

Section 4

Hazardous Waste Sites and Characterization of Sediment/Soil

A file review of hazardous waste sites and characterization of sediments and soil was conducted to determine potential environmental concerns and off-site disposal considerations.

4.1 File Review

A file review of existing nearby sites regulated under the Massachusetts Contingency Plan (MCP) by the Massachusetts Department of Environmental Protection (MassDEP) was conducted. Five release tracking numbers (RTNs) were found within 1.5 miles of the Poor Farm Pond Dam. Two of the RTNs are for the same property. These sites are discussed below and the locations are shown on Figure 4-1.

RTN 2-0000629 (Garrepy Plating – 722 Plantation Street)

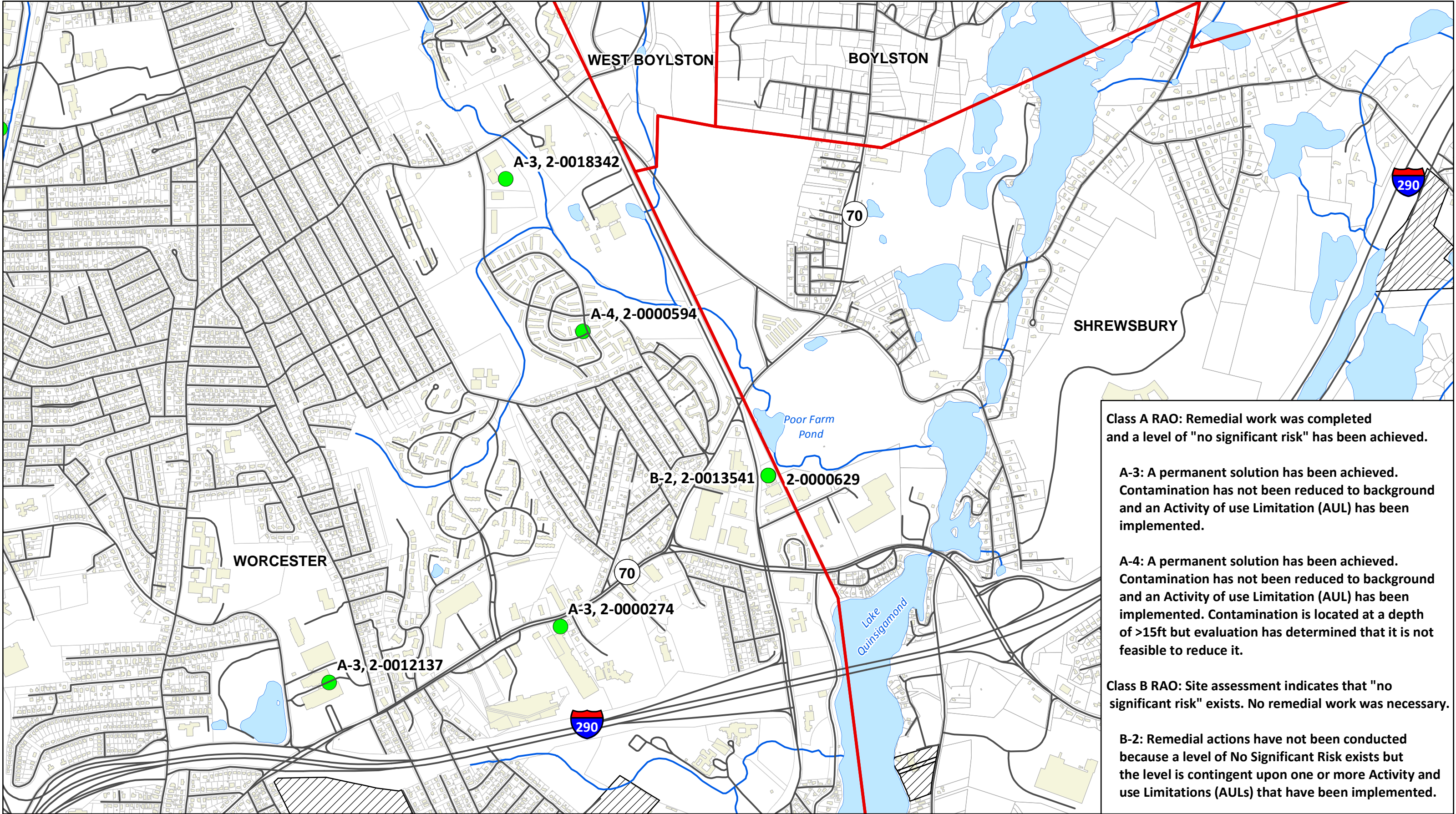
MassDEP listed the site (Garrepy Plating located at 722 Plantation Street) as a Location to Be Investigated (LTBI) on April 15, 1989 and assigned release tracking number 2-0000629 due to the discovery of chlorinated volatile organic compounds (VOCs) at the Shrewsbury well field located 600 feet to the east of the site. The site is located with the Zone II of the Shrewsbury well field and Zone II of the Worcester Home Farm Wellfield. MassDEP listed the site as a default Tier 1B site on August 2, 1996. A site investigation conducted on November 30, 1998 by Sandra Wyman & Associates (Wyman) found concentrations of nickel and chromium in soil samples above MassDEP Reportable Concentrations (RCs). The soil samples were collected from the south rear area of the site. It was concluded that the soil impacts were due to historical releases at the site. A subsurface soil investigation was conducted at the site on June 20, 2000 and July 7, 2000. Results of these investigations show detectable concentrations above MassDEP RCs of the following compounds; chromium, TPH, tetrachloroethene (PCE) and trichloroethene (TCE). Analysis of surface soil samples indicated no concentrations above RCs.

A Phase II Site Investigation was conducted under a new RTN 2-0013541 which is discussed below.

RTN 2-0013541 (Garrepy Plating – 722 Plantation Street)

A second RTN was issued for the Garrepy Plating facility by MassDEP in 2000 following a 120-day reporting condition that was identified by RANSOM in their August 2000 Limited Subsurface Investigation report due to the presence of chromium and petroleum hydrocarbons in soil samples above MassDEP RCs. In 2003, the firm, MACTEC, conducted a Phase I Site Investigation and concluded that EPH and metals are present in soil above MassDEP Method I S-2 and/or S-3 criteria. Groundwater samples collected by MACTEC during the Phase I investigation indicate concentrations of extractible petroleum hydrocarbons (EPH) and metals above applicable MassDEP Method I GW-1 or GW-3 standards.

The site has been closed out with a Class B-2 Response Action Outcome (RAO) Statement. Remedial actions were not required to be conducted at the site because a level of No Significant Risk existed for the current use of the facility as an industrial property. An Activity and Use Limitation (AUL) is in place at the site, which states that the site is not suitable for residential use.



Date: June 2013

Legend

Hazardous Waste Sites

Water Bodies

Buildings

Parcels

Town Boundary

Rivers

Roads

CDM
Smith

Worcester, Massachusetts

Poor Farm Pond Dam Removal Feasibility Study

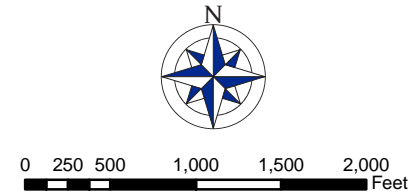


Figure 4-1

Hazardous Waste Sites

RTN 2-0000594 (Worcester Housing Authority – Great Brook Valley)

At the Worcester Housing Authority property located at 69 Tacoma Street is the site of two former 10,000 gallon underground storage tanks (USTs) that contained No. 6 heating oil. The Worcester Fire Department issued permits for removal of these two tanks on April 28, 1988. During the tank removal activities, contaminated soil was encountered although the tanks were reported to be in excellent condition. An unknown quantity of contaminated soil was removed and stockpiled on site prior to disposal at a MassDEP approved facility. The MassDEP subsequently listed the release as a Location to be Investigated (LTBI) and assigned the tracking number 2-0000594. The tracking number LTBI #2-0000594 utilizes a generic address of Great Brook Valley. A Phase I Report and Tier Classification were submitted to the MA DEP on July 30, 1996. The Site meets the requirements of a Tier II disposal site.

Five soil borings were advanced in the area of the former USTs on June 23, 1995. Two of the borings were completed as monitoring wells; however, at the time the Response Action Outcome (RAO) was written (May 1998), neither of the monitoring wells had yielded any water. During the soil boring activities auger refusal was encountered at four locations (B2 – B5) ranging in depth from four feet below ground surface (ft bgs) at B4 to 18 ft bgs at B2 and B5. Soil samples were collected for analysis of volatile organic compounds (VOCs) and total petroleum hydrocarbons (TPH). VOC results were below laboratory detection limits in each of the samples collected. The concentration of TPH collected from B1 (17 ft – 19ft) was 24,000 parts per million (ppm). This result exceeds both the Method 1 S-3 criteria and the Upper Concentration Limit (UCL).

The Method I Risk Characterization for the property meets the requirements of a Class A-4 Response Action Outcome (RAO) where remedial actions have been performed. The level of oil in the environment has not been reduced to background, so an Activity and Use Limitation (AUL) is necessary to maintain a level of No Significant Risk. Oil in soil is located at a depth greater than 15 feet from the ground surface exceeding the applicable Upper Concentration Limits in soil, and it is not feasible to reduce the concentrations of oil in soil located at a depth greater than 15 feet from the ground surface.

RTN 2-0000274 (Former Shell Station – 551 Lincoln Street)

Between 1964 and 1990, the site was operated as a Shell retail service station. In 1986, a 5,000 gallon gasoline underground storage tank (UST) failed a tightness test. The UST was removed on December 3, 1986. MassDEP listed the site as a LTBI on January 15, 1988 for a gasoline release to soil and groundwater and assigned RTN 2-0000274. Shell Oil Products Company, Inc. ceased operations at the site in 1990 and all USTs were removed at that time. The site then operated as an automobile repair facility between approximately 1990 and 1999. Groundwater was contaminated by benzene, toluene, ethylbenzene, and xylenes (BTEX), methyl tert butyl ether (MTBE); total petroleum hydrocarbons (TPH) and light non-aqueous phased liquid (LNAPL) was reported between 1986 and 1995. Chemicals of concern (COCs) in soil are consistent with those in groundwater, thus related to one or more gasoline releases. The risk assessment identified COCs as BTEX, MTBE, naphthalene, 2-methylnaphthalene, and ethylene dibromide (EDB). Response actions included operation of a groundwater recovery system and soil vapor extraction (SVE) system. An Activity and Use Limitation (AUL) was filed for this property in October 2000 to prevent future development for residential, child-care type uses, and agricultural uses.

In November 2002, MassDEP issued a Notice of Audit Findings and Notice of Non-Compliance (NON). These violations were administrative in nature (public notification failures, documentation failures/inadequate forms and notification to MassDEP). No violations of the requirements of the AUL were identified.

RTN 2-0012137 (Allmerica Financial – 440 Lincoln Street)

Two USTs were removed from the Allmerica Financial property located at 440 Lincoln Street. During removal of these USTs, there was evidence that the tanks had leaked and the DEP was notified in March 1998. The release was assigned Release Tracking Number (RTN) 2-0012137, under Immediate Response Action (IRA) status. Approximately 615 cubic yards of soil were excavated for off-site disposal. In addition, an overfill of No. 6 fuel oil occurred in 1990 outside of the building, and oil flowed down the lawn and into pipe galleries. Two additional release conditions were discovered during the response actions. Chlorinated volatile organic compounds (VOCs) were identified in soil adjacent to a concrete pipe chase. Carbon tetrachloride, chloroform, and tetrachloroethene were detected in the sample at concentrations above Reportable Concentrations (RCs). However, based on the absence of VOCs in soil samples collected elsewhere in the excavation, the VOCs were attributed to cleaning solvents that may have been used to clean the piping when No. 6 fuel oil was used on-site. The other release included polyaromatic hydrocarbons (PAHs) in site soil, which was originally attributed to the UST fuel oil release and the overfill. However, it was determined that the PAHs were associated with the fill used during construction. Elevated levels of arsenic were also found at the site. These levels of arsenic were considered naturally occurring due to the mining processes that have historically been conducted near the site. IRA and Release Abatement Measure (RAM) activities were conducted for the releases and a Class A-3 RAO was submitted in February 2003. The AUL restricts use of the site for recreational, agricultural, or residential purposes and limits regular presence of children, except those attending or visiting a day care.

RTN 2-0018342 (324 Clark Street)

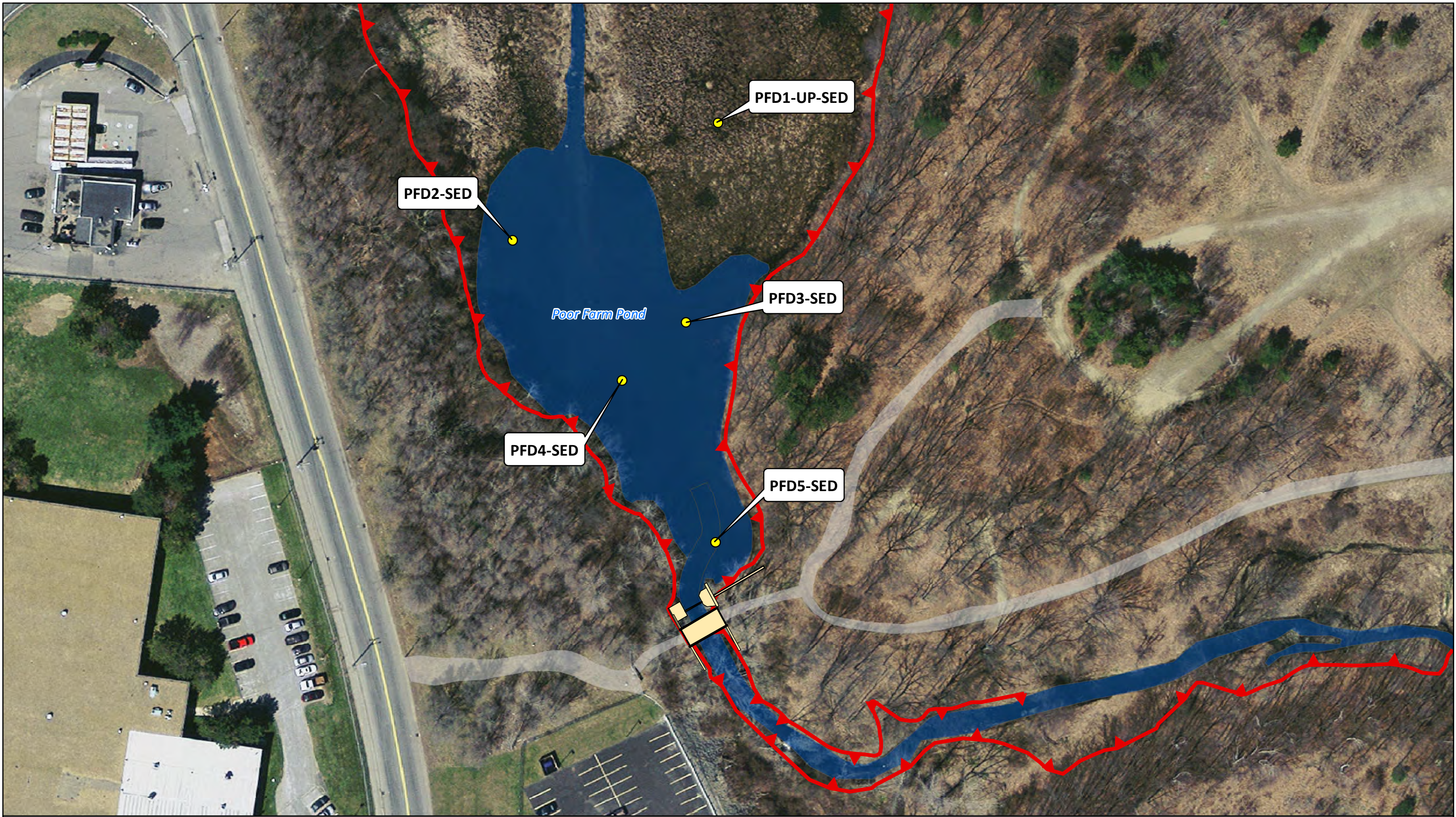
A Phase I Environmental Site Assessment was conducted in February 2011 for the site located at 324 Clark Street in Worcester, which was historically used as an electroplating facility, to investigate elevated concentrations of arsenic, cadmium, chromium, and lead believed to be associated with fill material. Upon completion of several subsurface soil and groundwater investigations, arsenic was determined to be associated with background and chromium concentrations were determined to be below the RCS-1 concentration. However, detected concentrations of cadmium and lead were above their respective RCS-1 and required notification to MassDEP. Notification occurred in September 2011 and MassDEP issued RTN-0018342. In September 2011 soil was characterized in the vicinity of an area proposed for a new loading dock and excavation was completed under a RAM. Upon completion of the RAM, concentrations of cadmium and lead remained in subsurface soil at concentrations above S-1 standards. Groundwater was not impacted by these metals. A Class A-3 RAO was submitted and an AUL was implemented to restrict access to site soil and to prevent the use of the site for residential use and schools, including child care centers, among other restrictions.

4.2 Sediment Sampling

On April 26, 2013, CDM Smith collected sediment samples from five discrete locations upstream of the dam, identified as PFD1-UP-SED, PFD2-SED, PFD3-SED, PFD4-SED, and PFD5-SED.

4.2.1 Sample Locations

CDM Smith collected four core samples of sediment from the existing impoundment for physical and chemical analysis, as described in the 401 water quality regulations (314 CMR 9.00). Sample locations were selected based on obtaining a representative coverage of the pond. Four sample locations were selected within the impoundment area - one immediately upstream of the dam (PFD5-SED), and three others (PFD2-SED, PFD3-SED, and PFD4-SED) further upstream spanning the width of the impoundment. The fifth sample (PFD1-UP-SED) was collected from the emergent marsh immediately east of the existing upstream stream channel and north of the impoundment. See Figure 4-2 for sample locations.



Date: June 2013



- Legend**
- Sediment Samples
 - Bridge & Dam
 - Spillway
 - Wetland Boundary
 - Road
 - Pond

Worcester, Massachusetts
Poor Farm Pond Dam Removal Feasibility Study

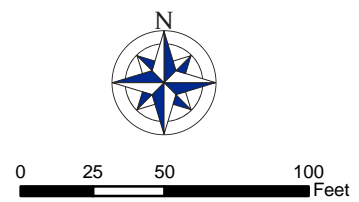


Figure 4-2
Sediment Sampling
Locations

The sediment sample locations are in areas of the impoundment with deeper sediment deposits, as shown by the sediment depth measurements. Sampling locations were selected to show the character of the sediment behind the dam in the areas that has the greatest likelihood of contributing sediment to downstream receptors. Field investigations showed the sediment depth to range from 11 to 44 inches.

4.2.2 Equipment and Materials

The following equipment was used to obtain the sediment samples:

- Stainless steel AMS Inc. extendable bucket auger;
- Stainless steel AMS Inc. extendable core sampler (with 2" x 12" butyrate plastic liner with liner caps);
- Stainless steel bowls and spoons;
- Laboratory-supplies sample glassware containers;
- Nitrile gloves;
- Decontamination liquids (detergent and de-ionized water);
- Logbook;
- Trimble global positioning system (GPS) receiver;
- Chest waders;
- Disposable plastic spoons; and
- Cooler and ice.

4.2.3 Equipment Decontamination Procedures

The sampling equipment was decontaminated on-site after every sample collection to prevent cross contamination between samples. The following decontamination procedure was used:

1. Rinse the equipment of sample (sediment/soil) with tap water brought in to the site in plastic containers;
2. Wash and scrub equipment with laboratory grade non-phosphate detergent (Liquinox);
3. Rinse with tap water;
4. Rinse with de-ionized water; and
5. Air dry.

4.2.4 Sediment Collection

Sediment samples were collected using the extendable bucket auger and the extendable core sampler. The volatile organic compounds samples were collected using the core sampler to avoid

exposure to the air during the transfer from the sampler to the laboratory provided vials. A separate butyrate plastic liner was used for each sample collected. The depth of sediment was collected down to what was believed to be native material. The native material below the accumulated sediment was also collected and analyzed for total arsenic. Water depth, depth of sediment, water temperature, dissolved oxygen, conductivity, and pH were recorded at each sample location (see Table 4-1 below). Sediment sampling glassware and vials were immediately placed on ice in coolers.

Table 4-1
Poor Farm Pond Sediment Sample Location Characteristics

<i>Sample ID</i>	<i>Depth of Water (inches)</i>	<i>Depth of Sediment (inches)</i>	<i>Water Temperature (°C)</i>	<i>% Dissolved Oxygen (DO)</i>	<i>Conductivity (us/cm)</i>	<i>pH</i>
PFD1-UP-SED	9	-	-	-		-
PFD2-SED	25	11	15.74	87.2	493	7.21
PFD3-SED	10	30	15.76	83.5	593	7.17
PFD4-SED	12	30	16.7	90.2	500	7.05
PFD5-SED	16	44	14.38	82.0	486	6.85

4.2.5 Sediment Analyses

Samples were transported in laboratory provided glass amber jars and vials with chain-of-custody documentation to Alpha Analytical Laboratory located at Eight Walkup Drive in Westborough, Massachusetts for chemical and physical analysis. In addition, samples were transported in zip lock plastic bags to the CDM Smith Geotechnical Laboratory located at 153 South St in Somerville, Massachusetts for particle size analysis in accordance with ASTM D422.

4.3 Sediment Characterization

Sediment data collected on April 26, 2013 from the surface sediment and analyzed for general chemistry, total metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyl (PCB) Aroclors, total petroleum hydrocarbons (TPH), and extractable petroleum hydrocarbon (EPH). Grain size was analyzed in accordance with ASTM D422. Additional samples were collected from the subsurface for total solids and total arsenic analyses to evaluate the underlying material. All of the data were compared to several criteria as shown in Table 4-2A (sediment results) and Table 4-2B (soil results).

Sediment is not specifically regulated under the Massachusetts Contingency Plan (MCP) (unless part of a larger site of release); however, as an indicator for general levels of contamination the concentrations were compared to the MCP criteria, which are primarily based on human health risk. A comparison to the MCP reportable concentrations (RCS-1) showed that some metals (arsenic, chromium and nickel) exceed the RCS-1 criteria. One analyte in the surface sample at location PFD5 and two analytes in subsurface samples at locations PFD3 and PFD5 had elevated levels of arsenic however based on a preliminary calculation; this should not pose a significant risk if humans were exposed to this material. The arsenic concentrations found at the site are considered typical for the Worcester area based on mining activities that have been historically conducted in the area.

Table 4-2A
Poor Farm Sediment Results

	Criteria						Sample Results - SEDIMENTS									
							PFD1-UP- SED-042013 26-APR-13	Qual	PFD2-SED- 042013 26-APR-13	Qual	PFD3-SED- 042013 26-APR-13	Qual	PFD4-SED- 042013 26-APR-13	Qual	PFD5-SED- 042013 26-APR-13	Qual
	RCS-1	S1/GW1	TEC	PEC	COMM-97 Unlined/Lined	Units	L1307536-01		L1307536-02		L1307536-03		L1307536-04		L1307536-05	
General Chemistry - Westborough Lab																
Specific Conductance					4000/8000	umhos/cm	40		72		45		41		33	
Solids, Total						%	65.2		49.1		45.3		45		59.3	
Solids, Total Volatile						%	3.5		12		12		12		6.5	
MCP Total Metals - Westborough Lab																
Antimony, Total	20	20				mg/kg	3	U	3.9	U	4.3	U	4.3	U	3.3	U
Arsenic, Total	20	20	9.79	33	40/40	mg/kg	14		26		31		32		41	
Beryllium, Total	100	100				mg/kg	0.32		0.72		0.81		0.86		0.56	
Cadmium, Total	2	2	0.99	4.98	30/80	mg/kg	0.6	U	1.3		1.2		1.4		1.1	
Chromium, Total	30	30	43.4	111	1000/1000	mg/kg	19		44		39		41		42	
Copper, Total	1000		31.6	149		mg/kg	13		64		57		61		40	
Lead, Total	300	300	35.8	128	1000/2000	mg/kg	30		180		120		150		100	
Mercury, Total	20	20	0.18	1.06	10/10	mg/kg	0.12	U	0.16		0.17	U	0.15		0.13	
Nickel, Total	20	20	22.7	48.6		mg/kg	17		41		43		49		39	
Selenium, Total	400	400				mg/kg	3	U	3.9	U	4.3	U	4.3	U	3.3	U
Silver, Total	100	100				mg/kg	0.6	U	0.78	U	0.86	U	0.86	U	0.66	U
Thallium, Total	8	8				mg/kg	3	U	3.9	U	4.3	U	4.3	U	3.3	U
Zinc, Total	2500	2500	121	459		mg/kg	64		210		200		240		140	
MCP Volatile Organics by 8260/5035 - Westborough Lab																
1,1,1,2-Tetrachloroethane	0.1	0.1				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
1,1,1-Trichloroethane	30	30				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
1,1,2,2-Tetrachloroethane	0.005	0.005				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
1,1,2-Trichloroethane	0.1	0.1				mg/kg	0.08	U	0.16	U	0.18	U	0.18	U	0.12	U
1,1-Dichloroethane	0.4	0.4				mg/kg	0.08	U	0.16	U	0.18	U	0.18	U	0.12	U
1,1-Dichloroethene	3	3				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
1,1-Dichloropropene						mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U

	Criteria						Sample Results - SEDIMENTS									
							PFD1-UP- SED-042013 26-APR-13	Qual	PFD2-SED- 042013 26-APR-13	Qual	PFD3-SED- 042013 26-APR-13	Qual	PFD4-SED- 042013 26-APR-13	Qual	PFD5-SED- 042013 26-APR-13	Qual
	RCS-1	S1/GW1	TEC	PEC	COMM-97 Unlined/Lined	Units	L1307536-01		L1307536-02		L1307536-03		L1307536-04		L1307536-05	
1,2,3-Trichlorobenzene						mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
1,2,3-Trichloropropane	100					mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
1,2,4-Trichlorobenzene	2	2				mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
1,2,4-Trimethylbenzene	1000					mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
1,2-Dibromo-3-chloropropane	10					mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
1,2-Dibromoethane	0.1					mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
1,2-Dichlorobenzene	9	9				mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
1,2-Dichloroethane	0.1	0.1				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
1,2-Dichloropropane	0.1	0.1				mg/kg	0.19	U	0.38	U	0.43	U	0.41	U	0.28	U
1,3,5-Trimethylbenzene	10					mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
1,3-Dichlorobenzene	1	1				mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
1,3-Dichloropropane	500					mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
1,4-Dichlorobenzene	0.7	0.7				mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
1,4-Dioxane	0.2	0.2				mg/kg	5.4	U	11	U	12	U	12	U	7.9	U
2,2-Dichloropropane						mg/kg	0.27	U	0.55	U	0.62	U	0.58	U	0.39	U
2-Butanone	4	4				mg/kg	0.54	U	1.1	U	1.2	U	1.2	U	0.79	U
2-Hexanone	100					mg/kg	0.54	U	1.1	U	1.2	U	1.2	U	0.79	U
4-Methyl-2-pentanone	0.4	0.4				mg/kg	0.54	U	1.1	U	1.2	U	1.2	U	0.79	U
Acetone	6	6				mg/kg	1.9	U	3.9	U	4.4	U	4.2	U	2.8	U
Benzene	2	2				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
Bromobenzene	100					mg/kg	0.27	U	0.55	U	0.62	U	0.58	U	0.39	U
Bromochloromethane						mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
Bromodichloromethane	0.1	0.1				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
Bromoform	0.1	0.1				mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
Bromomethane	0.5	0.5				mg/kg	0.11	U	0.22	U	0.25	U	0.23	U	0.16	U
Carbon disulfide	100					mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
Carbon tetrachloride	5	10				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
Chlorobenzene	1	1				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
Chloroethane	100					mg/kg	0.11	U	0.22	U	0.25	U	0.23	U	0.16	U
Chloroform	0.3	0.4				mg/kg	0.08	U	0.16	U	0.18	U	0.18	U	0.12	U
Chloromethane	100					mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
cis-1,2-Dichloroethene	0.3	0.3				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U

	Criteria						Sample Results - SEDIMENTS									
							PFD1-UP- SED-042013 26-APR-13	Qual	PFD2-SED- 042013 26-APR-13	Qual	PFD3-SED- 042013 26-APR-13	Qual	PFD4-SED- 042013 26-APR-13	Qual	PFD5-SED- 042013 26-APR-13	Qual
	RCS-1	S1/GW1	TEC	PEC	COMM-97 Unlined/Lined	Units	L1307536-01		L1307536-02		L1307536-03		L1307536-04		L1307536-05	
cis-1,3-Dichloropropene	0.01	0.01				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
Dibromochloromethane	0.005	0.005				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
Dibromomethane	500					mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
Dichlorodifluoromethane	1000					mg/kg	0.54	U	1.1	U	1.2	U	1.2	U	0.79	U
Ethyl ether	100					mg/kg	0.27	U	0.55	U	0.62	U	0.58	U	0.39	U
Ethyl-Tert-Butyl-Ether						mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
Ethylbenzene	40	40				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
Hexachlorobutadiene	6	6				mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
Isopropyl Ether	100					mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
Isopropylbenzene	1000					mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
Methyl tert butyl ether	0.1	0.1				mg/kg	0.11	U	0.22	U	0.25	U	0.23	U	0.16	U
Methylene chloride	0.1	0.1				mg/kg	0.54	U	1.1	U	1.2	U	1.2	U	0.79	U
n-Butylbenzene						mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
n-Propylbenzene	100					mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
Naphthalene	4	4				mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
o-Chlorotoluene	100					mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
o-Xylene	300	400				mg/kg	0.11	U	0.22	U	0.25	U	0.23	U	0.16	U
p-Chlorotoluene						mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
p-Isopropyltoluene						mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
p/m-Xylene	300	400				mg/kg	0.11	U	0.22	U	0.25	U	0.23	U	0.16	U
sec-Butylbenzene						mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
Styrene	3	3				mg/kg	0.11	U	0.22	U	0.25	U	0.23	U	0.16	U
tert-Butylbenzene	100					mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
Tertiary-Amyl Methyl Ether						mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
Tetrachloroethene	1	1				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
Tetrahydrofuran	500					mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
Toluene	30	30				mg/kg	0.08	U	0.16	U	0.18	U	0.18	U	0.12	U
trans-1,2-Dichloroethene	1	1				mg/kg	0.08	U	0.16	U	0.18	U	0.18	U	0.12	U
trans-1,3-Dichloropropene	0.01	0.01				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
Trichloroethene	0.3	0.3				mg/kg	0.054	U	0.11	U	0.12	U	0.12	U	0.079	U
Trichlorofluoromethane	1000					mg/kg	0.21	U	0.44	U	0.49	U	0.47	U	0.32	U
Vinyl chloride	0.6	0.6				mg/kg	0.11	U	0.22	U	0.25	U	0.23	U	0.16	U

	Criteria						Sample Results - SEDIMENTS									
							PFD1-UP- SED-042013 26-APR-13	Qual	PFD2-SED- 042013 26-APR-13	Qual	PFD3-SED- 042013 26-APR-13	Qual	PFD4-SED- 042013 26-APR-13	Qual	PFD5-SED- 042013 26-APR-13	Qual
	RCS-1	S1/GW1	TEC	PEC	COMM-97 Unlined/Lined	Units	L1307536-01		L1307536-02		L1307536-03		L1307536-04		L1307536-05	
MCP Semivolatile Organics - Westborough Lab																
1,2,4-Trichlorobenzene	2	2				mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
1,2-Dichlorobenzene	9	9				mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
1,3-Dichlorobenzene	1	1				mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
1,4-Dichlorobenzene	0.7	0.7				mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
2,4,5-Trichlorophenol	4	4				mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
2,4,6-Trichlorophenol	0.7	0.7				mg/kg	0.15	U	0.2	U	0.22	U	0.22	U	0.16	U
2,4-Dichlorophenol	0.7	0.7				mg/kg	0.23	U	0.3	U	0.32	U	0.33	U	0.25	U
2,4-Dimethylphenol	0.7	0.7				mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
2,4-Dinitrophenol	3	3				mg/kg	1.2	U	1.6	U	1.7	U	1.8	U	1.3	U
2,4-Dinitrotoluene	0.7	0.7				mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
2,6-Dinitrotoluene	100					mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
2-Chloronaphthalene	1000					mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
2-Chlorophenol	0.7	0.7				mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
2-Methylnaphthalene	0.7	0.7				mg/kg	0.3	U	0.4	U	0.43	U	0.44	U	0.33	U
2-Methylphenol	500					mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
2-Nitrophenol	100					mg/kg	0.55	U	0.72	U	0.78	U	0.79	U	0.59	U
3,3'-Dichlorobenzidine	1	1				mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
3-Methylphenol/4-Methylphenol	500					mg/kg	0.36	U	0.48	U	0.52	U	0.53	U	0.4	U
4-Bromophenyl phenyl ether	100					mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
4-Chloroaniline	1	1				mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
4-Nitrophenol	100					mg/kg	0.35	U	0.47	U	0.51	U	0.51	U	0.38	U
Acenaphthene	4	4				mg/kg	0.2	U	0.8		0.29	U	0.29	U	0.22	U
Acenaphthylene	1	1				mg/kg	0.2	U	0.27	U	0.29	U	0.29	U	0.22	U
Acetophenone	1000					mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
Aniline	1000					mg/kg	0.3	U	0.4	U	0.43	U	0.44	U	0.33	U
Anthracene	1000	1000	0.0572	0.845		mg/kg	0.15	U	0.9		0.22	U	0.22	U	0.16	U
Azobenzene						mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
Benzo(a)anthracene	7	7	0.108	1.05		mg/kg	0.15	U	1.7		0.22	U	0.22	U	0.3	
Benzo(a)pyrene	2	2	0.15	1.45		mg/kg	0.2	U	1.3		0.29	U	0.29	U	0.32	
Benzo(b)fluoranthene	7	7				mg/kg	0.15	U	2		0.34		0.4		0.53	
Benzo(ghi)perylene	1000	1000				mg/kg	0.2	U	0.81		0.29	U	0.29	U	0.25	

	Criteria						Sample Results - SEDIMENTS									
							PFD1-UP- SED-042013 26-APR-13	Qual	PFD2-SED- 042013 26-APR-13	Qual	PFD3-SED- 042013 26-APR-13	Qual	PFD4-SED- 042013 26-APR-13	Qual	PFD5-SED- 042013 26-APR-13	Qual
	RCS-1	S1/GW1	TEC	PEC	COMM-97 Unlined/Lined	Units	L1307536-01		L1307536-02		L1307536-03		L1307536-04		L1307536-05	
Benzo(k)fluoranthene	70	70				mg/kg	0.15	U	0.77		0.22	U	0.22	U	0.19	
Bis(2-chloroethoxy)methane	500					mg/kg	0.27	U	0.36	U	0.39	U	0.4	U	0.3	U
Bis(2-chloroethyl)ether	0.7	0.7				mg/kg	0.23	U	0.3	U	0.32	U	0.33	U	0.25	U
Bis(2-chloroisopropyl)ether	0.7	0.7				mg/kg	0.3	U	0.4	U	0.43	U	0.44	U	0.33	U
Bis(2-Ethylhexyl)phthalate	200	200				mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
Butyl benzyl phthalate	100					mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
Chrysene	70	70	0.166	1.29		mg/kg	0.15	U	1.8		0.29		0.32		0.42	
Di-n-butylphthalate	50					mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
Di-n-octylphthalate	1000					mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
Dibenzo(a,h)anthracene	0.7	0.7	0.033			mg/kg	0.15	U	0.23		0.22	U	0.22	U	0.16	U
Dibenzofuran	100					mg/kg	0.25	U	0.35		0.36	U	0.37	U	0.28	U
Diethyl phthalate	10	10				mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
Dimethyl phthalate	30	30				mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
Fluoranthene	1000	1000	0.423	2.23		mg/kg	0.15	U	4.3		0.47		0.52		0.69	
Fluorene	1000	1000	0.0774	0.536		mg/kg	0.25	U	0.65		0.36	U	0.37	U	0.28	U
Hexachlorobenzene	0.7	0.7				mg/kg	0.15	U	0.2	U	0.22	U	0.22	U	0.16	U
Hexachlorobutadiene	6	6				mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
Hexachloroethane	0.7	0.7				mg/kg	0.2	U	0.27	U	0.29	U	0.29	U	0.22	U
Indeno(1,2,3-cd)Pyrene	7	7				mg/kg	0.2	U	0.92		0.29	U	0.29	U	0.27	
Isophorone	100					mg/kg	0.23	U	0.3	U	0.32	U	0.33	U	0.25	U
Naphthalene	4	4	0.176	0.561		mg/kg	0.25	U	0.36		0.36	U	0.37	U	0.28	U
Nitrobenzene	500					mg/kg	0.23	U	0.3	U	0.32	U	0.33	U	0.25	U
Pentachlorophenol	3	3				mg/kg	0.51	U	0.67	U	0.72	U	0.73	U	0.55	U
Phenanthrene	10	10	0.204	1.17		mg/kg	0.15	U	4.5		0.26		0.26		0.32	
Phenol	1	1				mg/kg	0.25	U	0.34	U	0.36	U	0.37	U	0.28	U
Pyrene	1000	1000	0.195	1.52		mg/kg	0.15	U	3.8		0.48		0.48		0.6	
Total PAHs			1.61	22.8	100/100		ND		25.19		1.84		1.98		3.89	
MCP Polychlorinated Biphenyls - Westborough Lab																
Aroclor 1016	2	2				mg/kg	0.05	U	0.0646	U	0.0705	U	0.072	U	0.0527	U
Aroclor 1221	2	2				mg/kg	0.05	U	0.0646	U	0.0705	U	0.072	U	0.0527	U
Aroclor 1232	2	2				mg/kg	0.05	U	0.0646	U	0.0705	U	0.072	U	0.0527	U

	Criteria						Sample Results - SEDIMENTS									
							PFD1-UP- SED-042013 26-APR-13	Qual	PFD2-SED- 042013 26-APR-13	Qual	PFD3-SED- 042013 26-APR-13	Qual	PFD4-SED- 042013 26-APR-13	Qual	PFD5-SED- 042013 26-APR-13	Qual
	RCS-1	S1/GW1	TEC	PEC	COMM-97 Unlined/Lined	Units	L1307536-01		L1307536-02		L1307536-03		L1307536-04		L1307536-05	
Aroclor 1242	2	2				mg/kg	0.05	U	0.0646	U	0.0705	U	0.072	U	0.0527	U
Aroclor 1248	2	2				mg/kg	0.05	U	0.0646	U	0.0705	U	0.072	U	0.0527	U
Aroclor 1254	2	2				mg/kg	0.05	U	0.0646	U	0.0705	U	0.072	U	0.0527	U
Aroclor 1260	2	2				mg/kg	0.05	U	0.762		0.403		0.118		0.0527	U
Aroclor 1262	2	2				mg/kg	0.05	U	0.0646	U	0.0705	U	0.072	U	0.0527	U
Aroclor 1268	2	2				mg/kg	0.05	U	0.0646	U	0.0705	U	0.072	U	0.0527	U
Total PCBs			0.0598	0.676	2/2		ND		0.762		0.403		0.118			
Petroleum Hydrocarbon Quantitation - Westborough Lab																
TPH	1000	1000				mg/kg	81.6		171		164		391		364	
Extractable Petroleum Hydrocarbons - Westborough Lab																
C11-C22 Aromatics						mg/kg	34.2		145		113		82.4		52.6	
C11-C22 Aromatics, Adjusted	1000	1000				mg/kg	30.5		126		105		71.8		43.3	
C19-C36 Aliphatics	3000	3000				mg/kg	28.5		149		276		114		60.1	
C9-C18 Aliphatics	1000	1000				mg/kg	10	U	13.4		21.9		14.7	U	10.9	U
TPH					2500/5000		59		288.4		402.9		185.8		103.4	

U - Not detected above method reporting limit (RL)

Bolded criteria exceeds MCP RCS-1 criteria

TEC = Threshold Effects Concentration

ND - Not detected

PEC = Probable Effects Concentration

NA - Not analyzed

Yellow Highlighted concentration exceeds ecological risk screening criteria (PEC for metals and TEC for PAHs and PCBs).

Orange Highlighted concentration exceeds ecological criteria and the in-state landfill criteria.

Table 4-2B
Poor Farm Soil Results

	Criteria						Sample Results - SOILS									
							PFD1-UP-SOIL-042613 26-APR-13	Qual	PFD2-SOIL-042613 26-APR-13	Qual	PFD3-SOIL-042613 26-APR-13	Qual	PFD4-SOIL-042613 26-APR-13	Qual	PFD5-SOIL-042613 26-APR-13	Qual
	RCS-1	S1/GW1	TEC	PEC	COMM-97 Unlined/Lined	Units	L1307536-06		L1307536-07		L1307536-08		L1307536-09		L1307536-10	
General Chemistry - Westborough Lab																
Specific Conductance					4000/8000	umhos/cm	NA		NA		NA		NA		NA	
Solids, Total						%	72.2		49.7		47.2		49.2		55.8	
Solids, Total Volatile						%	NA		NA		NA		NA		NA	
MCP Total Metals - Westborough Lab																
Antimony, Total	20	20				mg/kg	NA		NA		NA		NA		NA	
Arsenic, Total	20	20	9.79	33	40/40	mg/kg	14		39		50		34		60	
Beryllium, Total	100	100				mg/kg	NA		NA		NA		NA		NA	
Cadmium, Total	2	2	0.99	4.98	30/80	mg/kg	NA		NA		NA		NA		NA	
Chromium, Total	30	30	43.4	111	1000/1000	mg/kg	NA		NA		NA		NA		NA	
Copper, Total	1000		31.6	149		mg/kg	NA		NA		NA		NA		NA	
Lead, Total	300	300	35.8	128	1000/2000	mg/kg	NA		NA		NA		NA		NA	
Mercury, Total	20	20	0.18	1.06	10/10	mg/kg	NA		NA		NA		NA		NA	
Nickel, Total	20	20	22.7	48.6		mg/kg	NA		NA		NA		NA		NA	
Selenium, Total	400	400				mg/kg	NA		NA		NA		NA		NA	
Silver, Total	100	100				mg/kg	NA		NA		NA		NA		NA	
Thallium, Total	8	8				mg/kg	NA		NA		NA		NA		NA	
Zinc, Total	2500	2500	121	459		mg/kg	NA		NA		NA		NA		NA	

U - Not detected above method reporting limit (RL)

Bolded criteria exceeds MCP RCS-1 criteria

TEC = Threshold Effects Concentration

ND - Not detected

PEC = Probable Effects Concentration

NA - Not analyzed

Yellow Highlighted concentration exceeds ecological risk screening criteria (PEC for metals and TEC for PAHs and PCBs).

Orange Highlighted concentration exceeds ecological criteria and the in-state landfill criteria.

In terms of ecological risks, the data were compared to the state screening levels - threshold effects concentrations (TECs) and probable effects concentrations (PECs). State guidance suggests the TECs be used for polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) and PECs be used for metals. Tables 4-2A and 4-2B show the exceedances of these respective criteria. These exceedances indicate the potential for ecological effects downstream if the sediment is released when the dam is removed. The sample location closest to the dam (PFD2) shows the most significant exceedances (primarily for PAHs) indicating that this material should be removed prior to the removal of the dam to minimize potential adverse downstream effects. The samples further upstream (PFD3, PFD4, and PFD5) show some exceedances; however, if washed downstream sediment from these areas would not likely pose a significant ecological risk. While the ecological risk is low, the question of impacts from the sediment plume or how the sediment compares to the Lake Quinsigamond sediments still need to be resolved and as a conservative position we have assumed removing the sediment within the flood channel to account for potential costs. During design and permitting, this decision should be revisited. The sample collected upstream from outside of the impoundment area (PFD1) did not show any detected exceedances of these criteria from either depth interval.

4.4 Sediment Handling and Disposal

In terms of off-site disposal, with the exception of the surface and subsurface samples at PFD5 and the subsurface sample at PFD3 based on total arsenic results, the data meets in-state landfill criteria. However, it should be noted that currently there are no in-state landfills accepting material and therefore, the material may ultimately require disposal out-of-state. The arsenic concentrations in the PFD3 and PFD5 samples referenced above exceed the in-state landfill criteria (40 ppm) and would therefore required disposal out-of-state if this material is removed. Some out-of-state facilities (i.e., Waste Management (TREE) in New Hampshire) require a sampling frequency of 1 sample per 250 tons. This would likely be the most stringent sampling frequency that would be encountered; other facilities may offer a more relaxed sampling frequency such as 1 sample per 500 tons. Material would have to be dried out prior to shipping. Material must pass a paint filter test in order to be transported to an off-site facility.

4.5 Conclusions

Samples showed levels of SVOCs, PCBs and metals that exceeded MCP RCS-1 criteria and ecological risk criteria; however, most of the concentrations were only slightly above these criteria. The sample closest to the dam (PFD2) showed the highest levels of SVOCs and should be removed prior to removal of the dam. Elevated concentrations of arsenic were found in 1 out of 5 of the surficial samples and 4 out of 5 of the deeper samples. Arsenic levels are attributed to the naturally elevated arsenic levels in the Worcester area.

CDM Smith spoke with personnel from the MassDEP Water Quality Certification Program on May 22, 2013 regarding the sampling results. An approach was outlined to MassDEP for removal of the sediments closest to the dam and along the expected flood channels, while leaving the remaining sediments in place. The MassDEP personnel stated that this is an acceptable approach as long as the sediments left in place were stabilized to allow the area to re-vegetate naturally to wetlands. Sediments left in place would need to be more thoroughly characterized during final design before a sediment management plan would be approved.