.23	0.04	0.04
DI-N-OCTYL PHTHALATE	mg/kg			0.03	0.03		
FLUORANTHENE	mg/kg	2.11	5.8	17.77	99	5	13
FLUORENE	mg/kg	0.33	0.81	2.96	16	1.14	3.8
INDENO(1,2,3-C,D)PYRENE	mg/kg	0.51	1.3	4.65	26	1.18	3.3
NAPHTHALENE	mg/kg	0.19	0.54	3.51	20	0.9	2.9
PENTACHLOROBENZENE	mg/kg	0.07	0.13	0.12	0.25	0.15	0.5
PHENANTHRENE	mg/kg	1.93	6	19.73	110	5.85	22
PHENOL	mg/kg			0.51	0.51		
PYRENE	mg/kg			19.62	110	5.29	16
PYRIDINE	mg/kg	1.78	6				
TEQ 2,3,7,8-TCDD (EPA)	mg/kg	0.0000105	0.0000266	0.000005	0.0000081	0.0000076	0.0000236
TEQ 2,3,7,8-TCDD (MADEP)	mg/kg	0.0000185	0.0000473	0.0000089	0.0000142	0.0000129	0.0000369
SULFIDE	mg/kg	10.17	15.5	9.28	14.3	13.93	57.2
ANTIMONY	mg/kg	1.1	1.1			4.11	7.7
ARSENIC	mg/kg	1.77	4.3	1.83	4.2	1.21	2.1
BARIUM	mg/kg	9.01	24.1	7.83	11.6	8.82	12.7
BERYLLIUM	mg/kg	0.11	0.16			0.08	0.15
CHROMIUM	mg/kg	6.33	10.1	5.25	6.9	6.4	12.8
COBALT	mg/kg	4.03	5.6	3.53	5.9	3.78	5.7
COPPER	mg/kg	20.81	47	8.28	12.6	14.82	30.2
LEAD	mg/kg	23.33	57	13.52	18.9	17.72	26.4
MERCURY	mg/kg	0.03	0.04			0.05	0.08
NICKEL	mg/kg	5.91	9	6.07	10.6	6.73	9.7
SELENIUM	mg/kg						
SILVER	mg/kg	0.38	0.38				
THALLIUM	mg/kg					0.43	0.43
TIN	mg/kg	14.25	17.4	17.4	17.4	43.3	62
VANADIUM	mg/kg	5	6.4	4	5.8	4.54	7
ZINC	mg/kg	42.07	85.5	35.5	54.4	42.13	80.3

Notes: Blank cells indicate that the compound was not detected in that subreach above the laboratory detection limit. Laboratory detection levels for each compound are presented in Appendix J of this report.

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB010705 (1 to 1.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
ACENAPTHYLENE	MG/KG	0.04			0.127		0.24			1000		No
BENZO(A)ANTHRACENE	MG/KG	0.22	0.56		0.709		1.6			1		No
BENZO(A)PYRENE	MG/KG	0.30	0.56		0.718		1.8			0.07	Exceeds	No
BENZO(B)FLUORANTHENE	MG/KG	0.17	0.56		0.715		2			1		No
BENZO(GHI)PERYLENE	MG/KG	0.38			0.223	Exceeds	0.49		Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	0.27	5.6		0.778		1.8			10		No
CHRYSENE	MG/KG	0.29	56		0.814		0.18	Exceeds	Exceeds	10		No
DIBENZO(A,H)ANTHRACENE	MG/KG	0.08	0.056	Exceeds	0.121		0.22			0.7		No
FLUORANTHENE	MG/KG	0.18	2000		1.266		2.8			1000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	0.30	0.56		0.247	Exceeds	0.053	Exceeds	Exceeds	1		No
NAPHTHALENE	MG/KG	0.03	55		0.085		0.099			1000		No
PHENANTHRENE	MG/KG	0.05			0.043	Exceeds	0.056			100		No
PYRENE	MG/KG	0.33	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000001	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000001								0.008		No
ARSENIC	MG/KG	2.20	21		5.48		17.4			30		No
BARIUM	MG/KG	43.90	5200		51.96		90.2			2500		No
BERYLLIUM	MG/KG	0.30	150		0.04	Exceeds	0.83		Exceeds	0.8		No
CHROMIUM	MG/KG	11.60	210		16.96		47.7			2500		No
COBALT	MG/KG	9.00	3300		8.89	Exceeds	21.8					No
COPPER	MG/KG	14.30	2800		31.14		144					No
LEAD	MG/KG	9.60	0.04	Exceeds	56.78		112			600		No
MERCURY	MG/KG	0.05	22		0.19		0.35					No
NICKEL	MG/KG	12.20	1500		16.55		38.5			700		No
THALLIUM	MG/KG	0.71			1.63		2.8			30		No
VANADIUM	MG/KG	11.90	520		31.21		182			2000		No
ZINC	MG/KG	59.10	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Apendix IX Riverbank Soil Comparison to Standards, Location RB020985 (1 to 1.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
2-METHYLNAPHTHALENE	MG/KG	0.60			0.082	Exceeds	0.08	Exceeds	Exceeds	1000		No
ACENAPHTHENE	MG/KG	0.37	2600		0.089	Exceeds	0.18	Exceeds	Exceeds	2500		No
ACENAPTHYLENE	MG/KG	2.20			0.127	Exceeds	0.24	Exceeds	Exceeds	1000		No
ANTHRACENE	MG/KG	2.70	14000		0.191	Exceeds	0.39	Exceeds	Exceeds	2500		No
BENZO(A)ANTHRACENE	MG/KG	6.80	0.56	Exceeds	0.709	Exceeds	1.6	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(A)PYRENE	MG/KG	7.40	0.056	Exceeds	0.718	Exceeds	1.8	Exceeds	Exceeds	0.7	Exceeds	Yes
BENZO(B)FLUORANTHENE	MG/KG	5.20	0.56	Exceeds	0.715	Exceeds	2	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(GHI)PERYLENE	MG/KG	5.90			0.223	Exceeds	0.49	Exceeds	Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	5.80	5.6	Exceeds	0.778	Exceeds	1.8	Exceeds	Exceeds	10		No
CHRYSENE	MG/KG	7.10	56		0.814	Exceeds	0.18	Exceeds	Exceeds	10		No
DIBENZO(A,H)ANTHRACENE	MG/KG	1.90	0.056	Exceeds	0.121	Exceeds	0.22	Exceeds	Exceeds	0.7	Exceeds	Yes
DIBENZOFURAN	MG/KG	0.96	210		0.08	Exceeds	0.13	Exceeds	Exceeds			No
FLUORANTHENE	MG/KG	12.00	2000		1.266	Exceeds	2.8	Exceeds	Exceeds	1000		No
FLUORENE	MG/KG	1.90	1800		0.108	Exceeds	0.24	Exceeds	Exceeds	2000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	5.60	0.56	Exceeds	0.247	Exceeds	0.053	Exceeds	Exceeds	1	Exceeds	Yes
METHAPYRILENE	MG/KG	0.55										No
NAPHTHALENE	MG/KG	1.00	55		0.085	Exceeds	0.099	Exceeds	Exceeds	1000		No
PHENANTHRENE	MG/KG	12.00			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PYRENE	MG/KG	13.00	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000020	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000028								0.08		No
ANTIMONY	MG/KG	0.61	30		1.85		3			40		No
ARSENIC	MG/KG	6.40	21		5.48	Exceeds	17.4			30		No
BARIUM	MG/KG	39.50	5200		51.96		90.2			2500		No
CHROMIUM	MG/KG	9.60	210		16.96		47.7			2500		No
COBALT	MG/KG	8.40	3300		8.89		21.8					No
COPPER	MG/KG	27.90	2800		34.14		144					No
LEAD	MG/KG	72.70	0.04	Exceeds	56.78	Exceeds	112			600		No
MERCURY	MG/KG	0.10	22		0.19		0.35			60		No
NICKEL	MG/KG	15.70	1500		16.55		38.5			700		No
THALLIUM	MG/KG	1.00			1.63		2.8			30		No
VANADIUM	MG/KG	11.40	520		31.21		182			2000		No
ZINC	MG/KG	82.10	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021026 (1 to 1.5 ft)
EE/CA Reach of the Houstonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
1,2,4-TRICHLOROBENZENE	MG/KG		480		0.071		0.08			800		No
1,3-DICHLOROBENZENE	MG/KG		41							500		No
1,4-DICHLOROBENZENE	MG/KG		3		0.08		0.09			60		No
2-METHYLNAPHTHALENE	MG/KG				0.082		0.08			1000		No
4-METHYLPHENOL	MG/KG		270									No
ACENAPHTHENE	MG/KG		2600		0.089		0.18			2500		No
ACENAPTHYLENE	MG/KG				0.127		0.24			1000		No
ANTHRACENE	MG/KG		14000		0.191		0.39			2500		No
BENZO(A)ANTHRACENE	MG/KG	0.05	0.56		0.709		1.6			1		No
BENZO(A)PYRENE	MG/KG	0.05	0.056		0.718		1.8			0.7		No
BENZO(B)FLUORANTHENE	MG/KG	0.06	0.56		0.715		2			1		No
BENZO(GHI)PERYLENE	MG/KG				0.223		0.49			2500		No
BENZO(K)FLUORANTHENE	MG/KG	0.07	5.6		0.778		1.8			10		No
BIS(2-ETHYLHEXYL) PHTHALATE	MG/KG		32		0.113		0.27			300		No
BUTYLBENZYLPHTHALATE	MG/KG		930		0.074		0.41					No
CHRYSENE	MG/KG	0.06	56		0.814		0.18			10		No
DIBENZO(A,H)ANTHRACENE	MG/KG		0.056		0.121		0.22			0.7		No
DIBENZOFURAN	MG/KG		210		0.08		0.13					No
DI-N-OCTYL PHTHALATE	MG/KG		1100									No
FLUORANTHENE	MG/KG	0.08	2000		1.266		2.8			1000		No
FLUORENE	MG/KG		1800		0.108		0.24			2000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG		0.56		0.247		0.053			1		No
METHAPYRILENE	MG/KG											No
NAPHTHALENE	MG/KG		55		0.085		0.099			1000		No
PHENANTHRENE	MG/KG	0.03			0.043		0.056			100		No
PYRENE	MG/KG	0.09	1500							2000		No
TCDF (TOTAL)	MG/KG											No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG		0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000001								0.08		No
SULFIDE	MG/KG	0.000001			165.88		284					No
ANTIMONY	MG/KG		30		1.85		3			40		No
ARSENIC	MG/KG	4.00	21		5.48		17.4			30		No
BARIUM	MG/KG	19.80	5200		51.96		90.2			2500		No
BERYLLIUM	MG/KG	0.26	150		0.4		0.83			0.8		No
CHROMIUM	MG/KG	7.80	210		16.96		47.7			2500		No
COBALT	MG/KG	7.90	3300		8.89		21.8					No
COPPER	MG/KG	12.40	2800		34.14		144					No
LEAD	MG/KG	8.40	0.04	Exceeds	56.78		112			600		No
MERCURY	MG/KG		22		0.19		0.35			60		No
NICKEL	MG/KG	14.20	1500		16.55		38.5			700		No
SELENIUM	MG/KG		370		0.48		1.3			2500		No
THALLIUM	MG/KG	1.00			1.63		2.8			30		No
VANADIUM	MG/KG	10.10	520		31.21		182			2000		No
ZINC	MG/KG	53.90	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021065 (1 to 1.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observe dConc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
2-METHYLNAPHTHALENE	MG/KG	0.11			0.082	Exceeds	0.08	Exceeds	Exceeds	1000		No
4-METHYLPHENOL	MG/KG	0.09	270									No
ACENAPHTHENE	MG/KG	0.29	2600		0.089	Exceeds	0.18	Exceeds	Exceeds	2500		No
ACENAPTHYLENE	MG/KG	0.18			0.127	Exceeds	0.24			1000		No
ANTHRACENE	MG/KG	2.40	14000		0.191	Exceeds	0.39	Exceeds	Exceeds	2500		No
BENZO(A)ANTHRACENE	MG/KG	4.10	0.56	Exceeds	0.709	Exceeds	1.6	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(A)PYRENE	MG/KG	2.60	0.056	Exceeds	0.718	Exceeds	1.8	Exceeds	Exceeds	0.7	Exceeds	Yes
BENZO(B)FLUORANTHENE	MG/KG	2.20	0.56	Exceeds	0.715	Exceeds	2	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(GHI)PERYLENE	MG/KG	1.10			0.223	Exceeds	0.49	Exceeds	Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	2.60	5.6		0.778	Exceeds	1.8	Exceeds	Exceeds	10		No
CHRYSENE	MG/KG	3.40	56		0.814	Exceeds	0.18	Exceeds	Exceeds	10		No
DIBENZO(A,H)ANTHRACEN	MG/KG	0.75	0.056	Exceeds	0.121	Exceeds	0.22	Exceeds	Exceeds	0.7	Exceeds	Yes
DIBENZOFURAN	MG/KG	0.35	210		0.08	Exceeds	0.13	Exceeds	Exceeds			No
FLUORANTHENE	MG/KG	5.60	2000		1.266	Exceeds	2.8	Exceeds	Exceeds	1000		No
FLUORENE	MG/KG	0.85	1800		0.108	Exceeds	0.24	Exceeds	Exceeds	2000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	1.00	0.56	Exceeds	0.247	Exceeds	0.053	Exceeds	Exceeds	1		No
NAPHTHALENE	MG/KG	0.19	55		0.085	Exceeds	0.099	Exceeds	Exceeds	1000		No
PHENANTHRENE	MG/KG	5.30			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PYRENE	MG/KG	5.50	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000005	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000013								0.08		No
ANTIMONY	MG/KG	0.93	30		1.85		3			40		No
ARSENIC	MG/KG	4.70	21		5.48		17.4			30		No
BARIUM	MG/KG	45.40	5200		51.96		90.2			2500		No
BERYLLIUM	MG/KG	0.33	150		0.4		0.83			0.8		No
CHROMIUM	MG/KG	22.60	210		16.96	Exceeds	47.7			2500		No
COBALT	MG/KG	12.30	3300		8.89	Exceeds	21.8					No
COPPER	MG/KG	85.60	2800		34.14	Exceeds	144		Exceeds			No
LEAD	MG/KG	69.90	0.04	Exceeds	56.78	Exceeds	112			600		No
MERCURY	MG/KG	0.24	22		0.19	Exceeds	0.35			60		No
NICKEL	MG/KG	23.50	1500		16.55	Exceeds	38.5			700		No
THALLIUM	MG/KG	0.87			1.63		2.8			30		No
VANADIUM	MG/KG	14.70	520		31.21		182			2000		No
ZINC	MG/KG	94.10	2200		90.43	Exceeds	145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021044 (2 to 2.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
1,2,4-TRICHLOROBENZENE	MG/KG	0.04	480		0.071		0.08			800		No
1,3-DICHLOROBENZENE	MG/KG	0.04	41							500		No
1,4-DICHLOROBENZENE	MG/KG	0.18	3		0.08	Exceeds	0.09	Exceeds	Exceeds	60		No
2-METHYLNAPHTHALENE	MG/KG	0.02			0.082		0.08			1000		No
4-METHYLPHENOL	MG/KG	0.03	270									No
ACENAPHTHENE	MG/KG	0.08	2600		0.089		0.18			2500		No
ACENAPTHYLENE	MG/KG	0.05			0.127		0.24			1000		No
ANTHRACENE	MG/KG	0.11	14000		0.191		0.39			2500		No
BENZO(A)ANTHRACENE	MG/KG	0.53	0.56		0.709		1.6			1		No
BENZO(A)PYRENE	MG/KG	0.54	0.056	Exceeds	0.718		1.8			0.7		No
BENZO(B)FLUORANTHENE	MG/KG	0.52	0.56		0.715		2			1		No
BENZO(GHI)PERYLENE	MG/KG	0.45			0.223	Exceeds	0.49		Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	0.51	5.6		0.778		1.8			10		No
CHRYSENE	MG/KG	0.66	56		0.814		0.18	Exceeds	Exceeds	10		No
DIBENZO(A,H)ANTHRACENE	MG/KG	0.11	0.056	Exceeds	0.121		0.22			0.7		No
DIBENZOFURAN	MG/KG	0.03	210		0.08		0.13					No
FLUORANTHENE	MG/KG	1.00	2000		1.266		2.8			1000		No
FLUORENE	MG/KG	0.05	1800		0.108		0.24			2000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	0.33	0.56		0.247	Exceeds	0.053	Exceeds	Exceeds	1		No
NAPHTHALENE	MG/KG	0.05	55		0.085		0.099			1000		No
PHENANTHRENE	MG/KG	0.54			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PYRENE	MG/KG	1.30	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000104	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000397								0.08		No
SULFIDE	MG/KG	20.00			165.88		284					No
ANTIMONY	MG/KG	0.67	30		1.85		3			40		No
ARSENIC	MG/KG	1.90	21		5.48		17.4			30		No
BARIUM	MG/KG	17.50	5200		51.96		90.2			2500		No
CHROMIUM	MG/KG	7.70	210		16.96		47.7			2500		No
COBALT	MG/KG	4.70	3300		8.89		21.8					No
COPPER	MG/KG	13.40	2800		34.14		144					No
LEAD	MG/KG	18.10	0.04	Exceeds	56.78		112			600		No
MERCURY	MG/KG	0.06	22		0.19		0.35			60		No
NICKEL	MG/KG	8.00	1500		16.55		38.5			700		No
VANADIUM	MG/KG	6.80	520		31.21		182			2000		No
ZINC	MG/KG	52.70	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021244 (1 to 1.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
1,2,4-TRICHLOROBENZENE	MG/KG	0.03	480		0.071		0.08			800		No
2-METHYLNAPHTHALENE	MG/KG	0.02			0.082		0.08			1000		No
4-METHYLPHENOL	MG/KG	0.42	270									No
ACENAPHTHENE	MG/KG	0.02	2600		0.089		0.18			2500		No
ACENAPTHYLENE	MG/KG	0.03			0.127		0.24			1000		No
ANTHRACENE	MG/KG	0.09	1400		0.191		0.39			2500		No
BENZO(A)ANTHRACENE	MG/KG	0.33	0.56		0.709		1.6			1		No
BENZO(A)PYRENE	MG/KG	0.26	0.056	Exceeds	0.708		1.8			0.7		No
BENZO(B)FLUORANTHENE	MG/KG	0.24	0.56		0.715		2			1		No
BENZO(GHI)PERYLENE	MG/KG	0.20			0.223		0.49			2500		No
BENZO(K)FLUORANTHENE	MG/KG	0.25	5.6		0.778		1.8			10		No
BIS(2-ETHYLHEXYL) PHTHALAT	MG/KG	9.80	32		0.113	Exceeds	0.27	Exceeds	Exceeds	300		No
CHRYSENE	MG/KG	0.35	56		0.814		0.18	Exceeds	Exceeds	10		No
DIBENZO(A,H)ANTHRACENE	MG/KG	0.06	0.056	Exceeds	0.121		0.22			0.7		No
DIBENZOFURAN	MG/KG	0.04	210		0.08		0.13					No
DI-N-OCTYL PHTHALATE	MG/KG	0.02	1100									No
FLUORANTHENE	MG/KG	0.67	2000		1.266		2.8			1000		No
FLUORENE	MG/KG	0.07	1800		1.8		0.24			2000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	0.19	0.56		0.247		0.053	Exceeds	Exceeds	1		No
NAPHTHALENE	MG/KG	0.02	55		0.085		0.099			1000		No
PENTACHLOROBENZENE	MG/KG	0.06			0.059		0.065					No
PHENANTHRENE	MG/KG	0.71			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PYRENE	MG/KG	0.68	1500							2000		No
ARSENIC	MG/KG	2.00	21		5.48		17.4			30		No
BARIUM	MG/KG	8.40	5200		51.96		90.2			2500		No
CADMIUM	MG/KG	0.41	37		0.54		1.1			80		No
CHROMIUM	MG/KG	8.50	210		16.96		47.7			2500		No
COBALT	MG/KG	3.30	3300		8.89		21.8					No
COPPER	MG/KG	94.00	2800		31.14	Exceeds	144		Exceeds			No
LEAD	MG/KG	23.80	0.04	Exceeds	56.78		112			600		No
MERCURY	MG/KG	0.03	22		0.19		0.35			60		No
NICKEL	MG/KG	7.30	1500		16.55		38.5			700		No
TIN	MG/KG	2.60	4500		6.61		22					No
VANADIUM	MG/KG	4.70	520		31.21		182			2000		No
ZINC	MG/KG	42.90	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021265 (2 to 2.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
1,2,4-TRICHLOROBENZENE	MG/KG	0.02	480		0.071		0.08			800		No
4-METHYLPHENOL	MG/KG	0.43	270									No
ANTHRACENE	MG/KG	0.03	1400		0.191		0.39			2500		No
BENZO(A)ANTHRACENE	MG/KG	0.16	0.56		0.709		1.6			1		No
BENZO(A)PYRENE	MG/KG	0.16	0.056	Exceeds	0.708		1.8			0.7		No
BENZO(B)FLUORANTHENE	MG/KG	0.10	0.56		0.715		2			1		No
BENZO(GHI)PERYLENE	MG/KG	0.13			0.223		0.49			2500		No
BENZO(K)FLUORANTHENE	MG/KG	0.15	5.6		0.778		1.8			10		No
CHRYSENE	MG/KG	0.17	56		0.814		0.18			10		No
FLUORANTHENE	MG/KG	0.25	2000		1.266		2.8			1000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	0.14	0.56		0.247		0.053	Exceeds	Exceeds	1		No
NAPHTHALENE	MG/KG	0.03	55		0.085		0.099			1000		No
PHENANTHRENE	MG/KG	0.14			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PYRENE	MG/KG	0.25	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000026	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000049								0.008		No
ARSENIC	MG/KG	3.00	21		5.48		17.4			30		No
BARIUM	MG/KG	30.40	5200		51.96		90.2			2500		No
BERYLLIUM	MG/KG	0.21	150		0.4		0.83			0.8		No
CHROMIUM	MG/KG	13.70	210		16.96		47.7			2500		No
COBALT	MG/KG	8.20	3300		8.89		21.8					No
COPPER	MG/KG	18.80	2800		31.14		144					No
LEAD	MG/KG	23.90	0.04	Exceeds	56.78		112			600		No
MERCURY	MG/KG	0.06	22		0.19		0.35			60		No
SELENIUM	MG/KG	0.55	370		0.48	Exceeds	1.3			2500		No
VANADIUM	MG/KG	10.50	520		31.21		182			2000		No
ZINC	MG/KG	72.80	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021183 (1 to 1.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
2-METHYLNAPHTHALENE	MG/KG	0.03			0.082		0.08			1000		No
ACENAPHTHENE	MG/KG	0.37	2600		0.089	Exceeds	0.18	Exceeds	Exceeds	2500		No
BENZO(A)ANTHRACENE	MG/KG	0.05	0.56		0.709		1.6			1		No
BENZO(A)PYRENE	MG/KG	0.05	0.056		0.708		1.8			0.7		No
BENZO(GHI)PERYLENE	MG/KG	0.03			0.223		0.49			2500		No
CHRYSENE	MG/KG	0.04	56		0.814		0.18			10		No
DIBENZOFURAN	MG/KG	0.04	210		0.08		0.13					No
FLUORANTHENE	MG/KG	0.06	2000		1.266		2.8			1000		No
FLUORENE	MG/KG	0.47	1800		1.8		0.24	Exceeds	Exceeds	2000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	0.03	0.56		0.247		0.053			1		No
NAPHTHALENE	MG/KG	0.34	55		0.085	Exceeds	0.099	Exceeds	Exceeds	1000		No
PHENANTHRENE	MG/KG	0.05			0.043	Exceeds	0.056			100		No
PYRENE	MG/KG	0.08	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000001	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000002								0.008		No
ARSENIC	MG/KG	2.40	21		5.48		17.4			30		No
BARIUM	MG/KG	31.70	5200		51.96		90.2			2500		No
BERYLLIUM	MG/KG	0.23	150		0.4		0.83			0.8		No
CADMIUM	MG/KG	0.73	37		0.54	Exceeds	1.1			80		No
CHROMIUM	MG/KG	9.90	210		16.96		47.7			2500		No
COBALT	MG/KG	8.70	3300		8.89		21.8					No
COPPER	MG/KG	14.40	2800		31.14		144					No
LEAD	MG/KG	13.90	0.04	Exceeds	56.78		112			600		No
NICKEL	MG/KG	13.60	1500		16.55		38.5			700		No
SELENIUM	MG/KG	0.74	370		0.48	Exceeds	1.3		Exceeds	2500		No
TIN	MG/KG	1.70	4500		6.61		22					No
VANADIUM	MG/KG	11.70	520		31.21		182			2000		No
ZINC	MG/KG	68.40	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021202 (1 to 1.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
2-METHYLNAPHTHALENE	MG/KG	0.72			0.082	Exceeds	0.08	Exceeds	Exceeds	1000		No
4-METHYLPHENOL	MG/KG	0.21	270									No
ACENAPHTHENE	MG/KG	5.00	2600		0.089	Exceeds	0.18	Exceeds	Exceeds	2500		No
ANTHRACENE	MG/KG	5.60	1400		0.191	Exceeds	0.39	Exceeds	Exceeds	2500		No
BENZO(A)ANTHRACENE	MG/KG	6.30	0.56	Exceeds	0.709	Exceeds	1.6	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(A)PYRENE	MG/KG	4.50	0.056	Exceeds	0.708	Exceeds	1.8	Exceeds	Exceeds	0.7	Exceeds	Yes
BENZO(B)FLUORANTHENE	MG/KG	2.80	0.56	Exceeds	0.715	Exceeds	2	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(GHI)PERYLENE	MG/KG	2.10			0.223	Exceeds	0.49	Exceeds	Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	4.40	5.6		0.778	Exceeds	1.8	Exceeds	Exceeds	10		No
CHRYSENE	MG/KG	5.60	56		0.814	Exceeds	0.18	Exceeds	Exceeds	10		No
DIBENZO(A,H)ANTHRACENE	MG/KG	0.83	0.056	Exceeds	0.121	Exceeds	0.22	Exceeds	Exceeds	0.7	Exceeds	Yes
DIBENZOFURAN	MG/KG	4.60	210		0.08	Exceeds	0.13	Exceeds	Exceeds			No
FLUORANTHENE	MG/KG	10.00	2000		1.266	Exceeds	2.8	Exceeds	Exceeds	1000		No
FLUORENE	MG/KG	7.60	1800		1.8	Exceeds	0.24	Exceeds	Exceeds	2000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	2.60	0.56	Exceeds	0.247	Exceeds	0.053	Exceeds	Exceeds	1	Exceeds	Yes
NAPHTHALENE	MG/KG	0.90	55		0.085	Exceeds	0.099	Exceeds	Exceeds	1000		No
PHENANTHRENE	MG/KG	19.00			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PYRENE	MG/KG	9.50	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000001	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000001								0.008		No
ARSENIC	MG/KG	3.40	21		5.48		17.4			30		No
BARIUM	MG/KG	48.20	5200		51.96		90.2			2500		No
BERYLLIUM	MG/KG	0.36	150		0.4		0.83			0.8		No
CADMIUM	MG/KG	0.85	37		0.54	Exceeds	1.1		Exceeds	80		No
CHROMIUM	MG/KG	17.30	210		16.96	Exceeds	47.7			2500		No
COBALT	MG/KG	11.60	3300		8.89	Exceeds	21.8					No
COPPER	MG/KG	35.90	2800		31.14	Exceeds	144					No
LEAD	MG/KG	46.30	0.04	Exceeds	56.78		112			600		No
MERCURY	MG/KG	0.55	22		0.19	Exceeds	0.35	Exceeds	Exceeds	60		No
NICKEL	MG/KG	16.20	1500		16.55		38.5			700		No
SELENIUM	MG/KG	1.10	370		0.48	Exceeds	1.3		Exceeds	2500		No
SILVER	MG/KG	0.21	370		0.41		0.8			200		No
TIN	MG/KG	6.50	4500		6.61		22					No
VANADIUM	MG/KG	15.70	520		31.21		182			2000		No
ZINC	MG/KG	86.70	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparision to Standards, Location RB021221 (0 to 0.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
2-METHYLNAPHTHALENE	MG/KG	0.11			0.082	Exceeds	0.08	Exceeds	Exceeds	1000		No
ACENAPHTHENE	MG/KG	0.10	2600		0.089	Exceeds	0.18			2500		No
ACENAPTHYLENE	MG/KG	0.16			0.127	Exceeds	0.24			1000		No
ANTHRACENE	MG/KG	0.52	1400		0.191	Exceeds	0.39	Exceeds	Exceeds	2500		No
BENZO(A)ANTHRACENE	MG/KG	3.70	0.56	Exceeds	0.709	Exceeds	1.6	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(A)PYRENE	MG/KG	4.40	0.056	Exceeds	0.708	Exceeds	1.8	Exceeds	Exceeds	0.7	Exceeds	Yes
BENZO(B)FLUORANTHENE	MG/KG	3.50	0.56	Exceeds	0.715	Exceeds	2	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(GHI)PERYLENE	MG/KG	4.20			0.223	Exceeds	0.49	Exceeds	Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	3.90	5.6		0.778	Exceeds	1.8	Exceeds	Exceeds	10		No
BUTYLBENZYLPHTHALATE	MG/KG	0.10	930		0.074	Exceeds	0.41					No
CHRYSENE	MG/KG	4.40	56		0.814	Exceeds	0.18	Exceeds	Exceeds	10		No
DIBENZO(A,H)ANTHRACENE	MG/KG	1.30	0.056	Exceeds	0.121	Exceeds	0.22	Exceeds	Exceeds	0.7	Exceeds	Yes
DIBENZOFURAN	MG/KG	0.09	210		0.08	Exceeds	0.13					No
FLUORANTHENE	MG/KG	7.50	2000		1.266	Exceeds	2.8	Exceeds	Exceeds	1000		No
FLUORENE	MG/KG	0.14	1800		1.8		0.24			2000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	3.70	0.56	Exceeds	0.247	Exceeds	0.053	Exceeds	Exceeds	1	Exceeds	Yes
NAPHTHALENE	MG/KG	0.30	55		0.085	Exceeds	0.099	Exceeds	Exceeds	1000		No
PHENANTHRENE	MG/KG	2.60			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PYRENE	MG/KG	9.60	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000020	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000035								0.008		No
ARSENIC	MG/KG	5.80	21		5.48	Exceeds	17.4			30		No
BARIUM	MG/KG	35.20	5200		51.96		90.2			2500		No
CADMIUM	MG/KG	1.50	37		0.54	Exceeds	1.1	Exceeds	Exceeds	80		No
CHROMIUM	MG/KG	14.80	210		16.96		47.7			2500		No
COBALT	MG/KG	9.60	3300		8.89	Exceeds	21.8					No
COPPER	MG/KG	41.20	2800		31.14	Exceeds	144					No
LEAD	MG/KG	118.00	0.04	Exceeds	56.78	Exceeds	112	Exceeds	Exceeds	600		No
MERCURY	MG/KG	0.08	22		0.19		0.35			60		No
NICKEL	MG/KG	17.10	1500		16.55	Exceeds	38.5			700		No
TIN	MG/KG	3.00	4500		6.61		22					No
VANADIUM	MG/KG	16.40	520		31.21		182			2000		No
ZINC	MG/KG	168.00	2200		90.43	Exceeds	145	Exceeds	Exceeds	2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021263 (1 to 1.5 ft)
EE/CA Reach of the Houstonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
1,2,4-TRICHLOROBENZENE	MG/KG	2.20	480		0.071	Exceeds	0.08	Exceeds	Exceeds	800		No
2-METHYLNAPHTHALENE	MG/KG	1.30			0.082	Exceeds	0.08	Exceeds	Exceeds	1000		No
4-METHYLPHENOL	MG/KG	0.38	270									No
ACENAPHTHENE	MG/KG	12.00	2600		0.089	Exceeds	0.18	Exceeds	Exceeds	2500		No
ACENAPTHYLENE	MG/KG	8.70			0.127	Exceeds	0.24	Exceeds	Exceeds	1000		No
ANTHRACENE	MG/KG	32.00	1400		0.191	Exceeds	0.39	Exceeds	Exceeds	2500		No
BENZO(A)ANTHRACENE	MG/KG	31.00	0.56	Exceeds	0.709	Exceeds	1.6	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(A)PYRENE	MG/KG	21.00	0.056	Exceeds	0.708	Exceeds	1.8	Exceeds	Exceeds	0.7	Exceeds	Yes
BENZO(B)FLUORANTHENE	MG/KG	13.00	0.56	Exceeds	0.715	Exceeds	2	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(GHI)PERYLENE	MG/KG	10.00			0.223	Exceeds	0.49	Exceeds	Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	18.00	5.6	Exceeds	0.778	Exceeds	1.8	Exceeds	Exceeds	10	Exceeds	Yes
CHRYSENE	MG/KG	25.00	56		0.814	Exceeds	0.18	Exceeds	Exceeds	10	Exceeds	Yes
DIBENZO(A,H)ANTHRACEN	MG/KG	4.20	0.056	Exceeds	0.121	Exceeds	0.22	Exceeds	Exceeds	0.7	Exceeds	Yes
DIBENZOFURAN	MG/KG	20.00	210		0.08	Exceeds	0.13	Exceeds	Exceeds			No
FLUORANTHENE	MG/KG	53.00	2000		1.266	Exceeds	2.8	Exceeds	Exceeds	1000		No
FLUORENE	MG/KG	25.00	1800		1.8	Exceeds	0.24	Exceeds	Exceeds	2000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	12.00	0.56	Exceeds	0.247	Exceeds	0.053	Exceeds	Exceeds	1	Exceeds	Yes
NAPHTHALENE	MG/KG	4.60	55		0.085	Exceeds	0.099	Exceeds	Exceeds	1000		No
PHENANTHRENE	MG/KG	84.00			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PYRENE	MG/KG	59.00	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000002	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000003								0.008		No
ARSENIC	MG/KG	5.80	21		5.48	Exceeds	17.4			30		No
BARIUM	MG/KG	25.00	5200		51.96		90.2			2500		No
BERYLLIUM	MG/KG	0.26	150		0.4		0.83			0.8		No
CHROMIUM	MG/KG	14.40	210		16.96		47.7			2500		No
COBALT	MG/KG	11.10	3300		8.89	Exceeds	21.8					No
COPPER	MG/KG	26.60	2800		31.14		144					No
LEAD	MG/KG	25.70	0.04	Exceeds	56.78		112			600		No
MERCURY	MG/KG	0.11	22		0.19		0.35			60		No
NICKEL	MG/KG	20.40	1500		16.55	Exceeds	38.5			700		No
SELENIUM	MG/KG	0.71	370		0.48	Exceeds	1.3			2500		No
TIN	MG/KG	21.30	4500		6.61	Exceeds	22		Exceeds			No
VANADIUM	MG/KG	13.50	520		31.21		182			2000		No
ZINC	MG/KG	71.30	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021282 (1 to 1.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
4-METHYLPHENOL	MG/KG	0.39	270									No
ACENAPHTHENE	MG/KG	0.04	2600		0.089		0.18			2500		No
ACENAPTHYLENE	MG/KG	0.03			0.127		0.24			1000		No
ANTHRACENE	MG/KG	0.18	1400		0.191		0.39			2500		No
BENZO(A)ANTHRACENE	MG/KG	0.63	0.56	Exceeds	0.709		1.6			1		No
BENZO(A)PYRENE	MG/KG	0.49	0.056	Exceeds	0.708		1.8			0.7		No
BENZO(B)FLUORANTHENE	MG/KG	0.33	0.56		0.715		2			1		No
BENZO(GHI)PERYLENE	MG/KG	0.25			0.223	Exceeds	0.49			2500		No
BENZO(K)FLUORANTHENE	MG/KG	0.54	5.6		0.778		1.8			10		No
CHRYSENE	MG/KG	0.57	56		0.814		0.18	Exceeds	Exceeds	10		No
DIBENZO(A,H)ANTHRACENE	MG/KG	0.09	0.056	Exceeds	0.121		0.22			0.7		No
DIBENZOFURAN	MG/KG	0.03	210		0.08		0.13					No
FLUORANTHENE	MG/KG	1.00	2000		1.266		2.8			1000		No
FLUORENE	MG/KG	0.05	1800		1.8		0.24			2000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	0.28	0.56		0.247	Exceeds	0.053	Exceeds	Exceeds	1		No
NAPHTHALENE	MG/KG	0.06	55		0.085		0.099			1000		No
PHENANTHRENE	MG/KG	0.38			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PYRENE	MG/KG	0.92	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000001	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000002								0.008		No
ARSENIC	MG/KG	1.80	21		5.48		17.4			30		No
BARIUM	MG/KG	5.90	5200		51.96		90.2			2500		No
BERYLLIUM	MG/KG	0.17	150		0.4		0.83			0.8		No
CHROMIUM	MG/KG	6.00	210		16.96		47.7			2500		No
COBALT	MG/KG	2.00	3300		8.89		21.8					No
COPPER	MG/KG	9.00	2800		31.14		144					No
LEAD	MG/KG	6.20	0.04	Exceeds	56.78		112			600		No
VANADIUM	MG/KG	3.70	520		31.21		182			2000		No
ZINC	MG/KG	33.30	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021324 (2 to 2.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
4,4'-DDE	MG/KG	0.02	1.7		0.008	Exceeds	0.015	Exceeds	Exceeds	2		No
ALDRIN	MG/KG	0.01	0.026							60		No
ENDRIN	MG/KG	0.02	16							1		No
2-METHYLNAPHTHALENE	MG/KG	230.00			0.082	Exceeds	0.08	Exceeds	Exceeds	1000		No
4-METHYLPHENOL	MG/KG	0.23	270									No
ACENAPHTHENE	MG/KG	150.00	2600		0.089	Exceeds	0.18	Exceeds	Exceeds	2500		No
BENZO(A)ANTHRACENE	MG/KG	32.00	0.56	Exceeds	0.709	Exceeds	1.6	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(A)PYRENE	MG/KG	28.00	0.056	Exceeds	0.718	Exceeds	1.8	Exceeds	Exceeds	0.7	Exceeds	Yes
BENZO(B)FLUORANTHENE	MG/KG	14.00	0.56	Exceeds	0.715	Exceeds	2	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(GHI)PERYLENE	MG/KG	20.00			0.223	Exceeds	0.49	Exceeds	Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	20.00	5.6	Exceeds	0.778	Exceeds	1.8	Exceeds	Exceeds	10	Exceeds	Yes
CHRYSENE	MG/KG	29.00	56		0.814	Exceeds	0.18	Exceeds	Exceeds	10	Exceeds	Yes
DIBENZO(A,H)ANTHRACENE	MG/KG	4.40	0.056	Exceeds	0.121	Exceeds	0.22	Exceeds	Exceeds	0.7	Exceeds	Yes
DIBENZOFURAN	MG/KG	8.80	210		0.08	Exceeds	0.13	Exceeds	Exceeds			No
FLUORANTHENE	MG/KG	50.00	2000		1.266	Exceeds	2.8	Exceeds	Exceeds	1000		No
FLUORENE	MG/KG	61.00	1800		0.108	Exceeds	0.24	Exceeds	Exceeds	2000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	16.00	0.56	Exceeds	0.247	Exceeds	0.053	Exceeds	Exceeds	1	Exceeds	Yes
NAPHTHALENE	MG/KG	620.00	55	Exceeds	0.085	Exceeds	0.099	Exceeds	Exceeds	1000		No
PHENANTHRENE	MG/KG	180.00			0.043	Exceeds	0.056	Exceeds	Exceeds	100	Exceeds	Yes
PYRENE	MG/KG	120.00	1500							2000		No
SULFIDE	MG/KG	65.10			165.88		284					No
ANTIMONY	MG/KG	0.90	30		1.85		3			40		No
ARSENIC	MG/KG	6.00	21		5.48	Exceeds	17.4			30		No
BARIUM	MG/KG	52.40	5200		51.96	Exceeds	90.2			2500		No
BERYLLIUM	MG/KG	0.21	150		0.4		0.83			0.8		No
CHROMIUM	MG/KG	31.10	210		16.96	Exceeds	47.7		Exceeds	2500		No
COBALT	MG/KG	8.70	3300		8.89		21.8					No
COPPER	MG/KG	86.60	2800		31.14	Exceeds	144		Exceeds			No
LEAD	MG/KG	105.00	0.04	Exceeds	56.78	Exceeds	112		Exceeds	600		No
MERCURY	MG/KG	0.32	22		0.19	Exceeds	0.35		Exceeds	60		No
NICKEL	MG/KG	15.30	1500		16.55		38.5			700		No
SELENIUM	MG/KG	1.30	370		0.48	Exceeds	1.3		Exceeds	2500		No
SILVER	MG/KG	0.32	370		0.41		0.8			200		No
THALLIUM	MG/KG	0.96			1.63		2.8			30		No
TIN	MG/KG	11.30	4500		6.61		22		Exceeds			No
VANADIUM	MG/KG	12.60	520		31.21		182			2000		No
ZINC	MG/KG	140.00	2200		90.43	Exceeds	145		Exceeds	2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021364 (2 to 2.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
2-METHYLNAPHTHALENE	MG/KG	1.00			0.082	Exceeds	0.08	Exceeds	Exceeds	1000		No
2-METHYLPHENOL (O-CRESOL	MG/KG	0.10	2700									No
4-METHYLPHENOL	MG/KG	0.28	270									No
ACENAPHTHENE	MG/KG	8.10	2600		0.089	Exceeds	0.18	Exceeds	Exceeds	2500		No
ACENAPTHYLENE	MG/KG	1.00			0.127	Exceeds	0.24	Exceeds	Exceeds	1000		No
ANTHRACENE	MG/KG	19.00	14000		0.191	Exceeds	0.39	Exceeds	Exceeds	2500		No
BENZO(A)ANTHRACENE	MG/KG	30.00	0.56	Exceeds	0.709	Exceeds	1.6	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(A)PYRENE	MG/KG	23.00	0.056	Exceeds	0.718	Exceeds	1.8	Exceeds	Exceeds	0.7	Exceeds	Yes
BENZO(B)FLUORANTHENE	MG/KG	14.00	0.56	Exceeds	0.715	Exceeds	2	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(GHI)PERYLENE	MG/KG	13.00			0.223	Exceeds	0.49	Exceeds	Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	16.00	5.6	Exceeds	0.778	Exceeds	1.8	Exceeds	Exceeds	10	Exceeds	Yes
CHRYSENE	MG/KG	27.00	56		0.814	Exceeds	0.18	Exceeds	Exceeds	10	Exceeds	Yes
DIBENZO(A,H)ANTHRACENE	MG/KG	4.50	0.056	Exceeds	0.121	Exceeds	0.22	Exceeds	Exceeds	0.7	Exceeds	Yes
DIBENZOFURAN	MG/KG	3.30	210		0.08	Exceeds	0.13	Exceeds	Exceeds			No
FLUORANTHENE	MG/KG	47.00	2000		1.266	Exceeds	2.8	Exceeds	Exceeds	1000		No
FLUORENE	MG/KG	7.30	1800		0.108	Exceeds	0.24	Exceeds	Exceeds	2000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	14.00	0.56	Exceeds	0.247	Exceeds	0.053	Exceeds	Exceeds	1	Exceeds	Yes
NAPHTHALENE	MG/KG	3.30	55		0.085	Exceeds	0.099	Exceeds	Exceeds	1000		No
PHENANTHRENE	MG/KG	43.00			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PYRENE	MG/KG	48.00	1500							2000		No
SULFIDE	MG/KG	24.40			165.88		284					No
ANTIMONY	MG/KG	0.67	30		1.85		3			40		No
ARSENIC	MG/KG	1.00	21		5.48		17.4			30		No
BARIUM	MG/KG	5.70	5200		51.96		90.2			2500		No
BERYLLIUM	MG/KG	0.11	150		0.4		0.83			0.8		No
CHROMIUM	MG/KG	5.30	210		16.96		47.7			2500		No
COBALT	MG/KG	4.70	3300		8.89		21.8					No
COPPER	MG/KG	8.50	2800		31.14		144					No
LEAD	MG/KG	9.70	0.04	Exceeds	56.78		112			600		No
MERCURY	MG/KG	0.02	22		0.19		0.35			60		No
NICKEL	MG/KG	7.80	1500		16.55		38.5			700		No
SELENIUM	MG/KG	0.62	370		0.48	Exceeds	1.3			2500		No
VANADIUM	MG/KG	3.10	520		31.21		182			2000		No
ZINC	MG/KG	42.00	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021385 (1 to 1.5 ft)
EE/CA Reach of the Houstonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
2-METHYLPHENOL (O-CRESOL)	MG/KG	0.38	2700									No
4-METHYLPHENOL	MG/KG	0.38	270									No
BENZO(A)ANTHRACENE	MG/KG	0.03	0.56		0.709		1.6			1		No
BENZO(A)PYRENE	MG/KG	0.03	0.056		0.718		1.8			0.7		No
BENZO(B)FLUORANTHENE	MG/KG	0.02	0.56		0.715		2			1		No
BENZO(GHI)PERYLENE	MG/KG	0.03			0.223		0.49			2500		No
BENZO(K)FLUORANTHENE	MG/KG	0.02	5.6		0.778		1.8			10		No
BIS(2-ETHYLHEXYL) PHTHALATE	MG/KG	2.80	32		0.113	Exceeds	0.27	Exceeds	Exceeds	300		No
CHRYSENE	MG/KG	0.04	56		0.814		0.18			10		No
DI-N-OCTYL PHTHALATE	MG/KG	0.03	1100									No
FLUORANTHENE	MG/KG	0.05	2000		1.266		2.8			1000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	0.03	0.56		0.247		0.053			1		No
PHENANTHRENE	MG/KG	0.04			0.043		0.056			100		No
PYRENE	MG/KG	0.07	1500							2000		No
ARSENIC	MG/KG	7.60	21		5.48	Exceeds	17.4			30		No
BARIUM	MG/KG	40.70	5200		51.96		90.2			2500		No
CHROMIUM	MG/KG	9.20	210		16.96		47.7			2500		No
COBALT	MG/KG	15.50	3300		8.89	Exceeds	21.8		Exceeds			No
COPPER	MG/KG	21.30	2800		31.14		144					No
LEAD	MG/KG	10.00	0.04	Exceeds	56.78		112			600		No
NICKEL	MG/KG	23.60	1500		16.55	Exceeds	38.5			700		No
SELENIUM	MG/KG	0.71	370		0.48	Exceeds	1.3			2500		No
SILVER	MG/KG	0.12	370		0.41		0.8			200		No
THALLIUM	MG/KG	1.60			1.63		2.8			30		No
VANADIUM	MG/KG	8.70	520		31.21		182			2000		No
ZINC	MG/KG	75.10	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021406 (1 to 1.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
BENZO(GHI)PERYLENE	MG/KG	0.02			0.223		0.49		2500		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	0.02	0.56		0.247		0.053		1		No
PYRENE	MG/KG	0.02	1500						2000		No
ARSENIC	MG/KG	8.60	21		5.48	Exceeds	17.4	Exceeds	30		No
BARIUM	MG/KG	38.60	5200		51.96		90.2		2500		No
BERYLLIUM	MG/KG	0.13	150		0.4		0.83		0.8		No
CHROMIUM	MG/KG	11.00	210		16.96		47.7		2500		No
COBALT	MG/KG	16.50	3300		8.89	Exceeds	21.8	Exceeds			No
COPPER	MG/KG	25.90	2800		31.14		144				No
LEAD	MG/KG	13.10	0.04	Exceeds	56.78		112		600		No
NICKEL	MG/KG	28.70	1500		16.55	Exceeds	38.5	Exceeds	700		No
SELENIUM	MG/KG	0.52	370		0.48	Exceeds	1.3		2500		No
THALLIUM	MG/KG	1.60			1.63		2.8		30		No
VANADIUM	MG/KG	10.70	520		31.21		182		2000		No
ZINC	MG/KG	95.40	2200		90.43	Exceeds	145		2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location SL0220 (1 to 1.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
1,2,4-TRICHLOROBENZENE	MG/KG	0.08	480		0.071	Exceeds	0.08	Exceeds	Exceeds	800		No
1,4-DICHLOROBENZENE	MG/KG	0.08	3		0.08	Exceeds	0.09			60		No
2-METHYLNAPHTHALENE	MG/KG	0.10			0.082	Exceeds	0.08	Exceeds	Exceeds	1000		No
ACENAPHTHENE	MG/KG	0.09	2600		0.089		0.18			2500		No
ACENAPTHYLENE	MG/KG	0.15			0.127	Exceeds	0.24			1000		No
ANTHRACENE	MG/KG	0.49	14000		0.191	Exceeds	0.039	Exceeds	Exceeds	2500		No
BENZO(A)ANTHRACENE	MG/KG	1.30	0.56	Exceeds	0.709	Exceeds	1.6		Exceeds	1	Exceeds	Yes
BENZO(A)PYRENE	MG/KG	1.10	0.056	Exceeds	0.718	Exceeds	1.8		Exceeds	0.7	Exceeds	Yes
BENZO(B)FLUORANTHENE	MG/KG	0.81	0.56	Exceeds	0.715	Exceeds	2			1		No
BENZO(GHI)PERYLENE	MG/KG	0.55			0.223	Exceeds	0.49	Exceeds	Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	0.94	5.6		0.778	Exceeds	1.8			10		No
CHRYSENE	MG/KG	1.10	56		0.814	Exceeds	0.18	Exceeds	Exceeds	10		No
DIBENZO(A,H)ANTHRACENE	MG/KG	0.21	0.056	Exceeds								No
DIBENZOFURAN	MG/KG	0.11	210									No
FLUORANTHENE	MG/KG	2.20	2000									No
FLUORENE	MG/KG	0.23	1800									No
INDENO(1,2,3-C,D)PYRENE	MG/KG	0.59	470									No
ISOPHORONE	MG/KG	0.15										No
NAPHTHALENE	MG/KG	0.31	55									No
PENTACHLOROBENZENE	MG/KG	0.20										No
PHENANTHRENE	MG/KG	1.80			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PYRENE	MG/KG	2.60	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000055	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000092								0.008		No
ANTIMONY	MG/KG	0.62	30		1.85		3			40		No
BARIUM	MG/KG	19.70	5200		51.96		90.2			2500		No
BERYLLIUM	MG/KG	0.14	150		0.04	Exceeds	0.83		Exceeds	0.08	Exceeds	Yes
CHROMIUM	MG/KG	10.70	210		16.96		47.7			2500		No
COBALT	MG/KG	5.60	3300		8.89		21.8					No
COPPER	MG/KG	22.80	2800		31.14		144					No
LEAD	MG/KG	30.10	0.04	Exceeds	56.78		112			600		No
MERCURY	MG/KG	0.07	22		0.19		0.35			60		No
NICKEL	MG/KG	10.90	1500		16.55		38.5			700		No
SILVER	MG/KG	0.16	370		0.41		0.8			200		No
TIN	MG/KG	3.60	4500		6.61		22					No
VANADIUM	MG/KG	8.30	520		31.21		182			2000		No
ZINC	MG/KG	63.70	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021802 (1 to 1.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
2-METHYLNAPHTHALENE	MG/KG	0.25			0.082	Exceeds	0.08	Exceeds	Exceeds	1000		No
4-METHYLPHENOL	MG/KG	2.60	270									No
ACENAPHTHENE	MG/KG	0.53	2600		0.089	Exceeds	0.18	Exceeds	Exceeds	2500		No
ACENAPTHYLENE	MG/KG	0.33			0.127	Exceeds	0.24	Exceeds	Exceeds	1000		No
ANTHRACENE	MG/KG	1.80	14000		0.191	Exceeds	0.039	Exceeds	Exceeds	2500		No
BENZO(A)ANTHRACENE	MG/KG	8.40	0.56	Exceeds	0.709	Exceeds	1.6	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(A)PYRENE	MG/KG	7.50	0.056	Exceeds	0.718	Exceeds	1.8	Exceeds	Exceeds	0.7	Exceeds	Yes
BENZO(B)FLUORANTHENE	MG/KG	5.00	0.56	Exceeds	0.715	Exceeds	2	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(GHI)PERYLENE	MG/KG	4.00			0.223	Exceeds	0.49	Exceeds	Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	7.50	5.6	Exceeds	0.778	Exceeds	1.8	Exceeds	Exceeds	10		No
CHRYSENE	MG/KG	7.60	56		0.814	Exceeds	0.18	Exceeds	Exceeds	10		No
DIBENZO(A,H)ANTHRACENE	MG/KG	1.50	0.056	Exceeds								No
DIBENZOFURAN	MG/KG	0.28	210									No
FLUORANTHENE	MG/KG	12.00	2000									No
FLUORENE	MG/KG	0.86	1800									No
INDENO(1,2,3-C,D)PYRENE	MG/KG	4.20	470									No
NAPHTHALENE	MG/KG	0.69	55									No
PHENANTHRENE	MG/KG	5.40			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PHENOL	MG/KG	2.60	33000							500		No
PYRENE	MG/KG	12.00	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000008	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000017								0.008		No
ARSENIC	MG/KG	2.70	21		5.48		17.4			30		No
BARIUM	MG/KG	20.80	5200		51.96		90.2			2500		No
CHROMIUM	MG/KG	16.70	210		16.96		47.7			2500		No
COBALT	MG/KG	5.90	3300		8.89		21.8					No
COPPER	MG/KG	25.90	2800		31.14		144					No
LEAD	MG/KG	34.90	0.04	Exceeds	56.78		112			600		No
MERCURY	MG/KG	0.15	22		0.19		0.35			60		No
NICKEL	MG/KG	9.80	1500		16.55		38.5			700		No
SILVER	MG/KG	0.13	370		0.41		0.8			200		No
TIN	MG/KG	20.00	4500		6.61	Exceeds	22		Exceeds			No
VANADIUM	MG/KG	6.60	520		31.21		182			2000		No
ZINC	MG/KG	66.50	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021702 (2 to 2.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
1,2,4-TRICHLOROBENZENE	MG/KG	0.06	480		0.071		0.08			800		No
1,4-DICHLOROBENZENE	MG/KG	0.15	3		0.08	Exceeds	0.09	Exceeds	Exceeds	60		No
2-METHYLNAPHTHALENE	MG/KG	0.10			0.082	Exceeds	0.08	Exceeds	Exceeds	1000		No
ACENAPHTHENE	MG/KG	0.15	2600		0.089	Exceeds	0.18		Exceeds	2500		No
ACENAPTHYLENE	MG/KG	0.12			0.127		0.24			1000		No
ANTHRACENE	MG/KG	0.32	14000		0.191	Exceeds	0.039	Exceeds	Exceeds	2500		No
BENZO(A)ANTHRACENE	MG/KG	1.70	0.56	Exceeds	0.709	Exceeds	1.6	Exceeds	Exceeds	1	Exceeds	Yes
BENZO(A)PYRENE	MG/KG	1.60	0.056	Exceeds	0.718	Exceeds	1.8		Exceeds	0.7	Exceeds	Yes
BENZO(B)FLUORANTHENE	MG/KG	1.30	0.56	Exceeds	0.715	Exceeds	2		Exceeds	1	Exceeds	Yes
BENZO(GHI)PERYLENE	MG/KG	1.30			0.223	Exceeds	0.49	Exceeds	Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	1.50	5.6		0.778	Exceeds	1.8		Exceeds	10		No
CHRYSENE	MG/KG	2.00	56		0.814	Exceeds	0.18	Exceeds	Exceeds	10		No
DIBENZO(A,H)ANTHRACENE	MG/KG	0.32	0.056	Exceeds								No
DIBENZOFURAN	MG/KG	0.13	210									No
FLUORANTHENE	MG/KG	3.50	2000									No
FLUORENE	MG/KG	0.32	1800									No
INDENO(1,2,3-C,D)PYRENE	MG/KG	1.30	470									No
NAPHTHALENE	MG/KG	0.23	55									No
PENTACHLOROBENZENE	MG/KG	0.10										No
PHENANTHRENE	MG/KG	2.50			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PHENOL	MG/KG	0.14	33000							500		No
PYRENE	MG/KG	3.80	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000051	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000137								0.008		No
ARSENIC	MG/KG	2.50	21		5.48		17.4			30		No
BARIUM	MG/KG	28.90	5200		51.96		90.2			2500		No
CHROMIUM	MG/KG	15.80	210		16.96		47.7			2500		No
COBALT	MG/KG	5.60	3300		8.89		21.8					No
COPPER	MG/KG	26.40	2800		31.14		144					No
LEAD	MG/KG	38.10	0.04	Exceeds	56.78		112			600		No
MERCURY	MG/KG	0.18	22		0.19		0.35			60		No
NICKEL	MG/KG	11.30	1500		16.55		38.5			700		No
SELENIUM	MG/KG	0.67	370		0.48	Exceeds	1.3			2500		No
SILVER	MG/KG	0.28	370		0.41		0.8			200		No
VANADIUM	MG/KG	9.00	520		31.21		182			2000		No
ZINC	MG/KG	70.20	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021781 (2 to 2.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
1,2,4-TRICHLOROBENZENE	MG/KG	0.11	480		0.071	Exceeds	0.08	Exceeds	Exceeds	800		No
1,4-DICHLOROBENZENE	MG/KG	0.07	3		0.08		0.09			60		No
2-METHYLNAPHTHALENE	MG/KG	0.08			0.082		0.08	Exceeds		1000		No
4-METHYLPHENOL	MG/KG	0.67	270									No
ACENAPHTHENE	MG/KG	0.11	2600		0.089	Exceeds	0.18			2500		No
ACENAPTHYLENE	MG/KG	0.09			0.127		0.24			1000		No
ANTHRACENE	MG/KG	0.31	14000		0.191	Exceeds	0.039	Exceeds	Exceeds	2500		No
BENZO(A)ANTHRACENE	MG/KG	1.50	0.56	Exceeds	0.709	Exceeds	1.6		Exceeds	1	Exceeds	Yes
BENZO(A)PYRENE	MG/KG	1.30	0.056	Exceeds	0.718	Exceeds	1.8		Exceeds	0.7	Exceeds	Yes
BENZO(B)FLUORANTHENE	MG/KG	0.99	0.56	Exceeds	0.715	Exceeds	2			1		No
BENZO(GHI)PERYLENE	MG/KG	0.82			0.223	Exceeds	0.49	Exceeds	Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	1.30	5.6		0.778	Exceeds	1.8		Exceeds	10		No
CHRYSENE	MG/KG	1.40	56		0.814	Exceeds	0.18	Exceeds	Exceeds	10		No
DIBENZO(A,H)ANTHRACENE	MG/KG	0.23	0.056	Exceeds								No
DIBENZOFURAN	MG/KG	0.09	210									No
FLUORANTHENE	MG/KG	2.60	2000									No
FLUORENE	MG/KG	0.21	1800									No
INDENO(1,2,3-C,D)PYRENE	MG/KG	0.86	470									No
NAPHTHALENE	MG/KG	0.22	55									No
PENTACHLOROBENZENE	MG/KG	0.08										No
PHENANTHRENE	MG/KG	1.40			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PHENOL	MG/KG	0.67	33000							500		No
PYRENE	MG/KG	3.30	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000761	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.001173								0.008		No
ARSENIC	MG/KG	2.10	21		5.48		17.4			30		No
BARIUM	MG/KG	29.10	5200		51.96		90.2			2500		No
CHROMIUM	MG/KG	12.30	210		16.96		47.7			2500		No
COBALT	MG/KG	5.60	3300		8.89		21.8					No
COPPER	MG/KG	24.80	2800		31.14		144					No
LEAD	MG/KG	36.90	0.04	Exceeds	56.78		112			600		No
MERCURY	MG/KG	0.12	22		0.19		0.35			60		No
NICKEL	MG/KG	10.60	1500		16.55		38.5			700		No
SELENIUM	MG/KG	0.70	370		0.48	Exceeds	1.3			2500		No
SILVER	MG/KG	0.23	370		0.41		0.8			200		No
VANADIUM	MG/KG	10.20	520		31.21		182			2000		No
ZINC	MG/KG	66.60	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021865 (2 to 2.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
1,2,4-TRICHLOROBENZENE	MG/KG	0.04	480		0.071		0.08			800		No
1,4-DICHLOROBENZENE	MG/KG	0.03	3		0.08		0.09			60		No
2,4-DIMETHYLPHENOL	MG/KG	0.02	1100							10		No
2-METHYLNAPHTHALENE	MG/KG	0.13			0.082	Exceeds	0.08	Exceeds	Exceeds	1000		No
2-METHYLPHENOL (O-CRESOL	MG/KG	0.03	2700									No
4-METHYLPHENOL	MG/KG	0.05	270									No
ACENAPHTHENE	MG/KG	0.04	2600		0.089		0.18			2500		No
ACENAPTHYLENE	MG/KG	0.12			0.127		0.24			1000		No
ANTHRACENE	MG/KG	0.19	14000		0.191		0.39			2500		No
BENZO(A)ANTHRACENE	MG/KG	1.20	0.56	Exceeds	0.709	Exceeds	1.6		Exceeds	1	Exceeds	Yes
BENZO(A)PYRENE	MG/KG	1.40	0.56	Exceeds	0.718	Exceeds	1.8		Exceeds	0.07	Exceeds	Yes
BENZO(B)FLUORANTHENE	MG/KG	1.10	56		0.715	Exceeds	2		Exceeds	1	Exceeds	Yes
BENZO(GHI)PERYLENE	MG/KG	1.10			0.223	Exceeds	0.49	Exceeds	Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	1.10	5.6		0.778	Exceeds	1.8			10		No
CHRYSENE	MG/KG	1.30	56		0.814	Exceeds	0.18	Exceeds	Exceeds	10		No
DIBENZO(A,H)ANTHRACENE	MG/KG	0.33	0.056	Exceeds	0.121	Exceeds	0.22	Exceeds	Exceeds	0.07	Exceeds	Yes
DIBENZOFURAN	MG/KG	0.05	210		0.08		0.13					No
FLUORANTHENE	MG/KG	1.80	2000		1.266	Exceeds	2.8			1000		No
FLUORENE	MG/KG	0.07	1800		0.108		0.24			2000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	0.98	0.56	Exceeds	0.247	Exceeds	0.053	Exceeds	Exceeds	1		No
NAPHTHALENE	MG/KG	0.21	55		0.085	Exceeds	0.099	Exceeds	Exceeds	1000		No
PHENANTHRENE	MG/KG	0.86			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PYRENE	MG/KG	3.40	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000158	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000274								0.008		No
ARSENIC	MG/KG	4.70	21		5.48		17.4			30		No
BARIUM	MG/KG	39.00	5200		51.96		90.2			2500		No
CHROMIUM	MG/KG	16.90	210		16.96		47.7			2500		No
COBALT	MG/KG	7.90	3300		8.89		21.8					No
COPPER	MG/KG	62.80	2800		31.14	Exceeds	144		Exceeds			No
LEAD	MG/KG	88.10	0.04	Exceeds	56.78	Exceeds	112		Exceeds	600		No
MERCURY	MG/KG	0.25	22		0.19	Exceeds	0.35			60		No
NICKEL	MG/KG	15.20	1500		16.55		38.5			700		No
SELENIUM	MG/KG	0.76	370		0.48	Exceeds	1.3		Exceeds	2500		No
SILVER	MG/KG	0.15	370		0.41		0.8			200		No
TIN	MG/KG	8.90	4500		6.61	Exceeds	22					No
VANADIUM	MG/KG	10.40	520		31.21		182			2000		No
ZINC	MG/KG	101.00	2200		90.43	Exceeds	145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021906 (0 to 0.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
1,2,4-TRICHLOROBENZENE	MG/KG	0.03	480		0.071		0.08			800		No
1,4-DICHLOROBENZENE	MG/KG	0.04	3		0.08		0.09			60		No
ACENAPHTHENE	MG/KG	0.04	2600		0.089		0.18			2500		No
BENZO(A)ANTHRACENE	MG/KG	0.47	0.56		0.709		1.6			1		No
BENZO(A)PYRENE	MG/KG	0.46	0.56		0.718		1.8			0.07	Exceeds	No
BENZO(B)FLUORANTHENE	MG/KG	0.42	56		0.715		2			1		No
BENZO(GHI)PERYLENE	MG/KG	0.34			0.223	Exceeds	0.49		Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	0.47	5.6		0.778		1.8			10		No
CHRYSENE	MG/KG	0.52	56		0.814		0.18	Exceeds	Exceeds	10		No
DIBENZO(A,H)ANTHRACENE	MG/KG	0.10	0.056	Exceeds	0.121		0.22			0.07	Exceeds	No
INDENO(1,2,3-C,D)PYRENE	MG/KG	0.33	0.56		0.247	Exceeds	0.053	Exceeds	Exceeds	1		No
PHENANTHRENE	MG/KG	0.53			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000038	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000074								0.008		No
ARSENIC	MG/KG	2.30	21		5.48		17.4			30		No
BARIUM	MG/KG	27.20	5200		51.96		90.2			2500		No
CHROMIUM	MG/KG	12.40	210		16.96		47.7			2500		No
COBALT	MG/KG	5.70	3300		8.89		21.8					No
COPPER	MG/KG	20.50	2800		31.14		144					No
LEAD	MG/KG	25.80	0.04	Exceeds	56.78		112			600		No
MERCURY	MG/KG	0.07	22		0.19		0.35			60		No
NICKEL	MG/KG	10.80	1500		16.55		38.5			700		No
SILVER	MG/KG	0.21	370		0.41		0.8			200		No
VANADIUM	MG/KG	9.70	520		31.21		182			2000		No
ZINC	MG/KG	62.00	2200		90.43		145			2500		No

BKG = Background

Table 2.3-7

Appendix IX Riverbank Soil Comparison to Standards, Location RB021965 (1 to 1.5 ft)
EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Analyte Name	Units	Observed Conc.	EPA Region IX PRG Conc.	Exceeds EPA Region IX PRG Conc.	BKG Average Conc.	Exceeds BKG Average Conc.	BKG Maximum Conc.	Exceeds BKG Maximum Conc.	Exceeds both BKG Concs. or >150% one BKG Conc.	MCP S-2 Conc.	Exceeds MCP S-2 Conc.	Exceeds both or >150% one BKG Conc. and Exceeds MCP S-2 Conc.
1,2,4-TRICHLOROBENZENE	MG/KG	0.21	480		0.071	Exceeds	0.08	Exceeds	Exceeds	800		No
1,4-DICHLOROBENZENE	MG/KG	0.34	3		0.08	Exceeds	0.09	Exceeds	Exceeds	60		No
2,4-DIMETHYLPHENOL	MG/KG	0.03	1100							10		No
2-METHYLNAPHTHALENE	MG/KG	0.14			0.082	Exceeds	0.08	Exceeds	Exceeds	1000		No
2-METHYLPHENOL (O-CRESOL)	MG/KG	0.04	2700									No
4-METHYLPHENOL	MG/KG	0.08	270									No
ACENAPHTHENE	MG/KG	0.08	2600		0.089		0.18			2500		No
ACENAPTHYLENE	MG/KG	0.09			0.127		0.24			1000		No
ANTHRACENE	MG/KG	0.24	14000		0.191	Exceeds	0.39			2500		No
BENZO(A)ANTHRACENE	MG/KG	1.20	0.56	Exceeds	0.709	Exceeds	1.6		Exceeds	1	Exceeds	Yes
BENZO(A)PYRENE	MG/KG	1.30	0.56	Exceeds	0.718	Exceeds	1.8		Exceeds	0.07	Exceeds	Yes
BENZO(B)FLUORANTHENE	MG/KG	1.20	56		0.715	Exceeds	2		Exceeds	1	Exceeds	Yes
BENZO(GHI)PERYLENE	MG/KG	1.10			0.223	Exceeds	0.49	Exceeds	Exceeds	2500		No
BENZO(K)FLUORANTHENE	MG/KG	1.00	5.6		0.778	Exceeds	1.8			10		No
CHRYSENE	MG/KG	1.50	56		0.814	Exceeds	0.18	Exceeds	Exceeds	10		No
DIBENZO(A,H)ANTHRACENE	MG/KG	0.37	0.056	Exceeds	0.121	Exceeds	0.22	Exceeds	Exceeds	0.07	Exceeds	Yes
DIBENZOFURAN	MG/KG	0.10	210		0.08	Exceeds	0.13					No
FLUORANTHENE	MG/KG	2.70	2000		1.266	Exceeds	2.8		Exceeds	1000		No
FLUORENE	MG/KG	0.16	1800		0.108	Exceeds	0.24			2000		No
INDENO(1,2,3-C,D)PYRENE	MG/KG	1.00	0.56	Exceeds	0.247	Exceeds	0.053	Exceeds	Exceeds	1		No
NAPHTHALENE	MG/KG	0.24	55		0.085	Exceeds	0.099	Exceeds	Exceeds	1000		No
PENTACHLOROBENZENE	MG/KG	0.04			0.059		0.065					No
PHENANTHRENE	MG/KG	1.80			0.043	Exceeds	0.056	Exceeds	Exceeds	100		No
PYRENE	MG/KG	4.30	1500							2000		No
TEQ 2,3,7,8-TCDD (EPA)	MG/KG	0.000172	0.001									No
TEQ 2,3,7,8-TCDD (MADEP)	MG/KG	0.000364								0.008		No
ARSENIC	MG/KG	3.20	21		5.48		17.4			30		No
BARIUM	MG/KG	36.60	5200		51.96		90.2			2500		No
CHROMIUM	MG/KG	21.30	210		16.96	Exceeds	47.7			2500		No
COBALT	MG/KG	6.50	3300		8.89		21.8					No
COPPER	MG/KG	35.50	2800		31.14	Exceeds	144					No
LEAD	MG/KG	58.70	0.04	Exceeds	56.78	Exceeds	112			600		No
MERCURY	MG/KG	0.37	22		0.19	Exceeds	0.35	Exceeds	Exceeds	60		No
NICKEL	MG/KG	12.70	1500		16.55		38.5			700		No
SELENIUM	MG/KG	0.78	370		0.48	Exceeds	1.3		Exceeds	2500		No
SILVER	MG/KG	0.36	370		0.41		0.8			200		No
TIN	MG/KG	3.80	4500		6.61		22					No
VANADIUM	MG/KG	10.50	520		31.21		182			2000		No
ZINC	MG/KG	92.70	2200		90.43	Exceeds	145			2500		No

BKG = Background

Table 2.3-8

Summary of Appendix IX Riverbank Soil Samples that Exceed Standards
EE/CA Reach of the Houstonic River, Pittsfield, Massachusetts

Subreach	Location ID	Transect	Bank	Location on Bank	Depth Interval	Compounds that Exceed Criteria
3-10	RB020985	T098	East	Middle	1-1.5	BENZO(A)ANTHRACENE BENZO(A)PYRENE BENZO(B)FLUORANTHENE DIBENZO(A,H)ANTHRACENE INDENO(1,2,3-C,D)PYRENE
3-10	RB021065	T106	East	Middle	1-1.5	BENZO(A)ANTHRACENE BENZO(A)PYRENE BENZO(B)FLUORANTHENE DIBENZO(A,H)ANTHRACENE
4-2	RB021202	T120	West	Middle	1-1.5	BENZO(A)ANTHRACENE BENZO(A)PYRENE BENZO(B)FLUORANTHENE DIBENZO(A,H)ANTHRACENE INDENO(1,2,3-C,D)PYRENE
4-2	RB021221	T122	West	Top	0-0.5	BENZO(A)ANTHRACENE BENZO(A)PYRENE BENZO(B)FLUORANTHENE DIBENZO(A,H)ANTHRACENE INDENO(1,2,3-C,D)PYRENE
4-2	RB021263	T126	West	Bottom	1-1.5	BENZO(A)ANTHRACENE BENZO(A)PYRENE BENZO(B)FLUORANTHENE BENZO(K)FLUORANTHENE CHRYSENE DIBENZO(A,H)ANTHRACENE INDENO(1,2,3-C,D)PYRENE
4-3	RB021324	T132	East	Bottom	2-2.5	BENZO(A)ANTHRACENE BENZO(A)PYRENE BENZO(B)FLUORANTHENE BENZO(K)FLUORANTHENE CHRYSENE DIBENZO(A,H)ANTHRACENE INDENO(1,2,3-C,D)PYRENE PHENANTHRENE
4-3	RB021364	T136	East	Bottom	2-2.5	BENZO(A)ANTHRACENE BENZO(A)PYRENE BENZO(B)FLUORANTHENE BENZO(K)FLUORANTHENE CHRYSENE DIBENZO(A,H)ANTHRACENE INDENO(1,2,3-C,D)PYRENE
4-5A	BT28		West		1-1.5	BENZO(A)ANTHRACENE BENZO(A)PYRENE BERYLLIUM

Table 2.3-8

Summary of Appendix IX Riverbank Soil Samples that Exceed Standards EE/CA Reach of the Houstonic River, Pittsfield, Massachusetts

Subreach	Location ID	Transect	Bank	Location on Bank	Depth Interval	Compounds that Exceed Criteria
4-5A	RB021702	T170	West	Middle	2-2.5	BENZO(A)ANTHRACENE BENZO(A)PYRENE BENZO(B)FLUORANTHENE
4-5A	RB021781	T178	West	Top	2-2.5	BENZO(A)ANTHRACENE BENZO(A)PYRENE
4-5A	RB021802	T180	West	Middle	1-1.5	BENZO(A)ANTHRACENE BENZO(A)PYRENE BENZO(B)FLUORANTHENE
4-5B	RB021865	T186	East	Middle	2-2.5	BENZO(A)ANTHRACENE BENZO(A)PYRENE BENZO(B)FLUORANTHENE DIBENZO(A,H)ANTHRACENE
4-5B	RB021965	T196	East	Middle	1-1.5	BENZO(A)ANTHRACENE BENZO(A)PYRENE BENZO(B)FLUORANTHENE DIBENZO(A,H)ANTHRACENE

SECTION 3

TABLES

Table 3.4-1

Summary of Excavation Depths and Sediment and Riverbank Soil Volumes To Be Removed EE/CA Reach of the Housatonic River, Pittsfield, Massachusetts

Subreach	Sediment		Riverbank Soils		Total Volume (yd^3)
	Volume (yd^3)	Depth (ft)	Volume (yd^3)	Depth (ft)	
3-8	5,630	3.0	4,174	3	9,804
3-9	3,065	2.0	4,655	3	7,720
3-10	5,838	3.0	5,229	varies	11,067
4-1	2,275	bedrock (2)	2,268	varies	4,543
4-2	3,928	bedrock (2)	5,145	varies	9,073
4-3	5,054	bedrock (2)	6,532	varies	11,586
4-4A	2,185	3.0	2,226	3	4,411
4-4B	3,228	3.0	3,682	3	6,910
4-5A	3,972	3.0	4,042	varies	8,014
4-5B	3,387	2.5	3,707	varies	7,094
4-6	4,663		4,847	3	9,510
(T198-T210)		2.5			
(T210-T212)		3.5			
TOTAL	43,225		46,507		89,732

Table 3.4-2

Summary of Excavation Areas and Depths
EE/CA Reach of the Housatonic River
Pittsfield, Massachusetts

Subreach	Sediment	East Bank	West Bank
3-8	0 to 3 ft	0 to 3 ft	0 to 3 ft
3-9	0 to 2 ft	0 to 3 ft	0 to 3 ft
3-10	0 to 3 ft	0 to 1 ft	0 to 3 ft
4-1	0 to bedrock	0 to 3 ft	0 to 1 ft
4-2	0 to bedrock	0 to 3 ft except for T116-T122 remove only 0 to 1 ft	0 to 2 ft*
4-3	0 to bedrock	0 to 3 ft except for T132-T140 remove only 0 to 1 ft on top 1/3 of bank and 0 to 3 ft on lower 2/3 of bank *	0 to 3 ft
4-4A	0 to 3 ft	0 to 3 ft	0 to 3 ft
4-4B	0 to 3 ft	0 to 3 ft	0 to 3 ft
4-5A	0 to 3 ft	0 to 3 ft	0 to 3 ft
4-5B	0 to 2.5 ft	0 to 3 ft*	0 to 3 ft
4-6	0 to 2.5 ft between T198 and T210, 0 to 3.5 ft between T210 and T212	0 to 3 ft	0 to 3 ft

T### Refers to specific transect number (see Figure 2.1-2).

For sediment in Subreaches 4-1, 4-2, and 4-3, assume a 2-ft average sediment depth.

* Excavation summary includes additional excavation required to address Appendix IX constituent exceedances as summarized in Table 2.3-8.

Table 3.4-3

95% UCL PCB Concentrations for Sediments Remaining After Excavation to Cleanup Goals EE/CA Reach of the Housatonic River Pittsfield, Massachusetts

Subreach	Depth of Excavation to Cleanup Goals (ft)	95% UCL PCB Concentration (ppm)		
		0 to 1 ft Below Excavation	1 to 2 ft Below Excavation	2 to 3 ft Below Excavation
3-8	3.0	0.4	0.3 (M)	ns
3-9	2.0	0.5	0.3	0.3
3-10	3.0	0.8 (M)	0.7 (M)	0.9 (M)
4-1	Bedrock	na	na	na
4-2	Bedrock	na	na	na
4-3	Bedrock	na	na	na
4-4A	3.0	ns	0.6 (M)	0.3
4-4B	3.0	0.4	0.3 (M)	ns
4-5A	3.0	0.4	0.3 (M)	ns
4-5B	2.5	0.8	0.3 (M)	ns
4-6 (T198-T210)*	2.5	0.6	0.3 (M)	ns
4-6 (T210-T212)*	3.5	0.6	ns	ns

Notes:

"M" indicates the calculated 95% UCL exceeded the maximum value for the data set or there were fewer than three data points (the calculations require a minimum of three data points), and so the maximum value was substituted for the 95% UCL.
"ns" indicates there were no samples collected from this interval.
"bedrock" indicates all sediment above bedrock will be removed.
"na" indicates the criteria is not applicable to this subreach.
*The upper portion of Subreach 4-6 between Transects 198 and 210 will be excavated to 2.5 ft. The lower portion between Transects 210 and 212 will be excavated to 3.5 ft.

Table 3.4-4

Summary of Non-Subreach-Specific Area PCB Data
EE/CA Reach of the Housatonic River
Pittsfield, Massachusetts

Arithmetic Average PCB Concentrations

Supplemental Reach	Recreational		Residential
	0 to 1 ft	1 to 3 ft	0 to 3 ft
East Bank T070 - T078	13.3 (14)	4.7 (24)	dna
East Bank T116 - T128	18.5 (19)	8.0 (29)	dna
East Bank T132 - T140	13.2 (27)	3.2 (51)	dna
West Bank T162 - 168	dna	dna	10.1 (104)

Note: Number of samples used for the calculation of each average is given in ( ).
All PCB concentrations given in mg/kg.
"dna" indicates this category does not apply to the data set.

95% UCL PCB Concentrations

Supplemental Reach	Recreational		Residential
	0 to 1 ft	1 to 3 ft	0 to 3 ft
East Bank T070 - T078	67.5 (M)	16.6	dna
East Bank T116 - T128	54.9	19.0	dna
East Bank T132 - T140	80.4 (M)	6.2	dna
West Bank T162 - 168	dna	dna	14.6

Note: All PCB concentrations are in mg/kg.
"M" indicates the calculated 95% UCL exceeded the maximum value for the data set, and so the maximum value was substituted for the 95% UCL.
"dna" indicates this category does not apply to the data set.

Table 3.4-5

Evaluation of Areas with Exceedance Percentages <25%
EE/CA Reach of the Housatonic River
Pittsfield, Massachusetts

Subreach/Bank/Depth with Exceedance Freq. <25%			Addressed by Subreach UCL Comparison?	Addressed by Non-Subreach UCL Comparison?	Suitable for Hotspot Removal?	Hotspot Removal Plan
Subreach	Bank	Depth				
3-8	East	1-3 ft	No	No	No	None
3-10	East	1-3 ft	Yes	--	--	--
4-1	West	0-1 ft	No	No	No	None
4-1	West	1-3 ft	Yes	--	--	--
4-2	East	1-3 ft	No	No	Yes	T116-T122: remove 0-1ft only.
4-2	West	0-1 ft	No	No	Yes	T118-T122: no removal required.
4-2	West	1-3 ft	Yes	--	--	--
4-3	East	1-3 ft	No	Yes	--	--
4-5A	East	1-3 ft	No	No	No	None
4-5A	West	1-3 ft	Yes	--	--	--
4-5B	East	0-3 ft	No	No	Yes	Full Subreach: no removal top 2/3 bank.

Notes: "--" indicates the location has been addressed by a previous comparison and thus was not considered under this category.

Table 3.4-6

Summary of PCB Data for Riverbank Soils
Remaining After Hotspot Removal
EE/CA Reach of the Housatonic River
Pittsfield, Massachusetts

Hotspot Removal Area	Depth Interval of Remaining Soil	Number of Samples Used in Calculations	Maximum PCB Concentration (mg/kg)	Average PCB Concentration (mg/kg)	95% UCL of the Average Concentration (mg/kg)
East Bank T116 - T122	1 to 3 ft	12	7.8	3.0	7.8 (M)
West Bank T118 - T122	0 to 3 ft	22	8.4	1.1	1.6
Subreach 4-5B	0 to 3 ft top 2/3 of bank	63	1.6	0.4	0.4

Note: "M" indicates the calculated 95% UCL exceeded the maximum value for the data set, and so the maximum value was substituted for the 95% UCL.

The 95% UCL was calculated for the 0- to 3-ft depth interval for the areas where the 95% UCL for the 1- to 3-ft depth exceeded 10 mg/kg to assess whether an ERE would be required at those locations. Those calculations were performed assuming that clean fill would be used to backfill the 0- to 1-ft interval. As such, samples representing the 0- to 1-ft interval were replaced (one for one) with a value of 1/2 the average detection level (0.25 mg/kg). The resulting 95% UCLs for the 0- to 3-ft depth interval in each area were all less than 5 mg/kg, indicating that EREs would not be required.

SECTION 4

TABLES

Table 4.1-1

Screening of River Diversion Technologies

Category/Criteria	Open Channel Diversion (Intrusive)	Open Channel Diversion (Non-Intrusive, Jersey Barrier/Concrete Blocks/Portable Dams)	Gravity Feed Bypass Piping	Bypass Pump/Piping	Alternate River Channel (new channel above-ground or underground bypass tunnel)
Description	Sheetpile would be installed along centerline of river. Flow diverted to ½ of river channel. Work in river completed in cells.	Flow in river diverted to less than ½ of the channel using a series of diversions. Work in river completed in cells.	River dammed and flow channeled into pipe placed in riverbed. Gravity conveys water to point downstream of active work area.	River dammed. Water pumped through piping placed above river channel on bank. Water discharged downstream of active work area.	A new channel, above or below ground would be constructed to carry river flow.
IMPLEMENTABILITY CRITERIA					
Technical Feasibility					
▪ Construction considerations					
Size of work area	Sheetpile installed from bank along area to be sheetpiled. Large crane needed to install sheetpile. Can be constructed from within riverbed if access ramps down banks can be constructed for crane. Need areas for equipment to operate and staging areas for sheetpiles pending installation.	Ideally installed from bank along length of river. Equipment must reach from banks to install. Can be installed from within riverbed if access ramps to riverbed can be constructed. Need areas for equipment to operate from and staging areas for diversion structures pending installation.	Pipe placed on riverbed would interfere with sediment excavation. Therefore, a second pipe is required to maintain flow when removing first pipe. Need areas for equipment to operate from and staging areas for piping pending installation.	Area needed in the river for wet wells and area needed for placement of pumps. Discharge piping does not need to be placed in river channel so the entire channel is available for excavation/restoration. Need areas for installation equipment to operate from and staging areas for pumps and piping pending installation.	**Large areas needed to stage equipment and construct a new diversion channel are not available along the river beginning at the cobble reaches and continuing downstream.**

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-1

Screening of River Diversion Technologies (Continued)

Category/Criteria	Open Channel Diversion (Intrusive)	Open Channel Diversion (Non-Intrusive, Jersey Barrier/Concrete Blocks/Portable Dams)	Gravity Feed Bypass Piping	Bypass Pump/Piping	Alternate River Channel (new channel above-ground or underground bypass tunnel)
Depth/ type of overburden in river channel	Requires substantial penetration to install effectively. **Will not work in areas with boulders or shallow bedrock, specifically the cobble Subreaches 4-1, 4-2, 4-3, and 4-4A.**	Works best on silty/sandy bottoms and in relatively shallow water (e.g., 2 feet for jersey barriers or bin blocks, 10 feet for portable dams). Will not effectively seal out river in cobble areas without first removing cobbles.	Does not affect gravity feed bypass piping except a smooth pipe bed in river would need to be established before installation and could require removal of boulders/large cobbles.	Shallow bedrock in the cobble reaches will potentially impact depth of wet wells. A small increase in the river depth, via a dam, may be needed to prevent vortexing at the pump suction.	Does not affect river diversion activities except that shallow overburden in the river may be indicative of shallow bedrock in the general area of the diversion channel.
Accessibility of channel from bank	More difficult to install in areas with steep, high banks.	More difficult to install in areas with steep, high banks.	More difficult to install in areas with steep, high banks, but much of the work will occur within the channel.	More difficult to install in areas with steep, high banks, but much of the work will occur within the channel. Pipes can be placed outside of river channel along banks.	Has little impact on river diversion activities.
Adequate riverbank area for piping, equipment	Extensive access areas needed along riverbanks to install.	Barriers must be placed from access areas along channel (at top or bottom of bank).	Limited area is needed, pipe installed within river channel, but equipment needed along banks to install.	Limited area is available at steep bank areas. Pipes may need to be placed at edges of roadways. Pumps may be placed on structure mounted in the river.	Diversion channel would likely be installed on or near the existing riverbanks. Significant space would be required.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-1

Screening of River Diversion Technologies (Continued)

Category/Criteria	Open Channel Diversion (Intrusive)	Open Channel Diversion (Non-Intrusive, Jersey Barrier/Concrete Blocks/Portable Dams)	Gravity Feed Bypass Piping	Bypass Pump/Piping	Alternate River Channel (new channel above-ground or underground bypass tunnel)
Ability to respond to storm events	Little effort to remove equipment. Sheetpiling can remain in place and will not interfere with storm flow. Overtopping can be controlled by height of sheetpiles but not prevented. Overtopping may cause recontamination of active cell area. Sheetpiling will cause the river to rise slightly higher during a storm event when compared to the open river.	**Relatively small rise in river will result in overtopping of barriers. Overtopping may cause recontamination of active cell area**.	**Pipe sized to handle normal flow rate but cannot handle storm flows without causing significant increases in the river depth upstream of the inlet because the design reduces the flood capacity of the river.** Overtopping would be allowed to relieve flood levels and may cause recontamination of active cell area.	Pumps/piping to be sized to handle design flow with some reserve capacity. River flow greater than reserve capacity will cause overtopping of the dam and possible recontamination of active work area.	Good. Temporary channel/ conduit will be sized to handle large flows.
Time required for construction	Moderate to long because numerous mobilizations would be required along the EE/CA Reach.	Short to moderate because of the ease of installation. However, numerous mobilizations would be required along the EE/CA Reach.	Moderate because each bypass would need to be short to minimize the impact on the river depth and numerous mobilizations would be required along the EE/CA Reach.	Moderate to long because of the complexity of each mobilization. However, the number of mobilizations would be significantly less than for other technologies.	Long because of the complexity and difficulties expected to be encountered in creating another river channel.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-1

Screening of River Diversion Technologies (Continued)

Category/Criteria	Open Channel Diversion (Intrusive)	Open Channel Diversion (Non-Intrusive, Jersey Barrier/Concrete Blocks/Portable Dams)	Gravity Feed Bypass Piping	Bypass Pump/Piping	Alternate River Channel (new channel above-ground or underground bypass tunnel)
▪ Operational considerations					
Seasonal considerations	Height of sheetpiling can be left to handle higher seasonal flows. Higher flows could cause overtopping.	Higher flows could cause overtopping.	Possible difficulty due to freezing in winter. Higher flows could cause overtopping and flooding upstream.	Possible difficulty due to freezing in winter. Higher flows could cause overtopping.	Possible difficulty due to freezing in winter.
Water depth/ velocity of stream	Stability of sheetpile limited by how deep it can be installed into sediment/bedrock and water depth.	**Not practical for deeper water depths because this technology relies primarily on the mass of the diversion structure to create stability**.	Only impacts the height and mass of the dam used to divert the river to the bypass pipe.	Impacts the height and mass of the dam used to divert the river to the bypass pumps. Shallow water depth could create vortexing at the pump suction.	Can be used for any depth/velocity of water.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-1

Screening of River Diversion Technologies (Continued)

Category/Criteria	Open Channel Diversion (Intrusive)	Open Channel Diversion (Non-Intrusive, Jersey Barrier/Concrete Blocks/Portable Dams)	Gravity Feed Bypass Piping	Bypass Pump/Piping	Alternate River Channel (new channel above-ground or underground bypass tunnel)
Other factors	Cannot place sheetpile beneath bridges. Pre-trenching may be required. Dewaters only ½ of river at once, must excavate river in halves. River will not be interrupted so fish can continue to move up and down river.	Dewaters only ½ of river at once. To excavate second half of river, barriers must be moved. May not fully block river flow in cobble areas without removal of the cobbles.	**River needs to be dammed to raise its level and channeled into pipe. Slope of riverbed very gentle, requiring large-size pipe. Debris floating down the river will require monitoring and will need to be kept out of diversion. Flooding of river area upstream of dammed locations is a potential concern because of the reduced flood capacity caused by the dam. Because of depth concerns, many dam installations will be required along the EE/CA Reach**.	Wet well excavation may be difficult due to shallow bedrock at some areas. Debris floating down the river will require monitoring and will need to be kept out of diversion. Pump efficiency reduced at areas of high banks due to increased suction required, depending on where pumps can be located. Only bypass a portion of the EE/CA Reach at any one time. Need to move system several times. No safe passage for fish.	**Large volume of soils/sediments/rock generated. Contaminated material will require disposal. Temporary channel must be backfilled and restored following remediation. Property acquisition required. Topography may not be conducive to diversion. Interference with utilities and infrastructure is likely**.
▪ Adaptable to environmental conditions	No. Vegetation must be cleared to allow access for equipment to install sheetpile.	Yes. Smaller installation equipment is needed, so land clearing is less than other activities. More passive approach.	Yes. Smaller installation equipment is needed, so land clearing is less than other activities. More passive approach.	No. Vegetation must be cleared to install discharge pipe. Staging areas for pumps can be placed in less sensitive areas.	No. Aboveground diversion channel would require extensive land clearing activities.
▪ Can be implemented within schedule limits	Yes. Adequate timeframe to implement.	Yes. Relatively short timeframe to implement. Can only be operated in times of relatively low flow	Yes. Adequate timeframe to implement. Can only be operated in times of relatively low flow	Yes. Lead time for ordering and installing pumps may be significant. Can only be operated in times of relatively low flow.	Uncertain. Longest timeframe to implement.
▪ Demonstrated performance	Yes	Yes	Yes	Yes	Yes

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-1

Screening of River Diversion Technologies (Continued)

Category/Criteria	Open Channel Diversion (Intrusive)	Open Channel Diversion (Non-Intrusive, Jersey Barrier/Concrete Blocks/Portable Dams)	Gravity Feed Bypass Piping	Bypass Pump/Piping	Alternate River Channel (new channel above-ground or underground bypass tunnel)
Availability of Services and Materials					
▪ Services/ equipment/ materials available	Commonly used construction method, materials and services are readily available.	Commonly used construction method, materials and services are readily available.	Commonly used construction method, materials and services are readily available.	Commonly used construction method, materials and services are readily available.	Construction materials and services are readily available. Method not commonly used.
Administrative Feasibility					
▪ Access Agreements required	Extensive access agreements required if sheetpiling installed from top of banks.	Extensive access agreements required.	Access agreements mainly needed at dam locations.	Access agreements needed primarily at dam locations and possibly along the riverbanks for piping.	Significant access agreements needed where installation of diversion channel is to occur.
▪ Impact on adjoining property	Will impact numerous properties during installation.	Will impact numerous properties during installation.	Will impact numerous properties during installation, but likely less than other options. Possible negative impacts from flooding above dammed locations.	Will impact numerous properties during installation, but likely less than other options.	Aboveground diversion will significantly impact numerous properties during installation. Underground conduit will impact fewer properties.
EFFECTIVENESS CRITERIA					
Protective of Human Health and tbe Environment					
▪ Protective of environment	Removal of trees required for access road to install sheetpile. Flow maintained in ½ of channel. Impacts along riverbanks.	Limited vegetation removal for access. Maintains river flow during remediation in ½ of channel. Impacts along riverbanks.	Limited vegetation removal for access. Maintains river flow in pipe rather than in channel. Impacts along riverbanks.	Maintains river flow in pipe rather than in channel. Large impact at pump/wet well area. Pipe has relatively low impact on environment. No safe passage for fish.	Flow maintained in new channel. No flow in existing channel. Impacts to areas in addition to the river.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-1

Screening of River Diversion Technologies (Continued)

Category/Criteria	Open Channel Diversion (Intrusive)	Open Channel Diversion (Non-Intrusive, Jersey Barrier/Concrete Blocks/Portable Dams)	Gravity Feed Bypass Piping	Bypass Pump/Piping	Alternate River Channel (new channel above-ground or underground bypass tunnel)
Ability to Achieve Removal Objectives					
▪ Prevent recontamination of previously remediated areas and further contamination of other areas	Will cause some disturbance of contaminated sediments during installation. Decrease in channel width may increase water velocity and potential for scour. Potential for recontamination of active cell area when removing sheetpile and during storm events.	Not likely to cause significant disturbance of contaminated sediments during installation. Decrease in channel width may increase water velocity and potential for scour. Significant risk of overtopping and potential recontamination of active cell during storm events.	Engineering controls required at pipe inlet and outfall to minimize scour. Damming of river required to create diversion will reduce flood capacity and increase potential for erosion upstream. Potential for recontamination of active cell from overtopping during storm events.	Engineering controls required at pipe inlet and outfall to minimize scour. Potential for recontamination of active work area during storm events.	Not likely to cause significant disturbance of contaminated sediments during installation. Recontamination unlikely.
▪ Prevent downstream migration of contaminated sediments	May mobilize contaminated sediment due to increased water velocities. Sediments mobilized during installation of sheetpile.	May mobilize contaminated sediment due to increased water velocities.	Engineering controls required at pipe inlet and outfall to minimize scour and resuspension of sediments.	Engineering controls required at pipe inlet and outfall to minimize scour and resuspension of sediments.	Will not cause downstream migration of contaminated sediments.
▪ Minimize impacts on wetland areas and floodplain	Minimal impacts expected.	Minimal impacts expected.	Increased river depth caused by dam will reduce flood capacity with potential adverse effects during flood conditions. Higher river depth will cause some loss of habitat along riverbanks.	Minimal impacts expected.	No impacts expected from river itself; however, diversion channel construction could cause large disruption to affected areas.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-1

Screening of River Diversion Technologies (Continued)

Category/Criteria	Open Channel Diversion (Intrusive)	Open Channel Diversion (Non-Intrusive, Jersey Barrier/Concrete Blocks/Portable Dams)	Gravity Feed Bypass Piping	Bypass Pump/Piping	Alternate River Channel (new channel above-ground or underground bypass tunnel)
▪ Potential impacts on community	Unmitigated noise and vibration. Extensive access agreements needed.	Extensive access agreements needed.	Limited access agreements needed.	Noise. Diesel exhaust. Limited access agreements needed. Electric pumps would reduce noise and eliminate air pollution impacts.	Noise. Extensive access agreements needed.
Short-Term Impacts					
▪ Potential impacts on worker	Noise. Potential for contact with contaminated sediments.	Potential for contact with contaminated sediments during barrier installation.	Potential for contact with contaminated sediments during pipe installation.	Noise. Potential for contact with contaminated sediments during pipe installation and wet well construction.	Noise.
▪ Potential impacts on downstream water quality	Limited, but increased water velocities and sheetpile installation and removal could resuspend sediments.	Minimal, but increased water velocities could increase scour and resuspension of sediments.	Minimal, but engineering controls required at inlet and outlet of bypass pipe to minimize scour and effects on water quality.	Minimal, but engineering controls required at inlet and outlet of bypass pipe to minimize scour and effects on water quality.	Minimal, but engineering controls required at inlet and outlet of by-pass channel to minimize scour and effects on water quality.
▪ Potential impact on downstream sediment	Limited, but increased water velocities and installation and removal of sheetpiles could resuspend sediments, resulting in deposition further downstream.	Minimal, but increased water velocities could increase scour and resuspension of sediments, resulting in deposition further downstream.	Engineering controls required at pipe outlet to minimize scour and resuspension of contaminated sediments.	Engineering controls required at pipe outlet to minimize scour and resuspension of contaminated sediments.	Would have minimal or no effect.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-1

Screening of River Diversion Technologies (Continued)

Category/Criteria	Open Channel Diversion (Intrusive)	Open Channel Diversion (Non-Intrusive, Jersey Barrier/Concrete Blocks/Portable Dams)	Gravity Feed Bypass Piping	Bypass Pump/Piping	Alternate River Channel (new channel above-ground or underground bypass tunnel)
▪ Potential impact on aquatic receptors in work area	Minimal, increased velocities could increase water turbidity. Riverbed is relatively dry in active work area.	Minimal, increased velocities could increase water turbidity.	Water will be removed from active cells in the diverted river sections altering habitat. Fish passage would be maintained through gravity pipes.	Water will be removed from active cells in the diverted river sections, altering habitat. Fish passage would be eliminated by pumping.	Riverbed will become dry. Fish passage would be maintained through alternate channel.
COST CRITERIA					
Direct Capital Costs					
▪ Labor costs	Moderate	Low to Moderate	Moderate	Moderate to High	**Extremely High**
▪ Equipment and material costs	Moderate to high	Moderate	Moderate	High	**Very High**

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-1

Screening of River Diversion Technologies (Continued)

Category/Criteria	Open Channel Diversion (Intrusive)	Open Channel Diversion (Non-Intrusive, Jersey Barrier/Concrete Blocks/Portable Dams)	Gravity Feed Bypass Piping	Bypass Pump/Piping	Alternate River Channel (new channel above-ground or underground bypass tunnel)
Indirect Capital Costs					
▪ Engineering and design	Moderate, engineering and design required.	Low, minimal engineering and design required.	Moderate, engineering and design required.	Moderate, engineering and design required.	**High, extensive engineering and design required.**
SCREENING STATUS					
	Retained for subreaches where bedrock is deep enough to allow sheetpile installation (3-8, 3-9, 3-10, 4-4B, 4-5A, 4-5B, and 4-6).	**Not retained.** Significant risk of overtopping will impact schedule and potentially cause recontamination of the active cell. Inability to effectively seal work areas from river infiltration in cobble areas without cobble removal. Some open-channel diversion structures may be applicable to wet excavation to reduce the impacts of river velocity.	**Not retained**. Increased river depth required to bypass flow will reduce flood capacity of the river and damage habitat along the riverbanks. Potential to alter groundwater flow directions due to higher river depth.	**Retained** for all subreaches of the EE/CA.	**Not retained**. Limited space/access available to construct diversion, very high cost.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-2

Screening of Sediment and Riverbank Soil Removal Technologies

Category/Criteria	Wet Excavation (Riverbed Only)	Barge-Mounted Dredging (Riverbed Only)	Dry Excavation (Riverbed and Riverbank)
Description	Excavate sediment using standard excavation equipment without river diversion.	Dredge using barge-mounted mechanical or hydraulic equipment.	Divert river, excavate using standard excavation equipment in the dry.
IMPLEMENTABILITY CRITERIA			
Technical Feasibility			
▪ Construction considerations			
Placement of equipment	Need to construct access road from top of bank to riverbed for trucks and excavation equipment to remove material and perform restoration. Access needed intermittently for trucks to haul material out of river. Alternatively, access through the river along the riverbank may be possible.	Equipment placed by crane from top of bank. Support area can be larger distance from unit. Support area does not need to be at top of bank, depending on type of dredging.	Need to construct access at top of bank, partially down bank, or in river. Need support areas at top of bank. Haul roads needed for trucks to remove material.
Ability to respond to storm events	Equipment can be removed from river before storm events. Access roads could be damaged during storms. Work impeded with any significant increased river flow.	It is less critical to remove equipment from river in anticipation of storm. Minimal interruption of work at increased flow rates.	Equipment can be removed from river before storm events. Access roads could be lost during storms if overtopping occurs. Work can proceed with caution under moderate increased flow conditions until the diversion is overtopped.
▪ Operational considerations			
Ease of cap construction	Difficult to construct cap accurately beneath water surface.	Difficult to construct cap accurately beneath water surface.	Most compatible with cap construction. Dry construction produces fewer quality control problems.
Compatibility with bank excavation.	Same equipment could excavate banks in some areas. Stability of bank during excavation must be controlled.	**Not compatible. Other equipment needed to excavate banks.**	Same equipment used to excavate banks. Stability of bank during excavation must be controlled.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-2

Screening of Sediment and Riverbank Soil Removal Technologies (Continued)

Category/Criteria	Wet Excavation (Riverbed Only)	Barge-Mounted Dredging (Riverbed Only)	Dry Excavation (Riverbed and Riverbank)
Excavation and backfill rates	Low to moderate	Low to moderate	Moderate
Dewatering of sediments	Large amount of water generated from dewatering of saturated sediments and free water carried with sediments.	**Very large amount of water generated from dewatering of sediments and free water. Eddy pump can generate up to 2,000 gpm.**	Water generated from dewatering of saturated sediments.
Water depth	Not practical in deep water; however, normal river depth is shallow enough for technology to be practical. Most suitable for shallow waters of cobble Subreaches 4-1, 4-2, 4-3, and 4-4A.	**Water depth not adequate to float a barge-mounted dredge. Likely significant controlled flooding of work area required with potential negative impacts.**	Requires river diversion and removal of infiltrating groundwater and river water to work in the dry.
Sediment resuspension	Resuspension of sediment and PCBs will occur; however, coarser particles will redeposit quickly. Control of fines, especially near the end of the EE/CA Reach, will require engineering controls.	Resuspension of sediment and PCBs will occur; however, coarser particles will redeposit quickly. Control of fines, especially near the end of the EE/CA Reach, will require engineering controls.	No suspension of fines during low flow/dry work related to excavation method but may occur from diversion method. During overtoping events, engineering controls will be required to control resuspension of sediment and transport downstream of fines and PCBs.
Access sufficient to place equipment in work area	Difficult at steep banks, if done from bank. Alternative of using a river route is possible.	Typically, fewer access areas needed compared to other technologies.	Difficult at steep banks if working from bank. Dry riverbed allows more space for equipment to be staged in riverbed.
Bank height	Multiple excavators/ bank access roads needed at higher banks. Steep banks may require significant reworking for work pads and placement of equipment using crane. Bank height less of an issue if working in river.	Not an issue for barge-mounted dredging equipment.	Multiple excavators/ bank access roads needed at higher banks. More work would be accomplished directly in riverbed, although haul roads would need to be constructed to remove material. Bank height less of an issue if working in river.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-2

Screening of Sediment and Riverbank Soil Removal Technologies (Continued)

Category/Criteria	Wet Excavation (Riverbed Only)	Barge-Mounted Dredging (Riverbed Only)	Dry Excavation (Riverbed and Riverbank)
▪ Can be implemented within schedule limits	Yes, excavation rates likely to be lower than dry excavation; however, overall productivity expected to be generally comparable to dry excavation.	Yes, overall productivity expected to be comparable to dry and wet excavation. Additional time may be needed for handling large volumes of water.	Yes, excavation rates likely to be higher than wet excavation; however, overall productivity expected to be generally comparable to wet excavation.
▪ Demonstrated performance	Yes	Yes, except for coarser materials to be encountered. **Not feasible in cobble areas.**	Yes
Availability of Services and Materials			
▪ Services/equipment/ materials available	Standard equipment readily available.	Specialty equipment available from specialty suppliers.	Standard equipment readily available.
Administrative Feasibility			
▪ Access agreements required	Access agreements required at various points along reach. Riverbed will be used as major haul route/access.	Access agreements required at various points along reach.	Variable, depending on river diversion method. Frequent access agreements needed along banks to excavate active cells in the dry with open channel diversion. Less frequent access needed for piped bypass diversion.
▪ Impact on adjoining property	Moderate to low, most work to occur within river. Properties at access points will be affected.	Moderate to low, most work to occur within river. Properties at access points will be affected.	Variable, from low to high, depending on river diversion method and character of the river along the EE/CA Reach.
EFFECTIVENESS CRITERIA			
Protective of Human Health and the Environment			
▪ Protective of environment	Potential for release of sediments and PCBs to downstream locations. Potential for release and migration of oil present at cobble reaches. Releases can be managed by engineering controls.	Potential for release of sediments and PCBs to downstream locations. Potential for release and migration of oil present at cobble reaches. Releases can be managed by engineering controls.	Potential for release of sediments and PCBs to downstream locations. Limited potential for release and migration of oil at cobble reaches.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-2

Screening of Sediment and Riverbank Soil Removal Technologies (Continued)

Category/Criteria	Wet Excavation (Riverbed Only)	Barge-Mounted Dredging (Riverbed Only)	Dry Excavation (Riverbed and Riverbank)
Ability to Achieve Removal Objectives			
▪ Prevent recontamination of previously remediated areas and further contamination of other areas	Recontamination not likely. Potential for further contamination of other areas, especially from oil present at cobble reaches.	Recontamination possible. Potential for further contamination of other areas, especially from oil present at cobble reaches.	Recontamination possible within individual cell areas during storm events. Release of oil from cobble areas not likely.
▪ Prevent downstream migration of contaminated sediments	Potential for downstream migration of resuspended sediment is likely but engineering controls would minimize impacts.	Potential for downstream migration of resuspended sediment is likely but engineering controls would minimize impacts.	This excavation method minimizes resuspension and downstream migration of sediment under normal operating conditions, but not during overtopping events. However, diversion method may contribute to resuspension and migration of sediment. Engineering controls would be required to minimize impacts.
▪ Minimize impacts on wetland areas and floodplain	Within the context of the removal action required, this technology minimizes secondary impacts.	**Because the river depth is expected to be increased to execute this remedy, wetland habitat would be impacted and flood capacity would be reduced.**	Because flow will be diverted from the river to execute this technology, some temporary adverse impact on the wetland habitat is expected.
Short-Term Impacts			
▪ Potential impacts on community	Access agreements needed. With access road in river, need for access agreements could be minimized.	Limited access agreements needed. (Potentially less than wet and dry excavation)	Access agreements needed. Will vary with river diversion method.
▪ Potential impacts on worker	Working with heavy equipment, contact with contaminated sediment and soil, riverbank instability, flowing river.	Working with heavy equipment, contact with contaminated sediment, flowing river.	Working with heavy equipment, contact with contaminated sediment and soil, riverbank instability, flowing river.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-2

Screening of Sediment and Riverbank Soil Removal Technologies (Continued)

Category/Criteria	Wet Excavation (Riverbed Only)	Barge-Mounted Dredging (Riverbed Only)	Dry Excavation (Riverbed and Riverbank)
▪ Potential impacts on downstream water quality	Potential for resuspension and migration of sediments, increase in turbidity possible.	Potential for resuspension and migration of sediments, increase in turbidity possible.	Resuspension minimized by excavation method but possible during storm flows. More significant potential possible due to diversion method.
▪ Potential impact on downstream sediment	Resuspended sediments could be carried downstream and redeposited. Redeposits within the EE/CA Reach will be subsequently removed. Engineering controls will minimize migration outside the EE/CA Reach.	Resuspended sediments could be carried downstream and redeposited. Redeposits within the EE/CA Reach will be subsequently removed. Engineering controls will minimize migration outside the EE/CA Reach.	Resuspended sediments could be carried downstream and redeposited. Redeposits within the EE/CA Reach will be subsequently removed. Engineering controls will minimize migration outside the EE/CA Reach.
▪ Potential impact on aquatic receptors in work area	Disrupted by excavation activities.	Disrupted by excavation activities.	Riverbed becomes dry, temporarily but significantly altering habitat.
COST CRITERIA			
Direct Capital Costs			
▪ Labor costs	Moderate to High	Moderate to High	Moderate to high considering the need for river diversion
▪ Equipment and material costs	Moderate	Moderate to High	Moderate to high considering the need for river diversion.
Indirect Capital Costs			
▪ Engineering and design	Moderate	Low to Moderate	Moderate to high considering the need for river diversion.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-2

Screening of Sediment and Riverbank Soil Removal Technologies (Continued)

Category/Criteria	Wet Excavation (Riverbed Only)	Barge-Mounted Dredging (Riverbed Only)	Dry Excavation (Riverbed and Riverbank)
Screening Status	**Retained.**	**Not Retained.** Likely negative impacts due to flooding of areas upstream of dams required to raise the river level. Reduced flood storage capacity increasing the probability of additional upstream flooding during storm events. Large volume of water to handle, different equipment required for bank excavation, not suitable for cobble reaches because of volume of large cobbles.	**Retained.**

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-3a

Screening of Treatment/In Situ Containment Technologies

Category/Criteria	Solvent Extraction	Soil Washing	Incineration	Thermal Desorption	In Situ Capping
Description	Removal of PCBs and other contaminants using extraction solutions. The process equipment will be located temporarily at the GE facility.	Separation and/or removal of PCBs and other contaminants using physical separation techniques and chemical surfactants. The process equipment will be located temporarily at the GE facility.	Destruction of PCBs and other contaminants at high temperatures using a transportable process located temporarily at the GE facility.	Removal of PCBs and other contaminants at elevated temperatures (not as high as for incineration) using a transportable process located temporarily at the GE facility.	Containment of PCBs by placement of a cap over contaminated riverbank soils and riverbed sediments. This technology will require some excavation of the river cross section so that there is no decrease in the capacity of the river channel.
IMPLEMENTABILITY CRITERIA					
Technical Feasibility					
▪ Construction/siting considerations	1. Basic components are commercially available, but system would have to be adapted to site specific requirements. 2. Requires adequate space for treatment system. 3. Height and noise issues may affect siting. 4. Requires adequate space and facilities for dewatering of excavated sediment to meet treatment requirements, including management and disposal of the water and treatment residuals including concentrated contaminant streams. 5. Control of air emissions may be required.	1. Basic components are commercially available, but system would have to be adapted to site specific requirements. 2. Requires adequate space for treatment system. 3. Height and noise issues may affect siting. 4. Requires adequate space and facilities for dewatering of treated sediment to meet transport and redisposal requirements, including management and disposal of the washwater. 5. May require post-treatment (i.e., stabilization to meet disposal criteria, either on site or at the disposal facility).	1. Conventional technology, transportable systems are available. 2. Requires adequate space for treatment system. 3. Height and noise issues may affect siting. 4. Control of air emissions will be required	1. Conventional technology, transportable systems are available. 2. Requires adequate space for treatment system. 3. Requires space for management and/or storage of treatment residuals including condensed contaminant streams.	Adequate space for staging areas for capping materials will be required. Difficult to perform if river is not dry.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-3a

Screening of Treatment/In Situ Containment Technologies (Continued)

Category/Criteria	Solvent Extraction	Soil Washing	Incineration	Thermal Desorption	In Situ Capping
▪ Operational Considerations					
Treatment rates	Varies with the specific treatment unit and with site and waste characteristics. Typically treatment rates of several tons per hour can be achieved.	Varies with the specific treatment unit and with site and waste characteristics. Typically treatment rates of several tons per hour can be achieved.	Varies with the specific treatment unit and with site and waste characteristics. Typically treatment rates in tens of tons per hour can be achieved.	Varies with the specific treatment unit and with site and waste characteristics, including moisture content. Typically treatment rates of 10 to 20 tons per hour can be achieved.	Not applicable
Ability of technology to treat all types and concentrations of wastes present	Oversize debris can sometimes be treated but pre-screening may be required. Solvent extraction is most practical for materials with a large percentage of coarse material. Solvent extraction requires multiple extraction cycles for fine-grained materials. Site- and waste-specific testing may be required to establish performance for PCBs and Appendix IX compounds.	Oversize debris cannot be treated so pre-screening will be required. Soil washing is most practical for materials with a large percentage of coarse material. Soil washing would be less effective for fine-grained materials. Site- and waste-specific testing may be required to establish performance for PCBs and Appendix IX compounds. Multiple treatment steps may be required for wastes containing multiple contaminants. Further study of grain size versus PCB concentration is required.	Large rocks or debris can not be treated by incineration, so pre-screening will be required. Incineration is applicable and demonstrated for PCBs. Incineration will likely destroy many other organic constituents. Metals and most inorganics will not be destroyed and the ash may require post-treatment prior to disposal. Some metals may be volatilized. Offgas treatment will depend on the nature of the waste incinerated.	In general oversize debris cannot be treated so pre-screening will be required. Pre-screening requirements will be based on the particular treatment unit configuration. Thermal desorption would be expected to effectively treat PCBs and will also remove many other volatile and some semivolatile constituents. Metals and inorganics will not be effectively treated and post-treatment for inorganics may be required prior to disposal.	In-situ capping would provide a physical barrier as well as a treatment layer that would be effective for the contaminants in the EE/CA reach. This technology will require long-term monitoring and maintenance.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-3a

Screening of Treatment/In Situ Containment Technologies (Continued)

Category/Criteria	Solvent Extraction	Soil Washing	Incineration	Thermal Desorption	In Situ Capping
Degree of dewatering required prior to disposal/treatment	Although dewatering is not required for some solvent extraction processes, dewatering would be necessary for transportation to the treatment facility. Generally sediments must be dewatered to the point of no free liquid for transport and disposal.	Although dewatering is not required for the soil washing process, dewatering would be necessary for transportation to the treatment facility. Generally sediments must be dewatered to the point of no free liquid for transport and disposal. The washwater or washwater and solvents resulting from the dewatering operation would require treatment and disposal.	Dewatering would be required for transportation to and treatment by incineration. Generally sediments for transport and disposal must be dewatered to the point of no free liquid. The amount of moisture remaining may affect the treatment rate.	Dewatering will be required prior to treatment in order to reduce treatment time and costs as well as for transportation to the treatment unit. Generally sediments for transport and disposal must be dewatered to the point of no free liquid. The amount of moisture remaining may affect the treatment rate and additional mechanical dewatering may be needed. The water resulting from the dewatering operation may require treatment and disposal. The volume of water to be treated would depend on the selected excavation/dredging approach	Not applicable
Pre- or post-treatment required	Basic pretreatment dewatering may reduce treatment costs. Screening for oversize particles necessary for some processes. Water and organics addition is required if treated soil is to be reused.	Additional treatment may be required for fine-grained material, depending on the plan for reuse or disposal of this material. Post treatment such as stabilization for inorganics may be needed.	Pre-screening of large materials will be required. Ash stabilization for inorganics may be required prior to disposal.	Pre-screening of large materials may be required depending on the configuration of the unit chosen Post-treatment may be needed to stabilize inorganics which are not removed by thermal desorption.	Long-term monitoring and maintenance of the cap will be required.
Residuals treatment	Water from dewatering operations may require treatment prior to discharge. Extracted water may require treatment. Concentrated PCB stream will require off-site disposal/treatment. Air emissions treatment may be required.	Water from dewatering operations may require treatment prior to discharge. Washwater and a sludge stream containing contaminated fines will require appropriate treatment/ disposal. Air emissions treatment may be required.	Water from dewatering operations may require treatment prior to discharge. Air emissions treatment will be required.	Water from dewatering operations may require treatment prior to discharge. Air emissions treatment will be required. Treatment and/or disposal of condensate will be needed.	Water from dewatering operations may require treatment prior to discharge. Removed sediments will require appropriate treatment or disposal.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-3a

Screening of Treatment/In Situ Containment Technologies (Continued)

Category/Criteria	Solvent Extraction	Soil Washing	Incineration	Thermal Desorption	In Situ Capping
Constraints on disposal or reuse of treated materials	Assuming the oversize particles are clean or able to be treated, they would be suitable for reuse after treatment and confirmation analysis. Treated soil would require water and organic addition if it was to be reused since water and organics are extracted during the treatment.	Assuming the cobbles are clean, the cobbles would be suitable for reuse after treatment and confirmation analysis. Fine-grained materials may require additional treatment prior to reuse or require appropriate disposal. Soil washing will affect the physical and geotechnical properties of the treated soil and sediment. The suitability for reuse in light of habitat restoration will require evaluation.	Large materials (including cobbles) would be suitable for reuse after treatment and confirmation analysis. Incinerated materials would be available for reuse or disposal after appropriate confirmation sampling. If re-use is pursued, ecological effects must be considered. Incineration will affect the physical and geotechnical properties of the treated sediment and their suitability for reuse in light of habitat restoration would require evaluation.	Depending on the treatment levels achieved, treated materials may be suitable for reuse after appropriate confirmation sampling. Desorption may affect the physical and geotechnical properties of the treated soil and sediment. The suitability for reuse in light of habitat restoration will require evaluation.	Not applicable.
▪ Can be implemented within schedule limits	Yes, significant time to set up system	Yes, significant time to set up system	Yes, but significant time required to set up and perform test burn.	Yes, significant time to set up system.	Yes
▪ Demonstrated performance	Solvent extraction has been successfully demonstrated to remove PCBs from soil/sediment. The process is more efficient on coarse materials than on finer particles.	Soil washing has been successfully used to remove PCBs from sediment in bench and pilot tests only. The process is more effective on coarse materials than on finer particles. Limited full-scale applications have been designed and implemented for PCB treatment.	Incineration has been successfully used to remove PCBs from sediment.	Thermal desorption has been demonstrated to effectively remove PCBs from soil/sediment.	Capping has been successfully implemented in marine environments, and is proposed for use in the upper 1/2 mile removal reach.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-3a

Screening of Treatment/In Situ Containment Technologies (Continued)

Category/Criteria	Solvent Extraction	Soil Washing	Incineration	Thermal Desorption	In Situ Capping
Availability of Services and Materials					
▪ Services/equipment/ materials available	An on-site treatment system will be constructed. The specific configuration would likely be customized to site conditions. Required equipment and services are available.	An on-site treatment system will be constructed. The specific configuration would likely be customized to site conditions. Required equipment and services are available.	An on-site treatment system will be used. Transportable field erected systems are available. Required equipment and services are available.	An on-site treatment system will be required. Transportable field erected systems are available. Required equipment and services are available.	Necessary services and equipment are available.
▪ Treatment or disposal capacity available	Treatment rate will be dictated by the capacity of the on-site treatment plant.	Treatment rate will be dictated by the capacity of the on-site treatment plant.	Treatment rate will be dictated by the capacity of the on-site treatment plant.	Treatment rate will be dictated by the capacity of the on-site treatment plant.	Not applicable.
Administrative Feasibility					
▪ Permits or waivers required	No permits or waivers are required for on-site activities, but treatment system must comply with ARARs.	No permits or waivers are required for on-site activities, but treatment system must comply with ARARs.	No permits or waivers are required for on-site activities, but treatment system must comply with ARARs.	No permits or waivers are required for on-site activities, but treatment system must comply with ARARs.	No permits or waivers are required for on-site activities, but capping must comply with ARARs.
▪ Impact on adjoining property	Noise, traffic, and visual impact on properties adjoining the treatment facility and properties along the truck route to the treatment facility are likely.	Noise, traffic, and visual impact on properties adjoining the treatment facility and properties along the truck route to the treatment facility are likely.	Noise, traffic, and visual impact on properties adjoining the treatment facility and properties along the truck route to the treatment facility are likely.	Noise, traffic, and visual impacts on properties adjoining the treatment facility and properties along the truck route to the treatment facility are likely.	Impact on properties adjoining the removal action itself and the staging areas is likely. Also, properties may be impacted by truck traffic associated with removal of excavated sediments and importation of materials for capping.
EFFECTIVENESS CRITERIA					
Protective of Human Health and the Environment					
▪ Protective of human health	Protective with proper construction, operation, and controls.	Protective with proper construction, operation, and controls.	Protective with proper construction, operation, and controls.	Protective with proper construction, operation, and controls.	Protective with proper design, installation, and monitoring.
▪ Protective of environment	Protective with proper construction, operation, and controls.	Protective with proper construction, operation, and controls.	Protective with proper construction, operation, and controls.	Protective with proper construction, operation, and controls.	Protective with proper design, installation, and monitoring.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-3a

Screening of Treatment/In Situ Containment Technologies (Continued)

Category/Criteria	Solvent Extraction	Soil Washing	Incineration	Thermal Desorption	In Situ Capping
Ability to Achieve Removal Objectives					
▪ Level of treatment/ containment expected	Solvent extraction is expected to provide a removal efficiency for PCBs and most organics.	The degree of treatment achievable will be to some extent site and waste-specific and testing may be required.	Incineration is expected to provide a high destruction efficiency for PCBs and most organics.	Desorption is expected to provide a high removal efficiency for PCBs, volatile and some semivolatile organics.	Containment and treatment are expected, although long-term permanence requires monitoring.
Long-Term Effectiveness and Permanence					
▪ Magnitude of risk from remaining waste and residuals	Risk posed by reuse of treated soil on-site (i.e. for river restoration) would depend on residual levels of contamination achieved by the process. Residual materials could be disposed or destroyed at an appropriate facility.	Risk posed by reuse of treated soil on-site (i.e. for river restoration). Would depend on residual levels of contamination achieved by the process. Residual materials could be disposed of at an appropriate facility.	Risk posed by reuse of treated soil on-site (i.e. for river restoration) would depend on residual levels on contamination achieved by the process Since incineration achieves high destruction efficiency this process may result in less residual risk than other treatment processes. Residual materials could be disposed of at an appropriate facility.	Risk posed by reuse of treated soil on-site (i.e. for river restoration) would depend on residual levels on contamination achieved by the process. Residual materials could be disposed of at an appropriate facility.	The risk of release over the long-term can only be approximated by modeling.
▪ Anticipated long-term effectiveness of controls to manage risk	Solvent extraction will effectively remove PCBs from the soil and sediment.	Soil washing may effectively remove PCBs from the soil and sediment only in bench and pilot tests.	Incineration will effectively destroy PCBs from the soil and sediment.	Thermal desorption will effectively remove PCBs from the soil and sediment.	The cap integrity and effectiveness would be monitored long-term.
▪ Adequacy and reliability of controls	Solvent extraction has been successfully used to remove PCB contamination from soil and sediment at the full-scale.	Soil washing has been successfully used to remove PCB contamination from soil and sediment only in bench and pilot tests.	Incineration has been successfully used to destroy PCB contamination from soil and sediment.	Thermal desorption has been successfully used to remove PCB contamination from soil and sediment.	Capping is a proven technology but due to limited experience with a river system where groundwater flow through the cap must be maintained, long-term monitoring will be required.
▪ Permanence of solution and potential need for replacement	PCBs would be permanently removed from soil and sediment. Some contaminated materials will be left in place.	PCBs would be permanently removed from soil and sediment. Some contaminated materials will be left in place.	PCBs would be permanently removed from soil and sediment. Some contaminated materials will be left in place.	PCBs would be permanently removed from the soil and sediment. Some contaminated materials will be left in place.	Long-term monitoring and maintenance will be required.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-3a

Screening of Treatment/In Situ Containment Technologies (Continued)

Category/Criteria	Solvent Extraction	Soil Washing	Incineration	Thermal Desorption	In Situ Capping
Reduction of Toxicity, Mobility, or Volume Through Treatment					
▪ Toxicity	The toxicity of the treated residual will be reduced. Contaminants sent off-site for disposal/treatment.	The toxicity of the treated residual will be reduced, although no contaminants are destroyed.	Toxicity of the media will be reduced.	The toxicity of the treated residual will be reduced, although no contaminants are destroyed.	The toxicity of the media will not be reduced.
▪ Mobility	Contaminant mobility reduced since contaminants will be destroyed off-site.	No reduction in mobility is anticipated since contaminants will not be destroyed.	Contaminant mobility will be reduced through destruction of the contaminants.	No reduction in mobility is anticipated since contaminants will not be destroyed.	Contaminant mobility will be reduced through placement of a physical barrier.
▪ Volume	The volume of contaminated material will be reduced.	The volume of contaminated material will be reduced. Further study is required to determine the relationship between grain size and PCB content and therefore the reduction of volume of materials requiring treatment.	The volume of contaminated material will be reduced.	The volume of contaminated material will be reduced.	No volume reduction will occur.
▪ Amount of hazardous materials to be treated or destroyed	Hazardous constituents will be removed from the treated material, and disposed/treated off-site.	Hazardous constituents will be removed from the treated material, but not destroyed.	Hazardous constituents will be destroyed or, in the case of inorganic constituents, retained in the ash for subsequent stabilization (if required) and disposal.	Hazardous constituents will be removed from the treated material, but not destroyed.	Treatment will occur only for contaminants migrating through the cap.
Short-Term Effectiveness					
▪ Time until RAOs are achieved	RAOs will be achieved following removal of soil and sediment exceeding cleanup goals from the EE/CA reach.	RAOs will be achieved following removal of soil and sediment exceeding cleanup goals from the EE/CA reach.	RAOs will be achieved following removal of soil and sediment exceeding cleanup goals from the EE/CA reach.	RAOs will be achieved following removal of soil and sediment exceeding cleanup goals from the EE/CA reach.	RAOs will be achieved with proper design, installation, and monitoring.
▪ Potential impacts to workers during implementation	Engineering controls, PPE, and monitoring will be used to minimize the potential for worker exposure to contaminants.	Engineering controls, PPE, and monitoring will be used to minimize the potential for worker exposure to contaminants.	Engineering controls, PPE, and monitoring will be used to minimize the potential for worker exposure to contaminants.	Engineering controls, PPE, and monitoring will be used to minimize the potential for worker exposure to contaminants.	Engineering controls, PPE, and monitoring will be used to minimize the potential for worker exposure to contaminants.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-3a

Screening of Treatment/In Situ Containment Technologies (Continued)

Category/Criteria	Solvent Extraction	Soil Washing	Incineration	Thermal Desorption	In Situ Capping
▪ Potential impacts to the environment during implementation	Engineering controls will be used to prevent releases of contaminants and solvents to the environment during implementation.	Engineering controls will be used to prevent releases of contaminants to the environment during implementation.	Engineering controls will be used to prevent releases of contaminants to the environment during implementation.	Engineering controls will be used to prevent releases of contaminants to the environment during implementation.	Engineering controls, PPE, and monitoring will be used to minimize the potential for worker exposure to contaminants.
COST CRITERIA					
Direct Capital Costs					
▪ Construction costs	Moderate to high, due to treatment plant equipment and site construction costs.	Moderate to high, due to treatment plant equipment and site construction costs.	**High, due to cost of incineration unit and site construction costs.**	Moderate to high, due to equipment and site construction costs.	Low, capping costs are only slightly higher than conventional backfilling.
▪ Potential access agreement costs	Since treatment will be at the GE facility, the only potential access agreement costs would be associated with the dewatering facility (if required) and river access.	Since treatment will be at the GE facility, the only potential access agreement costs would be associated with the dewatering facility (if required) and river access.	Since treatment will be at the GE facility, the only potential access agreement costs would be associated with the dewatering facility and river access.	Since treatment will be at the GE facility, the only potential access agreement costs would be associated with the dewatering facility and river access.	Potential access agreement costs will be associated with staging and dewatering facilities and river access.
▪ Transportation and disposal costs	Transportation costs to the GE facility for treatment will be low due to the relatively small distance involved. Transportation and disposal of the residuals will be moderate.	Transportation costs to the GE facility for treatment will be low due to the relatively small distance involved. Transportation and disposal of the residuals will be moderate.	Transportation costs to the GE facility for treatment will be low due to the relatively small distance involved. Transportation and disposal of the residuals will be moderate.	Transportation costs to the GE facility for treatment will be low due to the relatively small distance involved. Transportation and disposal of the residuals will be moderate.	No additional costs over those required to transport backfill materials to the site.
Annual Costs	Low. Residuals disposal will be included as a monthly cost during treatment. No further treatment cost will be required. Low annual costs of monitoring and maintenance of restored river sections	Low. Residuals disposal will be included as a one-time expenditure during treatment. No further treatment cost will be required. Low annual costs of monitoring and maintenance of restored river sections	Residuals disposal will be included as a one-time expenditure during treatment. No further treatment cost will be required. Low annual costs of monitoring and maintenance of restored river sections	Residuals disposal will be included as a one-time expenditure during treatment. No further treatment cost will be required. Low annual costs of monitoring and maintenance of restored river sections	High. Long-term monitoring and maintenance of the cap is required.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-3a

Screening of Treatment/In Situ Containment Technologies (Continued)

Category/Criteria	Solvent Extraction	Soil Washing	Incineration	Thermal Desorption	In Situ Capping
SCREENING STATUS					
▪ Retained or Not Retained	**Retained** as a proven technology at the site. Solvent extraction will be incorporated into a removal alternative as a representative process option for physical/ chemical treatment methods.	**Retained** due to its potential applicability to the site; however, due to limited applications performed at full-scale for PCB removal, this technology will not be incorporated into a removal alternative.	**Not retained** due to cost and public opposition.	**Retained** as a proven technology at the site.	**Retained** as an effective method isolating/retarding contamination for the lower riverbanks only.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-3b

Screening of Consolidation/Disposal Technologies

Category/Criteria	On-Site Consolidation	Off-Site Disposal
Description	Consolidation at the GE Facility in accordance with the Consent Decree (00-0388)	Disposal at an existing permitted facility (or facilities)
IMPLEMENTABILITY CRITERIA		
Technical Feasibility		
▪ Construction/siting considerations	1. On-site consolidation capacity is determined by the space available at the GE site for each category of materials to be placed per the Consent Decree. 2. Requires adequate space and facilities for dewatering of sediment to allow transport and placement, including management and disposal of the water. 3. May require pretreatment (i.e., drying agent) to meet consolidation criteria if gravity dewatering is not sufficient to remove all free water.	1. Adequate space and facilities for dewatering of sediment to allow transport, including management and disposal of the water. 2. May require pretreatment (i.e. stabilization to meet disposal criteria, either on site or at the disposal facility.
▪ Operational considerations		
Treatment rates	May have limited consolidation capacity per the Consent Decree.	The disposal facility would identify any limits on acceptance rates, however this is not typically expected to be a major constraint.
Ability of technology to treat all types and concentrations of wastes present	No waste treatment is provided. Types and concentrations of materials that can be consolidated will depend on Consent Decree terms. Both PCB and Appendix IX concentrations will be considered.	All types and concentrations of wastes may be disposed. However, several different disposal facilities may be required based on PCB concentrations detected and whether the materials are RCRA hazardous.
Degree of dewatering required prior to disposal/treatment	Dewatering of sediments would be required prior to transport and consolidation. Generally sediments for transport and consolidation must be dewatered to the point of no free liquid. The water resulting from the dewatering operation may require treatment and disposal. The volume of water to be treated would depend on the selected excavation/dredging approach	Dewatering of sediments would be required prior to transport and disposal. Generally sediments for transport and disposal must be dewatered to the point of no free liquid. The water resulting from the dewatering operation may require treatment and disposal. The volume of water to be treated would depend on the selected excavation/dredging approach.
Pre- or post-treatment required	Pre-treatment may be required (i.e. drying agent) depending upon consolidation site acceptance criteria. It may be desirable to reduce volume of material to be consolidated if the allowable volume is limited under the Consent Decree.	Pre-treatment may be required (such as stabilization) depending upon disposal site acceptance criteria. Such treatment could be accomplished at the Site or by the Disposal Facility.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-3b

Screening of Consolidation/Disposal Technologies (Continued)

Category/Criteria	On-Site Consolidation	Off-Site Disposal
Residuals Treatment	Water from dewatering operations may require treatment prior to discharge.	Water from dewatering operations may require treatment prior to discharge.
Constraints on disposition of materials	On-site restrictions are stated in the Consent Decree. Materials that are classified as RCRA hazardous or have PCB concentrations >50 mg/kg will be limited to placement at the Building 71 consolidation area. Non-RCRA and non-TSCA wastes can be disposed of at the Hill 78 Consolidation area. The total volume of material to be disposed of at the consolidation areas cannot exceed 50,000 yd^3, without GE approval.	Materials with PCB concentrations <2 mg/kg, >2 but <50 mg/kg, and >50 mg/kg may be disposed at different disposal facilities or cells. RCRA hazardous materials may be disposed at an alternate facility.
▪ Can be implemented within schedule limits	Yes	Yes
▪ Demonstrated performance	This is a demonstrated means of handling of contaminated materials.	This is a demonstrated means of disposal of contaminated materials.
Availability of Services and Materials		
▪ Services/equipment/ materials available	Necessary services and equipment are available.	Necessary services and equipment are available.
▪ Treatment or disposal capacity available	On-site consolidation area capacity is limited and is specified in the Consent Decree.	Off-site disposal capacity expected to be available.
Administrative Feasibility		
▪ Permits or waivers required	No permits are required, but consolidation areas must comply with ARARs.	The disposal facilities must have permits as required by applicable regulations.
▪ Impact on adjoining property	Visual impact on properties adjoining the consolidation facility. Noise and traffic will impact properties along the truck route to the facility are likely.	Noise and traffic impacts to properties along the truck route to the disposal facility are likely.
EFFECTIVENESS CRITERIA		
Protective of Human Health and the Environment		
▪ Protective of human health	Protective with proper construction, operation, and controls.	Protective with proper construction, operation, and controls.
▪ Protective of environment	Protective with proper construction, operation, and controls.	Protective with proper construction, operation, and controls.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-3b

Screening of Consolidation/Disposal Technologies (Continued)

Category/Criteria	On-Site Consolidation	Off-Site Disposal
Ability to Achieve Removal Objectives		
▪ Level of containment expected	Wastes will be contained in the consolidation facility with minimal risk of release.	Wastes will be contained in an appropriate disposal facility with minimal risk of release.
Long-Term Effectiveness and Permanence		
▪ Magnitude of risk from remaining waste and residuals	Wastes will be contained in a permanent consolidation facility with minimal risk of release.	Wastes will be contained in an appropriate permitted disposal facility with minimal risk of release.
▪ Anticipated long-term effectiveness of controls to manage risk	On-site consolidation facilities are anticipated to be an effective means of managing the contaminated soil and sediments.	Off-site disposal facilities are anticipated to be an effective means of managing the contaminated soil and sediments.
▪ Adequacy and reliability of controls	Consolidation at an appropriately designed and constructed on-site facility is a reliable means of managing waste.	Disposal at a permitted off-site facility is a common and reliable means of managing waste.
▪ Permanence of solution and potential need for replacement	Permanent maintenance is required for the consolidation facility. Some contaminated materials will be left in place.	Contaminated material will be removed from the site. Some contaminated materials will be left in place.
Short-Term Effectiveness		
▪ Time until RAOs are achieved	RAOs will be achieved following removal of soil and sediment exceeding cleanup goals from the EE/CA Reach.	RAOs will be achieved following removal of soil and sediment exceeding cleanup goals from the EE/CA Reach.
▪ Potential impacts to workers during implementation	Engineering controls, PPE, and monitoring will be used to minimize the potential for worker exposure to contaminants.	Engineering controls, PPE, and monitoring will be used to minimize the potential for worker exposure to contaminants.
▪ Potential impacts to the environment during implementation	Engineering controls will be used to prevent releases of contaminants to the environment during implementation.	Engineering controls, PPE, and monitoring will be used to minimize the potential for worker exposure to contaminants.
COST CRITERIA		
Direct Capital Costs		
▪ Construction costs	Low to moderate costs relating to construction activities required for consolidation cell construction and associated with dewatering facilities.	Low costs limited construction activities associated with dewatering facilities.
▪ Potential access agreement costs	None.	None.
▪ Transportation and disposal costs	Transportation costs to the GE facility will be low due to the relatively short distance involved.	Transportation costs will vary depending on the distances to the various facilities. Disposal costs will range from low to high depending on the type of disposal facility required.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-3b

Screening of Consolidation/Disposal Technologies (Continued)

Category/Criteria	On-Site Consolidation	Off-Site Disposal
Annual Costs	Low to moderate costs of monitoring and maintenance of the on-site consolidation facility.	None.
SCREENING STATUS		
▪ Retained or Not Retained	**Retained** subject to the restrictions imposed by the Consent Decree and construction of the on-site facilities.	**Retained**, some volume of material will require off-site disposal because the total volume of material to be disposed of exceeds the maximum allowed for disposal at the on-site consolidation facilities.

Note: Bolded information indicates a critical factor in not retaining a technology.

Table 4.1-4

Potential Bank Restoration Technologies

Category/Criteria	Revegetation	Bioengineered Structures	Hard Structures
Description	Banks are revegetated to stabilize slopes and reduce erosion to provide a natural appearance.	Banks are reinforced with live and dead vegetation to provide scour protection and conditions favorable to revegetation.	Engineered structures are used to stabilize slopes, examples include riprap, concrete revetment, and retaining walls.
IMPLEMENTABILITY CRITERIA			
Technical Feasibility			
▪ Design/construction considerations			
Complexity of planning and design	Low to moderate level of planning/design required.	Moderate to high level of planning/design required.	Moderate to high level of planning/design required.
Vegetation present following removal action	May be used in conjunction with natural vegetation remaining following removal action.	May be used in conjunction with natural vegetation remaining following removal action.	Hard structures may not be preferred in areas where a large percentage of natural vegetation remains. Existing vegetation must be removed. Natural vegetation may be used to partially conceal some structures such as retaining walls or concrete or polyethylene cells.
Bank slope following removal action	Generally applicable to slopes 2:1 or less steep. Mulch nettings and turf reinforcement may be used on steeper slopes. Steep slopes may hinder routine maintenance.	Varies, depending on structure design. Live cribwalls or vegetated gabions may be used on slopes approaching vertical. Structures such as brushmattress or fabric-encapsulated soil are more applicable to slopes 1.5:1 or less steep. Stabilization of toe of slope is essential to project success.	Applicable to unstable or very steep slopes. Large rocks (riprap) and other types of stone armor are generally used for slopes 1.5:1 or less steep. Armoring systems consisting of concrete or polyethylene cells can be used on slopes approximately 1.5:1 or less steep and still allow for revegetation within the cells. Other hard armoring structures may be used on steeper slopes approaching vertical (e.g., gabion baskets, retaining walls). If regrading of the slope is not possible due to available bank space, utilities, roads, etc., hard structures may be the only feasible alternative.
Bank height	May not be feasible to regrade tall, steep banks in order to revegetate. Banks greater than 10 feet high may hinder routine maintenance.	Applicable to all bank heights found in the EE/CA Reach.	Applicable to all bank heights found in the EE/CA reach.

Table 4.1-4

Potential Bank Restoration Technologies (Continued)

Category/Criteria	Revegetation	Bioengineered Structures	Hard Structures
River velocity	Typically applicable to design velocities less than 3-4 feet per second (fps) and shear forces less than 4 pounds per square foot (psf).	Typically applicable to design velocities less than 6 fps and shear forces less than 6 psf. Specific design velocity depends on structure type.	Applicable to all velocities but generally used when design velocities exceed 6 fps and shear forces greater than 6 psf. Rigid armor is generally able to withstand higher velocities than flexible materials.
Degree of anticipated potential bank erosion	Not applicable in areas subject to erosion, unless used in conjunction with hard or bioengineered structures.	Applicable to areas susceptible to moderate erosion. May be used in conjunction with hard structures in areas susceptible to erosion.	Applicable to areas susceptible to erosion. Solid, rigid materials (such as a retaining wall) offer a higher degree of protection against erosion than more flexible or less solid materials (such as rip rap).
Susceptibility to ice scour and jab impacts	Susceptible to failures and erosion caused by ice scour and jab impacts.	Susceptible to failures and erosion caused by ice scour and jab impacts.	Can withstand scour and jab impacts, depending on design conditions.
Other climatic conditions (freeze/thaw, heaving, etc.)	Weather conditions (drought, frosts, high winds, etc.) may reduce survivability of plantings.	Moderate potential for damage to bioengineered structures from heaving. Weather conditions (drought, frosts, high winds, etc.) may reduce survivability of plantings.	Can withstand variations in climatic conditions, depending on design. Rigid armors are susceptible to heaving. Flexible materials less subject to heaving. Potential for damage to stone armor from freeze/thaw cycles if high quality stone is not used.
Presence of bridges, storm drains, roads, utilities, adjacent structures, etc. which present an unacceptable risk should slope failure occur.	Not preferred, due to potential for erosion.	Generally higher risk for failure than hard structures. May be used in these areas, depending on slope and hydraulic conditions.	Applicable where bridges, storm drains, roads, utilities, or structures are located adjacent to the river to prevent erosion.
▪ Operational considerations	Periodic inspections and maintenance required. Moderate potential for replacement. Need for replacement dependent on environmental conditions (e.g., severe weather events). If trees are planted, maintenance would include removal of fallen trees and associated root mass and uprooted soil, and revegetation.	Periodic inspections and maintenance required by qualified personnel. Moderate potential for replacement. Need for replacement dependent on environmental conditions (e.g., severe weather events. etc.).	Little to no maintenance anticipated, depending on method selected. Low potential for replacement. Heavy equipment required for installation.
▪ Adaptable to environmental conditions	Generally adaptable to environmental conditions, however may be impacted by seasonal variations and weather conditions.	Generally adaptable to environmental conditions, however may be impacted by seasonal variations and weather conditions.	Yes.

Table 4.1-4

Potential Bank Restoration Technologies (Continued)

Category/Criteria	Revegetation	Bioengineered Structures	Hard Structures
▪ Can be implemented within schedule limits	Yes, however seasonal constraints and availability of materials may restrict the schedule.	Yes, however seasonal constraints and availability of materials may restrict the schedule.	Yes.
▪ Demonstrated performance	Yes.	Yes.	Yes.
Availability of Services and Materials			
▪ Services/equipment/ materials available	Desirable vegetation (species, size, and quantity) may not be readily available. Advance planning and ordering of plants required.	Bioengineering materials may not be readily available (e.g., crib logs, desirable vegetation, etc.) in great quantities. Advance planning and ordering of materials required.	Services, equipment, and materials required are readily available.
Administrative Feasibility			
▪ Access agreements required	In areas with low banks and slopes 3:1 or less, access agreements are not likely required if access can be obtained from the river. In areas of steep banks, access agreements would be required inland to the toe of the slope.	Construction and maintenance access agreements may be required.	Construction and maintenance access agreements may be required.
▪ Impact on adjoining property	Minimal potential for impacts to adjoining properties.	Potential for minor impacts to adjoining property due to construction.	Potential for minor impacts to adjoining property due to construction.
▪ Used previously at site	Revegetation has been used previously in this river system.	Bioengineered structures have been used previously in this river system.	Hard structures have been used previously in this river system.
EFFECTIVENESS CRITERIA			
Ability to Achieve Habitat Restoration Objectives (HROs)			
▪ Increase the diversity and productivity to support a mid-reach stream community	Expected to achieve objective.	Expected to achieve objective.	Does not achieve objective.

Table 4.1-4

Potential Bank Restoration Technologies (Continued)

Category/Criteria	Revegetation	Bioengineered Structures	Hard Structures
▪ Provide an overlying cover as required to support the mid-reach stream community and to enhance the bank vegetation by reestablishing plantings with native species.	Expected to achieve objective, depending on success of vegetative growth.	Expected to achieve objective, depending on success of vegetative growth.	Does not achieve objective.
▪ Prevent erosion of residual PCB-contaminated bank soils.	Ability to achieve objective depends on revegetation design, success of plantings, and climatic factors. For example, revegetation may not prevent natural incision of banks by the river. Erosion will also occur in areas where runoff is allowed to discharge to the bank. When trees are uprooted, contaminated bank soils will be exposed.	Expected to achieve objective, depending on structures used, success of plantings, and climatic factors. Generally more stable lower bank slopes than for revegetated slopes. Upper bank slopes may be susceptible to erosion depending on revegetation design employed.	Expected to achieve objective.
Long-Term Effectiveness and Permanence	Moderate degree of long-term effectiveness and permanence anticipated, depending on erosion of bank. Effectiveness also largely dependent on continued monitoring and maintenance of vegetation. Expected to improve water quality and habitat.	Moderate degree of long-term effectiveness and permanence anticipated, depending on erosion of bank. Effectiveness also largely dependent on continued monitoring and maintenance of structures and vegetation. Expected to improve water quality and habitat.	High degree of long-term effectiveness and permanence anticipated in preventing erosion of contaminated soil. Will not enhance habitat.
Short-Term Effectiveness	HROs would not be achieved in the short-term, due to time required for establishment of vegetation. Minor impacts to community, workers, and environment during implementation.	HROs would not be achieved in the short-term, due to time required for establishment of vegetation. Short-term effectiveness greater than for revegetated slopes due to use of stabilizing materials. Minor impacts to community and workers during implementation. Potential for impacts to river environment during installation, including changes in water quality and fish and terrestrial habitats.	In general, HROs would not be achieved on a short-term basis. Containment of residual contamination would be achieved following implementation. Minor impacts to community during installation of structures. Potential for impacts to river environment during installation, including changes in water quality and fish and terrestrial habitats.

Table 4.1-4

Potential Bank Restoration Technologies
(Continued)

Category/Criteria	Revegetation	Bioengineered Structures	Hard Structures
COST CRITERIA			
Capital Costs	Low to moderate due to minimal equipment and design required. Costs will depend on species selected.	Moderate to high, due to design costs, equipment, and materials. Heavy equipment may not be required, however installation is labor-intensive. Design costs expected to be moderate. Costs will depend on structures selected and revegetation strategy.	High, due to design costs, use of heavy equipment, and materials.
Annual Costs	High. Frequent inspections of the vegetation would be required, especially during the initial years following implementation. Maintenance required for maintaining and replacing vegetation. The use of large trees will provide an overlying cover, however maintenance costs are increased due to need to remove fallen trees and associated root mass and uprooted soil, and revegetation.	Moderate. Frequent inspections of the bioengineered structures would be required, especially during the initial years following implementation. Some structural replacement may be needed. Maintenance required for maintaining and replacing vegetation.	Low. Periodic inspections of the structures would be required. Little to no maintenance anticipated during the design life of the structure (100 years).

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Table 4.1-5

Potential Riverbed Restoration Technologies

Category/Criteria	Pool/Riffle Construction	Aquatic Cover and Bank-Side Cover	Armoring	Improve Substrate Conditions
Description	Current deflectors, low profile dams, and rock weirs are used to create pools and riffles necessary for aquatic species.	Logs, rocks, turbulence, aquatic plants, and overhanging vegetation are used to provide shelter and feeding areas for fish and aquatic macroinvertebrates.	Riprap, stones, or various forms of concrete are used to reinforce riverbed to prevent erosion.	Substrate is improved using silty mud, vegetation, gravel and rocks to enhance conditions for a variety of species.
IMPLEMENTABILITY CRITERIA				
Technical Feasibility				
▪ Design/construction considerations				
Complexity of planning and design	High level of planning and design required.	Moderate level of planning and design required.	Moderate level of planning and design required.	Moderate level of planning and design required.
River velocity	Feasible for all velocities in the EE/CA reach. Type of structure used (e.g., excavated pool, rock weir, etc.) will depend on site conditions and design velocities. Pools will be constructed as deeper areas in the riverbed where the reduction of river velocities is desired. Riffles will be constructed where areas of swift flowing water (typically 4 fps or greater) are desired.	The use of in-stream cover (boulders) is feasible at all velocities in the EE/CA reach. Boulders of significant size would be expected to withstand high velocities. Bank-side cover material would be subject to erosion under high flow rates depending on its location and anchoring system relative to design flows.	Feasible for all velocities in the EE/CA reach. Armoring may be designed to withstand high velocities. Degree of protection against high river velocities will depend on size and shape of stone and stream morphology.	Fine grained substrate material subject to movement under higher velocities and will only be attempted in areas with flow velocities less than 2 fps. Gravel would typically be placed in areas of slower flow velocities while riprap would be used in areas of higher velocity. Gravel would not be placed in locations where the design velocities exceed 3 fps.
Riverbed materials present following removal action	Construction of pools in areas of fine-grained sediments or cobbles may be restricted due to the potential for excessive sedimentation in the pools. The degree of sedimentation will depend on locations of created pools and riffles, structures used, and characteristics of riverbed material.	In general, may be used for all riverbed materials. However, the use of boulders is not practical in fine-grained sediments due to the potential for excessive scouring.	May be used on all riverbed materials. In fine-grained materials, a geotextile may be required beneath the armor layer.	In general, may be used for all riverbed materials. However, the addition of fine-grained materials in cobble/riffle areas is not practical due to the high potential for washout.

Table 4.1-5

Potential Riverbed Restoration Technologies (Continued)

Category/Criteria	Pool/Riffle Construction	Aquatic Cover and Bank-Side Cover	Armoring	Improve Substrate Conditions
Physical limitations (Note: The riverbed will be restored to existing riverbed conditions or better where conditions allow.)	Riverbed substrate consisting of bedrock or boulders, steep gradients (greater than 5%), and stream morphology (e.g., meanders, bar development) would limit extent of pools and riffles.	Boulders will need to be secured to the streambed, while bank cover materials will need to be secured to the bank. Shallow bedrock and stream morphology (e.g., pools) would limit sites for boulder placement. Locations for bank cover materials will be limited by bank conditions (stability, anchor features, etc.), stream morphology, and the method selected for bank restoration (e.g., retaining walls, rip-rap, etc.).	Additional excavation of sediments (i.e., sediment that meets cleanup goals) may be required in order to stabilize the channel cross-section.	Additional excavation of sediments (i.e., sediment that meets cleanup goals) may be required in order to stabilize the channel cross-section. Design flows may not permit gravel in slower velocity locations.
Potential for scour	High potential for scour in created pools. Low potential for scour in riffle areas. The pools/riffles must be carefully designed in order not to cause scour in undesirable locations. Pools and riffles will be constructed with designed allowances for scour and sedimentation.	Bank-side cover not practical in areas susceptible to scour. Tree revetments and cover logs have a high risk of failure in areas subject to scour. Some additional scour may occur downstream of the cover materials and boulders. Boulders must be located to avoid local bank scour.	May be used in areas susceptible to scour. Low potential to increase local scour. If channel structure and form altered (e.g., grade increased or large woody material removed) armoring may reduce overall channel roughness, and subsequently increase scour in downstream reach.	Low potential for scour where riprap is placed. Slower velocity locations where gravel is positioned have a high potential to erode at project design flows.
▪ Operational considerations	Periodic inspections required to ensure that scour is not increased and pool depths are maintained. Replacement may be required following large storm events. On-site inspections by a qualified person required.	Periodic inspections required by a qualified person to ensure the integrity of bank-side cover and to ensure that excessive scour is not occurring. Replacement may be required following large storm events.	Periodic inspections required to ensure integrity of armor. Low potential for replacement.	Periodic inspections required to ensure that substrate depth is maintained. High potential to replace gravel due to losses during storm events.
▪ Adaptable to environmental conditions	Yes.	Yes.	Yes.	Yes.
▪ Can be implemented within schedule limits	Yes.	Yes.	Yes.	Yes.
▪ Demonstrated performance	Yes.	Yes.	Yes.	Yes.

Table 4.1-5

Potential Riverbed Restoration Technologies (Continued)

Category/Criteria	Pool/Riffle Construction	Aquatic Cover and Bank-Side Cover	Armoring	Improve Substrate Conditions
Availability of Services and Materials				
▪ Services/equipment/ materials available	Services, equipment, and materials are readily available.	Services, equipment, and materials are readily available.	Services, equipment, and materials are generally readily available. Rounded or weathered stone would be less available than manufactured stone.	Services, equipment, and materials are readily available.
Administrative Feasibility	Technology is administratively feasible. Any impacts on adjoining properties would be minimal.	Technology is administratively feasible. Any impacts on adjoining properties would be minimal.	Technology is administratively feasible. Any impacts on adjoining properties would be minimal.	Technology is administratively feasible. Any impacts on adjoining properties would be minimal.
EFFECTIVENESS CRITERIA				
Ability to Achieve Habitat Restoration Objectives (HROs)				
▪ Increase the diversity and productivity to support a mid-reach stream community.	High potential to achieve objective.	Expected to achieve objective.	Low potential to achieve objective. The technology would provide some habitat but would not necessarily increase the diversity.	Expected to achieve objective if diverse substrate materials are used.
▪ Prevent erosion of residual PCB-contaminated river sediments.	Moderate potential to achieve objective. Potential increases if other technologies are used (e.g., armoring of excavated pools).	Would not achieve objective if implemented as the sole technology.	High potential to achieve objective.	Would not achieve objective if implemented as the sole technology.
Long-Term Effectiveness and Permanence	Moderate long-term effectiveness anticipated. Permanence subject to the behavior of the river system and storm events. Depending on design, bed sediment may be subject to scour, with ultimate exposure of contaminants in deeper sediment (if present).	Moderate long-term effectiveness anticipated. Permanence subject to the behavior of the river system and storm events. In-stream cover using boulders would be permanent. Scour downstream of boulders would need to be monitored. Bank-side cover using trees or limbs would not be permanent without significant maintenance or rigid anchoring system (e.g., cables, boulders).	High long-term effectiveness anticipated in preventing erosion of sediments. Degree of permanence subject to severe storm events (greater than 25 year storm). Diversity and productivity are not likely to be achieved in the long-term, unless the technology is combined with habitat components (tree revetments, etc.).	Low to moderate long-term effectiveness anticipated in preventing erosion of sediments. The long-term effectiveness in gravel areas may be limited by the susceptibility for these areas to be eroded. An increase in diversity and productivity would be achieved if diverse substrate materials are used. Permanence subject to the behavior of the river system and storm events.

Table 4.1-5

Potential Riverbed Restoration Technologies (Continued)

Category/Criteria	Pool/Riffle Construction	Aquatic Cover and Bank-Side Cover	Armoring	Improve Substrate Conditions
Short-Term Effectiveness	An increase in diversity and productivity would be achieved. The degree of erosion prevention will depend on design and river dynamics. Any impacts to the community or workers during implementation would be minimal. Short-term changes in water quality (i.e., turbidity increases) are expected due to construction of pools and riffles.	HROs would not be achieved in the short-term. Safety hazards to humans and animals posed by cables used to secure revetments. Any additional impacts to the community, workers, or the environment during implementation would be minimal.	Armoring would prevent the erosion of residual contaminated sediments following implementation. Diversity and productivity would not be increased. Any impacts to the community or workers during implementation would be minimal. Short-term changes in water quality (i.e., turbidity increases) are expected due to positioning of armor.	HROs would not be achieved in the short-term. Any impacts to the community or workers during implementation would be minimal. Short-term changes in water quality (i.e., turbidity increases) are expected due to positioning of substrate.
COST CRITERIA				
Capital Costs	Moderate. Costs impacted by increased excavation and disposal costs for pool construction. High level of planning and design.	Low. Low costs for materials and implementation. Moderate level of planning and design.	Moderate. High costs for materials and implementation. Low level of planning and design.	Moderate. Moderate costs for materials and implementation. Moderate level of planning and design.
Annual Costs	Low to moderate. Maintenance may be required following large storm events. Periodic inspections required to ensure that scour is not increased and pool depths are maintained.	Low. Maintenance may be required following large storm events. Periodic inspections required to ensure integrity of bank-side cover and to ensure that excessive scour is not occurring.	Low. Little maintenance expected to be required. Periodic inspections required to ensure integrity of armor and potential downstream geomorphic effects.	Low. Maintenance may be required following large storm events to ensure substrate depth is maintained.

References:

1. Veri-Tech, Inc. 1998. *Streambank Stabilization Handbook*. (99-0231)
2. USDA, et al. 1998. *Stream Corridor Restoration Handbook, Principles, Practices, and Processes.* Chapters 6,7,8 and Appendix A. (99-0229)
3. USDA. 1996. *Natural Resources Conservation Service Engineering Field Handbook*, Chapter 16, Streambank and Shoreline Protection. (99-0228)
4. Vanoni, V.A. (ed.). 1977. *Sedimentation Engineering*. Chapter 2, "Sediment Transport Mechanics," ASCE, N.Y., 745 pp. (99-0230)
5. Williams, J.E, C.A. Wood, and M.P. Dombeck (editors). 1997. Watershed Restoration: Principles and Practices. American Fisheries Society, Bethesda, Maryland. (99-0232)
6. Leopold, L.B., M.G. Wolman, and J.P. Miller. 1964. *Fluvial Processes in Geomorphology.* W.H. Freeman and Co., San Francisco, CA, 522 pp. (99-0223)
7. Richards, Keith, 1982. *Rivers: Form and Process in Alluvial Channels*. Chapter 3, "Mechanics of Flow and Sediment Transport, "Meuthen, N.Y. 358 pp. (99-0225)

Table 4.1-6

Summary of Retained Technologies Following Technology Screening

River Diversion	Sediment Removal	Treatment/In Situ Containment	Consolidation/ Disposal	Restoration	
				Riverbanks	Riverbed
▪ Sheetpile (non-cobble subreaches) ▪ Pumped Bypass (all subreaches)	▪ Wet Excavation[a] ▪ Dry Excavation	▪ In Situ Capping (lower river banks only) ▪ Solvent Extraction ▪ Soil Washing[b] ▪ Thermal Desorption	▪ Consolidation at designated areas at GE facility ▪ Off-Site Disposal	▪ Revegetation with native species ▪ Bioengineered structures ▪ Hard structures	▪ Improving substrate conditions ▪ Armoring systems ▪ Pool/riffle construction ▪ Aquatic cover

Note: [a]Wet excavation sediment removal technology does not require river diversion.

[b]Technology was retained as potentially feasible. However, because insufficient information is currently available for applications of this technology for this site, soil washing will not be incorporated into the alternatives developed in Section 5.

Table 4.3-1

95% UCL PCB Concentrations for Comparison of Capping versus Excavation to Cleanup Goal EE/CA Reach of the Housatonic River Pittsfield, Massachusetts

Subreach	Depth of Excavation to Cleanup Goal (ft)	95% UCL PCB Concentration (ppm)	
		2.5 to 3.5 ft Depth Interval	3 to 4 ft Depth Interval
3-8	3.0	4.3	0.4
3-9	2.0	0.3	0.3
3-10	3.0	18.7 (M)	0.8 (M)
4-1	Bedrock	na	na
4-2	Bedrock	na	na
4-3	Bedrock	na	na
4-4A	3.0		0.6(M)
4-4B	3.0	3.6	0.4
4-5A	3.0	12 (M)	0.4
4-5B	2.5	0.8	0.3
4-6 (T198-T210)*	2.5	0.3 (M)	0.3 (M)
4-6 (T210-T212)*	3.5	17 (M)	17 (M)

Notes:

1. "M" indicates the calculated 95% UCL exceeded the maximum value for the data set or there were fewer than three data points (the calculations require a minimum of three data points), and so the maximum value was substituted for the 95% UCL.
2. "ns" indicates there were no samples collected from this interval.
3. "bedrock" indicates all sediment above bedrock will be removed.
4. "na" indicates the criteria is not applicable to this subreach.
5. * The upper portion of Subreach 4-6 between Transects 198 and 210 will be excavated to 2.5 ft. The lower portion between Transects 210 and 212 will be excavated to 3.5 ft.
6. At subreaches where continuous 6-inch interval sediment sample results are not available, the excavation depth was selected based on the next available result. For example, for subreach 4-4A, an excavation depth of 3.0 ft is selected because data confirming that 95% UCL PCB concentrations are less than 1 ppm are not available until the 3.0- to 3.5-ft depth interval.

SECTION 5

TABLES

Table 5.5-1

Summary of Detailed Comparison of Base Alternatives 1, 2, and 3

Base Alternative	Effectiveness	Implementability	Cost
Alternative 1 (Wet Excavation)	This alternative is potentially the least effective because of quality control issues associated with accuracy of excavation and backfill depths when working below water. Excavation of sediments from pockets in bedrock in the cobble reaches will be problematic. Downstream migration of contaminated sediment will be an ongoing concern.	Installation of a sorptive cap on the lower riverbanks will be the most difficult to implement for this alternative. This alternative is expected to have the shortest construction time but is more susceptible to fluctuations in the river depth than other alternatives. Access requirements are likely to be the least for this alternative.	This alternative has the lowest estimated cost. Although confirmation sampling is not included for any alternative, limited confirmation sampling may be justified for this alternative because of uncertainty associated with the accuracy of excavations.
Alternative 2 (Dry Excavation/Sheetpiling)	This alternative is expected to provide the greatest control over construction quality and most assurance that cleanup goals will be achieved. The height of the sheetpile will minimize overtopping during storm events. Adverse short-term impacts from noise and vibration are significant. Downstream migration of contaminated sediment will be a concern during sheetpile installation and removal.	This alternative relies on the presence of sufficient overburden to support the load on the sheetpiles. A pumped bypass system would be used in areas found unsuitable for sheetpiling. Access requirements are likely to be the greatest for this alternative to facilitate sheetpile installation needs.	This alternative has the highest estimated cost. However, this alternative is the least susceptible to cost increases associated with wet weather during construction.
Alternative 3 (Dry Excavation/Bypass Pumping)	This alternative is expected to provide good control over construction quality and assurance that cleanup goals will be achieved. However, overtopping during storm events, which adversely impacts construction quality control, is most likely for this alternative. Adverse short-term impacts from noise and air pollution are potentially significant. Downstream migration of contaminated sediment is least likely for this alternative, however, fish migration will be impeded.	This alternative is expected to have a construction time comparable to Alternative 1, but is the most susceptible to fluctuations in the river depth. If diesel pumps are used, frequent monitoring and refueling will be required. Access requirements will be greater for this alternative than for Alternative 1. Land will be required, probably along the riverbanks, for the pumps and the bypass piping.	The cost of this alternative is less than Alternative 2 but more than Alternative 1. However, this alternative may be the most susceptible to cost increases associated with wet weather during construction.

Table 5.5-2

Summary of Detailed Comparison of Disposal Options A, B, C, and D

Disposal Option	Effectiveness	Implementability	Cost
Option A (Consolidation at GE/Off-Site Disposal)	The effectiveness of this option depends to a large degree on the design and operation of the consolidation areas. EPA has approved the ARARs and design for the consolidation areas. GE is responsible for achieving the ARARs. No reduction in toxicity, volume, and mobility by treatment would occur. Potential long-term exposure to odors and contaminants by local residents would be greatest for this option. This option would create the least impact from truck traffic.	The Consent Decree allows the consolidation of excavated materials at the designated areas at GE. Required capacity at the consolidation areas has been assumed, but some risk exists that capacity will not be available. Off-site facilities are expected to be available when needed for excess material beyond the consolidation areas' capacities.	This is the least expensive option. This option assumes that 50,000- yd^3 capacity will be available at the GE consolidation areas. If it is not available, the cost for off-site disposal will be borne by GE.
Option B (Off-Site Disposal)	No reduction in toxicity, volume, and mobility by treatment would occur. Potential short- and long-term exposure to odors and contaminants by local residents would be least for this option. However, risks of trucking untreated material long distances would be greatest. Off-site treatment/disposal would provide a reliable disposal option.	Off-site facilities are expected to be available when needed.	The cost of this option is significantly greater than Option A. The estimated costs are subject to change based on market fluctuations.
Option C (Thermal Desorption/Off-Site Disposal)	This option reduces toxicity, volume, and mobility by destroying contamination by treatment. Disposal of treated and untreated materials at properly designed off-site facilities provides the highest degree of long-term effectiveness and permanence. Short-term noise and exposure to contaminants during treatment could be mitigated by engineering controls. Transport of small volumes of concentrated PCB residuals would create a short-term risk of spill or exposure.	The technology is proven at full-scale for treating PCB contaminated soil and sediments. Additional land area would be required at the GE facility to locate equipment and for associated material handling. Equipment and services to conduct treatment are readily available through several vendors.	This option has the greatest estimated cost, which is significantly greater than non-treatment options. Although this cost is likely to decrease with competitive bids, it would still remain significantly greater than the cost for non-treatment options.
Option D (Solvent Extraction/Off-Site Disposal)	The effectiveness of this option is similar to Option C. In addition, potential short-term spill and exposure risks from storage and use of solvents would exist.	The implementability of this option is similar to Option C.	The cost of this option is significantly greater than non-treatment options. Although this cost is likely to decrease with competitive bids, it would still remain significantly greater than the cost for non-treatment options.

Table 5.5-3

Detailed Cost Summary Base Alternatives 1, 2, and 3
EE/CA Reach of the Housatonic River
Pittsfield, Massachusetts

Costs	Alternative 1 Subsection 5.2	Alternative 2 Subsection 5.3	Alternative 3 Subsection 5.4
Direct Capital Costs			
Pre-Design Investigations	$ 577,257	$ 577,257	$ 577,257
Mobilization/Demobilization	$ 1,954,182	$ 2,197,162	$ 2,083,579
Install Sheetpile	n/a	$ 2,492,378	n/a
Pumping Bypass	n/a	$ 1,853,218	$ 3,642,773
Dewatering of Riverbed	n/a	$ 1,614,382	$ 999,464
Excavate & Transport Soil/Sediment	$ 2,831,922	$ 2,037,389	$ 1,777,165
Dewatering of Excavated Material	$ 814,857	$ 1,453,473	$ 825,917
Characterization Sampling	$ 328,766	$ 328,766	$ 328,766
Soil/Sediment Treatment & Ancillary Costs	n/a	n/a	n/a
Restoration of Riverbed	$ 1,721,223	$ 1,341,052	$ 1,308,050
Restoration of Riverbank	$ 5,780,315	$ 5,785,482	$ 5,751,551
On-Site Consolidation (Transportation)	n/a	n/a	n/a
Off-Site Transportation & Disposal	n/a	n/a	n/a
Total Direct Capital Costs	$ 14,008,522	$ 19,680,559	$ 17,294,522
Indirect Capital Costs			
Escalation (0%)	$ -	$ -	$ -
Contingency (25%)	$ 3,502,131	$ 4,920,140	$ 4,323,631
Engineering and Design (6%)	$ 1,050,639	$ 1,476,042	$ 1,297,089
USACE Construction Management (8%)	$ 1,484,903	$ 2,086,139	$ 1,833,219
Total Indirect Capital Costs	$ 6,037,673	$ 8,482,321	$ 7,453,939
Total Capital Costs (Rounded)	**$ 20,046,200**	**$ 28,162,900**	**$ 24,748,500**
Direct O & M Costs			
Restoration Monitoring	$ 546,000	$ 546,000	$ 546,000
Cap Monitoring	$ 180,000	$ 180,000	$ 180,000
Annual Maintenance	$ 550,000	$ 550,000	$ 550,000
Total Direct O&M Costs	$ 1,276,000	$ 1,276,000	$ 1,276,000
Indirect O&M Costs			
Escalation (0%)	$ -	$ -	$ -
Contingency (25%)	$ 319,000	$ 319,000	$ 319,000
Engineering and Design (6%)	$ 95,700	$ 95,700	$ 95,700
USACE Construction Management (8%)	$ 135,256	$ 135,256	$ 135,256
Total Indirect O&M Costs	$ 549,956	$ 549,956	$ 549,956
Total O & M Costs (Rounded)	**$ 1,826,000**	**$ 1,826,000**	**$ 1,826,000**
TOTAL COSTS (Rounded)	**$ 21,872,200**	**$ 29,988,900**	**$ 26,574,500**
Present Value Costs			
Present Value of Capital Costs	$ 18,803,807	$ 25,511,439	$ 23,080,042
Present Value of O&M Costs	$ 1,140,801	$ 1,140,801	$ 1,140,801
TOTAL PRESENT VALUE COSTS (Rounded)	**$ 19,944,600**	**$ 26,652,200**	**$ 24,220,800**

Table 5.5-4

Detailed Cost Summary for Consolidation/Disposal/Treatment Options A, B, C, and D
EE/CA Reach of the Housatonic River
Pittsfield, Massachusetts

Costs		Disposal Option A Section 5.2.1.9.1	Disposal Option B Section 5.2.1.9.2	Disposal Option C Section 5.2.1.9.3	Disposal Option D Section 5.2.1.9.4
Direct Costs					
Soil/Sediment Treatment & Ancillary Costs		n/a	n/a	$ 28,297,569	$ 21,443,002
On-Site Consolidation (Transportation)		$ 422,384	n/a	n/a	n/a
Off-Site Transportation & Disposal		$ 8,000,295	$ 19,537,912	$ 8,467,233	$ 8,467,233
Total Direct Costs		$ 8,422,679	$ 19,537,912	$ 36,764,802	$ 29,910,235
Indirect Costs					
Escalation (0%)		$ -	$ -	$ -	$ -
Contingency (25%)		$ 2,105,670	$ 4,884,478	$ 9,191,201	$ 7,477,559
Engineering and Design (6%)		$ 631,701	$ 1,465,343	$ 2,757,360	$ 2,243,268
USACE Construction Management (8%)		$ 892,804	$ 2,071,019	$ 3,897,069	$ 3,170,485
Total Indirect Costs		$ 3,630,175	$ 8,420,840	$ 15,845,630	$ 12,891,311
Total Costs (Rounded)		**$ 12,052,900**	**$ 27,958,800**	**$ 52,610,400**	**$ 42,801,500**

Table 5.5-5

Comparative Cost Summary for Alternatives Incorporating Disposal Options
EE/CA Reach of the Housatonic River
Pittsfield, Massachusetts

Alternative	CAPITAL COSTS[a] (ACTUAL)	O&M COSTS (ACTUAL)	TOTAL COSTS (ACTUAL)	TOTAL COSTS (PRESENT VALUE)[b]
Alternative 1A - Wet Excavation & Consolidation at GE	$32,099,100	$1,826,000	$33,925,100	$31,251,000
Alternative 2A - Dry Excavation/Sheetpiling & Consolidation at GE	$40,215,800	$1,826,000	$42,041,800	$37,570,000
Alternative 3A - Dry Excavation/Pump Bypass & Consolidation at GE	$36,801,400	$1,826,000	$38,627,400	$35,461,000
Alternative 1B - Wet Excavation & Off-Site Disposal	$48,005,000	$1,826,000	$49,831,000	$46,171,000
Alternative 2B - Dry Excavation/Sheetpiling & Off-Site Disposal	$56,121,700	$1,826,000	$57,947,700	$51,979,000
Alternative 3B - Dry Excavation/Pump Bypass & Off-Site Disposal	$52,707,300	$1,826,000	$54,533,300	$50,295,000
Alternative 1C - Wet Excavation & Thermal Desorption Treatment	$72,656,600	$1,826,000	$74,482,600	$69,294,000
Alternative 2C - Dry Excavation/Sheetpiling & Thermal Desorption Treatment	$80,773,300	$1,826,000	$82,599,300	$74,309,000
Alternative 3C - Dry Excavation/Pump Bypass & Thermal Desorption Treatment	$77,358,900	$1,826,000	$79,184,900	$73,284,000
Alternative 1D - Wet Excavation & Solvent Extraction Treatment	$62,847,700	$1,826,000	$64,673,700	$60,093,000
Alternative 2D - Dry Excavation/Sheetpiling & Solvent Extraction Treatment	$70,964,400	$1,826,000	$72,790,400	$65,424,000
Alternative 3D - Dry Excavation/Pump Bypass & Solvent Extraction Treatment	$67,550,000	$1,826,000	$69,376,000	$64,137,000

Notes:

[a] The capital costs include the treatment costs for alternatives using Options C and D.

[b] The present worth of the capital costs was determined by assuming that all capital costs were incurred at the midpoint of the construction schedule and discounting (@7%) back to the beginning of the construction schedule.

SECTION 1

FIGURES

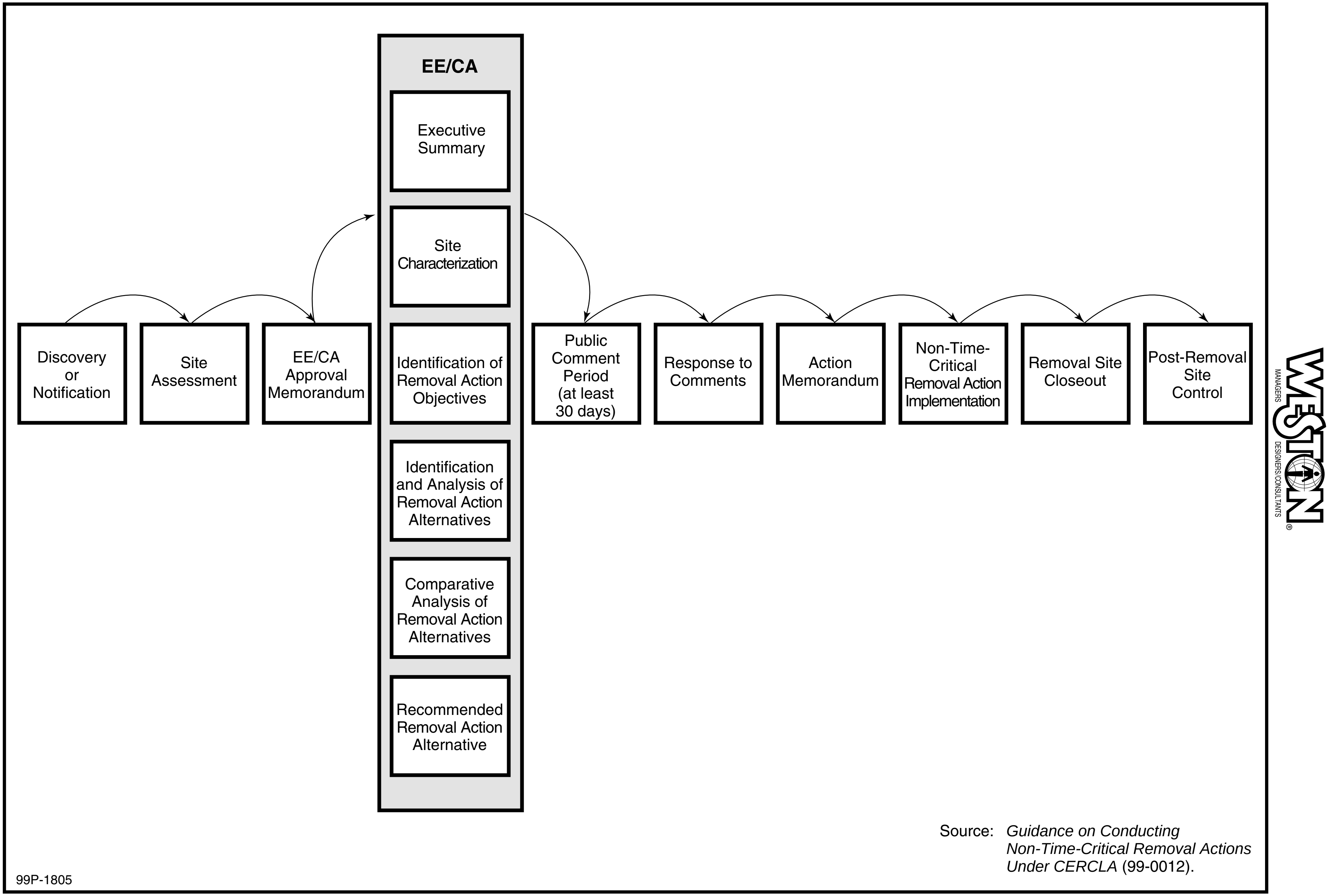
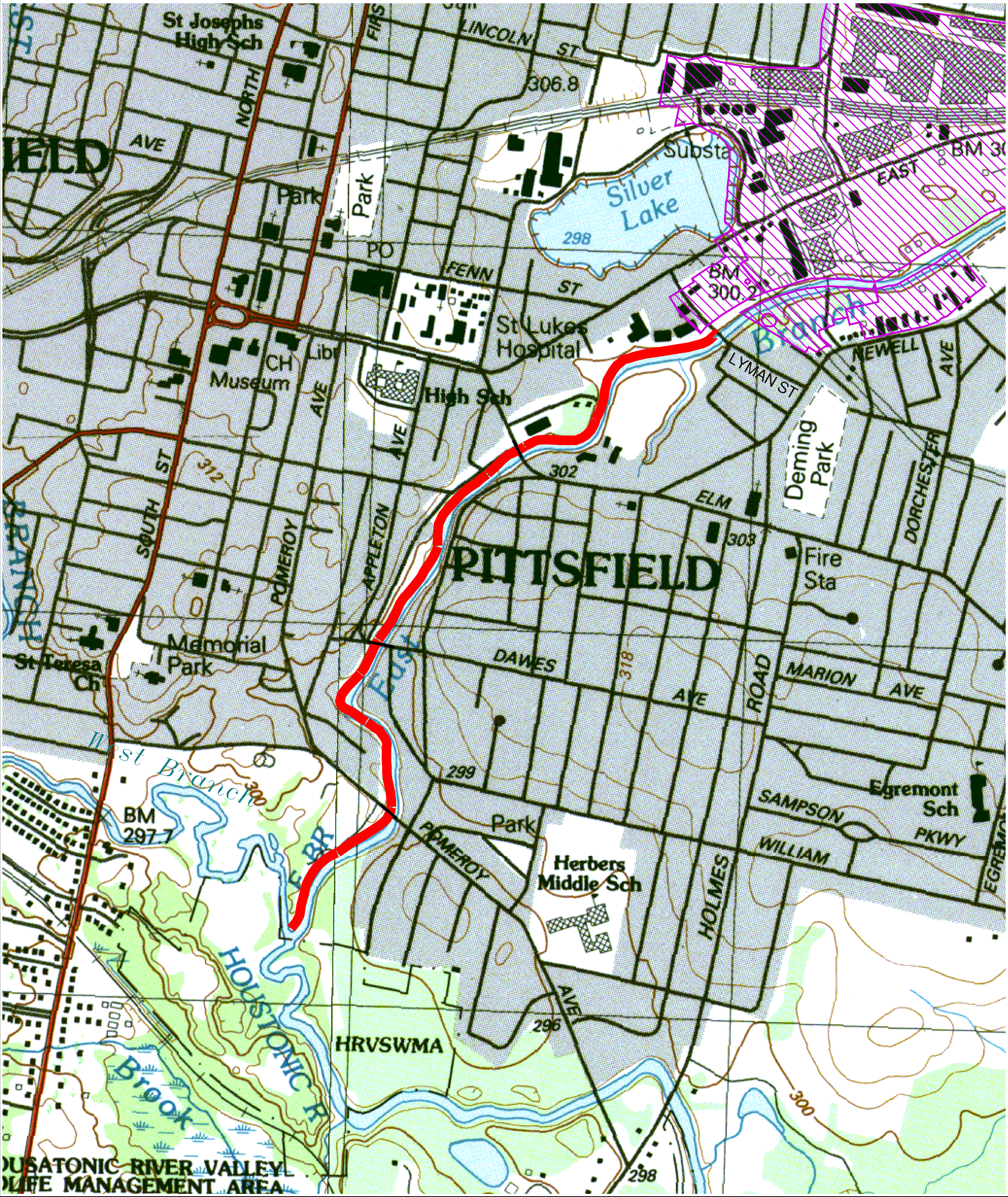


FIGURE 1.1-1 EE/CA DEVELOPMENT PROCESS

SECTION 2

FIGURES



LEGEND:

EE/CA Reach

GE Facility

NOTE: Base features derived from USGS Pittsfield East and West 1:24,000 quadrangles.

N

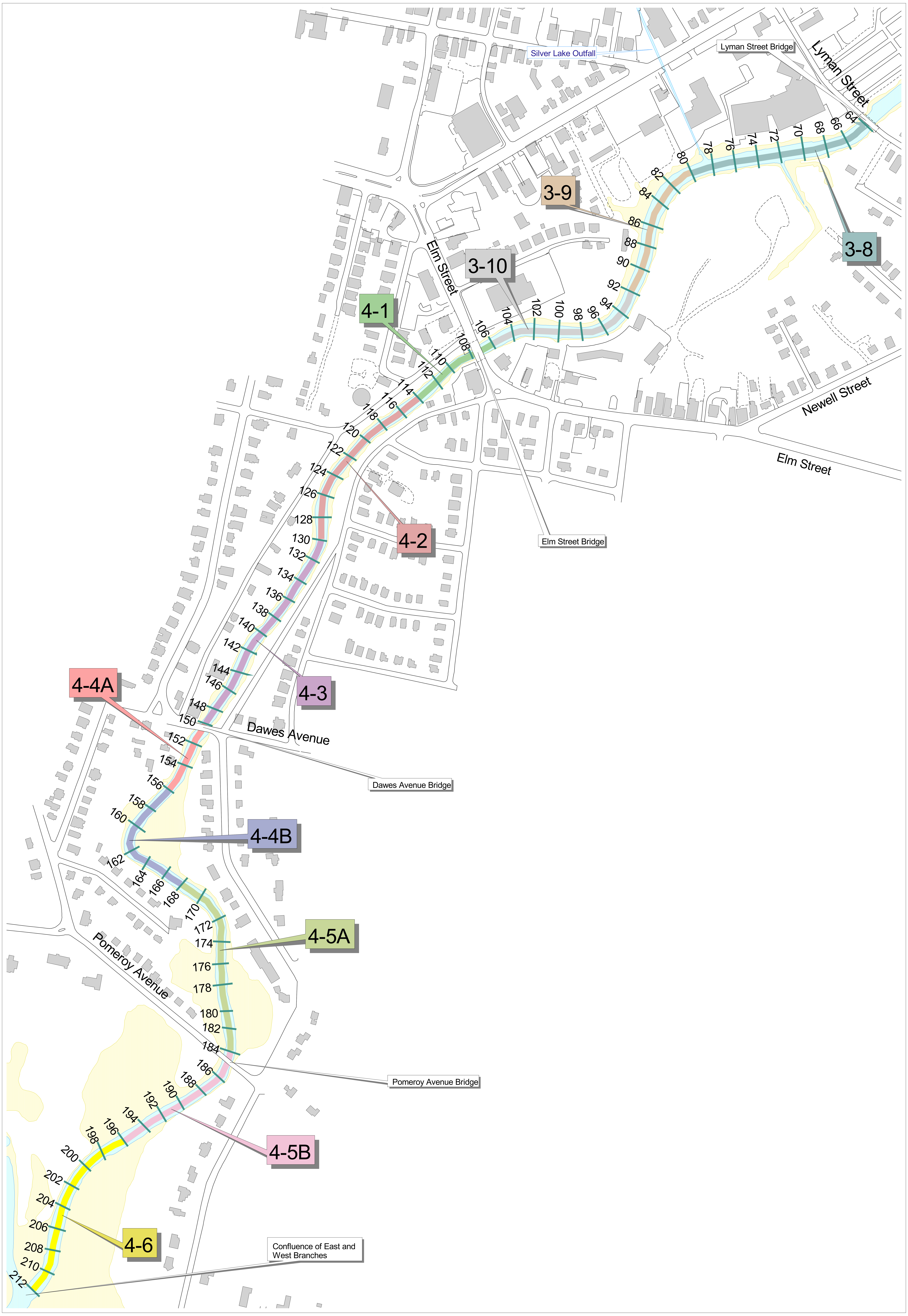
Scale In Feet

600 0 600 1200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.1-1
LOCATION MAP

| o:\gepitt\aprs\eeca_region.apr | layout-eeca_loc | o:\gepitt\epsfiles\in\eeca_loc.eps | 5:41 PM, 8/16/1999 |



LEGEND:

- Transect
- Roads
- 10-year Floodplain
- Surface Hydrology
- Building Footprints

N

Scale in Feet

200 0 200 400 600

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.1-2
SUBREACH LOCATION MAP

Figure 2.1-3
Average Daily Discharge: 1936-1996
Housatonic River, Coltsville Station

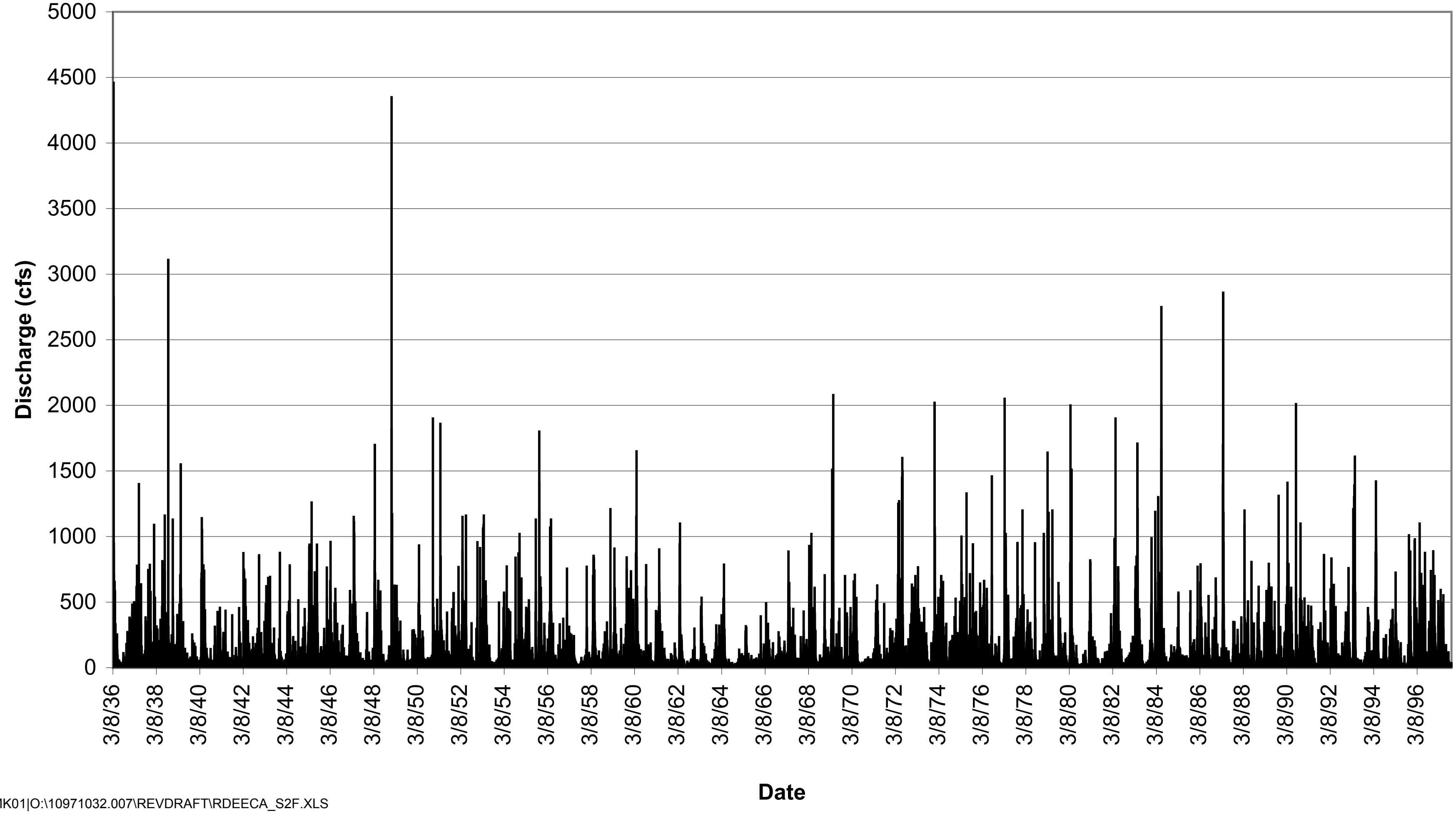


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Figure 2.1-4
Annual Peak Discharge: 1936-1996
Houstonic River, Coltsville Station

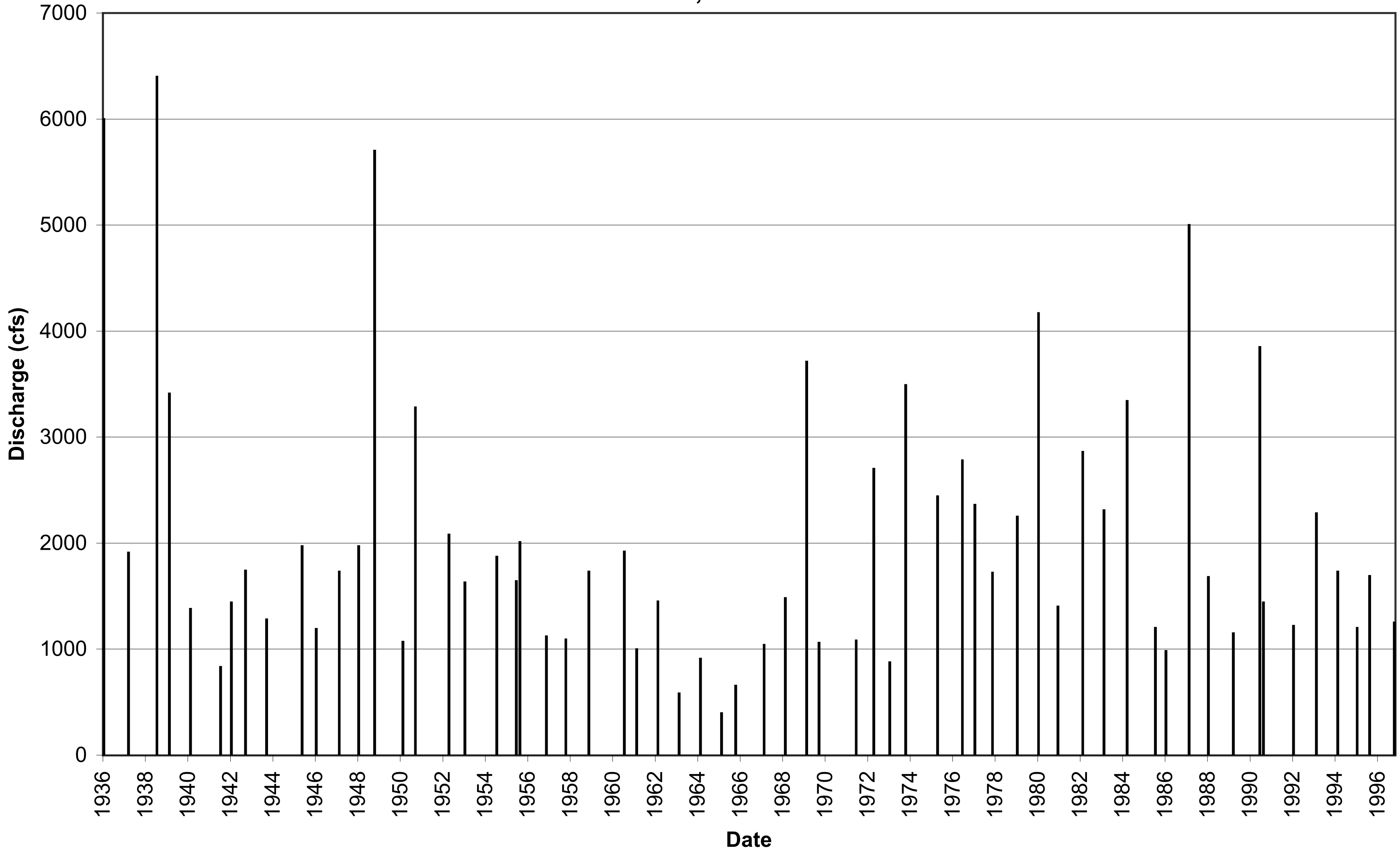
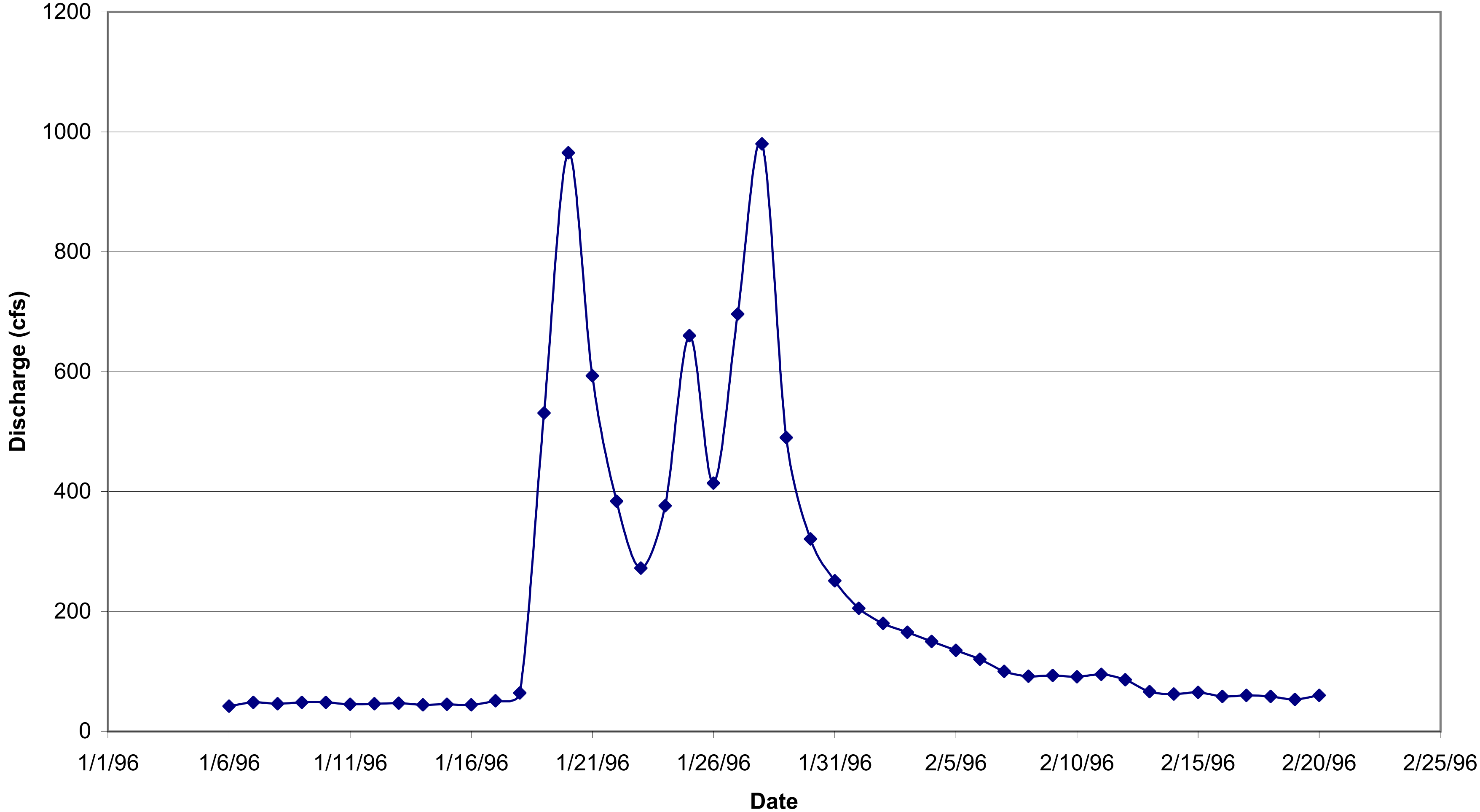


Figure 2.1-5
Response to Precipitation
Housatonic River, Coltsville Station



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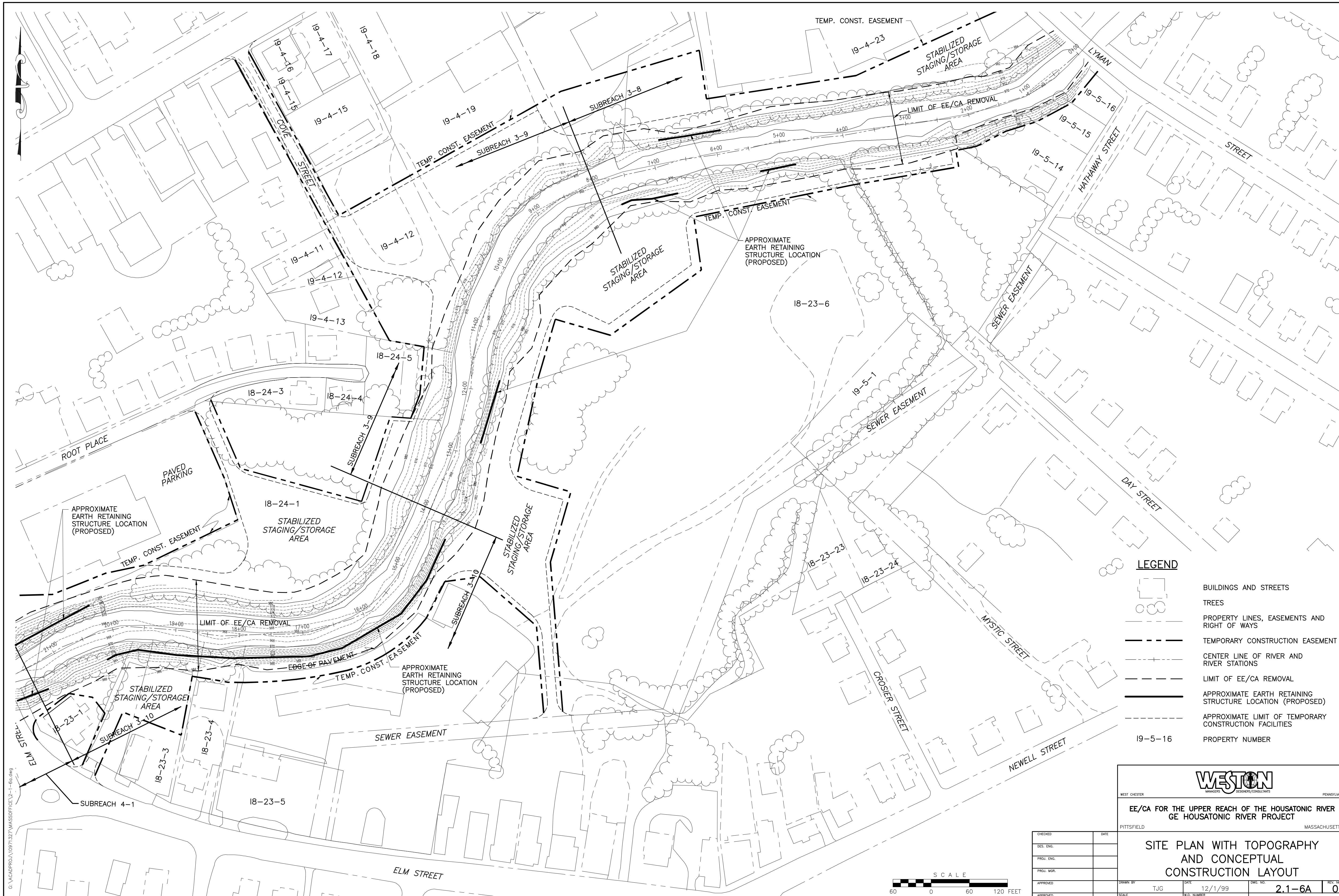
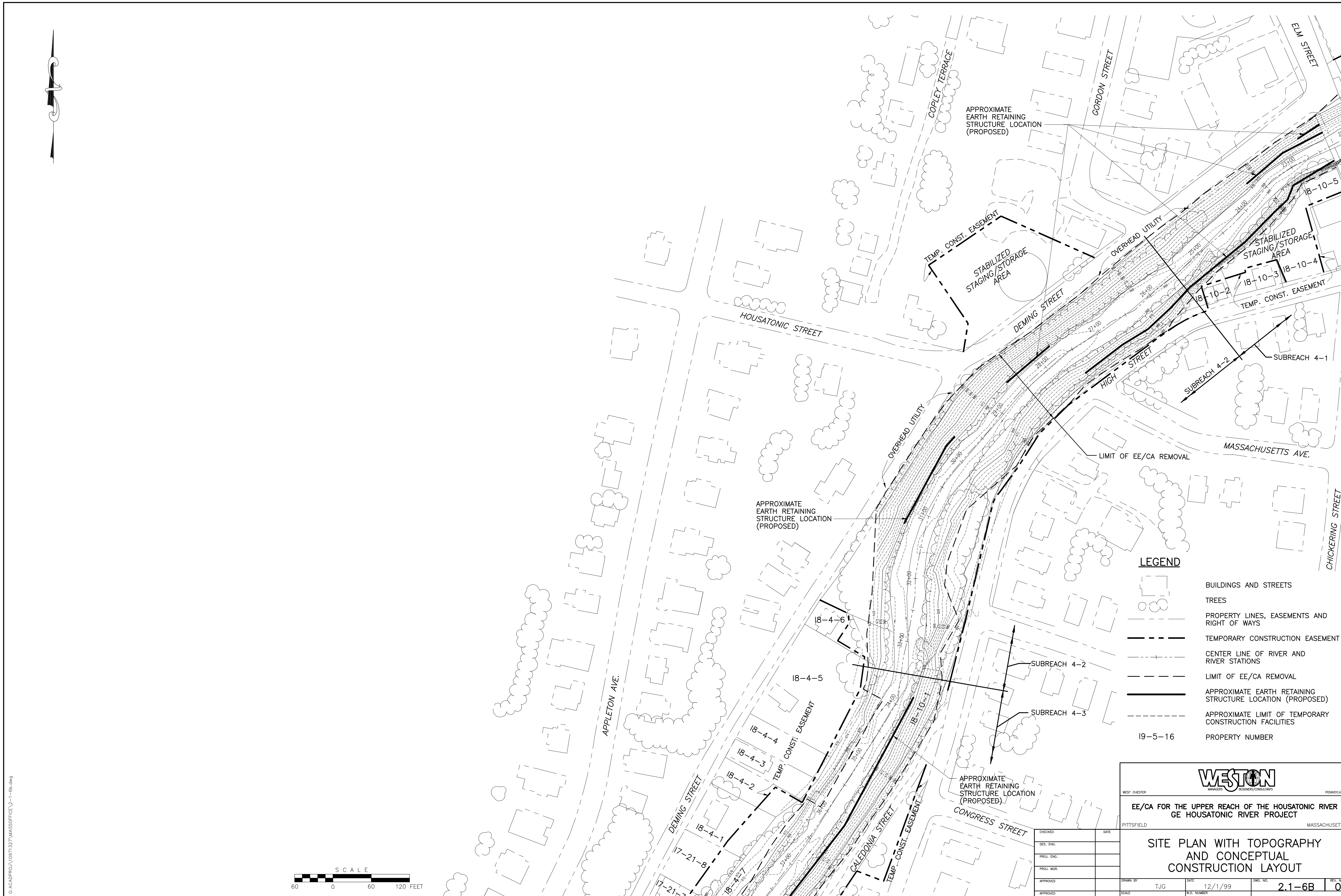
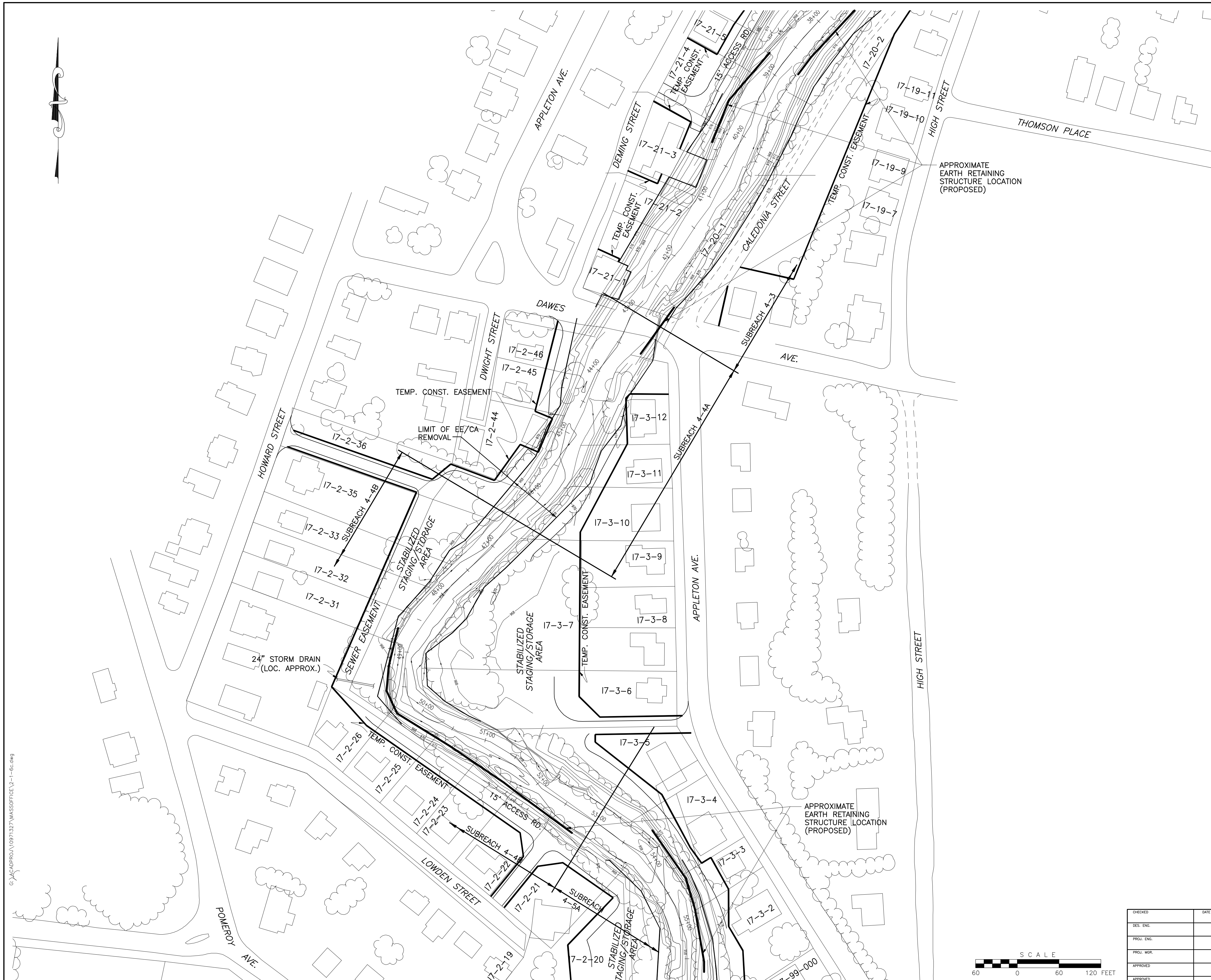

TEMP. CONST. EASEMENT
STABILIZED STAGING/STORAGE AREA
LIMIT OF EE/CA REMOVAL
SUBREACH 3-8
SUBREACH 3-9
SUBREACH 3-10
SUBREACH 4-1
APPROXIMATE EARTH RETAINING STRUCTURE LOCATION (PROPOSED)
EDGE OF PAVEMENT
SEWER EASEMENT
PAVED PARKING
COVE STREET
ROOT PLACE
ELM STREET
LYMAN STREET
HATHAWAY STREET
DAY STREET
MYSTIC STREET
CROSIER STREET
NEWELL STREET
19-4-23
19-4-17
19-4-16
19-4-18
19-4-15
19-4-19
19-4-12
19-4-11
19-4-13
19-5-16
19-5-15
19-5-14
19-5-1
18-23-6
18-24-5
18-24-3
18-24-4
18-24-1
18-23-23
18-23-24
18-23-1
18-23-3
18-23-4
18-23-5
LEGEND
BUILDINGS AND STREETS
TREES
PROPERTY LINES, EASEMENTS AND RIGHT OF WAYS
TEMPORARY CONSTRUCTION EASEMENT
CENTER LINE OF RIVER AND RIVER STATIONS
LIMIT OF EE/CA REMOVAL
APPROXIMATE EARTH RETAINING STRUCTURE LOCATION (PROPOSED)
APPROXIMATE LIMIT OF TEMPORARY CONSTRUCTION FACILITIES
19-5-16 PROPERTY NUMBER
SCALE
60 0 60 120 FEET
WESTON
WEST CHESTER PENNSYLVANIA
EE/CA FOR THE UPPER REACH OF THE HOUSATONIC RIVER
GE HOUSATONIC RIVER PROJECT
PITTSFIELD MASSACHUSETTS
SITE PLAN WITH TOPOGRAPHY AND CONCEPTUAL CONSTRUCTION LAYOUT
DRAWN BY TJG
DATE 12/1/99
DWG. NO. 2.1-6A
REV. NO. 0
SCALE 1"=60'
SHEET 1 OF 4



ELM STREET
COPLEY TERRACE
GORDON STREET
APPROXIMATE EARTH RETAINING STRUCTURE LOCATION (PROPOSED)
TEMP. CONST. EASEMENT
STABILIZED STAGING/STORAGE AREA
OVERHEAD UTILITY
DEMING STREET
HOUSATONIC STREET
18-10-5
18-10-4
18-10-3
18-10-2
STABILIZED STAGING/STORAGE AREA
TEMP. CONST. EASEMENT
SUBREACH 4-1
SUBREACH 4-2
HIGH STREET
MASSACHUSETTS AVE.
LIMIT OF EE/CA REMOVAL
OVERHEAD UTILITY
APPROXIMATE EARTH RETAINING STRUCTURE LOCATION (PROPOSED)
CHICKERING STREET
18-4-6
18-4-5
SUBREACH 4-2
SUBREACH 4-3
18-10-1
18-4-4
18-4-3
18-4-2
TEMP. CONST. EASEMENT
APPROXIMATE EARTH RETAINING STRUCTURE LOCATION (PROPOSED)
CONGRESS STREET
CALEDONIA STREET
TEMP. CONST. EASEMENT
APPLETON AVE.
DEMING STREET
18-4-1
17-21-8
18-4-7
17-21-7
SCALE
60 0 60 120 FEET
LEGEND
BUILDINGS AND STREETS
TREES
PROPERTY LINES, EASEMENTS AND RIGHT OF WAYS
TEMPORARY CONSTRUCTION EASEMENT
CENTER LINE OF RIVER AND RIVER STATIONS
LIMIT OF EE/CA REMOVAL
APPROXIMATE EARTH RETAINING STRUCTURE LOCATION (PROPOSED)
APPROXIMATE LIMIT OF TEMPORARY CONSTRUCTION FACILITIES
19-5-16 PROPERTY NUMBER
WESTON
MANAGERS DESIGNERS/CONSULTANTS
WEST CHESTER PENNSYLVANIA
EE/CA FOR THE UPPER REACH OF THE HOUSATONIC RIVER
GE HOUSATONIC RIVER PROJECT
PITTSFIELD MASSACHUSETTS
SITE PLAN WITH TOPOGRAPHY AND CONCEPTUAL CONSTRUCTION LAYOUT
CHECKED DATE
DES. ENG.
PROJ. ENG.
PROJ. MGR.
APPROVED
APPROVED
DRAWN BY TJG
DATE 12/1/99
DWG. NO. 2.1-6B
REV. NO. 0
SCALE 1"=60'
W.O. NUMBER
SHEET 2 OF 4
G:\CADPROJ\10971327\MASSOFFICE\2-1-6b.dwg



LEGEND

	BUILDINGS AND STREETS
	TREES
	PROPERTY LINES, EASEMENTS AND RIGHT OF WAYS
	TEMPORARY CONSTRUCTION EASEMENT
	CENTER LINE OF RIVER AND RIVER STATIONS
	LIMIT OF EE/CA REMOVAL
	APPROXIMATE EARTH RETAINING STRUCTURE LOCATION (PROPOSED)
	APPROXIMATE LIMIT OF TEMPORARY CONSTRUCTION FACILITIES
I9-5-16	PROPERTY NUMBER

WESTON
WEST CHESTER PENNSYLVANIA

EE/CA FOR THE UPPER REACH OF THE HOUSATONIC RIVER
GE HOUSATONIC RIVER PROJECT

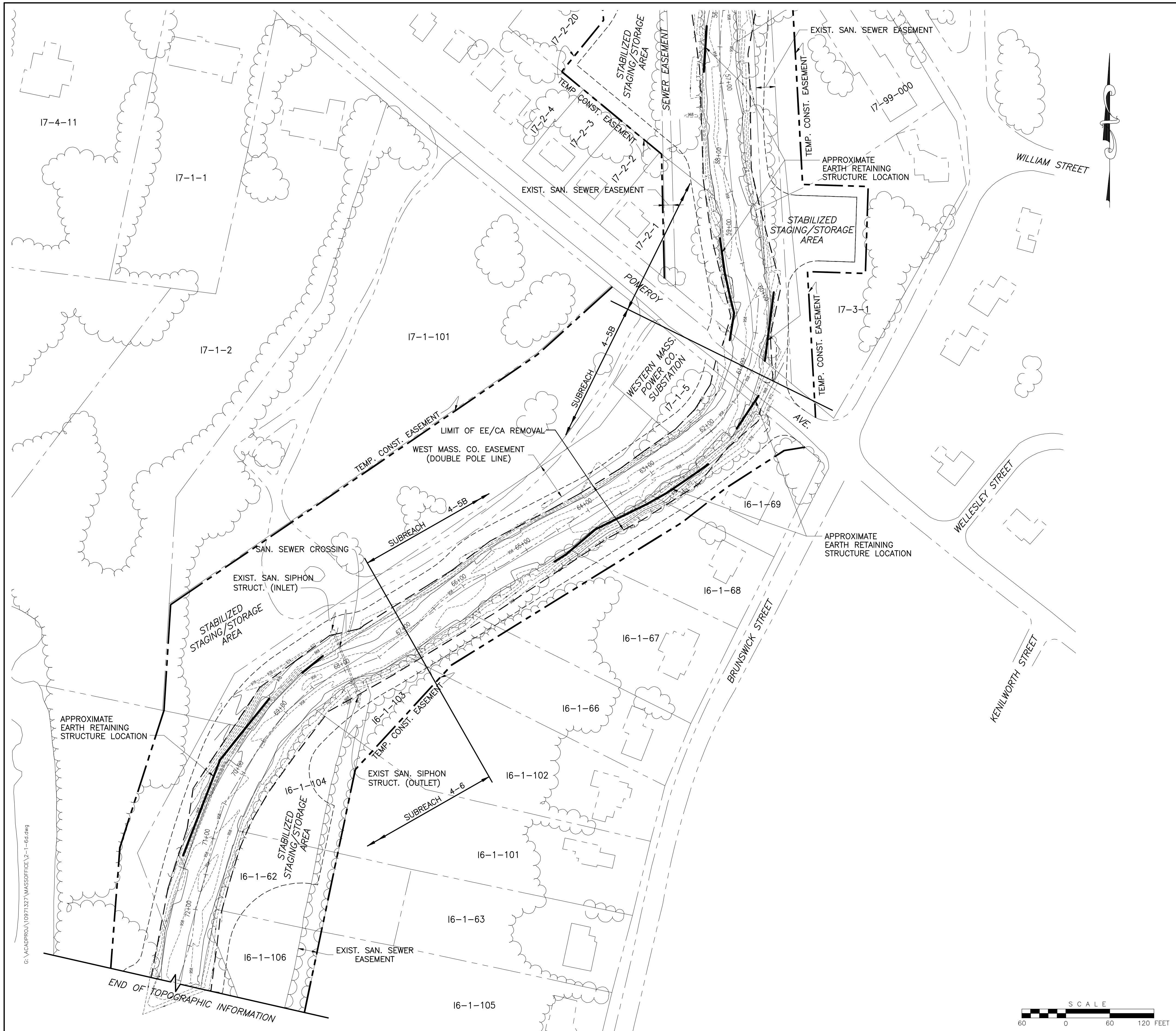
PITTSFIELD MASSACHUSETTS

SITE PLAN WITH TOPOGRAPHY AND CONCEPTUAL CONSTRUCTION LAYOUT

CHECKED	DATE
DES. ENG.	
PROJ. ENG.	
PROJ. MGR.	
APPROVED	
APPROVED	

DRAWN BY	DATE	DWG. NO.	REV. NO.
TJG	12/1/99	2.1-6C	0
SCALE 1"=60'	W.O. NUMBER	SHEET 3 OF 4	

G:\CADPROJ\10971327\MASSOFFICE\2-1-6c.dwg



LEGEND

	BUILDINGS AND STREETS
	TREES
	PROPERTY LINES, EASEMENTS AND RIGHT OF WAYS
	TEMPORARY CONSTRUCTION EASEMENT
	CENTER LINE OF RIVER AND RIVER STATIONS
	LIMIT OF EE/CA REMOVAL
	APPROXIMATE EARTH RETAINING STRUCTURE LOCATION (PROPOSED)
	APPROXIMATE LIMIT OF TEMPORARY CONSTRUCTION FACILITIES
I9-5-16	PROPERTY NUMBER

WESTON
MANAGERS DESIGNERS/CONSULTANTS
WEST CHESTER PENNSYLVANIA

EE/CA FOR THE UPPER REACH OF THE HOUSATONIC RIVER
GE HOUSATONIC RIVER PROJECT

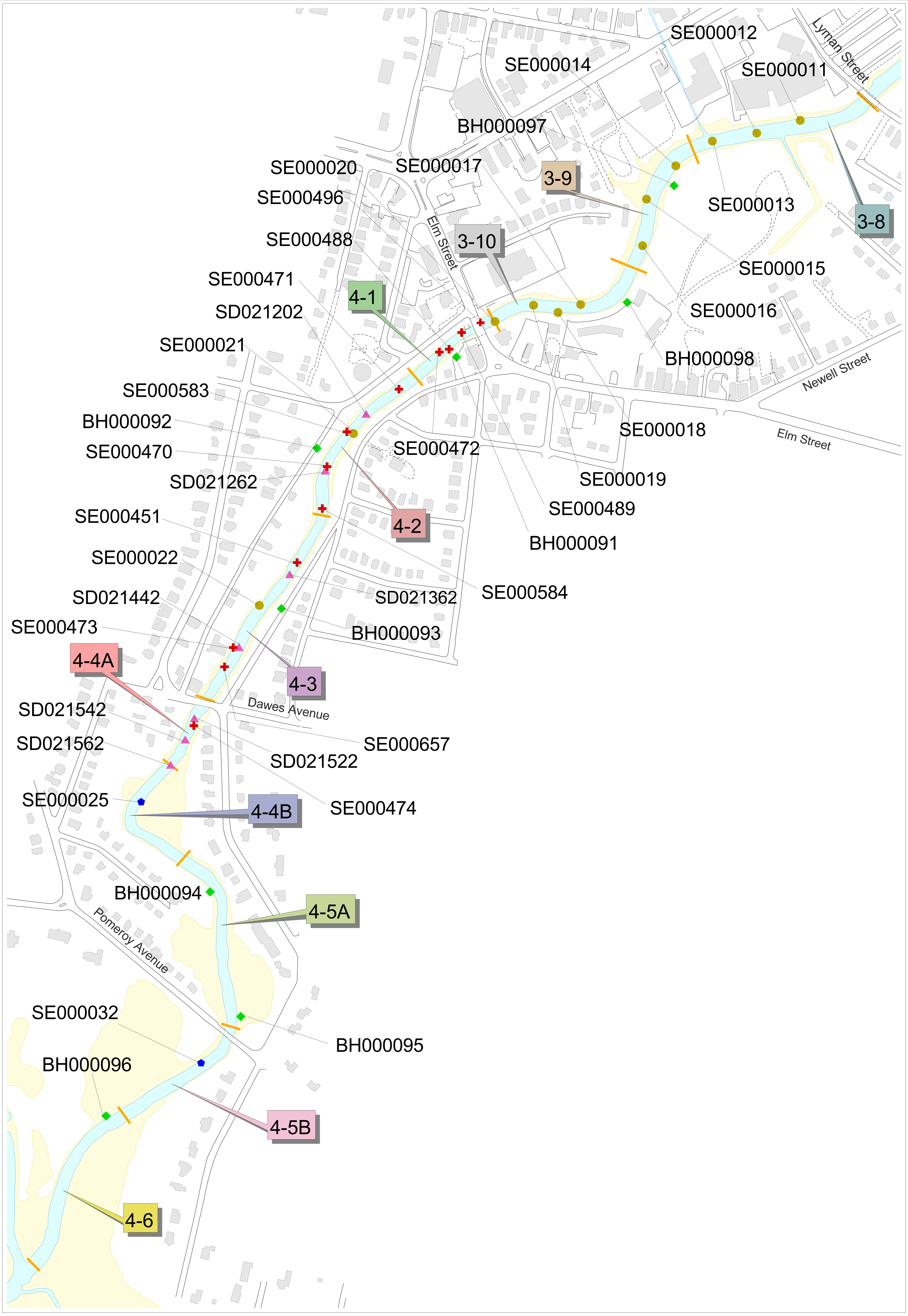
PITTSFIELD MASSACHUSETTS

SITE PLAN WITH TOPOGRAPHY AND CONCEPTUAL CONSTRUCTION LAYOUT

CHECKED	DATE
DES. ENG.	
PROJ. ENG.	
PROJ. MGR.	
APPROVED	
APPROVED	

DRAWN BY	DATE	DWG. NO.	REV. NO.
TJG	12/1/99	2.1-6D	0
SCALE 1"=60'	W.O. NUMBER	SHEET 4 OF 4	

G:\ACADPROJ\10971327\MASSOFFICE\2-1-6d.dwg



LEGEND:

- USACE/USEPA Barge Borings
- TCLP Samples
- Geotechnical Borings
- Cobble Test Plot Locations
- DRET, SBLT, Pore Water and Fractionation Samples
- Sub-Reach Divider
- Roads
- 10-year Floodplain
- Surface Hydrology
- Building Footprints

N

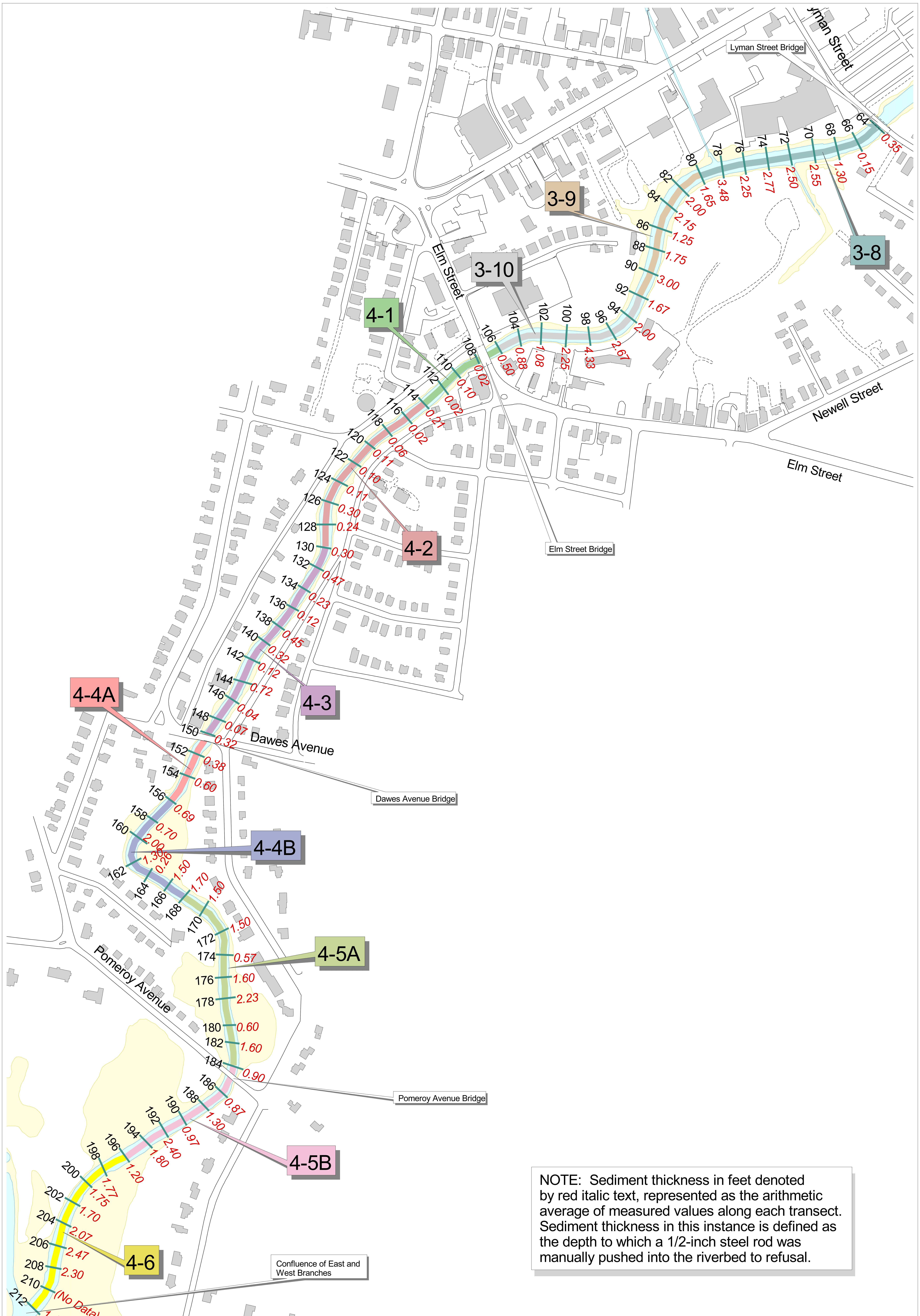
Scale in Feet

200 0 200 400 600

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.1-7
SPECIALTY SAMPLE LOCATIONS

| o:/gepitt/aprs/eeca_sub.apr | layout-EECA_speciality _samples | o:\gepitt\epsfiles\portrait24x36\in\eecaspecialty_samples.eps | 2:12 PM, 11/24/1999 |



NOTE: Sediment thickness in feet denoted by red italic text, represented as the arithmetic average of measured values along each transect. Sediment thickness in this instance is defined as the depth to which a 1/2-inch steel rod was manually pushed into the riverbed to refusal.

LEGEND:

- Transect
- Roads
- Floodplain
- Surface Hydrology
- Building Footprints

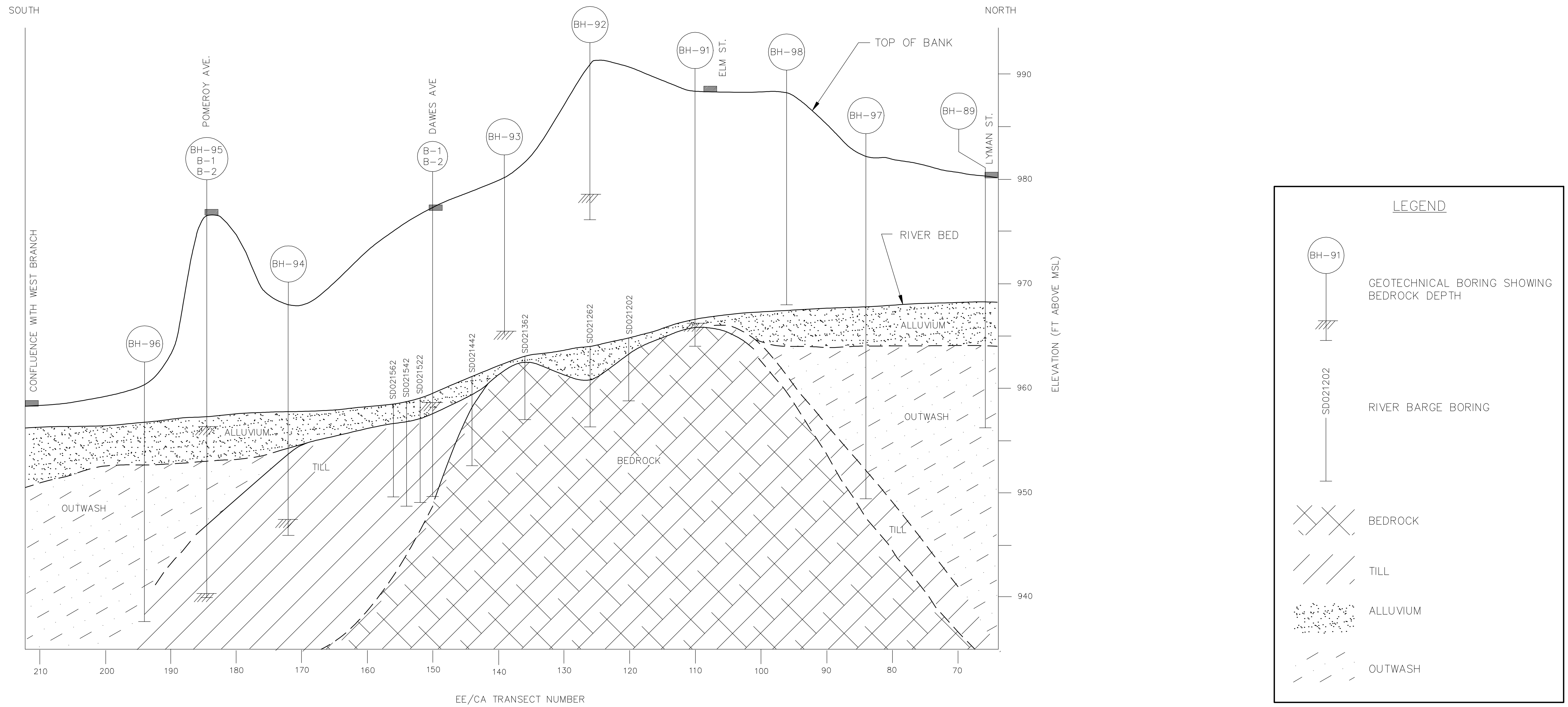
N

Scale in Feet

200 0 200 400 600

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.1-8
SEDIMENT THICKNESS



HORIZONTAL SCALE 1" = 400'

VERTICAL SCALE 1" = 5'

VERTICAL EXAGGERATION = 80X

NOTES:

1. CROSS-SECTION LOCATION IS BASED ON RIVER CENTERLINE AS SHOWN ON FIGURES 2.1-6A THROUGH 2.1-6D.
2. TOP OF BANK ELEVATIONS ESTIMATED FROM USACOE TOPOGRAPHIC MAPPING DATA.

FILE NAME: G:\ACADPROJ\10971327\MASSOFFICE\Transect.dwg

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

ENGINEERING EVALUATION/COST ANALYSIS
UPPER REACH OF THE HOUSATONIC RIVER

PITTSFIELD MASSACHUSETTS

WESTON
MANAGERS DESIGNERS/CONSULTANTS

MANCHESTER NEW HAMPSHIRE

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PROJ. ENG.			
PROJ. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

SCHEMATIC GEOLOGICAL CROSS-SECTION OF THE EE/CA REACH

DRAWN	DATE	DWG. NO.	REV. NO.
CDT	JUNE 1999	2.1-9	
SCALE	W.O. NO.	SHT. ___ OF ___	
AS NOTED	10971-032-007		

LEGEND:

Roads
Floodplain
Surface Hydrology
Building Footprints

N

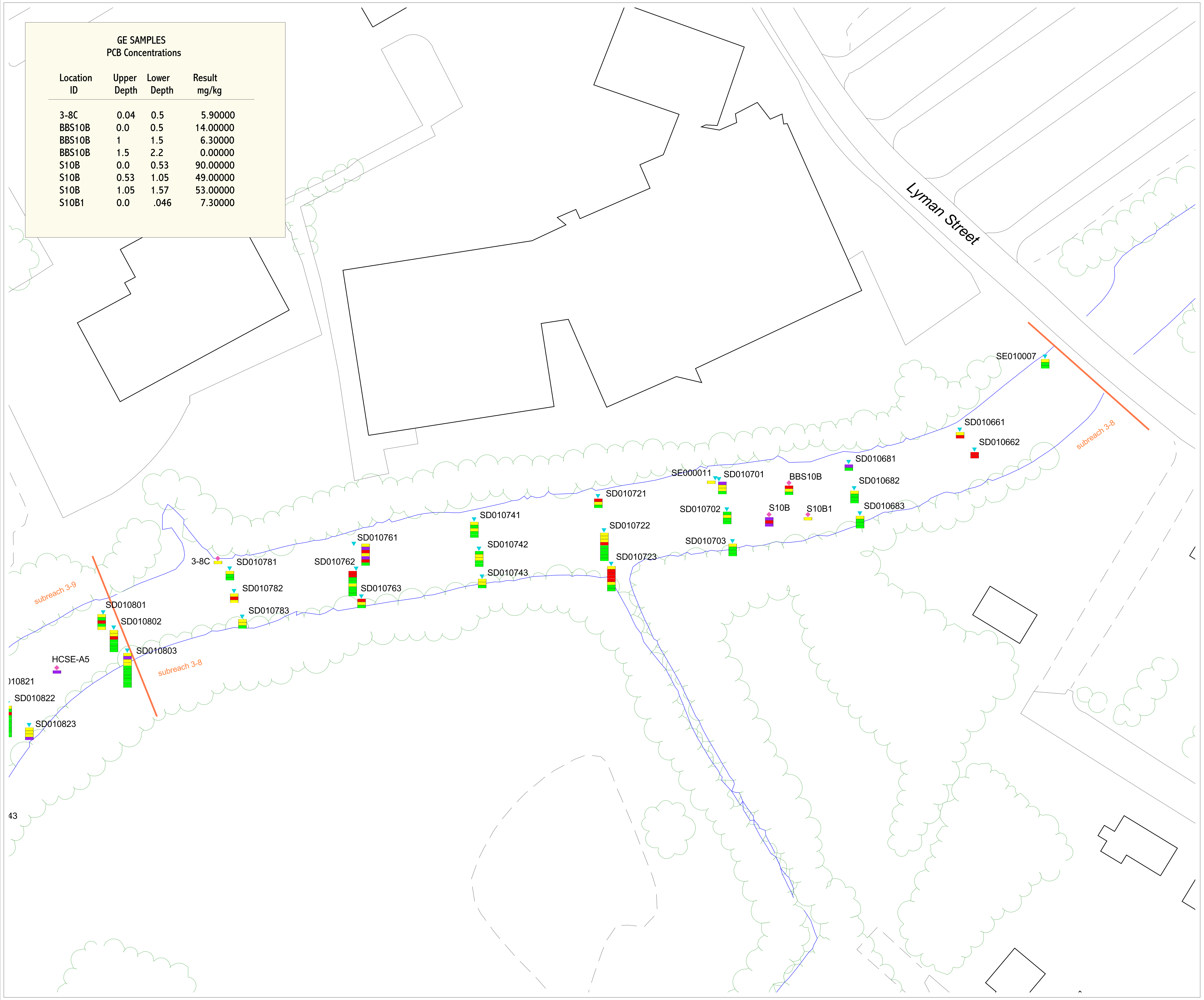
Scale in Feet

200 0 200 400 600

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3-1
SOURCE AREAS WITHIN THE EE/CA REACH

| o:/gepitt/aprs/eeca_sub.apr | Layout_PCB_eeca_sources | o:\gepitt\epsfiles\portrait24x36\in\eeca_pcb.eps | 9:53 AM, 11/24/1999 |



GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
3-8C	0.04	0.5	5.90000
BBS10B	0.0	0.5	14.00000
BBS10B	1	1.5	6.30000
BBS10B	1.5	2.2	0.00000
S10B	0.0	0.53	90.00000
S10B	0.53	1.05	49.00000
S10B	1.05	1.57	53.00000
S10B1	0.0	.046	7.30000

WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

GE Sediment Samples
EPA Sediment Samples
Subreach Dividers

Total PCB Concentrations in Sediments

0 - 1 ppm
1 - 10
10 - 50
>50

Sediment Depth Rank Key

Shallow
Deep

NOTE: Depth key is relative and dependent on source, location, and datamart status at the time of map compilation. The user is referred to data summary tables to get actual depth intervals.

N

Scale in Feet

40 0 40 80 120 160 200

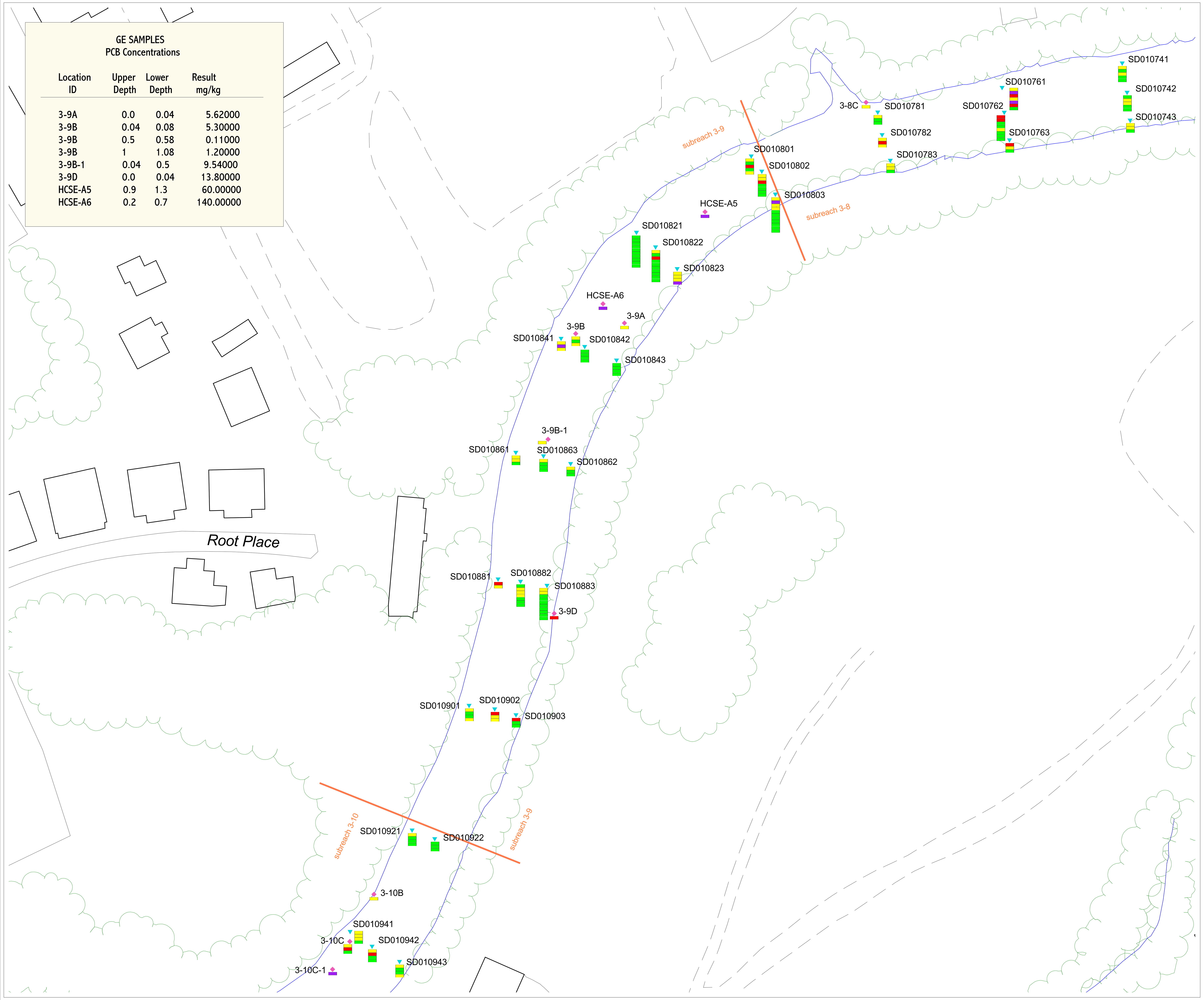
ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 2A
SEDIMENT PCB DATA
SUBREACH 3-8

| o:\gepitt\aprs\eeca_sedsnov.apr | layout-reach 3-8 | o:\gepitt\epsfiles\landscape24x36\in\eeca_sed3-8.eps | 10:30 AM, 11/29/1999 |

GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
3-9A	0.0	0.04	5.62000
3-9B	0.04	0.08	5.30000
3-9B	0.5	0.58	0.11000
3-9B	1	1.08	1.20000
3-9B-1	0.04	0.5	9.54000
3-9D	0.0	0.04	13.80000
HCSE-A5	0.9	1.3	60.00000
HCSE-A6	0.2	0.7	140.00000



WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

- GE Sediment Samples
- EPA Sediment Samples
- Subreach Dividers

Total PCB Concentrations in Sediments

- 0 - 1 ppm
- 1 - 10
- 10 - 50
- >50

Sediment Depth Rank Key

Shallow

Deep

NOTE: Depth key is relative and dependent on source, location, and datamart status at the time of map compilation. The user is referred to data summary tables to get actual depth intervals.

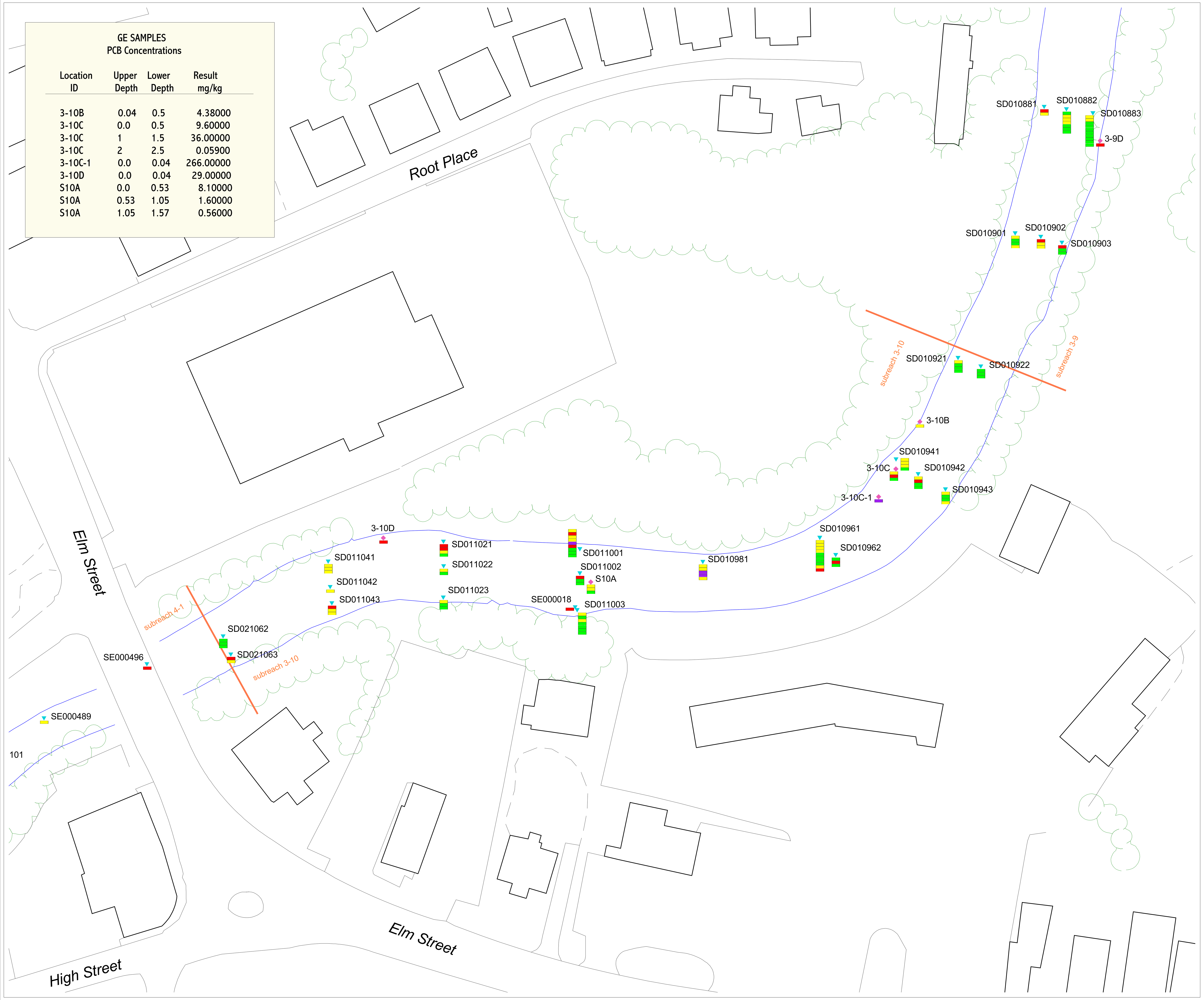
N

Scale in Feet

40 0 40 80 120 160 200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 2B
SEDIMENT PCB DATA
SUBREACH 3-9



GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
3-10B	0.04	0.5	4.38000
3-10C	0.0	0.5	9.60000
3-10C	1	1.5	36.00000
3-10C	2	2.5	0.05900
3-10C-1	0.0	0.04	266.00000
3-10D	0.0	0.04	29.00000
S10A	0.0	0.53	8.10000
S10A	0.53	1.05	1.60000
S10A	1.05	1.57	0.56000

WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

- GE Sediment Samples
- EPA Sediment Samples
- Subreach Dividers

Total PCB Concentrations in Sediments

- 0 - 1 ppm
- 1 - 10
- 10 - 50
- >50

Sediment Depth Rank Key

Shallow

Deep

NOTE: Depth key is relative and dependent on source, location, and datamart status at the time of map compilation. The user is referred to data summary tables to get actual depth intervals.

N

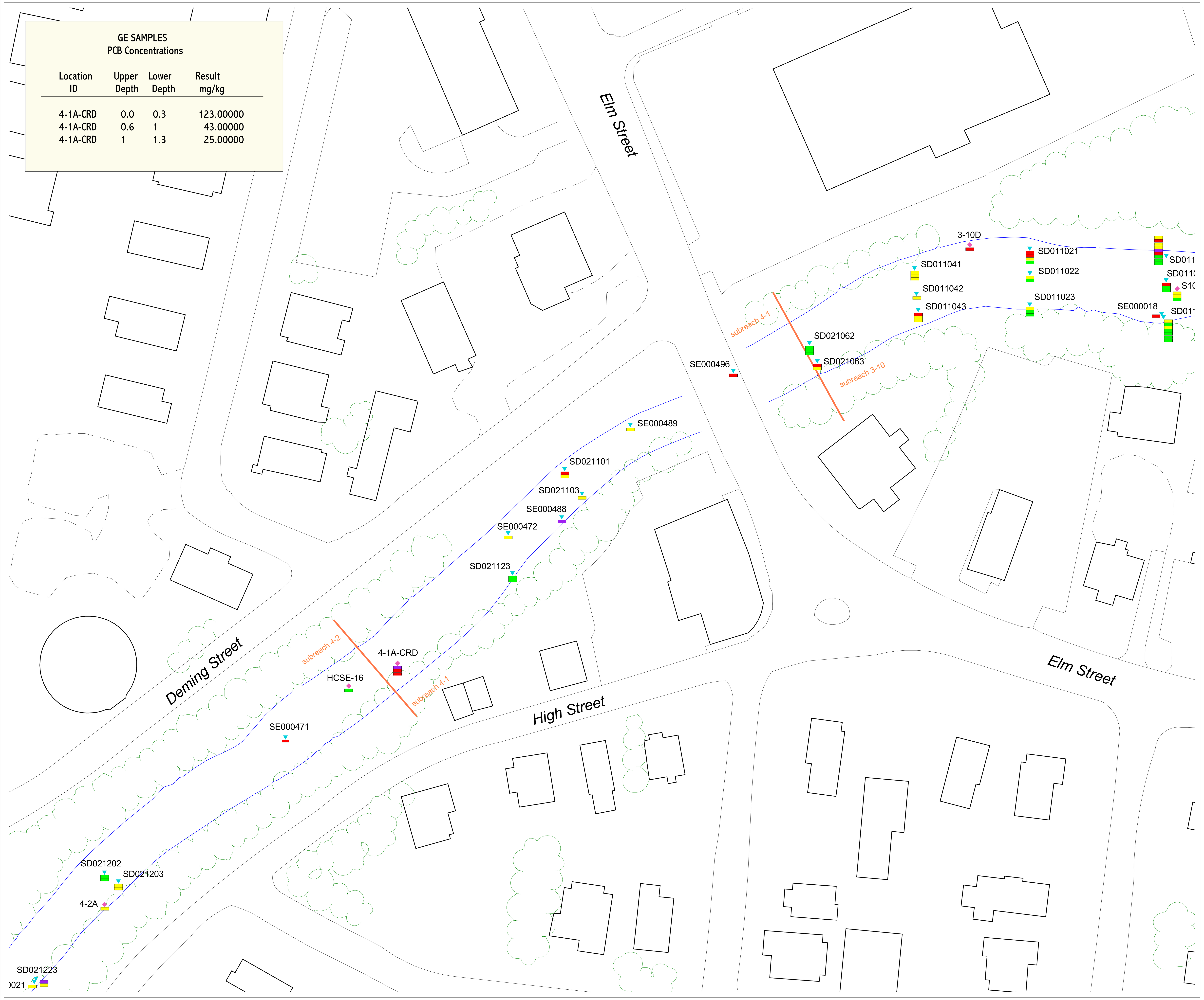
Scale in Feet

40 0 40 80 120 160 200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 2C
SEDIMENT PCB DATA
SUBREACH 3-10

| o:/gepitt/aprs/eeca_sedsnov.apr | layout-reach 3-10 | o:\gepitt\epsfiles\landscape24x36\in\eeca_sed3-10.eps | 10:46 AM, 11/29/1999 |



GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
4-1A-CRD	0.0	0.3	123.00000
4-1A-CRD	0.6	1	43.00000
4-1A-CRD	1	1.3	25.00000

WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

GE Sediment Samples

EPA Sediment Samples

Subreach Dividers

Total PCB Concentrations in Sediments

0 - 1 ppm

1 - 10

10 - 50

>50

Sediment Depth Rank Key

Shallow

Deep

NOTE: Depth key is relative and dependent on source, location, and datamart status at the time of map compilation. The user is referred to data summary tables to get actual depth intervals.

N

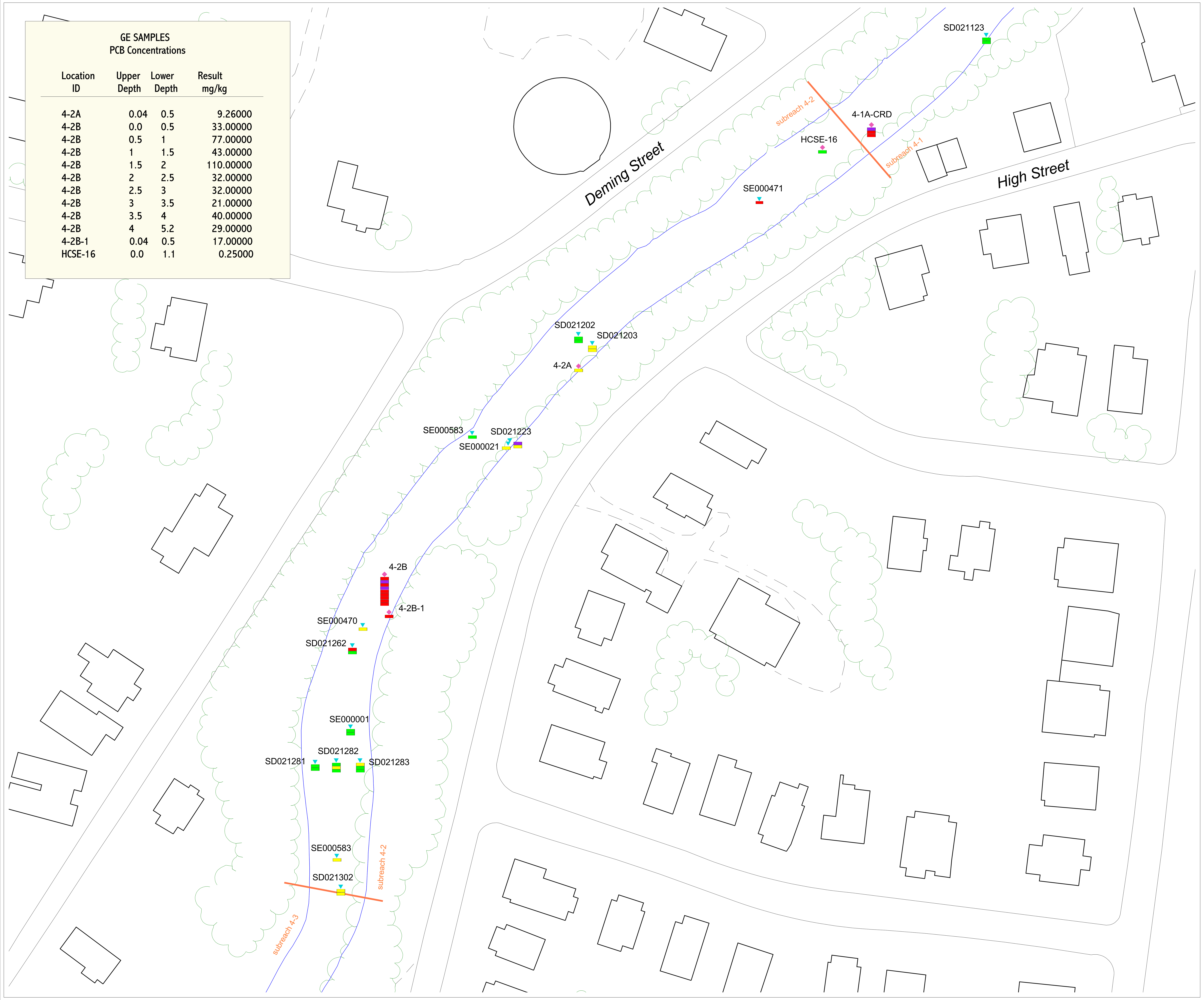
Scale in Feet

40 0 40 80 120 160 200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 2D
SEDIMENT PCB DATA
SUBREACH 4-1

| o:/gepitt/aprs/eeca_sedsnov.apr | layout-reach 4-1 | o:\gepitt\epsfiles\landscape24x36\in\eeca_sed4-1.eps | 10:49 AM, 11/29/1999 |



GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
4-2A	0.04	0.5	9.26000
4-2B	0.0	0.5	33.00000
4-2B	0.5	1	77.00000
4-2B	1	1.5	43.00000
4-2B	1.5	2	110.00000
4-2B	2	2.5	32.00000
4-2B	2.5	3	32.00000
4-2B	3	3.5	21.00000
4-2B	3.5	4	40.00000
4-2B	4	5.2	29.00000
4-2B-1	0.04	0.5	17.00000
HCSE-16	0.0	1.1	0.25000

WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

GE Sediment Samples
EPA Sediment Samples
Subreach Dividers

Total PCB Concentrations in Sediments

0 - 1 ppm
1 - 10
10 - 50
>50

Sediment Depth Rank Key

Shallow
Deep

NOTE: Depth key is relative and dependent on source, location, and datamart status at the time of map compilation. The user is referred to data summary tables to get actual depth intervals.

N

Scale in Feet

40 0 40 80 120 160 200

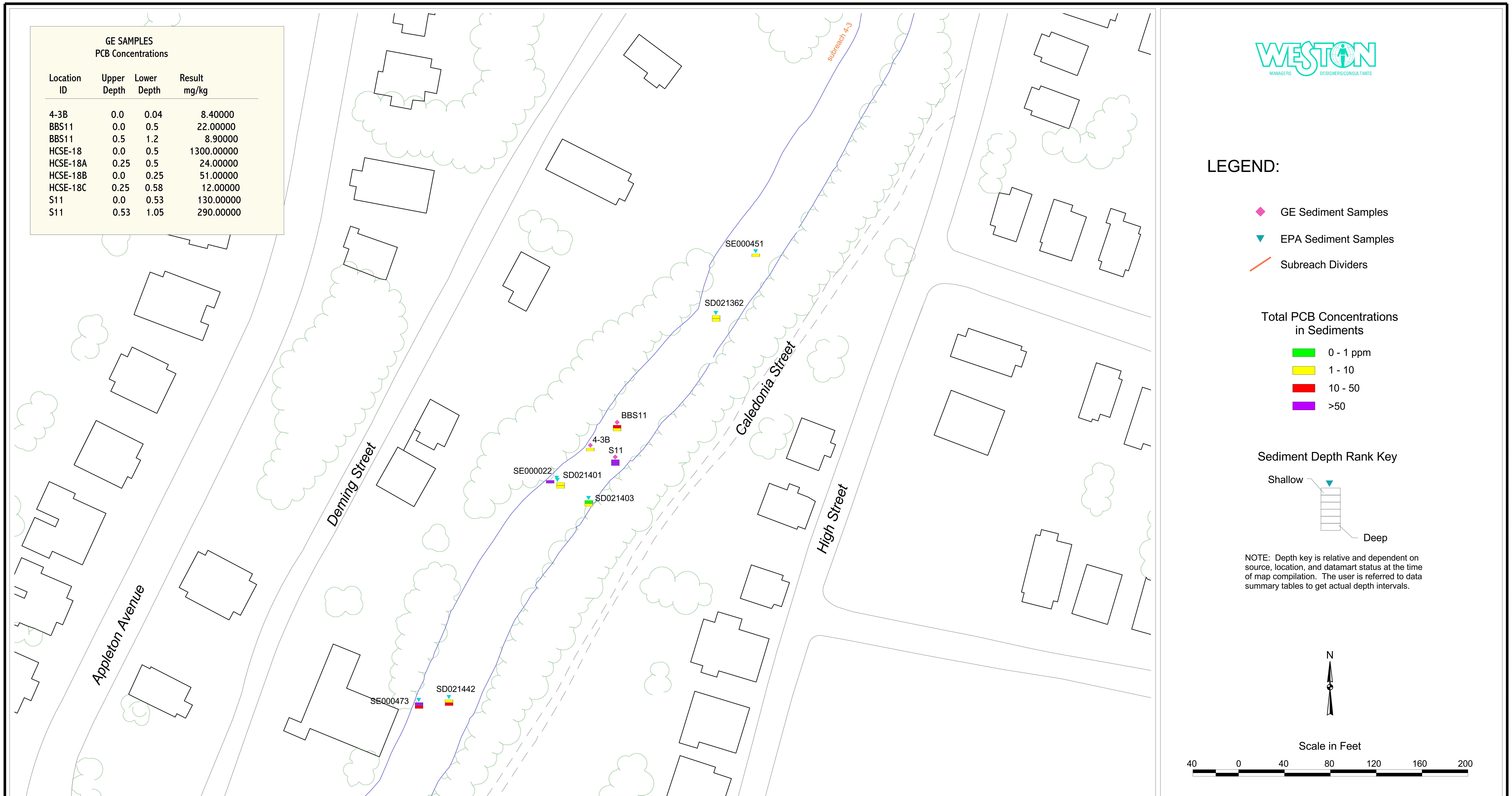
ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 2E
SEDIMENT PCB DATA
SUBREACH 4-2

| o:/gepitt/aprs/eeca_sedsnov.apr | layout-reach 4-2 | o:\gepitt\epsfiles\landscape24x36\in\eeca_sed4-2.eps | 4:24 PM, 11/29/1999 |

GE SAMPLES
PCB Concentrations

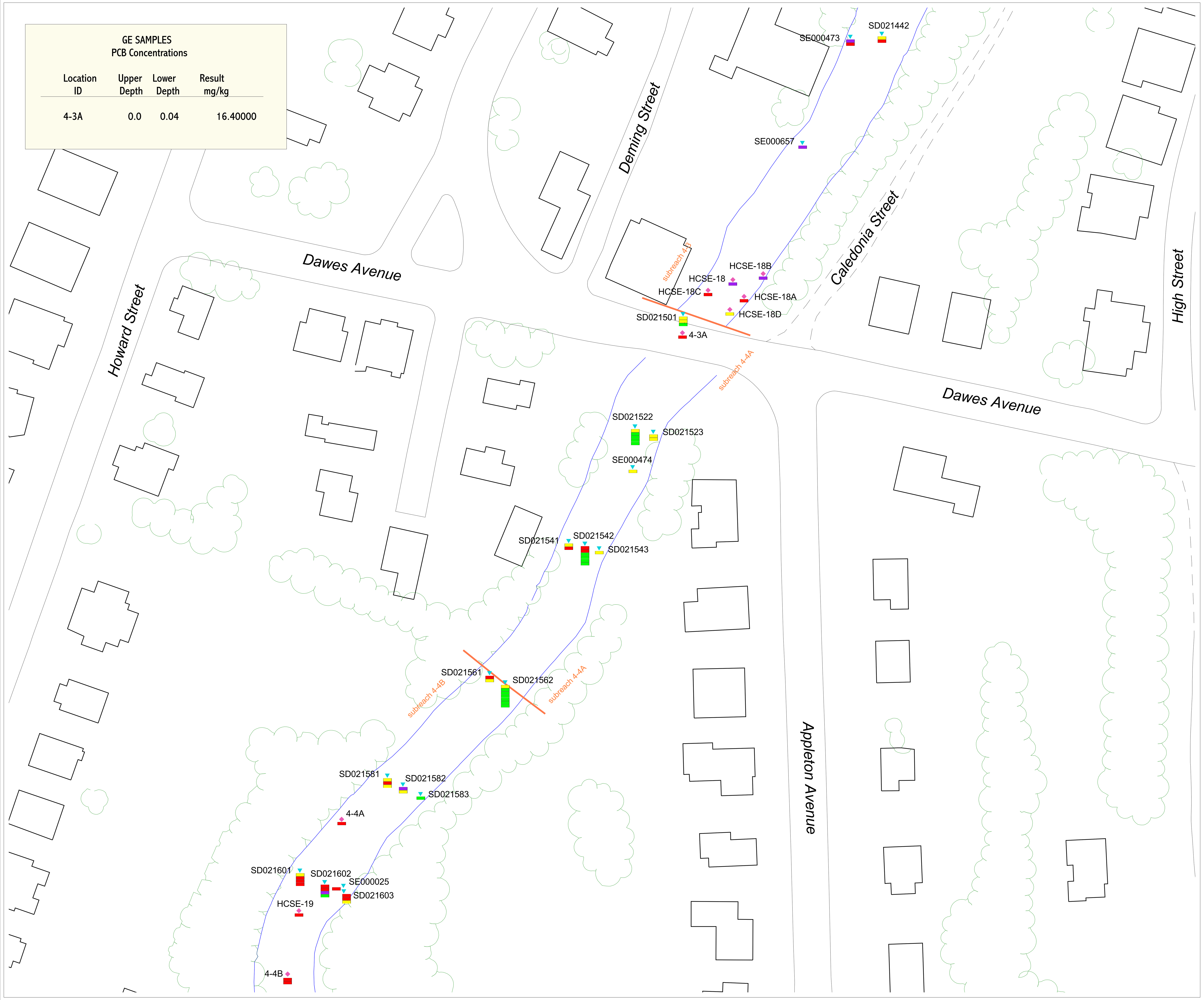
Location ID	Upper Depth	Lower Depth	Result mg/kg
4-3B	0.0	0.04	8.40000
BBS11	0.0	0.5	22.00000
BBS11	0.5	1.2	8.90000
HCSE-18	0.0	0.5	1300.00000
HCSE-18A	0.25	0.5	24.00000
HCSE-18B	0.0	0.25	51.00000
HCSE-18C	0.25	0.58	12.00000
S11	0.0	0.53	130.00000
S11	0.53	1.05	290.00000



ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 2F
SEDIMENT PCB DATA
SUBREACH 4-3

| o:/gepitt/aprs/eeca_sedsnov.apr | layout-reach 4-3 | o:\gepitt\epsfiles\landscape24x36\in\eeca_sed4-3.eps | 5:16 PM, 11/29/1999 |



GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
4-3A	0.0	0.04	16.40000

WESTON

LEGEND:

- GE Sediment Samples
- EPA Sediment Samples
- Subreach Dividers

Total PCB Concentrations in Sediments

- 0 - 1 ppm
- 1 - 10
- 10 - 50
- >50

Sediment Depth Rank Key

Shallow

Deep

NOTE: Depth key is relative and dependent on source, location, and datamart status at the time of map compilation. The user is referred to data summary tables to get actual depth intervals.

N

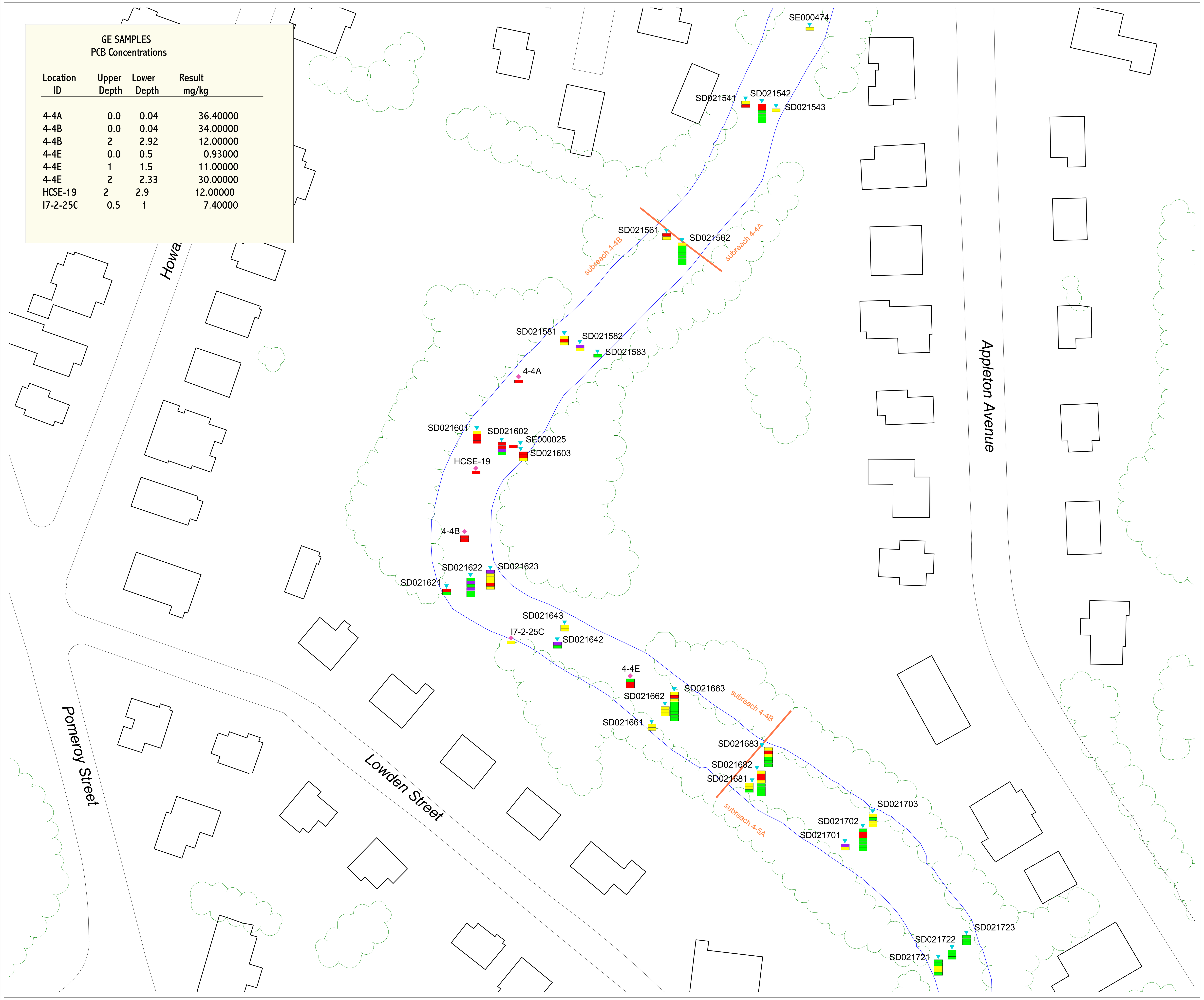
Scale in Feet

40 0 40 80 120 160 200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 2G
SEDIMENT PCB DATA
SUBREACH 4-4A

| o:\gepitt\aprs\eeca_sedsnov.apr | layout-reach 4-4A | o:\gepitt\epsfiles\landscape24x36\in\eeca_sed4-4a.eps | 5:20 PM, 11/29/1999 |



GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
4-4A	0.0	0.04	36.40000
4-4B	0.0	0.04	34.00000
4-4B	2	2.92	12.00000
4-4E	0.0	0.5	0.93000
4-4E	1	1.5	11.00000
4-4E	2	2.33	30.00000
HCSE-19	2	2.9	12.00000
I7-2-25C	0.5	1	7.40000

WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

GE Sediment Samples
EPA Sediment Samples
Subreach Dividers

Total PCB Concentrations in Sediments

0 - 1 ppm
1 - 10
10 - 50
>50

Sediment Depth Rank Key

Shallow
Deep

NOTE: Depth key is relative and dependent on source, location, and datamart status at the time of map compilation. The user is referred to data summary tables to get actual depth intervals.

N

Scale in Feet

40 0 40 80 120 160 200

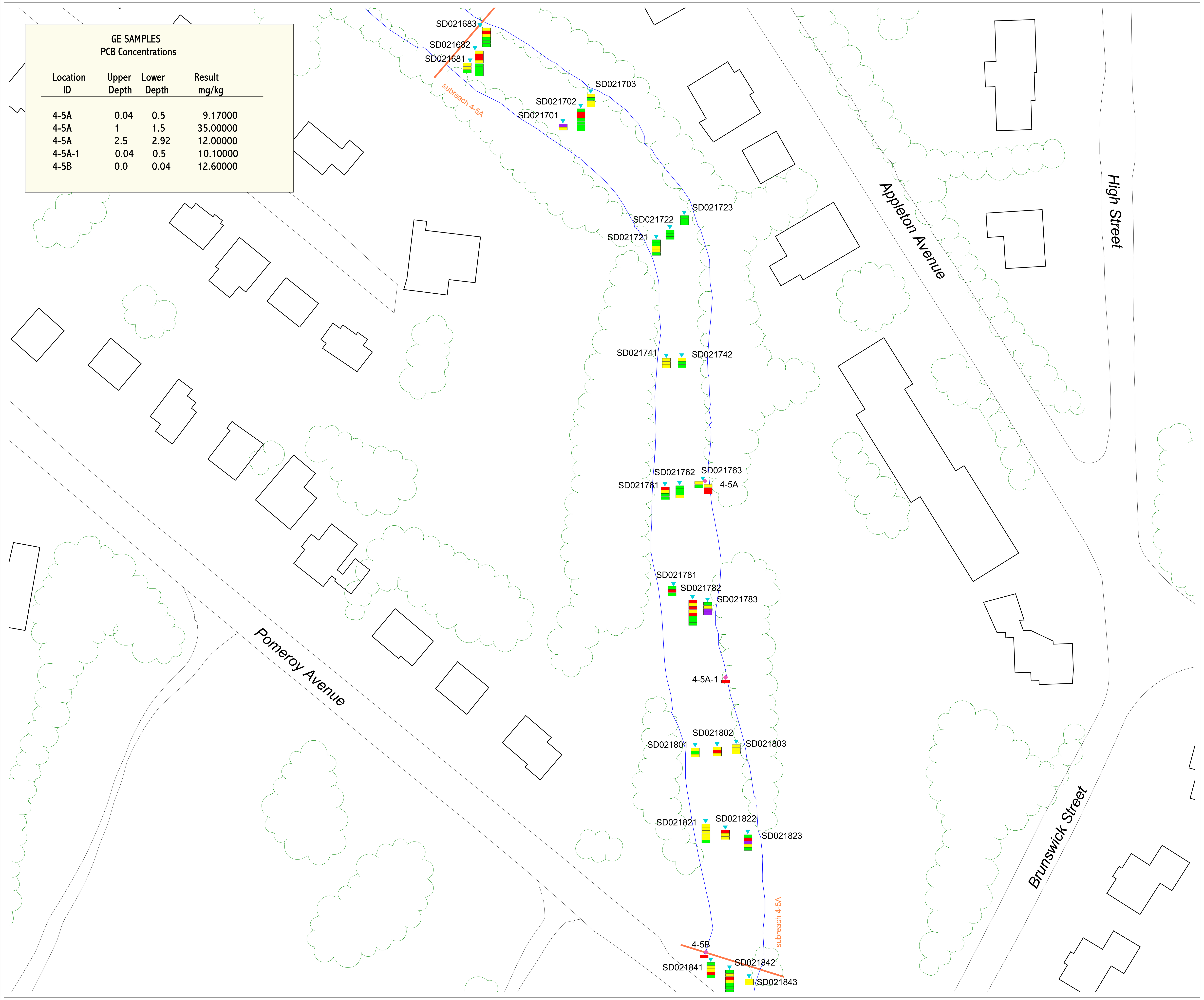
ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 2H
SEDIMENT PCB DATA
SUBREACH 4-4B

| o:\gepitt\aprs\eeca_sedsnov.apr | layout-reach 4-4B | o:\gepitt\epsfiles\landscape24x36\in\eeca_sed4-4b.eps | 5:22 PM, 11/29/1999 |

GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
4-5A	0.04	0.5	9.17000
4-5A	1	1.5	35.00000
4-5A	2.5	2.92	12.00000
4-5A-1	0.04	0.5	10.10000
4-5B	0.0	0.04	12.60000



WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

GE Sediment Samples
EPA Sediment Samples
Subreach Dividers

Total PCB Concentrations
in Sediments

0 - 1 ppm
1 - 10
10 - 50
>50

Sediment Depth Rank Key

Shallow
Deep

NOTE: Depth key is relative and dependent on source, location, and datamart status at the time of map compilation. The user is referred to data summary tables to get actual depth intervals.

N

Scale in Feet

40 0 40 80 120 160 200

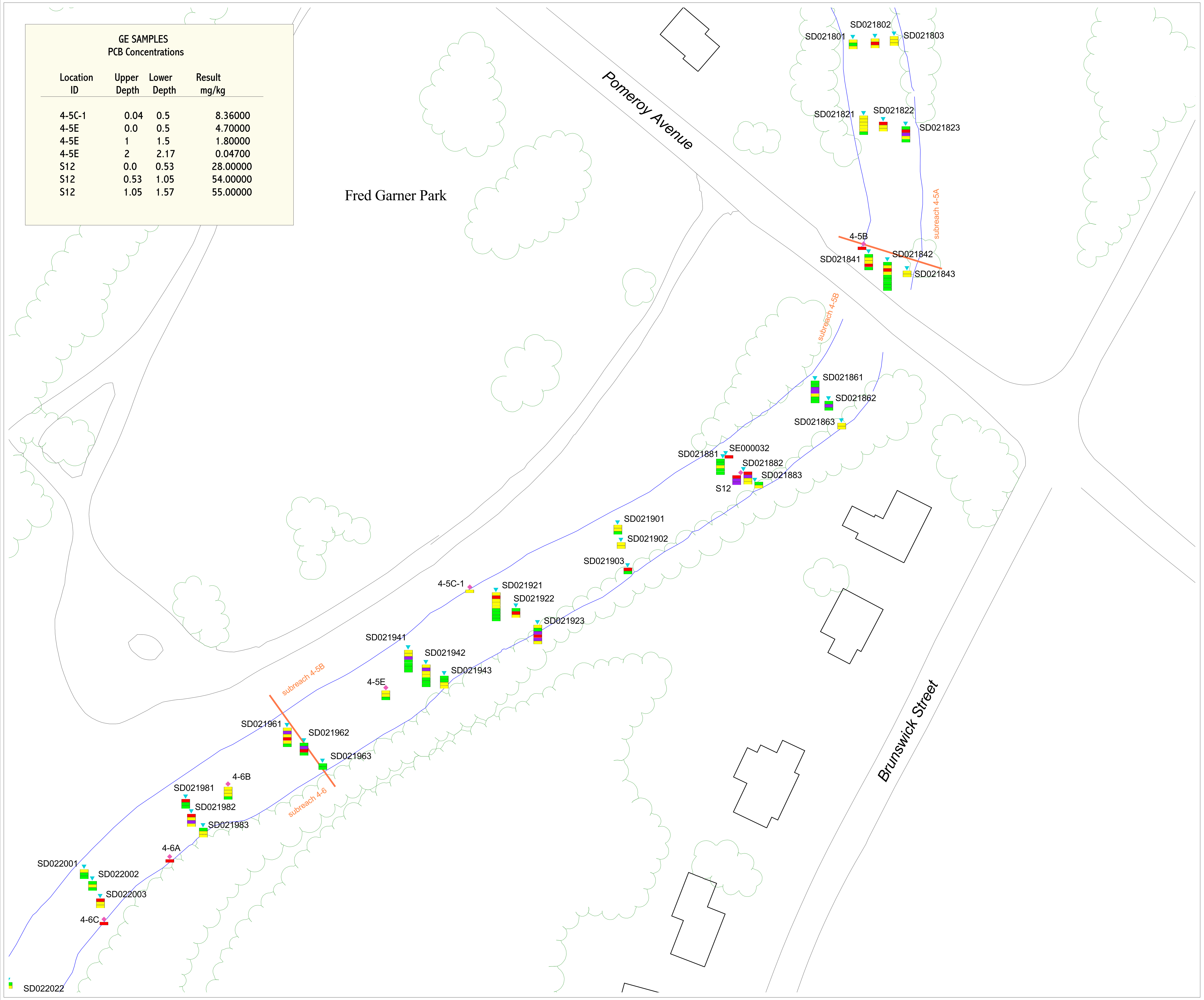
ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 2I
SEDIMENT PCB DATA
SUBREACH 4-5A

| o:/gepitt/aprs/eeca_sedsnov.apr | layout-reach 4-5A | o:\gepitt\epsfiles\landscape24x36\in\eeca_sed4-5a.eps | 5:24 PM, 11/29/1999 |

GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
4-5C-1	0.04	0.5	8.36000
4-5E	0.0	0.5	4.70000
4-5E	1	1.5	1.80000
4-5E	2	2.17	0.04700
S12	0.0	0.53	28.00000
S12	0.53	1.05	54.00000
S12	1.05	1.57	55.00000



WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

GE Sediment Samples

EPA Sediment Samples

Subreach Dividers

Total PCB Concentrations
in Sediments

0 - 1 ppm
1 - 10
10 - 50
>50

Sediment Depth Rank Key

Shallow

Deep

NOTE: Depth key is relative and dependent on source, location, and datamart status at the time of map compilation. The user is referred to data summary tables to get actual depth intervals.

N

Scale in Feet

40 0 40 80 120 160 200

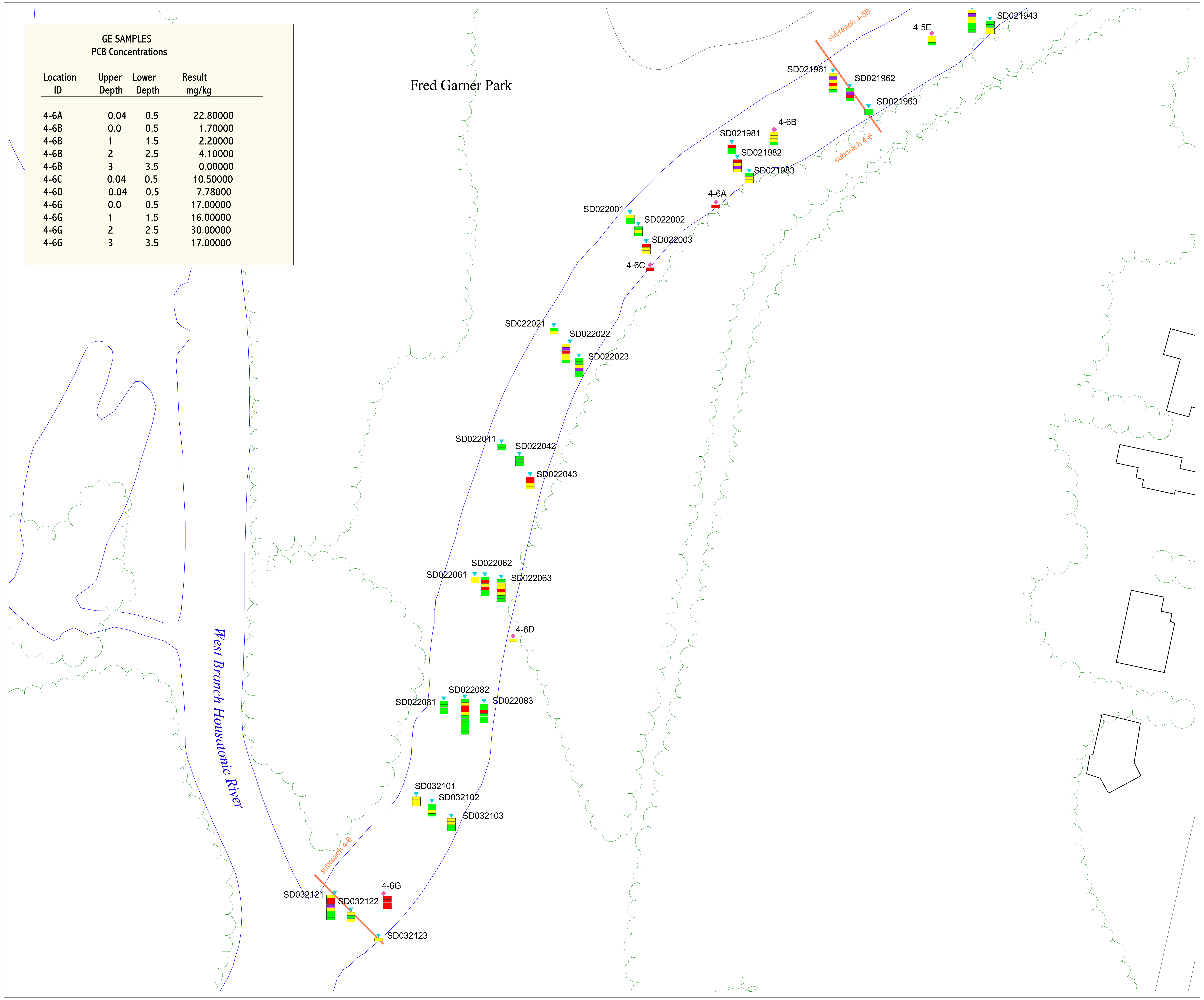
ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 2J
SEDIMENT PCB DATA
SUBREACH 4-5B

| o:\gepitt\aprs\eeca_sedsnov.apr | layout-reach 4-5B | o:\gepitt\epsfiles\landscape24x36\in\eeca_sed4-5b.eps | 5:27 PM, 11/29/1999 |

GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
4-6A	0.04	0.5	22.80000
4-6B	0.0	0.5	1.70000
4-6B	1	1.5	2.20000
4-6B	2	2.5	4.10000
4-6B	3	3.5	0.00000
4-6C	0.04	0.5	10.50000
4-6D	0.04	0.5	7.78000
4-6G	0.0	0.5	17.00000
4-6G	1	1.5	16.00000
4-6G	2	2.5	30.00000
4-6G	3	3.5	17.00000



WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

GE Sediment Samples
EPA Sediment Samples
Subreach Dividers

Total PCB Concentrations in Sediments

- 0 - 1 ppm
- 1 - 10
- 10 - 50
- >50

Sediment Depth Rank Key

Shallow
Deep

NOTE: Depth key is relative and dependent on source, location, and datamart status at the time of map compilation. The user is referred to data summary tables to get actual depth intervals.

N

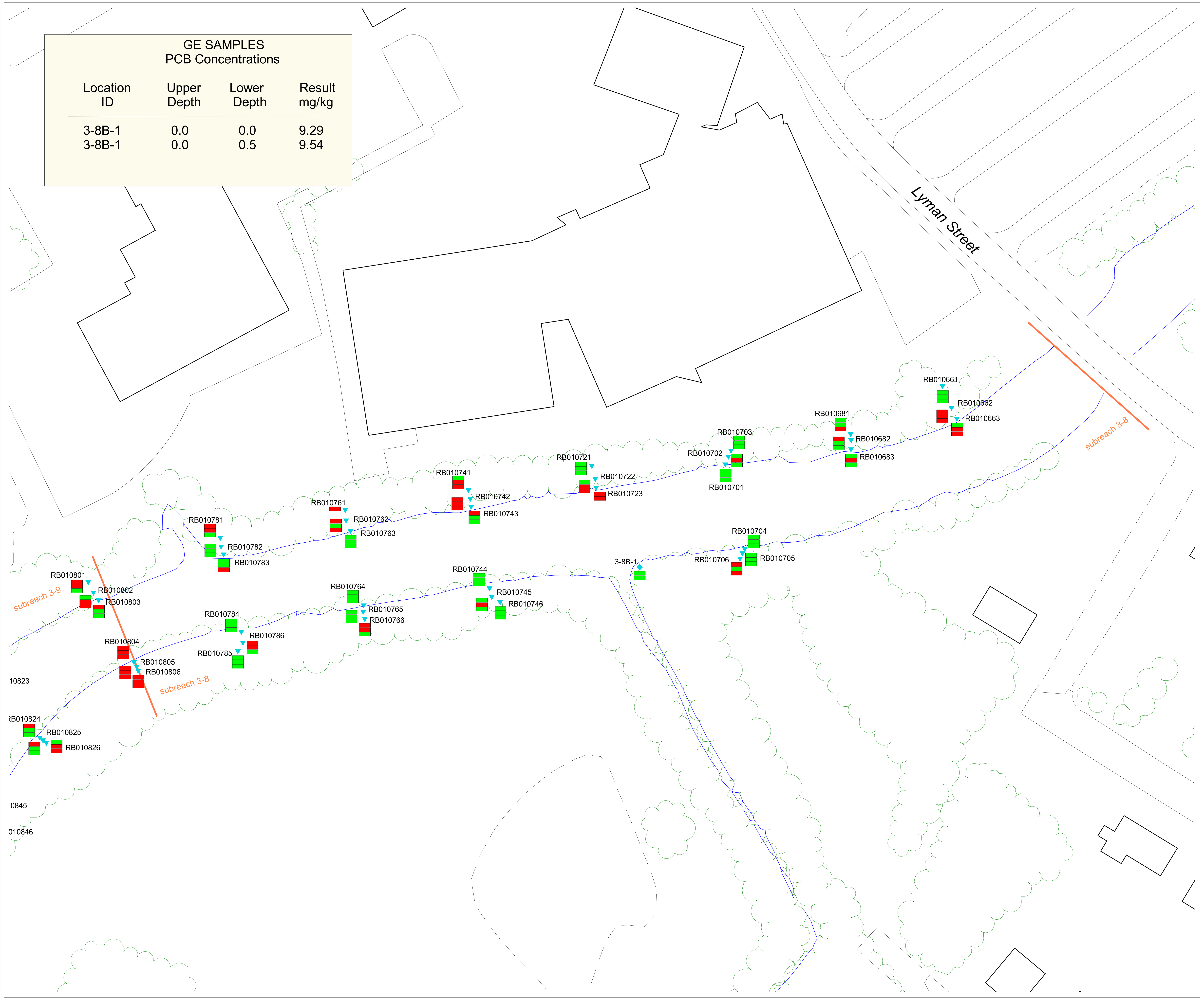
Scale in Feet

40 0 40 80 120 160 200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 2K
SEDIMENT PCB DATA
SUBREACH 4-6

| o:/gepitt/aprs/eeca_sedsnov.apr | layout-reach 4-6 | o:\gepitt\epsfiles\landscape24x36\in\eeca_sed4-6.eps | 5:29 PM, 11/29/1999 |



GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
3-8B-1	0.0	0.0	9.29
3-8B-1	0.0	0.5	9.54

WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

Recreational | Residential

- EPA Sample Locations
- EPA-START Sample Locations
- GE Sample Locations
- Subreach Dividers

Summary of PCB Concentrations in Bank Soils

- Does not exceed cleanup criteria
- Exceeds cleanup criteria

Bank Soil Depth Rank Key

Shallow: 0 - 0.5, 1.0 - 1.5
Deep: 2.0 - 2.5

NOTE: The depth intervals provided on the depth key above apply to the EPA samples which were collected from regular intervals in most cases. There are a few EPA samples however that do not fall into the specific depth intervals given above. The reader should refer to the data tables in Appendix H for confirmation of the sample interval for specific samples. The GE data were not collected from regular depth intervals and thus are summarized in the table on this figure for ease of viewing.

NOTES:

1. Cleanup concentration criteria for PCBs in recreational land use samples is 10 ppm in the top 1 foot and 10 ppm in the next 2 feet.

2. Cleanup concentration criteria for PCBs in residential land use samples is 2 ppm in the top 3 feet.

N

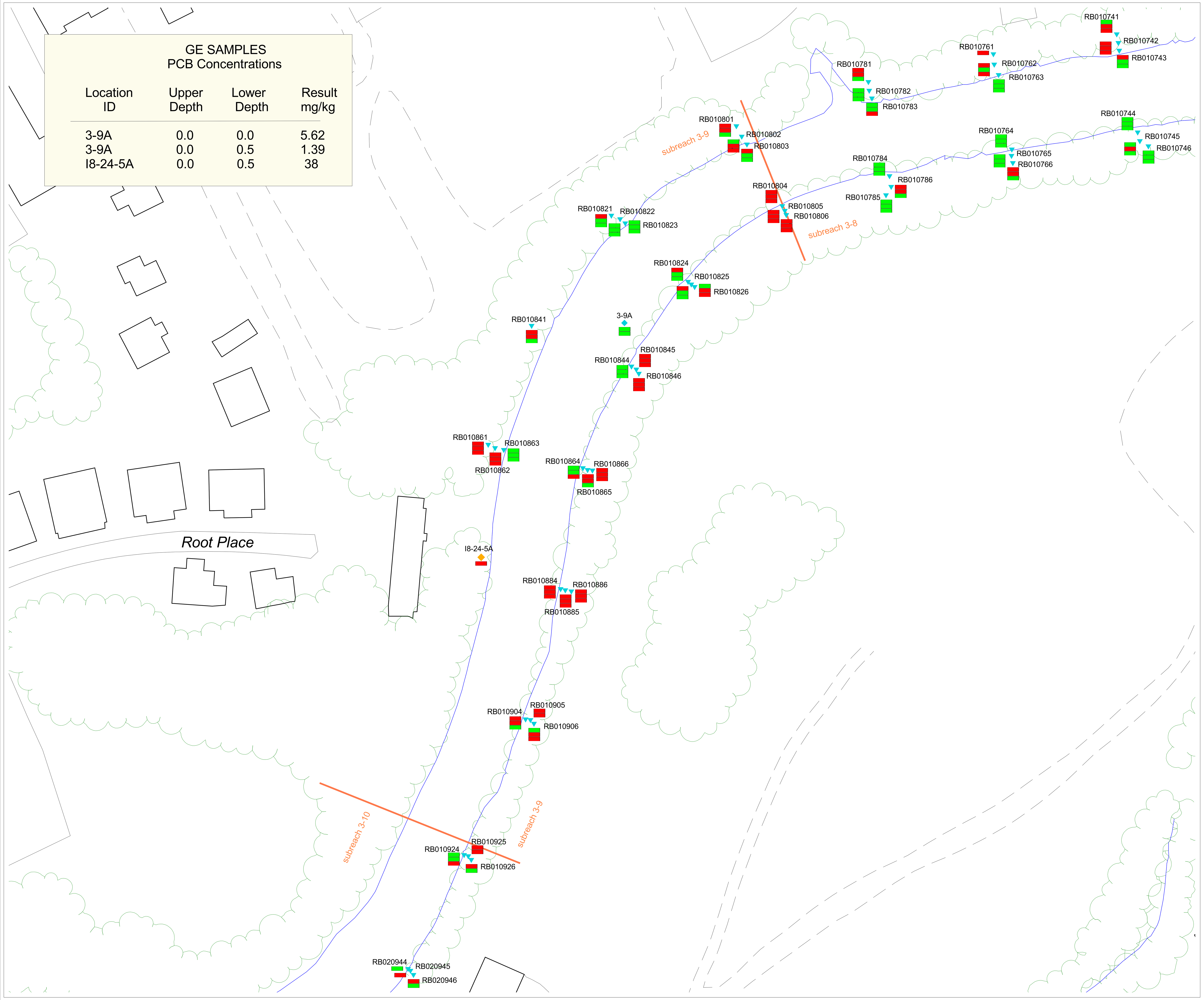
Scale in Feet

40 0 40 80 120 160 200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 3A
BANK PCB DATA
SUBREACH 3-8

| o:\gepitt\aprs\eeca_banksfeb.apr | Banks, Reach 3-8 | o:\gepitt\epsfiles\landscape24x36\in\eeca_bank3-8.eps | 10:31 AM, 2/15/2000 |



GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
3-9A	0.0	0.0	5.62
3-9A	0.0	0.5	1.39
I8-24-5A	0.0	0.5	38

WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

Recreational / Residential

- EPA Sample Locations
- EPA-START Sample Locations
- GE Sample Locations
- Subreach Dividers

Summary of PCB Concentrations in Bank Soils

- Does not exceed cleanup criteria
- Exceeds cleanup criteria

Bank Soil Depth Rank Key

Shallow 0 - 0.5
1.0 - 1.5
Deep 2.0 - 2.5

NOTE: The depth intervals provided on the depth key above apply to the EPA samples which were collected from regular intervals in most cases. There are a few EPA samples however that do not fall into the specific depth intervals given above. The reader should refer to the data tables in Appendix H for confirmation of the sample interval for specific samples. The GE data were not collected from regular depth intervals and thus are summarized in the table on this figure for ease of viewing.

NOTES:

1. Cleanup concentration criteria for PCBs in recreational land use samples is 10 ppm in the top 1 foot and 10 ppm in the next 2 feet.

2. Cleanup concentration criteria for PCBs in residential land use samples is 2 ppm in the top 3 feet.

N

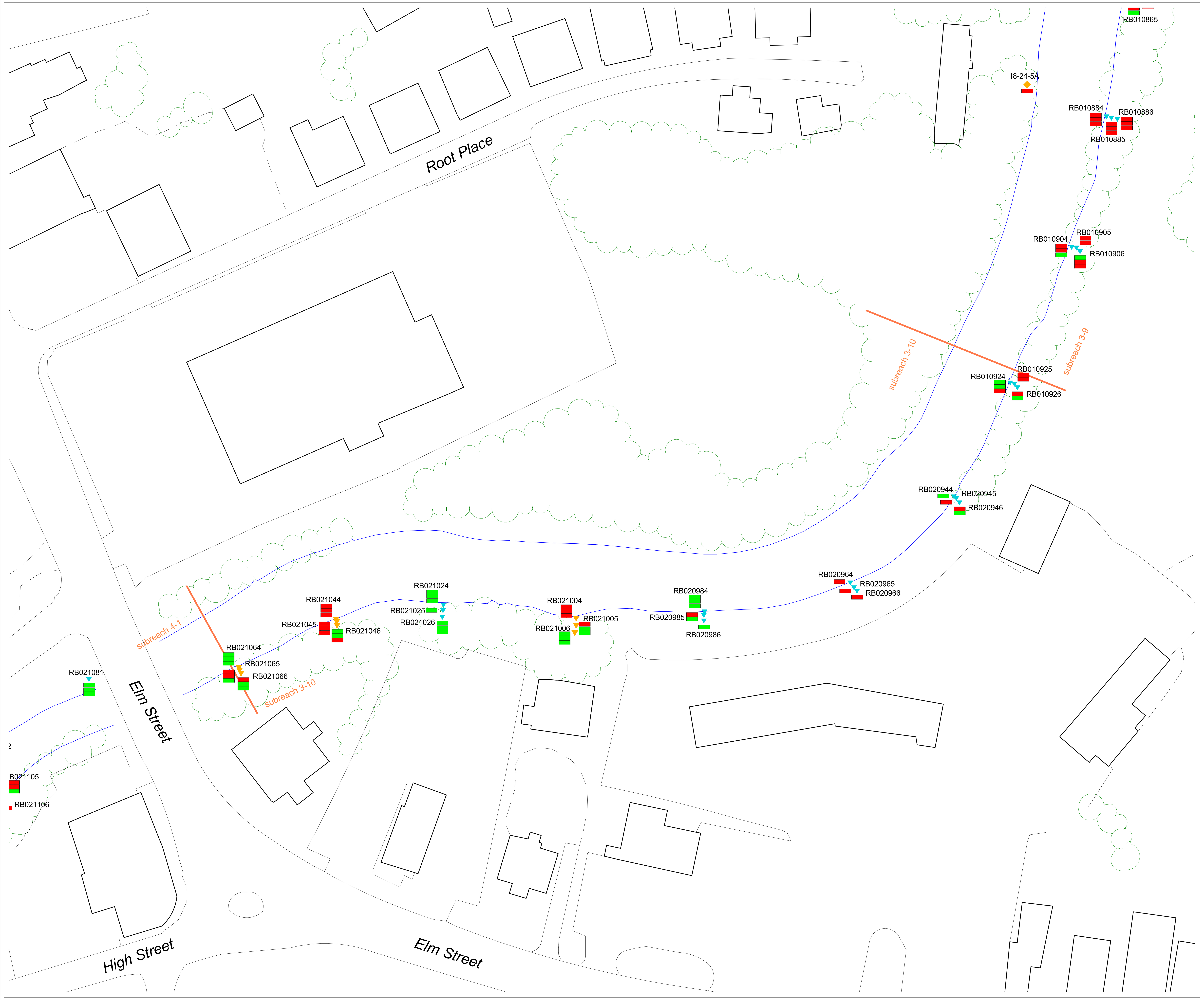
Scale in Feet

40 0 40 80 120 160 200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 3B
BANK PCB DATA
SUBREACH 3-9

| o:\gepitt\aprs\eeca_banksfeb.apr | Banks, Reach 3-9 | o:\gepitt\epsfiles\landscape24x36\in\eeca_bank3-9.eps | 10:32 AM, 2/15/2000 |



WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

Recreational | Residential

EPA Sample Locations

EPA-START Sample Locations

GE Sample Locations

Subreach Dividers

Summary of PCB Concentrations in Bank Soils

Does not exceed cleanup criteria

Exceeds cleanup criteria

Bank Soil Depth Rank Key

Shallow 0 - 0.5
1.0 - 1.5
Deep 2.0 - 2.5

NOTE: The depth intervals provided on the depth key above apply to the EPA samples which were collected from regular intervals in most cases. There are a few EPA samples however that do not fall into the specific depth intervals given above. The reader should refer to the data tables in Appendix H for confirmation of the sample interval for specific samples. The GE data were not collected from regular depth intervals and thus are summarized in the table on this figure for ease of viewing.

NOTES:

1. Cleanup concentration criteria for PCBs in recreational land use samples is 10 ppm in the top 1 foot and 10 ppm in the next 2 feet.

2. Cleanup concentration criteria for PCBs in residential land use samples is 2 ppm in the top 3 feet.

N

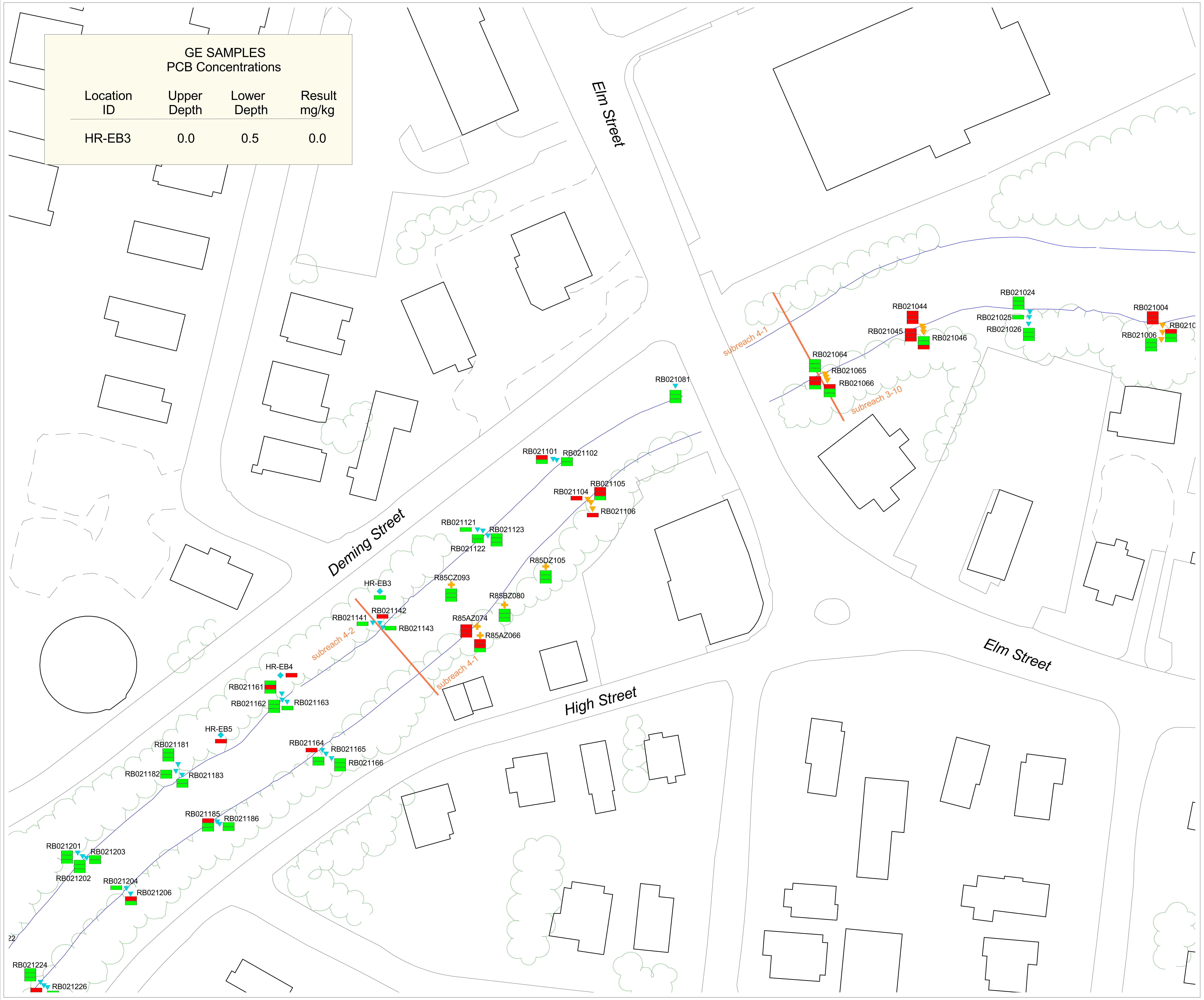
Scale in Feet

40 0 40 80 120 160 200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 3C
BANK PCB DATA
SUBREACH 3-10

| o:\gepitt\aprs\eeca_banksfeb.apr | Banks, Reach 3-10 | o:\gepitt\epsfiles\landscape24x36\in\eeca_bank3-10.eps | 10:30 AM, 2/15/2000 |



GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
HR-EB3	0.0	0.5	0.0

WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

Recreational | Residential
- EPA Sample Locations
- EPA-START Sample Locations
- GE Sample Locations
- Subreach Dividers

Summary of PCB
Concentrations in Bank Soils

- Does not exceed cleanup criteria
- Exceeds cleanup criteria

Bank Soil Depth Rank Key

Shallow 0 - 0.5
1.0 - 1.5
Deep 2.0 - 2.5

NOTE: The depth intervals provided on the depth key above apply to the EPA samples which were collected from regular intervals in most cases. There are a few EPA samples however that do not fall into the specific depth intervals given above. The reader should refer to the data tables in Appendix H for confirmation of the sample interval for specific samples. The GE data were not collected from regular depth intervals and thus are summarized in the table on this figure for ease of viewing.

NOTES:

1. Cleanup concentration criteria for PCBs in recreational land use samples is 10 ppm in the top 1 foot and 10 ppm in the next 2 feet.

2. Cleanup concentration criteria for PCBs in residential land use samples is 2 ppm in the top 3 feet.

N

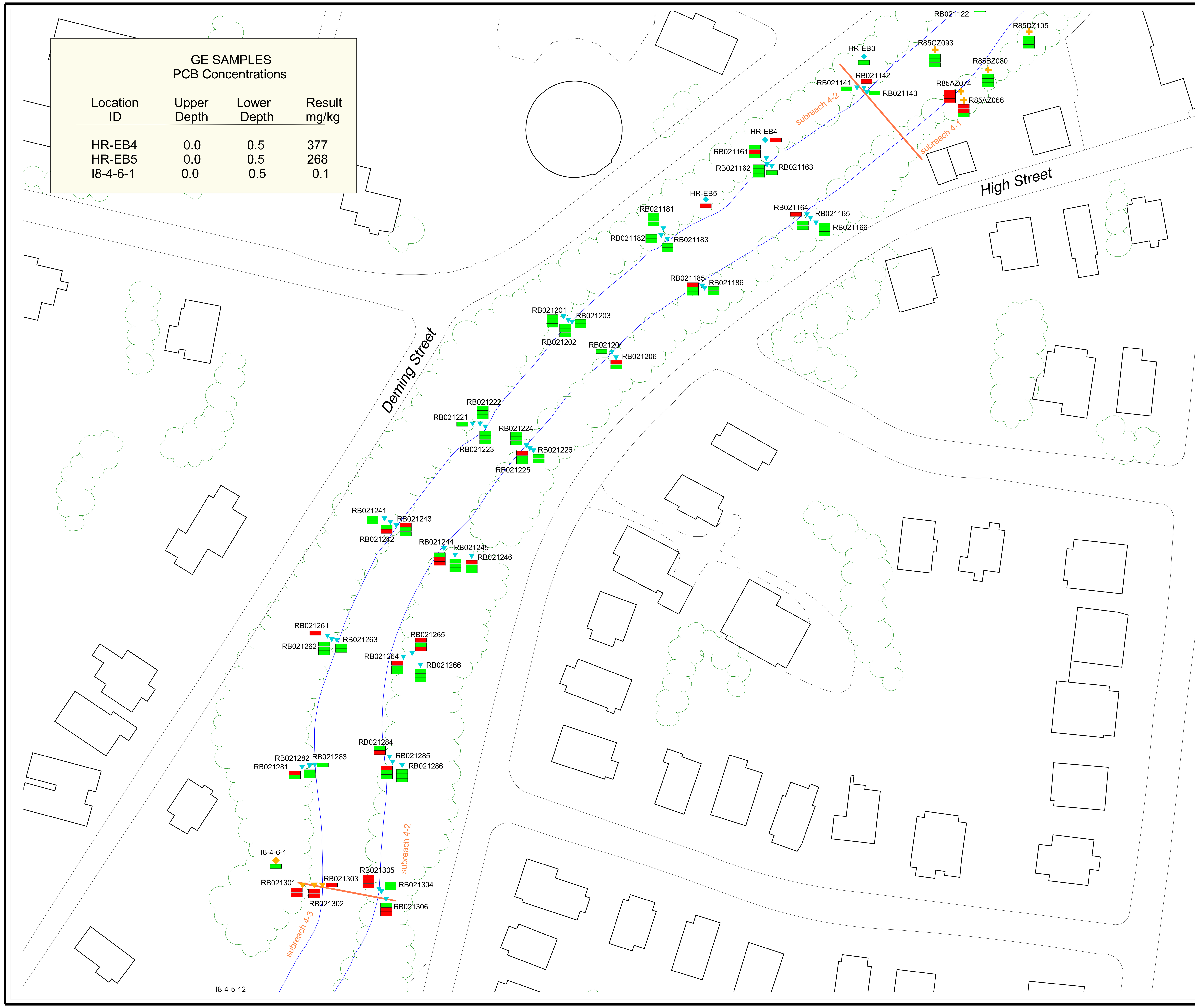
Scale in Feet

40 0 40 80 120 160 200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 3D
BANK PCB DATA
SUBREACH 4-1

| o:\gepitt\aprs\eeca_banksfeb.apr | Banks, Reach 4-1 | o:\gepitt\epsfiles\landscape24x36\in\eeca_bank4-1.eps | 10:33 AM, 2/15/2000 |



GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
HR-EB4	0.0	0.5	377
HR-EB5	0.0	0.5	268
I8-4-6-1	0.0	0.5	0.1

WESTON

MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

Recreational / Residential

- EPA Sample Locations
- EPA-START Sample Locations
- GE Sample Locations
- Subreach Dividers

Summary of PCB Concentrations in Bank Soils

- Does not exceed cleanup criteria
- Exceeds cleanup criteria

Bank Soil Depth Rank Key

Shallow	0 - 0.5
	1.0 - 1.5
Deep	2.0 - 2.5

NOTE: The depth intervals provided on the depth key above apply to the EPA samples which were collected from regular intervals in most cases. There are a few EPA samples however that do not fall into the specific depth intervals given above. The reader should refer to the data tables in Appendix H for confirmation of the sample interval for specific samples. The GE data were not collected from regular depth intervals and thus are summarized in the table on this figure for ease of viewing.

NOTES:

1. Cleanup concentration criteria for PCBs in recreational land use samples is 10 ppm in the top 1 foot and 10 ppm in the next 2 feet.

2. Cleanup concentration criteria for PCBs in residential land use samples is 2 ppm in the top 3 feet.

N

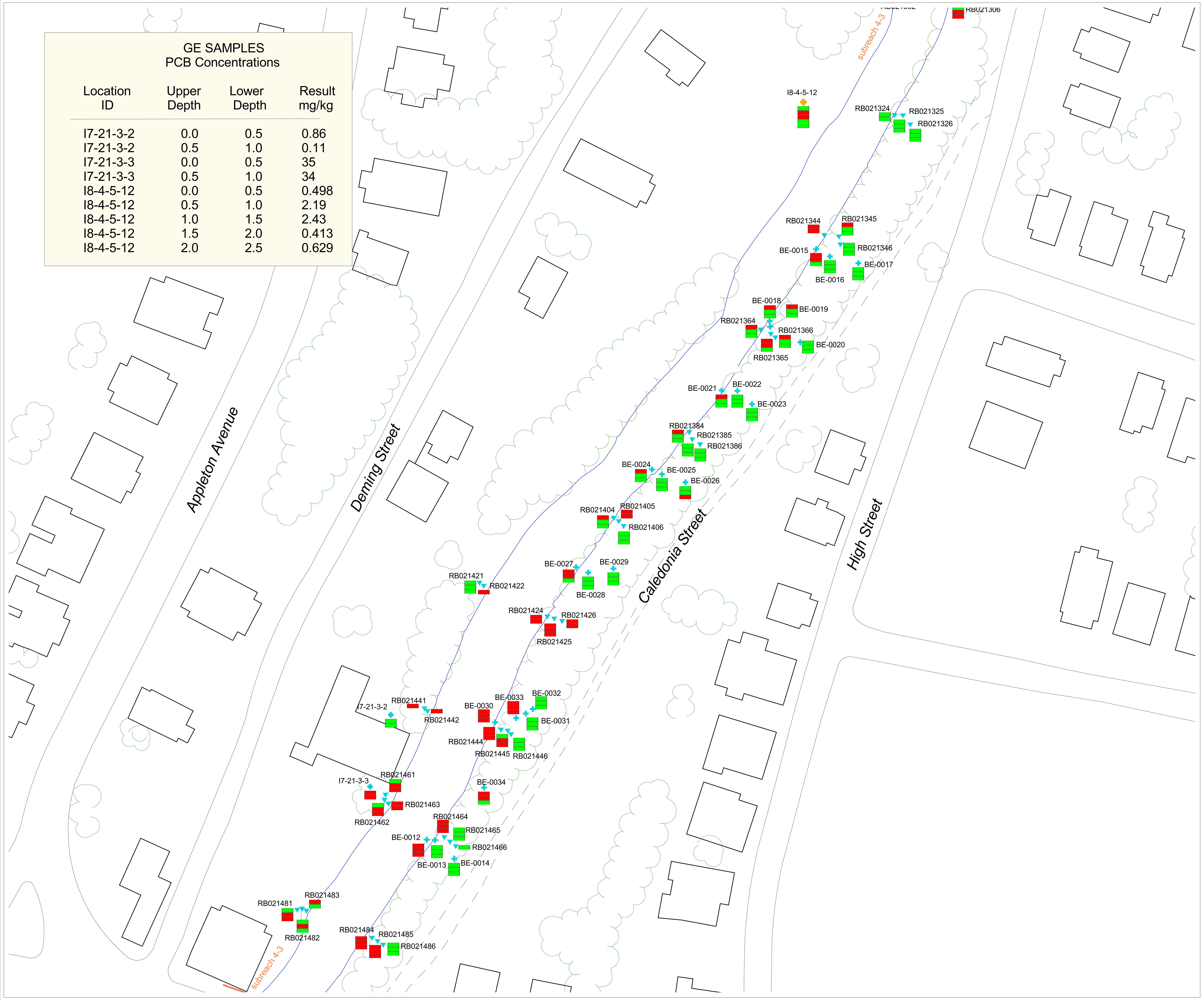
Scale in Feet

40 0 40 80 120 160 200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 3E
BANK PCB DATA
SUBREACH 4-2

| o:\gepitt\aprs\eeca_banksfeb.apr | Banks, Reach 4-2 | o:\gepitt\epsfiles\landscape24x36\in\eeca_bank4-2.eps | 10:34 AM, 2/15/2000 |



GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
I7-21-3-2	0.0	0.5	0.86
I7-21-3-2	0.5	1.0	0.11
I7-21-3-3	0.0	0.5	35
I7-21-3-3	0.5	1.0	34
I8-4-5-12	0.0	0.5	0.498
I8-4-5-12	0.5	1.0	2.19
I8-4-5-12	1.0	1.5	2.43
I8-4-5-12	1.5	2.0	0.413
I8-4-5-12	2.0	2.5	0.629

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MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

Recreational
Residential

EPA Sample Locations
EPA-START Sample Locations
GE Sample Locations
Subreach Dividers

Summary of PCB Concentrations in Bank Soils

Does not exceed cleanup criteria
Exceeds cleanup criteria

Bank Soil Depth Rank Key

Shallow 0 - 0.5
1.0 - 1.5
Deep 2.0 - 2.5

NOTE: The depth intervals provided on the depth key above apply to the EPA samples which were collected from regular intervals in most cases. There are a few EPA samples however that do not fall into the specific depth intervals given above. The reader should refer to the data tables in Appendix H for confirmation of the sample interval for specific samples. The GE data were not collected from regular depth intervals and thus are summarized in the table on this figure for ease of viewing.

NOTES:

1. Cleanup concentration criteria for PCBs in recreational land use samples is 10 ppm in the top 1 foot and 10 ppm in the next 2 feet.

2. Cleanup concentration criteria for PCBs in residential land use samples is 2 ppm in the top 3 feet.

N

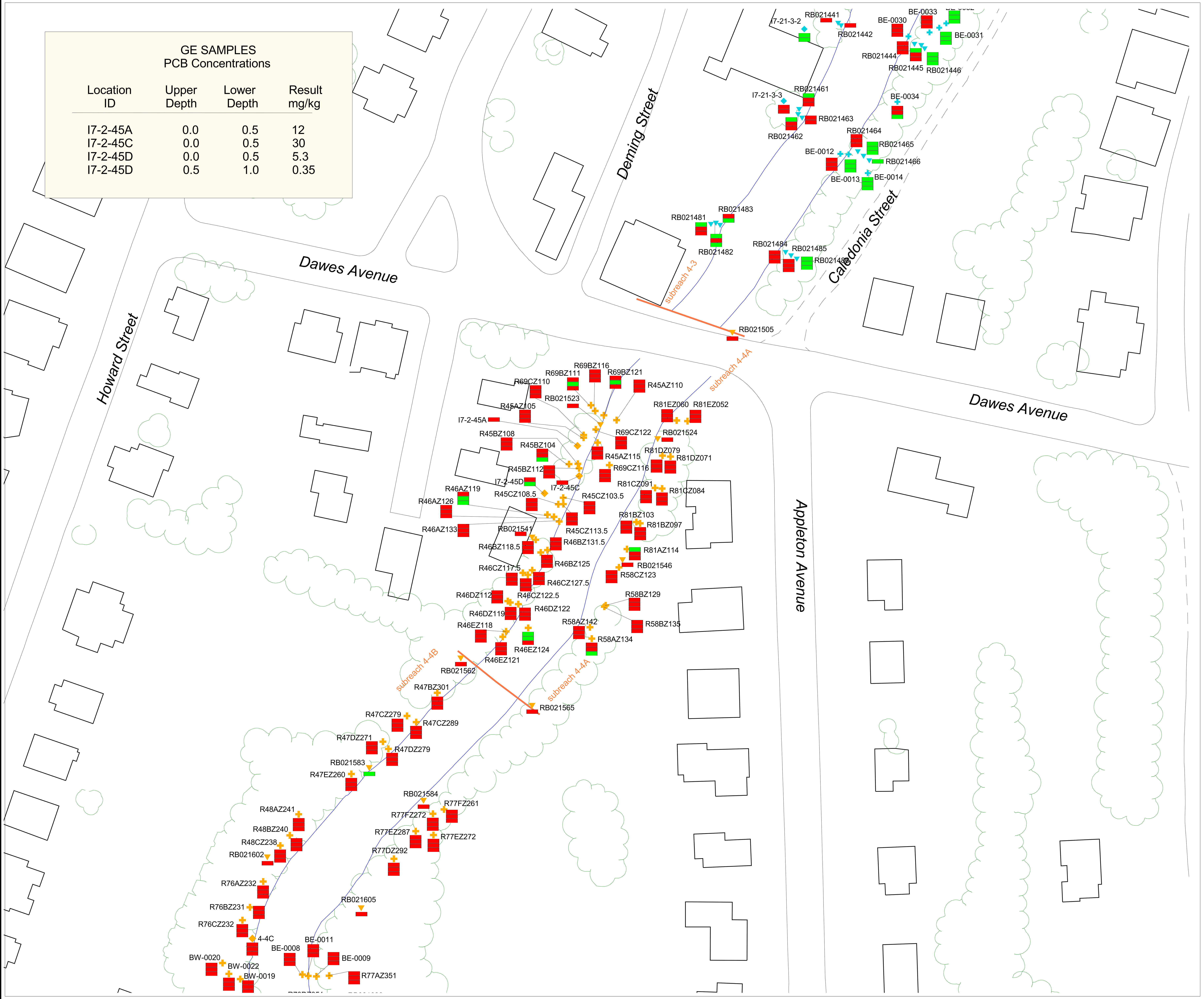
Scale in Feet

40 0 40 80 120 160 200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 3F
BANK PCB DATA
SUBREACH 4-3

| o:\gepitt\aprs\eeca_banksfeb.apr | Banks, Reach 4-3 | o:\gepitt\epsfiles\landscape24x36\in\eeca_bank4-3.eps | 10:35 AM, 2/15/2000 |



GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
I7-2-45A	0.0	0.5	12
I7-2-45C	0.0	0.5	30
I7-2-45D	0.0	0.5	5.3
I7-2-45D	0.5	1.0	0.35

WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

Recreational / Residential

- EPA Sample Locations
- EPA-START Sample Locations
- GE Sample Locations
- Subreach Dividers

Summary of PCB Concentrations in Bank Soils

- Does not exceed cleanup criteria
- Exceeds cleanup criteria

Bank Soil Depth Rank Key

Shallow	0 - 0.5
	1.0 - 1.5
Deep	2.0 - 2.5

NOTE: The depth intervals provided on the depth key above apply to the EPA samples which were collected from regular intervals in most cases. There are a few EPA samples however that do not fall into the specific depth intervals given above. The reader should refer to the data tables in Appendix H for confirmation of the sample interval for specific samples. The GE data were not collected from regular depth intervals and thus are summarized in the table on this figure for ease of viewing.

NOTES:

1. Cleanup concentration criteria for PCBs in recreational land use samples is 10 ppm in the top 1 foot and 10 ppm in the next 2 feet.

2. Cleanup concentration criteria for PCBs in residential land use samples is 2 ppm in the top 3 feet.

N

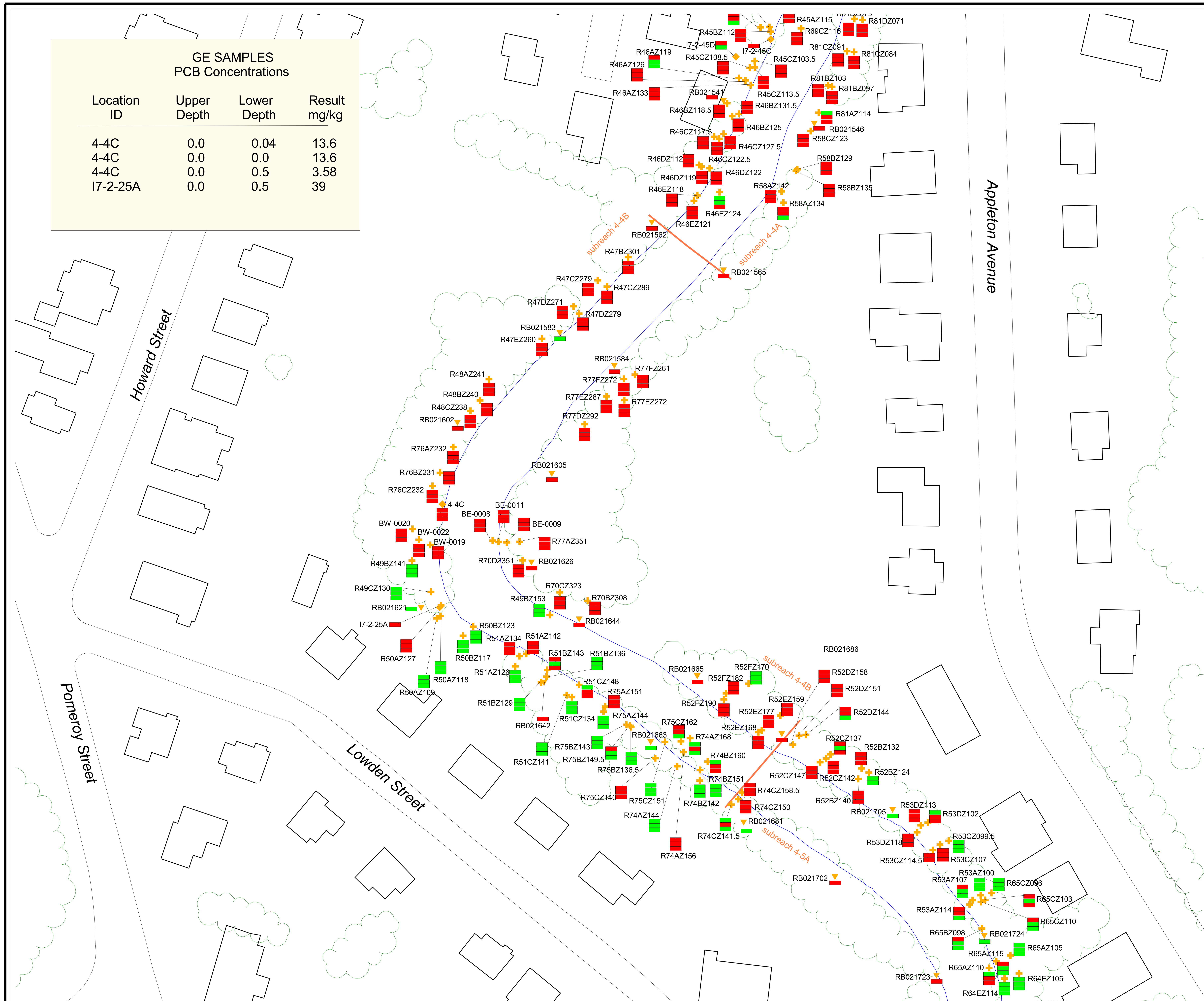
Scale in Feet
40 0 40 80 120 160 200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 3G
BANK PCB DATA
SUBREACH 4-4A

| o:\gepitt\aprs\eeca_banksfeb.apr | Banks, Reach 4-4A | o:\gepitt\epsfiles\landscape24x36\in\eeca_bank4-4a.eps | 10:36 AM, 2/15/2000 |

GE SAMPLES PCB Concentrations			
Location ID	Upper Depth	Lower Depth	Result mg/kg
4-4C	0.0	0.04	13.6
4-4C	0.0	0.0	13.6
4-4C	0.0	0.5	3.58
I7-2-25A	0.0	0.5	39



WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

Recreational
Residential

EPA Sample Locations
EPA-START Sample Locations
GE Sample Locations
Subreach Dividers

Summary of PCB Concentrations in Bank Soils

Does not exceed cleanup criteria
Exceeds cleanup criteria

Bank Soil Depth Rank Key

Shallow 0 - 0.5
1.0 - 1.5
Deep 2.0 - 2.5

NOTE: The depth intervals provided on the depth key above apply to the EPA samples which were collected from regular intervals in most cases. There are a few EPA samples however that do not fall into the specific depth intervals given above. The reader should refer to the data tables in Appendix H for confirmation of the sample interval for specific samples. The GE data were not collected from regular depth intervals and thus are summarized in the table on this figure for ease of viewing.

NOTES:

1. Cleanup concentration criteria for PCBs in recreational land use samples is 10 ppm in the top 1 foot and 10 ppm in the next 2 feet.

2. Cleanup concentration criteria for PCBs in residential land use samples is 2 ppm in the top 3 feet.

N

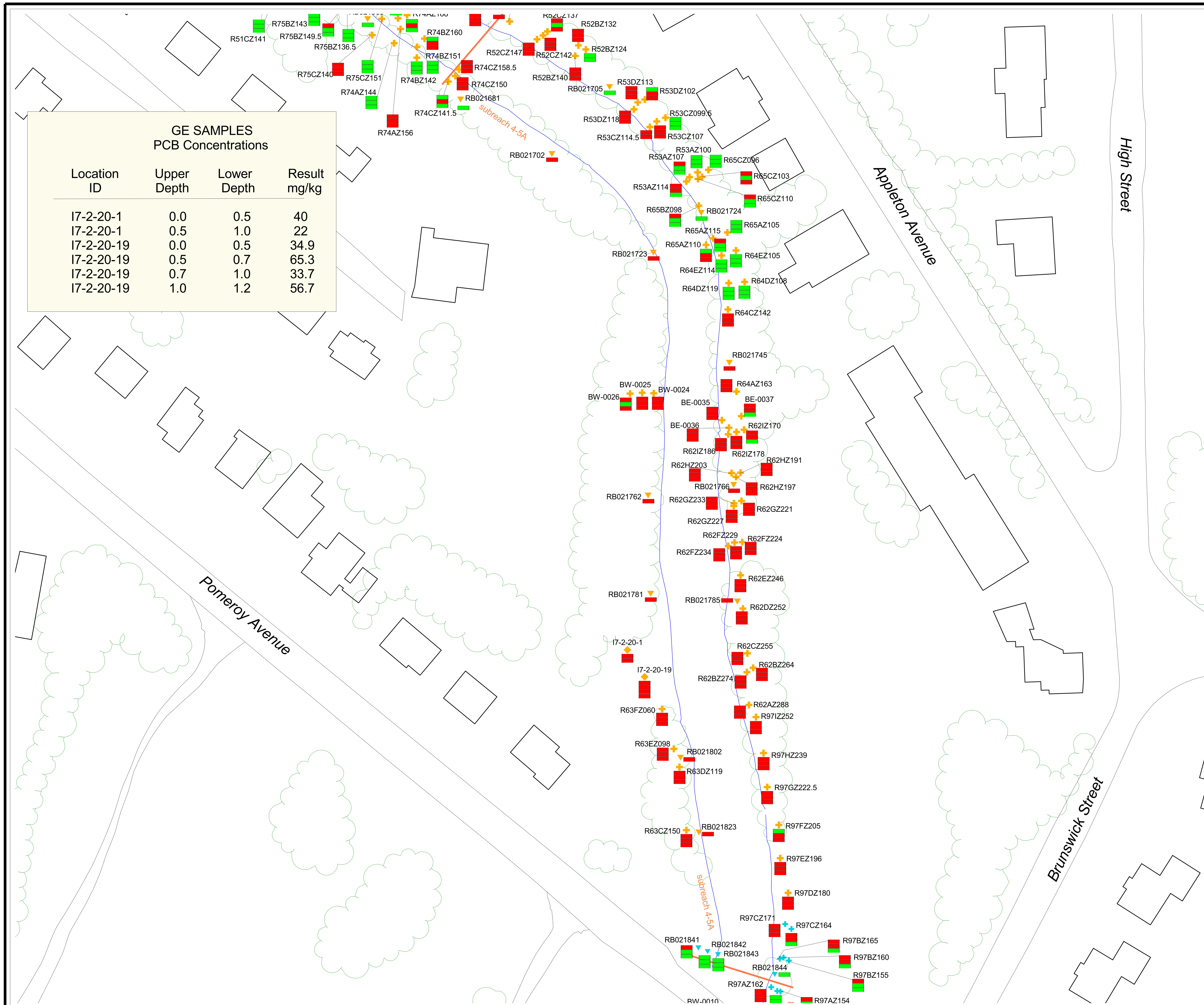
Scale in Feet

40 0 40 80 120 160 200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 3H
BANK PCB DATA
SUBREACH 4-4B

| o:\gepitt\aprs\eeca_banksfeb.apr | Banks, Reach 4-4B | o:\gepitt\epsfiles\landscape24x36\in\eeca_bank4-4b.eps | 10:36 AM, 2/15/2000 |



GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
I7-2-20-1	0.0	0.5	40
I7-2-20-1	0.5	1.0	22
I7-2-20-19	0.0	0.5	34.9
I7-2-20-19	0.5	0.7	65.3
I7-2-20-19	0.7	1.0	33.7
I7-2-20-19	1.0	1.2	56.7

WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

Recreational
Residential

EPA Sample Locations
EPA-START Sample Locations
GE Sample Locations
Subreach Dividers

Summary of PCB Concentrations in Bank Soils

Does not exceed cleanup criteria
Exceeds cleanup criteria

Bank Soil Depth Rank Key

Shallow
Deep
0 - 0.5
1.0 - 1.5
2.0 - 2.5

NOTE: The depth intervals provided on the depth key above apply to the EPA samples which were collected from regular intervals in most cases. There are a few EPA samples however that do not fall into the specific depth intervals given above. The reader should refer to the data tables in Appendix H for confirmation of the sample interval for specific samples. The GE data were not collected from regular depth intervals and thus are summarized in the table on this figure for ease of viewing.

NOTES:

1. Cleanup concentration criteria for PCBs in recreational land use samples is 10 ppm in the top 1 foot and 10 ppm in the next 2 feet.

2. Cleanup concentration criteria for PCBs in residential land use samples is 2 ppm in the top 3 feet.

N

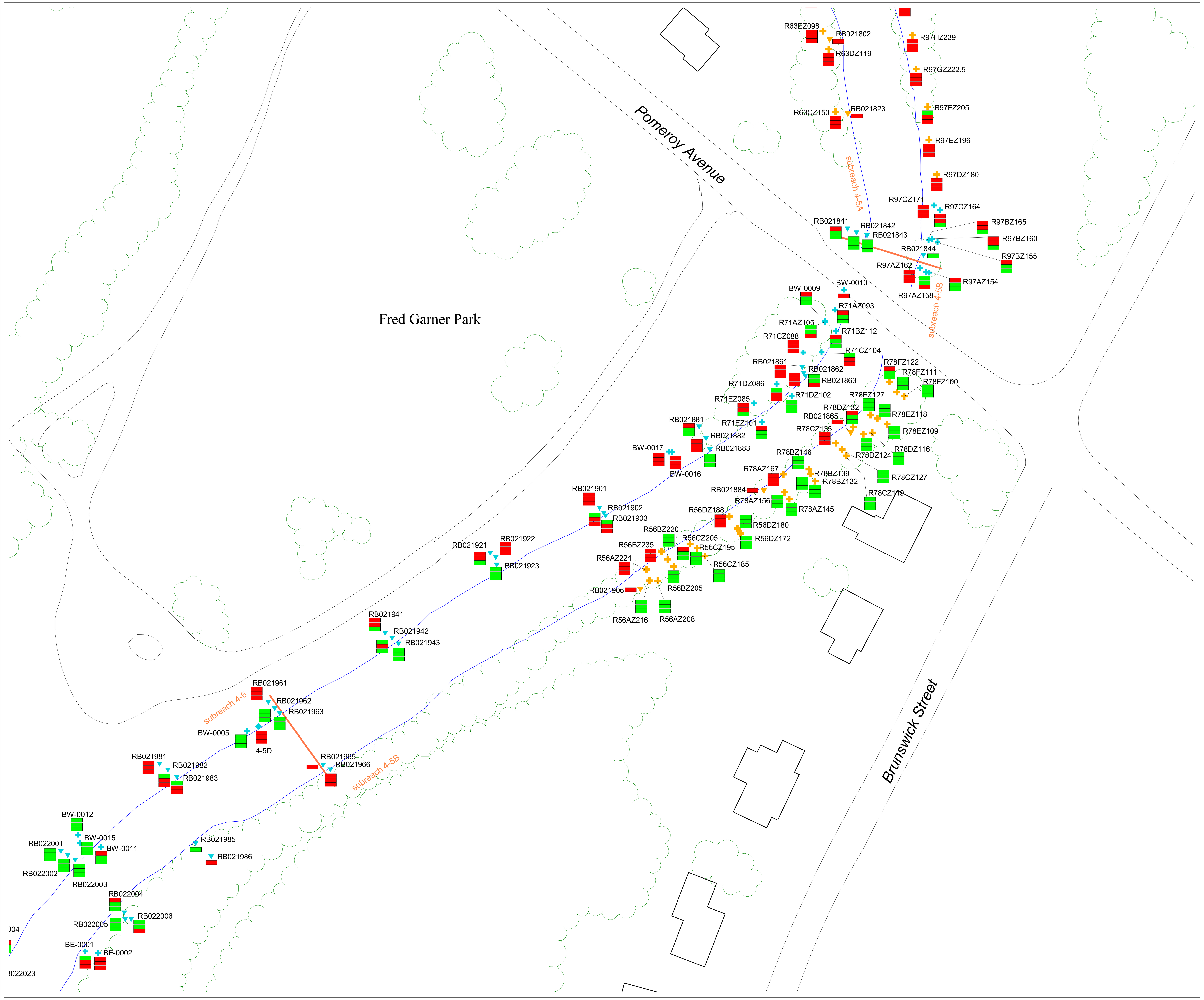
Scale in Feet

40 0 40 80 120 160 200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 3I
BANK PCB DATA
SUBREACH 4-5A

| o:\gepitt\aprs\eeca_banksfeb.apr | Banks, Reach 4-5A | o:\gepitt\epsfiles\landscape24x36\in\eeca_bank4-5a.eps | 10:37 AM, 2/15/2000 |



WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

Recreational
Residential

EPA Sample Locations
EPA-START Sample Locations
GE Sample Locations
Subreach Dividers

Summary of PCB Concentrations in Bank Soils

Does not exceed cleanup criteria
Exceeds cleanup criteria

Bank Soil Depth Rank Key

Shallow 0 - 0.5
1.0 - 1.5
Deep 2.0 - 2.5

NOTE: The depth intervals provided on the depth key above apply to the EPA samples which were collected from regular intervals in most cases. There are a few EPA samples however that do not fall into the specific depth intervals given above. The reader should refer to the data tables in Appendix H for confirmation of the sample interval for specific samples. The GE data were not collected from regular depth intervals and thus are summarized in the table on this figure for ease of viewing.

NOTES:

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2. Cleanup concentration criteria for PCBs in residential land use samples is 2 ppm in the top 3 feet.

N

Scale in Feet

40 0 40 80 120 160 200

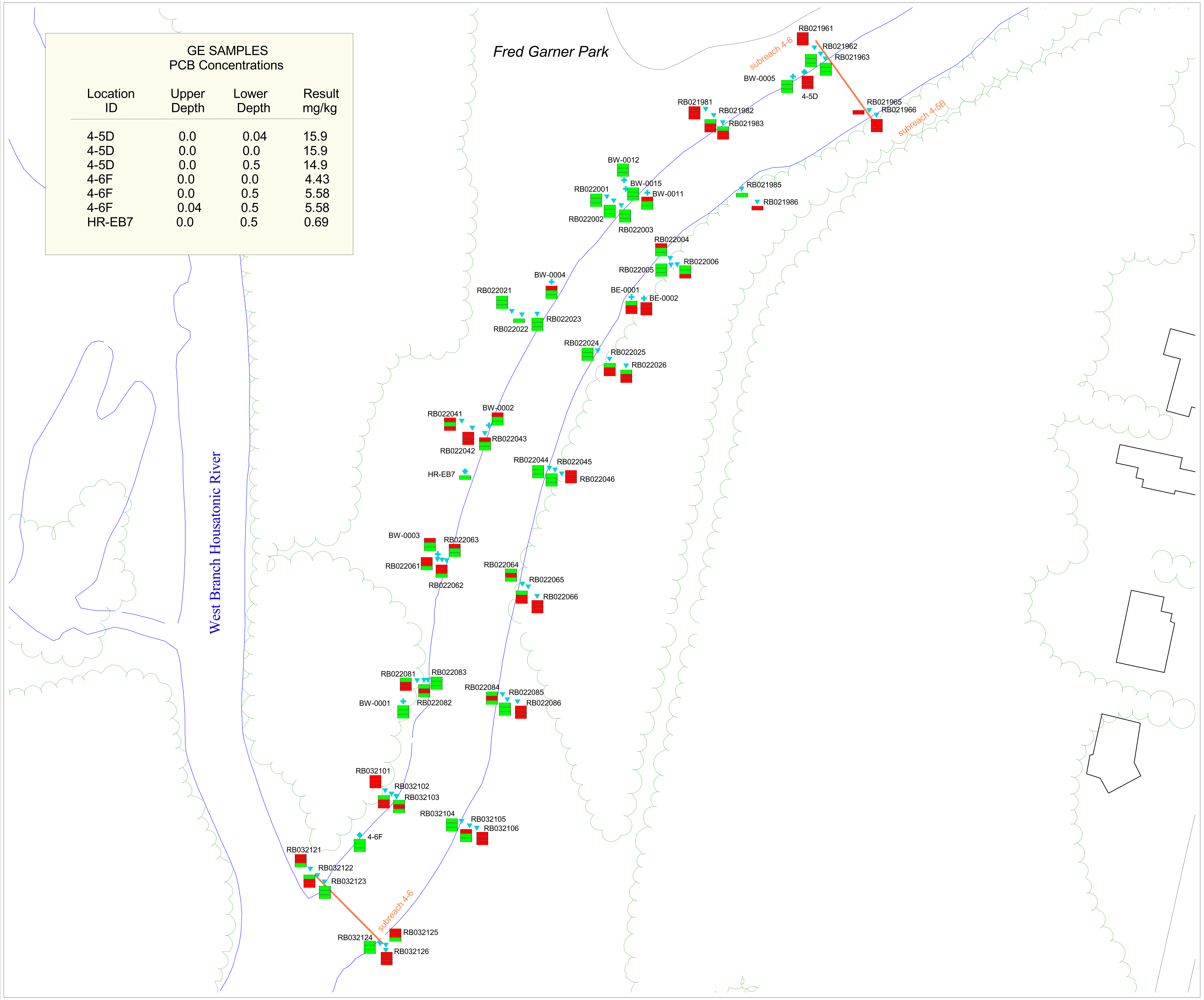
ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 3J
BANK PCB DATA
SUBREACH 4-5B

| o:\gepitt\aprs\eeca_banksfeb.apr | Banks, Reach 4-5B | o:\gepitt\epsfiles\landscape24x36\in\eeca_bank4-5b.eps | 10:38 AM, 2/15/2000 |

GE SAMPLES
PCB Concentrations

Location ID	Upper Depth	Lower Depth	Result mg/kg
4-5D	0.0	0.04	15.9
4-5D	0.0	0.0	15.9
4-5D	0.0	0.5	14.9
4-6F	0.0	0.0	4.43
4-6F	0.0	0.5	5.58
4-6F	0.04	0.5	5.58
HR-EB7	0.0	0.5	0.69



WESTON
MANAGERS DESIGNERS/CONSULTANTS

LEGEND:

Recreational / Residential

- EPA Sample Locations
- EPA-START Sample Locations
- GE Sample Locations
- Subreach Dividers

Summary of PCB Concentrations in Bank Soils

- Does not exceed cleanup criteria
- Exceeds cleanup criteria

Bank Soil Depth Rank Key

Shallow — 0 - 0.5
1.0 - 1.5
Deep — 2.0 - 2.5

NOTE: The depth intervals provided on the depth key above apply to the EPA samples which were collected from regular intervals in most cases. There are a few EPA samples however that do not fall into the specific depth intervals given above. The reader should refer to the data tables in Appendix H for confirmation of the sample interval for specific samples. The GE data were not collected from regular depth intervals and thus are summarized in the table on this figure for ease of viewing.

NOTES:

1. Cleanup concentration criteria for PCBs in recreational land use samples is 10 ppm in the top 1 foot and 10 ppm in the next 2 feet.

2. Cleanup concentration criteria for PCBs in residential land use samples is 2 ppm in the top 3 feet.

N

Scale in Feet

40 0 40 80 120 160 200

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3 - 3K
BANK PCB DATA
SUBREACH 4-6

| o:\gepitt\aprs\eeca_banksfeb.apr | Banks, Reach 4-6 | o:\gepitt\epsfiles\landscape24x36\in\eeca_bank4-6.eps | 10:39 AM, 2/15/2000 |

LEGEND:

- Appendix IX Sample Locations
- Sub-Reach Dividers
- Roads
- Floodplain
- Surface Hydrology
- Building Footprints

N

Scale in Feet

200 0 200 400 600

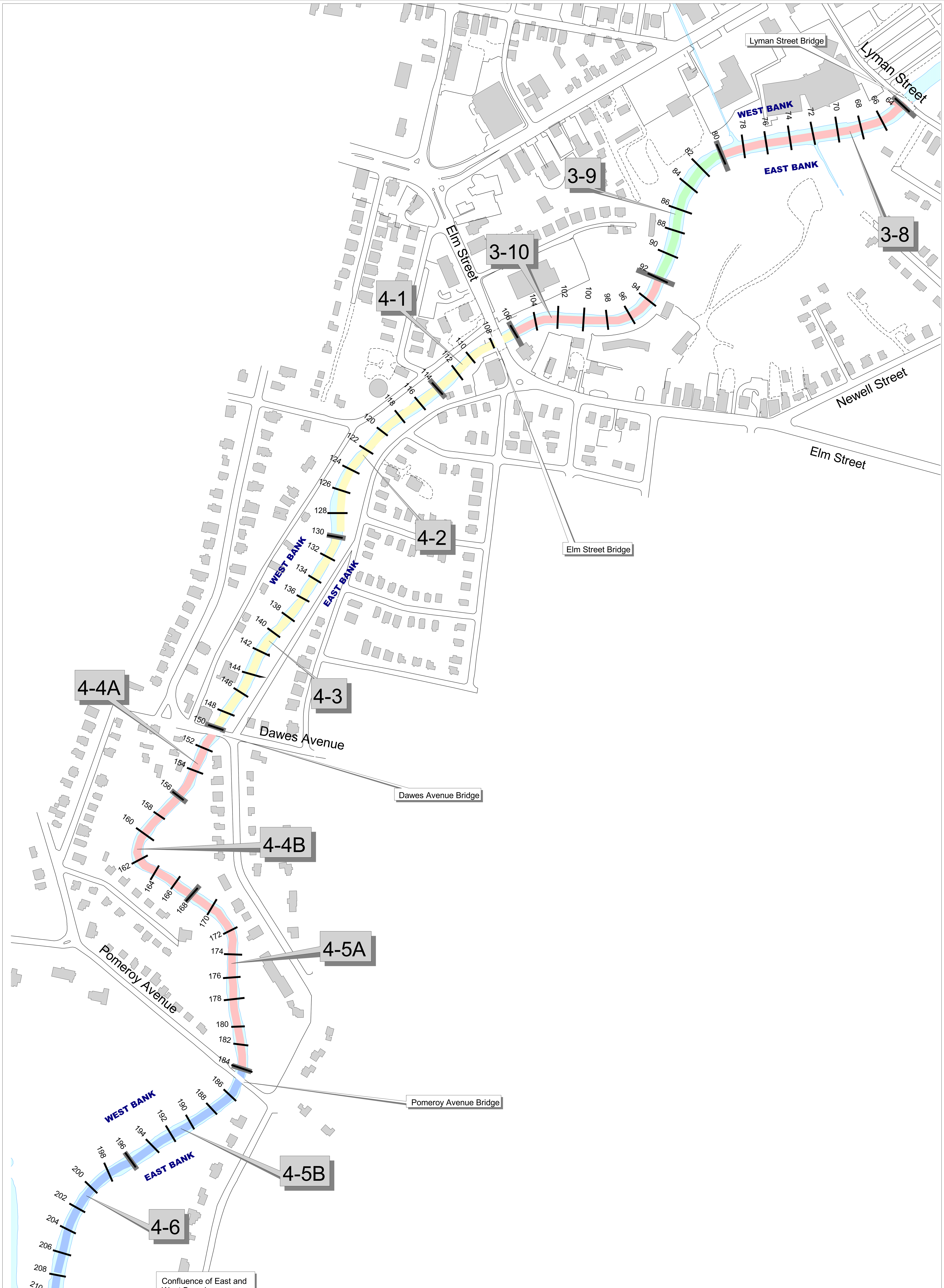
ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 2.3-4
SEDIMENT AND BANK
APPENDIX IX LOCATION MAP

| o:\gepitt\aprs\eeca_app9.apr | layout - App 9 | o:\gepitt\epsfiles\portrait24x36\in\eeca_app9.eps | 10:07 AM, 11/24/1999 |

SECTION 3

FIGURES



LEGEND:

Excavation Depths:
- 2 Ft.
- 2 Ft. (Bedrock)
- 2.5 Ft.
- 3 Ft.
- 3.5 Ft.

- Transects
- Sub-reach Dividers
- Roads
- Surface Hydrology
- Building Footprints

N

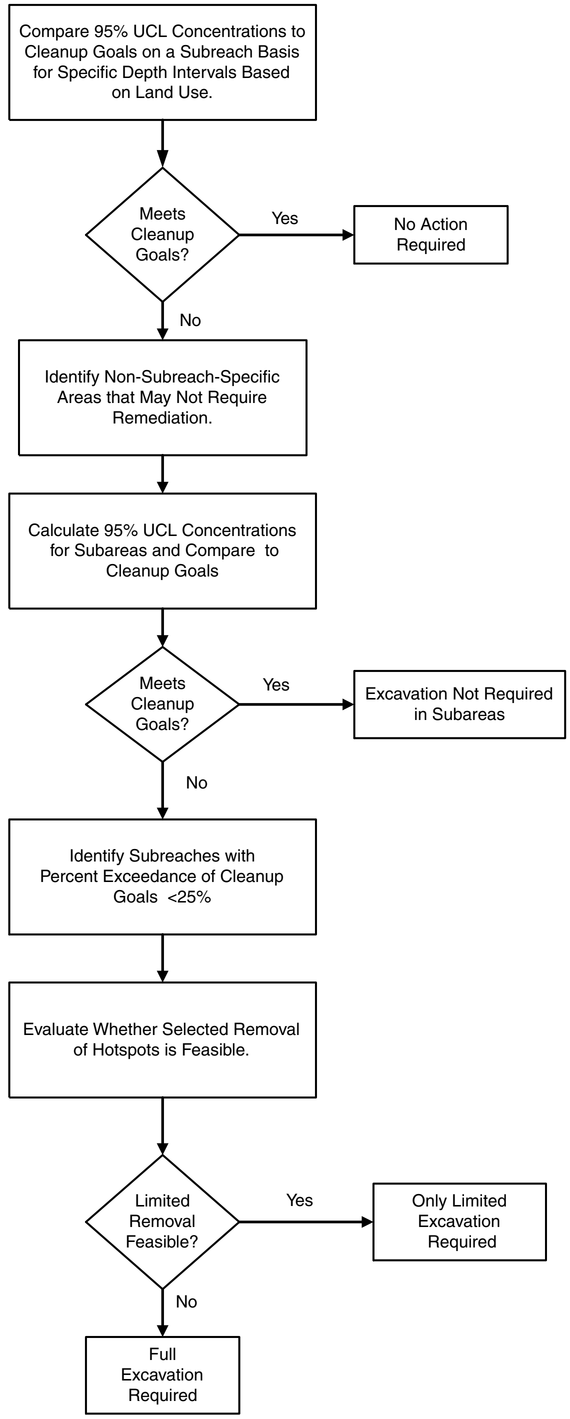
Scale in Feet

200 0 200 400 600

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 3.4-1
EXTENT OF SEDIMENT REMOVAL
FOR CLEANUP

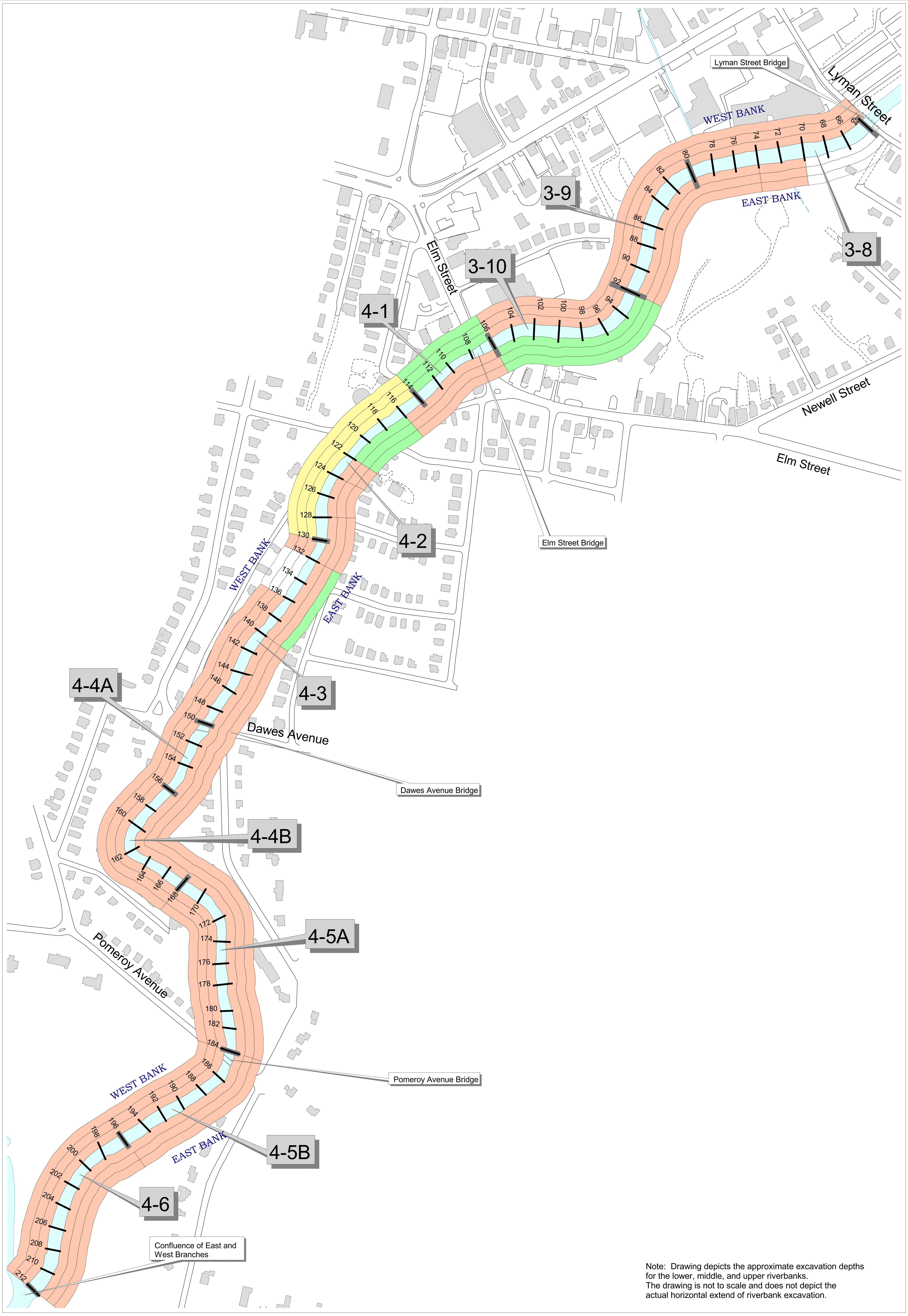
| o:/gepitt/aprs/eeca_sub.apr | lyout-sedexcavation | o:\gepitt\epsfiles\portrait24x36\in\sed_excav.eps | 2:25 PM, 12/14/1999 |



ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 3.4-2
EVALUATION OF RIVERBANK SOIL REMEDIATION AREAS
DECISION MATRIX

99P-3022



LEGEND:

Excavation Depths:

- No Excavation
- 1 Ft.
- 2 Ft.
- 3 Ft.

- Transects
- Sub-reach Dividers
- Roads
- Surface Hydrology
- Building Footprints

N

Scale in Feet

200 0 200 400 600

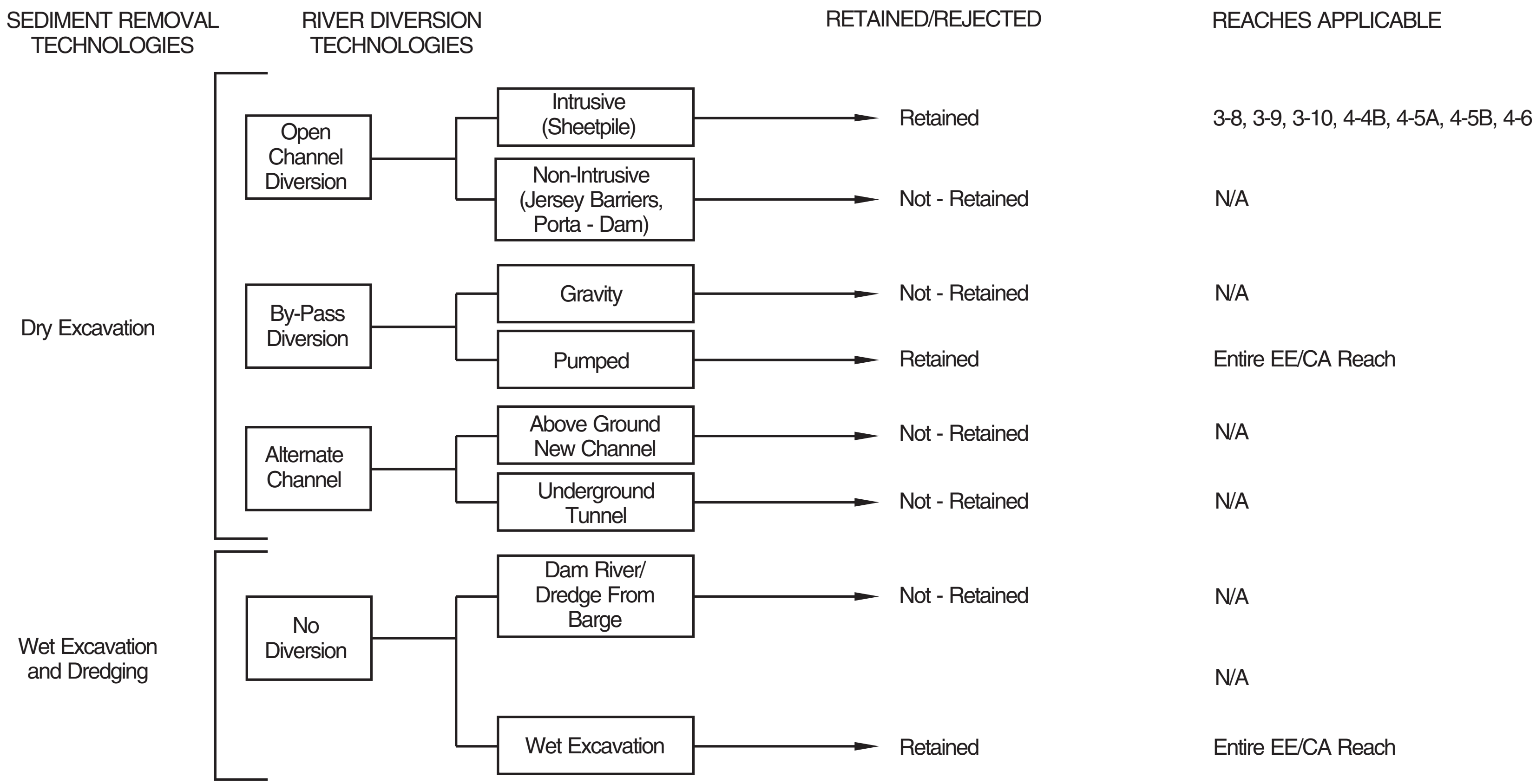
ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 3.4-3
EXTENT OF RIVERBANK SOIL REMOVAL FOR CLEANUP

| o:\gepitt\aprs\eeca_sub.apr | LYOUT-riverbank-excavation | o:\gepitt\epsfiles\portrait24x36\in\riverbank_excav.eps | 4:09 PM, 2/3/2000 |

SECTION 4

FIGURES

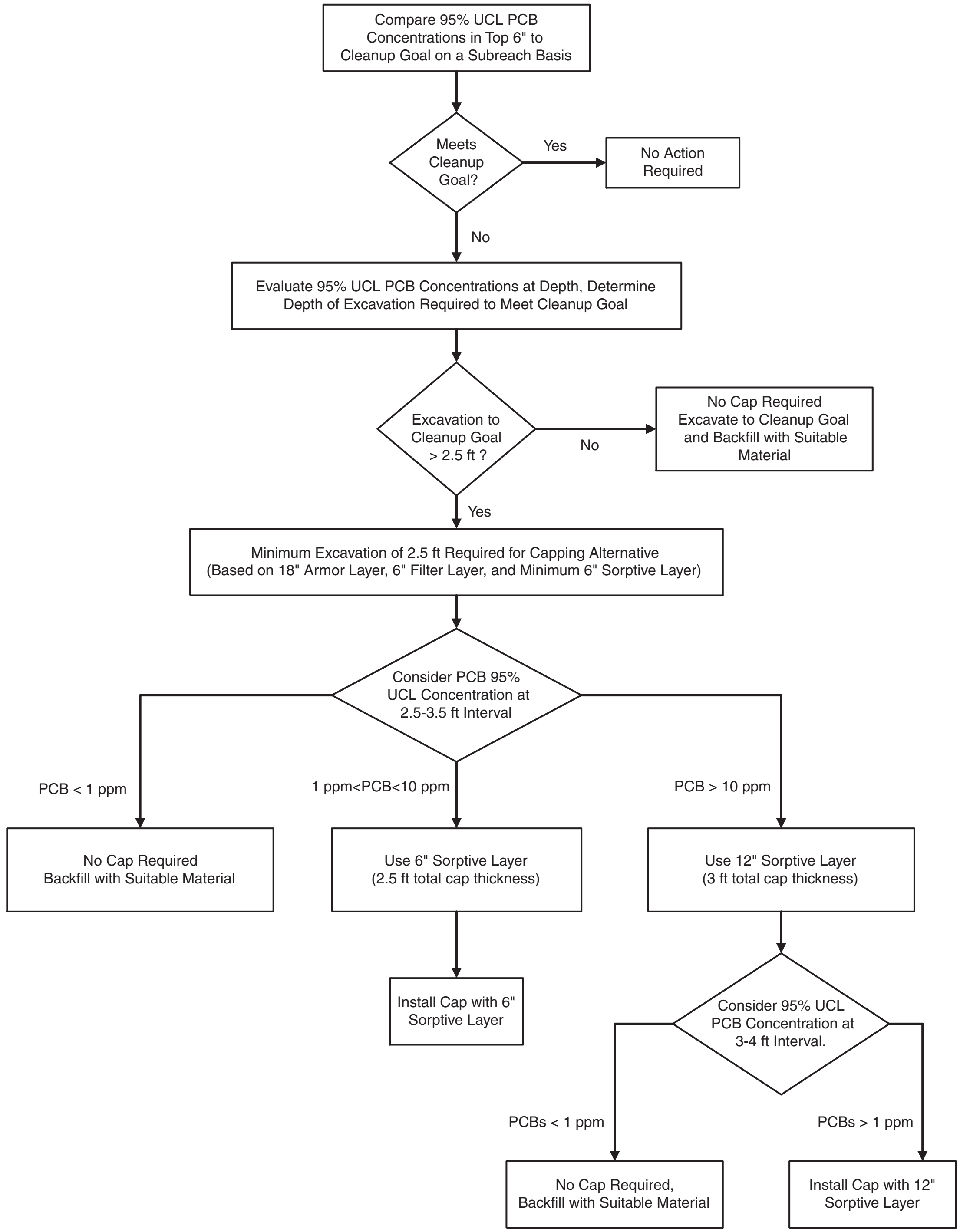


WESTON MANAGERS DESIGNERS/CONSULTANTS

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 4.2-1
SUMMARY CHART OF RIVER DIVERSION AND SEDIMENT REMOVAL SCREENING

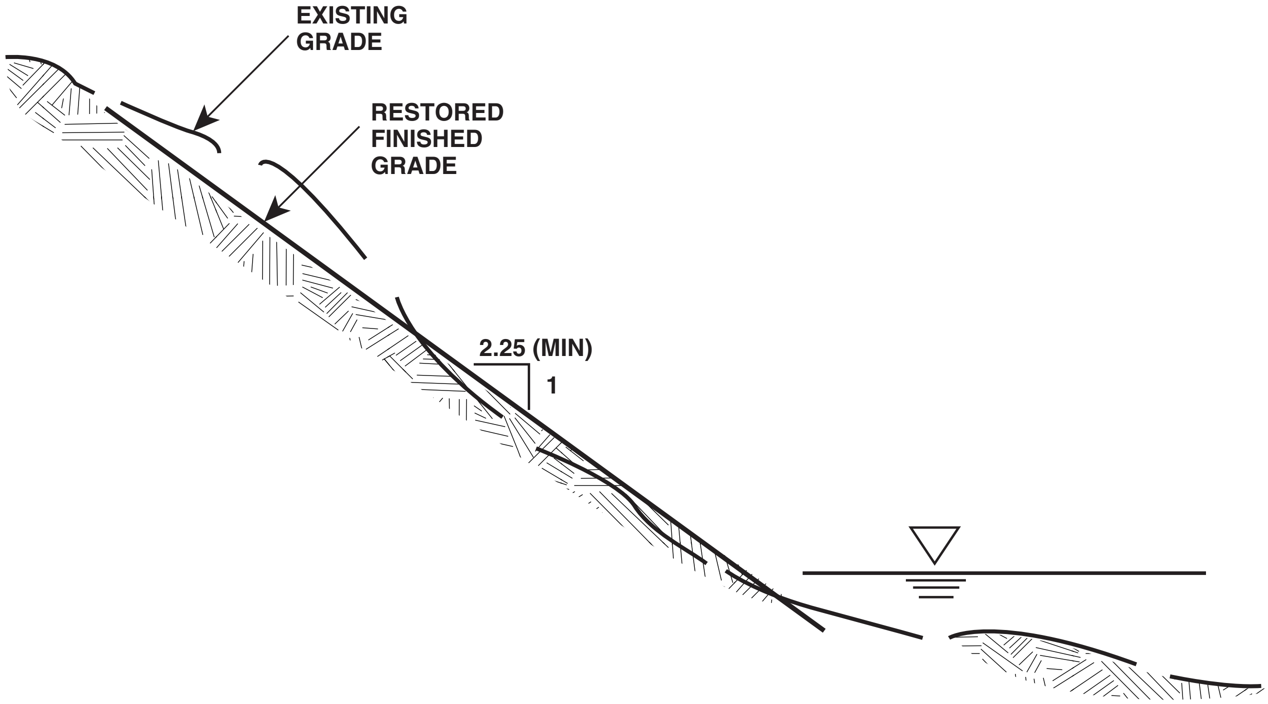
00P-0332



ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 4.3-1
EVALUATION OF SEDIMENT REMEDIAL ALTERNATIVES CAPPING VERSUS EXCAVATION TO CLEANUP GOALS

99P-3021

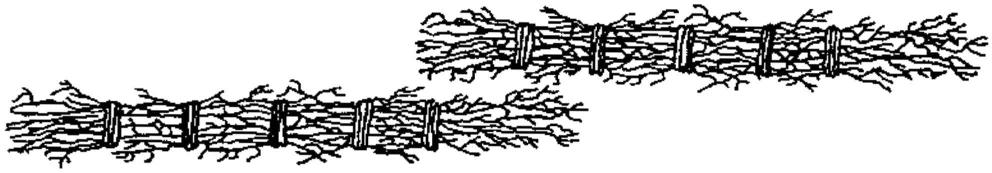


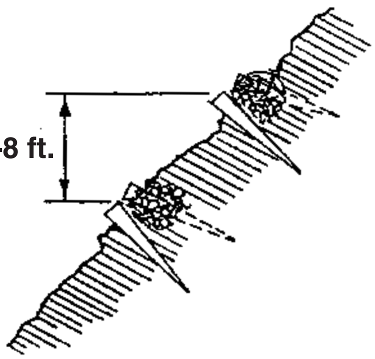
Source:
Roy F. Weston, Inc., 1999.

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 4.6-1
TYPICAL SLOPE REGRADING

99P-2020-1





DESIGN TABLE					
SLOPE	1:1	2:1	3:1	4:1	6:1
CONTOUR INTERVAL	3	4	5	6	8

CONSTRUCTION SPECIFICATIONS

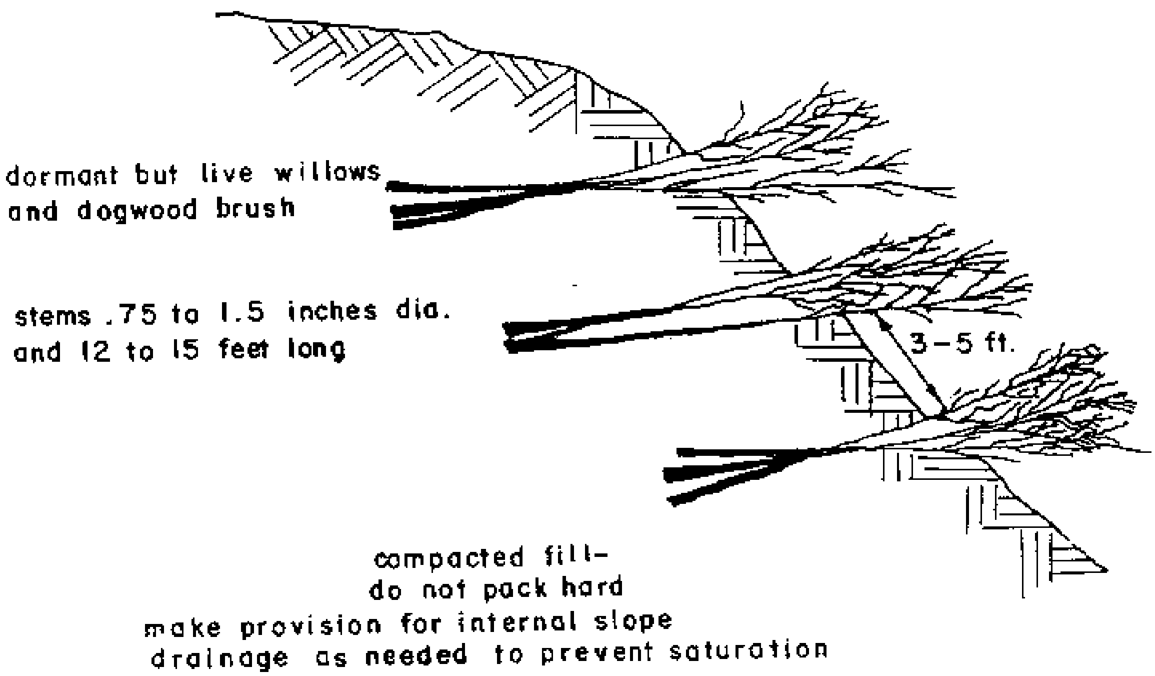
1. WATTLES SHALL BE 4" MINIMUM DIAMETER AND BUNDLED WITH TAPERED ENDS TO AN OVERALL LENGTH 18 INCHES LONGER THAN THE STEMS.
2. STRUCTURAL MEASURES SUCH AS REVETMENT, DRAINAGE, SURFACE DITCHES WILL BE INSTALLED PRIOR TO WATTLING. SLOPE SHALL BE GRADED AND SMOOTHED WITH OBSTRUCTIONS REMOVED.
3. ANCHOR STAKES WILL BE PLACED ON THE SLOPE AT THE DESIRED CONTOUR INTERVAL.
4. WORKING FROM THE BOTTOM OF THE SLOPE TO THE TOP, EXCAVATE WATTLE TRENCH JUST ABOVE THE STAKES. TRENCH SHALL BE HALF THE DIAMETER OF THE WATTLES. PLACE WATTLES IN TRENCH ANCHORING WITH ADDITIONAL STAKES AT 18 INCH INTERVALS. LOWER WATTLES WITH SOIL LEAVING ABOUT 10% EXPOSURE.
5. SOIL SHALL BE WORKED INTO THE WATTLES AND COMPACTED BY FOOT TRAFFIC.
6. ALL DISTURBED AREAS SHALL BE SEEDED UPON COMPLETION OF WATTLING OPERATIONS.

Source:
Guidelines for Urban Erosion and
Sediment Control: New York, 1991 (99-0156).

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 4.6-2
WATTLING DETAILS

99P-2020-3

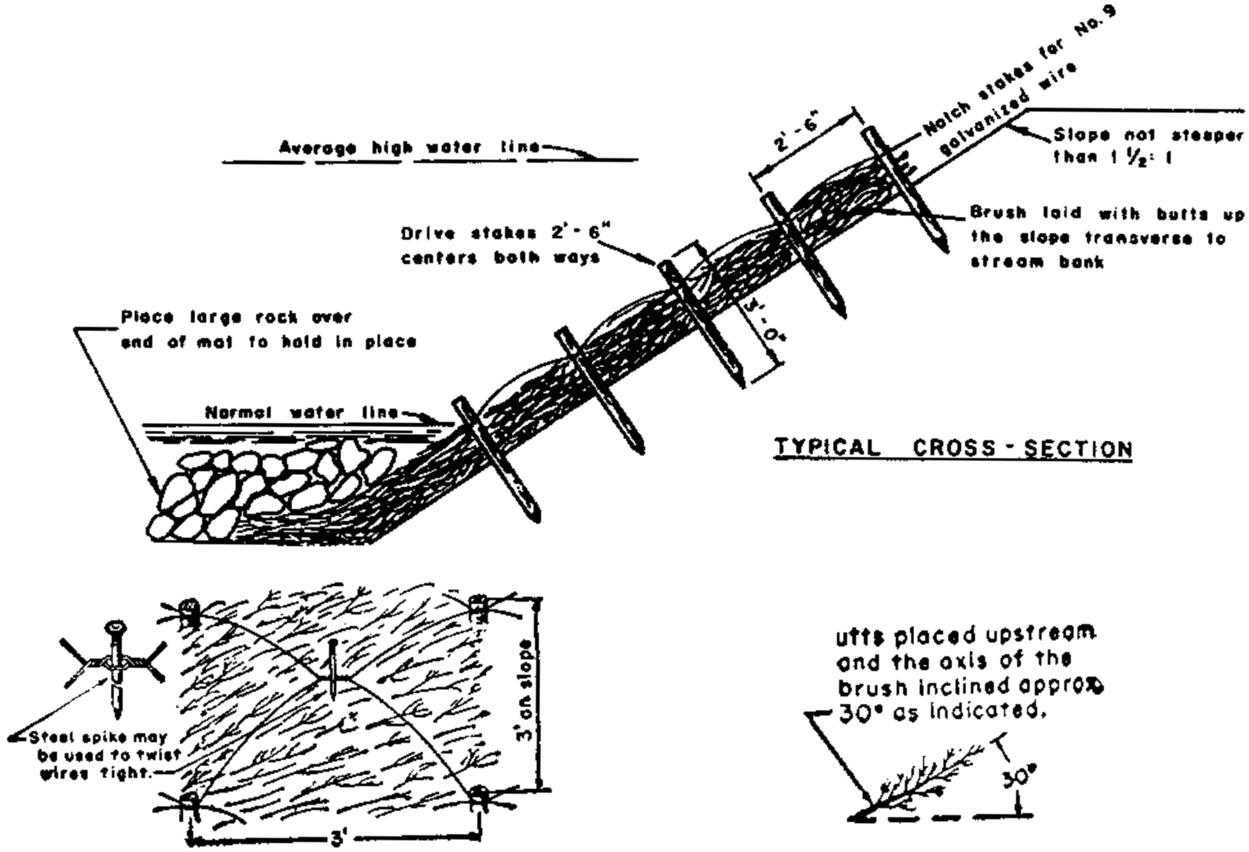


Source:
Guidelines for Urban Erosion and
Sediment Control: New York, 1991 (99-0156).

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 4.6-3
BRUSH LAYERING METHOD

99P-2020-4



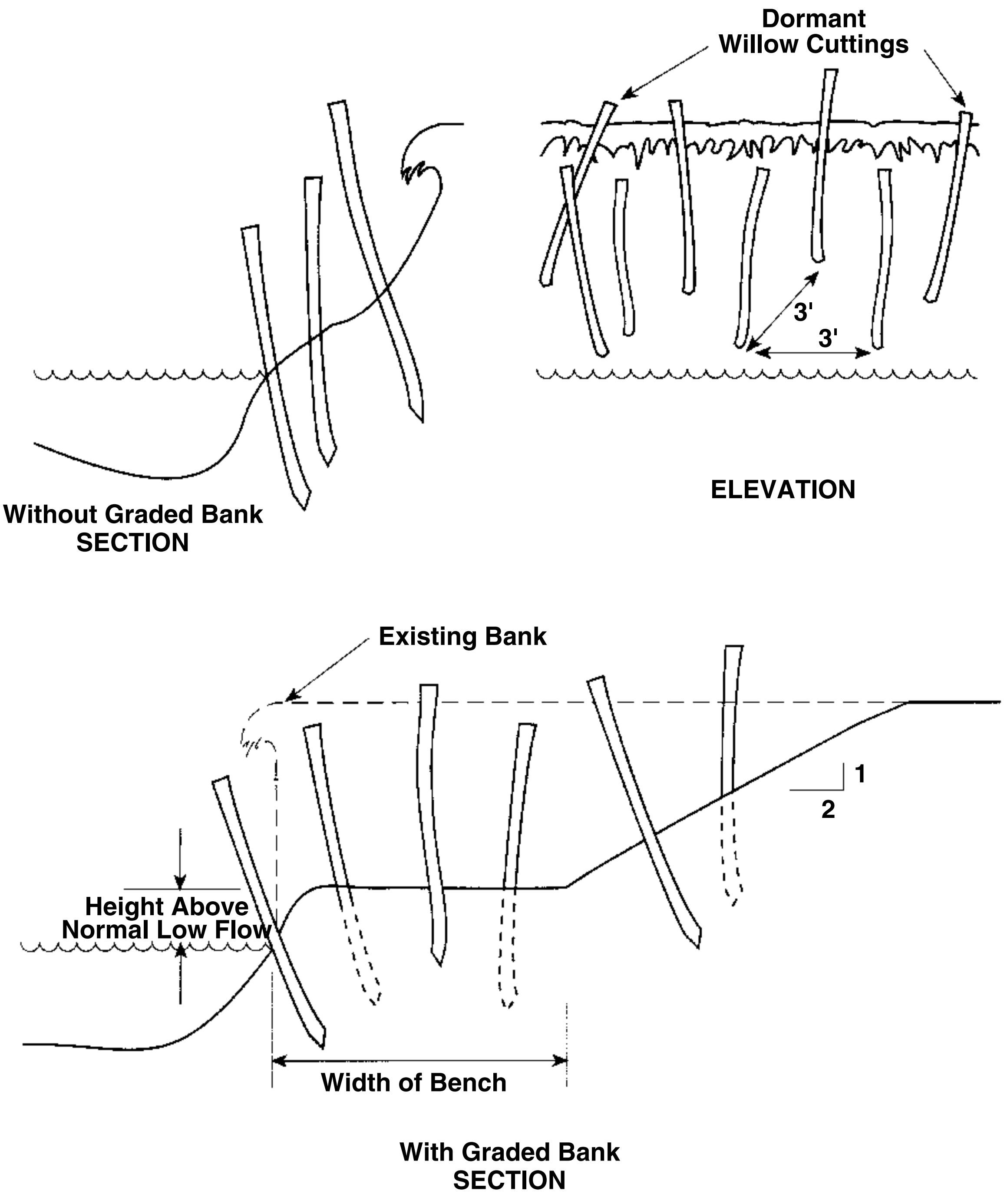
CONSTRUCTION SPECIFICATIONS

1. PREPARE SLOPE SURFACE BY GRADING TO A UNIFORM, SMOOTH SURFACE.
2. LAY HARDWOOD BRUSH IN AN UPSTREAM DIRECTION BEGINNING AT THE DOWNSTREAM END. THE TOE SHOULD BE ESTABLISHED FIRST.
3. THE BUTT END OF THE BRUSH WILL BE PLACED UPSTREAM AND THE PLANT MATERIALS INCLINED APPROXIMATELY 30 DEGREES.
4. THE UPSTREAM EDGE OF THE MAT WILL BE KEYED INTO THE SLOPE 2 FEET. STAKES WILL BE DRIVEN THROUGHOUT THE MATTING ON 3 FOOT CENTERS EACH WAY BEGINNING ALONG THE TOE OF THE MAT.
5. NO. 9 GALVANIZED WIRE WILL BE ATTACHED TO THE STAKES OVER THE MAT AND TIGHTENED TO SECURE THE MAT.
6. SLOPE AREAS ABOVE THE MAT WILL BE SLOPED AND SEEDED.

Source:
Guidelines for Urban Erosion and
Sediment Control: New York, 1991 (99-0156).

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 4.6-4
BRUSH MATTING DETAILS

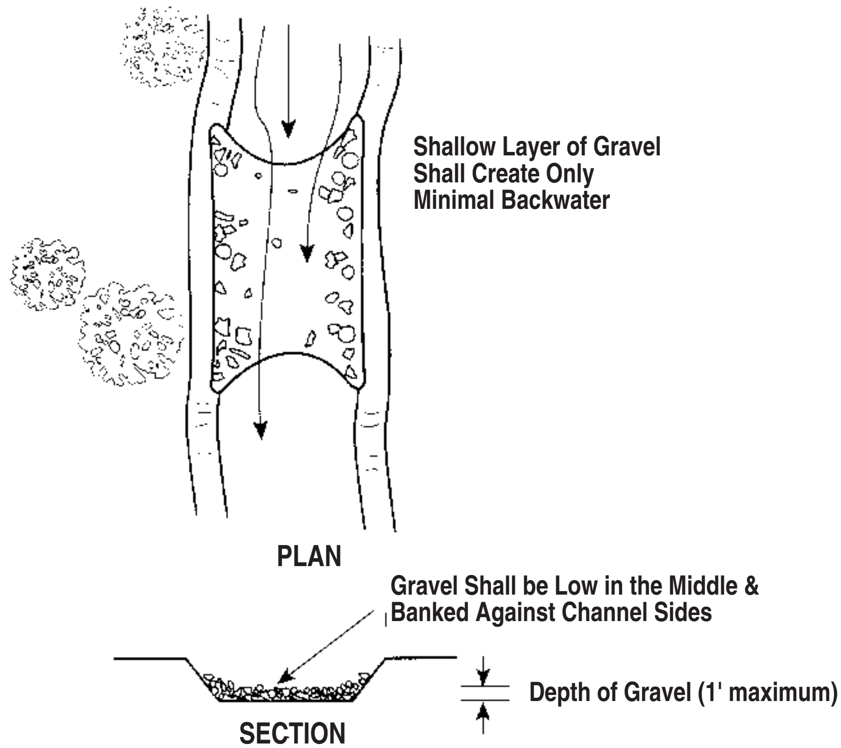


Source:
Ohio's Standards for Stormwater Management, 1996 (99-0157).

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 4.6-5
STREAMBANK STABILIZATION WITH DORMANT POSTS AND STAKES

99P-2020-6

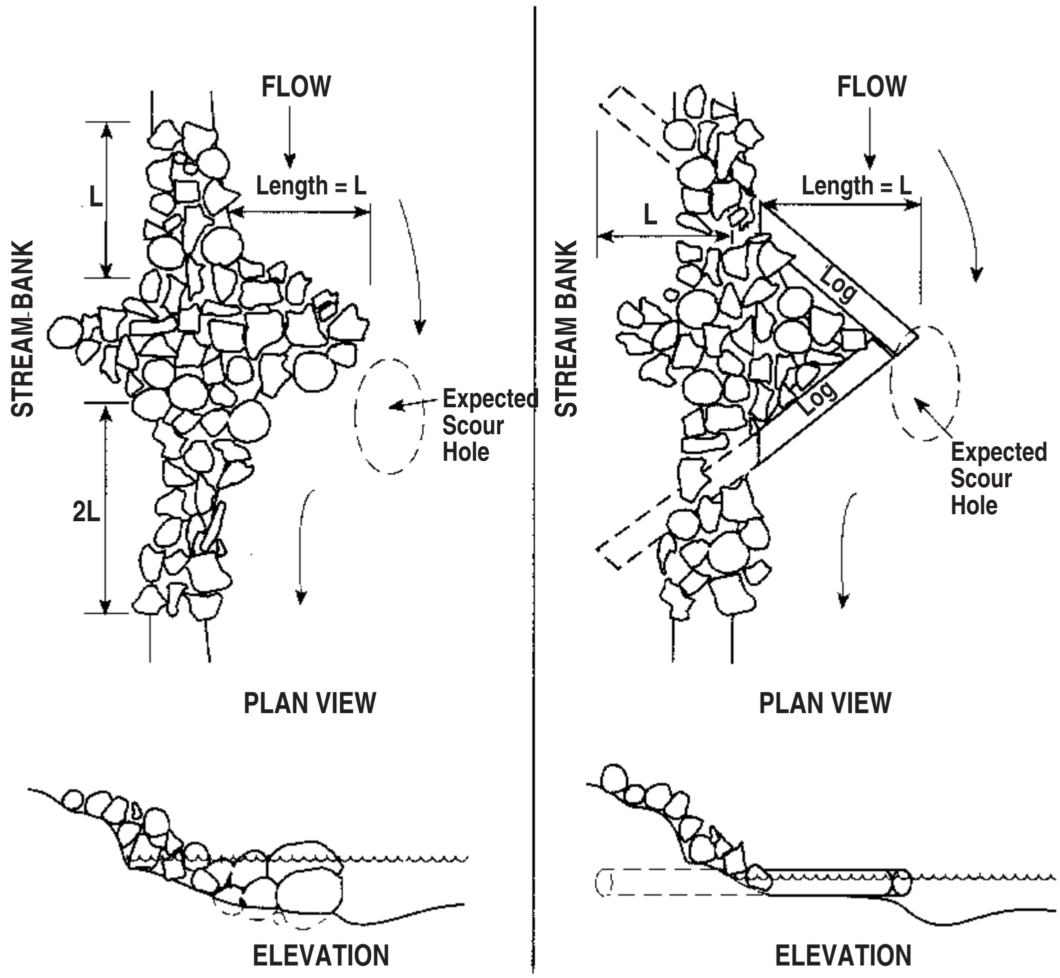


1. The length of gravel riffles shall be equivalent to 1.5 times the channel width.
2. The gravel shall NOT be placed so that it acts as a dam or creates a backwater pool. It shall be generally less than 1-ft. thick and no higher than the existing water surface elevation.
3. The gravel shall be placed so that it is slightly lower in the middle of the channel and higher by the streambanks.
4. Gravel size shall be similar to the substrate and gravel bars in the existing stream channel and so that the gravel will be stable at low and medium flows but erodible at high flows.

Source:
Ohio's Standards for Stormwater Management, 1996 (99-0157).

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 4.6-6
GRAVEL RIFFLE



1. The height of deflectors shall allow them to project above the water surface during low flows and be submerged during high flows.

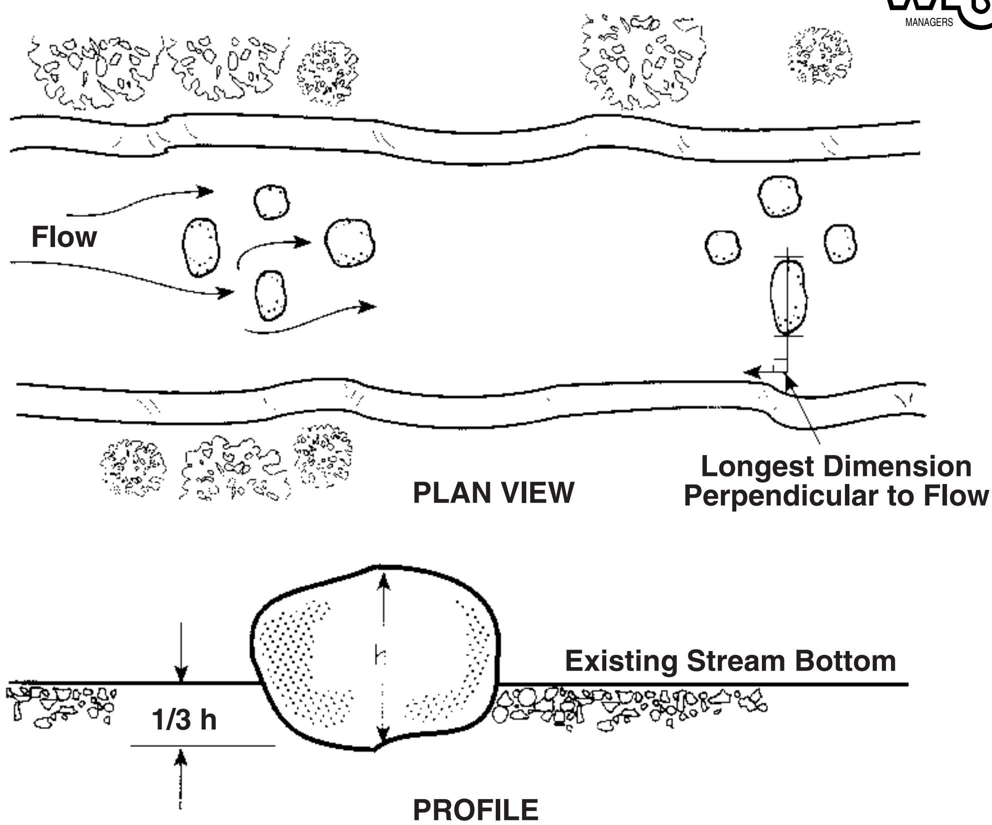
2. Rock used in the deflectors shall be large enough to be stable for high flows. The largest rocks should be arranged near the point of the deflector.

3. The voids in the rock and riprap shall be filled with soil and planted.

Source:
Ohio's Standards for Stormwater Management, 1996 (99-0157).

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 4.6-7
CURRENT DEFLECTORS



1. Eddy rocks shall be larger than 2 ft. except in small channels where they shall be no more than one-fifth the width of the channel.

2. Groups of three to seven rocks shall be placed in a staggered patterned so current deflected around one rock then flows into another.

3. Eddy rocks shall be placed in the center half of a channel in straight runs where they will be in swift current during high flow. However, they shall not be placed in riffles.

4. Rocks shall be placed with their longest dimension perpendicular to the flow, not angled to one bank or the other.

5. Rocks shall be placed so they will project above the surface during low flows and be submerged during high flows. Also, they shall be placed in an excavation so that they are at least one-third buried in the channel bed.

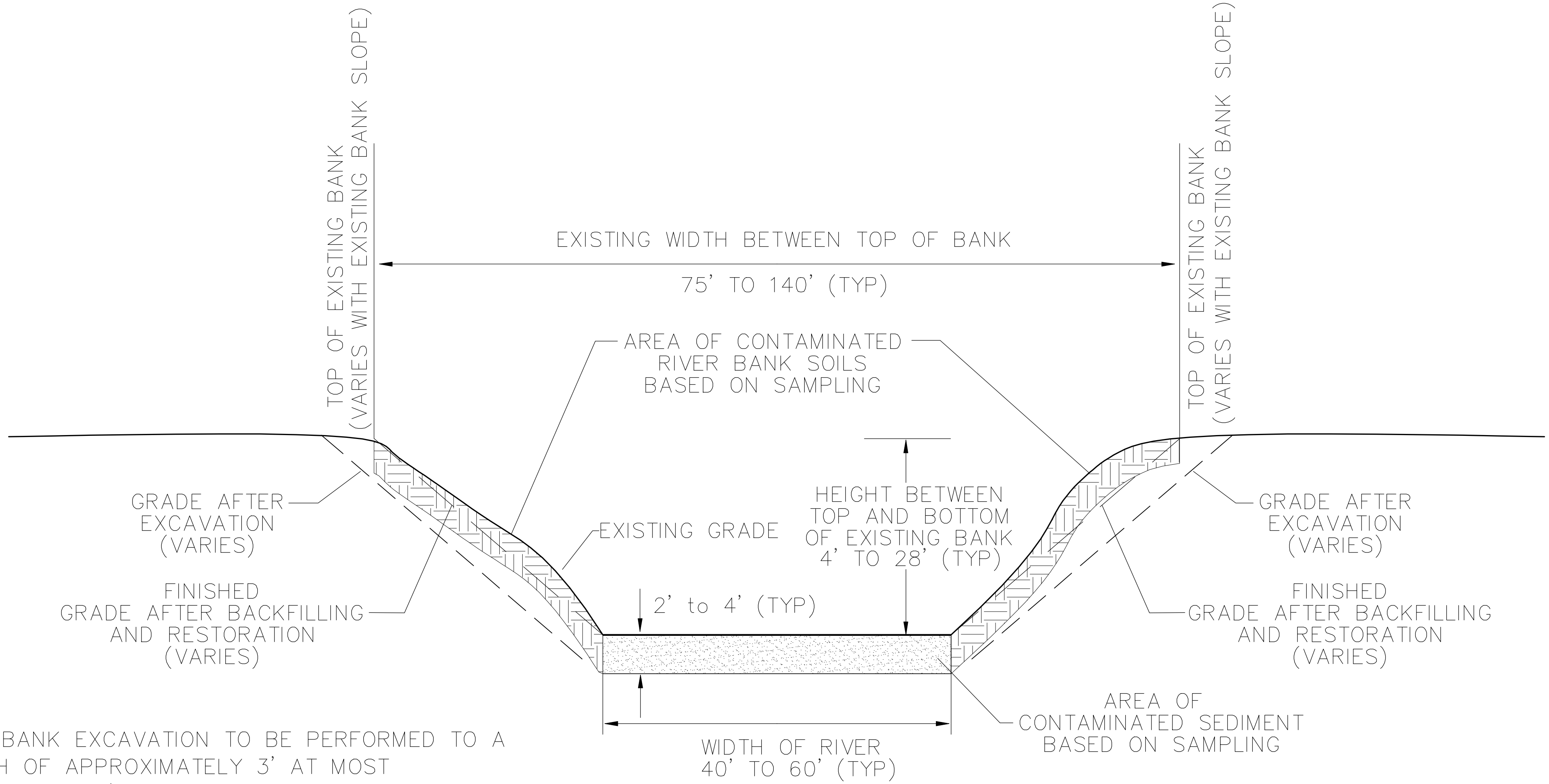
Source:
Ohio's Standards for Stormwater Management, 1996 (99-0157).

ENGINEERING EVALUATION/COST ANALYSIS
Upper Reach of the Housatonic River
Pittsfield, Massachusetts

FIGURE 4.6-8
BOULDER PLACEMENT

SECTION 5

FIGURES



NOTES:

1. RIVERBANK EXCAVATION TO BE PERFORMED TO A DEPTH OF APPROXIMATELY 3' AT MOST SUBREACHES. (REFER TO TABLE 3.4-2 FOR EXCEPTIONS BASED ON CONTAMINANT CONCENTRATIONS).

2. FINISHED GRADE TO HAVE A SLOPE OF 2.25H:IV OR SHALLOWER, UNLESS HARD STRUCTURES ARE INSTALLEDTO MAINTAIN EXISTING TOP OF BANK.

LEGEND

RIVER BED SEDIMENT EXCAVATION

RIVER BANK SOIL EXCAVATION

GRADE FOLLOWING EXCAVATION

FINISHED GRADE FOLLOWING RESTORATION

EXISTING GROUND/ RIVERBED SURFACE

NOT TO SCALE

ENGINEERING EVALUATION/COST ANALYSIS
UPPER REACH OF THE HOUSATONIC RIVER
PITTSFIELD, MASSACHUSETTS

FIGURE 5.2-1
RIVER EXCAVATION
CONCEPTUAL CROSS SECTION

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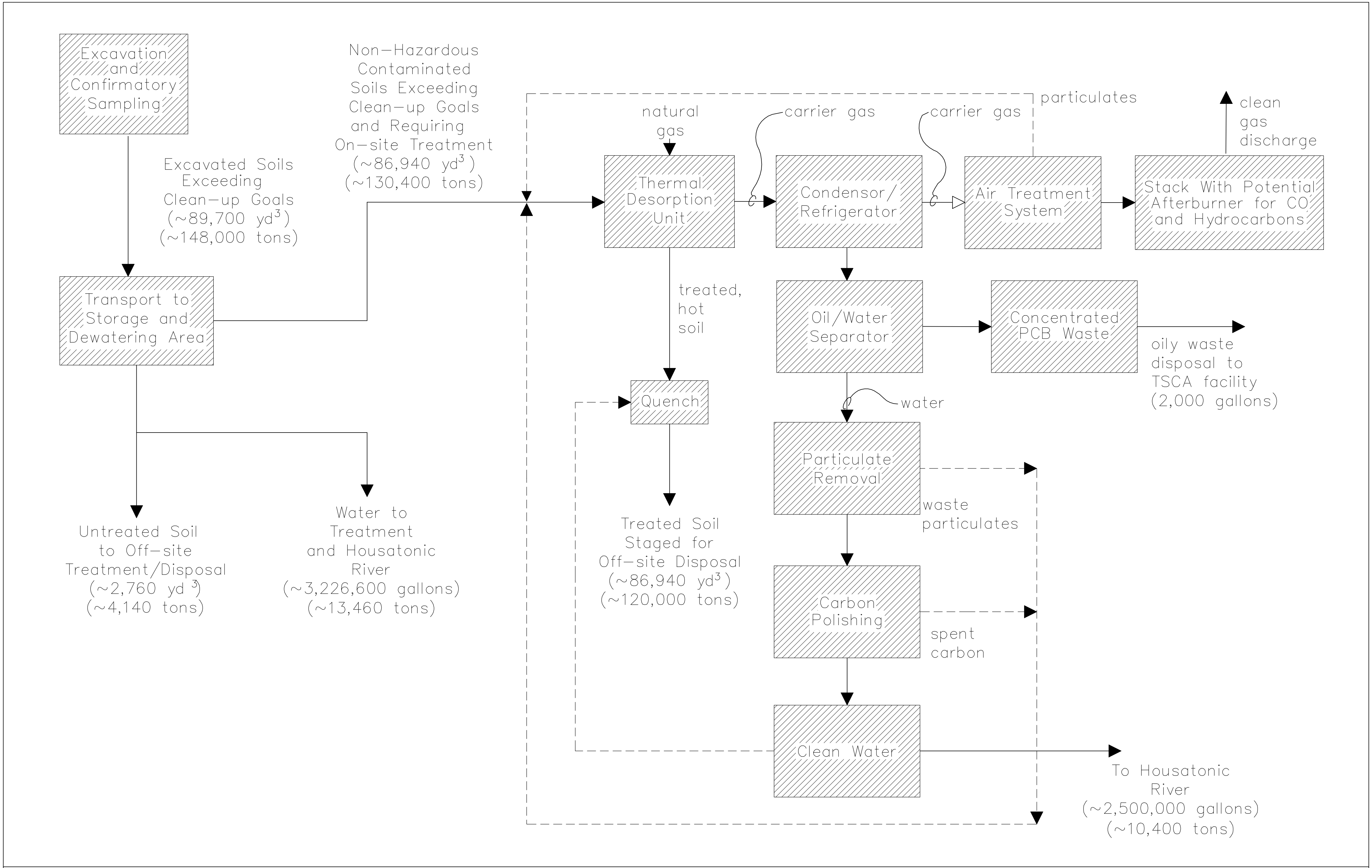


LEGEND

PROCESS FLOW

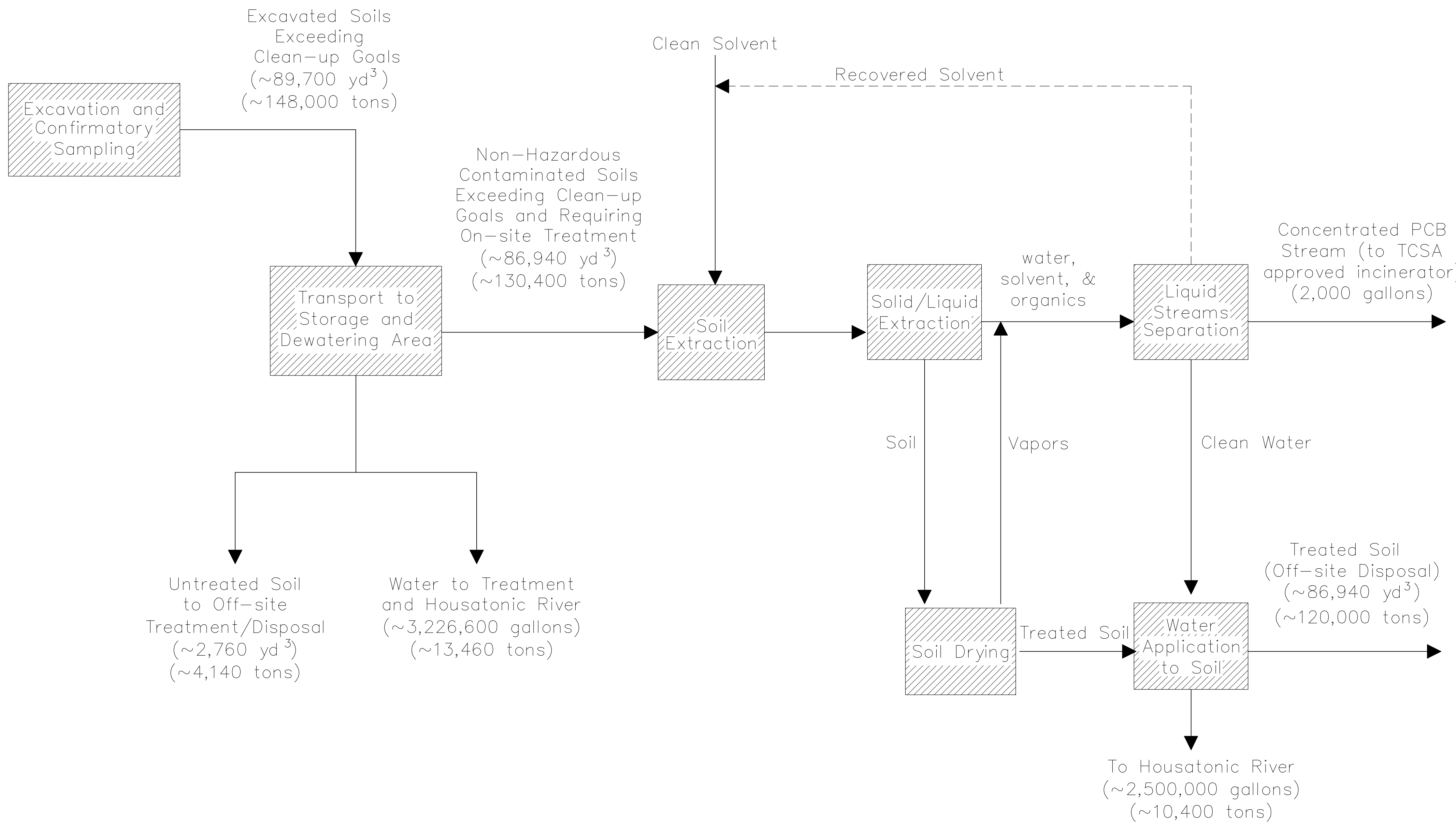
RECYCLE FLOW

NOT TO SCALE

ENGINEERING EVALUATION/COST ANALYSIS
UPPER REACH OF THE HOUSATONIC RIVER
PITTSFIELD, MASSACHUSETTS

FIGURE 5.2-2
REMEDIAL PROCESS FLOW SHEET
DISPOSAL OPTION C – THERMAL DESORPTION

G:\PROJECTS\10971032\FINLEECA\SECT5\FIGURES\EE-CA.DWG



LEGEND

PROCESS FLOW ——→

RECYCLE FLOW - - - - →

NOT TO SCALE

ENGINEERING EVALUATION/COST ANALYSIS
UPPER REACH OF THE HOUSATONIC RIVER
PITTSFIELD, MASSACHUSETTS

FIGURE 5.2-3
REMEDIAL PROCESS FLOW SHEET
DISPOSAL OPTION D – SOLVENT EXTRACTION

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