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SEDIMENT EVALUATION SUMMARY

Bartlet Mall Frog Pond

Submitted to:
Newburyport Parks Commission
60 Pleasant Street
Newburyport, MA 01950

Submitted by:
Horsley Witten Group, Inc.

October, 2014




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SEDIMENT EVALUATION SUMMARY
BARTLET MALL FROG POND RESTORATION PROJECT
NEWBURYPORT, MASSACHUSETTS

1.0 INTRODUCTION

Horsley Witten Group, Inc. (HW) has been contracted by the City of Newburyport, Massachusetts (the City), to conduct a screening-level sediment sampling program to characterize sediment from within the Bartlet Mall Frog Pond project area. The Bartlet Mall and Frog Pond together form a central green space in the urban core of historic downtown Newburyport. The pond, which is approximately 2.3 acres in size, currently exhibits excessive algal growth (eutrophication) leading to low water clarity and low dissolved oxygen, and generally poor aesthetic quality. Anecdotal accounts indicate that eutrophication has likely been ongoing for a significant time, but has perhaps accelerated in the past several decades.

To improve the water quality of Frog Pond and the aesthetic appeal of the area, the City has undertaken an assessment of restoration options that includes evaluating the removal (dredging) of sediment from the bottom of Frog Pond for off-site disposal. On August 28, 2014, HW conducted sediment depth profiling and pond bottom sediment core sampling to provide baseline sediment quality data and develop an estimate of sediment volume. The data collected during the investigation, and described in further detail herein, provide an initial assessment of suitable sediment disposal alternatives and costs.

2.0 SEDIMENT DEPTH PROFILING AND CORE SAMPLING

2.1 Sediment Depth Profiling

To measure sediment thickness in the pond, HW probed the sediment at the bottom of the pond at 20 locations across four transects. Three transects were completed across the width of the pond, and one transect was completed across the length of the pond (Figure 1). At each of the 20 measurement locations, a 15-foot long 3/8-inch diameter fiberglass rod was lowered into the pond water until reaching the top of sediment, and an initial measurement of depth below water surface (BWS) was recorded. The rod was then advanced into the soft, shallow sediment until a transition in sediment composition was detected, based on the level of force necessary to push the rod deeper. This transition indicated the bottom of soft, shallow sediment, and the depth BWS was recorded. The rod was then further advanced until refusal, and that depth BWS was recorded. Refusal was encountered between 10 to 14 feet BWS at the profile locations. This depth is more likely reflective of limitations to the sediment profiling methodology, and not indicative of a transition to a more consolidated sediment layer (i.e., native, mineral substrates). It is likely that several more feet of peat material exists beyond the sediment probe refusal depth.

Based on these sediment probe measurements, HW generated cross section profiles of sediment depth for each transect in AutoCAD (Figure 2). Results of the sediment depth profiling indicate approximately 3.5 feet of soft sediment exists above a more consolidated lower layer of material of undetermined thickness. Sediment stratigraphy is described in greater detail in Section 2.3.

2.2 Sediment Core Sampling

HW collected a total of five sediment cores from the pond bottom on August 28, 2014. Sampling locations were distributed across the area of the pond (Figure 1). Sediment cores were completed using ten-foot lengths of two inch inner-diameter PVC tubing. At each sediment core sampling location, the PVC tube was advanced into the pond bottom sediment with a safety hammer until effective refusal was encountered. At each of the sampling locations, the PVC tube could only be advanced approximately four feet into the pond sediment before refusal. The depth to which the core could be advanced is referred to as the penetration. A plug seal was then installed at the top of the PVC tube and the tube was retracted, with the sediment core contained within. The sediment cores were then brought ashore to a work station, where excess water from the sediment core tubes was drained. The PVC tubes were then cut open with a circular saw to allow for inspection. The amount of sediment retained in the core after removal from the pond is referred to as the recovery.

A consistent stratigraphy was observed across all of the core samples, generally described as a layer of dark brown peat beneath several feet of dark gray organic silt with sand. Peat is a consolidated mix of organic and mineral materials containing visible root materials and wood debris, and is the preserved remains of wetland vegetation that has accumulated over long periods of time. Additional details on each of the sediment sampling locations are summarized in Table 1, below:

Table 1. August 28, 2014 Sediment Sampling

Sample ID:	Sample Core Location:	Core Penetration / Recovery:	Description
1 (0' – 2')	Eastern Pond	48" / 24"	22" of dark gray organic silt, 2" of dark brown peat at bottom of sample
2 (0' – 2')	North Central Pond	54" / 32"	29" of dark gray organic silt, 3" of dark brown peat at bottom of sample
3 (0' – 2')	Western Pond	42" / 28"	26" of dark gray organic silt, 2" of dark brown peat at bottom of sample
4 (0' – 2')	South Central Pond	57" / 28"	24" of dark gray organic silt, 4" of dark brown peat at bottom of sample
5 (0' – 2')	At Pond Fountain (Center)	66" / 24"	17" of dark gray organic silt, 7" of dark brown peat at bottom of sample

2.3 Sediment Stratigraphy

By comparing the results of the sediment profiling with the observed stratigraphy from the five sediment core locations, a well-informed characterization of the pond bottom can be created. Approximately 3.5 feet of soft, organic, and loosely consolidate muck overlays a layer of peat. The thickness of the peat layer could not be confirmed by visual inspection of the sediment core samples, as the PVC tubes could not penetrate more than 7" inches into the peat layer. Based on the sediment depth profiling field measurements, more than four feet of peat may underlie the soft organic sediment. The observed thickness of both peat and muck are generally consistent across the pond, with less of both peat and muck measured in locations closer to the pond shoreline, and slightly more measured toward the center of the pond (Figure 2), consistent with the bowl-shaped geometry of the underlying kettle-hole depression.

Photo 1. Sediment core sample 2 after cutting the PVC tube open, note transition from gray organic silt to dark brown peat.

There are at least two plausible explanations of the observed stratigraphy. One is that the peat layer represents the remains of wetlands vegetation accumulated over thousands of years at the bottom of a kettle-hole depression formed after the last glacial ice retreated north of the Newburyport area, some 15,000 years ago. Sea level, and correspondingly the groundwater table, was lower during the post-glacial period than during current conditions and, therefore, the Frog Pond kettle hole likely existed as a shallow wetland with abundant vegetative growth. The kettle-hole wetland was eventually submerged by rising groundwater levels and preserved as a peat deposit at the bottom of Frog Pond. The overlying, loosely-compacted muck has accumulated since that time from atmospheric deposition, watershed runoff, stormwater inputs, and in-water vegetative growth and decay.

The same stratigraphic sequence could also have formed in a fashion similar that described above if the kettle hole wetland depression had been naturally drained by a stream that was dammed and filled in colonial times. Damming of the stream outlet would have allowed water levels to rise and flood the wetland vegetation at the bottom of the depression. Sedimentation would have occurred above the peat, as described above, but over a shorter and more recent time period. No dating of pond bottom sediments was conducted as part of this project, but anecdotal descriptions of past land use practices suggest that a large portion of the accumulated muck has been deposited in the last several hundred years under the influence of anthropogenic alterations to the pond and its watershed.

3.0 SEDIMENT QUALITY CHARACTERIZATION

3.1 Sediment Core Sample Collection and Analysis

To assess sediment quality characteristics from each of the sediment cores, samples were collected from the recovered material for laboratory analysis. From each core, the complete vertical thickness of sediment above the peat layer was composited by hand-mixing in a stainless steel bowl to create five, location-specific samples. Peat from each of the five sediment cores was then combined into one composite peat sample, which is representative of the peat layer, and mixed in the same manner. The samples were then placed into sample containers and submitted to ESS Laboratory in Cranston, Rhode Island.

Samples were submitted for analysis of key contaminants of concern to help assess the suitability of the sediments for upland disposal / reuse. Samples were analyzed for all parameters required by the Massachusetts Water Quality Certification (WQC) Regulations (310 CMR 9.07(9)) for sediment material management. Per 310 CMR 9.07(9), upland material reuse under a 401 WQC is permitted, provided the concentrations of oil and hazardous material in the dredged material are less than the Reportable Concentrations (RCS-1) soil standards established in the Massachusetts Contingency Plan (MCP 310.CMR 40.0000). Samples were also analyzed for all parameters required by the Massachusetts Department of Environmental Protection (DEP) "*Reuse and Disposal of Contaminated Soil at Massachusetts Landfills – Policy #COMM-97-001"* (COMM-97-001) and *"Interim Policy for Sampling, Analysis, Handling and Tracking Requirements for Dredged Sediment Reused or Disposed at Massachusetts Permitted Landfills - Interim Policy COMM-94-007"* (COMM-94-007). COMM-97-001 and 94-007 establish contaminant thresholds, sampling and analysis requirements, transportation requirements, and management procedures for the reuse or disposal of soil and sediment at Massachusetts landfills.

3.2 Laboratory Analysis Results

Laboratory analysis of the composite and discrete sediment samples indicates the presence of several contaminants at concentrations above the respective MCP RCS-1 or COMM-97-001 / 94-007 standards (highlighted and in bold on Table 2). The contaminants detected above RCS-1 standards are arsenic, chromium, and lead, all of which are heavy metals that are persistent in the environment (i.e., not subject to natural degradation). Several polycyclic aromatic hydrocarbons (PAHs) were also detected above laboratory detection limits, but were below the applicable RCS1 and COMM-97-001 / 94-007 total PAH standard. Table 2 presents a summary of some key contaminants of concern from the 2014 HW sampling program. A complete summary table of all laboratory analytical data is attached (Table 3).

Table 2. Summary of 2014 Sampling Results

Standards (mg/kg)			Sediment Samples – August 28, 2014					
	RCS1	Lined Landfill Reuse	1 (0' – 2')	2 (0' – 2')	3 (0' – 2')	4 (0' – 2')	5 (0' – 2')	Peat Composite
Total VOCs	NA	10	0.45	0.51	0.32	0.42	0.47	1.17
Total SVOCs	NA	100	19.92	19.68	16.05	19.16	37.72	33.63
Total PCBs	NA	<2	0.0097	0.0096	0.0089	0.0102	0.0164	0.0221
Total Organic Carbon	NA	NA	63,300	63,800	66,500	52,400	73,400	194,000
Total Phosphate	NA	NA	NC	NC	NC	NC	1,403	704
TPH	1,000	5,000	172	264	130	208	270	550
Total PAH's	NA	100	10.75	3.23	1.85	2.63	2.00	0.35
Conductivity	NA	8,000 umhos/cm	58	46	30	40	59	51
Arsenic	20	40	**52.8**	**49.4**	**47.2**	**47.3**	**58.3**	**25.2**
Cadmium	2	80	0.50	0.39	0.49	0.36	0.32	0.145
Chromium	30	1,000	**64.5**	**60.5**	**49.8**	**59.5**	**71.2**	**31.5**
Lead	300	2,000	**348**	292	**326**	296	294	34.5
Mercury	20	10	0.27	0.20	0.21	0.16	0.15	0.08

Notes:

Lined landfill reuse standards from COMM-97-001 and COMM-94-007."
RCS1 – Massachusetts Contingency Plan reportable concentrations for soil.
Bold text denotes result exceeds MCP RCS1.
Highlighted text denotes result exceeds COMM-97-001 / 94-007 standard for reuse at lined landfills.
NA – Not applicable, no standard established.
NC – Not collected.
TPH – Total petroleum hydrocarbons
PAH – Polycyclic aromatic hydrocarbons
PCB – polychlorinated biphenyls

4.0 SEDIMENT DISPOSAL OPTIONS

The City is prohibited from reusing any pond sediment with contaminants above the RCS1 standard at an upland location (i.e., as fill material). This leaves three remaining disposal options: reuse as daily cover at Massachusetts landfills, export to out-of-state landfills, and export to licensed hazardous waste disposal facilities.

Laboratory analysis indicates the presence of arsenic in the pond sediment at concentrations above the COMM-97-001 / 94-007 standards for reuse at Massachusetts landfills. However, this does not mean that reuse at a Massachusetts landfill is necessarily ruled out. The sediment may still qualify for reuse or disposal (i.e. burial) at a landfill facility, but would require a Special Waste Determination or other approval from MassDEP. There are currently three operating Massachusetts landfills within 50 miles of the Site (Saugus, Peabody, and Haverhill) that are permitted to accept contaminated sediment for reuse or disposal. HW contacted all three facilities and determined that none were able to accept the estimated volume of sediment that would be generated during dredging of the pond, due to operational considerations and/or need for material.

HW also contacted Waste Management's Turnkey Landfill in Rochester, New Hampshire (also within 50 miles of the Site). A preliminary discussion with Turnkey management indicates the material would be accepted for reuse and the facility has adequate capacity. A baseline cost estimate for transportation and disposal of sediment at Turnkey can be found in Table 3. Additional Massachusetts landfill facilities can be contacted during a feasibility evaluation to determine if alternatives to the Turnkey facility exist.

5.0 BASELINE SEDIMENT DISPOSAL COST ESTIMATION

Frog Pond is approximately 2.3 acres (101,000 square feet) in size. Based on field observations during the collection of sediment samples, approximately 3.5 feet of dark gray organic silt exists above a well defined peat layer. Because the peat layer can be considered the "native" or pre-anthropocene pond bottom, this layer was used as the conceptual bottom limit of dredging for developing sediment volume estimates and costs. HW calculated the volume of sediment above the peat layer using the Average End Area Method, a standard method for estimating earthwork calculations. A contingency of 20% was included in the Average End Area Method calculations to account for variations in sediment thickness across the pond during removal and dredging technique, which would increase or decrease the total volume removed. HW's calculations indicate there is approximately 8,300 cubic yards (c.y.) of soft organic sediment in the pond, and used this volume to estimate associated removal and disposal costs.

Dredged sediment would need to be dewatered at the site before it can be transported to a receiving facility for disposal. Dewatering techniques vary between projects, but typically involve the temporary stockpiling of sediment within a bermed containment area to allow water to drain from the material. Once dewatered, the material can be more efficiently managed, and the overall weight of the sediment will be reduced, decreasing transportation and disposal costs, which are priced per ton. To support the preliminary cost estimates for transportation and disposal costs in Table 4, the weight of dewatered sediment was estimated at 0.80 tons per c.y.

Photo 2. Sediment immediately after dredging.

Photo 3. Sediment after several weeks of dewatering.

Table 3. Baseline Sediment Transportation and Disposal Estimates

Estimated Volume of Sediment: 8,300 cubic yards Estimated Weight of Sediment: 6,640 tons		
Estimated Cost:	**Unit Cost:**	**Extended Cost:**
Landfill Disposal	**$55 / ton**	**$365,200**
Transportation Cost	**$18 / ton**	**$119,520**
Total Transportation and Disposal Cost Estimate:		**$484,720**

Notes:
1. Transportation and landfill disposal cost estimate provided by Turnkey Landfill, Rochester, NH.
2. Dredging, project design, permitting, and additional sediment characterization costs not included.

The sediment quality analysis conducted in support of this evaluation provides baseline sediment quality data that are sufficient for preliminary project planning only. Disposal of sediment at a Massachusetts permitted landfill or at the Turnkey facility in Rochester, NH will require additional sediment sampling to meet state permitting requirements of landfill-specific acceptance criteria. The number of samples that will be required will be based on the final volume of sediment planned for removal from the pond. Project design and permitting at the local and state level will also add additional cost, as would any post-construction restoration or improvements to the pond and surrounding park area. Non-monetary cost considerations include aesthetic impacts, temporary loss of recreation space during dredging and dewatering operations.

6.0 SEDIMENT INFLUENCE ON WATER QUALITY

Eutrophication of Frog Pond is likely fueled by an excessive supply of phosphorous, and because a significant portion of the current annual phosphorous load to the pond water column may consist of the regeneration of "legacy" phosphorous from the pond bottom sediments, the composite peat sample and the upper muck sample from core 5 at the center of the pond were submitted for laboratory analysis of total phosphate. That analysis revealed moderately high concentrations of total phosphate (as Phosphorus) in the upper organic muck of approximately 1,400 mg/kg, and about half as much in the underlying peat. The observed concentration of total phosphate from the upper muck samples is consistent with what had been previously observed by Higgins Environmental, Inc. (approximately 1,100 – 1,600 mg/kg) from numerous samples collected from the top six inches of the pond in 2013. Those concentrations are also consistent with data obtained for sediment beneath other ponds (e.g. Lovell's Pond in Barnstable, MA) for which data were obtained.

The fact that the total phosphate concentration observed for the lower peat level is approximately half of that observed for the upper muck layer is significant because it suggests that a limited dredging of only the muck layer, down to the peat, might be an effective measure to remove the bulk of the legacy phosphorous from the pond bottom sediment. Some recent research suggests that the observed soil profile of decreasing phosphate concentration with depth is characteristic of eutrophic ponds where, below a stabilization depth, organic phosphorous has already been degraded and released to the overlying water column due to the limited capacity of the sediment to retain mineralized phosphorous upon burial (Carey and Rydin, 2011). This thesis is encouraging as it suggests that the relatively low concentrations of phosphorus observed in the deeper peat sediments are unlikely to represent a significant source of available phosphorous that could be remobilized into the water column. Even still, prior to dredging, more detailed water column and sediment profile sampling is recommended to further evaluate the potential for the remobilization of deeply buried phosphorus after dredging.

If necessary, alum treatment could be considered following dredging to further isolate remaining phosphorous in the peat layer from re-suspension in the water column. Alum is effective for permanently binding phosphorous, but phosphorus loading from the watershed needs to be controlled beforehand to avoid simply rebuilding a new pool of available phosphorous following treatment.

7.0 CONCLUSIONS AND NEXT STEPS

This report has confirmed that sediment from the base of Frog Pond contains elevated levels of certain contaminants and would have to be disposed of at a landfill rather than being reused as unregulated upland fill on site, or at some other location. We also confirmed the depth of the mucky sediment to be evenly distributed at approximately 3.5 feet throughout the pond, and confirmed that the sediment overlays a significant peat layer. Dredging is recommended as the primary water quality improvement measure because it offers multiple and long-lasting benefits, including:

- Creation of a deeper water column that would better support long-term water quality and aesthetic/recreational appeal; and

- Physical removal of the impacted sediments so they are no longer available to degrade water quality in the future.

However, dredging is not a static solution, and must be considered along with a host of other management options, including the following:

- **Control of Geese and Ducks**. The City has placed signs around the pond to notify visitors that it is unlawful to feed the ducks and geese. This appears to be successful based on the lack of geese visiting the pond and the small population of ducks that inhabit the area. This effort should be actively continued.

- **Removal of Stormwater Discharges**. There has been ongoing uncertainty among City officials and interested parties about the possible existence of a stormwater discharge from the surrounding streets directly into Frog Pond. The City Engineer has confirmed that his staff will be performing an investigation of the surrounding stormwater infrastructure to determine if such a connection exists. This investigation is anticipated in October 2014 but, at the time of this memorandum, HW has not received any results. In the event that a stormwater outfall is identified in the pond, it should be removed as soon as possible. Given the small size of the pond and the inability of stormwater treatment practices to eliminate nutrients from the runoff, we recommend that the discharge be removed altogether rather than implementing a stormwater BMP to treat the stormwater discharging to the pond.

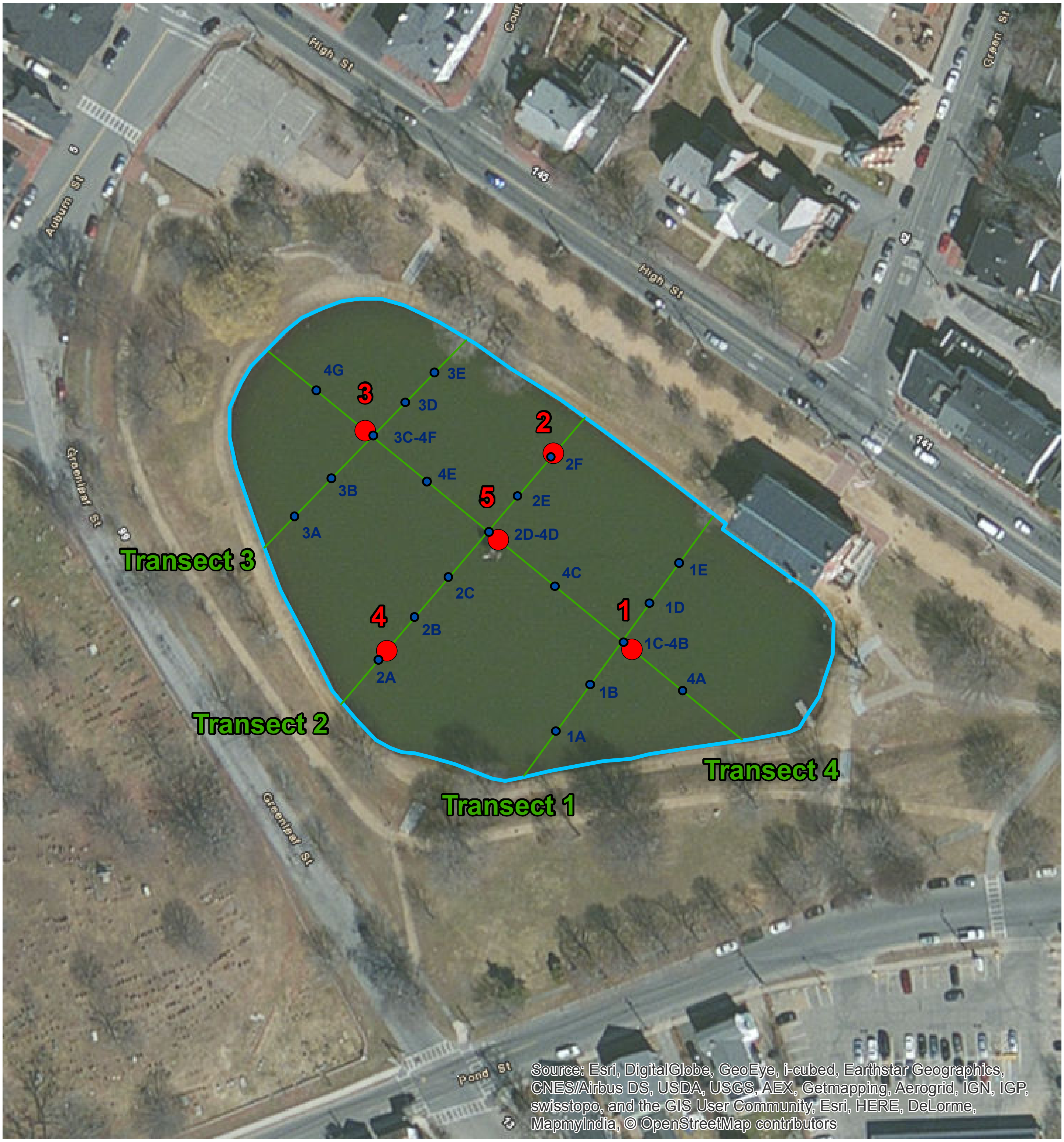
- **Vegetated Buffer**. Sedimentation in ponds is generally due to a combination of sources, including internal growth and cycling of biomass in the pond, which is fed by nutrient loading, as well as erosion from the surrounding watershed. The watershed for Frog Pond is very small and easily identified as the Bartlet Mall Park itself. The Bartlet Mall Park is vegetated primarily with grass, including along edge of the pond and along the very steep slopes, which are prone to erosion over time. This grass is maintained as an important feature of the historic landscape of the park. However, we suggest that the City consider amending the landscape plan to provide an additional vegetated buffer along the edge of all or a significant portion of the pond. In addition, the park maintenance plan should be reviewed to ensure that fertilizers are not used and that grass clippings are collected and disposed of offsite rather than left on the grass.

- **Alum Treatment**. As an additional measure after dredging, the City may also consider treating the pond with buffered alum, which scavenges phosphorus from the water column and precipitates it to the bottom of the pond. It then creates a sort of protective blanket at the bottom of the pond that inhibits the ability of phosphorus in the sediment to reenter the water column as available phosphorus in the water column. This can help to limit algal growth and can increase the clarity of the water.

HW has prepared a Scope of Work to assist the City in developing a management approach for Frog Pond. To date, only a portion of this scope of work has been funded. The remaining tasks include the development of a sediment management plan, an analysis of management alternatives (which would include those options listed above), and a workshop for the City and the interested public to discuss restoration options from a more holistic perspective that includes the recreational and historic landscape aspects of the project in addition to the ecological, engineering and cost details. We are hopeful that the City will pursue funding for these remaining tasks which together will result in working Restoration Plan for Frog Pond.

REFERENCES

Carey and Rydin, 2011. Lake trophic status can be determined by the depth distribution of sediment phosphorus. Limnology and Oceanography, 56(6).



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Legend

- Sediment Sampling Locations - August 28, 2014
- Sediment Depth Probe Locations - August 28, 2014
- Transect Locations - August 28, 2014

N

0 100

1" = 100 feet

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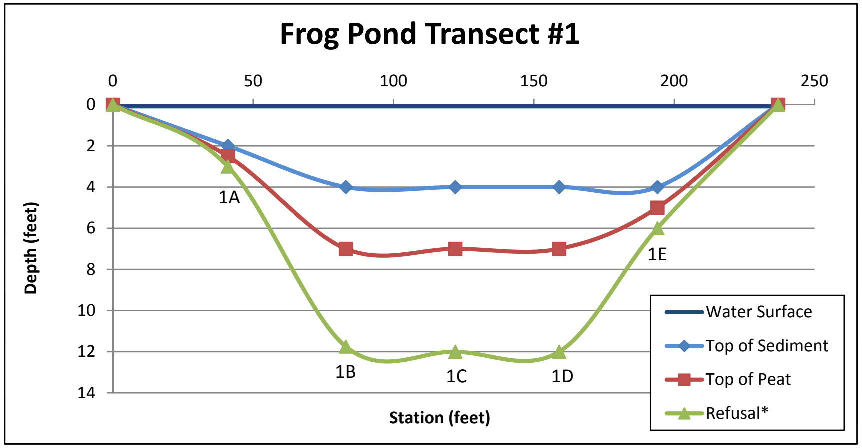
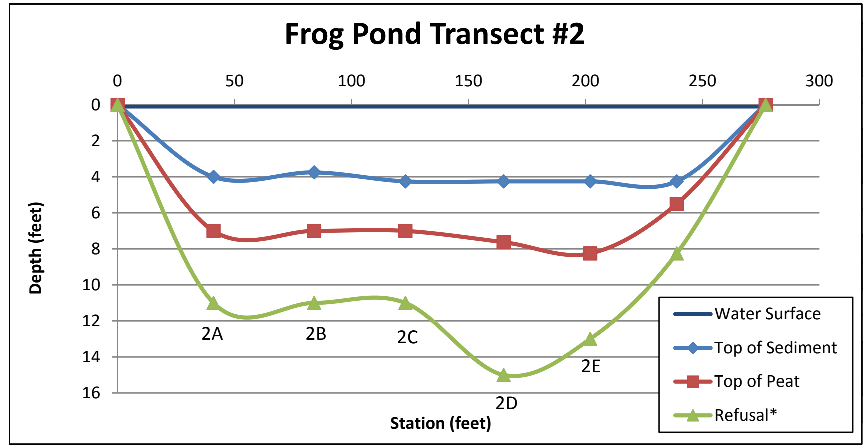
Sediment Sampling &
Depth Transect Locations
Frog Pond
Newburyport, MA

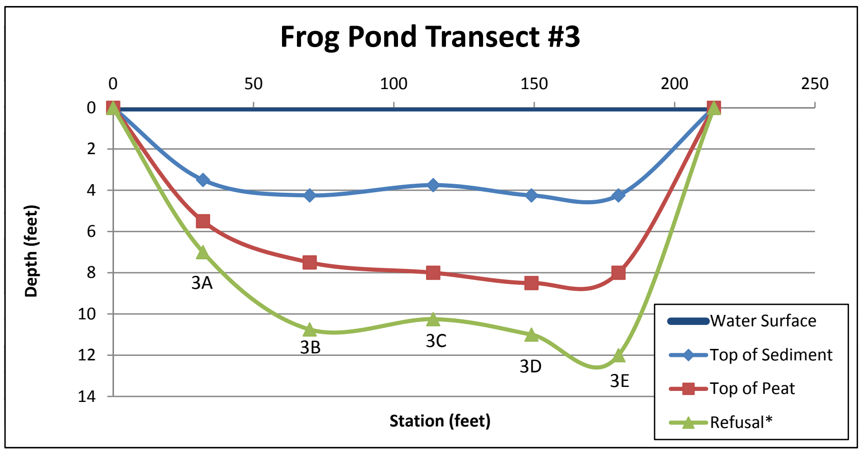
Date: 10/2/2014

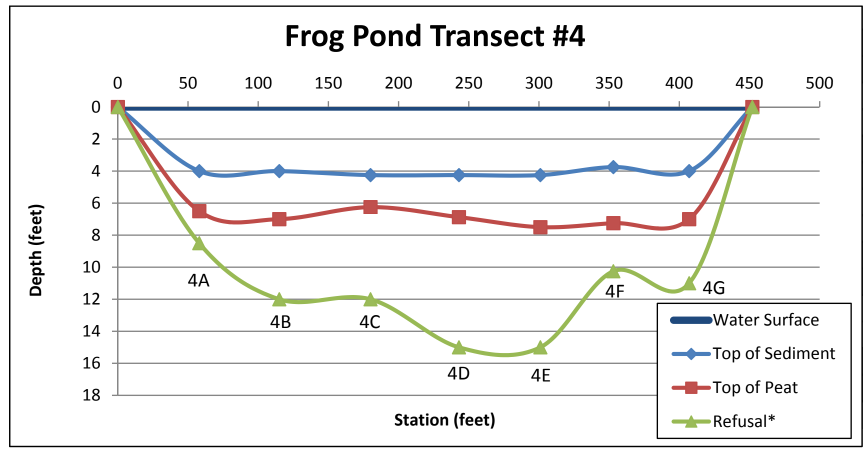
Figure 1

FIGURE 2 - FROG POND TRANSECTS









*Note: Refusal is based on maximum rod depth achieved through hand advancement. Peat bottom likely several feet lower than shown.

Table 3. Bartlet Mall - Frog Pond
Sediment Sampling Results For Comparison With MA-2014-RCS1 and Landfill Reuse Criteria

Sample Location		Lined Landfill		1 0'-2' Comp		2 0'-2' Comp		3 0'-2' Comp		4 0'-2' Comp		5 0'-2' Comp		Peat	
Sample Date	2014-RCS1	Reuse Criteria	Units	08/28/2014		08/28/2014		08/28/2014		08/28/2014		08/28/2014		08/28/2014	
5035/8260B Volatile Organic Compounds / Low Level															
1,1,1,2-Tetrachloroethane	0.1		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,1,1-Trichloroethane	30		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,1,2,2-Tetrachloroethane	0.005		mg/kg dry	0.0032	U	0.0035	U	0.0023	U	0.0028	U	0.0033	U	0.0054	U
1,1,2-Trichloroethane	0.1		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,1-Dichloroethane	0.4		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,1-Dichloroethene	3		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,1-Dichloropropene	NA		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,2,3-Trichlorobenzene	NA		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,2,3-Trichloropropane	100		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,2,4-Trichlorobenzene	2		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,2,4-Trimethylbenzene	1000		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,2-Dibromo-3-Chloropropane	10		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,2-Dibromoethane	0.1		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,2-Dichlorobenzene	9		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,2-Dichloroethane	0.1		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,2-Dichloropropane	0.1		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,3,5-Trimethylbenzene	10		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,3-Dichlorobenzene	3		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,3-Dichloropropane	500		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,4-Dichlorobenzene	0.7		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
1,4-Dioxane	0.2		mg/kg dry	0.162	U	0.175	U	0.117	U	0.141	U	0.163	U	0.269	U
2,2-Dichloropropane	NA		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
2-Butanone	4		mg/kg dry	0.0162	U	0.018		0.0117	U	0.021		0.0189		0.138	
2-Chlorotoluene	100		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
2-Hexanone	100		mg/kg dry	0.0162	U	0.0175	U	0.0117	U	0.0141	U	0.0163	U	0.0269	U
4-Chlorotoluene	NA		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
4-Isopropyltoluene	100		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
4-Methyl-2-Pentanone	0.4		mg/kg dry	0.0162	U	0.0175	U	0.0117	U	0.0141	U	0.0163	U	0.0269	U
Acetone	6		mg/kg dry	0.103	B	0.131	B	0.059	B	0.126	B	0.115	B	0.758	B
Benzene	2		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Bromobenzene	100		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Bromochloromethane	NA		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Bromodichloromethane	0.1		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Bromoform	0.1		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Bromomethane	0.5		mg/kg dry	0.0162	U	0.0175	U	0.0117	U	0.0141	U	0.0163	U	0.0269	U
Carbon Disulfide	100		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Carbon Tetrachloride	5		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U

Table 3. Bartlet Mall - Frog Pond

Sediment Sampling Results For Comparison With MA-2014-RCS1 and Landfill Reuse Criteria

Sample Location		Lined Landfill		1 0'-2' Comp		2 0'-2' Comp		3 0'-2' Comp		4 0'-2' Comp		5 0'-2' Comp		Peat	
Sample Date	**2014-RCS1**	**Reuse Criteria**	**Units**	**08/28/2014**		**08/28/2014**		**08/28/2014**		**08/28/2014**		**08/28/2014**		**08/28/2014**	
Chlorobenzene	1		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Chloroethane	100		mg/kg dry	0.0162	U	0.0175	U	0.0117	U	0.0141	U	0.0163	U	0.0269	U
Chloroform	0.2		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Chloromethane	100		mg/kg dry	0.0162	U	0.0175	U	0.0117	U	0.0141	U	0.0163	U	0.0269	U
cis-1,2-Dichloroethene	0.1		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
cis-1,3-Dichloropropene	0.01		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Dibromochloromethane	0.005		mg/kg dry	0.0032	U	0.0035	U	0.0023	U	0.0028	U	0.0033	U	0.0054	U
Dibromomethane	500		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Dichlorodifluoromethane	1000		mg/kg dry	0.0162	U	0.0175	U	0.0117	U	0.0141	U	0.0163	U	0.0269	U
Diethyl Ether	100		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Di-isopropyl ether	100		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Ethyl tertiary-butyl ether	NA		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Ethylbenzene	40		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Hexachlorobutadiene	30		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Isopropylbenzene	1000		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Methyl tert-Butyl Ether	0.1		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Methylene Chloride	0.1		mg/kg dry	0.0162	U	0.0175	U	0.0117	U	0.0141	U	0.0163	U	0.0269	U
Naphthalene	4		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
n-Butylbenzene	100		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
n-Propylbenzene	100		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
sec-Butylbenzene	100		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Styrene	3		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
tert-Butylbenzene	100		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Tertiary-amyl methyl ether	NA		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Tetrachloroethene	1		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Tetrahydrofuran	500		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Toluene	30		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
trans-1,2-Dichloroethene	1		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
trans-1,3-Dichloropropene	0.01		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Trichloroethene	0.3		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Trichlorofluoromethane	1000		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Vinyl Chloride	0.7		mg/kg dry	0.0162	U	0.0175	U	0.0117	U	0.0141	U	0.0163	U	0.0269	U
Xylene O	100		mg/kg dry	0.0081	U	0.0088	U	0.0059	U	0.007	U	0.0082	U	0.0135	U
Xylene P,M	100		mg/kg dry	0.0162	U	0.0175	U	0.0117	U	0.0141	U	0.0163	U	0.0269	U
Xylenes (Total)	100		mg/kg dry	0.0162	U	0.0175	U	0.0117	U	0.0141	U	0.0163	U	0.0269	U
TOTAL VOCs		10	mg/kg dry	0.45565		0.5128		0.3228		0.4273		0.4764		1.17615	

Table 3. Bartlet Mall - Frog Pond
Sediment Sampling Results For Comparison With MA-2014-RCS1 and Landfill Reuse Criteria

Sample Location Sample Date	2014-RCS1	Lined Landfill Reuse Criteria	Units	1 0'-2' Comp 08/28/2014		2 0'-2' Comp 08/28/2014		3 0'-2' Comp 08/28/2014		4 0'-2' Comp 08/28/2014		5 0'-2' Comp 08/28/2014		Peat 08/28/2014	
8082 Polychlorinated Biphenyls (PCB) / Congeners															
BZ#101	NA		mg/kg dry	0.00053	U	0.00053	U	0.00049	U	0.00056	U	0.00091	U	0.00122	U
BZ#105	NA		mg/kg dry	-	-	-	-	-	-	-	-	-	-	0.00122	U
BZ#105 [2C]	NA		mg/kg dry	0.0013		0.00153		0.00141		0.00201	P	0.00245	P	-	-
BZ#118	NA		mg/kg dry	0.0019		0.00222		0.00197		0.00275		0.00392		0.00122	U
BZ#128	NA		mg/kg dry	-	-	-	-	0.00055	LC, P	-	-	0.00122		0.00122	U
BZ#128 [2C]	NA		mg/kg dry	0.0007		0.00085		-	-	0.00101		-	-	-	-
BZ#138	NA		mg/kg dry	0.00226	LC, P	0.00258	LC, P	0.00229	LC, P	0.00327	LC, P	0.00443	LC, P	0.00122	U
BZ#153	NA		mg/kg dry	0.00203		0.00246		0.00216		0.00293		0.00418		0.00122	U
BZ#170	NA		mg/kg dry	0.00053	U	0.00053	U	0.00049	U	0.00065	LC, P	0.00091	U	0.00122	U
BZ#18	NA		mg/kg dry	0.00053	U	0.00053	U	0.00049	U	0.00056	U	0.00091	U	0.00122	U
BZ#180	NA		mg/kg dry	0.00074		-	-	-	-	-	-	0.00129		0.00122	U
BZ#180 [2C]	NA		mg/kg dry	-	-	0.00075		0.00068		0.00114		-	-	-	-
BZ#187	NA		mg/kg dry	0.00053	U	0.00053	U	0.00049	U	-	-	0.00091	U	0.00122	U
BZ#187 [2C]	NA		mg/kg dry	-	-	-	-	-	-	0.00097	P	-	-	-	-
BZ#195	NA		mg/kg dry	0.00053	U	0.00053	U	0.00049	U	0.00056	U	0.00091	U	0.00122	U
BZ#206	NA		mg/kg dry	0.00053	U	0.00053	U	0.00049	U	-	-	0.00091	U	0.00122	U
BZ#206 [2C]	NA		mg/kg dry	-	-	-	-	-	-	0.00131		-	-	-	-
BZ#209	NA		mg/kg dry	-	-	-	-	0.00049	U	-	-	0.00091	U	0.00122	U
BZ#209 [2C]	NA		mg/kg dry	0.00099		0.00075		-	-	0.0013		-	-	-	-
BZ#28	NA		mg/kg dry	0.00053	U	0.00053	U	0.00049	U	0.00056	U	0.00091	U	0.00122	U
BZ#44	NA		mg/kg dry	0.00053	U	0.00053	U	0.00049	U	0.00056	U	0.00091	U	0.00122	U
BZ#52	NA		mg/kg dry	0.00099	P	-	-	0.00065		0.00114		0.00159	P	0.00122	U
BZ#52 [2C]	NA		mg/kg dry	-	-	0.00067		-	-	-	-	-	-	-	-
BZ#66	NA		mg/kg dry	0.00053	U	0.00053	U	0.00049	U	0.00056	U	0.00098	LC, P	0.00122	U
BZ#8	NA		mg/kg dry	0.00053	U	0.00053	U	0.00049	U	0.00056	U	0.00091	U	0.00122	U
Total PCB Congeners	NA	<2	mg/kg dry	0.00968		0.00966		0.00886		0.0102		0.0164		0.0221	
8100M Total Petroleum Hydrocarbons															
Total Petroleum Hydrocarbons	1,000	5,000	mg/kg dry	172		264		130		208		270		550	
8270D Semi-Volatile Organic Compounds															
1,1-Biphenyl	0.05		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
1,2,4-Trichlorobenzene	2		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
1,2-Dichlorobenzene	9		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
1,3-Dichlorobenzene	3		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
1,4-Dichlorobenzene	0.7		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U

Table 3. Bartlet Mall - Frog Pond
Sediment Sampling Results For Comparison With MA-2014-RCS1 and Landfill Reuse Criteria

Sample Location		Lined Landfill		1 0'-2' Comp		2 0'-2' Comp		3 0'-2' Comp		4 0'-2' Comp		5 0'-2' Comp		Peat	
Sample Date	2014-RCS1	Reuse Criteria	Units	08/28/2014		08/28/2014		08/28/2014		08/28/2014		08/28/2014		08/28/2014	
2,4,5-Trichlorophenol	4		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
2,4,6-Trichlorophenol	0.7		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
2,4-Dichlorophenol	0.7		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
2,4-Dimethylphenol	0.7		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
2,4-Dinitrophenol	3		mg/kg dry	2.27	U	2.24	U	1.83	U	2.18	U	4.29	U	3.83	U
2,4-Dinitrotoluene	0.7		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
2,6-Dinitrotoluene	100		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
2-Chloronaphthalene	1000		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
2-Chlorophenol	0.7		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
2-Methylphenol	500		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
2-Nitroaniline	NA		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
2-Nitrophenol	100		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
3,3´-Dichlorobenzidine	3		mg/kg dry	0.905	U	0.895	U	0.729	U	0.871	U	1.72	U	1.53	U
3+4-Methylphenol	500		mg/kg dry	0.905	U	0.895	U	0.729	U	0.871	U	1.72	U	1.53	U
3-Nitroaniline	NA		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
4,6-Dinitro-2-Methylphenol	NA		mg/kg dry	2.27	U	2.24	U	1.83	U	2.18	U	4.29	U	3.83	U
4-Bromophenyl-phenylether	100		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
4-Chloro-3-Methylphenol	NA		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
4-Chloroaniline	1		mg/kg dry	0.905	U	0.895	U	0.729	U	0.871	U	1.72	U	1.53	U
4-Chloro-phenyl-phenyl ether	NA		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
4-Nitroaniline	NA		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
4-Nitrophenol	100		mg/kg dry	2.27	U	2.24	U	1.83	U	2.18	U	4.29	U	3.83	U
Acetophenone	1000		mg/kg dry	0.905	U	0.895	U	0.729	U	0.871	U	1.72	U	1.53	U
Aniline	1000		mg/kg dry	2.27	U	2.24	U	1.83	U	2.18	U	4.29	U	3.83	U
Azobenzene	50		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
Benzidine	NA		mg/kg dry	0.905	U	0.895	U	0.729	U	0.871	U	1.72	U	1.53	U
Benzoic Acid	NA		mg/kg dry	2.27	U	2.24	U	1.83	U	2.18	U	4.29	U	3.83	U
Benzyl Alcohol	NA		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
bis(2-Chloroethoxy)methane	500		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
bis(2-Chloroethyl)ether	0.7		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
bis(2-chloroisopropyl)Ether	0.7		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
bis(2-Ethylhexyl)phthalate	90		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
Butylbenzylphthalate	100		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
Carbazole	NA		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
Dibenzofuran	100		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
Diethylphthalate	10		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
Dimethylphthalate	0.7		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
Di-n-butylphthalate	50		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U

Table 3. Bartlet Mall - Frog Pond
Sediment Sampling Results For Comparison With MA-2014-RCS1 and Landfill Reuse Criteria

Sample Location		Lined Landfill		1 0'-2' Comp		2 0'-2' Comp		3 0'-2' Comp		4 0'-2' Comp		5 0'-2' Comp		Peat	
Sample Date	**2014-RCS1**	**Reuse Criteria**	**Units**	**08/28/2014**		**08/28/2014**		**08/28/2014**		**08/28/2014**		**08/28/2014**		**08/28/2014**	
Di-n-octylphthalate	1000		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
Hexachlorobenzene	0.7		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
Hexachlorobutadiene	30		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
Hexachlorocyclopentadiene	NA		mg/kg dry	2.27	U	2.24	U	1.83	U	2.18	U	4.29	U	3.83	U
Hexachloroethane	0.7		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
Isophorone	100		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
Nitrobenzene	500		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
N-Nitrosodimethylamine	50		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
N-Nitroso-Di-n-Propylamine	NA		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
N-nitrosodiphenylamine	NA		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
Pentachlorophenol	3		mg/kg dry	2.27	U	2.24	U	1.83	U	2.18	U	4.29	U	3.83	U
Phenol	1		mg/kg dry	0.452	U	0.447	U	0.364	U	0.435	U	0.856	U	0.763	U
TOTAL SVOCs	NA	100		19.9255		19.688		16.0535		19.16		37.719		33.6345	
Classical Chemistry															
Conductivity	NA	8,000	umhos/cm	58	WL	46	WL	30	WL	40	WL	59	WL	51	WL
Percent Solid	NA	NA	%	37		37		45		38		29		22	-
Total Organic Carbon	NA	NA	mg/kg	63300		63800		66500		52400		73400		194000	
Total Phosphate as P	NA	NA	mg/kg dry	-	-	-	-	-	-	-	-	1430	D	704	D
MADEP-EPH Extractable Petroleum Hydrocarbons															
2-Methylnaphthalene	0.7		mg/kg dry	0.069		0.039	U	0.031	U	0.037	U	0.049	U	0.051	U
Acenaphthene	4		mg/kg dry	0.038	U	0.039	U	0.031	U	0.037	U	0.049	U	0.051	U
Acenaphthylene	1		mg/kg dry	0.25		0.068		0.034		0.057		0.049	U	0.051	U
Anthracene	1000		mg/kg dry	0.272		0.071		0.037		0.059		0.042		0.021	U
Benzo(a)anthracene	7		mg/kg dry	0.579		0.159		0.105		0.147		0.106		0.021	U
Benzo(a)pyrene	2		mg/kg dry	0.961		0.288		0.163		0.232		0.171		0.021	U
Benzo(b)fluoranthene	7		mg/kg dry	1.4		0.449		0.232		0.34		0.253		0.051	U
Benzo(g,h,i)perylene	1000		mg/kg dry	0.785		0.253		0.132		0.184		0.139		0.051	U
Benzo(k)fluoranthene	70		mg/kg dry	0.416		0.12		0.078		0.089		0.076		0.051	U
C11-C22 Aromatics1,2	1000		mg/kg dry	62.3		29.5	U	24	U	28.5	U	37.3	U	43.5	
C11-C22 Unadjusted Aromatics1	1000		mg/kg dry	73		29	U	23.5	U	28	U	36.6	U	43.5	
C19-C36 Aliphatics1	3000		mg/kg dry	101		52.2		41.4		37.2		41.2		45.7	
C9-C18 Aliphatics1	1000		mg/kg dry	28.8	U	29	U	23.5	U	28	U	36.6	U	38.6	U
Chrysene	70		mg/kg dry	0.979		0.302		0.182		0.237		0.187		0.051	U
Dibenzo(a,h)Anthracene	0.7		mg/kg dry	0.186		0.055		0.029		0.043		0.031		0.021	U
Fluoranthene	1000		mg/kg dry	1.5		0.461		0.281		0.403		0.288		0.051	U

Table 3. Bartlet Mall - Frog Pond
Sediment Sampling Results For Comparison With MA-2014-RCS1 and Landfill Reuse Criteria

Sample Location Sample Date	2014-RCS1	Lined Landfill Reuse Criteria	Units	1 0'-2' Comp 08/28/2014		2 0'-2' Comp 08/28/2014		3 0'-2' Comp 08/28/2014		4 0'-2' Comp 08/28/2014		5 0'-2' Comp 08/28/2014		Peat 08/28/2014	
Fluorene	1000		mg/kg dry	0.161		0.04		0.019		0.036		0.026		0.021	U
Indeno(1,2,3-cd)Pyrene	7		mg/kg dry	0.859		0.264		0.14		0.217		0.16		0.051	U
Naphthalene	4		mg/kg dry	0.119		0.039	U	0.031	U	0.037	U	0.049	U	0.051	U
Phenanthrene	10		mg/kg dry	0.914		0.25		0.131		0.213		0.163		0.051	U
Pyrene	1000		mg/kg dry	1.28		0.39		0.245		0.321		0.252		0.051	U
Total PAHs	NA	100	mg/kg dry	10.75		3.23		1.85		2.63		2		0.35	
Metals															
Arsenic	20	40	mg/kg dry	**52.8**		**49.4**		**47.2**		**47.3**		**58.3**		**25.2**	
Cadmium	70	80	mg/kg dry	0.507	D	0.395	D	0.498	D	0.365	D	0.324	D	0.145	U, D
Chromium	30	1,000	mg/kg dry	**64.5**		**60.5**		**49.8**		**59.5**		**71.2**		**31.5**	
Copper	NA	NA	mg/kg dry	59		53.1		52.7		48.4		54.8		20.4	
Lead	200	2,000	mg/kg dry	**348**		**292**		**326**		**296**		**294**		34.5	
Mercury	20	10	mg/kg dry	0.271		0.202		0.21		0.166		0.152		0.084	U
Nickel	600	NA	mg/kg dry	51.3		48		40.8		47.5		58.1		24	
Zinc	1000	NA	mg/kg dry	178		158		159		149		169		58.6	

Notes:
1. Bold Font - result for this analyte exceeds the MCP RCS-1 Standard.
2. Shaded Font - results for this analyte exceeds the COMM-97-001 or WSC-94-007 standard for reuse of contaminated soil at Massachusetts landfill facilities.
3. Underlined Text - The method requested for this analysis does not meet criteria for all compounds. The compound is undetected, however, the Method Reporting Limit is greater than the State limit.
3. NA - Not Applicable / No Standard
4. RCS1 - Massachusetts Contingency Plan reportable concentrations for soil contaminants.
5. Lined landfill reuse criteria standards from COMM-97-001 and COMM-94-007.

Qualifiers
D = Sample was diluted in order to obtain a value within the calibration range.
U = Not Detected